HST
Gardelle, all invitees/ attendees,
M.S.

Sixteenth Meeting of the Hipparcos Science Team

ESTEC, 14-15 July 1987

Attendance:

HST: Dr M. Crézé, Dr. M. Grenon, Prof. M. Grewing (first day only), Dr E. Høg, Prof. J. Kovalevsky, Dr F. van Leeuwen, Dr L. Lindegren, Dr H. van der Marel, Mr C.A. Murray, Mr R.S. Le Poole, Dr C. Turon.

(Prof. F. Donati was unable to attend)

ESTEC: M.A.C. Perryman, R.D. Wills

H. Hassan, G. Ratier, K. van Katwijk, M. Schuyer, T. Batut (part time)

ESOC: J. van der Ha, A. Schütz

MATRA: J. P. Gardelle was invited but unable to attend

Agenda: the Agenda given in Annex I was adopted

1. Project Status Report

Hassan gave a report of the overall technical status of the payload and spacecraft. Problem areas included the thermo-mechanical distortion between the gyros and the star mappers, and the distortions of the mirrors leading to a differential defocus between the two fields of view. Both topics would be dealt with in further detail during the meeting.

The satellite was on schedule for a Flight Acceptance Review at the end of February 1988. A Qualification Results Review was presently ongoing.

The recently published Arianespace Launch Manifest had placed Hipparcos on launch V 33, scheduled for April 1989. The flight of V 19 was presently expected for 8 September 1987.

The HST members were naturally disturbed by this major delay in the launch date. Letters would be drafted by the consortia leaders for submission to the Director General via the ESA D/Sci.

2. Project Scientist Report

Perryman reported on the status of the outstanding actions from the 15th HST Meeting, and from the Third Selection Committee Meeting. Concerning the former, an action on ESOC to include reference to the current value of Ω_0 and $\bar{\nu}_0$ was awaiting the next issue of the DDID and is recalled as Action 1. Guidelines for consortia involvement in payload switching procedures during commissioning and routine operations had not been provided by Grewing, and this action was dropped.

On this subject, Perryman noted that he expected the following procedures for DRC/ESOC interaction to be followed: all information on payload calibration (whether arising from ESOC, SRL/FAST First Look, or the DRCs) would be circulated. Any party discovering anomolous or undesirable data features would flag this to all other involved parties via the Project Scientist. If considered, a meeting (or electronic mail discussions) would be held with ESOC, and recommendations made to ESOC who would then implement them if they were in agreement and if considered acceptable in operational terms.

Concerning actions resulting from the Third Selection Committee meeting, only actions taken by INCA members had been completed, while nothing further had been submitted by the Committee Members. Perryman would write to Professor Blaauw, copied to members of the Selection Committee, summarising the action status (action completed 16 July).

Perryman informed the HST that Dr Wilkinson (Jodrell Bank) had expressed an interest in observing Hipparcos radio objects with Merlin or with the European VLBI network. After consultation with the consortia leaders, this request had been approved, and Dr Argue had subsequently sent the list of relevant objects to Dr Wilkinson.

The draft slide set was reviewed by the HST and a series of comments were made on the slides. These would be implemented by Perryman, along with written comments on the accompanying description received before the end of the HST meeting. Comments were received from Grewing, Grenon, van der Marel and Turon, and were subsequently included as proposed.

3. Payload Aspects

Van Katwijk presented the payload overall status report (Annex II).

Ratier presented his updated paper on the F11 grid calibration report (ESA-HIP-09894, Issue 1, Rev. 1) and distributed copies to van Leeuwen, Kovalevsky, Lindegren, Le Poole and van der Ha (Annex IIIa). A memo with replies to all consortia comments was also distributed (Annex IIIb). The CSEM Measurement Report (TPD-HIP-GRD-MR-199), detailing the location of all blemishes (complete to ESA/TPD knowledge) was also distributed to Kovalevsky, van Leeuwen and Lindegren. The DRC would read and provide comments on the ESA-provided tape (Action 2). Ratier also announced that he would be distributing a full report on F9, for information.

Ratier provided details of the present straylight status (Annex IV). For the earth a longitudinal interruption of 21 degrees (cf a 24 degrees specification) and a transverse interruption of 16-17 degrees (cf a 13.5 degrees specification) were currently predicted. For RTAD, an interval of about 18 degrees between two occultations would be obtained, sufficient to allow IDT observations in this interval. In reply to a question from Kovalevsky, van der Ha noted that shuttering is done on the basis of earth/moon ephemerides and the NSL.

Van Katwijk presented details of the PFM photometric calibration plans (Annex V). The results of the PFM photocathode homogeneity measurements were much better than those of EM, and the best-fit quadratic surface had a residual of 1–2 per cent. IDT detection efficiency measurements on a finer grid were passed to Kovalevsky, van Leeuwen and Grenon after the meeting (Annex VI). Van Katwijk noted that the calibrations on an 11×11 grid might, if time was restricted, be requested to be reduced to an 8×8 grid, but in this eventuality Grenon and Kovalevsky would again be consulted.

Wills presented some details of the problems of the thermo-mechanical distortion between the gyros and the star mapper (Annex VII) which might impact on the DRC's (especially NDAC's) method of attitude reconstruction. Van Leeuwen requested an indication of the model used and the amplitude of the effects. Wills would supply this information (Action 3).

4. ESOC Aspects

Van der Ha presented his note on on-ground datation errors (Annex VIII). The conclusion was that the specifications for the relative and absolute time datation errors were easily met, and that the DRC would have to account only for the time of propagation between the satellite and the ground station.

A proposal for a comparison of orbit data interpretation, which had been suggested by Kovalevsky, was made by van der Ha. Kovalevsky insisted that the outputs be in different reference systems (viz. the mean equatorial system of date, and the J2000 equatorial and ecliptic system). The simulated orbit and eclipse data files would be sent by ESOC to CERGA, RGO and ARI (Action 4). These data might also be included in the next level of the test data tape.

Van der Ha presented the status of the DDID. Kovalevsky urged that some further details of the house-keeping data contents are provided. Van der Ha would send relevant data from the HUM to the DRC (Action 5). Van der Ha distributed the calibration 'annex' to the DDID prepared by P. Davies (Perryman also forwarded this to Pieplu, CNES after the meeting). Any comments on the present DDID should be made in time for a discussion to be held at the next HST meeting (Action 6).

Van der Ha presented the status of the test data tapes. Number 2 had been distributed in June, although it had not yet been received by RGO. (After the meeting, Perryman was informed by CNES that the tape they had received appeared to be empty. This fact had been forwarded to ESOC. If confirmed new data tapes would be despatched by ESOC).

Van der Ha stated that a test tape 3 could be available by about January or February 1988. At this time, IDT/SM and other payload data simulated by ESOC would be available (along with some orbit data, observation reports and timing information, but probably without payload monitoring data). A comparison procedure based on the consortia's interpretation of the tape contents would then have to be set up.

Perryman made a propsal for numbering of objects in payload chromaticity calibration mode (Annex IX) which was accepted by all parties.

The HST requested that the next HST meeting included a presentation by ESOC on the status of the payload monitoring activities, and a description of the type of simulated data that ESOC was preparing (Action 7).

5. Data Reduction Aspects

(a) Double Star Law for INCA:

Kovalevsky presented his concerns on the IDT IFOV piloting strategy for double stars, as proposed by Lindegren. Kovalevsky's suggestion was to point to the centre, rather than the photocentre, of the double system up to a magnitude difference of 3 mag, when only the primary would be targetted. Lindegren had no major objsections to the proposal of Kovalevsky. Lindegren and Söderhjelm would reflect on the proposal (Action 8). If there were no new suggestions, then Kovalevsky's proposal could be adopted at the next HST meeting. Turon did not object to this schedule.

Le Poole suggested that the DRC considered 'de-pointing'. The HST listened to Le Poole's proposal, and while not enthusiastic, would be at liberty to reflect further on the subject.

