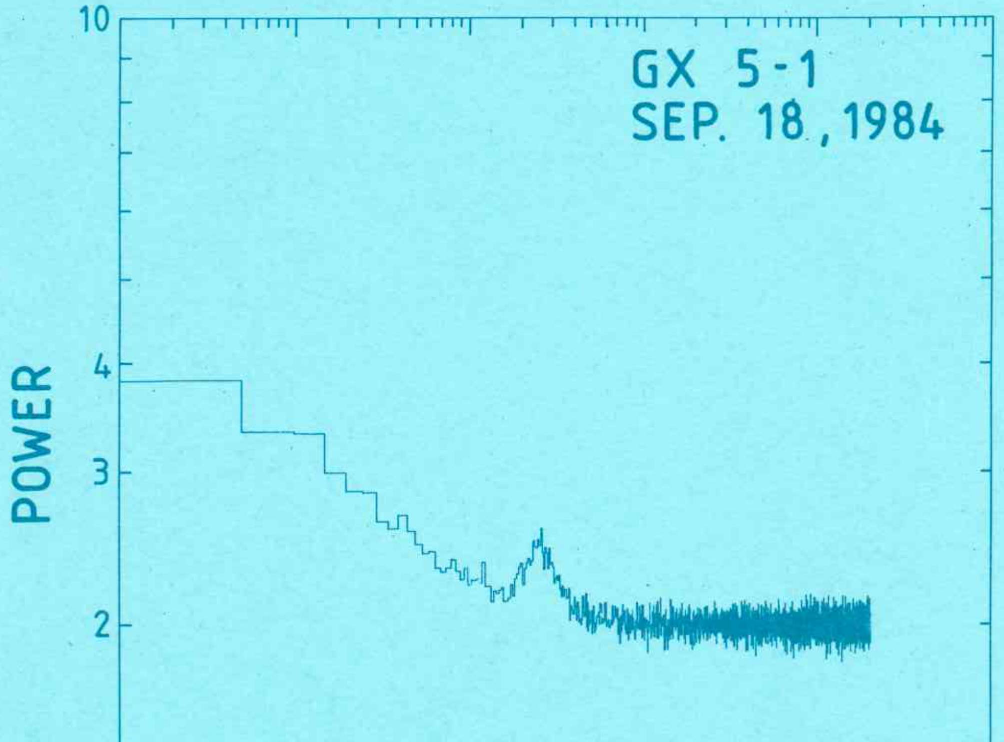
DA

EXOSAT EXPRESS

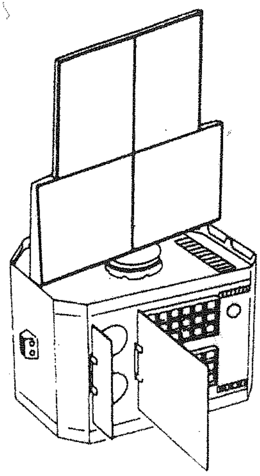


EXOSAT

June 1985

EUROPEAN X-RAY ASTRONOMY SATELLITE

No. 11



esa

EXOSAT EXPRESS

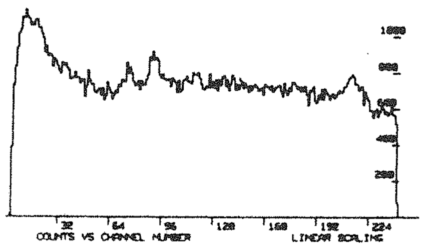


TABLE OF CONTENTS

NO. 11 JUNE 1985

Front Cover

A power spectrum derived from 8 hrs of high time resolution ME data from the bright galactic bulge source GX 5-1. The detection of a broad peak between 15 and 40 Hz led to the discovery of intensity dependent quasi-periodic millisecond oscillations from GX 5-1. These oscillations are a new phenomenon in the field of X-ray binaries and have subsequently been observed from Sco X-1 and Cyg X-2.

Courtesy: M. van der Klis.

FOREWORD

With the passing of the nominal two-year mission lifetime milestone, it is a pleasure to note a major scientific discovery of EXOSAT, viz: quasi-periodic oscillations from some binary X-ray sources as illustrated on this issue's front cover and caption. Appropriately, at this time, articles on the scientific highlights and a broad discussion of the programmatic aspects of the mission are published.

Attention is drawn to the list of data currently available in the EXOSAT data archive, given on pp.73-87. This list, derived from the observation log and ordered in RA, comprises observations carried out prior to 30.6.84. Future issues of the EXPRESS will contain RA-ordered lists of data released during the previous two month period. Computer listings of the complete archive or the observation log are available on request (please specify chronological or RA-ordered).

An erratum to the article on ME calibration (Express No. 10, p.40) is published on p.70 and researchers actively involved in ME data analysis are requested to take note.

An announcement is given on p.89, at the request of the Organising Committee, of IAU Symposium No. 125 on the 'Origin and Evolution of Neutron Stars' to be held from 26-30 May 1986 in Nanjing, People's Republic of China.

Because of an error in the production of computer-addressed labels, not discovered until mid-way through mailing, several readers received two copies of EXPRESS No. 10. To these readers, our apologies and assurance that the 'practice' will not continue!

EXOSAT EXPRESS

Editor: David Andrews

Published by: EXOSAT Observatory
ESOC,
Robert Bosch Str. 5,
6100 Darmstadt,
W. Germany.

Tel: 06151-886-705
Telex: 419453/49441
Telefax: 886/622/611

OBSERVATORY STATUS AS OF 30.6.85

Significant re-scheduling of the AO-3 programme for the July-October period and deletion of some observations (eg. Error Box searches) has occurred in order to carry out observations of sources in the galactic centre region as priority targets, given the uncertainty regarding remaining attitude/manoeuvre gas (ref. Express No.10 p.2). The Observatory Team regret any inconvenience caused to EXOSAT PI's, particularly in regard to rearrangement of co-ordinated observations, however our continuing goal is to maximise the scientific return from the mission.

1. Hardware

There have been no changes in the status of the spacecraft hardware.

Reference was made in Express No.7 p.2 to an error in the star tracker calibration reference points (Local Lord Points) and the implication for possible (small) systematic errors in determined pointing positions. SODERN have provided new reference data which ESOC and the Observatory Team are currently using to check previous pointings and the positions of known X-ray sources. Details will be given in the next issue of the Express.

During investigation of the GSPC dead time effects (ref. p.67), a malfunction of the electronic single channel analyser for energy discrimination has been discovered. The upper level threshold is commandable in 4 steps (equivalent to ADC channels 60, 120, 180, 240 ie. ~10, 20, 30 & 40 keV at gain = 1) with the nominal value being channel 240. This threshold has shown a gradual deterioration in sharpness of cut-off, manifested initially as a few counts remaining between channels 240 and 255 in spectra observed during 1984 and presently as a rather smeared-out cut-off with significant counts still at channel 255 (ref. p.68). Note that this precludes any correlation between QEP counts and spectral counts, and users should not, therefore, use the QEP counts for flux or dead time estimates.

2. Performance and Operations

Tables 1 and 2 on p.5/6 give the current performance parameters of the EXOSAT instruments.

A power failure at ESOC occurred on 22.6.85 and resulted in the loss of approximately two hours of observing time with considerable restructuring of observation start and end times.

Recent estimates of the remaining attitude/manoeuvre gas (propane) using the two methods of logging and gauging (ref. Express No.9 p.51) indicate approximately 4 kgs as of June 9th 1985. With a current gas consumption of $\sim$240 gm/month (based on the logging data) and predicted use for stabilisation during an orbit manoeuvre to extend the mission beyond its natural end in April 1986, careful use and timing of the orbit maneouvres should permit a full observation programme until late 1986 (provided operations remain nominal and albeit with considerable uncertainty!). Regular gauging exercises and continual logging will be carried out to maintain realistic estimates of mission lifetime in order to optimise the programme where possible. With respect to gas conservation measures (ref. Express No.9 p.6), use of 1 star and the sun for attitude determination can increase the probability of tracking an incorrect (single) star, hence confirmation of pointing will always be done with two stars. This will add a slight overhead (few minutes) to total manoeuvre times from source to source.

3. On-board Software

Attention is drawn to the article on p.71 concerning potential (rare) errors in packet reference times of certain time-critical OBC programs when executed in specific 'program slots'.

Following the important discovery of quasi-periodic oscillations from X-ray binaries, a new OBC mode (MHER7) has been specified and is being developed/tested to be ready for appropriate observations of galactic centre sources in August/September. This mode will provide high time resolution intensity samples (sub-millisecond) and/or limited spectral information (maximum 4 energy bands). A detailed specification and operational procedures will be given in the August issue of the Express, but in the meantime PI's with observations for which this mode is relevant should contact A. Parmar at the Observatory.

4. Observation Output

With reference to the original specification of the observation log (Express No.9 p.44), note that a minor change has occurred: the accumulation time for ME energy histograms will be shown to a resolution of 0.1s and not 1s.

Note that data archive listings derived from the log have a layout which broadly follows the specification (p.72). In the Observation log listings, however, the PI name will be replaced by payload and OBC configuration details, as described in Express no. 9.

Details of the GSPC calibration history and status are given on pp.51-66. An update to the GSPC CCF will be implemented shortly (description in the next issue of the Express).

A second data analysis workshop held at ESOC on 22/23 May 1985, was attended by 7 scientists active in EXOSAT data analysis. Presentations were given by Observatory Team members and discussions highlighted a number of areas for further action (future articles in the Express). One area of immediate interest concerned the off-axis point spread function of the LE CMA and the definition of its functional form. At present, the best description of the off-axis PSF can be given as a set of 43 images of Cyg X-2 (raster scan calibration, Lexan 3000 Å filter). No change to the CCF is currently planned. These images, together with the standard set of background images per filter (ref. Express No.9 p.5) are available on request. Demonstrations of the Interactive Analysis System were given to illustrate general and specific aspects of the analysis of EXOSAT data.

Future Plans

AO-4 will be issued in August 1985 with a response required by 1st January 1986. Selection of the AO-4 programme, with a duration from March to the end of the mission will be undertaken by the Committee on Observation Proposal Selection (COPS) in February next year.

TABLE 1

PERFORMANCE CHARACTERISTICS (LE)

LE1	Characteristics			
Energy Range	0.04-2 keV (6-300 A) CMA* 0.3 - 2 keV PSD			
Energy resolution	Five filters are available for broad-band spectroscopy (CMA) $(\Delta E/E) = 41/E(keV)^{0.5}$ %FWHM (PSD)			
Field of view	2.2° diameter (CMA) 1.5° diameter (PSD)			
Effective area (cm^2)	Thin Lexan Filter	Al/P Filter	Boron Filter	Open position (PSD)
.05 keV	0.4	2.6	-	-
.1 keV	11.1	0.4	-	-
.5 keV	4.5	3.3	0.4	1.9
1.0 keV	3.2	2.5	2.0	13.5
1.5 keV	2.2	1.6	1.8	9.7
2.0 keV	0.6	0.5	0.6	1.9
Spatial resolution (Line spread function HEW)				
On axis	18 arc sec (CMA) 3 arc min (PSD)			
20 arc minutes off-axis:	40 arc sec (CMA) 3.5 arc min (PSD)			
Average steady residual background**	1.8 cnts/sec/cm^2 (CMA) 0.7 cnts/sec/cm^2/kev (PSD)			

* Subject to UV contamination between 900 - 2600 A
** Background rate subject to flaring

TABLE 2

PERFORMANCE CHARACTERISTICS (ME & GSPC)

Medium Energy Experiment	Characteristics
Total effective area	1500 cm^2 (all quadrants co-aligned)
Effective energy range	1-20 keV (Argon proportional counters) 5-50 keV (Xenon proportional counters)
Energy resolution ($\Delta E/E$)	51/E $(kev)^{1/2}$ % FWHM (Argon counters) 18% for 10 keV$\leq$E$\leq$30 keV (Xenon counters)
Field of view	45 arc minutes FWHM, triangular response with a 3' flat top
Total residual background	4 cnts/sec/keV (2-10 keV Argon counters co-aligned)

Gas Scintillation Counter (GSPC)	
*Total effective area	100 cm^2
Effective energy range	2-18 keV or 2-40 keV, depending on gain setting
Energy resolution ($\Delta E/E$)	27/E $(kev)^{1/2}$ % FWHM
Field of view	45 arc minutes FWHM triangular response with a 3' flat top
Total residual background rate	1.3 cnts/sec/keV (2-10 keV)

* depends on E and burst length window setting

LIST OF AO-3 OBSERVATIONS 1.5.85 - 30.6.85

Day (85)	Time	Target	RA	Dec	SAA	Duration h m	Principal Investigator
121	04.59	Vela X-1	09 00 02	-40 23 29	105	9 16	Van der Klis
121	19.02	1308+326	13 07 54	+32 27 32	128	2 40	McHardy
122	02.50	EXO 1847-031	18 46 44	-03 19 34	117	1 10	TOO
122	08.49	GX 13+1	18 11 43	-17 07 46	128	6 11	Stella
122	18.10	3A1845-024	18 45 24	-02 14 23	117	8 50	Lewin
123	07.03	OY Carina	10 05 48	-69 59 13	111	2 42	Charles AO-2
123	12.41	Vela X-1	09 00 01	-40 23 25	103	16 5	Van der Klis
124	07.45	ESO 103-G35	18 33 46	-65 26 53	117	6 13	Pounds
125	03.30	OY Car	10 05 48	-69 59 10	111	5 30	Charles AO-2
125	12.00	Vela X-1	09 00 00	-40 23 25	102	9 9	Van der Klis
126	00.50	2A1822-371	18 22 34	-37 06 00	129	16 59	Mason
126	22.25	MKN 421	11 01 25	+38 27 49	102	6 31	Warwick
127	07.30	Vela X-1	09 00 00	-40 23 20	101	11 45	Van der Klis
127	22.39	1156+295	11 56 42	+29 30 54	116	3 42	McHardy
128	04.45	NGC 4151	12 07 44	+39 41 19	110	3 48	Pounds
128	18.01	NGC 4151	12 07 47	+39 41 11	110	4 49	Pounds
129	00.30	PG0923+129	09 23 11	+12 55 32	91	6 35	Kriss
129	09.52	Vela X-1	09 00 02	-40 23 08	100	12 17	Van der Klis
129	23.02	Vela SNR	08 40 30	-42 36 06	97	3 58	Smith AO-2
130	03.46	Vela SNR	08 32 24	-42 36 02	95	3 29	Smith "
130	08.10	Vela SNR	08 24 24	-42 35 59	94	3 21	Smith "
130	12.32	Vela SNR	08 24 23	-43 55 11	94	3 16	Smith "
130	16.44	Vela SNR	08 32 24	-43 55 14	95	2 46	Smith "
130	21.38	OY Car	10 05 02	-70 01 10	111	3 42	Charles AO-2
131	05.25	NGC 3277	10 20 37	+20 05 38	99	5 34	Elvis
131	13.38	ON 325	12 16 25	+30 25 50	115	4 81	TOO
131	20.52	MKN 421	11 01 28	+38 27 41	98	6 21	Warwick
132	18.46	1308+326	13 07 55	+32 37 10	120	6 19	McHardy
133	02.30	NGC 4051	12 00 21	+44 48 27	102	16 30	Lawrence
134	03.00	G292.0+1.8	11 22 41	-58 59 00	121	9 0	Peacock AO-1
134	14.45	G299.0+0.2	12 14 32	-62 10 26	125	5 24	Peacock AO-2
135	01.56	M51	13 27 57	+47 29 10	108	7 14	Barr
135	11.30	NGC 4151	12 07 47	+39 41 12	105	10 28	Pounds
136	18.06	1156+295	11 56 46	+29 30 47	108	3 43	McHardy
137	00.25	Kohoutek 1-16	18 21 30	+64 22 51	90	17 20	Barstow
137	20.35	SS433	19 09 23	+04 56 14	122	10 57	Watson AO-2
138	11.49	3C273	12 26 24	+02 18 28	128	5 48	Turner AO-1
138	22.29	EXO 2030+375	20 31 22	+37 30 39	91	9 11	TOO
139	10.40	4U0833-45	08 34 11	-44 48 02	92	14 52	Smith
140	17.04	PG 1159-035	11 59 01	-03 29 59	122	17 36	Barstow
141	13.00	MKN 421	11 01 26	+38 27 44	90	6 16	Warwick
141	23.18	CEN X-3	11 18 48	-60 23 21	118	26 26	Tennent
143	05.22	EXO 2030+375	20 30 21	+37 22 56	93	2 40	TOO
143	10.14	NGC 4151	12 07 45	+39 41 06	99	1 13	Pounds
144	01.30	1156+295	11 56 46	+29 30 35	102	2 9	McHardy
144	06.55	CH CYG	19 23 19	+50 07 00	96	2 26	TOO
144	12.40	4U 1916-05	19 16 10	-05 17 22	130	8 20	Mason

Day (85)	Time	Target	RA	Dec	SAA	Duration h m	Principal Investigator	
145	01.15	PKS 2005-489	20 05 57	-48 57 00	125	5 20	Warwick	
145	09.05	AT MIC	20 38 49	-32 34 31	119	9 14	Nelson	
145	21.32	ER VUL	21 00 18	+27 38 54	94	25 55	White	
147	01.47	IRAS1833+326	18 33 08	+32 41 36	116	3 13	OPS	
147	20.51	SS433	19 09 22	+04 56 07	130	10 8	Watson	
148	10.00	2223-052	22 23 13	-05 10 15	90	6 0	McHardy	
148	18.20	4U1957+11	19 57 03	+11 36 27	117	10 24	Lewin	
149	07.10	EXO2030+37	20 30 30	+37 27 36	97	5 20	TOO	
149	15.55	ERROR BOX	12 16 15	+47 03 20	91	3 54	OPS	
149	21.26	1308+326	13 07 57	+29 30 42	108	3 20	McHardy	
150	03.12	1156+295	11 56 47	+35 26 50	97	3 35	McHardy	
150	09.25	Her X-1	16 55 54	+35 26 50	122	6 35	Kahabka	
150	19.10	NGC 4151	12 07 49	+39 40 57	93	4 20	Pounds	
151	14.09	A1118-61	11 18 30	-61 40 14	114	4 59	Pakull	
152	21.30	EXO 0748-676	07 47 28	-67 36 10	96	11 31	TOO	
152	18.13	IH 2158-6026	21 56 04	-60 19 58	114	3 10	Schwartz	AO-2
153	00.40	IH 2032-358	20 32 30	+35 47 26	127	3 11	Schwartz	AO-2
153	07.40	3A1954+319	19 54 01	+32 00 25	108	3 25	Watson	AO-2
153	13.11	IRAS1833+326	18 33 07	+32 42 09	118	3 39	OPS	
153	19.26	Her X-1	16 55 51	+35 27 14	122	6 24	Kahabka	
154	04.35	ERROR BOX	14 22 36	+48 11 30	102	5 28	OPS	
154	11.48	1156+295	11 56 44	+29 30 19	93	6 23	McHardy	
155	17.39	AM CVN	12 32 14	+37 54 02	94	3 25	King	
156	00.11	EXO 2030+37	20 30 32	+37 25 35	100	3 50	TOO	
156	06.25	ERROR BOX	13 11 53	+39 18 04	99	2 59	OPS	
156	11.45	AC Draconis	16 01 03	+66 58 10	90	6 42	Viotti	
156	20.00	Her X-1	16 55 54	+35 27 12	122	13 10	Parmar	
157	11.58	LE Cal	19 56 30	+35 06 34	108	6 7	CAL	
157	21.15	2223-052	22 23 15	-05 10 03	99	2 36	McHardy	
158	04.48	1156+295	11 56 44	+29 39 53	90	8 32	McHardy	
159	02.00	PG1229+204	12 29 21	+20 25 51	100	17 30	Kriss	
159	22.08	NGC 5548	14 15 30	+25 22 34	116	6 22	Branduardi	AO-2
160	07.44	Her X-1	16 55 54	+35 27 12	121	11 21	Kahabka	
160	21.10	E1821+643	18 21 36	+64 22 04	91	6 22	Stanger	
161	05.50	3C382	18 33 09	+32 41 53	121	5 55	Perryman	AO-2
161	14.50	E2003+225	20 03 33	+22 34 04	118	15 32	Osborne	
162	21.22	Nova Vul 84	19 23 58	+27 18 01	121	6 17	TOO	
163	06.37	Draco Nebula	16 52 08	+61 53 14	94	1 57	Mebold	
163	09.26	Draco Nebula	16 49 38	+61 03 12	95	4 58	Mebold	
163	16.02	Her X-1	16 55 49	+35 26 17	121	12 5	Parmar	
164	07.20	1308+326	13 07 55	+32 35 44	97	3 57	McHardy	
164	13.20	PG1211+143	12 11 34	+14 18 22	94	6 17	Elvis	
164	22.53	2223-052	22 23 11	-05 09 36	106	4 57	McHardy	
165	05.15	R Aquarii	23 41 15	-15 30 57	93	6 45	Viotti	
165	15.24	EXO 2030+37	20 30 39	+37 25 15	105	3 35	TOO	
165	23.38	PSR0540-69	05 43 08	-68 49 49	92	13 30	Helfand	
167	09.06	Her X-1	16 55 53	+35 26 14	120	8 58	Kahabka	
167	21.00	RS CVn	13 08 08	+36 11 32	92	11 13	White	
168	11.14	AM Her	18 14 50	+49 52 32	106	3 7	Heise	AO-2
168	17.13	Coma Cluster	12 57 20	+28 10 50	94	5 37	Branduardi	AO-2
168	23.35	Coma Cluster	13 00 20	+28 10 52	94	22 23	Branduardi	AO-2

Day (85)	Time	Target	RA	Dec	SAA	Duration h m	Principal Investigator
170	16.48	PSR 0540-69	05 43 04	-68 52 01	92	3 33	Helfand
170	22.05	Cen X-3	11 18 42	-60 21 43	106	3 37	Tennant
171	02.26	1E1048-5937	10 47 48	-59 37 47	102	7 8	Charles
171	14.46	2223-052	22 23 15	-05 10 13	112	2 57	McHardy
171	21.05	IRAS 1833+326	18 33 07	+32 41 35	123	4 51	OPS
172	05.05	Her X-1	16 55 52	+35 26 37	119	12 56	Parmar
172	20.50	EXO 2030+37	20 30 29	+37 25 00	109	3 16	TOO
173	04.10	NGC 5548	14 15 30	+25 22 07	106	5 20	Branduardi AO-2
173	11.42	1E1352+182	13 52 01	+18 20 53	106	3 57	Giommi
174	02.10	1E1352+182	13 52 01	+18 20 36	105	15 23	Giommi
174	19.45	GP Com	13 03 05	+18 16 28	94	16 15	Lamb
175	14.30	Her X-1	16 55 51	+35 26 18	118	11 40	Parmar
176	06.05	NGC 4593	12 36 55	-05 05 02	97	8 24	Clavel
176	19.00	HD 193793	20 18 56	+43 39 10	107	3 7	TOO
176	23.55	Cyg X-2	21 42 38	+38 07 58	101	12 25	Hasinger
177	20.40	Cyg X-2	21 42 36	+38 08 04	102	5 25	Hasinger
178	05.41	IRAS 1833+326	18 33 03	+32 41 09	123	6 20	Ops
178	15.10	EXO 2030+37	20 30 28	+37 25 00	112	1 37	TOO
178	18.36	3A2206+543	22 06 07	+54 16 20	89	2 3	TOO
178	23.22	MK 464	13 53 32	+38 48 12	91	5 8	Bell-Burnell
179	09.36	2223-052	22 23 13	-05 09 55	120	2 11	McHardy
179	14.34	NGC 526A	01 21 42	-35 16 28	93	4 26	Pounds
179	22.51	G304.6+0.1	13 03 11	-62 24 25	114	8 39	Peacock
180	10.15	Centaraus-A	13 22 20	-42 47 07	114	4 45	Molteni
180	17.25	NGC 4593	12 36 55	-05 05 21	93	5 44	Clavel
181	01.48	PSR 0540-69	05 43 43	-68 53 24	92	4 7	Helfand

OUTSTANDING AO-1/AO-2 POINTINGS

AO-1 (6)

Target	Proposal No.	Comments
SC 0627-54	CLU F10	To be scheduled
3C345	AGN F50	TOO Status waiting for outburst
U Gem	LLX G17	" " " "
GX340+0	OCC G1	Occultation - on hold
GX349+2	OCC G4	" "
PKS 1934-63	EXG F36	To be scheduled

AO-2 (36)

Target	Proposal No.	Comments
Decided by PI	AGN 024	
NGC 7172	AGN 036	To be scheduled
NGC 1808	AGN 057	" "
Abell 2235	CLU 006	" "
3A1006+475	MIS 011	" "
IH2236-372	MIS 011	" "
N63A	SNR 028	" "
G41.1-0.3	SNR 030	" "
G39.9+0.0	SNR 041	" "
U Gem	LLX 105	TOO status waiting for outburst (2 observations)
GL 754	LLX 171	To be scheduled
3A1954+319	HLX 039	" "
A0538-66	HLX 053	TOO Status (5 observations)
NGC 6553	HLX 055	To be scheduled
AM Her	HLX 063	Partially complete (1 observation remaining)
A0535+26	HLX 154	Scheduled Mar.86 (5 observations)
2S1536-536	HLX 046	To be " (partially completed)
Fornax	AGN 075	" " (partially completed)
NGC 5448	AGN 032	Partially complete (2 observations remaining)
1758-250	HLX 095	To be scheduled (AO2 extension)
Nova Muscae	LLX 162	" "
PK318+41.1	LLX 110	" "
IH0422-086	MIS 011	" "
Cyg X-1	HLX 044	" re-scheduled
H1615+09	MIS 019	" "
RCW 86	SNR 039	Partially complete to be scheduled

EXOSAT X-RAY SOURCES

'New' X-ray sources are discovered by EXOSAT serendipitously in the FOV of the telescope or in the offset quadrants of the ME or from an analysis of ME/GSPC 'background' data recorded during manoeuvres. We intend to maintain a list of published 'new' sources and readers are encouraged to report 'discoveries'.

It is recommended that the following convention be used when referring to EXOSAT sources in publications; in any case, this format will be adopted for any list maintained by the Observatory Team and is consistent with the recommendations referenced (below) and the Einstein HRI format.

Please note that this convention supercedes and renders obsolete the definition printed in Express issues 4 to 6.

EXOSAT Source Nomenclature

Source Position:	RA	02H	30m	20.5s	(1950)
	DEC	-02D	20m	33.2s	
Name :	EXO 023020-0220.5				

EXO 074824-6737.4:	IAU Telegram No. 4039
EXO 184639-0307.5:	IAU Telegram No. 4051
EXO 174725-2124.7:	IAU Telegram No. 4058
EXO 203021+3727.9:	IAU Telegram No. 4066

Ref.(1) Dictionary of the Nomenclature of Celestial Objects
M.C. Lortet and F. Spite, Observatoire de Paris, Meudon

(2) IAU Sub-Group on Nomenclature Problems

IAU (EXOSAT) TELEGRAMS

Circular No.	Title	Comment	Authors
3841	Hercules X-1	Anomalous X-ray behaviour	EXOSAT Team
3842	Supernova in NGC 5236	Multi-waveband observations	W. Wamsteker
3850	GK Persei	351s periodicity during an outburst	M. Watson, A. Smith EXOSAT Team
3854	MXB 1730-335	Active, type 1 bursts	G. Pollard, N. White P. Barr, L. Stella
3858	4U 1543-45	Accurate position, ultra-soft spectrum	R. Blissett, EXOSAT Team
3872	GX 1+4	Unexpected low X-ray state: $\lesssim$ 4 UFU	R. Hall, J. Davelaar EXOSAT Team
3882	4U1755-33	Periodic dips in intensity	N. White, A. Parmar K. Mason
3887	4U2129+47 = V1727 Cygni	Unexpected low X-ray and optical state	W. Pietsch, H. Steinle M. Gottwald
3893	V0332+53	Accurate position, and flux	J. Davelaar, R. Blissett, L. Stella M. McKay, N. White, J. Bleeker
3902	V0332+53	Discovery of 4.4s period	L. Stella, N. White
3906	V0332+53	Unexpected brightening	A.N. Parmar R.J. Blissett T. Courvoisier L. Chiappetti
3912	V0332+53	Orbital parameters determination	N. White, J.Davelaar, A.N. Parmar, L. Stella M. van der Klis

Circular No.	Title	Comment	Authors
3923	Her X-1	Her X-1 'on' again at 80 Uhuru flux units, 1.24s pulsations (March 1.5 - 1.8)	J. Trümper, P. Kahabka H. Ögelmann, W. Pietsch, W. Voges, M. Gottwald, A. Parmar
3932	2S1254-690	Discovery of type 1 Burst and an absorption 'event'.	T. J.-L. Courvoisier, A. Peacock, M. Pakull
3935	AN URSAE MAJORIS	Serendipitous observation: soft X-ray flux suggests a return to the 'bright' state.	J.P. Osborne
3939	VW HYDRI	Discovery of X-ray pulsations during superoutburst	J. Heise, F. Paerels, H. van der Woerd
3952	2S1254-690	Discovery of a 3.9hr period in the X-ray light curve	T. J.-L. Courvoisier A. Parmar, A. Peacock
3961	4U1323-62	Type 1 Burst discovered	M. van der Klis, F.A. Jansen, J. van Paradijs, W.H.G. Lewin
3980	TV Columbae	X-ray periodicity discovered in range 1-7 keV.	A.C. Brinkman, J. Schrijver
3996	2S 0142+61	1456 sec Modulation of the X-ray flux	N.E. White, P. Giommi, A.N. Parmar, F.E. Marshall
4033	1E1402.3+0416	Rapid variability in BL Lac Objects.	P. Giommi, P. Barr
4038	PG0834-488	Detection of a hard X-ray flux	M.C. Cook
4039	EXO 0748-676	Discovery of a bright transient X-ray source which shows bursts, irregular intensity dips and periodic total eclipses	A.N. Parmar, N.E. White, P. Giommi F. Haberl.
4043	GX 5-1	Quasi periodic oscillation in the 1-10 keV flux	M. van der Klis, F. Jansen, J. van Paradijs, W. Lewin, J. Trümper, M. Sztajno
4044	4U 1323-62	Periodic dips in the 1-10 keV flux	M. van der Klis, A. Parmar, J. van Paradijs, F. Jansen, W. Lewin
4044	NGC 3031	Flux increases and variablity in the 0.1-6 keV range	P. Barr, P. Giommi

Circular No	Title	Comment	Authors
4049	RS OPHIUCHI	Intense X-ray emission detected; spectrum soft & absorbed.	F.A. Cordova, K.O. Mason, M.F. Bode, P. Barr
4051	EXO 1846-031	Detection of a new bright X-ray transient; non-variable flux .2 Crab.	A.N. Parmar, N.E.White
4051	4U1624-49	Periodic intensity dips discovered in the 2-10 keV flux.	M.G. Watson, R. Willingale, R. King I.E. Grindlay, J. Halpern
4054	NGC 4051	Quasi-periodic flux variations observed.	A. Lawrence, M. Elvis K. Pounds, M. Watson
4057	EXO 0748-676	Still active at 0.01 Crab - 21 type I bursts in total.	A.N. Parmar, M. Gottwald, F.Haberl N.E. White
4058	EXO 1747-214	New transient X-ray source Intensity 0.07 Crab, Type I bursts seen.	A.N. Parmar, N.E.White P. Giommi, L. Stella M. Sweeney
4060	SCO X-1	Quasi-periodic fast variability between 4 and 9 Hz during quiescent state.	J. Middleditch, W. Priedhorsky
4065	Nova Vul 1984 No. 2	Detected at 3σ level in 0.04-2 keV range soon after outburst.	J. Krautter, H. Ögelman,
4066	EXO 2030+375	Discovery of a bright, uncatalogued, transient X-ray pulsar period 41.83s.	A.N. Parmar, L. Stella P. Ferri, N.E. White
4068	SCO X-1	Intensity dependent quasi-periodic oscillations in 5-35 KeV data.	M. van der Klis, F. Jansen, N. White, L. Stella, A. Peacock
4070	CYG X-2	Intensity dependent quasi-periodic oscillations in 1-10 KeV flux.	G. Hasinger, A. Langmeier, M. Sztajno, N. White,

RECENT EXOSAT Preprint List

This list of recent EXOSAT preprints refers to all papers, with an Observatory Team member as author, which have been accepted for publication. Once the paper is published in the literature, it will be removed from this list.

4. The Structure of Low-Mass X-ray Binaries.
   White, N.E., Mason, K.

5. The Contributions of the EXOSAT Observatory to the 18th ESLAB Symposium.
   Observatory Team.

7. EXOSAT Observations of broad Iron-K line emission from Sco X-1.
   White, N.E., Peacock, A., Taylor, B.G.

Copies of these preprints are available on request to the Observatory Secretary.

EXOSAT BIBLIOGRAPHY

Hardware

Pre-Launch

A simple method of obtaining high background rejection in large area proportional counters. Bailey, T.A., Smith, A., and Turner, M.J.L. Nucl. Instrum. and Methods 115, 177 (1978).

Efficiency and resolution measurements of gratings between 7.1 and 304 Angstroms. Brinkman, A.C., Dijkstra, J.H., Geerlings, W.F.P.A.L., van Rooijen, F.A., Timmermann, C., and de Korte, P.A.J. Appl. Opt. 19, 1601 (1980).

X-ray scattering from epoxy replica surfaces. de Korte, P.A.J. SPIE Proceedings Space Optics - Imaging X-ray Optics Workshop 184, 189 (1979).

The X-ray imaging telescopes on EXOSAT. de Korte, P.A.J., Bleeker, J.A.M., den Boggende, A.J.F., Branduardi-Raymont, G., Brinkman, A.C., Culhane, J.L., Gronenschild, E.H.B.M., Mason, I. and McKechnie, S.P. Space.Sci.Rev. 30, 495 (1981).

X-ray imaging telescope on EXOSAT. Lainé, R., Giralt, R., Zobl, R., de Korte, P.A.J., and Bleeker, J.A.M. SPIE Proceedings Space Optics - Imaging X-ray Optics Workshop 184, 181 (1979).

The gas scintillation proportional counter on EXOSAT. Peacock,A., Andresen, R.D., Manzo, G., Taylor, B.G., Re, S., Ives, J.C., and Kellock, S. Space.Sci.Rev. 30, 525 (1981).

The parallel-plate imaging proportional counter and its performance with different gas mixtures. Sanford, P.W., Mason, I.M., Dimmock, K. and Ives, J.C. IEEE Trans.Nucl.Sci., NS-26 (1) 169 (1979).

The EXOSAT Mision. Taylor, B.G., Andresen, R.D., Peacock, A. and Zobl, R. Space.Sci.Rev. 30, 479 (1981).

The Medium Energy Instrument on EXOSAT. Turner, M.J.L., Smith,A., and Zimmermann, H.U. Space.Sci.Rev. 30, 513 (1981).

Post-Launch

The in-orbit performance of the EXOSAT Gas Scintillation Proportional Counter. Peacock, A., Taylor, B.G., White, N.E., Courvoisier, T., Manzo, G. IEEE Trans. Nucl. Sci., Vol. NS-32, No. 1, 1985.

The EXOSAT imaging X-ray detectors. Mason, I.M., Branduardi-Raymont, G., Culhane, J.L., Corbet, R.H.D., Sanford, P. IEEE Trans. Nucl. Sci., Vol. NS-31, No. 1, 1984.

The suppression of destructive sparks in parallel plate proportional counters. Cockshott, R.A., Mason, I.M. IEEE Trans. Nucl. Sci.. NS-31, No. 1, 1984.

High Luminosity X-ray sources (HLX)

Spectral and temporal features in bursts from 2S1636-536 observed with EXOSAT. Turner, M.J.L. and Breedon, L.M. M.N.R.A.S. (1984), 208, 29p.

Evidence for 4.4 hour periodic dips in the X-ray flux from 4U1755-33. White, N.E., Parmar, A.N., Sztajno, M., Zimmermann, H.U., Mason, K.O., Kahn, S.M. Ap.J., 238, L9-12, 1984.

An extended X-ray low state from Hercules X-1. Parmar, A.N., Pietsch, W., McKechnie, S., White, N.E., Trümper,J. Voges, W., Barr, P. Nature 313 (1985), 119.

The Discovery of 4.4 second X-ray pulsations from the rapidly variable X-ray transient V0332+53. Stella, L., White, N.E. Davelaar, J., Parmar, A.N., Blissett, R.J., and van der Klis, M. Ap.J., 288, L45-49 (1985).

Transient quasi-periodic oscillations in the X-ray flux of Cygnus X-3. Van der Klis, M., Jansen, F.A. Nature 313 (1985), p.768-770.

Evidence for variation in the phase-dependent ionisation structure of the stellar wind in VELA X-1. Van der Klis, M., Hammerschlag-Hensberg, G. Proc. 4th European IUE Conference 15-18 May 1985, Rome. ESA SP(218), 443.

Spectral Studies of Low Mass X-ray Binaries Observed by EXOSAT. Sztanjno, M., Trümper, J,. & Langmeier, A. Proceedings Int. Symposium on X-ray Astronomy, Bologna, 1984, p.111.

Discovery of Regularities in the Cycle-to-Cycle Variability of Cygnus X-3. van der Klis, M., Jansen, F. Proceedings Int. Symposium on X-ray Astronomy, Bologna, 1984, p.115.

EXOSAT Observation of 4U1705-44. Langmeier, A., Sztajno, M., & Trümper, J. Proceedings Int. Symposium on X-ray Astronomy, Bologna, 1984, p.121.