Van Leeuwen commented on the observation of double stars near the edge of the FOV – the geometry would change as the primary or secondary moved out of the FOV, while the other component might remain observable. After a brief discussion it was agreed that the best way to handle this problem was for the DRC to discard such data, rather than consider any modification to the way in which the PSF is constructed.

(b) IDT Data Treatment Report

Murray presented his report on further work on the IDT data processing, which now contained variations in the spin rate, and velocities about all three axes. He noted that minor planets will not be treated if they are 'partially observed'.

Van Leeuwen said that NDAC were going in a direction where they may only use the 3-parameter solution for double star treatment, not for the photometry or for estimating phase errors.

(c) SM/Attitude Treatment Report

Van Leeuwen presented the progress of these tasks within NDAC (Annex X). Simulated data had been sent to Utrecht, and Schrijver had already sent some results of his processing of the data back to van Leeuwen. A more detailed comparison of results would take place later.

(d) Great Circle Treatment Report

Van der Marel presented a status of some activities related to the GCR processing (Annex XI). A comparison note had been drawn up and distributed, and comments should be provided before 15 September (Action 9) in time for a new note to be produced before the next HST meeting.

(e) Comparison

A time schedule for the comparison tasks was set up (Annex XII).

(f) Software Readiness Review

The document prepared by Perryman was discussed. Inputs from Kovalevsky/Lindegren (Section 1), Murray (Section 2), van Leeuwen (Section 3), Lindegren (Section 5, including astrometric parameter solution) and Kovalevsky (Section 6) were requested before September 15. This schedule would allow distribution of a new draft by October 1, a first round of consortia completion before October 30, and a discussion of the conclusions of this preliminary exercise at the next HST meeting (Action 10).

(g) NDAC Status Report

Van Leeuwen reported that successful transfer of data had taken place between RGO and CUO/DSRI. Petersen has completed a geometrical GCR package, not fully tested. Dynamical smoothing would be implemented soon. Lindegren reported on the NDAC interfaces and software status at Lund (Annex XIII).

(h) FAST Status Report

The DCMS is expected to be ready in September 1987, with integration of the other packages (mostly written) starting in October. Reception and preparation of data (including manual and automatic selection of RGC poles and end points) was expected to be integrated in November. The outputs of simulations should be functioning in September. The SM/IDT work stopped about 3 months ago, but should re-start in September. The magnitudes package was due in January/February 1988. GCR reception is due end 1987.

Kovalevsky thought that the rms on the RGC origins in the sphere reconstitution was still too large (1 milli-arcsec), but studies were still going on. The astrometric parameter package (Heidelberg) was completed, but not yet transferred to CNES. There are still problems with the double star treatment, with work ongoing in Bari and CERGA. The decision on who would do the final analysis was not yet made – probably it would be either Torino or Padova.

The calibration package is due to end at end 1987. Photometric calibration of SM, IDT and SSR has been completed. Geometric calibration of SM is still ongoing, using IDT data and SM crossings of vertical slits. The fellowship position of Miss Gonano ends on 1 October: a final meeting would take place in September, organised by Vaghi.

The work on alternative sphere reconstitution in Italy depends on the 5-year funding plans of CNR: if approved, it would be run at Pisa.

(i) TDAC Status Report

Høg reported on the progress of the Tycho analysis definition (Annex XIV). Companion recognition will now take place outside the 12 arcsec boxes, out to a box size of 60 arcsec centred on the TIC star positions, and down to 0.3 mag brighter than the Tycho limit. Serendipity recognition will, in consequence, be less important, and may not even take place. Høg was considering the publication of TIC3, based on the first year of observation, perhaps on microfiche, and in a format not necessarily related to that of the final Tycho Catalogue. Positions would be good to about 0.15 arcsec, and the catalogue could be available mid-way through the mission.

(j) Miscellaneous

It was agreed to dedicate part of the next HST meeting to discussions on photometry – this should cover the main mission as well as Tycho photometry. On the suggestion of Kovalevsky, Mignard would also be invited to participate in these discussions. Perryman asked that Grenon be given the possibility of a full overview of the entire photometric aspects, including Tycho, Utrecht, etc. Grenon remarked that he planned some coordinating work after the Liège PFM calibration results were available.

Turon asked about the status of the IC1 within the data reduction consortia. Van Leeuwen said that he had read the IC1 tape, without problems, and that the data would be incorporated in the RGO simulations in October. Kovalevsky remarked that Falin is writing the software to read the data tape, and that a report would be issued on this subject at Sitges. Lindegren remarked that he was using IC1 for the sphere simulations. The double star annex catalogue was also being used for some statistical work at Lund. Lund had no comments on the catalogue so far.

Lindegren proposed that the comparison of the determination of star positions be formalised (some comparisons had already been carried out between Lund and Heidelberg). Lindegren would provide appropriate inputs for this to be set up (Action 11).

(k) Data Publication using Optical Discs

A proposal had been made by Perryman, and distributed to the HST before the meeting. Le Poole and Turon presented results of some measurement work carried out by Astroscan (Leiden) and MAMA (Dr Guibert, Annex XV) concerning the trade off between field size and pixel size. It was evident from the discussions that the trade off depended on the application foreseen for the data – if finding charts for small telescopes, a large pixel size (up to 160 micron) was considered possible by Turon. If the data were to be used to study the environments of the Hipparcos stars, the 25 micron pixels of the ST GSSS (for the majority of the plates scanned) were desirable. Van Leeuwen pointed out that if finding charts were the main application, this could be achieved using filtered images, representing objects as circles with a radius dependent on the star's magnitude. HST would reflect on these points, and Perryman would continue some investigations with people at ST-ECF (München) working on optical disc catalogues.

7. Input Catalogue Aspects

Turon presented the status of the INCA/ESOC interface, and a debrief of the working group meeting that had taken place on 13 July (Annex XVI). The minutes of the interface meeting would also be distributed to all HST members by Perryman. The question of ESOC updates of the Input Catalogue was discussed, after which it was agreed that the procedure of deleting an incorrect entry and adding a new star with the next available INCA running number was appropriate. Turon's current estimate of the Input Catalogue size was 118 700, based on present simulation results, although this should be an upper limit to the final contents.

Turon informed the HST that Arlot was now involved in the Input Catalogue Consortium to work on the preparation of ephemerides of planetary satellites. Some correspondence had taken place between Arlot and Lindegren concerning the choice of these objects. A supplementary proposal was in preparation to cover this topic, with Arlot as principal investigator, and including Lindegren (if he was in agreement) as co-investigator.

Turon outlined some first thoughts on plans for the publication of the Input Catalogue. It apppeared feasible to do this in printed form (Annex XVII). Turon would investigate publication by the Paris Observatory, and Perryman would investigate in parallel with Longdon ESTEC (Action 12).

8. Miscellaneous

(a) Publicity status: Perryman said that copies of all printed material were still available through him. The work on a film was proceeding at a low level. Murray noted that a Sky At Night television programme was presently scheduled for December 13.

(b) Consortia brochures: a schedule for a draft of the INCA document, to be ready in time for Sitges, had been drawn up. Only a handful of contributions had been received by Perryman so far – these had all been through a 'first pass' editing, and had been returned to the original authors for their comments.

(c) Agreement: Grenon raised a point of concern about the means of access to the Tycho data. This prevented the signing of the Agreement at the meeting. Grenon would discuss these concerns with Høg, and a proposal for the revision of the Agreement, if necessary, would be made before the next HST meeting by Grenon (Action 13).

(d) Radial Velocity program: Perryman had received a proposal submitted by Dr Griffin (Cambridge) to the SERC for the construction of two telescopes dedicated to the radial veolcity measurements of Hipparcos stars. After a brief discussion, it was suggested that Perryman write to Dr Mayor to establish his views on the proposal before submitting any recommendations to Dr Griffin (action completed on 16 July).

(e) IAU preparations: Turon thought that a preparation of the INCA work might be made at the 1988 IAU meeting. The consensus amongst the HST was that no other Hipparcos-specific presentations would be appropriate at that time.

9. Areas of Concern

Le Poole expressed concern about the internal problems that were known to exist within FAST concerning the participation of CSS. It was felt that, at some point, this issue might become a problem for the project in general, and not simply FAST – for example concerning simulated data comparison, preparations for launch, etc. Kovalevsky felt that this problem might be cleared up in the near future, but that ESA would be informed if it appeared that the problem was not being solved.

10. Future Meetings

The next meeting of the Hipparcos Science Team would take place on 16-17 November, to be followed by a one-day meeting of NDAC (Perryman noted his unavailability on 19-20 November). Hassan invited the HST members to hold this meeting either at ESTEC or in Toulouse, depending on the location of the PFM at that time.

M.A.C. Perryman, 16 July 1987

esa estec

HIPPARCOS

MEETING HIPPARCOS: HST 16

PLACE: ESTEC

REF.

DATE: 14-15/7/87

PAGE: 9

ACTION No		DESCRIPTION (not more than 4 lines)	CLOSING DATE	ACTIONNEE Person/firm	INITIATOR Person/firm
	1	Include reference to current value of Ω_0 and $\overline{v}_0$ in the DDID [carried over from last HST actions].	next DDID issue	van der Ha / Head	Perryman
new action	2	Read FII grid calibration tape and provide comments to ESA	October 1	van Leeuwen / Kovalevsky	"
EPI-QT-HIP-21-8074 sent 27/8/87 to FvL, LL, JK ✓	3	Provide details of model / amplitude of effects of thermo-mechanical distortion	October 15	Wills	"
HIP-MAV-21-8157 17/9/87 ✓ ✓	4	Provide simulated orbit and eclipse data files to ARI/CERGA/RGO	October 15	van der Ha	"
✓	5	Extract relevant data from HUM on housekeeping and send to DRC (Kovalevsky, van Leeuwen)	August 15	van der Ha	"
✓	6	Comments on present DDID in time for discussions at next HST	Sept. 30	HST (all)	"
✓	7	Coordinate presentation by ESOC on P/L monitoring status + ESOC simulated data description for next HST	next HST	van der Ha	"
✓	8	Consider Kovalevsky proposal for double star observation	next HST	Lindegren / Söderhjelm	"
✓	9	Provide comments on van der Marel GCR comparison note	Sept. 15	HST (all)	"
✓	10	Provide inputs (as agreed in minutes) on Software Readiness Review document.	Sept. 15	HST (see minutes for names)	"
✓	11	Provide inputs on formalisation of calculation of star positions (comparison)	next HST	Lindegren	"
✓	12	Investigate facilities for publication of Input Catalogue	next HST	Turon / Perryman	"
✓	13	Propose revision to Agreement w.r.t. TDAC data access	next HST	Crézé	"

Signatures

Annex I

Agenda

ANNEX I

Sixteenth Meeting

of the

HIPPARCOS SCIENCE TEAM

ESTEC, 14-15 July 1987

(Start of meeting: 09:30 on 14 July, Room 32004)

AGENDA

1. Project status report (09.30-09.45) (Hassan)

2. Project Scientist report (09.45-10.30) (Perryman)
   - Selection Committee meeting debrief/action status/etc

--- Interval to inspect slide series, etc (10.30-11.00) ------

2. (cont.) HST response to launch delay (11.00-11.15)

3. Payload aspects (11.15-13.00):
   - payload status report (van Katwijk, 15 min)
   - grid calibration report (Ratier, 15 min)
   - straylight status/occultations (Ratier, 15 min)
   - PFM photometric calibration plans (van Katwijk, 30 min)
   - thermo-mechanical effects on attitude (Wills, 30 min)

4. ESOC aspects (14.00-15:00):
   - on-ground datation errors of TM data (van der Ha)
   - proposal for comparison of orbit data (van der Ha)
   - DDID and test data tape status (van der Ha)
   - notation for stars in chromaticity GCR mode/dummy stars

5. Data Reduction aspects (15.00-17.30):
   - double star law for INCA (Lindegren, 15 min)
   - IDT data treatment report (Murray/van Leeuwen, 60 min)
   - SM/attitude comparison progress report (van Leeuwen, 45 min)
   - GCR comparison progress report (van der Marel, 30 min)

15 July

6. Data Reduction aspects, continued (09.00-11.00)
   - Software Readiness Review discussion (Perryman, 45 min)
   - NDAC/FAST/TDAC Status Reports (Hog/Kovalevsky, 60 min)
   - data publication using optical discs (Perryman, 15 min)

7. INCA aspects (11.00-13.00):
   - status of INCA/ESOC interface: debrief (Turon/Schutz/Wills)
   - planets and satellites - BdL involvement: debrief (Turon)
   - proposal for publication of Input Catalogue (Turon)

8. Miscellaneous (14.00-15.00):
   - publicity status (film, ESA brochures, poster, slides)
   - consortia brochure/Agreement
   - radial velocity programs

9. Any other business, future Hipparcos meetings, next HST meeting

Annex II

Payload Status

(1) Date 14/7/87

HIPPARCOS PAYLOAD
STATUS REPORT
FOR HST
14 TH JULY 1987

PREPARED BY
PHP TEAM

Annex II

752495

(2) Date 14/7/87

CONTENTS

(3) Date 14/7/87

1. PRESENT HARDWARE STATUS

- TELESCOPE OPTICAL PERFORMANCES (0g)

	C_c	C_v	C_d	LMTF *
PFM	0,3 mas	1,3 mas	1,0 mas	14 %
SPEC	2,7 mas	1,5 mas	—	—

*AT COMMON BEST FOCUS

- GRID-CALIBRATION STATUS REPORTED SEPARATELY
- BAFFLES – IMPROVEMENTS WRT EM IMPLEMENTED
- REFOCUSSING MECHANISM – UPGRADED
- STARMAPPER DETECTION ASSEMBLY – EXCHANGED
- ALL OTHER HARDWARE – NOMINAL

(4) Date 14/7/87

2. RECENT TEST RESULTS

- STRAYLIGHT TEST (MAY '87) – SEPARATE REPORT
- VIBRATION TEST (JUNE '87) – POSITIVE RESULTS

3. NEAR FUTURE PROGRAM

– ALL ACTIVITIES IN IAL, LIEGE (B)

- PERFORMANCES TEST IN AMBIANT (JULY)
- THERMAL VACUUM TEST (JULY)
- PHOTOMETRIC CALIBRATION * IN VACUUM (AUGUST
- "DELIVERY" TO AERITALIA, TORINO (I) FOR INTEGRATION WITH SPACECRAFT (SEPTEMBER)

* AGREED CALIBRATION PROGRAM – SEPARATE REPORT

752495

(5) Date 14/7/87

4. AREAS OF CONCERN

- · DIFFERENTIAL DEFOCUS BETWEEN TWO FOV's
- · LONG TERM STABILITY OF FLAT FOLDING MIRROR
- – EFFECT OF TEMPERATURE PROFILE, HUMIDITY AND ACCELERATIONS ON MIRRORMOUNTS BONDING, IMPACTING ON DIFFERENTIAL DEFOCUS, UNDER REVIEW
- – VARIATION OF MODULATION IN THE FIELD

6 Date 14/7/87

DIFFERENTIAL DEFOCUS BETWEEN FOV's

SIMPLIFIED GEOMETRICAL ASSESSMENT

FOV (A) $f = 1/\{1/f(BC) + 1/f(FM) + 1/f(SM)\}$ (ASSUMING FM

FOV (B) $f = 1/\{1/f(BC) - 1/f(FM) + 1/f(SM)\}$ WFE DISSYMMETRY)

$f(BC) = 1{,}40 \; 10^6$ (mm)

$f(FM) = 7{,}84 \; 10^7$ (mm)

$f(SM) = 1400$ (mm)