EXOSAT Observations of 1636-536. Breedon, L.M., Turner, M.J.L. Proceedings Int. Symposium on X-ray Astronomy, Bologna, 1984, p.145.

Recent Results of EXOSAT observations of 2S1254-690. Courvoisier, T. J.-L., Parmar, A.N., Peacock, A. Proceedings Int. Symposium on X-ray Astronomy, Bologna, 1984, p.153.

Pulse Phase Spectroscopy of Her X-1 with EXOSAT. Kahabka, P., Pietsch, W., Trümper, J., Voges, W., Kendziorra, E., and Staubert, R. Proceedings Int. Symposium on X-ray Astronomy, Bologna, 1984, p.193.

EXOSAT Observations of the 35 days Intensity Variations of Her X-1. Oegelman, H., Kahabka, P., Pietsch., W., Trümper, W., Voges, W., Kendziorra, E, & Staubert, R. Proceedings Int. Symposium on X-ray Astronomy, Bologna, 1984, p.197.

EXOSAT Observations of 3A1954+319. Cook, M.C., Warwick, R.S., and Watson, M.G. Proceedings Int. Symposium on X-ray Astronomy, Bologna, 1984, p.225.

EXOSAT Observations of the X-ray Transient V0332+53. Davelaar,J., White, N.E., Parmar, A.N., Blissett, R.J., van der Klis, M., and Schrijver, H. Proceedings Int. Symposium on X-ray Astronomy, Bologna, 1984, p.235.

Observations of LMC X-3 with EXOSAT. Treves, A., Bonnet-Bidaud, J.M., Chiappetti, L., Maraschi, L., Stella, L., Tanzi, E.G., and van der Klis, M. Proceedings Int. Symposium on X-ray Astronomy, Bologna, 1984, p.259.

EXOSAT Observations of the Andromeda Nebula. McKechnie, S.P., Jansen, F.A., de Korte, P.A.J., Hulscher, F.W.H., van der Klis,M. Bleeker, J.A.M., and Mason, K.O. Proceedings Int. Symposium on X-ray Astronomy, Bologna, 1984, p.373.

X-ray observation of VELA-X. Smith, A., Zimmermann, H.U., Adv. Space Res., Vol. 5 No. 3, p.33, 1985.

Is Cygnus X-3 a low-mass X-ray binary? Van der Klis, M., Jansen, F. Adv. Space Res., Vol. 5, No. 3, p.109, 1985.

EXOSAT observation of the galactic bulge X-ray source GX17+2. Sztajno, M., Trümper, J., Zimmermann, H.U., Langmeier, A. Adv. Space Res., Vol. 5, No. 3, p.121, 1985.

Optical and X-ray observations of 4U2129+47/V1727 Cyg in a quiescent state. Pietsch, W., Steinle, N., Gottwald, M. Adv. Space Res., Vol. 5, No. 3, p.117, 1985.

Search for millisecond rotational periods in some low-mass X-ray binaries observed by EXOSAT. Langmeier, A., Sztajno, M., Trümper, J. Adv. Space Res., Vol. 5, No. 3, p.121, 1985.

Cygnus X-3: The dependence of the Iron-line parameters on orbital phase. van der Klis, M. Proc. Japan-US Seminar on Galactic and Extragalactic compact X-ray sources. Tokyo, 1985. p.195.

Low Luminosity X-ray sources (LLX)

EXOSAT Observation of the candidate X-ray counterpart of Geminga. Caraveo, P.A., Bignami, G.F., Giommi, P., Mereghetti, S., and Paul, J.A. Nature 310, 481-483 (1984).

EXOSAT Observations of H2215-086: detection of the X-ray pulse period. Cook, M.C., Watson, M.G., McHardy, I.M. M.N.R.A.S (1984), 210, 7p.

Further Evidence on the Increasing One Minute Period in the X-ray Data of Geminga (1E0630+178). Bignami, G.F., Caraveo, P.A., and Salotti, L. Proceedings Int. Symposium on X-ray Astronomy, Bologna, 1984, p.209.

EXOSAT Observation of "Geminga". Caraveo, P., Bignami, G.F., and Mereghetti, S. Proceedings Int. Symposium on X-ray Astronomy, Bologna, 1984, p.213.

The detection of X-rays from Nova Muscae 1983 with the EXOSAT Satellite. Ögelman, H., Beuermann, K., Krautter, J., Ap.J., 287, L31-34, 1984.

EXOSAT soft X-ray Observations of EX HYDRAE. Cordova, F.A., Mason, K.O., Kahn, S.M. M.N.R.A.S. (1985), 212, 447-461.

An X-ray corona in SS Cygni. King, A.R., Watson, M.G., Heise, J. Nature 313 (1985), p.290-291.

The old Nova GK Per: discovery of the X-ray pulse period. Watson, M.G., King, A.R., Osborne, J. M.N.R.A.S. (1985), 212, 917-930.

Preliminary results of co-ordinated optical UV and X-ray observations of magnetic white dwarfs in binaries. Maraschi, L., Beuermann, K., Bonnet-Bidaud, J.M., Charles, P.A., Chiappetti, L. Hammerschlag, G., Howarth, I., Motch, C., Mouchet, M., Osborne,J. Stella, L., Treves, A., Van Paradijs, J., Willis, A.J., Wilson,R. Proc. 4th European IUE Conference 15-18 May 1985, Rome. ESA SP(218), 427.

EXOSAT hard X-ray observations of EX Hydrae. Beuermann, K., and Osborne, J. Proceedings, Int. Symposium on X-ray Astronomy, Bologna, 1984. p.23.

X-ray observations of the AM Her Star CW1103+254. Beuermann, K., Stella, L., and Krautter, J. Proceedings Int. Symposium on X-ray Astronomy, Bologna, 1984. p.27.

EXOSAT Observations of late-type stars: Preliminary Results. Landini, M., Monsignori-Fossi, B.C., and Pallavicini, R. Proceedings Int. Symposium on X-ray Astronomy, Bologna, 1984. p.31.

X-ray Emission from the Planetary Nebulae NGC 1360. de Korte, P.A.J., Claas, J.J., Jansen, F.A., McKechnie, S.P. Proceedings Int. Symposium on X-ray Astronomy, Bologna, 1984. p.35.

The soft X-ray superoutburst of VW Hydri: 14 second periodicity. van der Woerd, H., Heise, J., and Paerels, F. Proceedings Int. Symposium on X-ray Astronomy, Bologna, 1984. p.55.

EXOSAT Observations of Am Her objects: Preliminars Results. Osborne, J., Maraschi, L., Beuermann, K., Bonnet-Bidaud, J.M., Charles, P.A., Chiappetti, L., Motch, C., Mouchet, M., Tanzi, E.G., Treves, A., and Mason, K.O. Proceedings Int. Symposium on X-ray Astronomy, Bologna, 1984. p.59.

EXOSAT observations of Intermediate Polars: Preliminary Results. Osborne, J., Mason, K.O., Bonnet-Bidaud, J.M., Beuermann, K., and Rosen, S. Proceedings Int. Symposium on X-ray Astronomy, Bologna, 1984. p.63.

Simultaneous EXOSAT and optical observations of the pulsing X-ray binary H2252-035/AO Psc. Pietsch, W., Pakull, M., Tjemkes, S., Voges, W., Kendziorra, E., and van Paradijs, J. Proceedings Int. Symposium on X-ray Astronomy, Bologna, 1984. p.67.

X-ray emission from the planetary nebula NGC 1360. de Korte, P.A.J., Claas, J.J., Jansen, F.A., McKechnie, S.P. Adv. Space Res., Vol. 5, No. 3, p.57, 1985.

Soft X-ray characteristics of White Dwarfs observed by EXOSAT. Heise, J., Bleeker, J.A.M., Brinkman, A.C., Gronenschild, E., Paerels, F., Grewing., M., Wulf-Mathies, C., Beuermann, K. Adv. Space Res., Vol. 5., No. 3, p.61, 1985.

Spectral and temporal studies of various late-type stars. Brinkman, A.C., Gronenschild, E., Mewe, R., McHardy, I., Pye, J.P. Adv. Space Res., Vol. 5, No. 3, p.65, 1985.

A simultaneous X-ray and radio observation of a flare from ALGOL. Parmar, A.N., Culhane, J.L., White, N.E., van den Oord, G.H.J. Adv. Space Res., Vol. 5, No. 3, p.65, 1985.

A search for X-ray emitting coronal structures in ALGOL. Culhane, J.L., White, N.E., Kahn, S., Parmar, A.N., Blisset, R.J., Kellett, B. Adv. SPace Res., Vol. 5, No. 3, p.73, 1985.

Einstein and EXOSAT observations of Geminga (1E0630+1748). A summary of the short- and medium-term variability data. Bignami, G.F., Caraveo, P.A., Mereghetti, S., Salotti, L. Adv. Space Res., Vol. 5, No. 3, p.145, 1985.

The identification of H2311+77 with HD220140: A probable RS CVn. Pravdo, S., White, N.E., Giommi, P. M.N.R.A.S. (1985), 215, 118.

Active Galactic Nuclei (AGN)

EXOSAT Observations of Active Galactic Nuclei. Branduardi-Raymont G. MPE Report 184. X-ray and UV Emission from Active Galactic Nuclei. October 1984, p.88.

EXO1102.8+2539, an X-ray Variable AGN. Beuermann, K. MPE Report 1984. X-ray and UV Emission from Active Galactic Nuclei. October 1984, p.111.

Multi-frequency observations of active galactic nuclei. Tanzi, E.G., Chiappetti, L., Danziger, J., Palomo, R., Maccagni, D., Maraschi, L., Treves, A., Wamsteker, W. Proc. 4th European IUE Conference 15-18 May 1985, Rome. ESA SP(218), 111.

X-ray timing and spectral observations of active galactic nuclei. McHardy, I.M. Proceedings: 'Non-thermal and very high temperature phenomena in X-ray Astronomy, Rome, 1983. p.117.

EXOSAT Observations of Active Galactic Nuclei. Pounds, K.A., McHardy, I.M., Stewart, G., and Warwick, R.S. Proceedings Int. Symposium on X-ray Astronomy, Bologna, 1984. p.409.

EXOSAT Observations of Three Bright BL Lac objects. Warwick, R.S. McHardy, I.M., Pounds, K.A. Proceedings Int. Symposium on X-ray Astronomy, Bologna, 1984. p.467.

IUE-EXOSAT Observations of NGC 4151. Perola, G.C., Altmore, A., Boksenberg, A., Bromage, G.E., Clavel, J., Elvius, A., Penson, M.V., Pettini, M., Piro, L., Snijders, M.A.J., Tarenghi, M., and Ulrich, M.H. Proceedings Int. Symposium on X-ray Astronomy, Bologna, 1984. p.475.

The Soft X-ray emission from ON 235 and MK766. Maccagni, D., Garilli, B., Rampini, A., Chiappetti, L., & Giommi, P. Proceedings Int. Symposium on X-ray Astronomy, Bologna, 1984. p.479.

EXOSAT observation of the Perseus Cluster. Branduardi-Raymont, G., Kellett, B., Fabian, A.C., McGlynn, T., Manzo, G., Peacock, A. Adv. Space Res., Vol. 5, No. 3, p.133, 1985.

EXOSAT observation of Active Galactic Nuclei. Branduardi-Raymont, G., Bell-Burnell, S.J., Kellett, B., Fink, H., Molteni, D., McHardy, I. Adv. Space Res., Vol. 5, No. 3, p.129, 1985.

Broad band X-ray spectra and time variability of selected Active Galactic Nuclei observed with EXOSAT. Pounds, K. Proceedings Japan-US Seminar on Galactic and Extragalactic compact X-ray sources. Tokyo, 1985, p.26.

EXOSAT observations of a 2000s intensity dip in Seyfert Galaxy NGC 4151. Whitehouse, D.R., Cruise, A.M. Nature, <u>315</u>(1985) p.554.

Supernova Remnants (SNR)

X-ray spectra of Supernova Remnants: observations in continuum and lines. Bleeker, J.A.M. Proceedings: 'Non-thermal and very high temperature phenomenon in X-ray Astronomy, Rome, 1983, p.77.

The X-ray structure of the Crab Nebula. Aschenbach, B., Brinkmann, W., Langmeier, A., Hasinger, G., and Bork, T. Proceedings Int. Symposium on X-ray Astronomy, Bologna, 1984. p.302. Also in Adv. Space Res., Vol. 5, No. 3, p.45, 1985.

EXOSAT Observations of SN 1006. Jones, L.R., Pye, J.P., Culhane, J.L. Proceedings Int. Symposium on X-ray Astronomy, Bologna, 1984. p.305.

Recent results on the Crab pulsar X-ray light curve. Hasinger, G. Proceedings Int. Symposium on X-ray Astronomy, Bologna, 1984. p.321.

EXOSAT observations of the Supernova Remnant Cas A. Jansen, F.A., McKechnie, S.P., de Korte, P.A.J., Bleeker, J.A.M., Gronenschild, E., Peacock, A., Manzo, G., Branduardi-Raymont, G., & Kellett, B. Proceedings Int. Symposium on X-ray Astronomy, Bologna, 1984. p.289. Also in Adv. Space Res., Vol. 5, No. 3, p.49, 1985.

General

First Results from the X-ray Satellite EXOSAT. Biermann, P., Mitteilungen der Astronomischen Gesellschaft Nr. 62, p.101-121, 1984 (Minden 1984).

The EXOSAT mission. Taylor, B.G. Adv. Space Res., Vol. 5, No.3, p. 35, 1985.

NB: Reprints are obtainable from authors in the usual way.

REFLECTIONS ON EXOSAT AFTER TWO YEARS IN OPERATION

May 26, 1985 was the second anniversary of EXOSAT's launch and, in the bureaucratic sense, the culmination of the mission with its initially approved and funded operational lifetime of two years.

EXOSAT's origins can be traced to the late 1960's when a mission (code named HELOS) to determine accurately the location of bright X-ray sources, using the lunar occultation technique, was studied by a 'Mission Definition Group' of European scientists. The instrumentation, sealed proportional counters, was to be carried in a small, 150 kg satellite launched by a Delta vehicle into a highly eccentric 'polar' orbit to maximise the area of the sky over which occultations could be performed.

The EXOSAT mission was approved by the ESA Council in 1973 but did not start its phase B until 1977 because of the financial limitations of the ESA scientific programme budget. Also in 1977 it was decided that EXOSAT should be launched on the Ariane vehicle. In the intervening eight years since the HELOS study, the UHURU and Ariel 5 satellites (to name two) had been launched to give the first exciting views of the X-ray sky and NASA's HEAO programme had been restructured to contain a powerful, few arc-second resolution imaging telescope on the second satellite in that series which was named Einstein after launch.

The Announcement of Opportunity to propose instruments for EXOSAT was issued by the Agency in 1973 with a model payload defined to include large-area proportional counters and crude non-imaging flux collectors for the lower energies. Instrument groups, known as hardware groups in EXOSAT parlance, were selected in 1974 and, following a so-called scientific model phase, the instrument complement were significantly up-graded by the B-phase of the project. It comprised the large area proportional counter array (the ME, medium energy experiment), two imaging telescopes each with transmission gratings, position sensitive proportional counters (PSD) with good energy resolution as colour cameras and channel multiplier arrays (CMA) as high resolution black-and-white cameras and, a newly developed and unique instrument, a single gas scintillation proportional counter (GSPC). It is interesting to note that an array of similar-looking GSPC's formed the major part of the highly successful Japanese satellite, TENMA, launched a few months before EXOSAT in February 1983.

One overall requirement which was maintained throughout the programme was compatibility with the Delta vehicle which constrained mass (though eventually 120 kg of a satellite mass of 500 kg was allocated to the instruments), dimensions (one metre focal length telescopes compared with Einstein's 3.4 m) and, not least, programme cost. Such constraints led to extremely innovative and state-of-the art designs in the areas of the ME detectors' bodies (all beryllium) and collimators (microchannel plate technology), the ultra-lightweight, imaging telescope optics (gold reflecting layers replicated within beryllium carriers), and to the selection of a cold gas (propane) system rather than reaction wheels for attitude control.

While these constrains would limit, à priori, certain performance characteristics, eg. telescope throughput, energy range and resolution, the vehicle compatibility requirement did mean that we could launch in 1983 on a Delta, following the difficult period facing the Ariane programme after the L5 launch failure. As we now know Ariane has performed faultlessly since then - the launcher earmarked at that time for EXOSAT being used for the GIOTTO probe to Halley's Comet on July 2nd this year.

> It has been remarked that EXOSAT was "too little, too late". Given the delay from approval in 1973 to the Phase B start in 1977, should the programme have been reappraised then? Did the 'upgrading' of the instrumentation within the constraints go far enough and were the constraints reasonable? Would a satellite, launched in 1978 (earliest time from mission approval in 1973 should early funding have been available) centred on occultations and 'lunar offset pointing' as originally conceived, been enough anyway? Clearly there is food for thought here, when planning and selecting future scientific missions.

EXOSAT's development programme both for the spacecraft and the scientific instruments was not without incident and difficulty. Fortunately with the passage of time only a few now come readily to mind and no longer in nightmares, though one remains to haunt us. The major concerns centred on the attitude control system (EXOSAT was ESA's first scientific satellite with a true 3-axis stabilised capability), the timely availability of ME detector collimator elements and thin beryllium windows (where we had to find and 'qualify' an alternative source in the middle of the flight model phase), the long term stability of the gold-onto-epoxy-onto-beryllium X-ray reflecting surfaces and, the haunting one, the PSD's. A full complement of ME detectors was flown but more later of the attitude control and PSDs.

EXOSAT was launched flawlessly by Delta number 169 on 26 May 1983 at 08.18 hours local time (15.18 GMT) from the Western Test Range (Vandenberg), California, at the first attempt, within a few milliseconds of the start of a one-minute long launch window. Such a narrow window was needed to yield the maximum orbital lifetime (limited by celestial mechanics) of just under three years without violating other launch window requirements and constraints. Getting the launch to take place at that moment, rather than a moment twelve minutes earlier, which would have given the statutory two year minimum lifetime, was no easy task but was made possible by the record and experience of the Delta launch team.

Let's back-track now to the beginning of the programme in 1973. At that time it was decided that EXOSAT should be a facility to be used by an 'observing community' on a European-wide basis and its use should not be restricted to the few groups responsible for the hardware. The decision had two important ramifications.

For the first time in the ESA (ESRO) scientific programme it was decided therefore that the instrument procurement would be funded and managed by the Agency rather than nationally and through national groups. (Hipparcos and the ST-FOC are more recent examples of this). However, as noted earlier, hardware groups and instruments were selected through the AO process and responsibility for the instruments shared between the groups and the Agency. In practice the groups were responsible for scientific design, testing and calibration, particularly for the 'front-ends', the Agency for the engineering, system aspects, procurement from industry and overall management.

It was further decided at that time that all observing time would be open to competition through the peer review process with no time reserved for or guaranteed to the hardware groups. For a variety of reasons, one being the "quid pro quo" this approach was modified in 1979 by a decision of ESA's Scientific Programme Committee. This granted 'data rights' to the hardware groups for the calibration and performance verification phases with a guarantee of a percentage of observing time in the routine operational phase. Nonetheless, hardware group proposals for this guaranted time were subject to the peer review process.

> Partly as a result of the EXOSAT experience where, perhaps for some, the shared responsibility for procurement was unsatisfactory, and with a view not to load the ESA scientific budget with the costs of instrument procurement, the scheme adopted for the focal plane instruments of ISO, ESA's Infrared Space Observatory to be launched in 1992, calls for PI instruments funded nationally, gives the PI's commissioning time and a percentage of guaranteed time but makes available to the scientific community the majority of the observing time. A similar scheme is likely to be adopted for ESA's high throughput X-ray spectroscopy mission.

While EXOSAT was expected to be a facility for use by the astronomical community, the originally approved plans for the mission did not specify how this could be achieved. To be fair of course, the full, final scope of EXOSAT as flown was radically different from that primary occultation mission originally foreseen. Preliminary plans for the ground segment of the observatory were laid in 1978, though within very tight financial limitations, as this was seen as a new requirement, even though by this time IUE was operational. These limitations of course impacted on manpower levels and facilities that could be made available. However, by the time of launch an Observatory team and system had been established at ESOC geared to carry out the scientific operation, to provide quick-look data for observers, an observation data tape with instrument calibration files to a defined, standard format and a basic automatic scientific analysis (going far beyond quick-look). The basics of an interactive analysis system were also established. The originally foreseen observatory product was little more than a telemetry tape but the "miracle" was achieved with the use and upgrading of HP equipment originally purchased to support the instrument ground test and calibration programme. No VAX clusters here!

In order to review the observing programme proposals and initially to provide input to ESA on the Announcements of Opportunity (AO), the COPS (Committtee for Observation Proposal Selection) was formed and comprised twelve astronomers from assorted disciplines from the community. (Were there robbers?). The first AO was issued in mid-1981, within the ESA member states.

From the overwhelming number of proposals with the available time many-times over subscribed, a selection was made of the observations requiring the full scope of EXOSAT's instrumentation. It was decided not to time-line the observations in any detail due to launch date uncertainty and in case there would be any surprises during the in-orbit commissioning phase. Surprises there were!

Activation of the instruments began some 10 days after launch and initial results showed that all had survived the rigours of that event and were operating apparently nominally in accordance with ground test and calibration. However, the PSD of telescope 2 failed soon after turn-on and by the end of June 1983 the PSD of telescope 1 showed signs reminiscent of those discovered late in the development programme. A fundamental problem with the PSD was discovered during X-ray beam calibrations of the flight model telescopes in the spring of 1981, at that time within about one year of the planned Ariane launch date. It was found that high energy background events could produce localised sparks (or 'pings' as they became known) in the parallel plate counter geometry, which 'cracked' the methane quench gas, and led to electrode damage, spurious low energy pulsing and eventually continuous breakdown. A solution to the problem was found by modifying electronic component values and by the addition of a small active device known as the 'ping quencher'. Nothing conclusive has been found to explain the in-orbit failures but in the light of the 'ping' saga it is not inconceivable that the PSD's parallel-plate geometry with planar, resistive-disc readout - attractive for reasons of electronic simplicity, but with its demand for very high voltages to achieve the necessary gas gain - possessed little margin of safety to cope with the unforeseen.

Two further failures occurred within the next few months. The grating mechanism of telescope 1 jammed half-in/half-out and eventually was literally dragged out and the CMA of telescope 2 stopped working, started again and finally (?) stopped. Extensive investigations of a spare mechanism on the ground yielded no clues and analysis of CMA 2 data and the implementation of various operational procedures have been to no avail.

The provision of two independent telescopes to maximise throughput was also intended to permit flexibility in observations, eg. a PSD in one telescope together with CMA/grating in the other and to provide a degree of reliability through redundancy or duplication. This concept was undone by the systematic (?) failure of the PSD's and the random, indeed perverse, failure combination of the other two which left us with a working grating and CMA but in different telescopes!

> With these failings two important facets of the mission were denied us: broad-band and high resolution spectroscopy in the low energy domain. The results obtained early in the mission did show, tantalisingly, what might have been. However it might be interesting to note that greater observing time was achieved with the EXOSAT gratings in these first few months than with the Objective Grating Spectrometer on Einstein during the whole mission. It is not excluded that further grating observations be undertaken towards the end of the mission, if the grating can be dragged back in. Thankfully for the rest of the operational life, the instruments have operated fully satisfactorily and according to expectation.

On the spacecraft side the major concern has centred on the attitude control system. In the first months of operations, various anomalies occurred, with the spacecraft switching from star pointing mode to slowly-rotating, sun 'safety mode'. Eventually a working combination of on-board black-box functions was found but not before a considerable mass of propane attitude control gas had been lost. As the mission has progressed, the observing programme timeline has been constructed with increasing emphasis placed on the conservation of this resource - no easy task given the high percentage of observations conducted simultaneously with ground-based observatories and satellites like IUE, IRAS and TENMA.

On January 1st this year, the X-axis gyro malfunctioned and in the following weeks numerous anomalies involving the triggering of safety mode occurred with the resultant loss of a large amount of control gas. Spurious triggering of safety mode has been prevented meanwhile by disabling the hard-wired autonomous safety function and giving the task to the on-board computer.

> The on-board computer has proven invaluable for the mission, not only in this unforeseen application, but in its flexibility and application to the various instrument/telemetry operational modes, the vast majority of which have been modified or newly implemented since launch.

Again it may be interesting to recall that there was considerable opposition 10 years ago to having such a facility on EXOSAT! Flexibility should not be confused with complexity and the built-in ability to cope with the unexpected or ill-defined is essential in any mission.

The problem with the control gas (propane) is to determine what remains in the tank since no accurate, direct method is available. Currently the results from logging (i.e. estimating via telemetry, the usage from thruster activations) and gauging (i.e. measuring rate of temperature rise after switching on the heaters to give a measure of thermal capacity) are converging to give some 4 kg remaining. Providing this is accurate, that there are no more 'anomalous' events and the current minimum usage strategy is continued, operations can be expected to last through to late 1986. However as a precaution the galactic centre region will get top priority in the next two months or so. As noted earlier the orbit would decay naturally in April 1986, but by firing the hydrazine motor (intended to adjust the orbit parameters for occultations) at apogee, the perigee height can be raised. As the hydrazine motor is fired, propane must be used to keep the satellite pointing the right way. The trick will be to ensure that the propane runs out on the last orbit. So although not used for its intended purpose, the hydrazine and the more-than-sufficient-for-two-years propane capacity should extend the useful mission lifetime of the statutory two years by at least 18 months.

While on the subject of useful mission lifetime, it might be recalled that EXOSAT's orbit, primarily chosen for the occultation role, was highly eccentric with a 190.000 km apogee at high northern latitudes. This orbit has allowed uninterrupted observations for 72 hours per orbit. Earth obscuration of the celestial sphere is essentially zero and the detectors do not have to cope with high backgrounds associated with the South Atlantic Anomaly as for earth orbit satellites. On the other hand the particle background in the high orbit is a factor of only 2 or 3 higher than the low orbit, though solar flare activity can disrupt operations for several hours.

EXOSAT's orbit does allow continuous coverage from a single ground station and permits very efficient operation and control. The satellite design and the orbit together have proved ideal for coordinated measurements and has enabled very quick response to alerts. Many of the most exciting results from EXOSAT so far have stemmed from the long, uninterrupted look capability.

EXOSAT's operational efficiency, i.e. useful time on target is very high and would be even higher had the attitude control system been built around reaction wheels rather than the cold gas system to allow high slewing rates. Plans for operation of the Space Telescope (in low orbit) indicate that only some 35% will be spent on target. For future X-ray astronomy missions (like XMM) serious thought should be given to the utilisation of a highly eccentric orbit - though it should be more equatorial for orbit lifetime/ stability reasons. The attitude system should of course be capable of high slew rates. The table (later) shows that in two years EXOSAT has spent only 50% of total elapsed time on target, the major contribution to the losses coming from perigee passage (operations only above the radiation belts taken at 70,000 km) and slewing from target to target.

Given the constantly changing on-board situation in the summer and autumn of 1983 it was hardly surprising, at least to those in ESA connected with EXOSAT, that time-lining the observation programme more than a few orbits in advance (forget a few months) was impossible. This view was not shared by some of the user community. Gradually however things improved with time-lines being generated in adequate time, in particular for those EXOSAT observations conducted simultaneously with others - such observations being used as fixed points in the schedule around which non-simultaneous observations were fitted in. It was also impossible to supply data tapes (with calibration data) to observers within the statutory one-month delay and indeed it was not until mid-1984 that the observatory team had caught up with the backlog.

The observatory team, who were working flat-out, were certainly not encouraged in the early days by comparisons drawn with other missions and one wondered whether the comparison was drawn for the same relative epoch or whether memories were playing tricks. Having waited about a decade for EXOSAT anyway, waiting for tapes for somewhat longer should have posed no real hardship. What was important was that the observations be done properly with instruments whose calibration was known and understood.

When it was realised that certain of EXOSAT's mission objectives would be compromised by the on-board problems, it was decided in July 1983 not to time-line (i.e. defer) many of the observations selected from those proposed in A01 prior to launch, which it was thought could be affected by the unavailability of certain instruments. The COPS was asked to look again at the deferred proposals and it recommended with very few exceptions that all previously accepted observations should be undertaken. A02 was released earlier than planned on a world-wide basis and indicated to the user community the new situation and emphasised what could and could not be done by EXOSAT. A03 was issued in August 1984 and A04 (the last) will be issued in August 1985. Since A01 the COPS membership has been changed to bring as broad a range of expertise as possible to bear and expanded to cope with the massive load of proposals that have been submitted in response to each AO.

It might be remarked here that no guidelines were or are established for the à priori allocation of time to small, medium and large observing programmes, or to key projects or to classes of celestial object. The COPS recommended selection of observing proposals from those submitted, naturally trying to maintain a reasonable balance between galactic and extragalactic astronomy and the various subsets and of course making sure that the investigations selected are properly matched to EXOSAT's strengths and unique capabilities. It may be interesting to compare this approach with those adopted for IUE, the Space Telescope and even ground-based facilities. Which approach ensures that the best science with expensive facilities is done?

The EXOSAT programme conducted during the first two years and the complete programme approved are shown in the table. It might be noted that no occultation manoevures have yet been performed. One serendipitous occultation observation has been performed to check the system and the hydrazine motor has been fired successfully for calibration purposes.

Object Classification	Approved Pointings 1)	Pointings Performed 2)	Time Approved 3)	Time Observed 4)
Active Galactic Nuclei	544	381	1043	671
Clusters of galaxies	54	36	181	118
Deep fields	1	1	15	15
Extragalactic (Other)	73	67	97	89
High luminosity galactic	378	245	1175	599
Low luminosity galactic	524	355	1076	561
Miscellaneous	118	78	184	121
Occultations	2	0	2	0
Supernova remnants	115	77	274	195
Targets of Opportunity	59	59	120	120
Calibration/Operations	107	89	449	424
Performance Verification	21	17	69	53
GRAND TOTAL	1966	1405	4685	2966

1) Down to and including supernova remnants: approved from AO1/AO2/AO3 responses.
2) Pointings performed as of May 28, 1985 to orbit 196.

3)&4) Units of 10^4s.

As the mission progressed and observational data were disseminated, requests for help with the analysis began to come in from the community, especially from those members with no previous experience in X-ray astronomy and who perhaps lacked institutional computer and software support. Requests ranged from proposals to change data tape formats to FITs (not done), to distribute auto-analysis software (done on a case-by-case basis) to distribute interactive analysis software (not done) and to provide an interactive analysis capability for external users within the observatory at ESOC (done). This latter was implemented during 1984 by the Observatory team and, following a trial period to iron out the bugs, is now in full use. However it would now appear that the community has got to grips with EXOSAT analysis in that at a recent EXOSAT data analysis workshop at ESOC, the observatory staff outnumbered the external visitors.

> The above improvements and indeed the Observatory system as a whole have been implemented within existing resources on a very low budget and shows what can be done by a young, keen Team. However with the hardware development costs of satellites as high as they are, with the flying of ever more complex instrumentation and the ensuing nuances in analysis, just where should ESA draw the line on the services it provides to a user community to ensure the best possible return on the original investment? How much should the 'observer' be expected to have provided through national resources? Is NASA's approach to ST the appropriate one with the Science Institute?

Support is now given to process requests for archival research on those observations conducted a year or more ago. This support is given currently from within available resources, with operations of course having priority. However, this does open up a new window on EXOSAT, and, if IUE archival retrieval and research is any guide, a most important and far reaching one.

What did EXOSAT cost to build and what are the running costs now? When EXOSAT was launched in 1983, the development cost of the spacecraft in industry was some 73 MAU while that of the scientific instruments was about 13 MAU. For those for whom cost per unit mass in orbit is a yardstick, these figures convert to about 200 KAU/kg and 100 KAU/kg for spacecraft and instruments respectively. The total programme expenditure to launch in 1983 including internal costs, satellite testing, launch vehicle procurement, preparations for orbital operations, overheads, etc. came to about 155 MAU. Amortised over a two year orbital lifetime this represented an investment of about 2.5 AU per orbital second. This might explain why the EXOSAT Observatory within given resources, always puts first priority on operations if necessary, at the expense of other non-time-critical functions.

The current yearly cost of EXOSAT is about 5 MAU for 24 hr/day, 7 days-a-week operations, observations, data production, analysis and science.

It would appear that the value of EXOSAT is well recognised by ESA's advisory bodies, the Astrophysics Working Group, the Space Sciecne Advisory Committee and indeed the community as a whole who in the shape of the delegate body, the Scientific Programme Committee, agreed, at their meeting of 27/28 June 1985, that EXOSAT be operated through 1986 to the end of its useful life.

Perhaps this in itself is testament enough to those who, over the course of the project's development, made their contribution and it would be appropriate here to thank on EXOSAT's second birthday:

- MBB the satellite main contractor and the COSMOS industrial consortium
- the instrument contractors and suppliers:
  BAe (ME system), LND (ME detectors), Galileo (ME + GSPC collimators), Electrofusion (ME + GSPC windows), Matra (LE focal plane system and LE/ME electronics), SIRA (PSD/CMA detectors), SNIAS (PSD gas system), Laben (LE/ME electronics and GSPC system), AEG (GSPC gas cell) and CIT-Alcatel, ISA and Fichou (X-ray optics);
- the McDonnell Douglas and NASA launch teams.
- the satellite project team and the payload team at ESTEC.

While there is still a job to be done, thanks to my colleagues in the observatory team, the ESOC operations group, in SSD, ESTEC and in the hardware groups might be recorded on some future occasion when the job is really finished.

As a final point, the EXOSAT Observatory at ESOC is always open to constructive criticism and we are keen to do the best we can for the scientific community within budgetary resources. If you have suggestions, please let us know - it's not too late!

Brian G. Taylor,
Astrophysics Division,
Space Science Department
ESTEC, Noordwijk

EXOSAT: TWO YEARS OF ACHIEVEMENT

With the second anniversary of the EXOSAT launch it was felt timely to review the current mission status and mention some of the scientific highlights from the wealth of data obtained over the last two years. Since launch, about 2000 observations have been performed by the Observatory covering the complete range of astrophysical objects. These observations have come from the AO 1, 2 and 3 observing programmes. The final AO-4 program which will be selected in February 1986 will run to the end of the mission.

The AO-1 program, whilst providing some good scientific results, suffered from its early selection 1 year prior to launch and did not in general utilise the actual strength of EXOSAT. The program was based on pre-launch sensitivities and a payload complement which differed somewhat from that finally commissioned. Given the limitations of this AO-1 program, the Observatory has produced some excellent science. The single most important mission strength is the long uninterrupted look afforded by the deep orbit, which coupled to the real time control and data processing capability at the Observatory Centre has led to the maximisation of the scientific results from observations made with a well-balanced payload. This is particularly true in the study of classical X-ray binary sources.

One of the first examples of the scientific return that could be achieved with this orbit and near real time data processing was the observation of the transient source V0332+53 by Stella et al. (1984). After notification of a transient, the source was precisely located by the Observatory and an optical counterpart identified.Near real time data analysis revealed rapid Cyg X-1 like variability and stable 4.37s pulsations. Doppler variations of these pulsations indicated an eccentric 34.3 day binary orbit with X-ray outbursts occurring at periastron passage. This predicted outburst period was confirmed when EXOSAT later re-observed the source. Another example was the discovery by Parmar et al. (1984) of an anomalous extended low state from Her X-1 in the summer of 1983. Results by Trümper et al. (1985) from further Her X-1 observations when it had returned to its normal 35 day behaviour suggest the 35 day cycle is not caused by the precession of an accretion disk, but rather by the precession of the neutron star itself. A long uninterrupted observation of Her X-1, through one complete orbital cycle of 2 days is unprecedented in the history of X-ray astronomy and has paved the way for many more long exposures on galactic binary X-ray sources. Indeed, it is a sobering thought that, post EXOSAT, future missions currently planned will not have this long look capability.

In the field of low mass X-ray binaries EXOSAT has had a major impact. These systems, with binary orbits of typically a few hours, are difficult to observe with low earth orbiting satellites which suffer data losses due to earth occultations, Atlantic anomalies etc. A continuous exposure of 9-12 hours is quite typical for EXOSAT. This, coupled with the high sensitivity of the ME detector array, has led to the determination of many binary periods eg. 2S1254-68 (Courvoisier et al. 1984), 4U1755-33 (White et al. 1984).

The ME has also been very successful in discovering many new transient and bursting X-ray sources such as EXO 0748-676 (Parmar et al. 1985), EXO 2030+37 (Parmar et al. 1985).

The study of accretion-powered binary systems has taken a major step forward with the discovery by Van der Klis et al. 1985 of quasi-periodic oscillations (QPO) in the galactic bulge source GX5-1. This discovery has been followed by similar results from Sco X-1 (Middleditch et al. 1985, Van der Klis et al. 1985) and Cygnus X-2 (Hasinger et al. 1985) and we may finally be getting to grips with the nature of these sources. The detection of QPO in Sco X-1 is particularly satisfying since observations of this source essentially founded the subject of Cosmic X-ray astronomy some 20 years ago. A systematic study of the well known bulge sources in the galactic centre region will be carried out to search for similar behaviour. New OBC modes have been written and the observatory mission planning tuned to take maximum advantage of the forthcoming observing window.

The GSPC developed by the European Space Agency and flown successfully on the EXOSAT and TENMA satellites has complemented the sensitive ME array. In the study of bright galactic sources, the ME provides data on the temporal characteristics whilst detailed broad band spectra have been obtained from the GSPC. Some notable results include the discovery of broadened iron emission lines from low mass X-ray binaries by White et al., (1985a), Sco X-1 (White et al. 1985b) and the black hole candidate Cyg X-1 (Barr et al. 1985).