FOV(A) $f = 1398{,}5764$ (mm)

FOV(B) $f = 1398{,}6263$ (mm)

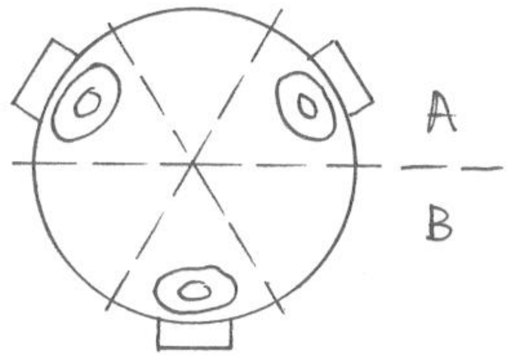
$\Delta f = 0{,}0499$ (mm) $\hat{=}$ 50 μm

FM $WFE(max) = r^2/2f(FM)$

$r = 178$ mm (mirror radius)

$WFE(max) = 2{,}0207 \; 10^{-4}$ (mm) $\hat{=} \lambda/2{,}722$

→ $\Delta f = 247 \; WFE(max)$



⑦ Date 14/7/87

MECHANISMS OF MIRRORDISTORTION (INSTABILITY)

- "HIGH" TEMPERATURE EFFECT ON MIRRORMOUNT GLUE
  - LARGE THERMAL DEFLECTIONS WITHIN THE GLUE

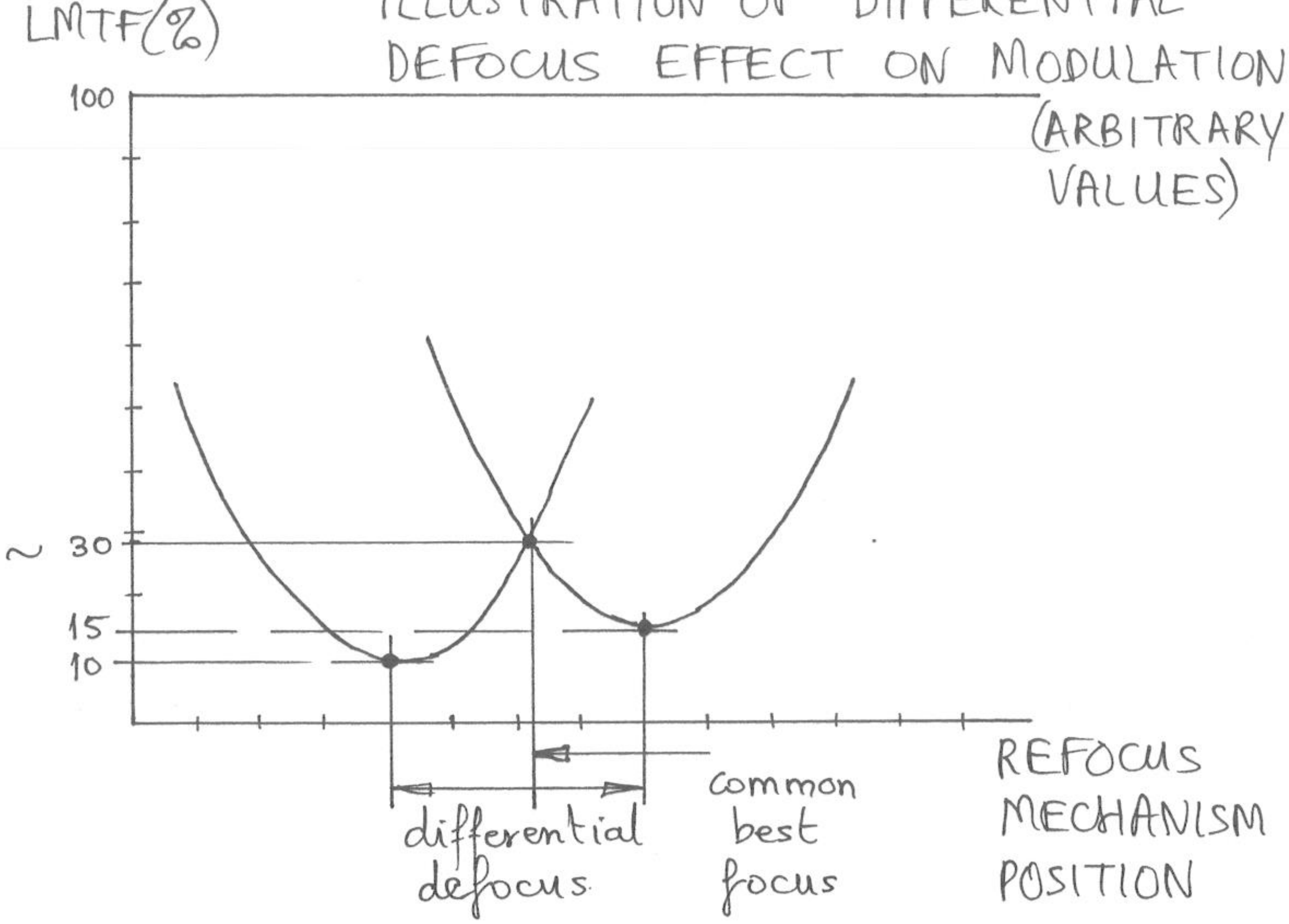
  \+ LOW YOUNGS MODULUS

  = LARGE NONLINEAR STRAINS } HISTERESIS

  \+ MATERIAL YIELDING NONLINEARITY }
- MOISTURE EFFECT ON MIRRORMOUNT GLUE
  - SWELLING WITHIN THE GLUE, DEPENDENT ON DIFFUSION STATE → STRESSES
- RESULTANT STRESS SYSTEM DEPENDS ON TEMPERATURE, LOADS & HUMIDITY HISTORIES

(8) Date 14/7/87

ILLUSTRATION OF DIFFERENTIAL DEFOCUS EFFECT ON MODULATION



752495

Annex III

Grid Calibration Report

ANNEX IIIa

HIPPARCOS

Update Grid calibration report

(F-11.)

H.S.T.
14 -JULY -1987

Date ....

Date ....

COMMENTS (on issue 1):

- Received from FAST, NDAC, MATRA, TPD , ESOC and J.H.Lecat
- Most of these comments have been incorporated in the new issue
- Detailed reply is provided separately.

Major changes:

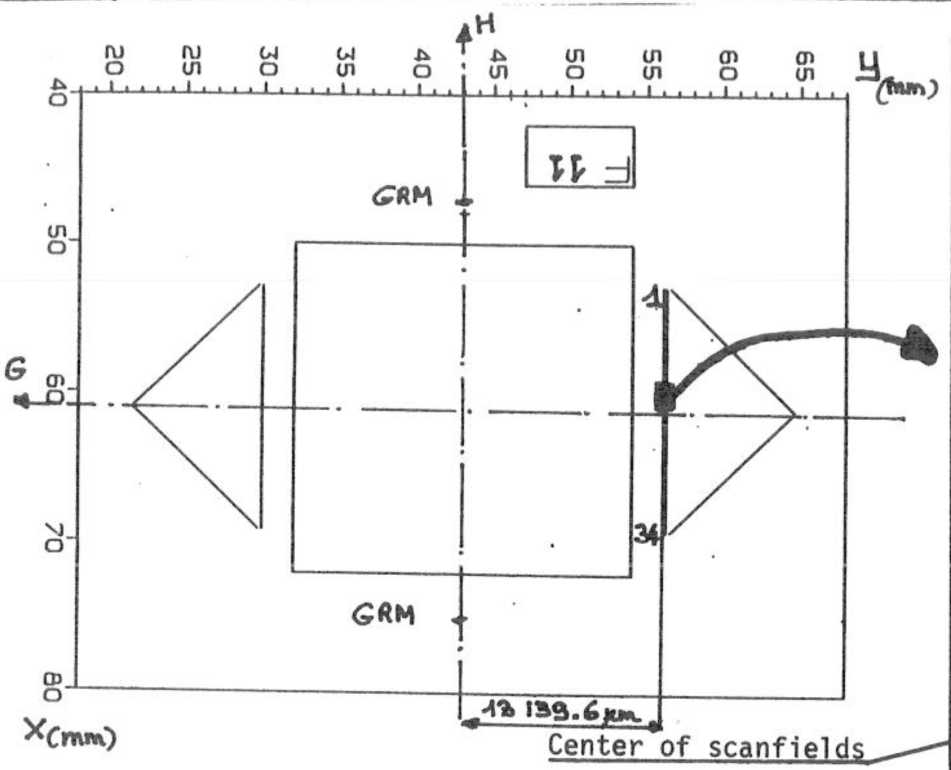
- Summary table of various reference frames has been added.
- Explanation of the computation of MSI for Star Mapper vertical slits has been put in line with delivered data.
- Figure 3.5.1.a on ESA runs definition has been revised.

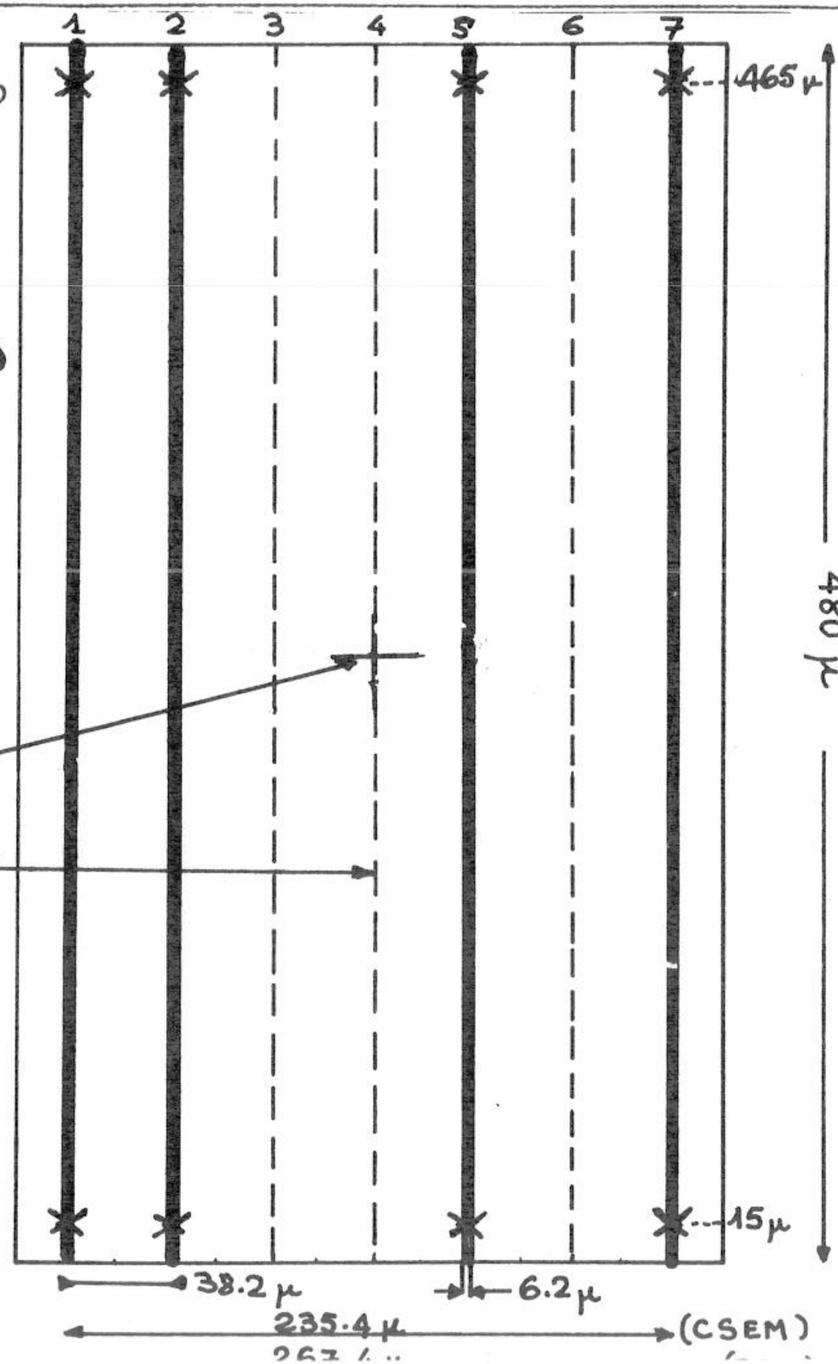
Conclusion:

- Data delivered on tape with issue 1. are unaffected.

A.O.B.:

- Report on spare grid (F9) still to be issued.





Scanfield size:

- -for writing: 480µ x 235.4µ
- -for calibration: 480µ x 267.4µ

Note: For the 34 scanfields,

- -8 points are obtained during seq. SMPUI.3
- -MSI is computed for the centre of the scanfield, using 8 points.

FIG 1.2.1.b

CALIBRATION OF STAR MAPPER PARALLEL SLITS (SMPU)