Another area of science reaping benefits from the EXOSAT mission is that of the study of cataclysmic variables, in particular those containing magnetic white dwarfs. Here the LE and in some cases the ME instruments provide the bulk of the results. A systematic study of the light curves of the AM Her binaries (again made possible for the first time by the uninterrupted coverage) revealed repeatable features from source to source that has led to new ideas regarding the geometry of the accretion flow (King et al. 1985, Mason 1984). The discovery of 350 second pulsations from the old nova GK Per by Watson et al. 1984 and the detection of a 12.4 minute period in the intermediate polar V1223 Sgr by Osborne et al. 1985, also illustrate the sensitivity to periods of the order of tens of minutes.

This type of data in conjunction with spectral information and often simultaneous coverage at optical and UV wavelengths will provide information on the physics of the accreting material onto the white dwarf.

It is in this area of science also that the flexibility of the mission has been so well demonstrated, responding with notable success to optical outburst alerts from such organisations as the AAVSO. Some good examples are the observations of SS Cygni in outburst and quiescence by Watson et al. (1985) and VW Hydri during super outburst by Van der Woerd et al. (1984). The latter observation revealed a 14 second coherent period probably associated with the rotation period of the white dwarf.

The other area of science in which considerable effort and observing time has been invested is that of active galactic nuclei. These studies have involved both the long and short term variability of AGN's with particular emphasis on the exposures being performed over as wide a range of the electromagnetic spectrum as possible. In particular UV quasi-simultaneous coverage with IUE has become common place. Only a few examples of short term variability have to date been observed. This is a particularly difficult area of science to address but a notable success is the observation of quasi periodic X-ray variations on timescales of 1 hour from NGC 4051 by the Leicester group. Another important result was the discovery by Barr et al. (1985) that the flux from the nearby emission line galaxy M81 had increased by a factor of 5 compared to measurements made 5 years previously and that during the EXOSAT exposure the flux varied by up to 50% on a timescale of less than an hour. Certain improvements in observing strategy may help to improve the chance of detecting short term variability in these types of objects in future exposures. As EXOSAT moves into its third year the results from the extensive long term monitoring of these AGN's will start to appear in the literature.

At the two year point in the mission, the EXOSAT Observatory is providing high quality scientific results with increasing regularity. These observational results and the associated theoretical interpretation will keep the scientific community engaged for many years to come. Certainly future missions will have to build on these original EXOSAT results. The experience gained by the Agency in building, flying and operating the EXOSAT Observatory will be utilised in its next major project in High Energy Astrophysics - the high throughput X-ray spectroscopy mission XMM - a cornerstone of the Agency's scientific programme.

A. Peacock

References

L. Stella et al. 1985. Ap.J., 288, L45.
A. Parmar et al. 1985. Nature, 313, 119.
J. Trümper et al. 1985. Talk presented at the Bamberg Meeting on CV's
T. Courvoisier et al. 1985. XXII Eslab Symposium
N. White et al. 1984. Ap.J., 283, L9.
A. Parmar et al. 1985. IAU 4039.
A. Parmar et al. 1985. IAU 4066.
M. Van der Klis et al. 1985. Nature in press.
J. Middledietch et al. 1985. IAU 4060.
M. Van der Klis et al. 1985. IAU 4068.
G. Hasinger et al. 1985. IAU 4070.
N. White et al. 1985a. MNRAS submitted.
N. White et al. 1985b. Ap.J. in press.
P. Barr et al. 1984. XXII Eslab Symposium.
M. Watson et al. 1984. MNRAS
J. Osborne et al. 1984. XXII Eslab Symposium.
M. Watson et al. 1984. XXII Eslab Symposium.
H. Van der Woerd et al. 1984. Bologna Symposium.
A. Lawrence et al. 1985. IAU 4054.
P. Barr et al. 1985 IAU 4044.
A. King et al. 1985. MNRAS, 215, IP.
K. Mason, 1985. Review talk at the XII Eslab Symposium.

EXOSAT UV CONTAMINATION - A PROGRESS REPORT

1. Introduction

These notes give an account of the current knowledge of the sensitivity of the EXOSAT CMA to ultraviolet radiation. Reference is made to section 8.1.4. of the EXOSAT Observers Guide (Part III - the Final Observation Tape Handbook).

We recall here a basic summary of earlier work - theoretically, a UV effective area was computed from the filter transmission, CMA efficiency and optics area (including grid and flap). The CMA efficiency in the UV region as supplied by Leiden was normalised to the X-ray efficiency contained in the CCF. From the observational point of view the count rates of a number of UV sources (including a large number of AO sources) had been collected in a small data base, using the results of the automatic analysis. Both the theoretical area and the first observational results are reported in the FOTH. In principle the next step should have been a straight-forward comparison between observed and predicted count rates, ie. taking the UV (IUE) spectrum of the object, convolving it through the theoretical effective area and comparing the number thus obtained with the observed value. This has not been possible, since for most of the objects in the EXOSAT sample no spectrum could be found in the IUE data bank (as an exception, for the brightest objects used as UV calibration targets one could find high dispersion spectra, which cannot be easily used for our purposes - see eg. Heck et al. 1984).

A different approach had then to be taken, ie. using "standard reference" spectra and normalising them to the visual magnitude of the object in the EXOSAT sample of the same spectral type. Of course the appropriate correction for interstellar absorption has to be taken into account. The "simulated" spectra could then be convolved through the theoretical area. This procedure adds an extra uncertainty to the results, caused by the limitations cf the spectral classification in the UV domain (see Heck et al. 1984). A description of the procedure, and of the current results is given below. We stress that this is a progress report and further information will be described as the work proceeds.

2. Selection of the Reference Sample

The sample containing the reference IUE spectra has been produced using the FITS tape containing the (ESA) IUE Low-Dispersion Atlas (Heck et al. 1984). This atlas comprises 229 objects, mainly of early spectral types. A small data base containing the magnitudes and spectral classification of the objects has been created using the data given for the individual spectra. Information on the extinction has been derived using the table in the (NASA) IUE Ultraviolet Spectral Atlas (Wu et al 1983), a partially different sample.

3. Production of the Reference Sample and of the EXOSAT Sample

The resulting reference sample consists therefore of the intersection of the two catalogues, a total of 65 objects with known E(B-V).

The EXOSAT sample comprises all UV targets observed by EXOSAT, for which automatic analysis results were available. All objects later than the K spectral type have been discarded (apart from one, for which the UV spectrum was available). The magnitude and spectral classification have been derived from the Bright Star Catalogue. Since objects observed in Guest Observer programs are included in the sample, only statistical information is given here. The sample comprises 28 objects, distributed among the spectral types as indicated in the table below.

A subset of the reference sample described above has been used, consisting of the stars of the same spectral type as the targets in the EXOSAT sample. This contains 35 objects and is referred to in the remainder of this paper. The A5 stars, for which no EXOSAT target exists, have been introduced into the sample in order to produce some prediction in a region where the UV component of the spectrum is rapidly changing with spectral type (they are used in Fig. 1 and 2 only).

It should be noted that <u>all</u> objects in the reference sample with the same spectral type as one object in the EXOSAT sample have been included (irrespective of the luminosity class). Therefore for some spectral types there are up to 6 reference objects, while for other types just one. The problems related to this are briefly discussed in the next section.

A breakdown indicating the coverage of different spectral types is given below:

B0	:	2 EXOSAT objects	6 reference objects	
B1	:	1 EXOSAT "	3 " "	
B3	:	2 EXOSAT "	6 " "	
B8-9	:	3 EXOSAT objects	3 reference objects	(B8)
A0	:	1 EXOSAT "	2 " "	
A2	:	1 EXOSAT "	1 " "	
A5	:	no EXOSAT "	2 " "	
A7	:	2 EXOSAT "	2 " "	
F0-1	:	3 EXOSAT "	3 " "	(F0)
F2	:	2 EXOSAT "	1 " "	
F5	:	2 EXOSAT "	1 " "	
F8	:	1 EXOSAT "	1 " "	(F9)
G0-1	:	5 EXOSAT "	1 " "	(G1)
G5	:	1 EXOSAT "	1 " "	
G8	:	1 EXOSAT "	1 " "	
K2	:	1 EXOSAT "	1 " "	

Three objects in the EXOSAT sample appear also in the reference sample (ie. we have the IUE spectrum of the EXOSAT target): they are the one F, one G and one K star. EXOSAT data exist for at least two other objects in the reference sample, but they are as yet not available in the automatic analysis result data base.

4. Normalisation of the Reference Sample

The following procedure has been adopted to produce the standard reference spectra. Spectra and magnitudes in the reference sample have been de-reddened using the extinction law given by Seaton (1979). The reference spectra are then transformed into "simulated" spectra of the EXOSAT target under examination in two steps: first they are reddened using the E(B-V) of the EXOSAT target, then they are scaled to the appropriate V magnitude. At this stage they can be convolved with the theoretical area.

This procedure has been applied to all objects in the EXOSAT sample for all reference objects of the same spectral type.

As a guideline, all the reference spectra, normalised at V=6.0 and E(B-V)=0.0, have been convolved through the theoretical UV effective area. Note that sometimes a non-negligible scatter exists in the UV flux of objects with the same class and magnitude. This could be due to uncertainties in the spectral classification (we noted that sometimes the same object has different classifications in the different sources we used), and/or to the neglect of possible luminosity effects.

An indication of this scatter is given in Fig.1, where the UV flux in the 1150-2600 Å range is plotted against the spectral class for the objects in the reference sample (normalised to V=6.0 and no absorption). The wavelength range has been defined on the short wavelength side by the limit of the IUE range as used in the Atlas, and on the long wavelength side by the range in which the UV effective area is defined (see FOTH).

Predicted EXOSAT count rates have been produced for the different filters for the normalised reference sample. These could serve as a guideline to estimate the UV contamination and are shown in Figs. 2a and 2b where the predicted count rates are plotted versus the 1150-2600 Å flux (a fair indicator of the spectral type).

Note, as expected, that the UV contamination is negligible for stars of spectral types later than or equal to F, and that the contribution in filter 6 (Al-Par) is negligible, in filter 3 (thick Lexan) quite low, in filters 7 and 2 (thin Lexan and Polypropylene) quite high. For early-type stars the prediction indicates a similar contribution in the latter two filters.

A word of warning is however necessary, since shortwards of 1500 Å the Polypropylene transmission is not available and has been assumed to be zero, consistent with the sharp edge in our data - possibly a drastic assumption. As a further caveat, note that no attempt has been made to estimate the contribution in the EUV region between 900 Å and 0.02 keV, where there is no data on filter transmissions (because of the edges in the PPL and Lexan filters a meaningful interpolation between existing UV and X-ray data is not possible).

5. Comparison between prediction and observations

The predicted count rates based on the "simulated" spectra produced according to the procedure described above have been inserted into the data base containing the observed count rates and the other information relevant to the EXOSAT sample. Where more than one reference spectrum existed, the mean has been assumed (and the deviation from the mean as associated uncertainty).

The results are shown in Figs. 3(a) to 3(d); one should be aware of the fact that some of the EXOSAT detections plotted are more properly upper limits (whenever the observed value was less than one sigma, the one sigma value is plotted instead).

Please note that the sample for different filters is different, ie. some of the objects in the EXOSAT sample have not been observed in all filters, and that:

a. There is agreement between prediction and observation for filter 2 (PPL) ; however the sample is limited to 4 intermediate type objects.

b. For the other filters early type stars show a predicted count rate higher than the value actually observed. The difference is generally within a factor 2 to 5, but reaches 50 in one case.

c. For late type stars the observed value exceeds the prediction by at least 2-3 orders of magnitudes.

The larger effect, ie. the excess of counts in the late type objects can be explained in a simple way by selection effects. These objects are taken from the Guest Observer program, not from a UV calibration program, therefore they are likely to show coronal emission in the X-ray domain. This can be confirmed by the examination of the few objects for which IUE spectra exist. Excluding one for which there is only a marginal detection in thick Lexan, we note that the other two are obviously X-ray sources since they have been clearly detected in the Boron filter, and the discrepancy between prediction and observation is larger in the Al-Par filter (ie. the least transparent to UV). A similar explanation holds also for the majority of the other late type objects. In three cases there is a detection in Boron (also in the case where more than one filter was used) and the discrepancy is always larger in the filter which is less transparent to UV.

No obvious explanation exists at a first glance for the opposite effect, ie. the apparent deficit in the early type objects. Note here that the predictions are based on the value of the theoretical effective area (ie. as given in the FOTH), without any sum signal dependent efficiency correction. It is however known (see FOTH Section 8.1.3.4) that this effect could be quite large for UV sources (on the other hand the correction factor would be subject to large uncertainties, since fitting would be to the tail of the Pearson distribution).

Note finally that the apparent agreement obtained for the PPL filter may be affected by the poor knowledge of the PPL area shortwards of 1500 Å, as noted in Section 4.

The observed ratio of count rates between two filters (since the most widely used filter is thin Lexan, ie. FW7, the ratios FW7 over FW3, FW7 over FW6 and FW7 over FW2 have been used) have been compared with the predictions. For early type stars the predicted ratio FW7 over FW6 and FW7 over FW3 is quite close to the observed value, while the disagreement is larger for late type stars (and larger for the FW7 over FW6 ratio than for the FW7 over FW3). This seems on one hand to confirm that a significant X-ray flux is seen from the late type objects, on the other hand to indicate that the relative transmissions of filters 3, 6 and 7 are consistent with the theoretical values.

The ratio FW7 over FW2 shows a different behaviour: late A-F type objects give a good agreement between prediction and observation (with a slight overestimation of the count rate in FW7) while for B-early A objects the FW7 count rate appears clearly overestimated. Alternatively (and consistent with the impression from observational evidence that early type objects show up quite extensively in the PPL filter) one can attribute the effect to the fact that the PPL area is erroneously assumed to be zero below 1500 Å, where most of the UV flux from early type objects is concentrated.

6. Conclusion

A possible explanation which needs confirmation by a re-examination of the theoretical values for the CMA efficiency and filter transmissions is presented below.

The transmission of filters 7, 6 and 3 is probably correct, while the transmission of filter 2 is arbitrarily set to zero shortwards of 1500 Å, but could instead be non-zero. Alternatively, the channel plate efficiency could be overestimated: this overestimation reflects the fact that the effective area of the plate + filter is also overestimated for filters 7, 6 and 3, while the overestimation of the CMA efficiency and the underestimation in the PPL transmission cancel out each other (and the latter effect is of course visible for early stars which have a significant far UV flux).

With the explanation given above, one can use the areas given in the FOTH for a conservative estimate of the UV contamination when planning EXOSAT observations. However a more precise quantitative approach, in order to correct observed count rates for the UV contribution and perform an X-ray analysis, requires further work.

Request

In view of the remaining uncertainties in the quantum efficiency of the CMA and the mass absorption coefficients of the filter materials (especially PPL) we urgently request the scientific community for references or data on these topics. Please contact Ed Gronenschild or Paolo Giommi.

L. Chiappetti IFCTR, Milan
P. Giommi

References

Chiappetti, L., 1984. EXOSAT Observers Guide (Part III), Section 8.1.4 (FOTH).

Heck, A., Egret, D., Jaschek, M., and Jaschek, C. 1984. IUE Low-dispersion Spectra Reference Atlas - Part I. Normal Stars, ESA SP-1052.

Hoffleit, D. 19?? Catalogue of Bright Stars.

Seaton, M.J., 1979. M.N.R.A.S., 187, 73p.

Wu, C.C., Ake, T.B., Boggess, A., Bohlin, R.C., Imhoff, C.L., Holm, A.V., Levay, Z.G., Panek, R.J., Schiffer, F.H., and Turnrose, B.E. 1983. The IUE Ultraviolet Spectral Atlas, NASA IUE Newsletter 22.

Figure Captions

Fig. 1

The 1150-2600 Å flux of a sample of stars normalised to V=6 and E(B-V)=0 as a function of the spectral type.

Fig. 2(a) & 2(b)

Predicted countrates for different EXOSAT filters as a function of the 1150-2600 Å UV flux for the same sample of objects reported in Fig. 1.

Fig. 3(a) - 3(d)

Comparison between observed EXOSAT count rates and predictions based on the theoretical effective area and the UV reference spectra for filters 2,3,6,7. The horizontal line markes the ratio predicted/observed equal to unity.

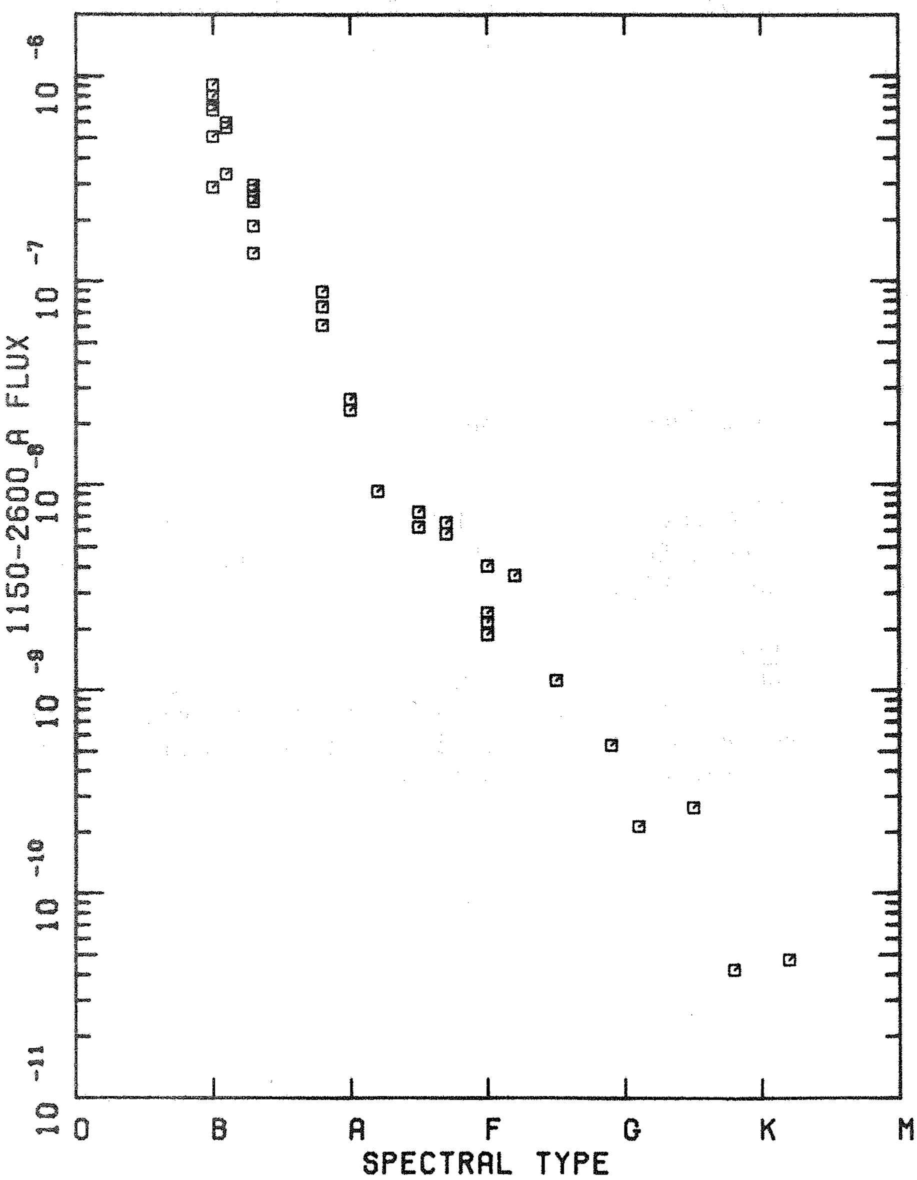

1150-2600 Å FLUX
10^-6
10^-7
10^-8
10^-9
10^-10
10^-11
O
B
A
F
G
K
M
SPECTRAL TYPE

Figure 1

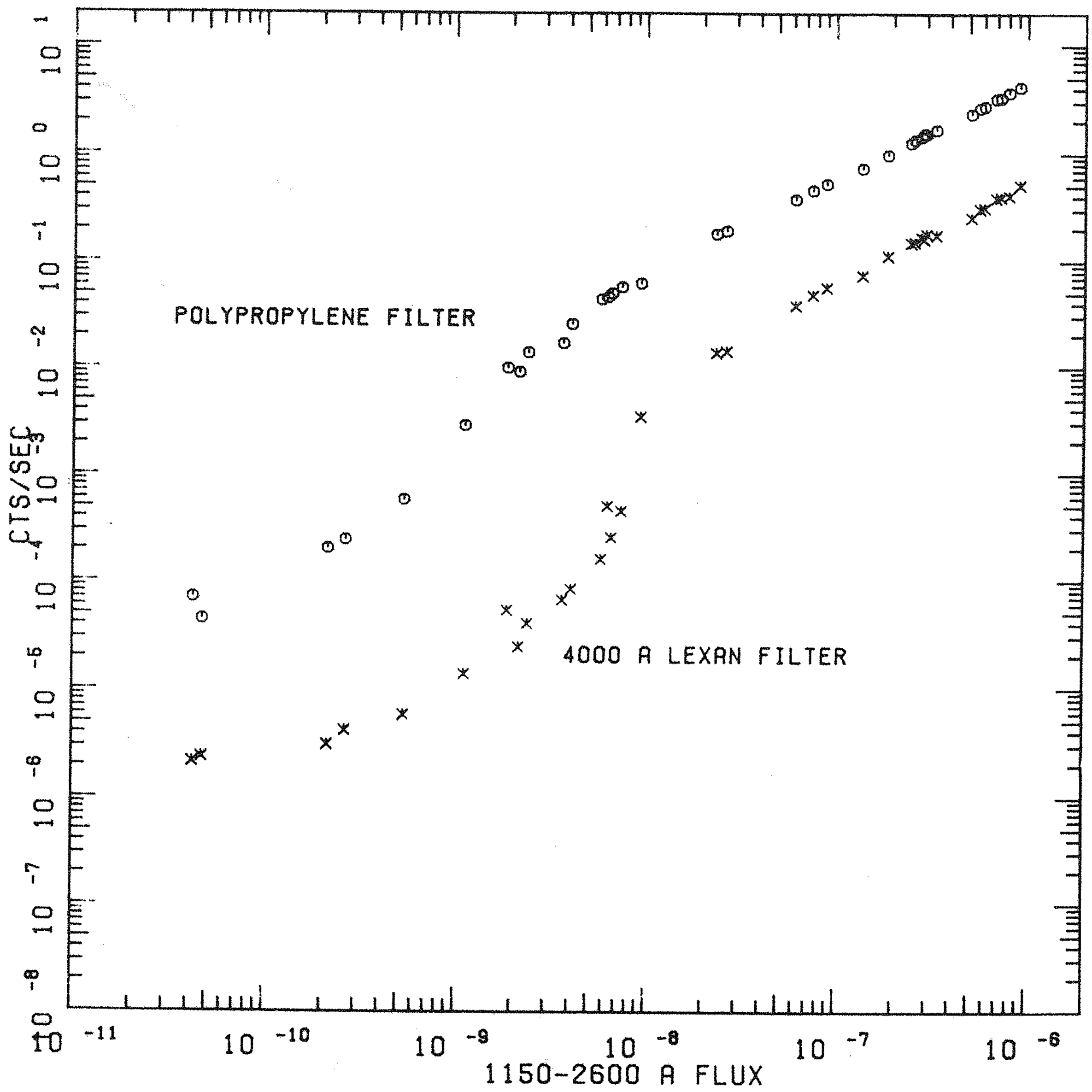

POLYPROPYLENE FILTER
4000 A LEXAN FILTER
CTS/SEC
1150-2600 A FLUX

Figure 2(a)

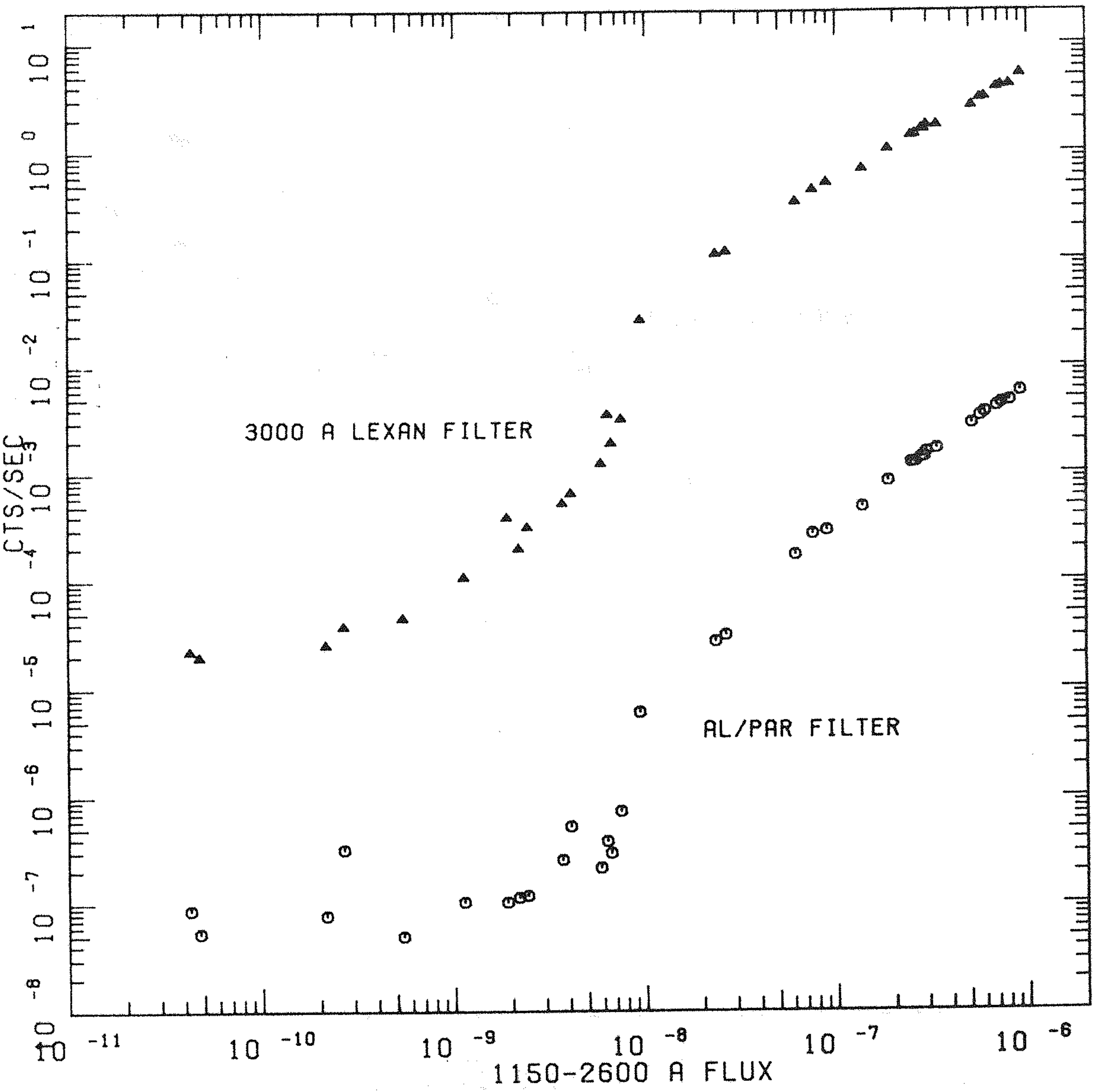

3000 A LEXAN FILTER
AL/PAR FILTER
CTS/SEC
1150-2600 A FLUX
10 -11
10 -10
10 -9
10 -8
10 -7
10 -6
10 -8
10 -7
10 -6
10 -5
10 -4
10 -3
10 -2
10 -1
10 0
10 1

Figure 2(b)

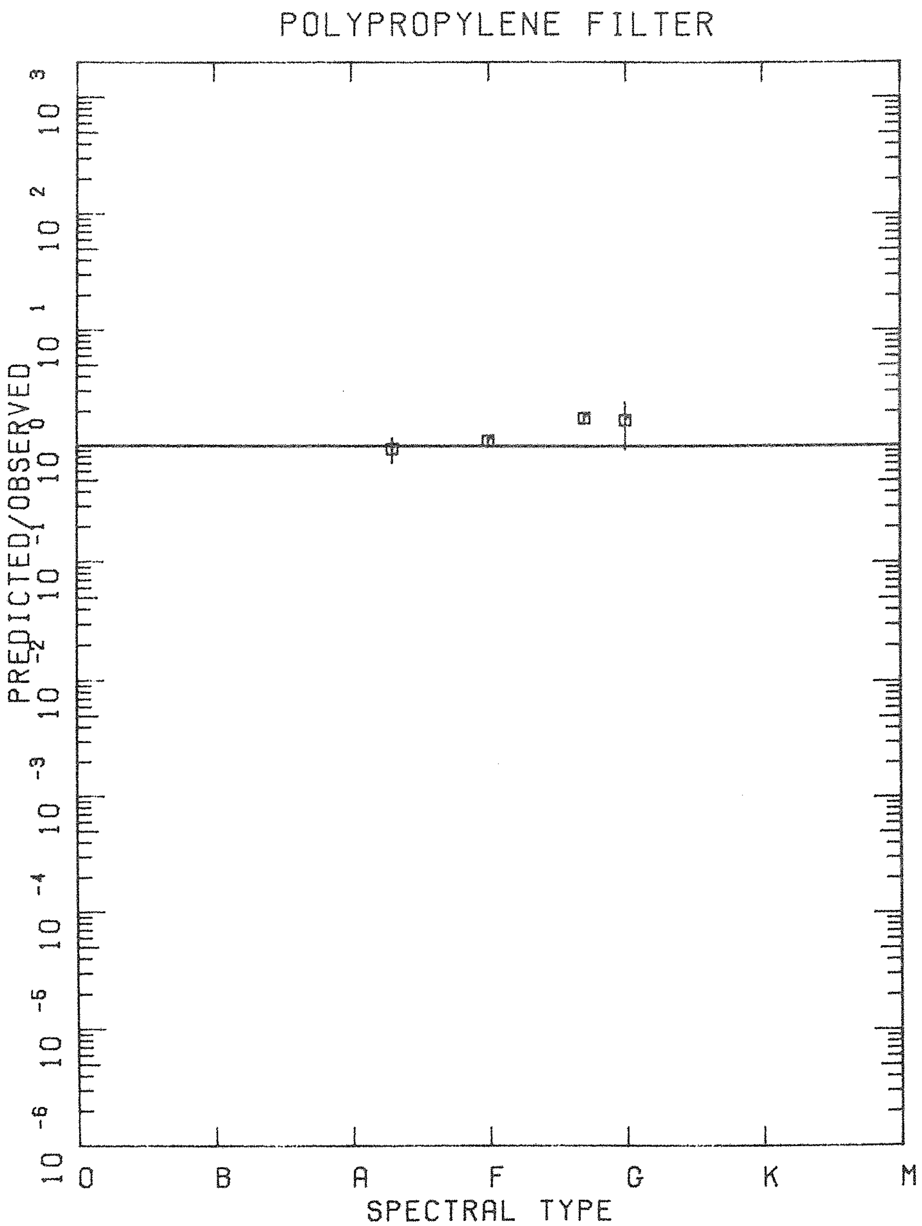

POLYPROPYLENE FILTER
PREDICTED/OBSERVED
10 3
10 2
10 1
10 0
10 -1
10 -2
10 -3
10 -4
10 -5
10 -6
O
B
A
F
G
K
M
SPECTRAL TYPE

Figure 3(a)

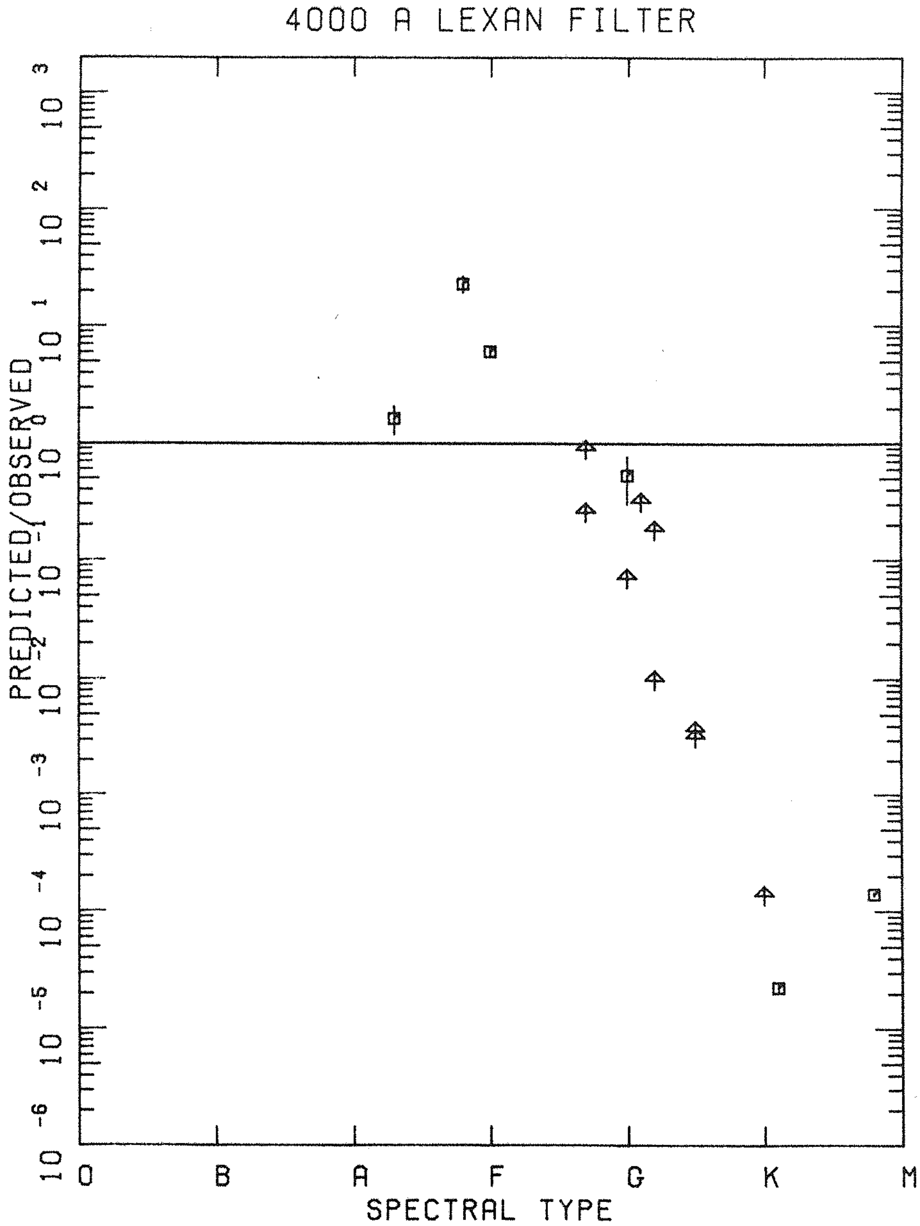

4000 A LEXAN FILTER
PREDICTED/OBSERVED
10^3
10^2
10^1
10^0
10^-1
10^-2
10^-3
10^-4
10^-5
10^-6
O
B
A
F
G
K
M
SPECTRAL TYPE

Figure 3(b)

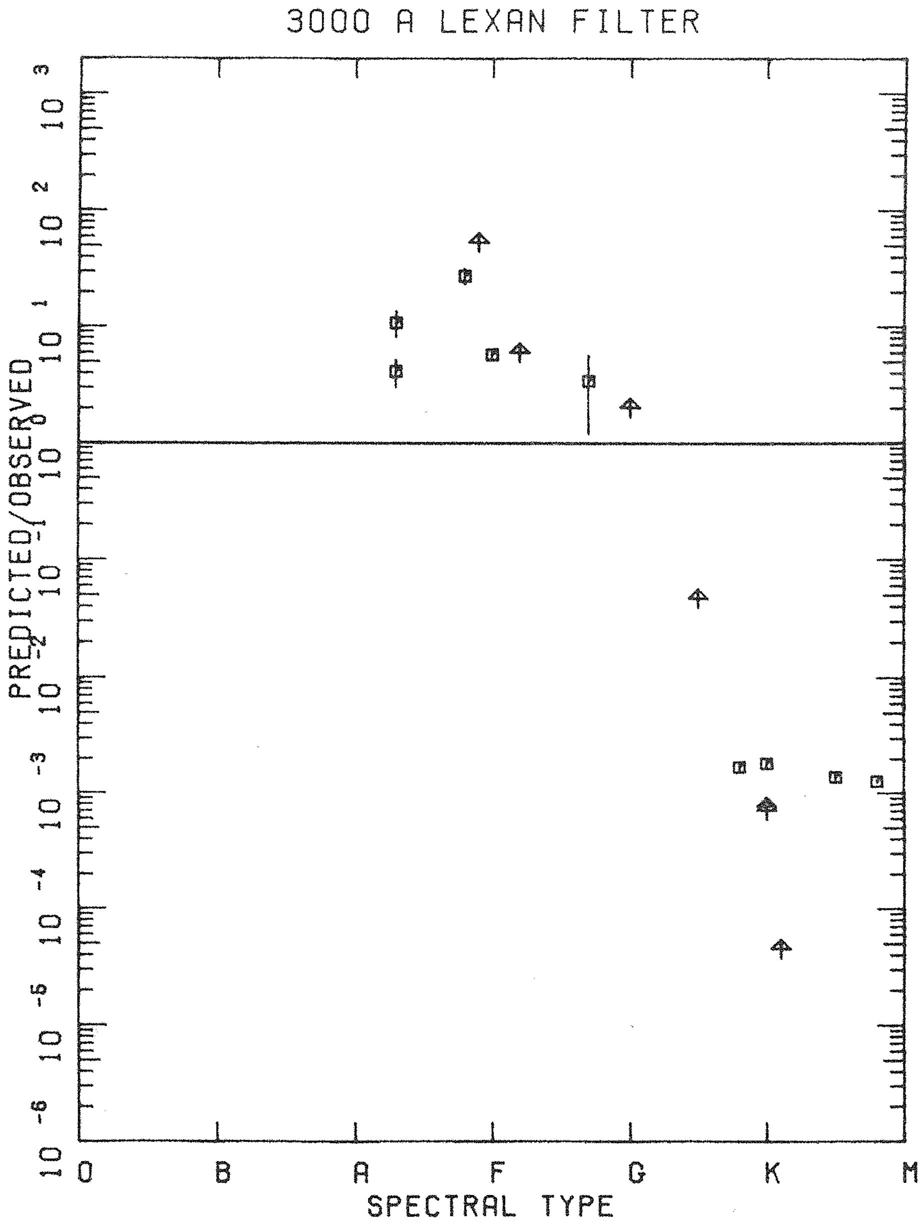

3000 A LEXAN FILTER
PREDICTED/OBSERVED
10^3
10^2
10^1
10^0
10^-1
10^-2
10^-3
10^-4
10^-5
10^-6
O
B
A
F
G
K
M
SPECTRAL TYPE