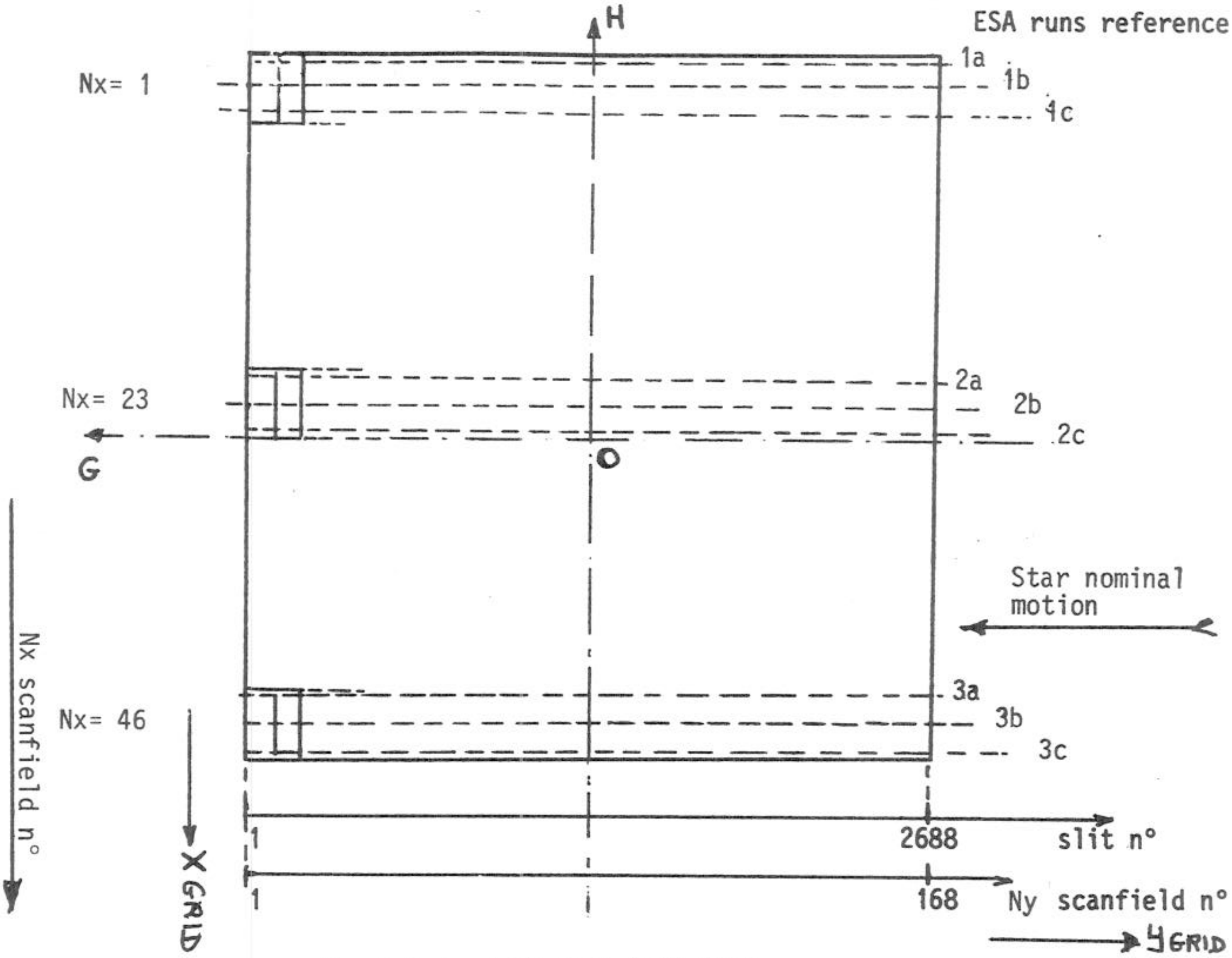
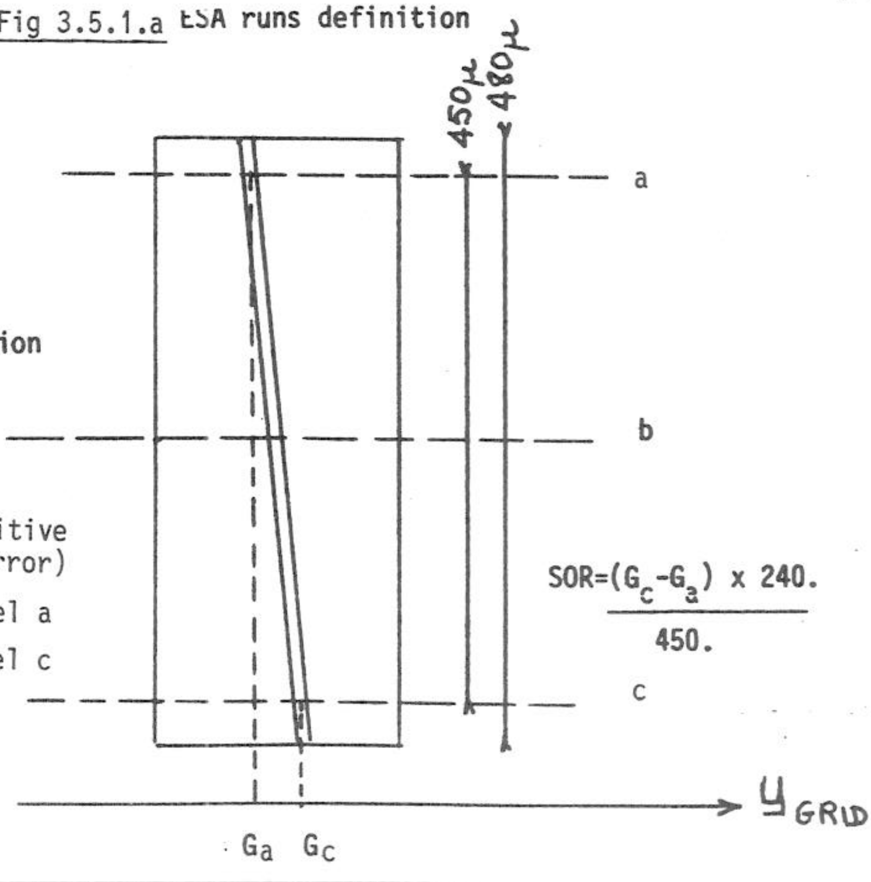


Fig 3.5.1.a ESA runs definition

FIG 3.5.1.b

Slit orientation error



(this fig. shows a positive slit orientation error)

G_a= Grid coord.at level a

Gc= Grid coord.at level c

$$SOR = \frac{(G_c - G_a) \times 240.}{450.}$$

Reference system	Axis designation	Units	Reference	Comments
Payload reference frame	(Op,Xp,Yp,Zp)	e.g.: mm.	§ 1.3.1 p14	Origin Op located at intersection point between the Zp axis and the assembly plane of the 2 halves of the Beam Combiner
Grid reference frame	(Og,F,G,H)	e.g.: mm.	§ 1.3.2 p14	Og ,on the spherical surface of the grid,is equidistant from the 2 GRM's. For nominal spin motion,a star moves ---> + G
Field reference frames	$(\Omega_P, \eta_P, \zeta_P)$ $(\Omega_F, \eta_F, \zeta_F)$	(Angles)	§ 1.3.3 p14	Ω_P & Ω_F are the geometrical images of the grid centre Og. They define a great circle called the" viewing plane"
(TPD)Grid reference frame	(X, Y)	e.g.:mm	§ 1.3.4. p17	Defined by markers on grid (at CSEM) Slits are // to X-axis. Og coordinates are: X=61.000 mm Y=43.000 mm
EBPG coordinate system	(X1 , Y1)	e.g. mm	§1.3.4 p17	Defined by the EBPG meas..machine in Delft. Usually the " APEX" is not identical to Og.due to tilt of holder.=> distortions removed by LSI
Index for scanfield (Main grid)	Nx , Ny	None	§1.3.4 p18	$1 \leq Nx \leq 46$ $1 \leq Ny \leq 168$ For a star moving on grid according to nominal scanning law, Ny decreases from 168 to 1
L.S.I. index	XLSI, YLSI	None	§1.3.4. p18	Origin of this system is grid centre Og. XLSI=Nx-23.5 YLSI=Ny-84.5
(un-named)	(Og, X', Y')	e.g.:mm	§1.3.4 p18	axis Og X' // to X axis OgY' // to Y XLSI=(X' * 22.5)/10.800 with X'=X-61.000mm YLSI=(Y' * 83.5)/10.9552 with Y'=Y-43.000mm

Reference system	Axis/designation	Units	Reference	Comments
Index Star Mapper	ISM	None	§ 4.1. p 47	Define the distance where a star crosses the StarMapper w.r.t. H axis. ISM varies between -34 and +34
Microscope reference frame	(x , y)	mm	§ 5.1 p55	Reference frame used by TPD for visual inspection. x is // Y' y is anti // X' Origin is close to Og

Annex IIIb

esa estec

HIPPARCOS

MEMO

from: G.Ratier (ESA/ESTEC) date:13 july 1987

to: HST members : J.Kovalevsky,L.Lindegren
M.A.C.Perryman
c/o HIPPARCOS Project team:K.van Katwijk, T.Batut,S.Vaghi, R.Wills

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Subject: Reply to comments on ESA-HIP-09894 (issue 1):
Geometrical calibration of HIPPARCOS flight grid unit (F11)

FAST (J.Kovalevsky):letter 13-5-87

-MSI data for star mappers are based on 8 measurements per scanfield. Only the averaged value is given in the ESA report, but data could be made available on special request. However the accuracy obtained on a single slit measurement will be significantly worse than for the whole scanfield.

-Coordinates of blemishes are not available on tape (and it is not the intention of ESTEC to perform this task !). The size is roughly indicated in the column "Histogram" and the nature of each defect is reported in column "Notes".

Photographs of a few major defects have been taken by CSEM and are available in reference 10.

NDAC(L.Lindegren):Letter 26-3-87

-2) Definition of scanfield indices given in 1985 by S.Vaghi is now obsolete.(ref his memo dated 26-5-87).

-3) Sign of the M.S.I.:There is no inconsistency between figure 4.2.b and the table given page 81. Updated figure in issue 1 Rev1 should clarify this point.

-5) page 37:The figure has been modified.

-It is really a pity that there no better coordination for definitions in various documents,such as MAT-HIP-7697, but this is out of the scope of the present report...Your comment should be re-discussed separately.

MATRA(J.P.Gardelle):FAX n° 392.87

811231

Annex IV

PFM Straylight Performances

ANNEX IV

Date....................................