Figure 3(c)

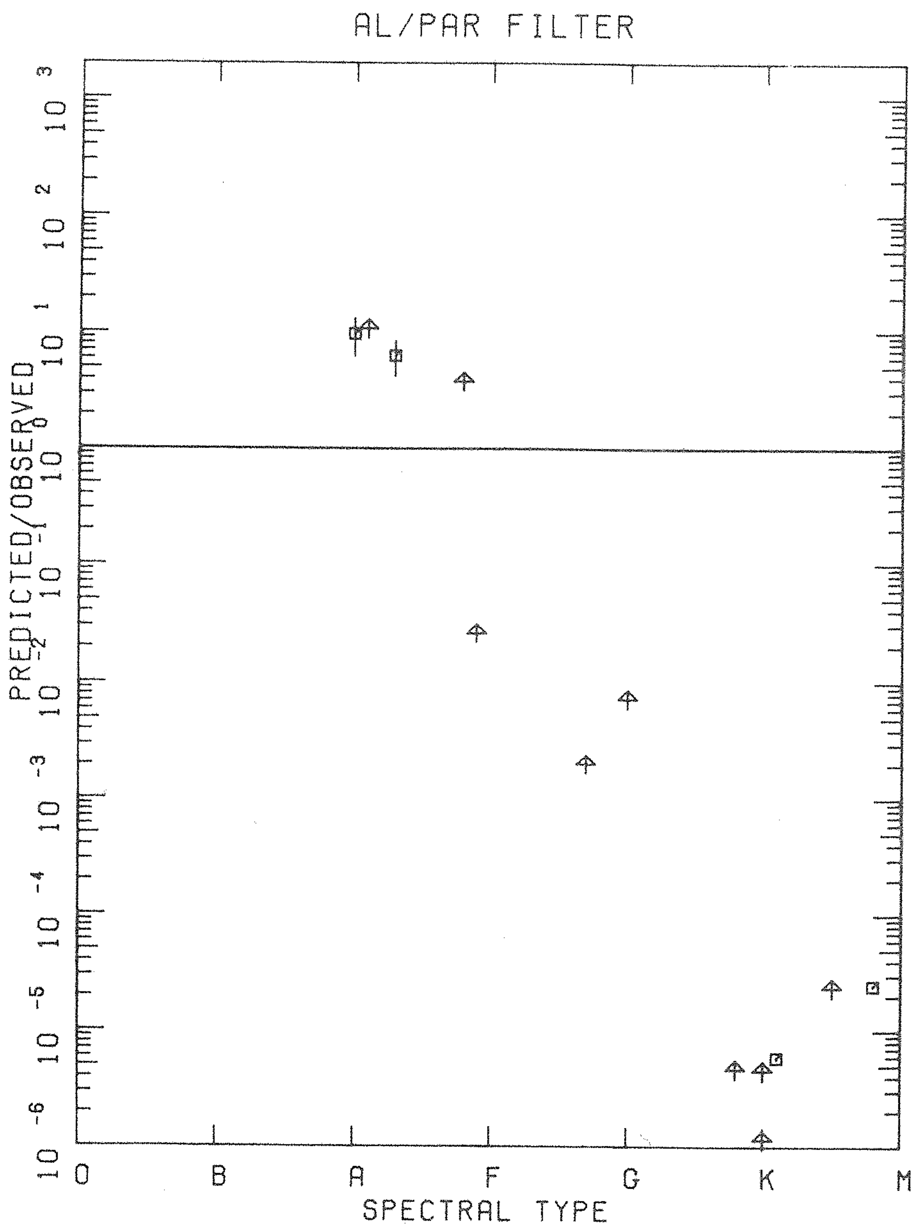

AL/PAR FILTER
PREDICTED/OBSERVED
10^3
10^2
10^1
10^0
10^{-1}
10^{-2}
10^{-3}
10^{-4}
10^{-5}
10^{-6}
O
B
A
F
G
K
M
SPECTRAL TYPE

Figure 3(d)

GSPC CALIBRATIONS

Introduction

The first observation of the Crab made in 1983 with the GSPC on EXOSAT indicated that the response of the detector as given by the pre-launch calculations and calibrations was incorrect. A large deficiency in counts below 4 keV was apparent along with a line feature in the spectrum around 4.78 keV. Effective areas as a function of energy were modified to give the correct fit to the Crab. In addition to these problems the absolute gain calibration as defined by two line features in the background, which had been ascribed to Lead L fluorescence, did not give the correct energy for the Sulphur line measured from Cas A. This suggested that these lines might not be Lead, but rather were from Bismuth, perhaps caused by the radio-active decay of a lead isotope.

Over the past few months a major effort has been made to obtain a fuller understanding of the GSPC response. This has, in part, been helped by the performance of a long observation of the Crab made with the burst length discriminator set to give a maximum acceptance range. This discriminator is used to reduce the particle background, but also removes a small percentage of X-rays in an energy dependent way. Since the energy dependence of this process requires calibration, such an observation was essential in order to investigate the above problems. The appropriate observation of the Crab was made in February 1985.

Using data from this observation, considerable progress has been made. A number of uncertainties in critical detector parameters have come to light and make it possible to reproduce the Crab spectrum to within 2% without making arbitrary changes to the response. The following describes the various steps that were taken to resolve the problem of the GSPC calibration.

It should be stressed that calibration of the GSPC, a new instrument with a resolution approximately a factor of two better than that of a conventional proportional counter, presented new and unexpected problems. The improved resolution revealed many subtle effects that hitherto would have gone unnoticed in a proportional counter. In retrospect, the ground calibration fell short of what was required to fully model the nuances of the instrument response.

1. The Absolute Energy Calibration

A detailed study of the background spectrum has been made by P. de Korte. A spectrum taken in gain one is shown in Figure 1. This reveals a number of line features that can be identified as resulting from three separate processes. First the two strong lines between channels 65 and 100 are the L alpha and beta lines from the fluorescence of lead in the collimator. A cursory glance at Figure 1 reveals that the L beta line is stronger than the alpha line, which is contrary to the expected branching ratio of 110:70. This is caused by a second line complex that overlaps the lead lines. The broad bump around channel 125 is a blend of the lead L gamma line and a Thorium L beta line at 16.2 keV, the latter resulting from the radioactive decay of residual plutonium in the Beryllium window. The K alpha Thorium line is at 12.9 keV and lies very close to the lead K beta line at 12.6 keV such that the upper of the two lead lines is a blend, which can be treated as a single line with a mean energy of 12.703 keV.The energy of the lead L alpha line is 10.541 keV.

The remaining line in the spectrum between channels 200 and 225 is identified with Xenon K alpha and arises from the escape photons of high energy background particle events that are captured by the detector walls. This line cannot be used as an absolute calibration standard since comparison with the energies of the lead lines gives an energy lower than the expected value of 29.67 keV, probably arising from the fact that the escape photons illuminate the whole detector. If the photons deposit their energy in the scintillation region or close to the detector walls then the total energy deposited will be less than that of a photon entering via the detector window. The apparent energy of this line appears to be 29.4 keV. For very bright sources where the lead lines are not visible it can be used to lock the gain. Otherwise the two lead lines should be used since they lie closer to the critical iron line region. It is recommended that the bump around 16 keV should not be used since it is too weak to accurately lock the gain. To summarise:

Lead L alpha = 10.541 keV

Lead L beta + Thorium L alpha = 12.703 keV

Xenon K feature = 29.4 keV

2. The Detector Gain

The line feature that appears around 4.78 keV in all X-ray spectra occurs because the gain of the detector increases above the L_{III} edge of the Xenon filling gas the reason being that the Xenon atoms do not completely de-excite after the initial ionisation process and a small amount of energy is not recorded in the detector. Above the L_{III} edge the final ionisation state of the Xenon atom increases. Measurements of this effect by Carlson et al. (1966, Phys.Rev. 151,41) for Xenon atoms in close to vacuum conditions confirm this, although the value of the gain jump predicted by the Carlson work is much larger than the 50 eV estimated from the Crab spectrum. This difference is most likely due to the fact that the Xenon in the GSPC is at a presssure of one atmosphere. There do not appear to be any major gain jumps across the first two L edges, although it is difficult to rule out small jumps of 10 eV or less.

There must be similar jumps in the gain across the other shells. While these are not relevant to the absolute gain calibration in the energy range that the GSPC is sensitive, they will cause the zero channel offset (as defined above the L_{III} edge) to be greater than 50 eV. The amount of this offset could not with any degree of confidence be determined from the pre-launch calibrations, but was estimated to be +150 eV from fitting to the Crab spectrum as described below.

In dealing with the gain jump in spectral fitting programs it is best to consider the problem in volts. The decrease in gain above the L_{III} edge (at 4.78 keV) is equivalent to the volts generated by a photon above the edge being lower by 50 eV times the slope of the energy/volts curve (GP). Another way of thinking of this effect is that just above and below the edge a measured voltage corresponds to one of two possible energies. Since the absolute energy calibration of the detector is determined above the L_{III} edge all channel boundary definitions are referenced to the gain above the L_{III} edge.

The channel boundary convention is defined as follows:

$$E = (N-0.5).GP + 0.150$$

where N is the channel no. from 1-256 and E is the energy of the required channel. In this definition N=1.0 gives the centroid energy of the first channel. This applies to all gain modes. The value of GP should be determined for each observation from the measured position of the lead lines. GP is approximately 0.13 for gain 1.0 and 0.065 for gain 2.0.

If the source is too bright to determine accurately the position of the lead lines and the gain is 2.0 so that the Xenon feature is not available, then use the data from the proceeding slew to determine the gain. DO NOT use the following slew. This is because for thermal control of the CMA the 28 volt A1 power lines (which drive the HT convertors) to all the experiments are briefly switched off after an observation. The gain of the GSPC photomultiplier may change by several percent when high voltages are switched off and on. During long continuous observations the gain drifts by at most one gain 2.0 channel per 12 hours, and usually by less.

3. Loss to the Window

Part of the elctron track created in the detector will be lost to the window before it has time to drift away. In general the total number of events for which this causes a significant decrease in the measured energy of the ionising event is confined to those which occur very close to the window. While this constitutes a small fraction of the total events registered it is still sufficient to cause a low energy tail to the gaussian distribution. Because the penetration depth of the photons is a very strong function of energy this effect is strongest at low energies and just above the L edge. Inoue et al. (1978, Nuc.Inst. Method, 157,295) have considered this problem in detail and give the following formula which gives the probability of a photon with energy E1 giving a measured energy in the detector of E (where $E < E1$):

$$f(E).dE = k.(1-E/E_1)^{k-1}.dE$$

The parameter k depends on the diffusion coefficient, drift velocity density and mass absorption coefficient of the detector filling gas. For the EXOSAT GSPC, k has a value of 0.03 at 5.9 keV, determined by adjusting its value to reproduce the observed low energy tail to be consistent with the residual flux observed below the low energy cut-off of the window (<2keV). This value of k is insensitive to other uncertainties in the detector calibrations. It is comparable to that expected from the theoretical value and also with that found by the TENMA group from their pre-launch calibrations (Koyama et al. 1985, P.A.S.P. 36,659).

Appendix I contains a listing of a function PTAIL which returns the probability of measuring in a given energy interval DE centered on E a residual low energy tail from a photon with an initial energy E_1. It should be noted that the above function becomes undetermined at $E=E_1$. This is taken care of in PTAIL by integrating over the last milli-percent of the function up to E_1. The resulting line profile should then be spread by the detector broadening function. In Figure 3 the expected profile of a line injected at a single energy is illustrated. The second peak is the escape peak. In the Observatory software to save computing time, the low energy tail is not included on the escape peak. This will not make any difference since the L-escape only represents < 3% of the total count rate above 4.78 keV.

4. The Beryllium Window Thickness

The pre-launch calculations assumed that the window had a constant thickness of 175 microns (the specified minimum). They failed to take into account the fact that the window is dome shaped and that the projected thickness increases towards the edge of the dome (where most of the effective area is). Measurements on flight spare windows indicated that thicknesses varied between 175 and 220 microns, and the window thickness of the flight GSPC must at present be considered a free parameter (within reasonable limits).

5. Edge Effects

Towards the edge of the detector the electric field geometry becomes uncertain such that electron tracks may be deflected to the detector walls and not registered. This area of the detector is critical because it constitutes a large fraction of the total effective area. In addition at this point the conical shaped detector walls meet the dome shaped window ie. the total gas depth decreases to zero. This can cause a fairly large L edge to appear in the response because photons just below the edge have a higher probability of not being stopped than those just above it where the penetration depth is low.

The fitting procedure described below indicated a stronger L edge in the spectrum than would be expected. It could be removed to a large extent by adjusting the detector parameters to take into account the expected field geometry.

6. The Burst Length Efficiencies

Discrimination of events based on the rise time of the pulse generated (the burst length) can be used to increase the signal to noise ratio, by reducing the particle background counting rate. The optimum setting of the single channel analyser discriminator is a trade-off between the reduction in background and the number of X-rays rejected and was established during the performance verification phase as channels 89-107.

This results in a loss of between 10 and up to 90% of the X-rays registered in the detector, with the fraction lost increasing rapidly below 5 keV. The burst length discrimination efficiency as a function of energy was determined during the February 1985 observation of the Crab by dividing the burst length discrimination 89-107 spectrum by the 'no-discrimination' spectrum. The data were smoothed and fit to a splined polynomial. The function GSAXE given in Appendix II returns for a given energy E, the fraction of X-rays that are not attenuated. The efficiencies are not well determined above $\sim$15 keV because of limitations in the background subtraction. However there appears to be no major change in efficiency at higher energies and it is taken to be a constant. Also given are the efficiencies for the 89-104 setting used early in the PV phase.

These efficiencies should be applied AFTER the spreading by the detector response. Thus there will be only one set of effective areas for all burst length window settings. (In the earlier calibration the burst length efficiencies had been included in the initial effective areas because of uncertainties in deconvolving these from the other problems in the detector response).

7. Escape Fractions

A certain number of photons emitted by the Xenon ions as they de-excite will escape the detector and hence will cause a deficiency in the detected energy of precisely the energy of the fluorescent photon. The efficiency of this process for the L shell of Xenon is 3% at 5.1 keV, and decreases linearly to zero up to the K absorption edge. At the K edge this then increases to 58% and is kept constant. The edge energies are taken to be an average of the various sub-shells and are 5.1 keV (L) and 34.56 (K). Note the escape energy that must be subtracted is 4.33 keV and 30.49 keV respectively.

8. Systematic Uncertainties

The main limiting factor will always be the fact that the channel boundary widths are only known to 1%. This means that a systematic error of 1% of the total count rate should be added quadratically to the statistical error.

9. The Effective Areas and Zero Offset

The above considerations leave two unknowns in the detector parameters: 1) The average thickness of the window; 2) the energy offset of channel zero (when referenced to energies above 4.78 keV). The effect of varying the zero offset on fits to the Crab data without burst length discrimination was tested allowing the window thickness to be a free parameter. The Crab spectrum was assumed to have an energy index of 2.1 and a low energy cut- off of 3.5×10^{21} H/cm^2. Residuals from the fit using two different offsets of 50 eV and 250 eV are shown in Figure 3. The deviation from the fit in the lower channels around 2-3 keV strongly depends on the chosen offset. When 50 eV is used there is a strong excess of counts, whereas for 250 eV this becomes a deficit. In Figure 4 finer steps of varying offset are used. A reasonable fit to the data can be obtained for an offset of 150 eV with an uncertainty of at most 50 eV in total. This translates to plus or minus 25 eV at the iron line. The required window thickness was $\sim$ 200 microns

There are still some small ($<$ 2%) systematic trends in the residuals left centered on 4.78 keV which can be attributed to edge effects in the detector. Since these are very difficult to model they were removed by fitting a polynomial to the response. The final residuals are shown in Figure 5 along with the original PHA spectrum. Also given is the best fit to the data obtained from the Crab using the 89-107 burst length setting. The final overall effective areas fall short of the pre-launch values by $\sim$15%. This is ascribed to uncertainties in masking by the collimator support structures, edge effects in the detector and count rate independent dead time effects (see §10). It has been corrected by re-normalising the effective areas. In Appendix III the current set of effective areas is listed.

These calibrations were then applied to the data on Cas A. The energy of the Sulphur line is now consistent with that measured by the Einstein SSS. In the case of the various different Crab observations, the new calibrations all give in the 2-16 keV band (and where available the 2-30 keV band) a fit consistent with a slope of 2.10 ± 0.03 and a column density of 3.5 ± 1.5 x 10^{21} H/cm^2.

10. Dead Time

The accumulation times for the Crab observations were corrected for data handling sampling effects using the formula:

$$f = C_0/(-S.Log(1.0 - C_0/S))$$

where C_0 is the observed count rate, and S is the sampling rate in Hz given by the workspace parameter No.2 of all GSPC OBC programs. The typical dead time is ~0.7% for the background and ~5% for the Crab (gain 2.0).

Additional 2.5% dead time effects (ref. p.67) were not included for the Crab observations used to determine the GSPC effective areas. Since these are count rate independent they were taken into account during the re-normalisation of the effective areas to give the correct normalisation for the Crab spectrum. Only the sampling effect should be included when computing the dead time for spectral data. Note that the current CCF backgrounds are not dead time corrected.

11. Outstanding Issues

A self-consistent fit to the GSPC spectrum of the Crab can now be obtained up to a level of a few percent. Any remaining uncertainties are most likely caused by edge effects in the detector. The only improvement possible is in measuring the burst length discrimination efficiency as a function of energy. The current values become limited by uncertainties in the background subtraction, which may lead to systematic variations at around the one percent level. This is well within the quoted systematic uncertainties. A further set of observations of the Crab will soon be carried out to better determine this parameter. However for all purposes the current values are quite adequate and the difference will not be noticed except for the very brightest sources (> 1 Crab).

There have been reports of problems with subtracting the CCF background from recent data suggesting that the shape of the background is varying. This may be because there is either a long term evolution with time or a dependence with the absolute detector gain. A study of this problem is currently underway and it is likely that a time/gain dependent CCF background will be issued. In the meantime, users should compare the background obtained from the slew file with that from the CCF. If there are obvious discrepancies, in particular an excess or deficiency below channel 40 (gain 2.0), then two possible solutions exist. First if the slew is long enough, use this as the background. Otherwise, contact M. Gottwald for selection of a new background from an observation close to the one in question.

12. New GSPC Operating Procedures

Two changes to the operation of the GSPC have been made:

(1) The photomultiplier LED stimulations have been discontinued except for one made before and after the high voltage has been turned off. Experience has shown that the lead lines are quite adequate for measuring the gain stability and that stimulations have a perverse habit of being done when X-ray bursts or other interesting events occur.

(2) The standard gain mode is now gain 1.0. This is to accumulate a time history of the background in gain 1.0 and to ensure that any (cyclotron) line features in spectra above 15 keV are not missed. It should be noted that this will in no way impact on measurements of the iron line which in gain 2.0 was grossly oversampled (gain 1.0 gives 10 channels across a narrow iron line). The only justification for using gain 2.0 is for studying the Sulphur line in bright supernova remnants, however no more observations of these objects (basically Cas A and Tycho) are presently planned. If a user still feels strongly that gain 2.0 is best then a background observation carried out in gain 2.0 will be assigned on the same orbit.

N.E. White

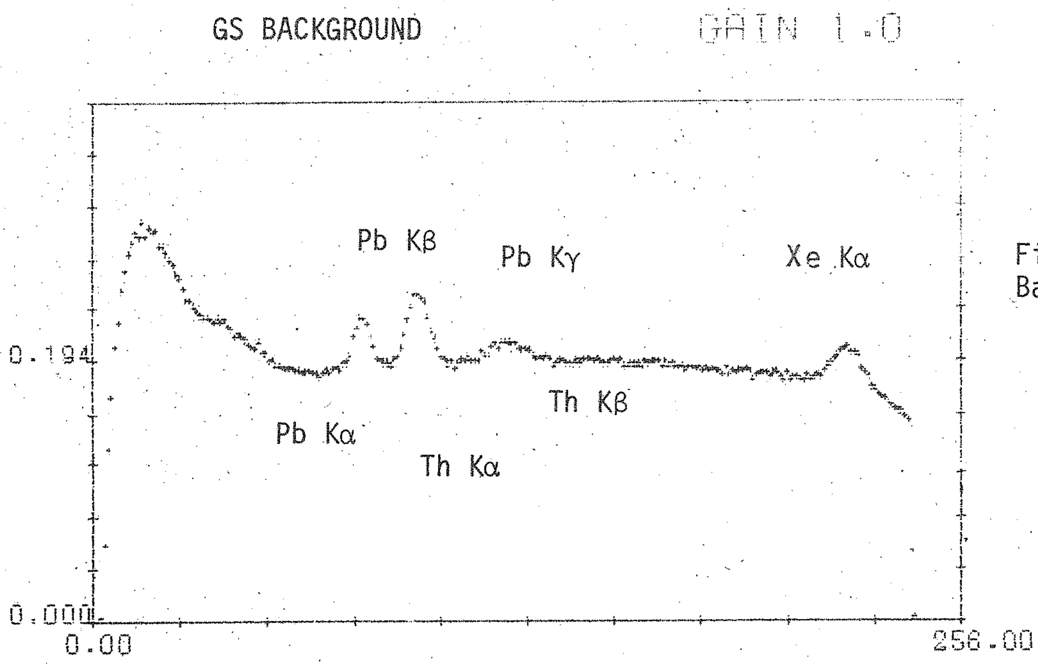


Figure 1: The GSPC Background Spectrum

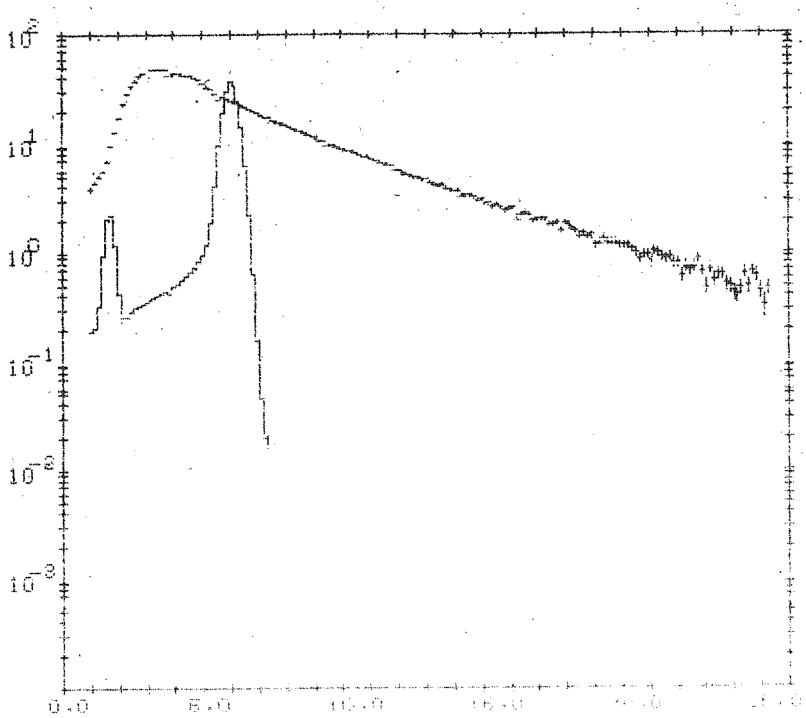
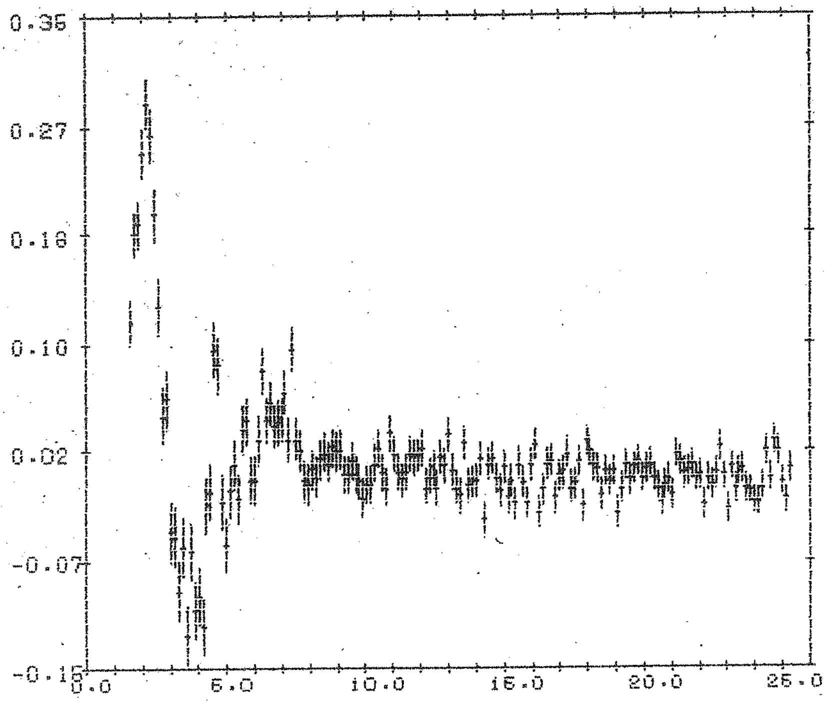
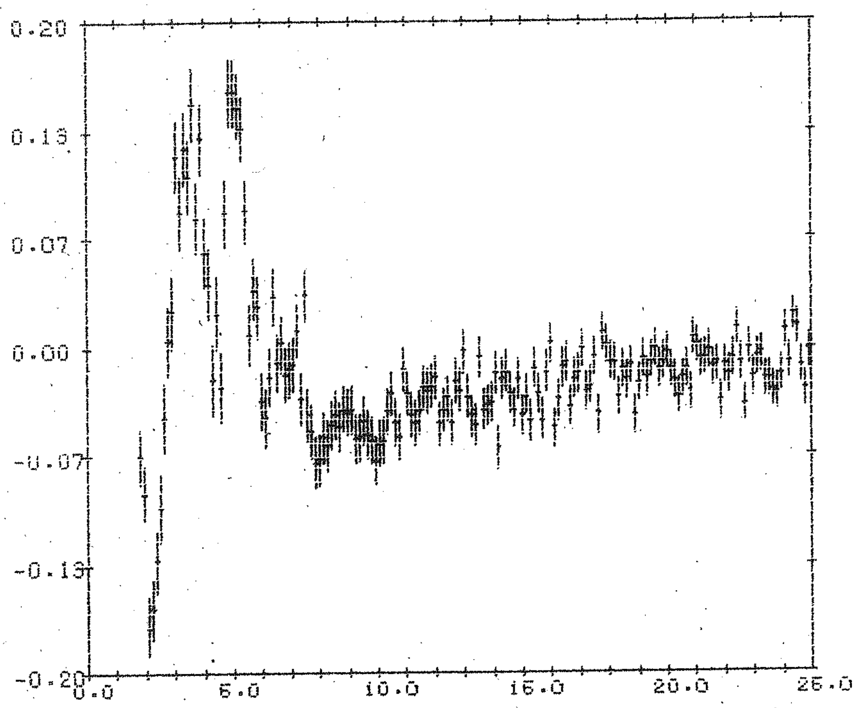


Figure 2: The response of a GSPC to a narrow line at 6 keV.



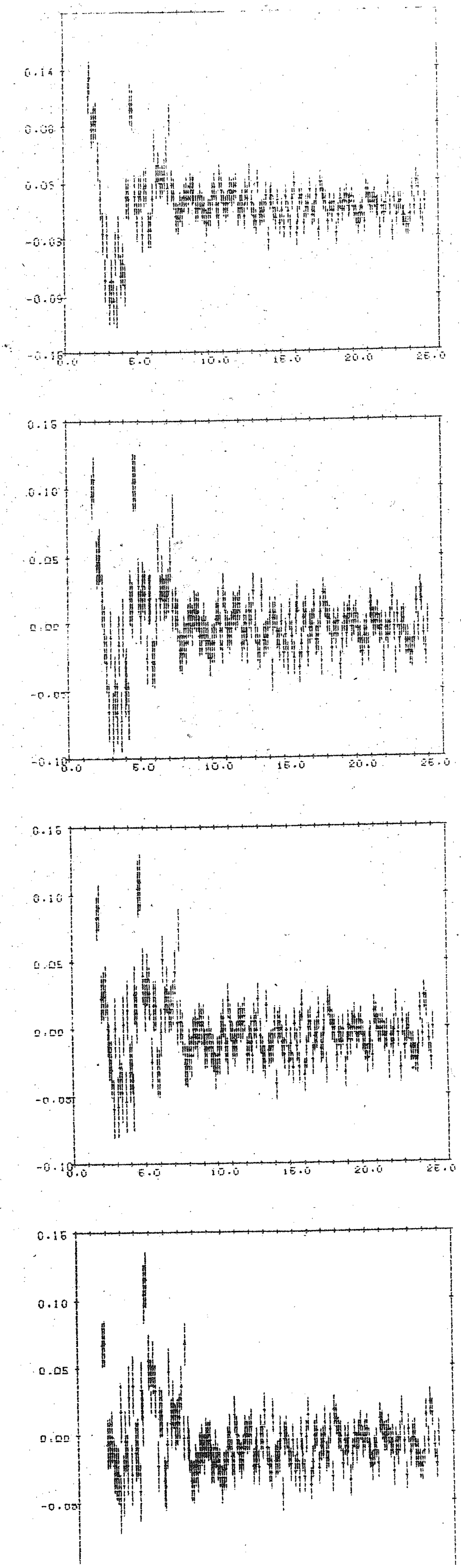
GC = 0.050



GC = 0.250

Figure 3: The residuals from the Crab fits for varying detector offset

GC



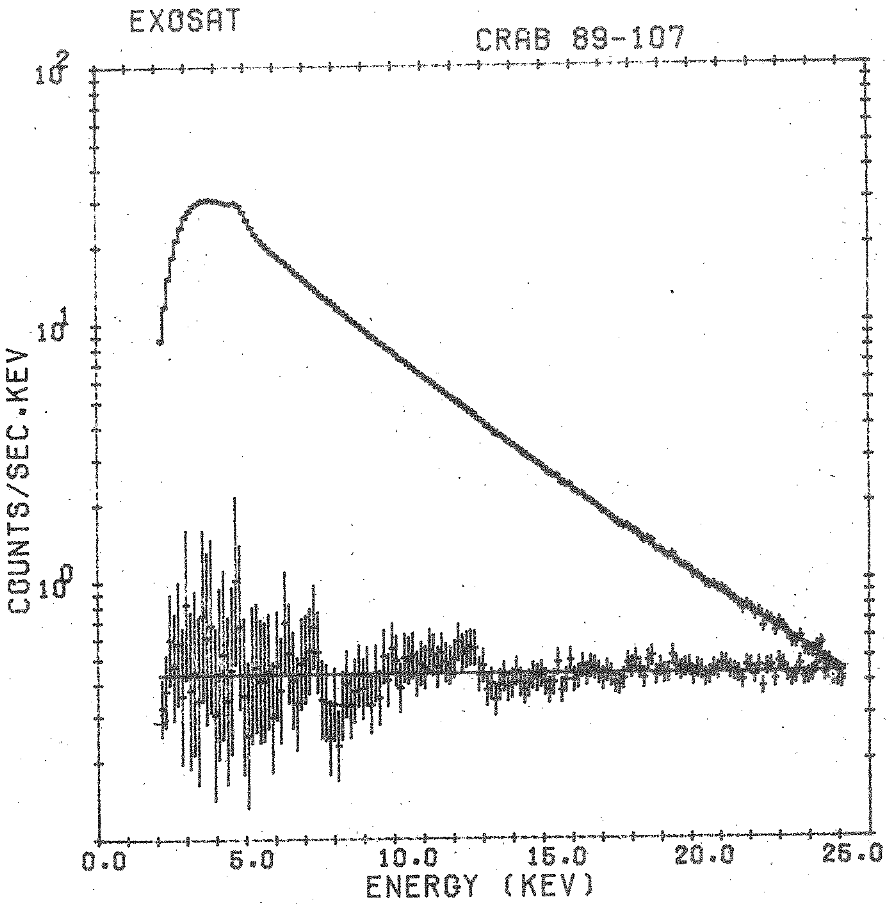
0.120

0.140

0.160

0.180

Figure 4: See Figure 3 but finer steps of varying offset



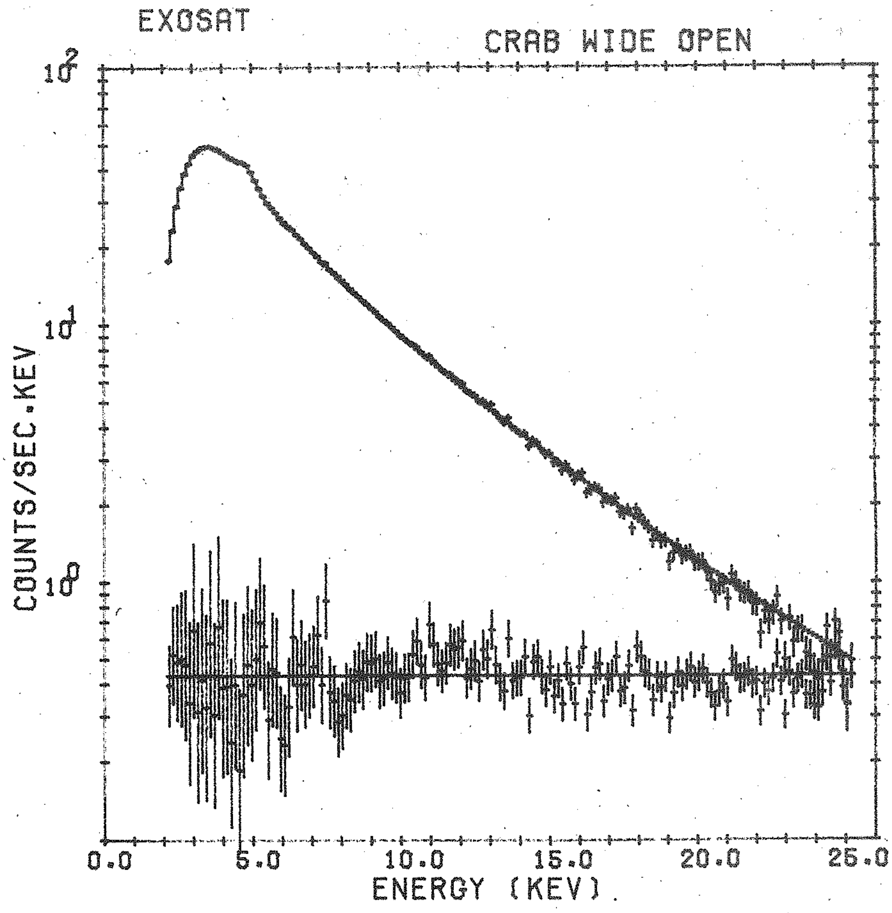


Figure 5: The final Crab fits and residuals.

Appendix I

```
FTN4,L
      FUNCTION PTAIL(ELINE,EOBS,DE)
C
C
C     THIS FUNCTION PUTS IN THE LOW ENERGY
C     TAIL IN THE GSPC RESPONSE          NEW JUNE 85
C     SEE INOUE ET AL (1978) NUCL. INST. METHODS, 157, 295.
C
C
      DATA IJ/1/
      IF(IJ.EQ.0)GO TO 1
      AKMN=0.03
      IJ=0
    1 PTAIL=0.0
C
C
      EEL=ELINE/5.9
      IF(ELINE.GT.10.)EEL=1.69
      AK=AKMN/(EEL)**2.66667
      IF(ELINE.LT.4.78)AK=AK*0.348
      IF(ELINE.LT.5.10)AK=AK*0.710
      IF(ELINE.LT.5.45)AK=AK*0.860
C
C
C
C
    9 IF(EOBS.GE.0.9999*ELINE)GO TO 8
      PTAIL=AK*(1-EOBS/ELINE)**(AK-1)*DE/ELINE
      RETURN
    8 PTAIL=(1.0-(EOBS-DE/2.0)/ELINE)**AK
      RETURN
      END
```

Appendix II

```
FTN4,L
      FUNCTION GSAXE(EIN,IBL)
C
C
C  THIS FUNCTION RETURNS THE BURST LENGTH EFFICIENCY AS A FUNCTIO
C       OF ENERGY
C
C  ACCEPTANCES   IBL=0   WIDE OPEN
C                    1   89-107
C                    2   89-104
C
C
      DIMENSION E(5),POL1(13),POL2(13)
      DATA E/0.0,15.0,28.0,88.0,188.0/
C
C
C
C  89-107/WO: SPLINE FIT TO 85 +84 CRAB DATA
C
      DATA POL1/0.390,0.249E-01,-0.105E-02,0.227E-04,0.160E-01,
     *-0.122E-02,0.386E-04,0.578E-02,-0.630E-04,0.238E-06,
     *0.129E-02,0.838E-04,-0.385E-05/
C
C
C  89-104/WO
C
      DATA POL2/0.322,0.184E-01,-0.969E-03,0.278E-04,0.153E-01,
     *-0.133E-02,0.437E-04,0.543E-02,-0.36E-04,-0.197E-07,
     *0.270E-02,0.222E-04,-0.429E-05/
C
C
C
      DATA NMIN/12/,NMAX/100/
C
C
C
      IF(IBL.NE.0)GO TO 1
      GSAXE=1.0
      RETURN
    1 CONTINUE
      CHAN=(EIN-0.150)/0.138792+0.5
      IF(CHAN.LT.NMIN)CHAN=NMIN
      IF(CHAN.GT.NMAX)CHAN=NMAX
      CHAN=CHAN-NMIN+1
      IF(IBL.EQ.1)CALL SPLIN(POL1,E,4,CHAN,GSAXE)
      IF(IBL.EQ.2)CALL SPLIN(POL2,E,4,CHAN,GSAXE)
      IF(GSAXE.GT.1.0)GSAXE=1.0
      RETURN
      END
```

```
FTN4,L
      SUBROUTINE SPLIN(P,E,N,EIN,VAL)
      DIMENSION P(1),E(1)
      VALP=P(1)
      VAL=VALP
      IF(EIN.LE.E(1))RETURN
      DO 88 IV=1,N
      IF(EIN.GE.E(IV).AND.EIN.LT.E(IV+1))GO TO 90
      EE=E(IV+1)-E(IV)
      VAL=VALP+POLY(P,EE,IV)
   88 VALP=VAL
      IF(EIN.GT.E(N+1))RETURN
   90 EE=EIN-E(IV)
      VAL=VALP+POLY(P,EE,IV)
      RETURN
      END
      FUNCTION POLY(P,EE,IV)
      DIMENSION P(1)
      IN=(IV-1)*3+1
       POLY=P(IN+1)*EE+P(IN+2)*EE*EE+P(IN+3)*EE*EE*EE
      RETURN
      END
```

Appendix III - GSPC Effective Areas

1	1.0000	.0000
2	1.1000	.0000
3	1.2000	.0001
4	1.3000	.0022
5	1.4000	.0170
6	1.5000	.0815
7	1.6000	.2757
8	1.7000	.7209
9	1.8000	1.6306
10	1.9000	3.1601
11	2.0000	5.4313
12	2.1000	8.4935
13	2.2000	12.3211
14	2.3000	16.8275
15	2.4000	21.8858
16	2.5000	27.3496
17	2.6000	33.0705
18	2.7000	38.9102
19	2.8000	44.7474
20	2.9000	50.4815
21	3.0000	56.0329
22	3.1000	61.3419
23	3.2000	66.3661
24	3.3000	71.0789
25	3.4000	75.4660
26	3.5000	79.5236
27	3.6000	83.2557
28	3.7000	86.6728
29	3.8000	89.7899
30	3.9000	92.6256
31	4.0000	95.2011
32	4.1000	97.5389
33	4.2000	99.6629
34	4.3000	101.5972
35	4.4000	103.3663
36	4.5000	104.9942
37	4.6000	107.5619
38	4.7000	111.6849
39	4.8000	121.0973
40	4.9000	122.6857
41	5.0000	119.4384
42	5.1000	121.7029
43	5.2000	122.8926
44	5.3000	123.9889
45	5.4000	124.9976
46	5.5000	126.3690
47	5.6000	127.2448
48	5.7000	128.0493
49	5.8000	128.7864
50	6.3000	131.5941
51	6.8000	133.2057
52	7.3000	133.8900
53	7.8000	133.8328
54	8.3000	133.1673
55	8.8000	131.9922
56	9.3000	130.3839
57	9.8000	128.4043
58	10.3000	126.4752
59	10.8000	124.5567
60	11.3000	122.4343
61	11.8000	120.1254
62	12.3000	117.6462
63	12.8000	115.0128
64	13.3000	112.2418
65	13.8000	109.3504
66	14.3000	106.3563
67	14.8000	103.2782
68	15.3000	100.1353
69	16.3000	93.7318
70	17.3000	87.2949
71	18.3000	80.9571
72	19.3000	74.8260
73	20.3000	68.9814
74	25.3000	45.1878
75	30.3000	29.8375
76	35.3000	78.1392
77	40.3000	64.3952
78	45.3000	52.6245
79	50.3000	42.9379
80	55.3000	35.1340
81	60.3000	28.9043
82	65.3000	23.9414
83	70.3000	19.9784
84	75.3000	16.7982

GSPC DEAD TIME CONSIDERATIONS

This note extends to the GSPC experiment the discussion of experiment dead times given in Express No. 10, p.35 for the ME.

Reference is made to the hardware status report (p.2) on the partially functioning upper level single channel analyser (SCA) energy discriminator. Because there is no sharp upper cut-off by the SCA (E) at channel 240 of the ADC spectrum, the valid events counter (QEP) integrates according to the detector response all counts between channel 240 and 255 (maximum ADC channel) and above channel 255 as illustrated in Fig.1. Note that the ADC inherently has a sharp cut-off at channel 255 and that there is therefore no simple correlation possible between spectral counts and QEP. All calculations of fluxes should therefore, as a base-line, integrate the spectral counts (ADC) between given channels (eg. ch.30 to ch.240 ie. 2 to 16 keV at gain 2) and include the necessary corrections for dead time effects.

Figure 2 shows the distribution of time tags (raw channel counts) of a sample of GSPC events (40128, mainly background), selected on board according to valid E with a sample scheme of E, BL, TT at 2k s^{-1} and the BL acceptance window set to nominal. Note that the maximum time tag possible is 63, determined by sample interval/clock period (488.2 μs/7.63 μs) and that the following contribute to the overall dead time:

a. Loss of events from an expected flat random input signal because of the restriction of ≤ 1 event/sample interval, statistically insignificant in figure 2 because of high sample rate (2Ks^{-1}) and low event rate (background ~ 30 s^{-1}).

b. Deficit of counts in channels 57 ($\sim$ 66% loss) and channels 5863 (0 counts), most of which are assigned to channel 0 with, however, an overall loss equivalent to about 1.66 channels ($\sim$1000 cts).

Simple Poisson statistics give the dead time correction factor associated with (a). A fixed correction ($\sim$2.5%) must be included to account for the overall loss of events from time tag channels 57 $\rightarrow$ 63 representing the time between the sample pulse trailing edge and reset (2 x 7.63 μs TM clock pulses). For a 2k s^{-1} sample rate, 15.26 μs/483.1 μs gives approximately 3% in fair agreement with the observed loss.

In principle a second order correction should be applied, as for the ME, for the probability of events occurring in channels 57-63 having a second event within the period of the next sample cycle (which is effectively "dead" in these cases) but for normal GSPC count rates this correction can usually be neglected.

Note that approximately 6.66 time tag channels have zero data corresponding to a reset occurring within the time of ADC conversion and time-to-amplitude burst length conversion (in total 48 μs) in comparison with the ME (4.5 channels - ADC conversion only).

D. Andrews

FIG. 1 Typical GSPC Energy Spectrum

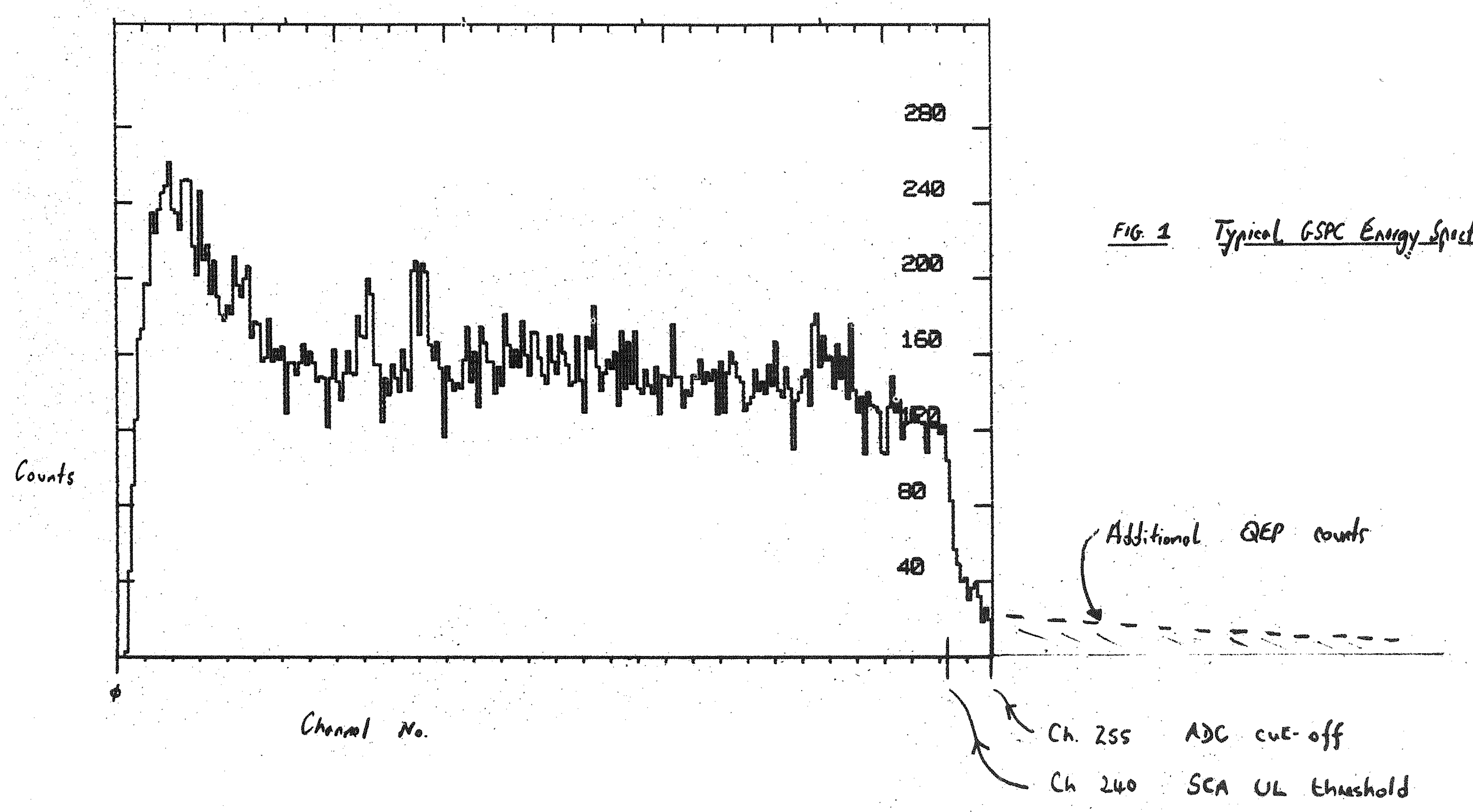
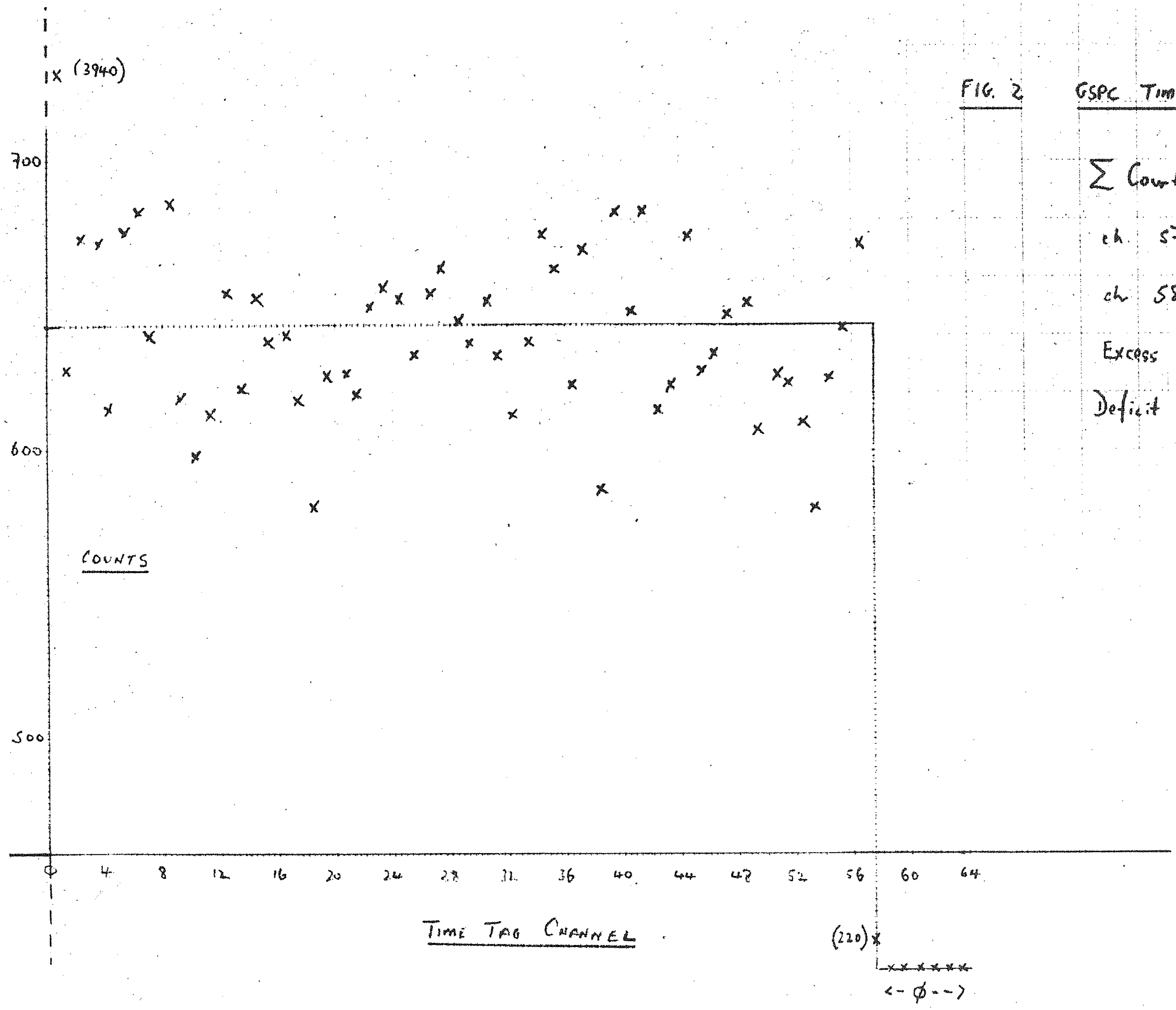


FIG. 2 GSPC TIME TAG SPECTRUM

$\sum$ Counts	:	40128
ch. 57	:	220
ch. 58→63	:	0
Excess ch. ϕ	:	~ 3300
Deficit (ch. 57-63)	:	~ 4260



ME CALIBRATIONS - ERRATUM

Unfortunately, there were a number of errors in the recent article on ME calibrations in the Express (No. 10, p.40-44). My apologies for any inconvenience caused.

1. Xenon Resolution Function

The Xenon resolution ($\Delta V/V$; as a percentage) is given by:

Res = N1+N2/SQRT(E) + N3 x E+ N4 x E^3 (E < N5)

Res = N6 + N7 x E (E > N5)

The extra term is then added (as given in the Express article) as:

Res = SQRT(Res x Res + $(N8 \times 20/E)^2$)

2. Xenon Gain Coefficients

A2 should be given by A2 = A2/(DG+1.0) and not A2/(DGx1.0) as in the Express article. Also for consistency, TX = t - T1 should be replaced by TX = t -T_{Fud} although for Xenon T1 = T_{Fud}.

3. Argon Gain Coefficients

In order to make the method of applying the gain correction more apparent the three lines:

A1 = A1 + DG1

$A2_{real}$ = $A2_{real}$ + DG2

A2 = $A2_{real}$ - A4 x A1

should be replaced with:

A1 = A1 + DG1

$A2_{stored}$ = $A2_{stored}$ + DG2

A2 = $A2_{stored}$ - A4 x A1

A.N. Parmar

MHER6 OBC PROGRAM ANOMALY

Under certain, rare circumstances the packet reference times (PRT's) contained in I6 packets can be in error by 1 software cycle (31.25 msec) when compared with their expected values. Normally the difference in PRT's between two I6 packets during an observation is constant and given by:

$$\frac{\text{Workspace Parameter (4)} \times 16384 \times \text{No. of Samples/packet}}{\text{Energy Sampling Rate (Hz)}}$$

This anomaly can only occur when MHER6 is executed in slots 5 or 6. The slot numbers in use are contained within the Housekeeping data and can be obtained using (see FOTH Ch. 3.4.2.1):

Parameter	Description	Frame	Byte	Bit	Width	Commu-tation
D190	Prog # in slot 1	84	2	0	16	1
D191	" " 2	84	4	0	16	1
D192	" " 3	84	6	0	16	1
D193	" " 4	84	8	0	16	1
D194	" " 5	84	10	0	16	1
D195	" " 6	84	12	0	16	1

Note that MHER6 is application program number 70 in this context and not 105 as on FOT's. The data contained within the affected packets is unaffected ie. the PRT calculated using the above formula is the one to use in all data processing applications and not the PRT read from telemetry. The number of records with incorrect PRT's when MHER6 is executed in slots 5 or 6 is dependent on OBC load and is typically ~ 5% of the total.

In principle, a similar error can occur if any high time resolution program eg. GDIR, MDIR (or MHER7) is executed in slot 5 or 6 and, these programs will therefore in future be executed only in program slots 1-4.

A.N. Parmar

FORMAT OF PRINTED LINE OF ARCHIVE

The information in the data archive list is from 3 sources:

A = auxiliary data (=manoeuvre history)
F = FOT request file
- = manual (via editor) insertion

description of field	data source	printout format
start time of stable pointing	A	yy/ddd hhmm
end " " " "	A	..ddd hhmm
right ascension (of star tracker)	A	hh mm ss
declination (" " ") (RA & dec are in 1950 epoch; note that these are not the target coordinates - normally target is offset from star tracker by about 2 arc mins)	A	+/-dd mm.m
target name (left justified) (no special convention for names; the + sign to indicate a trim is always the 16th character, if present)	A	up to 16 characters
proposal code : divided into 2 fields,		up to 8 characters
- class of proposal(PV ,TOO,LLX,AGN, OPS,CAL,HLX,CLU,SNR,OCC,EXG, or MIS)	F	
- identification of proposal	F	

miscellaneous footnotes:

11 = solar aspect angle < 90 degs.
12 = unstable attitude
13 = partial data loss
18 = ME/HER4 data problem
19 = OBC problem or crash
21 = raster scan
* = 1st pointing of multi-pointing FOT
C = continuation of a '*' FOT

description of field	data source	printout format
principal investigator (a number > 0 pointing to a table of PI's names and addresses. 0 means 'Observatory'.)	F	
4 flags for whether FOTs exist : (space means corresponding FOT doesn't exist)	F	L = LE1 available K = LE2 " M = ME " G = GS "
P.I. name (from FOT request; a blank space is shown if the request was for the Observatory, e.g. for data from performance verification phase; PI name will not be in final log, only the PI number plus list of names)	F	

E X O S A T   D A T A   A R C H I V E

Sorted list of all public data up to 1984 day 18Ø

83/3Ø9	Ø525..3Ø9 Ø849	ØØ Ø3 45	+19 55.5	MKN335		AGN	F34		*	8	L MG	Pcunds, Prof. K.A.
84/Ø19	Ø929..Ø19 1342	ØØ Ø4 17	+72 31.3	3AØØØ4+725		MIS	F18			27	L MG	Pye, Dr. J.P.
83/352	11Ø1..352 1454	ØØ Ø8 ØØ	+1Ø 42.Ø	III ZW 2		AGN	G15			66	L MG	De Korte, Dr. P.A.J.
83/257	Ø418..257 Ø84Ø	ØØ Ø8 52	-11 45.4	WW CET		LLX	G9		C	63	LKMG	Beuermann, Dr. K.
84/123	1745..124 Ø427	ØØ 12 49	-73 8.8	EØØ12.7-73Ø8		EXG	F3			27	L	Pye, Dr. J.P.
84/Ø39	ØØ48..Ø39 Ø4ØØ	ØØ 14 Ø3	+81 18.4	ØØ14+81		EXG	F1Ø			3Ø	L MG	Witzel, Dr. A.
83/339	235Ø..34Ø Ø23Ø	ØØ 17 24	+13 36.Ø	FEIGE 4		LLX	G26			61	L MG	Heise, Dr. J.
83/33Ø	Ø62Ø..33Ø Ø953	ØØ 18 12	-25 59.Ø	3AØØ2Ø-26Ø	+	MIS	F18			27	L MG	Pye, Dr. J.P.
83/268	1746..269 Ø355	ØØ 22 3Ø	+63 51.6	TYCHO SNR	+	SNR	G-1		C	Ø	LKMG	
83/311	2Ø17..311 2325	ØØ 26 38	+12 59.4	PGØØ26+129		AGN	G12			22	L MG	Maraschi, Dr. L.
84/Ø31	1821..Ø31 2111	ØØ 3Ø Ø8	+62 39.3	HD 29Ø5		LLX	F3			64	L MG	Zwaan, Dr. C.
83/347	Ø5Ø4..347 Ø759	ØØ 31 36	-Ø7 38.5	PSRØØ31-Ø7		LLX	F134		*	18	L MG	Bell-Burnell, Dr. S.J.
83/3Ø5	1627..3Ø5 2Ø14	ØØ 33 12	+58 5Ø.9	4U ØØ33+58		HLX	F42			55	L MG	Van Paradijs, Dr. J.
84/ØØ6	1531..ØØ6 1635	ØØ 33 12	+58 51.Ø	4UØØ33+58		HLX	F42			55	L MG	Van Paradijs, Dr. J.
83/181	2129..184 Ø518	ØØ 39 48	+4Ø 58.9	M31		PV		11	*	Ø	LKMG	
83/184	123Ø..184 143Ø	ØØ 39 48	+4Ø 58.9	M31		PV		11	C	Ø	LKMG	
83/2Ø7	1521..2Ø8 1732	ØØ 39 48	+4Ø 58.9	M31		PV				Ø	LKMG	
83/348	2325..349 Ø23Ø	ØØ 44 32	-12 8.7	NGC 246		LLX	G23+		*	66	L MG	De Korte, Dr. P.A.J.
84/Ø12	Ø131..Ø12 Ø347	ØØ 46 Ø3	+57 33.Ø	HD 4614		LLX	F7Ø			75	L MG	Pallavicini, Dr. R.
84/Ø27	Ø536..Ø27 1432	ØØ 46 Ø4	+31 41.Ø	MKN348		AGN	F53	11		16	L MG	Bergeron, Dr. J.
83/3Ø3	14Ø3..3Ø3 1655	ØØ 49 26	-73 39.4	SMC SURVEY 9		EXG	F3			27	L MG	Pye, Dr. J.P.
83/319	Ø246..319 Ø347	ØØ 57 Ø8	+31 33.5	MKN352		AGN	F4Ø			14	L MG	Fink, Dr. H.
83/3Ø2	1825..3Ø3 ØØØØ	ØØ 57 39	-72 28.Ø	SMC SURVEY 8		EXG	F3		C	27	L MG	Pye, Dr. J.P.
83/3Ø2	1414..3Ø2 18Ø6	ØØ 59 Ø4	-72 28.9	SMC SURVEY 8		EXG	F3		C	27	L MG	Pye, Dr. J.P.
84/126	Ø148..126 1327	ØØ 59 1Ø	-72 28.8	EØØ59.Ø-7228		EXG	F3			27	L MG	Pye, Dr. J.P.
83/224	Ø546..224 1152	Ø1 ØØ 18	-22 4.Ø	A 133		PV				Ø	LKMG	
83/3Ø2	Ø553..3Ø2 Ø91Ø	Ø1 Ø1 2Ø	-73 1.3	SMC SURVEY 1		EXG	F3		C	27	L MG	Pye, Dr. J.P.
84/137	Ø927..137 1Ø44	Ø1 Ø1 24	-73 1.6	EØ1Ø1.3-73Ø1		EXG	F3		*	27	L MG	Pye, Dr. J.P.
84/137	1Ø59..137 1127	Ø1 Ø1 24	-73 .4	EØ1Ø1.3-73Ø1	+	EXG	F3		C	27	L MG	Pye, Dr. J.P.
83/3Ø2	1Ø2Ø..3Ø2 1341	Ø1 Ø1 33	-72 26.5	SMC SURVEY 6		EXG	F3		C	27	L MG	Pye, Dr. J.P.
84/137	1153..138 ØØØ3	Ø1 Ø2 39	-73 1Ø.Ø	EØ1Ø1.3-73Ø1		EXG	F3		C	27	L MG	Pye, Dr. J.P.
83/348	Ø853..348 1443	Ø1 Ø7 Ø1	+59 48.4	HT CAS		LLX	F36			36	L MG	Mason, Dr. K.O.
83/363	Ø739..363 123Ø	Ø1 Ø7 Ø1	+59 48.4	HT CAS		LLX	G14			Ø	L MG	
84/Ø11	2Ø54..Ø11 2218	Ø1 Ø9 Ø5	+49 12.6	Ø1Ø9+49		EXG	F8			29	L MG	Miller, Dr. L.
83/3Ø2	Ø245..3Ø2 Ø445	Ø1 12 Ø2	-7Ø 59.7	SMC SURVEY 9		EXG	F3		*	27	L MG	Pye, Dr. J.P.
83/2Ø9	Ø63Ø..2Ø9 1422	Ø1 14 42	+65 1.5	2SØ114+65		PV		11		Ø	LKMG	
83/355	Ø232..355 1334	Ø1 15 14	+63 28.6	4UØ115+634	+	HLX	G7			5Ø	MG	Staubert, Dr. R.
84/Ø15	2217..Ø16 Ø3Ø3	Ø1 15 14	+63 28.6	4UØ115+63		HLX	G7			5Ø	L MG	Staubert, Dr. R.
84/Ø45	1931..Ø45 2346	Ø1 15 14	+63 28.6	4UØ115+63		HLX	G7	11		5Ø	L MG	Staubert, Dr. R.
84/Ø55	224Ø..Ø56 Ø21Ø	Ø1 15 14	+63 28.6	4UØ115+63		HLX	G7	11		5Ø	L MG	Staubert, Dr. R.
83/249	2239..25Ø 2133	Ø1 16 32	-28 53.Ø	1978 NOV 19		MIS	F9			46	LKMG	Hurley, Dr. K.
83/349	Ø344..349 Ø814	Ø1 19 3Ø	-Ø1 17.9	II ZW 1		LLX	G23+		C	66	L MG	De Korte, Dr. P.A.J.

84/ØØ2	Ø325..ØØ2 Ø546	Ø1 19 3Ø	-Ø1 18.Ø	II ZW 1	+	AGN	G15			66	L MG	De Korte, Dr. P.A.J.
83/31Ø	Ø9Ø5..31Ø 1534	Ø1 21 39	-35 19.Ø	NGC526 A		AGN	F34+		C	8	L MG	Pounds, Prof. K.A.
83/282	1633..282 1955	Ø1 21 47	-58 59.Ø	FAIRALL 9		AGN	F51			9Ø	LKMG	Scarsi, Dr. L.
83/284	1244..284 1449	Ø1 21 47	-58 59.Ø	FAIRALL 9		AGN	F51		C	9Ø	LKMG	Scarsi, Dr. L.
83/286	1215..286 1941	Ø1 21 47	-58 59.Ø	FAIRALL 9		AGN	F51+			9Ø	LKMG	Scarsi, Dr. L.
83/288	1615..288 1941	Ø1 21 47	-58 58.9	FAIRALL 9		AGN	F51			9Ø	LKMG	Scarsi, Dr. L.
83/29Ø	1433..29Ø 1734	Ø1 21 47	-58 59.Ø	FAIRALL 9		AGN	F51			9Ø	LKMG	Scarsi, Dr. L.
83/249	Ø157..249 Ø449	Ø1 21 51	-59 3.9	FAIRALL 9		AGN	F34+		C	8	LKMG	Pounds, Prof. K.A.
83/3ØØ	1Ø17..3ØØ 1325	Ø1 21 52	-73 4Ø.7	EØ121.9-7335		EXG	F3	18		27	LKMG	Pye, Dr. J.P.
83/249	1316..249 1936	Ø1 22 ØØ	-35 18.Ø	NGC526A		AGN	F34+		C	25	KMG	Turner, Dr. M.J.L.
83/321	Ø821..321 Ø947	Ø1 33 48	+5Ø 41.4	KT PER		LLX	G12			61	L MG	Heise, Dr. J.
83/327	Ø115..327 Ø248	Ø1 33 48	+5Ø 41.4	KT PER		LLX	G12			61	L MG	Heise, Dr. J.
83/362	Ø3Ø4..362 Ø555	Ø1 34 28	+Ø7 1.1	PGØ134+Ø7Ø		LLX	F132			36	L MG	Mason, Dr. K.O.
83/3ØØ	Ø555..3ØØ Ø846	Ø1 35 1Ø	-71 27.2	EØ135.1-7122		EXG	F3	18		27	LKMG	Pye, Dr. J.P.
83/2Ø6	Ø155..2Ø6 1132	Ø1 35 5Ø	-57 3Ø.Ø	A ERI		PV				Ø	LKMG	
83/361	2256..362 Ø2Ø6	Ø1 47 54	+Ø5 54.8	NGC 693		EXG	F36			35	L MG	Peacock, Dr. A.
83/269	Ø6ØØ..269 1Ø1Ø	Ø2 Ø1 51	+64 35.3	3C58		SNR	F2			Ø	LKMG	
83/336	2ØØ3..336 2235	Ø2 Ø3 Ø9	+14 58.Ø	TT ARI		LLX	G7			63	L MG	Beuermann, Dr. K.
83/34Ø	21Ø1..34Ø 2343	Ø2 Ø3 Ø9	+14 58.Ø	TT ARI		LLX	G7			63	L MG	Beuermann, Dr. K.
84/Ø15	185Ø..Ø15 1944	Ø2 Ø6 34	+25 42.2	HD 13174		LLX	G11			64	L MG	Zwaan, Dr. C.
83/282	2121..283 Ø12Ø	Ø2 Ø8 17	-63 28.2	WX HYI		LLX	F35			36	LKMG	Mason, Dr. K.O.
84/ØØ3	Ø543..ØØ3 Ø912	Ø2 12 Ø5	-ØØ 59.9	MKN59Ø		AGN	G15			66	L MG	De Korte, Dr. P.A.J.
83/245	Ø945..245 11Ø9	Ø2 2Ø 2Ø	+31 57.7	MKN1Ø4Ø	+	AGN	F34		C	8	KMG	Pounds, Prof. K.A.
83/245	Ø7Ø9..245 Ø844	Ø2 25 17	+31 5.3	MKN1Ø4Ø		AGN	F34		C	8	KMG	Pounds, Prof. K.A.
84/Ø31	Ø8Ø7..Ø31 Ø949	Ø2 32 28	-44 .6	HD 16157		LLX	F7Ø	11	*	75	L MG	Pallavicini, Dr. R.
83/234	Ø159..234 1143	Ø2 32 3Ø	+Ø3 3Ø.9	FEIGE 24		LLX	G28		*	95	LKMG	Gronenschild, Dr. E.H.B.
84/ØØ3	ØØ1Ø..ØØ3 Ø3Ø9	Ø2 33 ØØ	-Ø9 34.5	NGC988		AGN	F54			17	L MG	Fricke, Prof. Dr. K.J.
83/341	ØØ45..341 Ø555	Ø2 35 53	+16 24.Ø	Ø235+164		AGN	F3			19	L MG	McHardy, Dr. I.
83/343	Ø9ØØ..343 122Ø	Ø2 35 53	+16 24.Ø	Ø235+164		AGN	F3		*	19	L MG	McHardy, Dr. I.
83/345	Ø924..345 125Ø	Ø2 35 53	+16 24.Ø	Ø235+164		AGN	F3		*	19	L MG	McHardy, Dr. I.
83/348	Ø3Ø8..348 Ø545	Ø2 35 53	+16 24.Ø	Ø235+164		AGN	F3			19	L MG	McHardy, Dr. I.
83/249	Ø735..249 1Ø49	Ø2 36 41	-52 24.5	3AØ234-526		AGN	F34+		C	27	LKMG	Pye, Dr. J.P.
83/234	1755..235 Ø633	Ø2 4Ø Ø7	-ØØ 13.5	NGC1Ø68		AGN	F38			13	LKMG	Lawrence, Dr. A.
83/245	1355..245 19Ø4	Ø2 41 Ø1	+62 15.4	Ø241+622		AGN	F34		C	21	KMG	Warwick, Dr. R.S.
83/35Ø	1744..35Ø 2334	Ø2 41 Ø1	+62 15.4	Ø241+622		AGN	G11			21	L MG	Warwick, Dr. R.S.
83/235	Ø728..235 Ø937	Ø2 43 59	-ØØ 27.4	NGC1Ø9Ø		AGN	F54		*	17	LKMG	Fricke, Prof. Dr. K.J.
84/Ø22	Ø4ØØ..Ø22 Ø629	Ø2 53 59	-Ø9 5.8	HD 18322		LLX	F12Ø			81	L MG	Bedford, Dr. D.K.
84/Ø46	1Ø52..Ø46 13Ø9	Ø3 ØØ 1Ø	+47 4.5	Ø3ØØ+47Ø		AGN	F13			9	L MG	Biermann, Prof. Dr. P.
83/234	1259..234 1656	Ø3 Ø1 59	+Ø2 45.9	FEIGE 31		LLX	G28		C	95	LKMG	Gronenschild, Dr. E.H.B.
84/18Ø	Ø724..18Ø Ø851	Ø3 Ø4 26	-65 25.Ø	HØ3Ø5-65		MIS	F16			Ø	L MG	
83/333	Ø232..333 Ø639	Ø3 12 ØØ	-22 46.8	2AØ311-227		LLX	G18			57	L MG	Watson, Dr. M.G.
84/Ø25	Ø331..Ø25 1Ø23	Ø3 12 5Ø	+41 2Ø.Ø	3AØ316 + 414		CLU	G-1		*	1	L MG	Branduardi-Raymont, Dr.
84/ØØ2	19Ø5..ØØ2 2149	Ø3 16 12	-44 16.5	3AØ316-442		MIS	F18			27	L MG	Pye, Dr. J.P.
84/Ø24	Ø922..Ø24 1524	Ø3 16 3Ø	+4Ø 5Ø.Ø	4UØ316+41		CLU	G-1		*	1	L MG	Branduardi-Raymont, Dr.
84/Ø25	1157..Ø25 19Ø6	Ø3 16 3Ø	+42 4.9	A426		CLU	G-1		C	1	L MG	Branduardi-Raymont, Dr.
84/Ø17	2255..Ø17 2353	Ø3 16 44	+Ø3 11.3	HD 2Ø63Ø		LLX	F7Ø		C	75	L MG	Pallavicini, Dr. R.
84/Ø18	ØØ36..Ø18 Ø125	Ø3 16 44	+Ø3 11.3	HD 2Ø63Ø	+	LLX	F7Ø		C	75	L MG	Pallavicini, Dr. R.
83/243	2226..244 Ø75Ø	Ø3 19 1Ø	+41 2Ø.Ø	2AØ316+413		CLU	G1			1	LKMG	Branduardi-Raymont, Dr.
84/Ø39	1333..Ø39 2Ø22	Ø3 2Ø 44	+49 41.1	HD2Ø9Ø2		CAL				Ø	L MG	
83/232	Ø75Ø..232 1236	Ø3 23 ØØ	-37 12.Ø	NGC1316		SNR	G2			37	LKMG	Machetto, Dr. F.
83/221	Ø322..221 112Ø	Ø3 27 46	+43 44.4	GK PER		LLX	G19	11		57	LKMG	Watson, Dr. M.G.
83/227	2134..228 Ø644	Ø3 27 46	+43 44.4	GK PER		TOO		11		Ø	LKMG	

83/236	Ø725..236 2Ø28	Ø3 27 46	+43 44.4	GK PER		TOO		11		Ø	KMG	
83/333	Ø811..333 1519	Ø3 3Ø 34	-Ø9 37.5	HD 22Ø49		LLX	F84			177	L MG	Cecchini, Dr.S.
83/324	Ø435..324 11Ø1	Ø3 31 Ø5	+53 .6	VØ332+53		TOO				35	L MG	Peacock, Dr. A.
83/325	1532..325 1849	Ø3 31 Ø5	+53 .5	VØ332+53		TOO				Ø	L MG	
83/335	2344..336 Ø627	Ø3 31 Ø5	+53 .6	VØ332+53		TOO				Ø	L MG	
83/232	1417..232 1745	Ø3 31 Ø7	-26 2.3	NGC 136Ø		LLX	G23			66	LKMG	De Korte, Dr. P.A.J.
83/329	Ø539..329 1148	Ø3 31 14	+53 .2	VØ332+53		TOO				Ø	MG	
83/332	18Ø9..332 2334	Ø3 31 14	+53 .2	VØ332+53		TOO				Ø	L MG	
83/358	1248..358 1612	Ø3 31 14	+53 .4	VØ332+53	+	TOO				Ø	L MG	
83/359	184Ø..359 223Ø	Ø3 31 14	+53 .4	VO332 + 53	+	TOO				Ø	L MG	
83/363	22Ø7..364 ØØ41	Ø3 31 14	+53 .4	VØ332+53	+	TOO				Ø	L MG	
84/ØØ2	Ø824..ØØ2 112Ø	Ø3 31 15	+53 .4	VO332 + 53	+	TOO				Ø	L MG	
84/ØØ7	Ø839..ØØ7 12ØØ	Ø3 31 15	+53 .4	VØ332 +53		TOO				Ø	L MG	
84/Ø1Ø	Ø844..Ø1Ø 1431	Ø3 31 15	+53 .4	VO332 + 53		TOO				Ø	L MG	
84/Ø19	1551..Ø19 185Ø	Ø3 31 15	+53 .4	VØ332+53	+	TOO				Ø	L MG	
84/Ø22	Ø855..Ø22 1336	Ø3 31 15	+53 .4	VØ332+53		TOO				Ø	L MG	
84/Ø23	2Ø57..Ø24 Ø631	Ø3 31 15	+53 .3	VØ332+53		TOO				Ø	L MG	
83/29Ø	2Ø34..29Ø 2339	Ø3 34 Ø5	+ØØ 3Ø.2	HR1ØØ9		LLX	F48			73	LKMG	Barstow, Dr. M.A.
84/Ø12	1Ø51..Ø12 1826	Ø3 36 54	-35 41.Ø	EØ336-358		EXG	F4Ø			36	L M	Mason, Dr. K.O.
84/Ø49	1418..Ø5Ø Ø324	Ø3 45 ØØ	+23 58.Ø	PLEIADES		PV	REP			Ø	L G	
83/356	Ø929..356 1134	Ø3 52 15	+3Ø 54.Ø	X PER	+	LLX	G2Ø			91	L MG	Robba, Dr. R.
84/ØØ9	1846..ØØ9 2Ø26	Ø3 52 15	+3Ø 54.Ø	4UØ352+3Ø9		LLX	G2Ø			91	L MG	Robba, Dr. R.
84/Ø1Ø	1915..Ø1Ø 2Ø22	Ø3 52 15	+3Ø 54.Ø	4UØ352+3Ø9		LLX	G2Ø			91	L MG	Robba, Dr. R.
84/Ø25	231Ø..Ø26 Ø61Ø	Ø3 52 15	+3Ø 54.Ø	4UØ352+3Ø9		LLX	G2Ø			91	L MG	Robba, Dr. R.
84/Ø55	1814..Ø55 2Ø18	Ø3 52 15	+3Ø 54.Ø	4UØ352+3Ø9		LLX	G2Ø	11		91	L MG	Robba, Dr. R.
83/319	Ø6Ø2..319 Ø8Ø7	Ø4 Ø9 28	-71 25.3	VW HYI		LLX	G12	11		61	L MG	Heise, Dr. J.
83/329	2137..33Ø Ø359	Ø4 Ø9 28	-71 25.3	VW HYI		LLX	G12	11		61	L MG	Heise, Dr. J.
84/138	Ø123..138 Ø435	Ø4 Ø9 28	-71 25.3	VW HYI		LLX	F12			61	L MG	Heise, Dr. J.
83/318	1624..318 1946	Ø4 Ø9 29	-71 25.3	VW HYI		LLX	G12			61	L MG	Heise, Dr. J.
83/325	212Ø..326 ØØ21	Ø4 Ø9 29	-71 25.3	VW HYI		LLX	G12	11		61	L MG	Heise, Dr. J.
83/333	2338..334 Ø737	Ø4 Ø9 29	-71 25.3	VW HYI		LLX	G12	11		61	L MG	Heise, Dr. J.
83/337	Ø521..337 Ø645	Ø4 Ø9 29	-71 25.3	VW HYI		LLX	G12	11		61	L MG	Heise, Dr. J.
83/34Ø	1118..34Ø 1251	Ø4 Ø9 29	-71 25.3	VW HYI		LLX	G12	11		61	L MG	Heise, Dr. J.
84/158	Ø139..158 Ø3Ø5	Ø4 Ø9 29	-71 25.3	VW HYI		LLX	?			61	L MG	Heise, Dr. J.
84/131	Ø83Ø..131 161Ø	Ø4 Ø9 31	-71 25.3	VW HYI		LLX	G12	11		61	L MG	Heise, Dr. J.
84/122	2127..123 1359	Ø4 Ø9 32	-71 25.8	VW HYI		LLX	G12	11		61	L	Heise, Dr. J.
84/126	1453..126 2137	Ø4 Ø9 32	-71 25.Ø	VW HYI		LLX	G12	11	*	61	L MG	Heise, Dr. J.
83/328	1447..328 1958	Ø4 Ø9 42	+Ø5 25.1	IRAS I		TOO			*	66	L MG	De Korte, Dr. P.A.J.
83/243	145Ø..243 2Ø48	Ø4 13 ØØ	-Ø7 44.Ø	4Ø ERI-B		LLX	G24			61	LKMG	Heise, Dr. J.
83/328	2246..329 Ø245	Ø4 13 47	+12 17.6	IRAS II		TOO			C	66	L MG	De Korte, Dr. P.A.J.
83/318	223Ø..318 235Ø	Ø4 15 Ø1	+37 54.3	3C111		AGN	G21			26	L MG	Briel, Dr. U.
84/Ø27	1747..Ø27 2ØØ1	Ø4 15 Ø2	+37 54.3	3C111		AGN	G21+			26	L MG	Briel, Dr. U.
83/29Ø	Ø9Ø5..29Ø 1212	Ø4 16 15	+28 22.7	V41ØTAU:STAR+SMC		LLX	F8			43	LKMG	Charles, Dr. P.A.
83/233	15ØØ..233 1752	Ø4 19 Ø4	+19 25.Ø	T TAU		LLX-F8+		11		97	LKMG	Brown, Dr. A.
83/3Ø5	Ø82Ø..3Ø5 135Ø	Ø4 29 59	+Ø5 15.Ø	3C12Ø		AGN	G22			86	L MG	Tanzi, Dr. E.
83/228	Ø847..229 Ø735	Ø4 3Ø ØØ	+Ø5 15.Ø	3C 12Ø		AGN	G22	11		86	LKMG	Tanzi, Dr. E.
84/ØØ8	Ø219..ØØ8 Ø352	Ø4 3Ø 31	+Ø5 15.Ø	3C12Ø		AGN	G22			86	L MG	Tanzi, Dr. E.
83/314	233Ø..315 Ø411	Ø4 34 ØØ	-1Ø 28.6	MKN618		AGN	F4Ø			14	L MG	Fink, Dr. H.
84/Ø54	1855..Ø54 2145	Ø4 45 22	-17 1.3	HD 3Ø945		LLX	F2Ø			81	L MG	Bedford, Dr. D.K.
83/244	2345..245 Ø419	Ø4 5Ø Ø3	-Ø3 1.Ø	NGC1685		AGN	F34	11	*	8	LKMG	Pounds, Prof. K.A.

84/1Ø5	Ø558..1Ø5	1Ø41	Ø4 59 45	-75 21.3	HD 32918		LLX	F12Ø			81	L MG	Bedford, Dr. D.K.
84/1Ø5	2Ø56..1Ø5	2244	Ø4 59 48	-75 2Ø.9	HD 32918		LLX	F36		*	36	L MG	Mason, Dr. K.O.
84/Ø69	23Ø7..Ø7Ø	Ø33Ø	Ø5 Ø1 31	+52 44.8	G191 B2B		LLX	G25			61	L MG	Heise, Dr. J.
83/264	Ø328..264	Ø533	Ø5 Ø9 47	-15 44.8	NGC1832		AGN	F54			17	LKMG	Fricke, Prof. Dr. K.J.
83/297	191Ø..297	2Ø3Ø	Ø5 11 35	+45 58.9	CAPELLA		PV			*	Ø	LKMG	
83/275	Ø417..275	1ØØ1	Ø5 12 Ø8	-Ø8 15.4	BETA ORI		CAL				66	LKMG	De Korte, Dr. P.A.J.
83/297	2157..298	2256	Ø5 13 ØØ	+45 54.3	CAPELLA	+	PV			C	Ø	LKMG	
83/251	Ø915..251	12ØØ	Ø5 13 38	-ØØ 12.2	AKN12Ø		AGN	F34	11	*	8	KMG	Pounds, Prof. K.A.
83/3Ø6	1Ø3Ø..3Ø6	15ØØ	Ø5 21 14	-36 3Ø.2	PKSØ521-365		AGN	G18		*	88	L MG	Maccagni, Dr. D.
83/334	1ØØ6..334	1459	Ø5 21 14	-36 3Ø.1	PKSØ521-365		AGN	G18		*	88	L MG	Maccagni, Dr. D.
84/Ø33	Ø1Ø1..Ø33	Ø758	Ø5 21 17	-72 .3	LMC X-2		LLX	F133	11		56	L MG	Pietsch, Dr. W.
84/Ø62	Ø943..Ø62	1142	Ø5 21 3Ø	+17 2Ø.3	HD 35296		LLX	F7Ø			75	L MG	Pallavicini, Dr. R.
83/33Ø	1916..331	Ø115	Ø5 27 33	-32 51.3	OAØ526-328		LLX	F9Ø			84	L MG	Brinkman, Dr. A.C.
83/332	Ø133..332	Ø75Ø	Ø5 27 33	-32 51.3	2AØ526-328		LLX	F9Ø			84	L MG	Brinkman, Dr. A.C.
83/275	1223..276	1652	Ø5 31 31	+21 58.9	CRAB NEBULA		CAL	OBS			39	LKMG	Aschenbach, Dr. B.
84/Ø73	1516..Ø73	2Ø15	Ø5 31 31	+21 58.8	CRAB NEBULA		CAL				35	L MG	Peacock, Dr. A.
84/Ø85	161Ø..Ø86	Ø73Ø	Ø5 31 31	+21 58.9	CRAB NEBULA		TOO		11		35	L MG	Peacock, Dr. A.
83/276	1652..277	1958	Ø5 31 46	+2Ø 25.4	CRAB RASTER		CAL	OBS	21	*	Ø	LKMG	
83/291	1821..292	Ø1ØØ	Ø5 32 Ø4	-66 21.5	LMC X-4		HLX	F11			98	LKMG	Pakull, Dr. M.
83/326	1728..326	2238	Ø5 32 46	-66 24.2	LMC X-4		HLX	F11		C	98	L MG	Pakull, Dr. M.
83/3Ø3	Ø126..3Ø3	Ø6Ø2	Ø5 32 47	-66 24.2	LMC X-4		HLX	F11			98	L MG	Pakull, Dr. M.
83/321	1751..322	2218	Ø5 32 47	-66 24.2	LMC X-4	+	HLX	F11		C	56	L MG	Pietsch, Dr. W.
84/116	Ø148..116	1Ø53	Ø5 32 48	-66 23.9	LMC X-4		HLX	F11	11		98	L MG	Pakull, Dr. M.
84/Ø66	Ø6Ø7..Ø66	1858	Ø5 32 5Ø	-Ø5 24.Ø	ORION		PV				Ø	L MG	
83/291	1133..291	1635	Ø5 33 28	-Ø1 9.8	EPS ORI		CAL			C	Ø	LKMG	
83/293	214Ø..294	1143	Ø5 33 28	-Ø1 9.8	EPS ORI		LLX	G2			59	LKMG	Bianchi, Dr. L.
83/321	1244..321	1717	Ø5 34 15	-66 38.9	LMC X-4		HLX	F11		*	56	L MG	Pietsch, Dr. W.
83/318	Ø5Ø3..318	Ø647	Ø5 34 47	-66 24.2	LMC X-4 +CELRE		HLX	F11			56	L MG	Pietsch, Dr. W.
83/337	Ø755..337	1753	Ø5 36 44	-67 17.9	AØ538-66		TOO				Ø	L MG	
84/1ØØ	Ø83Ø..1ØØ	1723	Ø5 36 55	+69 19.7	NGC1961		EXG	F25	11		33	L MG	Shostak, Dr. G.S.
83/288	ØØ25..288	Ø121	Ø5 37 2Ø	-66 58.4	OAØ538-66	+	TOO			C	Ø	LKMG	
83/287	1439..287	2345	Ø5 37 23	-66 58.4	OAØ538-66		TOO			*	Ø	LKMG	
83/345	Ø1Ø5..345	Ø7Ø8	Ø5 38 4Ø	-64 6.5	LMC X-3		HLX	G4			85	L MG	Treves, Dr. A.
83/2Ø8	1931..2Ø9	Ø357	Ø5 4Ø Ø6	-69 46.Ø	LMC X-1		PV				Ø	LKMG	
83/326	1ØØØ..326	1636	Ø5 43 49	-68 23.6	AØ543-68		HLX	F11	11	*	98	L MG	Pakull, Dr. M.
83/241	Ø53Ø..241	Ø751	Ø5 48 46	+ØØ 11.2	G191 B2B		LLX	G25	11		61	LKMG	Heise, Dr. J.
83/3Ø6	1651..3Ø6	1959	Ø5 48 49	-32 16.9	PKSØ548-322		AGN	G18		C	88	L MG	Maccagni, Dr. D.
83/334	1656..334	194Ø	Ø5 48 5Ø	-32 16.9	PKSØ548-322		AGN	G18		C	88	L MG	Maccagni, Dr. D.
83/28Ø	232Ø..281	Ø541	Ø5 49 4Ø	-Ø5 25.5	CN ORI		LLX	F35		C	36	LKMG	Mason, Dr. K.O.
83/251	132Ø..251	17Ø8	Ø5 49 47	-Ø7 28.1	NGC211Ø		AGN	F34	11	C	8	KMG	Pounds, Prof. K.A.
83/312	21Ø3..312	2245	Ø5 51 1Ø	+46 25.9	MCG8-11-11		AGN	G1			22	L MG	Maraschi, Dr. L.
84/Ø27	Ø133..Ø27	Ø243	Ø5 51 1Ø	+46 25.9	MCG8-11-11		AGN	G1			22	L MG	Maraschi, Dr. L.
83/254	Ø251..254	Ø846	Ø5 52 42	-Ø4 9.Ø	LP658-2		LLX	G24	11		61	LKMG	Heise, Dr. J.
84/Ø57	ØØ54..Ø57	Ø42Ø	Ø6 1Ø 45	+78 22.5	N2146		EXG	F15			17	L MG	Fricke, Prof. Dr. K.J.
84/Ø62	Ø518..Ø62	Ø739	Ø6 15 33	+82 3.9	Ø615+82		EXG	F1Ø			3Ø	L MG	Witzel, Dr. A.
83/291	Ø232..291	Ø957	Ø6 22 19	-52 38.2	HD45348		CAL			*	Ø	LKMG	
83/252	2218..253	Ø8Ø8	Ø6 3Ø ØØ	+17 47.9	1EØ63Ø+1748		LLX	G 6	11		62	LKMG	Caraveo, Dr. P.
84/169	Ø25Ø..169	1313	Ø6 37 21	-75 13.2	PKSØ637-75		AGN	G13			23	L MG	Zimmermann, Dr. H.U.
83/253	1Ø23..254	ØØ41	Ø6 38 17	+Ø9 42.3	NGC2264		LLX	F77	11		43	LK	Charles, Dr. P.A.
84/Ø41	Ø424..Ø41	Ø943	Ø6 43 Ø4	-16 48.4	1EØ643-1648		LLX	G8			63	LKMG	Beuermann, Dr. K.
84/Ø41	21Ø5..Ø41	2222	Ø6 43 Ø4	-16 48.4	1EØ643-1648		LLX	G8			63	LKMG	Beuermann, Dr. K.
84/Ø43	Ø211..Ø43	Ø256	Ø6 43 Ø4	-16 48.4	1EØ643-1648		LLX	G8			63	L MG	Beuermann, Dr. K.

84/Ø43	1646..Ø43 19Ø9	Ø6 43 Ø4	-16 48.4	1EØ643-1648	LLX	G8			63	L MG	Beuermann, Dr. K.
83/292	Ø325..293 Ø454	Ø6 43 44	-16 38.7	SIRIUS B	LLX	G1Ø			61	LKMG	Heise, Dr. J.
83/264	Ø743..264 Ø935	Ø6 47 29	-43 59.9	HD 497985	LLX	G23	11		66	LKMG	De Korte, Dr. P.A.J.
83/262	1636..262 19Ø9	Ø6 56 ØØ	-Ø7 12.Ø	3AØ656-Ø72	MIS	F23	11		21	KMG	Warwick, Dr. R.S.
84/1Ø3	231Ø..1Ø4 Ø43Ø	Ø6 56 Ø2	-Ø7 11.7	3AØ656-Ø72	MIS	F23	11	C	21	L MG	Warwick, Dr. R.S.
83/295	Ø556..295 Ø837	Ø7 Ø3 37	+59 33.5	4C59.Ø8	EXG	F6			28	LKMG	Strom, Dr. R.G.
84/Ø4Ø	14Ø6..Ø4Ø 1935	Ø7 1Ø Ø3	+43 54.4	OI417	EXG	F9		*	15	LKMG	Cavaliere, Prof. A.
84/Ø72	1844..Ø72 2151	Ø7 18 28	-31 17.3	EØ718-312	EXG	F4Ø			36	L MG	Mason, Dr. K.O.
84/ØØ4	1846..ØØ5 ØØ35	Ø7 28 43	+1Ø 2.7	3AØ729+1Ø3	MIS	F18			27	L MG	Pye, Dr. J.P.
84/Ø98	1154..Ø98 1844	Ø7 31 25	+31 58.4	EØ731.4+3158	LLX	F84			177	L MG	Cecchini, Dr.S.
84/Ø56	Ø442..Ø56 11Ø3	Ø7 31 26	+31 58.7	EØ731.4+3158	LLX	F84			177	L MG	Cecchini, Dr.S.
83/318	Ø933..318 1356	Ø7 35 13	+17 49.1	PKSØ735+178	AGN	F26			12	L MG	Willmore, Prof. A.P.
83/316	1356..316 1919	Ø7 35 14	+17 49.1	PKSØ735+178	AGN	F26			12	L MG	Willmore, Prof. A.P.
83/317	1432..317 1826	Ø7 35 14	+17 49.1	PKSØ735+178	AGN	F26			12	L MG	Willmore, Prof. A.P.
83/294	18Ø8..295 ØØØ9	Ø7 36 21	+Ø5 22.4	ALPHA CM	LLX	F95	12		79	LKMG	Mewe, Dr. R.
84/Ø37	13Ø7..Ø37 143Ø	Ø7 38 47	+49 55.8	MKN79	AGN	F34			8	L MG	Pounds, Prof. K.A.
84/Ø9Ø	Ø459..Ø9Ø Ø92Ø	Ø7 38 47	+49 55.8	MKN79	AGN	F34			8	L MG	Pounds, Prof. K.A.
83/344	1352..344 2149	Ø7 52 Ø3	+39 19.1	MKN382	AGN	F4Ø			14	L MG	Fink, Dr. H.
84/Ø89	Ø94Ø..Ø89 124Ø	Ø7 52 35	+25 5Ø.6	Ø752+258	AGN	F13			9	L MG	Biermann, Prof. Dr. P.
84/Ø43	Ø6Ø7..Ø43 1336	Ø7 54 23	+1Ø 4.6	Ø754+1ØØ	AGN	F25			Ø	L MG	
84/Ø85	Ø415..Ø85 Ø7ØØ	Ø7 57 3Ø	+6Ø 28.Ø	HD65339A	LLX	F125			83	L MG	Ferrari, Dr. A.
84/Ø81	ØØ12..Ø81 11Ø9	Ø8 Ø1 49	-39 51.6	ZETA PUP	LLX	G27			67	L MG	Den Boggende, dr. A.
83/256	1811..256 2Ø29	Ø8 Ø4 44	+75 6.8	BD 75-325	LLX	G23	11	*	66	LKMG	De Korte, Dr. P.A.J.
83/3ØØ	Ø139..3ØØ Ø35Ø	Ø8 Ø7 51	+28 17.4	YZ CNC	LLX	G12		C	61	LKMG	Heise, Dr. J.
83/3Ø1	2131..3Ø1 2347	Ø8 Ø7 51	+28 17.4	YZ CNC	LLX	G12			61	L MG	Heise, Dr. J.
83/3Ø3	1937..3Ø3 2117	Ø8 Ø7 51	+28 17.3	YZ CNC	LLX	G12			61	L MG	Heise, Dr. J.
83/3Ø5	224Ø..3Ø6 ØØ55	Ø8 Ø7 51	+28 17.4	YZ CNC	LLX	G12			61	L MG	Heise, Dr. J.
83/3Ø7	2155..3Ø8 ØØØØ	Ø8 Ø7 51	+28 17.4	YZ CNC	LLX	G12		C	61	L MG	Heise, Dr. J.
83/3Ø9	2313..31Ø ØØ47	Ø8 Ø7 51	+28 17.4	YZ CNC	LLX	G12			61	L MG	Heise, Dr. J.
83/312	Ø214..312 Ø321	Ø8 Ø7 51	+28 17.4	YZ CNC	LLX	G12			61	L MG	Heise, Dr. J.
83/313	2125..314 Ø711	Ø8 Ø7 51	+28 17.4	YZ CNC	LLX	G12			61	L MG	Heise, Dr. J.
83/315	173Ø..315 1954	Ø8 Ø7 51	+28 17.4	YZ CNC	LLX	G12			61	L MG	Heise, Dr. J.
83/317	21Ø9..317 2221	Ø8 Ø7 51	+28 17.4	YZ CNC	LLX	G12			61	L MG	Heise, Dr. J.
83/256	Ø743..256 1Ø59	Ø8 Ø8 Ø4	+62 45.6	SU UMA	LLX	F25	11		36	LKMG	Mason, Dr. K.O.
83/3Ø3	Ø83Ø..3Ø3 115Ø	Ø8 Ø8 Ø4	+62 45.6	SU UMA	LLX	F25			69	L MG	Evans, Dr. A.
83/364	1953..364 23ØØ	Ø8 Ø8 Ø5	+62 45.6	SU UMA	LLX	F25			69	L MG	Evans, Dr. A.
84/Ø77	2135..Ø77 23Ø8	Ø8 Ø8 Ø5	+62 45.6	SU UMA	TOO				36	L MG	Mason, Dr. K.O.
84/1Ø5	Ø144..1Ø5 Ø359	Ø8 Ø8 Ø5	+62 45.6	SU UMA	LLX	F25	11		36	L MG	Mason, Dr. K.O.
84/1Ø7	Ø814..1Ø7 1121	Ø8 1Ø Ø5	+29 48.4	HD68351	LLX	F125			83	L MG	Ferrari, Dr. A.
84/Ø35	2346..Ø36 Ø34Ø	Ø8 12 52	-18 53.9	VV PUP	LLX	G16			Ø	L MG	
84/Ø83	21Ø9..Ø83 222Ø	Ø8 19 43	+73 16.6	Z CAM	LLX	F35			36	L MG	Mason, Dr. K.O.
84/Ø41	ØØØ5..Ø41 Ø15Ø	Ø8 31 Ø4	+55 44.6	4C55.16	EXG	F9		C	15	LKMG	Cavaliere, Prof. A.
84/Ø31	1356..Ø31 1546	Ø8 34 47	+65 11.7	HD 729Ø5	LLX	F7Ø		C	75	L MG	Pallavicini, Dr. R.
83/313	1137..313 1913	Ø8 37 ØØ	+2Ø 1Ø.Ø	PRAESEPE	LLX	F14			6	L MG	Schnopper, Prof. H.W.
84/Ø88	13ØØ..Ø88 16ØØ	Ø8 39 14	+18 46.4	DWØ839+18	AGN	F22			11	L MG	Kollatschny, Dr. W.
83/283	2149..283 2315	Ø8 41 31	+12 59.2	HØ85Ø+13	MIS	F17	11		48	LKMG	Sims, Dr. M.
83/3Ø1	1414..3Ø1 2ØØØ	Ø8 49 48	+12 36.Ø	HØ85Ø+13	MIS	F17	11		48	L MG	Sims, Dr. M.
84/Ø38	Ø547..Ø38 1Ø33	Ø8 51 Ø3	+2Ø 9.4	Ø851+2Ø2	AGN	F26			12	L MG	Willmore, Prof. A.P.
84/Ø39	Ø634..Ø39 11ØØ	Ø8 51 Ø3	+2Ø 9.4	Ø851+2Ø2	AGN	F26			12	L MG	Willmore, Prof. A.P.
84/Ø4Ø	Ø62Ø..Ø4Ø Ø733	Ø8 51 Ø3	+2Ø 9.4	Ø851+2Ø2	AGN	F26		*	12	LKMG	Willmore, Prof. A.P.
84/Ø4Ø	Ø749..Ø4Ø 11ØØ	Ø8 51 Ø7	+2Ø 8.9	Ø851+2Ø2	+ AGN	F26		C	12	LKMG	Willmore, Prof. A.P.
83/281	2326..282 Ø132	Ø8 51 57	+2Ø 17.9	Ø851+2Ø2	AGN	F26	11		12	LKMG	Willmore, Prof. A.P.

83/341	1947..342 Ø235	Ø8 51 57	+2Ø 17.9	Ø851+2Ø2	AGN F26			68	L MG	Pollock, Dr. A.M.T.
84/112	Ø845..112 1745	Ø8 52 26	+2Ø 25.2	Ø851+2Ø2	TOO			68	L MG	Pollock, Dr. A.M.T.
83/224	1353..224 195Ø	Ø8 53 48	-46 12.6	AØ851-467	PV	11		Ø	LKMG	
84/Ø91	18Ø9..Ø91 2113	Ø8 55 46	+12 12.2	HØ85Ø+13	MIS F17			48	L MG	Sims, Dr. M.
84/Ø91	1427..Ø91 161Ø	Ø8 58 15	+18 6.4	SY CNC	LLX F35			36	L MG	Mason, Dr. K.O.
84/Ø46	Ø514..Ø46 Ø745	Ø9 ØØ 13	-4Ø 21.4	VELA X-1	HLX G17			35	L MG	Peacock, Dr. A.
84/Ø47	Ø6Ø5..Ø47 Ø853	Ø9 ØØ 13	-4Ø 21.4	VELA X-1	HLX G17			35	L MG	Peacock, Dr. A.
84/Ø48	1921..Ø48 2115	Ø9 ØØ 13	-4Ø 21.4	VELA X-1	HLX G17			35	L MG	Peacock, Dr. A.
84/Ø49	1Ø53..Ø49 1229	Ø9 ØØ 13	-4Ø 21.4	VELA X-1	HLX G17			35	L MG	Peacock, Dr. A.
84/Ø5Ø	Ø534..Ø5Ø Ø824	Ø9 ØØ 13	-4Ø 21.4	VELA X-1	HLX G17			35	L MG	Peacock, Dr. A.
84/Ø52	Ø623..Ø52 Ø829	Ø9 ØØ 13	-4Ø 21.4	VELA X-1	HLX G17		C	35	L G	Peacock, Dr. A.
84/Ø53	Ø72Ø..Ø53 Ø925	Ø9 ØØ 13	-4Ø 21.4	VELA X-1	HLX G17+		*	35	L G	Peacock, Dr. A.
84/Ø83	1631..Ø83 1835	Ø9 Ø2 37	-32 1Ø.7	T PYX	LLX F4Ø			7Ø	L MG	Duerbeck, Dr. H.W.
84/1Ø4	18Ø1..1Ø4 2329	Ø9 11 24	+Ø5 19.4	4CØ5.38	AGN F22			11	L MG	Kollatschny, Dr. W.
83/325	Ø445..325 Ø826	Ø9 13 48	-16 6.2	NGC2811	AGN F54			17	L MG	Fricke, Prof. Dr. K.J.
84/Ø29	Ø7Ø7..Ø29 1ØØØ	Ø9 16 17	+86 25.2	Ø916+86	EXG 1Ø			3Ø	L MG	Witzel, Dr. A.
84/16Ø	Ø739..16Ø 1659	Ø9 18 53	-54 59.5	XØ918-549	HLX 128			3	L MG	McKechnie, Dr. S.P.
83/346	182Ø..347 Ø239	Ø9 21 25	-63 4.7	2SØ921-63Ø	HLX G5	11		49	L MG	Corbet, Dr. R.H.D.
83/32Ø	Ø82Ø..32Ø 135Ø	Ø9 22 Ø2	+Ø6 2Ø.7	GØ921+Ø6	AGN F34			8	L MG	Pounds, Prof. K.A.
84/Ø93	2Ø34..Ø94 Ø344	Ø9 23 35	+39 6.7	Ø923+39	EXG F7			29	L MG	Miller, Dr. L.
84/Ø21	234Ø..Ø22 ØØ51	Ø9 25 Ø1	-22 7.4	HD 81799	LLX G11			79	L MG	Mewe, Dr. R.
84/143	223Ø..144 Ø148	Ø9 34 35	-29 51.4	MCG5-23-16	AGN F34		*	8	L MG	Pounds, Prof. K.A.
84/166	171Ø..167 12Ø9	Ø9 39 13	-52 32.Ø	GAL PLANE SCAN 1	MIS G1			25	MG	Turner, Dr. M.J.L.
84/168	1511..169 ØØ44	Ø9 39 13	-52 32.Ø	GAL PLANE SCAN 2	MIS G1	11		25	MG	Turner, Dr. M.J.L.
84/17Ø	1321..171 Ø217	Ø9 39 13	-52 32.Ø	GAL PLANE SCAN 3	MIS G1			25	MG	Turner, Dr. M.J.L.
84/171	1225..172 1ØØ3	Ø9 39 13	-52 32.Ø	GAL PLANE SCAN 4	MIS G1			25	MG	Turner, Dr. M.J.L.
84/174	Ø739..175 Ø6ØØ	Ø9 39 13	-52 32.Ø	GAL PLANE SCAN 5	MIS G1	11		25	MG	Turner, Dr. M.J.L.
84/175	1442..176 11Ø3	Ø9 39 13	-52 32.Ø	GAL PLANE SCAN 6	MIS G1	11		25	MG	Turner, Dr. M.J.L.
84/177	1818..178 1419	Ø9 39 13	-52 32.Ø	GAL PLANE SCAN 7	MIS G1	11		25	MG	Turner, Dr. M.J.L.
84/179	Ø714..18Ø Ø522	Ø9 39 13	-52 32.Ø	GAL PLANE SCAN 8	MIS G1	11		25	MG	Turner, Dr. M.J.L.
83/285	115Ø..285 192Ø	Ø9 4Ø 42	+56 7.6	W UMA	LLX F97	11		61	LKMG	Heise, Dr. J.
83/286	Ø84Ø..286 Ø932	Ø9 4Ø 42	+56 7.6	W UMA	LLX F97	11		61	MG	Heise, Dr. J.
83/352	1745..352 235Ø	Ø9 43 17	-14 5.7	NGC2922	AGN G17			25	L MG	Turner, Dr. M.J.L.
84/Ø96	2234..Ø97 Ø43Ø	Ø9 43 2Ø	-14 2.2	NGC2992	AGN G17			25	L MG	Turner, Dr. M.J.L.
83/347	1958..348 ØØ11	Ø9 45 24	-3Ø 43.Ø	MCG5-23-16	AGN F34			8	L MG	Pounds, Prof. K.A.
84/144	Ø238..144 Ø923	Ø9 45 26	-3Ø 42.6	MCG5-23-16	AGN F34		C	8	L MG	Pounds, Prof. K.A.
84/Ø65	2111..Ø66 ØØØ5	Ø9 45 5Ø	+4Ø 53.7	Ø945+4Ø	EXG F7			29	L MG	Miller, Dr. L.
83/273	Ø21Ø..273 Ø634	Ø9 48 29	+69 Ø.Ø	NGC3Ø31	EXG G1	11		3	LKMG	McKechnie, Dr. S.P.
84/1Ø1	Ø625..1Ø1 1617	Ø9 5Ø 3Ø	+69 54.9	M82	EXG F22			9	L MG	Biermann, Prof. Dr. P.
83/358	19Ø7..359 1551	Ø9 51 52	+69 54.9	M82	+ EXG F22			9	L MG	Biermann, Prof. Dr. P.
84/Ø64	1631..Ø64 1924	Ø9 54 14	+55 37.2	Ø954+55	EXG F7			29	L MG	Miller, Dr. L.
84/144	1Ø2Ø..144 1339	Ø9 56 31	-31 3Ø.9	MCG5-23-16	AGN F34		C	8	L MG	Pounds, Prof. K.A.
83/325	Ø111..325 Ø15Ø	Ø9 58 57	+17 4Ø.Ø	XY LEO	LLX F97		*	61	L MG	Heise, Dr. J.
83/325	Ø2Ø3..325 Ø326	Ø9 58 57	+17 4Ø.Ø	XY LEO	LLX F97		C	61	L MG	Heise, Dr. J.
84/Ø97	162Ø..Ø97 1831	1Ø Ø3 Ø5	+35 8.8	1ØØ3+35	EXG F7			29	L MG	Miller, Dr. L.
84/Ø75	22Ø9..Ø76 Ø118	1Ø Ø3 23	+83 4.6	1ØØ3+83	EXG F1Ø		*	3Ø	L MG	Witzel, Dr. A.
84/Ø87	1Ø35..Ø87 1327	1Ø Ø4 17	+33 16.Ø	NGC 31185	EXG F36		C	35	L MG	Peacock, Dr. A.
84/1Ø6	ØØ14..1Ø6 Ø42Ø	1Ø Ø5 2Ø	-69 59.2	OY CAR	LLX F36		C	36	L MG	Mason, Dr. K.O.
83/338	1Ø52..339 ØØ13	1Ø 12 37	-Ø2 53.5	PG1Ø12-Ø29	LLX F132		*	36	L MG	Mason, Dr. K.O.
83/339	Ø2ØØ..339 Ø456	1Ø 12 37	-Ø2 53.5	PG1Ø12-Ø29	LLX F132		C	36	L MG	Mason, Dr. K.O.

84/Ø99	Ø734..Ø99 Ø929	1Ø 13 56	+23 4Ø.2	HD 89Ø25	LLX G11			64 L MG	Zwaan, Dr. C.
84/Ø83	1Ø35..Ø83 1344	1Ø 13 57	-47 43.2	E1Ø13-477	LLX F15			22 L MG	Maraschi, Dr. L.
84/Ø62	ØØØ9..Ø62 Ø246	1Ø 2Ø 13	+4Ø 3.5	1Ø2Ø+4Ø	EXG F7			29 L MG	Miller, Dr. L.
83/349	1142..349 1716	1Ø 2Ø 46	+2Ø 7.1	NGC3227	AGN F33			13 L MG	Lawrence, Dr. A.
83/313	Ø139..313 Ø944	1Ø 28 47	+29 2.4	TON524A	AGN F4Ø	11		14 L MG	Fink, Dr. H.
83/324	2Ø24..324 2355	1Ø 28 48	+29 6.Ø	TON 524A	AGN G15	11		24 L MG	Bleeker, Dr. J.A.M.
83/364	Ø728..364 15ØØ	1Ø 33 35	-35 42.Ø	3A1Ø3Ø-346	MIS F18		C	27 L MG	Pye, Dr. J.P.
84/ØØ4	Ø851..ØØ4 16ØØ	1Ø 34 3Ø	-27 16.Ø	A1Ø6Ø	CLU F16			6 L MG	Schnopper, Prof. H.W.
84/Ø12	Ø8Ø8..Ø12 Ø843	1Ø 36 1Ø	-56 33.Ø	4U1Ø36-56	HLX F42			55 L MG	Van Paradijs, Dr. J.
83/324	1644..324 19Ø4	1Ø 38 33	+43 12.6	EG 71	LLX G23		C	66 L MG	De Korte, Dr. P.A.J.
84/Ø62	1434..Ø62 18Ø3	1Ø 38 43	+52 49.3	1Ø38+52	EXG F7			29 L MG	Miller, Dr. L.
84/Ø76	Ø2Ø2..Ø76 Ø6Ø3	1Ø 53 39	+81 3Ø.5	1Ø53+81	EXG F1Ø		C	3Ø L MG	Witzel, Dr. A.
84/Ø23	Ø333..Ø23 165Ø	1Ø 55 49	-52 1Ø.7	PSR1Ø55-52	LLX F117			96 L MG	Brinkmann, Dr. W.
84/15Ø	Ø253..15Ø Ø8ØØ	1Ø 57 42	+1Ø 5.4	1Ø57+1ØØ	AGN F13			9 L MG	Biermann, Prof. Dr. P.
84/Ø91	Ø914..Ø91 12ØØ	1Ø 58 42	+45 55.5	A 1Ø58+45	EXG F36			35 L MG	Peacock, Dr. A.
84/1Ø2	2335..1Ø3 1354	11 Ø1 35	+45 19.4	AN UMA	SNR F4		*	35 L MG	Peacock, Dr. A.
84/Ø32	11Ø3..Ø32 1458	11 Ø1 39	+38 28.Ø	MKN421	AGN G19		*	21 L MG	Warwick, Dr. R.S.
84/Ø33	1144..Ø33 142Ø	11 Ø1 39	+38 28.Ø	MKN421	AGN G19		*	21 L MG	Warwick, Dr. R.S.
84/Ø37	ØØ54..Ø37 Ø349	11 Ø1 4Ø	+38 27.9	MKN421	AGN G19		C	21 L MG	Warwick, Dr. R.S.
84/Ø2Ø	Ø139..Ø2Ø Ø749	11 Ø3 58	-ØØ 36.6	PKS11Ø3-ØØ6	AGN F21			16 L MG	Bergeron, Dr. J.
83/324	1235..324 1529	11 11 54	+55 17.5	NGC 3587	LLX G23		*	66 L MG	De Korte, Dr. P.A.J.
84/155	Ø73Ø..155 1335	11 14 37	+18 14.Ø	1114+18	HLX Ø15	11		9 L MG	Biermann, Prof. Dr. P.
84/Ø46	1544..Ø47 Ø329	11 19 Ø2	-6Ø 2Ø.9	CEN X-3	HLX G19			35 L MG	Peacock, Dr. A.
84/134	Ø3Ø6..134 Ø831	11 19 Ø4	-6Ø 21.Ø	CEN X-3	HLX G19			35 L MG	Peacock, Dr. A.
84/Ø85	Ø9Ø7..Ø85 1316	11 22 48	+54 39.4	MKN4Ø	AGN G15			66 L MG	De Korte, Dr. P.A.J.
84/Ø73	1Ø49..Ø73 1258	11 27 42	+46 55.9	HD 99967	LLX G11		C	64 L MG	Zwaan, Dr. C.
84/Ø89	16ØØ..Ø9Ø Ø238	11 28 27	+69 36.4	HD 1ØØ29	LLX F12Ø			81 L MG	Bedford, Dr. D.K.
83/347	1Ø44..347 1842	11 36 33	-37 27.6	NGC3783	LLX F134	11	C	18 L MG	Bell-Burnell, Dr. S.J.
84/162	17Ø8..162 23ØØ	11 36 34	-37 27.5	NGC3783	AGN G2			18 L MG	Bell-Burnell, Dr. S.J.
84/Ø28	Ø4ØØ..Ø28 1536	11 36 38	-13 34.1	PKS1136-13	AGN F53+			16 L MG	Bergeron, Dr. J.
84/Ø3Ø	222Ø..Ø31 Ø417	11 36 39	-13 34.1	PKS1136-13	AGN F21			16 L MG	Bergeron, Dr. J.
84/ØØ5	Ø8Ø8..ØØ5 17ØØ	11 41 53	+2Ø 6.9	A1367	CLU F16			6 L MG	Schnopper, Prof. H.W.
83/188	1818..188 2257	11 45 Ø2	-61 4Ø.5	1E1145-616	PV			Ø LKMG	
83/177	1544..178 Ø11Ø	11 45 5Ø	-61 4Ø.7	1E1145-616	PV			Ø LKMG	
83/364	Ø321..364 Ø542	11 46 29	-11 51.3	3A1146-118	MIS F18		*	27 L MG	Pye, Dr. J.P.
84/Ø16	Ø644..Ø16 1535	11 47 44	+24 34.5	1147+245	AGN F26			12 L MG	Willmore, Prof. A.P.
84/Ø17	Ø92Ø..Ø17 1541	11 47 44	+24 34.5	1147+245	AGN F26			68 L MG	Pollock, Dr. A.M.T.
84/Ø18	Ø943..Ø18 15Ø5	11 47 44	+24 34.5	1147+245	AGN F26			68 L MG	Pollock, Dr. A.M.T.
84/Ø43	2147..Ø44 Ø3Ø8	11 48 15	-62 15.Ø	E1149.4-62Ø9	SNR G6			38 L MG	Bignami, Dr. G.
84/111	Ø412..111 Ø949	11 49 33	-66 55.2	NOVA MUSCAE	TOO			63 L MG	Beuermann, Dr. K.
84/Ø76	Ø726..Ø76 1Ø48	11 5Ø 22	+81 15.1	115Ø+81	EXG F1Ø		C	3Ø L MG	Witzel, Dr. A.
83/362	1719..363 Ø45Ø	11 54 57	+32 37.6	NGC3991/4/5	EXG F18			228 L MG	Casini, Dr. C.
84/111	13Ø9..111 2Ø1Ø	11 54 59	+32 37.6	NGC3991/4/5	EXG F18			32 L MG	Gavazzi, G.
83/339	11Ø1..339 164Ø	11 55 1Ø	+49 13.1	BE UMA	LLX F85			61 L MG	Heise, Dr. J.
84/Ø18	Ø4ØØ..Ø18 Ø55Ø	11 55 1Ø	+49 13.Ø	BE U MA	LLX G13			65 L MG	Cole, Dr. R.
84/Ø18	1755..Ø18 191Ø	11 55 1Ø	+49 13.Ø	BE U MA	LLX G13			65 L MG	Cole, Dr. R.
84/Ø19	2147..Ø19 23ØØ	11 55 1Ø	+49 13.Ø	BE U MA	LLX G13			65 L MG	Cole, Dr. R.
83/34Ø	Ø525..34Ø Ø848	11 56 17	+29 33.4	1156+295	AGN F3	11		19 L MG	McHardy, Dr. I.
83/342	2234..343 Ø15Ø	11 56 56	+29 33.4	1156+295	AGN F3	11		19 L MG	McHardy, Dr. I.
83/336	Ø839..336 1238	11 56 57	+29 33.4	1156+295	AGN F3	11	*	19 L MG	McHardy, Dr. I.
83/345	21Ø8..346 ØØØ6	11 56 57	+29 33.4	1156+295	AGN F3		C	19 L MG	McHardy, Dr. I.
84/151	Ø814..151 1333	11 56 57	+29 31.4	1156+295	AGN ØØ5			19 L MG	McHardy, Dr. I.

84/167	1413..167	2131	11 58 58	-Ø3 29.8	PG1159-Ø35		LLX	Ø68			73	L MG	Barstow, Dr. M.A.
84/Ø99	2136..1ØØ	Ø553	12 ØØ 37	+44 49.3	NGC4Ø51		AGN	F33			13	L MG	Lawrence, Dr. A.
83/348	17Ø9..348	2Ø5Ø	12 Ø2 Ø5	+31 27.Ø	A12Ø2+31		EXG	F36			35	L MG	Peacock, Dr. A.
83/356	19Ø1..356	22Ø4	12 Ø3 29	+47 45.2	NGC4Ø96		EXG	F14		*	164	L MG	Gioia, Dr.I.
84/144	1548..144	21ØØ	12 Ø3 52	+53 .1	N41Ø2		EXG	F15			17	L MG	Fricke, Prof. Dr. K.J.
83/311	11Ø8..311	1742	12 Ø8 ØØ	+39 4Ø.8	NGC4151		AGN	F37	11		87	L MG	Perola, Prof. G.
83/315	1Ø56..315	1448	12 Ø8 ØØ	+39 4Ø.8	NGC4151		AGN	F37	11		87	L MG	Perola, Prof. G.
83/319	1115..319	1745	12 Ø8 ØØ	+39 4Ø.8	NGC4151		AGN	F37	11		87	L MG	Perola, Prof. G.
83/323	Ø117..323	Ø715	12 Ø8 ØØ	+39 4Ø.8	NGC 4151		AGN	F37	11		87	L MG	Perola, Prof. G.
83/351	Ø2Ø1..351	Ø831	12 Ø8 Ø1	+39 41.Ø	NGC4151		AGN	G4			8	L MG	Pounds, Prof. K.A.
84/Ø98	2317..Ø99	Ø459	12 Ø8 Ø1	+39 41.5	NGC4151		AGN	G4+			8	L MG	Pounds, Prof. K.A.
84/154	Ø112..154	Ø417	12 Ø8 Ø2	+39 41.Ø	12Ø7+39		AGN	Ø72			113	L MG	Dean, A. J.
84/1Ø9	2Ø24..11Ø	Ø344	12 Ø8 Ø3	+39 4Ø.9	NGC4151		AGN	G4			8	L MG	Pounds, Prof. K.A.
83/351	Ø946..351	12Ø2	12 11 24	+33 12.Ø	HZ 21		LLX	G25+		*	61	L MG	Heise, Dr. J.
83/36Ø	Ø516..36Ø	Ø715	12 14 59	+38 5.1	NGC4244		EXG	F14		C	164	L MG	Gioia, Dr.I.
83/353	Ø157..353	Ø955	12 15 21	+3Ø 23.6	1215+3Ø3		AGN	F25			88	L MG	Maccagni, Dr. D.
84/156	Ø144..156	1ØØ9	12 17 35	+29 33.6	NGC 4278		AGN	Ø24			174	L MG	Palumbo, G.G.C.
84/Ø29	ØØ44..Ø29	Ø439	12 17 38	+Ø2 2Ø.3	PKS1217+23		AGN	G13+			23	L MG	Zimmermann, Dr. H.U.
84/135	Ø516..135	1Ø14	12 17 38	+Ø2 2Ø.1	PKS1217+23		AGN	G13			23	L MG	Zimmermann, Dr. H.U.
84/Ø31	2335..Ø32	Ø248	12 18 33	+3Ø 23.4	2A1219+3Ø5		AGN	G19			21	L MG	Warwick, Dr. R.S.
84/Ø33	1716..Ø33	2Ø47	12 18 34	+3Ø 23.4	2A1219+3Ø5		AGN	G19		C	21	L MG	Warwick, Dr. R.S.
84/Ø37	Ø623..Ø37	Ø944	12 18 34	+3Ø 23.4	2A1219+3Ø5		AGN	G19		C	21	L MG	Warwick, Dr. R.S.
83/314	18ØØ..314	2Ø56	12 19 34	+75 35.2	MKN2Ø5		AGN	G13			23	L MG	Zimmermann, Dr. H.U.
84/Ø27	2247..Ø28	ØØ56	12 19 34	+75 35.2	MKN2Ø5		AGN	G13+			23	L MG	Zimmermann, Dr. H.U.
84/149	1719..15Ø	Ø1ØØ	12 2Ø Ø5	+13 5Ø.Ø	VIRGO D'		PV			C	Ø	L MG	
84/147	1739..147	2119	12 21 33	+Ø9 57.8	VIRGO E		PV			*	Ø	L MG	
84/1Ø2	1825..1Ø2	212Ø	12 21 42	+8Ø 56.7	1221+8Ø		EXG	F1Ø			3Ø	L MG	Witzel, Dr. A.
84/149	Ø657..149	16ØØ	12 22 18	+13 31.5	VIRGO C'		PV			C	Ø	L MG	
84/155	15Ø8..155	1816	12 22 53	+16 44.8	NGC 4383		EXG	F36			35	L MG	Peacock, Dr. A.
83/36Ø	1151..36Ø	15Ø5	12 23 21	+33 49.3	NGC4395		EXG	F14		C	164	L MG	Gioia, Dr.I.
84/148	Ø15Ø..148	Ø245	12 23 25	+1Ø 55.4	VIRGO D		PV			C	Ø	MG	
84/159	2Ø38..159	2155	12 23 47	-62 29.7	4U1223-62		HLX	G23			92	L MG	Re, Dr. S.
84/161	Ø545..161	Ø718	12 23 47	-62 29.7	4U1223-62		AGN	Ø65		C	5	L MG	Molteni, Dr. D.
84/111	23Ø2..112	Ø6Ø2	12 23 48	-62 29.1	4U1223-62		HLX	G23			92	L MG	Re, Dr. S.
84/113	2Ø45..113	22Ø2	12 23 48	-62 29.5	4U1223-62		HLX	G23			92	L MG	Re, Dr. S.
84/115	2121..115	2321	12 23 48	-62 29.5	4U1223-62		HLX	G23			92	L MG	Re, Dr. S.
84/156	124Ø..156	1524	12 23 48	-62 29.7	4U1223-62		HLX	G23			92	L MG	Re, Dr. S.
83/231	214Ø..232	Ø554	12 23 5Ø	-62 29.6	4U1223-62		HLX	G23	11		92	KMG	Re, Dr. S.
84/153	2118..153	2259	12 23 53	-62 29.3	4U1223-62		HLX	G23			92	L MG	Re, Dr. S.
84/148	Ø32Ø..148	Ø342	12 24 28	+1Ø 46.8	VIRGO D	+	PV			C	Ø	MG	
84/148	2354..149	Ø6ØØ	12 25 25	+13 4.6	VIRGO B'		PV			*	Ø	L MG	
84/148	Ø43Ø..148	12ØØ	12 26 21	+11 23.7	VIRGO C		PV			*	Ø	L MG	
84/Ø29	1824..Ø29	2225	12 26 32	+Ø2 19.4	3C273		AGN	G16			25	L MG	Turner, Dr. M.J.L.
83/351	171Ø..352	ØØ4Ø	12 26 33	+Ø2 19.4	3C273		AGN	G16	11		25	L MG	Turner, Dr. M.J.L.
84/ØØ5	23ØØ..ØØ6	1317	12 26 33	+Ø2 19.7	3C273		AGN	F15			1Ø	L MG	Grewing, Prof. Dr. M.
84/137	ØØ14..137	Ø659	12 26 33	+Ø2 19.8	3C273		AGN	G16			25	L MG	Turner, Dr. M.J.L.
84/18Ø	1135..18Ø	2251	12 26 34	+Ø2 19.4	3C273		AGN	Ø79	11		25	L MG	Turner, Dr. M.J.L.
84/148	131Ø..148	19ØØ	12 27 35	+11 54.7	VIRGO B		PV			C	Ø	L MG	
83/356	2333..357	Ø31Ø	12 28 Ø9	+41 54.9	NGC449Ø		EXG	F14		C	164	L MG	Gioia, Dr.I.
84/148	1957..148	2259	12 28 44	+12 36.2	VIRGO A		PV			C	Ø	L MG	

84/Ø21	1514..Ø21	21ØØ	12 32 54	-39 38.Ø	NGC45Ø7	AGN F21			16	L MG	Bergeron, Dr. J.
83/36Ø	1851..36Ø	2252	12 33 29	+28 14.3	NGC4559	EXG F14			164	L MG	Gioia, Dr.I.
83/363	1726..363	193Ø	12 33 52	+26 15.8	NGC4565	EXG F14		C	164	L MG	Gioia, Dr.I.
84/ØØ9	Ø94Ø..ØØ9	1556	12 35 36	+Ø1 43.Ø	NGC4581	EXG F36			35	L MG	Peacock, Dr. A.
84/Ø34	22Ø1..Ø35	ØØ4Ø	12 37 Ø1	-Ø5 4.Ø	NGC4593	AGNG19+F		C	21	L MG	Warwick, Dr. R.S.
84/154	Ø63Ø..154	122Ø	12 37 Ø6	-Ø5 4.2	NGC4593	AGN Ø3Ø			1Ø8	L MG	Clavel, J.
84/Ø42	212Ø..Ø42	2339	12 39 Ø7	-59 55.7	3A1239-599	MIS F23			21	L MG	Warwick, Dr. R.S.
83/36Ø	Ø845..36Ø	1Ø39	12 41 33	+32 27.Ø	NGC4656	EXG F14		C	164	L MG	Gioia, Dr.I.
84/Ø2Ø	1Ø39..Ø21	1424	12 46 ØØ	-41 2.Ø	NGC4696	CLU F4			4	L MG	Manzo, Dr. G.
83/243	Ø9Ø5..243	13Ø5	12 46 38	-58 51.Ø	3A1246-588	MIS F23	11		21	LKMG	Warwick, Dr. R.S.
83/363	1449..363	1617	12 48 ØØ	+25 46.3	NGC4725	EXG F14		*	164	L MG	Gioia, Dr.I.
83/36Ø	1619..36Ø	1747	12 49 16	+27 48.7	HD 111812	LLX G11			64	L MG	Zwaan, Dr. C.
83/211	22Ø9..213	Ø112	12 49 43	-28 58.6	EX HYA	PV	11		Ø	LKMG	
84/175	Ø744..175	1255	12 51 ØØ	-28 44.9	SC 1251-288	CLU Ø12			3	L MG	McKechnie, Dr. S.P.
83/351	1313..351	1515	12 53 ØØ	+37 34.Ø	HZ 34	LLX G25+		C	61	L MG	Heise, Dr. J.
84/178	1547..178	2125	12 53 1Ø	+26 9.6	LT 5	LLX 158	11		66	L MG	De Korte, Dr. P.A.J.
84/Ø55	ØØ48..Ø55	Ø9Ø9	12 53 35	-Ø5 31.1	3C279	AGN F5Ø			15	L MG	Cavaliere, Prof. A.
84/136	Ø517..136	1659	12 54 17	-69 .8	2S1254-69Ø	HLX G25			35	L MG	Peacock, Dr. A.
84/Ø36	Ø545..Ø36	12Ø3	12 54 21	-69 1.1	2S1254-69Ø	HLX G25	11		35	L MG	Peacock, Dr. A.
83/362	Ø825..362	1332	12 54 36	+22 18.Ø	EG 187	+ LLX G22+			61	L MG	Heise, Dr. J.
83/339	Ø7ØØ..339	Ø923	12 57 Ø3	+27 54.3	PG1257+279	LLX F132	11	C	36	L MG	Mason, Dr. K.O.
83/197	Ø816..197	231Ø	12 57 29	+28 11.4	COMA CLUSTER	PV	11		Ø	LKMG	
84/177	Ø325..177	Ø35Ø	12 58 19	+12 48.7	GL 494	CLU ØØ4		C	2	L MG	Morini, Dr. M.
84/155	1944..155	2349	13 Ø3 15	+18 17.1	GP COM	LLX 138			173	L MG	Lamb, Dr. D. Q.
84/1Ø7	Ø1Ø7..1Ø7	Ø528	13 Ø4 Ø9	+79 11.1	13Ø4+79	EXG F1Ø			3Ø	L MG	Witzel, Dr. A.
83/365	2Ø55..ØØ2	ØØ58	13 Ø6 ØØ	+29 3Ø.Ø	SA57	CLU G3			3	L MG	McKechnie, Dr. S.P.
84/Ø66	2152..Ø67	Ø149	13 Ø8 Ø7	+32 36.9	13Ø8+326	AGN F3			19	L MG	McHardy, Dr. I.
84/Ø69	1745..Ø69	2Ø53	13 Ø8 Ø7	+32 36.9	13Ø8+326	AGN F3			19	L MG	McHardy, Dr. I.
84/Ø59	1318..Ø59	1722	13 Ø8 Ø8	+32 36.8	13Ø8+326	AGN F3			19	L MG	McHardy, Dr. I.
84/Ø68	133Ø..Ø68	1639	13 Ø8 Ø8	+32 36.9	13Ø8+326	AGN F3			19	L MG	McHardy, Dr. I.
84/173	Ø512..173	Ø922	13 Ø8 Ø9	+32 37.Ø	13Ø8-326	AGN Ø85			19	L MG	McHardy, Dr. I.
83/36Ø	ØØ37..36Ø	Ø332	13 Ø8 38	+37 19.4	NGC5ØØ5	EXG F14		*	164	L MG	Gioia, Dr.I.
84/Ø13	2146..Ø14	112Ø	13 Ø9 Ø2	-Ø5 36.1	13Ø9-Ø57	AGN F19			6	L MG	Schnopper, Prof. H.W.
84/Ø34	1629..Ø34	1935	13 11 Ø9	+36 52.Ø	NGC5Ø33	AGNG19+F		C	21	L MG	Warwick, Dr. R.S.
84/142	2346..143	Ø427	13 13 36	+42 17.4	NGC5Ø55	EXG F14			31	L MG	Gregorini, Dr. L.
84/ØØ5	1834..ØØ5	2124	13 14 18	+Ø9 41.1	HD 115383	LLX F7Ø			75	L MG	Pallavicini, Dr. R.
84/Ø14	13ØØ..Ø14	2235	13 15 Ø4	+Ø5 43.9	HD 115521	LLX F12Ø			81	L MG	Bedford, Dr. D.K.
84/16Ø	192Ø..161	Ø349	13 22 3Ø	-42 45.6	CENTAURUS-A	AGN Ø65		*	5	L MG	Molteni, Dr. D.
84/Ø44	Ø527..Ø44	1635	13 22 32	-42 45.5	4U1322-42	AGN G23			5	L MG	Molteni, Dr. D.
84/Ø42	18Ø9..Ø42	2Ø14	13 23 Ø4	-61 48.Ø	4U1323-62 RETRY	HLX F42			55	L MG	Van Paradijs, Dr. J.
84/1Ø6	2114..1Ø7	ØØ16	13 23 25	+79 57.9	1323+79	EXG F1Ø			3Ø	L MG	Witzel, Dr. A.
84/Ø42	Ø1Ø9..Ø42	1454	13 23 48	-47 23.Ø	OMEGA CEN	SNR F44			44	L MG	Koch-Miramond, Dr. L.
84/176	1335..177	Ø1Ø6	13 29 24	-31 25.9	SC1329-314	CLU ØØ4		*	2	L MG	Morini, Dr. M.
84/Ø17	1737..Ø17	2Ø19	13 32 Ø7	-Ø8 5.1	HD 1181ØØ	LLX F7Ø		*	75	L MG	Pallavicini, Dr. R.
83/218	1743..218	2328	13 34 Ø2	-29 38.8	SN EVANS	PV	11		Ø	LKMG	
83/187	1123..188	Ø6ØØ	13 34 18	-29 37.Ø	S'NOVA EVANS	PV		*	Ø	LKMG	
83/188	Ø6Ø9..188	1513	13 34 3Ø	-29 35.4	S'NOVA EVANS	PV		C	Ø	LKMG	
83/2Ø2	Ø441..2Ø3	Ø759	13 34 3Ø	-29 35.4	S'NOVA EVANS	TOO			Ø	LKMG	
83/2Ø3	Ø83Ø..2Ø3	1659	13 34 3Ø	-29 35.4	S'NOVA EVANS	TOO			Ø	LKMG	
84/161	22ØØ..162	Ø125	13 34 4Ø	+52 1Ø.2	UX UMA	LLX Ø9Ø			145	L MG	Van der Woerd, H.
84/15Ø	1111..15Ø	1555	13 35 2Ø	+78 15.5	H1338+76	MIS F13	11		226	L MG	White, Dr. N.
84/Ø29	12Ø9..Ø29	16ØØ	13 44 58	-32 35.Ø	3A1344-325	MIS F18			27	L MG	Pye, Dr. J.P.

83/356	1355..356	17Ø1	13 49 58	+64 58.1	HD 12113Ø		LLX	F12Ø			81	L MG	Bedford, Dr. D.K.
83/32Ø	1652..32Ø	2Ø48	13 51 52	+69 33.2	2A1348+7ØØ		AGN	G2Ø	11		14	L MG	Fink, Dr. H.
84/Ø28	1829..Ø28	2147	13 51 52	+69 33.2	2A1348+7ØØ		AGN	G2Ø+			14	L MG	Fink, Dr. H.
84/Ø16	1726..Ø16	2315	13 52 12	+18 2Ø.9	E1352.2+183Ø		AGN	F1			7	L MG	Stewart, Dr. G.C.
84/Ø3Ø	1637..Ø3Ø	1944	13 55 21	-37 1Ø.4	EPS CRA		LLX	F97	11		61	L MG	Heise, Dr. J.
84/Ø13	ØØ37..Ø13	Ø5Ø6	14 Ø4 46	+28 41.4	OQ 2Ø8		EXG	F9			15	L M	Cavaliere, Prof. A.
84/Ø84	Ø2Ø4..Ø84	Ø93Ø	14 Ø5 58	-45 3.1	E14Ø5-451		LLX	F15			22	L MG	Maraschi, Dr. L.
83/235	1929..236	Ø436	14 1Ø 42	-Ø2 58.Ø	NGC55Ø6		AGN	G3	11		Ø	LKMG	
84/Ø61	Ø254..Ø61	Ø848	14 1Ø 42	-Ø2 58.Ø	NGC55Ø6		AGN	G3			19	L MG	McHardy, Dr. I.
84/Ø17	ØØ39..Ø17	Ø6Ø5	14 13 23	+19 26.5	HD 124897		LLX	F7Ø			75	L MG	Pallavicini, Dr. R.
84/Ø32	Ø438..Ø32	Ø829	14 15 42	+25 22.Ø	NGC5548		AGN	G7			1	L MG	Branduardi-Raymont, Dr.
84/Ø62	2113..Ø63	Ø519	14 15 42	+25 22.Ø	NGC5548		AGN	G7			1	L MG	Branduardi-Raymont, Dr.
84/141	1229..141	2156	14 15 42	+25 21.4	NGC5548		AGN	G7			1	L MG	Branduardi-Raymont, Dr.
84/14Ø	ØØ34..14Ø	Ø9Ø6	14 18 Ø6	+54 37.1	1418+546		AGN	F26			68	L MG	Pollock, Dr. A.M.T.
84/141	Ø519..141	1Ø15	14 18 Ø6	+54 36.4	1418+546		AGN	F26			68	L MG	Pollock, Dr. A.M.T.
84/139	Ø6Ø9..139	1Ø15	14 18 Ø8	+54 37.1	1418+546		AGN	F26			68	L MG	Pollock, Dr. A.M.T.
83/216	Ø2Ø4..216	1Ø19	14 26 34	+Ø1 3Ø.6	H1426+Ø1		PV		11	*	Ø	LKMG	
83/216	1Ø4Ø..216	1337	14 26 5Ø	+Ø1 3Ø.6	H1426+Ø1		PV		11	C	Ø	LKMG	
84/Ø51	1237..Ø51	1438	14 29 Ø8	-22 29.5	HD 127493		LLX	G23			66	L	De Korte, Dr. P.A.J.
84/Ø1Ø	2255..Ø11	ØØ45	14 3Ø Ø4	+38 31.5	HD 127762		LLX	G11			64	L MG	Zwaan, Dr. C.
84/Ø11	1825..Ø11	1918	14 3Ø Ø4	+38 31.5	HD 127762		LLX	G11			64	MG	Zwaan, Dr. C.
83/365	16Ø6..365	1858	14 33 Ø5	+48 52.7	MKN474		AGN	G15		C	66	L MG	De Korte, Dr. P.A.J.
84/Ø44	1825..Ø44	2244	14 33 34	-4Ø 59.5	3A1431-4Ø9		MIS	G2			19	L MG	McHardy, Dr. I.
84/Ø84	21ØØ..Ø85	ØØ21	14 33 34	-4Ø 59.5	3A1431-4Ø9		MIS	G2			19	L MG	McHardy, Dr. I.
84/136	2Ø14..136	2123	14 55 53	+4Ø 56.Ø	TT BOO		LLX	G12			61	L MG	Heise, Dr. J.
84/142	Ø1Ø4..142	Ø2Ø4	14 55 53	+4Ø 56.Ø	TT BOO		LLX	F86			61	L MG	Heise, Dr. J.
84/Ø12	2Ø52..Ø12	2316	14 58 54	+47 28.Ø	HD133Ø29A		LLX	F125			83	L MG	Ferrari, Dr. A.
84/Ø89	Ø4Ø1..Ø89	Ø647	14 58 54	+47 28.Ø	HD133Ø29A		LLX	F125			83	L MG	Ferrari, Dr. A.
84/Ø88	1849..Ø88	2248	15 Ø1 17	+66 23.9	H15Ø4+65		MIS	F15			226	L MG	White, Dr. N.
84/Ø74	Ø31Ø..Ø74	Ø4ØØ	15 1Ø 11	+7Ø 57.1	151Ø+7Ø		EXG	F8			29	L MG	Miller, Dr. L.
84/128	1748..128	21ØØ	15 1Ø 11	+7Ø 57.1	151Ø+7Ø		EXG	F8			29	L MG	Miller, Dr. L.
83/229	2144..23Ø	Ø714	15 14 45	-24 11.3	1514-241		AGN	F25	11		Ø	LKMG	
84/Ø36	14Ø2..Ø36	1617	15 24 1Ø	+43 51.9	PG1524+438		LLX	F132			36	L MG	Mason, Dr. K.O.
83/365	1255..365	1448	15 34 45	+58 4.Ø	MKN29Ø		AGN	G15	11	*	66	L MG	De Korte, Dr. P.A.J.
84/Ø54	Ø714..Ø54	1622	15 38 31	+14 57.4	1538+149		AGN	F25			88	L MG	Maccagni, Dr. D.
84/Ø77	Ø922..Ø77	19ØØ	15 38 39	-52 13.5	4U1538-52		HLX	F59			5	L MG	Molteni, Dr. D.
84/Ø48	14Ø5..Ø48	1659	15 43 34	-47 3Ø.9	4U1543-47	+	TOO		11		Ø	L	
83/24Ø	Ø521..24Ø	Ø724	15 43 49	-47 33.5	1543-475		TOO				Ø	LKMG	
84/145	1753..145	2333	15 5Ø 35	+19 4.9	PG155Ø+191		LLX	F47			72	L MG	King, Dr. A.R.
84/Ø52	1Ø39..Ø52	1632	15 52 54	+19 2Ø.3	MKN291		AGN	G15			66	L	De Korte, Dr. P.A.J.
84/Ø58	1558..Ø58	21ØØ	15 52 54	+19 2Ø.3	MKN 291		AGN	G15			66	L MG	De Korte, Dr. P.A.J.
84/Ø92	ØØØØ..Ø92	Ø45Ø	15 52 55	+19 19.9	MKN291		AGN	G15			66	L MG	De Korte, Dr. P.A.J.
83/213	Ø24Ø..213	172Ø	15 53 5Ø	-19 42.Ø	JUPITER		MIS-F1				6	LKMG	Schnopper, Prof. H.W.
84/Ø73	23Ø4..Ø74	ØØ34	15 56 51	+Ø8 .5	H1557+Ø8		MIS	F16			226	L MG	White, Dr. N.
84/Ø51	1644..Ø51	2249	15 58 56	+16 5.Ø	A2147		CLU	G2			2	L	Morini, Dr. M.
84/Ø93	1Ø59..Ø93	16ØØ	15 58 56	+16 5.Ø	A2147		CLU	G2			2	L MG	Morini, Dr. M.
84/Ø52	ØØ22..Ø52	Ø324	16 Ø3 22	+17 56.1	MKN 29845		HLX	G17		*	35	L	Peacock, Dr. A.
83/254	1413..254	2121	16 Ø5 12	-38 58.3	HR 5999		LLX	F8	11		55	LKMG	Van Paradijs, Dr. J.
83/189	Ø758..189	1243	16 12 Ø9	+26 11.7	TON 256		PV				Ø	LKMG	
83/271	1119..272	1452	16 12 48	+33 59.Ø	D 143631		LLX	F91	11		84	LKMG	Brinkman, Dr. A.C.
84/Ø38	1432..Ø38	225Ø	16 13 48	+65 5Ø.Ø	MKN876 WITH SMC		AGN	F34			8	L MG	Pounds, Prof. K.A.
84/Ø67	Ø5Ø8..Ø67	1821	16 13 48	-5Ø 55.Ø	RCW1Ø3		SNR	F47			35	L MG	Peacock, Dr. A.

83/242	163Ø..242	1855	16 16 57	-15 26.9	SCO X-1	+	HLX G15	11	C	95 LKMG	Gronenschild, Dr. E.H.B.
83/219	1546..22Ø	Ø123	16 17 Ø4	-15 31.2	SCO X-1		PV		*	Ø LKMG	
83/241	222Ø..242	Ø43Ø	16 17 Ø4	-15 31.2	SCO X-1		HLX G15	11	*	95 LKMG	Gronenschild, Dr. E.H.B.
84/Ø71	Ø237..Ø71	Ø7Ø4	16 17 Ø4	-15 31.2	SCO X-1		HLX G15			Ø LKMG	
84/Ø73	ØØ48..Ø73	Ø232	16 17 Ø4	-15 31.2	SCO X-1		HLX G15		*	35 L MG	Peacock, Dr. A.
84/Ø73	Ø25Ø..Ø73	Ø444	16 17 Ø4	-15 3Ø.9	SCO X-1	+	HLX G15		C	35 L MG	Peacock, Dr. A.
83/242	Ø5Ø5..242	1ØØ1	16 17 Ø5	-15 29.2	SCO X-1	+	HLX G15	11	C	95 LKMG	Gronenschild, Dr. E.H.B.
83/242	1Ø35..242	16ØØ	16 17 Ø5	-15 27.2	SCO X-1	+	HLX G15	11	C	95 LKMG	Gronenschild, Dr. E.H.B.
83/22Ø	Ø839..22Ø	133Ø	16 17 23	-15 35.9	SCO X-1	+	PV		C	Ø LKMG	
83/22Ø	Ø15Ø..22Ø	Ø759	16 17 24	-15 25.9	SCO X-1		PV		C	Ø LKMG	
84/Ø58	23Ø6..Ø59	Ø525	16 2Ø 3Ø	+26 2.4	GR 275		LLX G2			61 L MG	Heise, Dr. J.
84/Ø53	1746..Ø53	1931	16 23 12	+Ø1 52.1	H1626+Ø1		MIS F16	11		226 L MG	White, Dr. N.
83/246	Ø655..247	ØØ41	16 24 ØØ	-24 2Ø.Ø	ROPH(C)		LLX F119	11		8Ø LKMG	Montmerle, Dr. T.
84/Ø65	1232..Ø65	1749	16 24 18	-49 5.3	4U1624-49		HLX F51			57 L MG	Watson, Dr. M.G.
84/Ø99	1527..Ø99	1822	16 26 46	+Ø1 35.5	H1626+Ø1		MIS F16			226 L MG	White, Dr. N.
83/242	2113..243	Ø5Ø5	16 27 14	-67 21.2	4U1626-67		HLX G2			36 KMG	Mason, Dr. K.O.
84/1Ø2	Ø825..1Ø2	1442	16 3Ø 11	-47 16.2	163Ø-47		TOO			Ø L MG	
84/131	Ø15Ø..131	Ø6ØØ	16 3Ø 16	-47 16.8	4U163Ø-47		TOO			Ø MG	
83/241	1738..241	1952	16 34 19	-57 22.2	HD 149499B		LLX G26			61 LKMG	Heise, Dr. J.
83/198	1757..199	Ø521	16 36 55	-53 39.2	2S1636-536		PV			Ø LKMG	
84/127	Ø124..127	2Ø14	16 36 56	-53 39.3	1636-53		HLX O46		C	25 L MG	Turner, Dr. M.J.L.
84/129	11Ø4..13Ø	1ØØØ	16 36 56	-53 39.9	4U 1636-53		TOO - AO			25 L MG	Turner, Dr. M.J.L.
84/Ø55	1Ø55..Ø55	1529	16 39 54	+36 33.Ø	M13A		LLX F44			71 L MG	Birkinshaw, Dr. M.
84/Ø59	Ø9Ø5..Ø59	1Ø3Ø	16 41 Ø5	+11 51.Ø	H1642+11		MIS F16			226 L MG	White, Dr. N.
83/224	2319..225	Ø235	16 48 3Ø	-59 7.9	NGC6221		PV			Ø LKMG	
84/Ø86	12ØØ..Ø86	143Ø	16 52 12	+39 5Ø.3	MKN5Ø1		AGN G19			21 L MG	Warwick, Dr. R.S.
84/Ø32	1744..Ø32	2137	16 52 13	+39 47.Ø	MKN5Ø1		AGN G19	11	C	21 L MG	Warwick, Dr. R.S.
84/Ø34	12Ø2..Ø34	1426	16 52 14	+39 47.Ø	MKN5Ø1		AGNG19+F	11	*	21 L MG	Warwick, Dr. R.S.
84/Ø36	1744..Ø36	2149	16 52 14	+39 46.9	MKN5Ø1		AGN G19	11	*	21 L MG	Warwick, Dr. R.S.
84/1Ø3	1716..1Ø3	2Ø16	16 52 49	-Ø7 57.2	E1652.7-Ø815		LLX F84		C	177 L MG	Cecchini, Dr.S.
84/13Ø	1331..13Ø	1633	16 56 Ø1	+35 25.Ø	HER X-1		HLX G13			99 L MG	Trumper, Prof. Dr. J.
84/163	1445..165	Ø547	16 56 Ø3	+35 24.8	HER X-1		HLX G13	13		99 L MG	Trumper, Prof. Dr. J.
84/Ø92	13Ø6..Ø92	143Ø	16 56 Ø4	+35 25.3	HER X-1		HLX G13		*	99 L MG	Trumper, Prof. Dr. J.
84/Ø92	16Ø2..Ø93	Ø721	16 56 Ø4	+35 25.3	HER X-1		HLX G13		C	99 L MG	Trumper, Prof. Dr. J.
84/Ø96	Ø338..Ø96	1824	16 56 Ø4	+35 25.Ø	HER X-1		HLX G13			99 L MG	Trumper, Prof. Dr. J.
84/Ø92	Ø741..Ø92	1Ø5Ø	16 58 25	+44 4.6	H1658+44		MIS F16			226 L MG	White, Dr. N.
83/215	Ø457..215	1347	16 58 54	-29 52.4	H1658-298		PV			Ø LKMG	
84/Ø57	Ø6ØØ..Ø57	Ø749	16 59 ØØ	+44 28.2	H1659+44		MIS F16			226 L MG	White, Dr. N.
84/125	Ø432..125	1Ø15	16 59 Ø1	-48 43.5	GX339-4		HLX F17			93 L MG	Ilovaisky, Dr S.A.
83/198	Ø141..198	Ø8Ø1	16 59 Ø2	-48 43.1	GX339-4		PV			Ø LKMG	
84/Ø72	1ØØ6..Ø72	16Ø3	16 59 Ø2	-48 43.1	GX339-4		HLX F17			93 L MG	Ilovaisky, Dr S.A.
83/261	Ø4Ø2..261	Ø645	16 59 12	+29 29.Ø	MKN5Ø4		AGN G15	11		24 KMG	Bleeker, Dr. J.A.M.
84/122	151Ø..122	16Ø2	17 ØØ 31	-37 46.Ø	4U17ØØ-37		HLX G27			96 L	Brinkmann, Dr. W.
83/213	19Ø4..214	1515	17 Ø2 24	-36 21.3	17Ø2-363		PV			Ø LKMG	
83/211	1229..211	2ØØ4	17 Ø2 4Ø	-42 57.9	2S17Ø2-429		PV			Ø LKMG	
83/211	Ø25Ø..211	111Ø	17 Ø5 18	-44 2.2	2S17Ø5-44Ø		PV			Ø LKMG	
83/254	2245..255	ØØ16	17 Ø5 4Ø	-32 13.2	4U17Ø5-32		HLX F42			55 LKMG	Van Paradijs, Dr. J.
83/174	2Ø52..175	Ø539	17 Ø5 43	+Ø4 43.9	N POLAR SPUR		PV			Ø LKMG	
84/Ø77	Ø2Ø5..Ø77	Ø73Ø	17 12 18	-66 53.6	HD155555		LLX F48			73 L MG	Barstow, Dr. M.A.
84/Ø57	Ø837..Ø58	1344	17 15 ØØ	+5Ø 13.Ø	HER 1/2		CLU G3			3 L MG	McKechnie, Dr. S.P.

83/254	113Ø..254	1251	17 15 Ø7	-39 19.2	4U1715-39		HLX	F42			55	KMG	Van Paradijs, Dr. J.
84/1Ø8	Ø532..1Ø8	Ø8Ø2	17 17 Ø3	+41 18.8	PG1717+413		LLX	F132			36	L MG	Mason, Dr. K.O.
83/238	2335..239	Ø3Ø5	17 2Ø 42	+3Ø 55.9	MKN5Ø6		AGN	G15			24	LKMG	Bleeker, Dr. J.A.M.
84/Ø81	211Ø..Ø82	Ø238	17 21 11	-56 19.9	GAMMA GEM		CAL				Ø		
84/Ø63	Ø814..Ø63	2Ø4Ø	17 27 Ø4	+5Ø 15.5	I ZW 186		AGN	G18			88	L MG	Maccagni, Dr. D.
83/214	193Ø..215	Ø3Ø7	17 28 4Ø	-33 47.8	2S1728-337		PV				Ø	LKMG	
83/27Ø	ØØ14..27Ø	1817	17 28 49	-16 55.5	4U1728-16		HLX	F16	11		43	LKMG	Charles, Dr. P.A.
83/267	14ØØ..268	Ø156	17 28 58	-24 42.7	GX1+4		HLX	G21	11		54	LKMG	Hall, Dr. R.
83/226	1952..226	222Ø	17 3Ø Ø6	-33 21.2	173Ø-333		TOO			*	Ø	LKMG	
83/219	1128..219	133Ø	17 3Ø Ø7	-33 21.2	173Ø-333		PV				Ø	LKMG	
83/227	1452..227	19ØØ	17 3Ø Ø7	-33 21.2	173Ø-333	+	TOO			C	Ø	LKMG	
83/227	ØØ2Ø..227	14Ø1	17 31 36	-32 54.Ø	173Ø-333	+	TOO			C	Ø	LKMG	
84/Ø76	1324..Ø76	1542	17 33 43	-42 58.Ø	HD 159532		LLX	F48			73	L MG	Barstow, Dr. M.A.
83/265	Ø947..265	13Ø7	17 36 59	-3Ø 57.Ø	G357.7-Ø.1		SNR	F3	11		39	LKMG	Aschenbach, Dr. B.
84/1Ø6	1525..1Ø6	184Ø	17 36 59	-3Ø 57.Ø	G357.7-Ø.1		TOO				39	L MG	Aschenbach, Dr. B.
84/Ø81	1355..Ø81	19Ø9	17 43 26	-28 3Ø.4	4U1743-28		TOO				99	M	Trumper, Prof. Dr. J.
84/Ø8Ø	195Ø..Ø8Ø	2149	17 44 Ø5	-4Ø 6.5	HD 161471		LLX	F3			64	L MG	Zwaan, Dr. C.
83/266	13Ø2..266	2341	17 44 49	-26 32.8	4U1744-26		HLX	G16	11		53	M	D'Amico, Dr. N.
83/258	2346..259	Ø716	17 48 53	+7Ø 52.7	GR 372		LLX	G24	11		61	LKMG	Heise, Dr. J.
83/26Ø	2238..261	Ø156	17 54 23	+Ø4 59.5	V 566 OPH		LLX	F97			61	KMG	Heise, Dr. J.
83/219	Ø113..219	1ØØ6	17 55 21	-33 48.2	2S1755-338		PV				Ø	LKMG	
83/257	17Ø3..257	1857	17 58 Ø3	-25 4.6	GX5-1		HLX	G9		*	56	LKMG	Pietsch, Dr. W.
83/175	2227..176	Ø455	17 58 21	-2Ø 31.9	1758-2Ø5		PV				Ø	LKMG	
83/296	1621..297	Ø3Ø4	18 Ø2 Ø9	+78 25.7	18Ø3+78		AGN	F24			9	LKMG	Biermann, Prof. Dr. P.
83/281	1439..281	21Ø5	18 Ø3 38	+78 27.9	18Ø3+78		AGN	F24			9	LKMG	Biermann, Prof. Dr. P.
83/251	ØØ2Ø..251	Ø738	18 Ø3 39	+78 27.9	18Ø3+78		AGN	F24	11		9	LKMG	Biermann, Prof. Dr. P.
83/266	Ø311..266	1112	18 Ø3 39	+78 27.9	18Ø3+78		AGN	F24			9	LKMG	Biermann, Prof. Dr. P.
83/2ØØ	2157..2Ø2	Ø225	18 Ø9 53	+31 23.5	DEEP FIELD		PV				Ø	LKMG	
84/11Ø	2122..111	Ø15Ø	18 1Ø 17	-64 49.9	ESO1Ø3-G35		AGN	F34			8	L MG	Pounds, Prof. K.A.
83/265	2Ø39..265	2342	18 11 37	-17 1Ø.2	GX13+1		HLX	G26			1Ø4	LKMG	Taylor, Dr. B.
83/261	1241..261	14Ø6	18 12 26	-12 7.8	4U1812-12		HLX	F42		C	55	KMG	Van Paradijs, Dr. J.
83/215	154Ø..216	ØØ42	18 13 11	-14 3.2	GX 17+2		PV				Ø	LKMG	
84/151	22Ø2..152	Ø54Ø	18 14 58	+49 5Ø.4	AM HER		HLX	Ø62			61	L MG	Heise, Dr. J.
83/258	Ø747..258	Ø918	18 15 Ø8	+5Ø .9	3U18Ø9+5Ø		LLX	F93		*	61	LKMG	Heise, Dr. J.
83/258	1ØØ4..258	1624	18 15 Ø8	+49 3Ø.9	3U18Ø9+5Ø	+	LLX	F93		C	61	LKMG	Heise, Dr. J.
84/Ø73	Ø655..Ø73	Ø814	18 17 48	-29 51.Ø	HD 168454		LLX	G11	11	*	64	L MG	Zwaan, Dr. C.
83/28Ø	1516..28Ø	2Ø5Ø	18 22 22	-37 8.Ø	1822-371		HLX	G3	11	*	36	LKMG	Mason, Dr. K.O.
83/217	ØØØ9..217	Ø752	18 22 49	-ØØ 2.4	4U 1822-ØØ		PV				Ø	LKMG	
83/274	Ø313..274	Ø64Ø	18 3Ø 47	-1Ø 36.9	G21.5-Ø.9		SNR	F-2			Ø	LKMG	
83/275	ØØ11..275	Ø151	18 31 22	-1Ø 35.1	G21.5-Ø.9+ZDRIFT		SNR	F2			Ø	MG	
84/Ø97	131Ø..Ø97	1328	18 33 Ø9	+32 38.8	3C382		AGN	G8+			2Ø	M	Perryman, Dr. M.A.C.
84/13Ø	1924..13Ø	2258	18 33 12	+32 39.2	3C 382		AGN	G8+			2Ø	L MG	Perryman, Dr. M.A.C.
84/11Ø	1Ø52..11Ø	2Ø3Ø	18 33 17	-65 28.6	ESO1Ø3-G35		AGN	F34			8	L MG	Pounds, Prof. K.A.
83/247	17Ø1..248	Ø6ØØ	18 33 22	-65 28.2	ESO1Ø3-G35		AGN	F34			8	KMG	Pounds, Prof. K.A.
84/Ø87	Ø459..Ø87	Ø732	18 34 48	-63 49.5	PKS1934-63		EXG	F36		*	35	L MG	Peacock, Dr. A.
83/176	Ø8Ø1..176	124Ø	18 35 Ø2	+38 44.1	VEGA		PV				Ø	LKMG	
83/175	Ø933..175	184Ø	18 37 3Ø	+Ø4 59.3	1837+Ø49		PV				Ø	LKMG	
84/132	1549..132	2129	18 42 4Ø	+37 56.8	AY LYR	+	LLX	G12		C	61	L MG	Heise, Dr. J.
84/134	1118..134	1229	18 42 4Ø	+37 56.8	AY LYR		LLX	G12			61	L MG	Heise, Dr. J.
84/135	1348..135	1512	18 42 4Ø	+37 56.8	AY LYR		LLX	G12			61	L MG	Heise, Dr. J.
84/132	1244..132	15Ø3	18 42 41	+39 33.4	AY LYR		LLX	G12	19	*	61	L MG	Heise, Dr. J.
84/143	19Ø9..143	2Ø23	18 42 41	+37 56.2	AY LYR		LLX	G12			61	L MG	Heise, Dr. J.

84/146	1715..146 233Ø	18 42 41	+37 56.2	AY LYR	LLX G12			61	L MG	Heise, Dr. J.
84/128	225Ø..129 Ø644	18 42 43	+39 33.5	AY LYR	TOO			61	L MG	Heise, Dr. J.
84/153	Ø7Ø4..153 14Ø4	18 45 37	+79 42.6	3C 39Ø.3	TOO	11		Ø	L MG	
83/284	165Ø..285 ØØØ4	18 52 Ø2	-31 17.8	V 1223 SGR	LLX G16	11	C	Ø	LKMG	
84/11Ø	Ø629..11Ø Ø944	18 57 15	-65 53.7	ESO1Ø3-G35	AGN F34			8	L MG	Pounds, Prof. K.A.
84/1Ø6	Ø715..1Ø6 13Ø5	19 Ø6 31	+Ø4 59.8	W 5Ø	SNR F5			96	L MG	Brinkmann, Dr. W.
84/114	192Ø..114 2147	19 Ø7 15	+Ø9 44.6	4U19Ø7+Ø9	HLX F42			55	L MG	Van Paradijs, Dr. J.
84/151	16ØØ..151 1936	19 Ø7 15	+Ø9 44.9	A19Ø7+Ø9	HLX F-14			52	L MG	Page, Dr. C.G.
84/153	1636..153 1814	19 Ø7 15	+Ø9 44.9	A19Ø7+Ø9	HLX F14			52	L MG	Page, Dr. C.G.
84/155	Ø328..155 Ø444	19 Ø7 15	+Ø9 44.9	A19Ø7+Ø9	HLX F14			52	L MG	Page, Dr. C.G.
84/156	1825..156 1955	19 Ø7 15	+Ø9 44.9	A19Ø7+Ø9	HLX F14			52	L MG	Page, Dr. C.G.
84/158	Ø545..158 Ø71Ø	19 Ø7 15	+Ø9 44.9	4U19Ø7+Ø9	HLX F42			52	L MG	Page, Dr. C.G.
83/223	1549..224 Ø32Ø	19 Ø8 45	+Ø9 1.4	W 49B	PV			Ø	LKMG	
84/133	ØØØ2..133 15Ø5	19 Ø8 45	+Ø9 1.4	W49B	+ TOO CAL			42	L MG	Smith, Dr. A.
84/1ØØ	2ØØ8..1Ø1 Ø344	19 Ø8 58	+Ø5 14.4	W5Ø	SNR F5			84	L MG	Brinkman, Dr. A.C.
83/286	2239..287 1Ø59	19 Ø9 Ø2	+Ø4 52.Ø	SS433	HLX G1Ø	11		57	LKMG	Watson, Dr. M.G.
83/261	Ø913..261 1Ø24	19 Ø9 12	+Ø7 37.5	4U19Ø9+Ø7	HLX F42		*	55	KMG	Van Paradijs, Dr. J.
84/1Ø8	17Ø4..1Ø9 Ø535	19 Ø9 2Ø	+Ø4 54.Ø	SS433	HLX G1Ø			57	L MG	Watson, Dr. M.G.
83/288	Ø31Ø..288 1359	19 Ø9 32	+Ø4 52.Ø	SS433	HLX G1Ø	11		57	KMG	Watson, Dr. M.G.
83/289	Ø25Ø..289 1435	19 Ø9 32	+Ø4 52.Ø	SS433	HLX G1Ø	11		57	LKMG	Watson, Dr. M.G.
83/29Ø	Ø245..29Ø Ø337	19 Ø9 32	+Ø4 52.Ø	SS433	HLX G1Ø	11		57	K	Watson, Dr. M.G.
84/Ø99	12Ø7..Ø99 133Ø	19 14 51	-27 36.Ø	H1914-27	MIS F16			226	L MG	White, Dr. N.
83/26Ø	1258..26Ø 2Ø55	19 16 ØØ	-Ø5 19.8	XB1916-Ø5	HLX F3			36	KMG	Mason, Dr. K.O.
83/3Ø6	Ø328..3Ø6 Ø755	19 16 56	-58 45.8	ESO141-G55	AGN G7	11		1	L MG	Branduardi-Raymont, Dr.
83/247	1147..247 1519	19 16 57	-58 45.8	ESO141-G55	AGN G6-7		C	1	LKMG	Branduardi-Raymont, Dr.
84/115	Ø3Ø6..115 Ø6ØØ	19 25 59	+3Ø 59.9	GKP	SNR F23		C	43	L MG	Charles, Dr. P.A.
83/283	Ø352..283 1159	19 27 37	+73 51.2	1928+73	AGN F24			9	LKMG	Biermann, Prof. Dr. P.
83/316	2149..317 Ø527	19 28 49	+73 51.7	1928+73	AGN F24			9	L MG	Biermann, Prof. Dr. P.
83/344	Ø4Ø7..344 1129	19 28 49	+73 51.7	1928+73	AGN F24+			9	L MG	Biermann, Prof. Dr. P.
84/ØØ9	23ØØ..Ø1Ø Ø63Ø	19 28 49	+73 51.7	1928+73	AGN F24			9	L M	Biermann, Prof. Dr. P.
83/3Ø6	2213..3Ø6 2349	19 3Ø 53	-1Ø 27.Ø	NGC 6814	AGN G6	11	*	1	L MG	Branduardi-Raymont, Dr.
84/115	1117..115 1355	19 31 ØØ	+31 59.7	GKP	SNR F23		C	43	L MG	Charles, Dr. P.A.
84/114	2319..115 Ø213	19 32 ØØ	+29 59.7	GKP	SNR F23		*	43	L MG	Charles, Dr. P.A.
84/115	Ø654..115 1Ø2Ø	19 34 ØØ	+3Ø 59.7	GKP	SNR F23		C	43	L MG	Charles, Dr. P.A.
84/115	15Ø5..115 184Ø	19 35 ØØ	+31 59.7	GKP	SNR F23	11	C	43	L MG	Charles, Dr. P.A.
84/144	2338..145 Ø135	19 36 42	+3Ø 23.5	EM CYG	LLX 612			61	L MG	Heise, Dr. J.
84/152	1421..152 1845	19 37 28	+21 28.Ø	PSR1937+214	PV			Ø	L MG	
83/19Ø	1854..192 ØØ42	19 37 29	+21 28.4	PSR1937+214	PV			Ø	LKMG	
84/127	2244..128 Ø22Ø	19 39 2Ø	+45 24.Ø	HD 186155	LLX G11			64	L MG	Zwaan, Dr. C.
84/114	Ø848..114 18ØØ	19 39 41	+16 37.3	HM SGE	LLX F74			77	L MG	Allen, Dr. D.A.
83/3Ø7	ØØ43..3Ø7 Ø53Ø	19 39 53	-1Ø 27.Ø	NGC 6814	AGN G6	11	C	1	L MG	Branduardi-Raymont, Dr.
83/247	Ø313..247 Ø9Ø4	19 39 54	-1Ø 26.9	NGC6814	AGN G6-7		*	1	LKMG	Branduardi-Raymont, Dr.
84/152	2135..153 Ø435	19 39 54	-1Ø 26.9	NGC6814	AGN ØØ1			1	L MG	Branduardi-Raymont, Dr.
84/114	ØØ31..114 Ø7Ø7	19 48 21	+Ø8 44.6	HD187642	CAL			Ø	L MG	
84/124	2225..125 Ø159	19 48 31	-4Ø 1.3	HD187474	LLX F125			83	L MG	Ferrari, Dr. A.
83/17Ø	2Ø22..17Ø 2238	19 52 29	+35 3.9	CYGNUS X-1	PV		*	Ø	LKMG	
83/279	Ø2Ø5..279 Ø945	19 52 4Ø	+32 13.6	EY CYGNI	LLX G8			63	LKMG	Beuermann, Dr. K.
83/295	22Ø9..296 Ø124	19 53 38	+31 57.6	3A1954+319	MIS F29			21	LKMG	Warwick, Dr. R.S.
83/17Ø	2348..171 Ø8Ø2	19 54 29	+35 3.9	CYGNUS X-1 -3Ø'	PV		C	Ø	LKMG	
83/171	Ø9Ø9..171 163Ø	19 55 29	+35 3.9	CYGNUS X-1 -15'	PV		C	Ø	LKMG	

83/171	1739..172 1337	19	56	17	+35	3.9	CYGNUS X-1 -3'		PV			C	Ø	LKMG	
83/173	Ø556..173 Ø73Ø	19	56	17	+35	3.9	CYGNUS X -1 -3'		PV			C	Ø	LKMG	
84/142	Ø45Ø..142 1321	19	56	26	+35	3.7	CYGNUS X-1		HLX	G-8			52	L MG	Page, Dr. C.G.
83/268	Ø415..268 Ø956	19	56	28	+35	3.9	CYG X-1		HLX	G11			52	KMG	Page, Dr. C.G.
83/2Ø9	1841..21Ø Ø338	19	56	29	+35	3.9	CYG X-1		PV				Ø	LKMG	
83/239	Ø426..239 1126	19	57	Ø2	+11	34.2	2S1957+115		HLX	F29			98	KMG	Pakull, Dr. M.
83/3Ø8	Ø425..3Ø8 Ø54Ø	19	57	25	+22	34.7	NGC 6853		LLX	F37	11		Ø	L MG	
83/2Ø9	1613..2Ø9 1728	19	58	3Ø	+35	7.7	CYG X-1 (OFFSET)		PV				Ø	LKMG	
84/125	122Ø..125 1611	2Ø	ØØ	21	-55	52.4	RR TEL		LLX	G1			6Ø	L MG	Cassatella, Dr. A.
83/285	Ø258..285 Ø914	2Ø	Ø3	Ø9	+22	31.6	H2ØØ3+22		LLX	F15		C	22	LKMG	Maraschi, Dr. L.
83/216	1551..216 2125	2Ø	Ø5	2Ø	+17	33.5	WZ SGE		PV				Ø	LKMG	
83/353	1234..353 1536	2Ø	1Ø	17	+38	12.2	NGC 6888		LLX	F73	11		76	L MG	Wendker, Prof. Dr. H.J.
83/354	Ø73Ø..355 ØØ45	2Ø	1Ø	17	+38	12.2	NGC 6888		LLX	F73	11		76	L MG	Wendker, Prof. Dr. H.J.
84/156	222Ø..157 2317	2Ø	1Ø	17	+38	12.4	NGC 6888		LLX	F73			76	L MG	Wendker, Prof. Dr. H.J.
83/235	1145..235 17Ø9	2Ø	14	48	-57	43.Ø	FA 71		AGN	F54		C	17	LKMG	Fricke, Prof. Dr. K.J.
84/138	Ø634..138 18Ø8	2Ø	15	1Ø	+37	15.7	HD 193Ø77		LLX	F1Ø			68	L MG	Pollock, Dr. A.M.T.
84/14Ø	1158..14Ø 18Ø1	2Ø	18	44	+43	41.5	HD 193793		LLX	F1Ø			68	L MG	Pollock, Dr. A.M.T.
84/142	1443..142 2136	2Ø	3Ø	35	+4Ø	47.1	4U2Ø3Ø+4Ø		HLX	F24			58	MG	Van der Klis, Dr. M.
84/ØØ3	13Ø5..ØØ3 1726	2Ø	3Ø	38	+4Ø	47.2	4U2Ø3Ø+4Ø		HLX	F24	11		58	MG	Van der Klis, Dr. M.
84/163	Ø117..163 1225	2Ø	3Ø	38	+4Ø	47.3	CYGNUS X-3	+	HLX	Ø37			162	L MG	Willingale, R.
84/168	ØØ55..168 1324	2Ø	3Ø	38	+4Ø	47.3	CYGNUS X-3	+	HLX	Ø37			162	L MG	Willingale, R.
84/165	Ø9ØØ..165 1522	2Ø	3Ø	39	+4Ø	47.Ø	CYGNUS X-3		HLX	Ø37			162	L MG	Willingale, R.
83/296	Ø8Ø8..296 14Ø6	2Ø	32	37	+18	5Ø.3	GR 288		LLX	G24			61	LKMG	Heise, Dr. J.
83/251	2Ø45..251 221Ø	2Ø	38	Ø3	+75	24.8	VW CEP		LLX	F97			61	LKMG	Heise, Dr. J.
83/252	Ø957..252 111Ø	2Ø	38	Ø3	+75	24.8	VWCEP		LLX	F97			61	LKMG	Heise, Dr. J.
84/Ø79	191Ø..Ø8Ø Ø3ØØ	2Ø	38	Ø3	+75	24.9	VW CEP		LLX	F86	11		61	L MG	Heise, Dr. J.
83/283	1434..283 1745	2Ø	41	12	-1Ø	5Ø.5	MK5Ø9		AGN	G5			5	LKMG	Molteni, Dr. D.
83/295	12Ø9..295 1416	2Ø	41	12	-1Ø	5Ø.5	MK5Ø9		AGN	G5			5	KMG	Molteni, Dr. D.
83/3Ø7	Ø724..3Ø7 1139	2Ø	41	26	-1Ø	54.2	MK5Ø9		AGN	G5			5	L MG	Molteni, Dr. D.
84/125	182Ø..125 2347	2Ø	45	Ø7	-Ø5	13.Ø	HD 198Ø26		LLX	F12Ø			81	L MG	Bedford, Dr. D.K.
84/145	Ø732..145 1421	2Ø	47	24	+31	43.3	CYGNUS LOOP		SNR	F24			41	L MG	Arnaud, Dr. M.
84/138	1916..139 Ø3Ø2	2Ø	47	25	+31	38.6	NGC 6964		SNR	F17	11		24	L MG	Bleeker, Dr. J.A.M.
84/16Ø	Ø225..16Ø Ø514	2Ø	48	1Ø	+29	13.Ø	IE2Ø48+292		SNR	Ø31			43	L MG	Charles, Dr. P.A.
84/172	1528..173 Ø3ØØ	2Ø	5Ø	5Ø	+55	9.6	DA 53Ø		SNR	ØØ3			Ø	L MG	
83/317	Ø716..317 1Ø38	2Ø	56	ØØ	+49	19.8	3A2Ø56+493		MIS	F23			21	L MG	Warwick, Dr. R.S.
83/337	1959..337 2325	21	Ø9	28	-Ø9	1.9	21Ø9-Ø9		TOO		11		Ø	L MG	
84/159	1559..159 1755	21	22	41	+55	51.4	H2126+56	+	LLX	F52	11	C	74	L MG	Pringle, Dr. J.E.
84/159	1147..159 15Ø5	21	26	Ø1	+56	.2	H2126+56		LLX	F52	11	*	74	L MG	Pringle, Dr. J.E.
84/134	1458..135 Ø23Ø	21	26	25	-15	51.8	PKS2126-158		AGN	F1			7	L MG	Stewart, Dr. G.C.
83/272	2Ø2Ø..272 2334	21	29	35	+47	4.1	4U2129+47		HLX	F43			56	LKMG	Pietsch, Dr. W.
83/277	1957..278 Ø53Ø	21	29	35	+47	4.1	4U2129+47		HLX	F43			56	LKMG	Pietsch, Dr. W.
84/14Ø	2Ø44..141 Ø3Ø5	21	34	58	-14	46.4	PKS2135-147		AGN	F21			16	L MG	Bergeron, Dr. J.
84/133	1732..134 ØØ41	21	34	59	-14	46.3	PHL1657		AGN	F1			7	L MG	Stewart, Dr. G.C.
83/315	Ø642..315 Ø756	21	4Ø	44	+43	21.3	SS CYGNI		HLX	G12			57	L MG	Watson, Dr. M.G.
83/338	Ø149..338 Ø825	21	4Ø	44	+43	21.3	SS CYGNI		HLX	G12			57	L MG	Watson, Dr. M.G.
84/179	ØØØ5..179 Ø43Ø	21	4Ø	44	+43	21.3	SS CYG	+	HLX	G12			57	L MG	Watson, Dr. M.G.
83/329	1422..329 1926	21	41	13	+17	29.8	OX169		AGN	G9			2Ø	L MG	Perryman, Dr. M.A.C.
83/33Ø	12Ø9..33Ø 17Ø8	21	41	13	+17	29.8	OX169		AGN	G9			2Ø	L MG	Perryman, Dr. M.A.C.
83/331	1847..331 2319	21	41	13	+17	29.8	OX 169		AGN	G9	11		2Ø	L MG	Perryman, Dr. M.A.C.
84/145	Ø4Ø1..145 Ø543	21	42	Ø6	+14	31.9	HD 2Ø686Ø		LLX	F7Ø	11		75	L MG	Pallavicini, Dr. R.
83/256	225Ø..257 Ø117	21	42	37	+38	5.4	CYG X-2		HLX	G14		C	85	LKMG	Treves, Dr. A.
83/258	192Ø..258 2124	21	42	37	+38	5.4	CYG X-2		HLX	G14			85	LKMG	Treves, Dr. A.

83/261	1625..261	1821	21 42 37	+38 5.4	CYG X-2	HLX G14			85 KMG	Treves, Dr. A.
83/263	2334..264	ØØ44	21 42 37	+38 5.4	CYG X-2	HLX G14+			85 LKMG	Treves, Dr. A.
83/265	1612..265	1829	21 42 37	+38 5.4	CYG X-2	HLX G14			85 LKMG	Treves, Dr. A.
83/186	1ØØ5..187	Ø426	21 45 2Ø	+37 37.8	CYG X-2 RASTER	PV	21	*	Ø LKMG	
83/187	Ø534..187	Ø759	21 46 5Ø	+36 56.1	CYG X-2	PV		C	Ø LKMG	
83/3Ø4	ØØ44..3Ø4	1611	21 55 58	-3Ø 27.8	PKS2155-3Ø4	AGN G18			88 L MG	Maccagni, Dr. D.
83/333	1846..333	2137	21 55 58	-3Ø 27.8	PKS2155-3Ø4	AGN G18	11		88 L MG	Maccagni, Dr. D.
83/261	2Ø46..261	225Ø	22 ØØ 13	+82 37.8	HD 2Ø9943	LLX F97			61 KMG	Heise, Dr. J.
83/341	Ø811..341	1723	22 ØØ 39	+42 2.1	22ØØ+42Ø	AGN F25			88 L MG	Maccagni, Dr. D.
83/22Ø	1555..22Ø	19ØØ	22 Ø6 Ø8	+54 16.3	2A 22Ø6+542	PV			Ø LKMG	
83/31Ø	Ø258..31Ø	Ø649	22 Ø6 14	-47 25.Ø	NGC7213	AGN F34+		*	8 L MG	Pounds, Prof. K.A.
84/146	1Ø39..146	143Ø	22 Ø8 42	-13 43.5	22Ø8-137	AGN F13			9 L MG	Biermann, Prof. Dr. P.
83/32Ø	2317..321	Ø159	22 11 36	+12 27.1	RU PEG	LLX G9			63 L MG	Beuermann, Dr. K.
83/284	Ø411..284	Ø944	22 15 21	-Ø8 31.6	H225-Ø86	LLX F15		*	22 LKMG	Maraschi, Dr. L.
83/222	1Ø54..222	1445	22 15 29	-Ø8 4Ø.2	H 2215-Ø86	PV			Ø LKMG	
83/22Ø	2132..221	ØØ31	22 21 15	-Ø2 21.4	3C445	PV			Ø LKMG	
84/159	Ø23Ø..159	Ø929	22 21 15	-Ø2 21.2	3C 445	AGN Ø36			8 L MG	Pounds, Prof. K.A.
84/152	Ø8Ø7..152	1119	22 23 Ø8	-Ø5 12.7	2223-Ø52	AGN Ø85			19 L MG	McHardy, Dr. I.
83/336	1448..336	1825	22 23 1Ø	-Ø5 12.3	2223-Ø5	AGN F3	11	C	19 L MG	McHardy, Dr. I.
83/34Ø	15ØØ..34Ø	1842	22 23 1Ø	-Ø5 12.3	2223-Ø5	AGN F26	11		12 L MG	Willmore, Prof. A.P.
83/343	1452..343	182Ø	22 23 1Ø	-Ø5 12.3	2223-Ø5	AGN F3	11	C	19 L MG	McHardy, Dr. I.
83/345	16Ø6..345	1849	22 23 1Ø	-Ø5 12.3	2223-Ø5	AGN F3	11	C	19 L MG	McHardy, Dr. I.
84/146	Ø629..146	Ø912	22 23 5Ø	-17 .4	HD 212697	LLX F7Ø			75 L MG	Pallavicini, Dr. R.
83/327	2152..328	1154	22 25 54	-Ø5 34.2	PHL52ØØ	AGN F19			6 L MG	Schnopper, Prof. H.W.
83/326	Ø143..326	Ø41Ø	22 26 55	-21 5.6	NGC 7293	LLX F37			Ø L MG	
83/268	122Ø..268	1521	22 29 59	+63 51.6	TYCHO SNR	SNR G-1		*	Ø LKMG	
83/248	185Ø..248	2249	22 33 Ø1	-26 18.Ø	NGC7314	AGN F34+		*	8 LKMG	Pounds, Prof. K.A.
83/311	Ø356..311	Ø55Ø	22 4Ø 12	-Ø4 3Ø.Ø	PHL 38Ø	LLX G26			61 L MG	Heise, Dr. J.
83/288	2147..289	ØØ43	22 51 21	-17 46.Ø	MR2251-179	AGN F4			8 KMG	Pounds, Prof. K.A.
83/3ØØ	1545..3ØØ	212Ø	22 51 21	-17 46.Ø	MR2251-179	AGN F4			8 LKMG	Pounds, Prof. K.A.
83/279	13Ø9..28Ø	1315	22 51 25	-17 5Ø.9	MR2251	AGN F4			Ø LKMG	
83/31Ø	1825..31Ø	2Ø24	22 51 26	-17 5Ø.9	MR2251-179	AGN F34+		C	8 L MG	Pounds, Prof. K.A.
83/321	Ø42Ø..321	Ø553	22 51 26	-17 5Ø.9	MR2251-179	AGN F4			8 L MG	Pounds, Prof. K.A.
83/331	1445..331	1715	22 51 26	-17 5Ø.9	MR2251-179	AGN F4+			8 L MG	Pounds, Prof. K.A.
83/332	Ø949..332	1544	22 51 26	-17 5Ø.9	MR2251-178	AGN F1			7 L MG	Stewart, Dr. G.C.
83/343	Ø525..343	Ø64Ø	22 51 26	-17 5Ø.9	MR2251-179	AGN F4	11		8 L MG	Pounds, Prof. K.A.
83/352	Ø72Ø..352	Ø929	22 51 26	-17 5Ø.9	MR2251-179	AGN F4	11		8 L MG	Pounds, Prof. K.A.
83/361	192Ø..361	2Ø52	22 51 26	-17 5Ø.9	MR2251-179	AGN F4+	11		8 L MG	Pounds, Prof. K.A.
83/257	214Ø..258	Ø459	22 52 43	-Ø3 26.6	H2252-Ø35	LLX F137		C	56 LKMG	Pietsch, Dr. W.
83/26Ø	Ø424..26Ø	1Ø41	22 52 43	-Ø3 26.6	H2252-Ø35	LLX F137			56 KMG	Pietsch, Dr. W.
83/3Ø9	1148..3Ø9	1452	23 ØØ 44	+Ø8 36.3	NGC7469	AGN F34		C	8 L MG	Pounds, Prof. K.A.
83/31Ø	2249..311	Ø212	23 Ø2 Ø7	-Ø8 57.3	MCG2-58-22	AGN F34+		C	8 L MG	Pounds, Prof. K.A.
83/326	Ø6ØØ..326	Ø71Ø	23 Ø9 48	+1Ø 31.Ø	BPM 97859	LLX G26			61 L MG	Heise, Dr. J.
84/161	1525..161	1935	23 11 16	-42 59.8	SERSIC159-Ø3	EXG F38		C	27 L MG	Pye, Dr. J.P.
84/161	1Ø27..161	14ØØ	23 15 31	-42 37.8	NGC 7582	EXG F38		*	27 L MG	Pye, Dr. J.P.
84/173	2343..174	Ø532	23 17 59	+16 56.8	III ZW 1Ø2	AGN 119			117 L MG	Loose, H. H.
84/171	Ø349..171	Ø816	23 21 23	+16 32.6	A 2589	CLU Ø12	11		3 L MG	McKechnie, Dr. S.P.
83/339	19Ø3..339	2Ø54	23 35 Ø5	+46 11.2	LAMDA AND	LLX F5			95 L MG	Gronenschild, Dr. E.H.B.
84/ØØ8	Ø555..ØØ8	1226	23 35 Ø6	+46 11.2	LAMDA AND	LLX F5			95 L M	Gronenschild, Dr. E.H.B.
83/3Ø9	1829..3Ø9	2Ø41	23 53 29	+Ø7 15.4	AFTER A SLEW	+ AGN F34		C	8 L MG	Pounds, Prof. K.A.
84/Ø39	2239..Ø4Ø	Ø132	23 53 58	+81 36.1	2353+81	EXG F1Ø			3Ø L MG	Witzel, Dr. A.
84/ØØ2	1319..ØØ2	1722	23 58 12	+44 58.Ø	HD224801	LLX F125			83 L MG	Ferrari, Dr. A.

OBSERVATORY TEAM

		Ext.
David Andrews	Observatory Manager	705*
Julian Sternberg	Observatory Software	703
Julian Lewis	System Software/HP Computers	702
Nick White	Senior Observatory Scientist	764
Paul Barr	Duty Scientist/Mission Planning	711
Paolo Giommi	"	710
Manfred Gottwald	"	758
Ed Gronenschild	"	712
Julian Osborne	"	714
Arvind Parmar	"	763
Luigi Stella	"	715
Anne Fahey	Mission Planning	707
Paolo Ferri	Observatory Controller	427
Maria Gonano	" "	427
Frank Haberl	" "	717
Geoff Mellor	" "	716
Antonella Nota	" "	717
Mark Sweeney	" "	716
Susanne Ernst	Data Assistant	713
Margit Farkas	" "	709
Grazia Giommi	" "	709
Sandra Andrews	Secretary	704

*Direct dialling to any extension, prefixed by 886, is possible, eg. 06151-886-705

Personnel Changes (1.5.85 - 30.6.85)

Dr E. Gronenschild has been recruited as a Duty Scientist.

Linda Osborne has resigned her position as Data Assistant.

IAU SYMPOSIUM NO. 125:

"THE ORIGIN AND EVOLUTION OF NEUTRON STARS"

The first IAU meeting to be held in the Peoples Republic of China, Symposium No. 125 on the "Origin and Evolution of Neutron Stars", is scheduled for 26-30 May 1986 in Nanjing, the capital city of Jiangsu Province. Nanjing University will host the meeting with Professor Q.Y. Qu and Professor T. Lu serving as Co-Chairmen of the Local Organising Committee. Professor D.J. Helfand (Columbia University) and Professor S.G. Wang (Beijing Observatory) co-chair the Scientific Organising Committee which has designed a program to review the diverse problems relevant to the questions of where neutron stars are born, how they evolve and where they go. Topics to be discussed include "guest stars" as harbingers of neutron star birth, supernova and supernova remnant models and observations relevant to the problem of neutron star formation, the distribution, kinematics, and evolution of radio pulsars, binary X-ray sources and gamma ray bursters, and other questions in the study of neutron star astrophysics relating to evolutionary considerations.

Those persons interested in attending the meeting should contact Professor D.J. Helfand, Columbia Astrophysics Laboratory, 538 West 120th Street, New York, NY 10027, USA for a copy of the meeting circular which contains further information and an application form.

QUESTIONNAIRE

☐ There is an error/change of address on the current mailing list; the correct version is given below.

☐ Please add my name and address (printed below) to the EXOSAT Express mailing list.

☐ Please delete my name and address (printed below) from the EXOSAT Express mailing list.

NAME: ______________________________

ADDRESS: ______________________________

____

____

____

Tear off the page and return to: EXOSAT Observatory, ESOC,
Robert Bosch Str. 5,
6100 Darmstadt, W. Germany.