HIPPARCOS

STRAYLIGHT PERFORMANCES

(P.F.M.)

H.S.T.
14 -JULY -1987

Date ....

1.) SUMMARY OF PREVIOUS STRAYLIGHT ACTIVITIES:

-**Tests performed on OSTM**:

-main objectives were:

1)to check straylight predictions generated by the mathematical model.(TPD/NIC)

2)to identify critical areas in the straylight reduction H/W.(internal & external baffles, Beam Combiner,...)

3)to debug the test set-up.

-Tests results,(analysed with support from R.Breault) led to refinement of mathematical. model, as well as some H/W modifications (mainly inside the P/L)

-**Tests performed on E.M.**:

-Results:

-Agreement between theoretical predictions and measurements was fair at small angles, but large discrepancies were found at large angles (> 10°)

-P/L straylight requirements were not met for Earth and were considered marginal for Sun illumination.

Date ....

-Corrective actions:

- External baffles (which were designed for ARIANE III accommodation) were suspected to be responsible of the poor straylight rejection.

- Inside parts of external baffles have been re-painted with a more appropriate black paint (Chemglaze Z 306) (as well as a lateral flat).

- The first diaphragm of each external baffle (formerly in CFRP) has been re-manufactured in Invar to get sharper edges,in order to minimize scattering.

Date..........................

2.) TEST SET-UP:

Description:

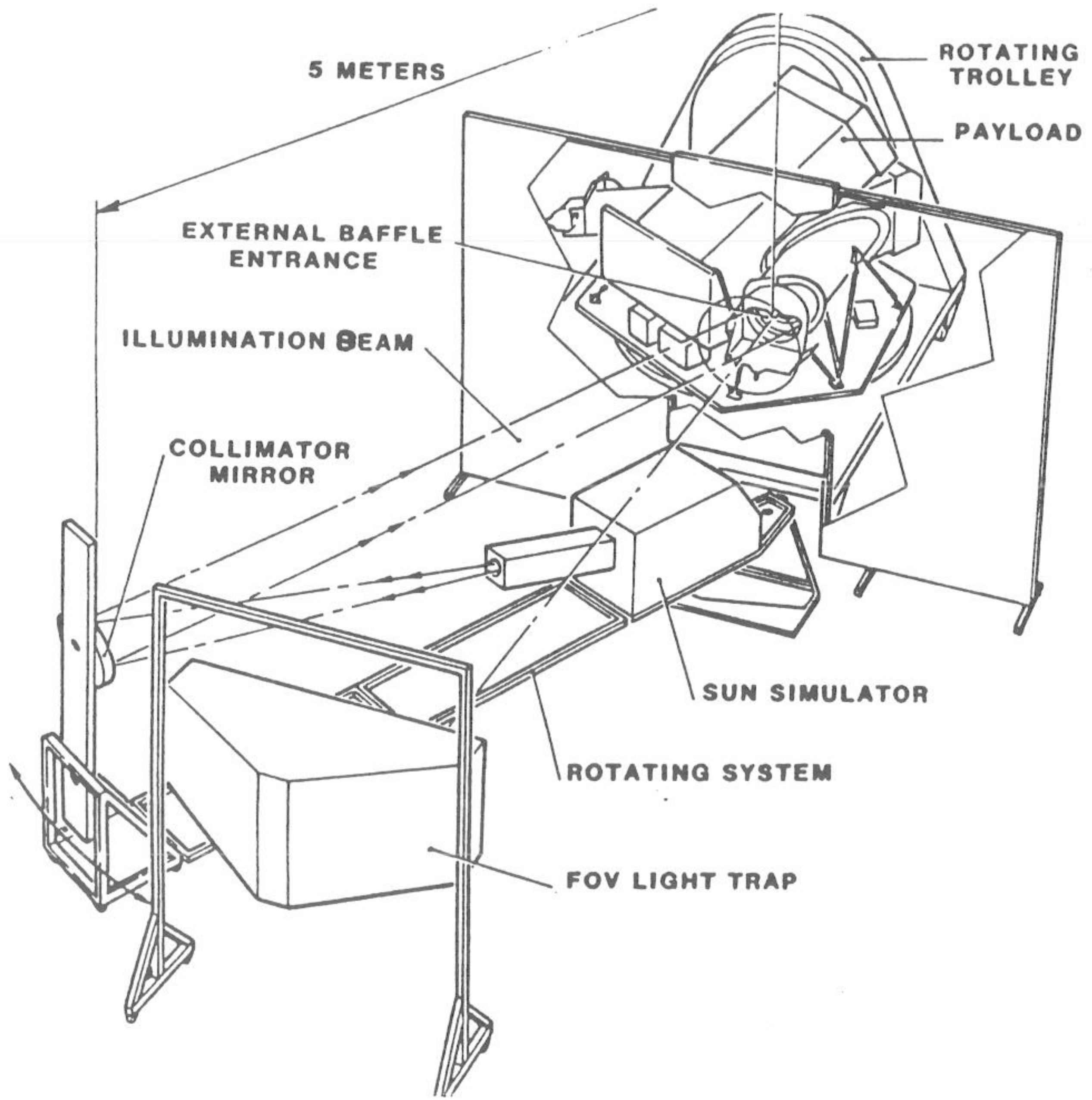
- A " Sun simulator" sends a collimated beam of light on the entrance of the baffle.
- Apparent diameter of the source is equivalent to the "full moon" (0.5 °)
- Measurements can be performed at large incidence angles (± 30° mini.) in 8 directions.
- Test set-up is installed in a dark-room with very clean conditions. Light traps are used to simulate "deep space".

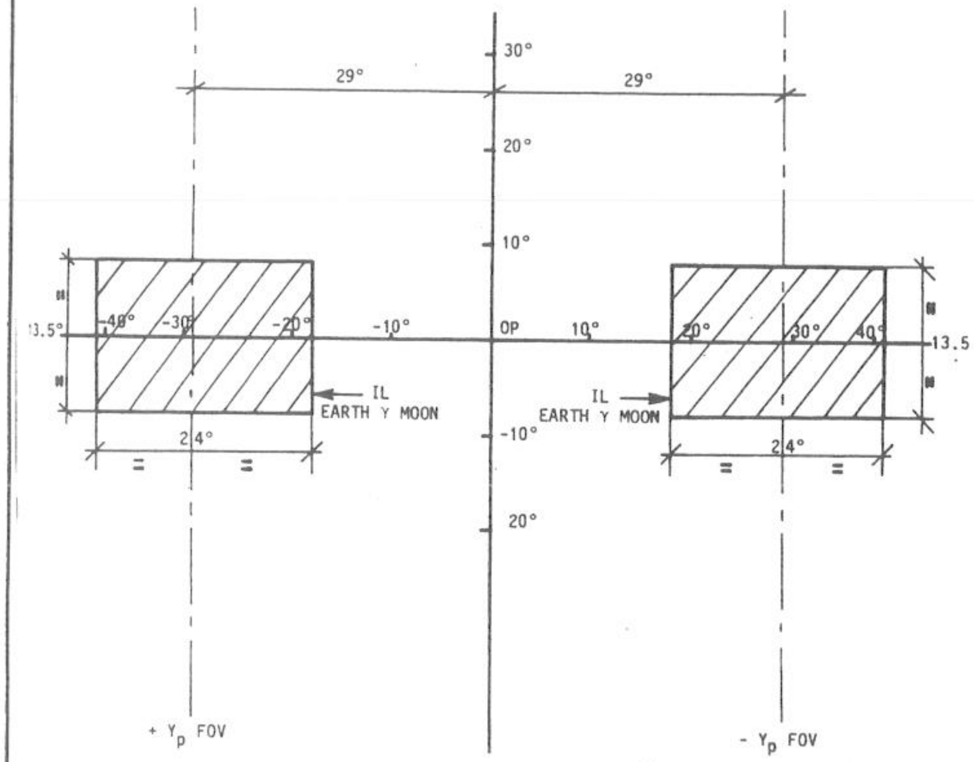
Limitations:

- Limited power of light source prevents direct measurements of Sun light attenuation ($\approx 10^{+13}$)

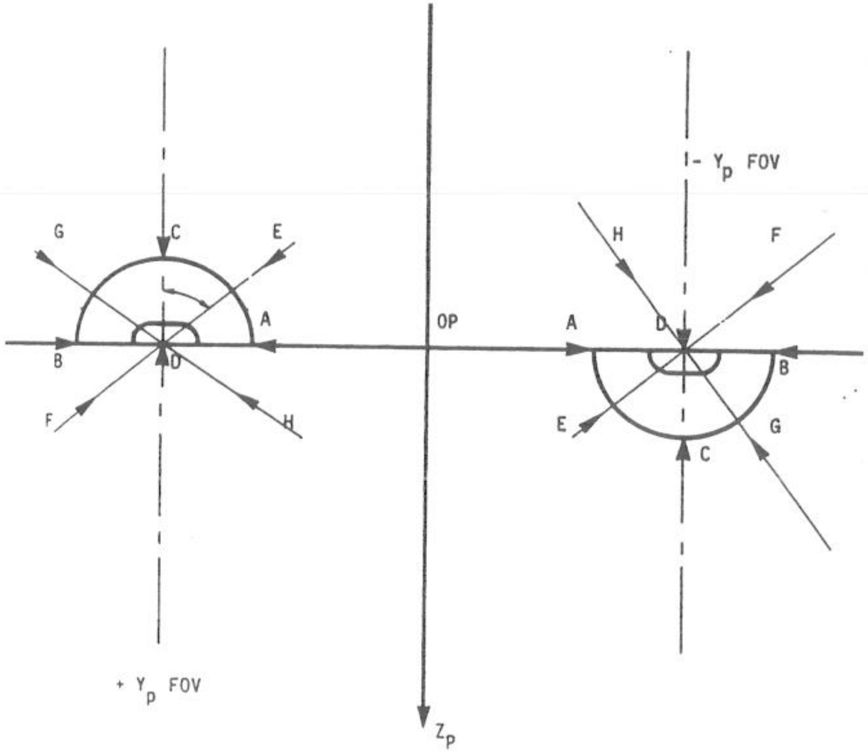
- Air scattering (even in dust free environment) is a major contributor when attenuation larger than 10^{+10} have to be measured. (i.e. for angles > 10°).Measurements of scattering is performed "in-situ" to derive corrected straylight values, but the achievable accuracy is limited.

Date ....


5 METERS
ROTATING TROLLEY
PAYLOAD
EXTERNAL BAFFLE ENTRANCE
ILLUMINATION BEAM
COLLIMATOR MIRROR
SUN SIMULATOR
ROTATING SYSTEM
FOV LIGHT TRAP



SYSTEM PERFORMANCES REQUIREMENT



- STRAYLIGHT SOURCE POSITION DEFINITION

Date..........................

Date ....

3.) PFM TEST RESULTS:

-Following data are related to the main FOV (IDT). Results obtained for star mappers (PMT B & V) are similar.

Sun aspects:

-Direct measurement, after correction of air scattering, is within the dark room background.

-Assessment (based on "Moon case A /30° " and scattering of vertical flap) leads to a sun throughput of **0.7** $\mathbf{10^{-13}}$

-Specification (which corresponds to a level equivalent to 20 % of the sky background) is : **6.2** $\mathbf{10^{-13}}$

Conclusion: Straylight rejection requirement for nominal Sun aspects (43°5 from spin axis) is met.

Date

Moon aspects:

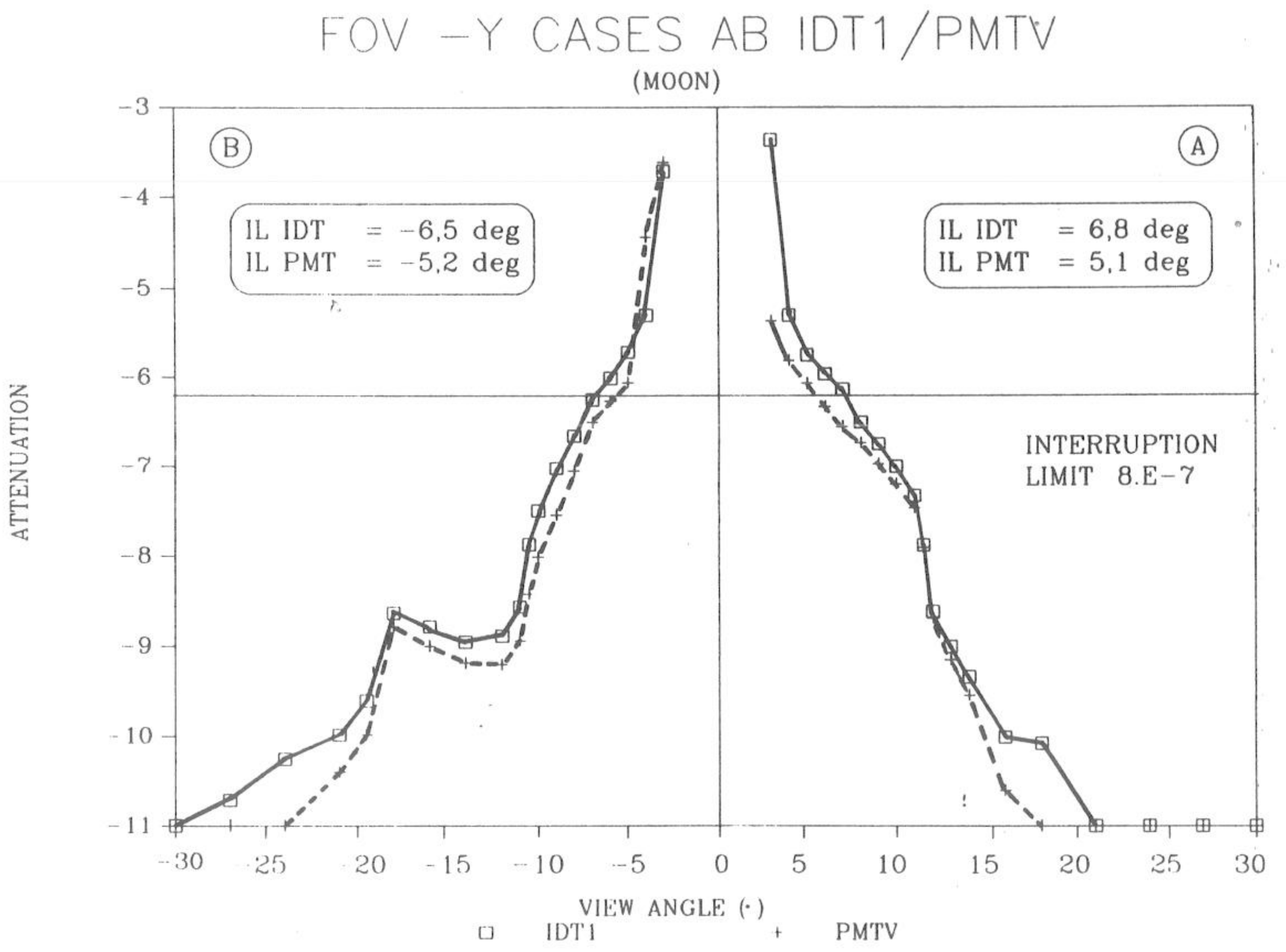
-The interruption limit angle corresponds to the angle for which straylight induced by the full Moon is 10 times the sky background.

case	A	B	C	D
Baffle +Yp	7.0°	6.3°	5.5°	4.4°
Baffle -Yp	7.5°	6.7°	5.8°	4.7°

-Total interrupted angles are:
  direction (A+B): 13.3° (baffle +Yp) 14.2° (baffle-Yp)
  direction (C+D): 9.9° " " 10.5° " "

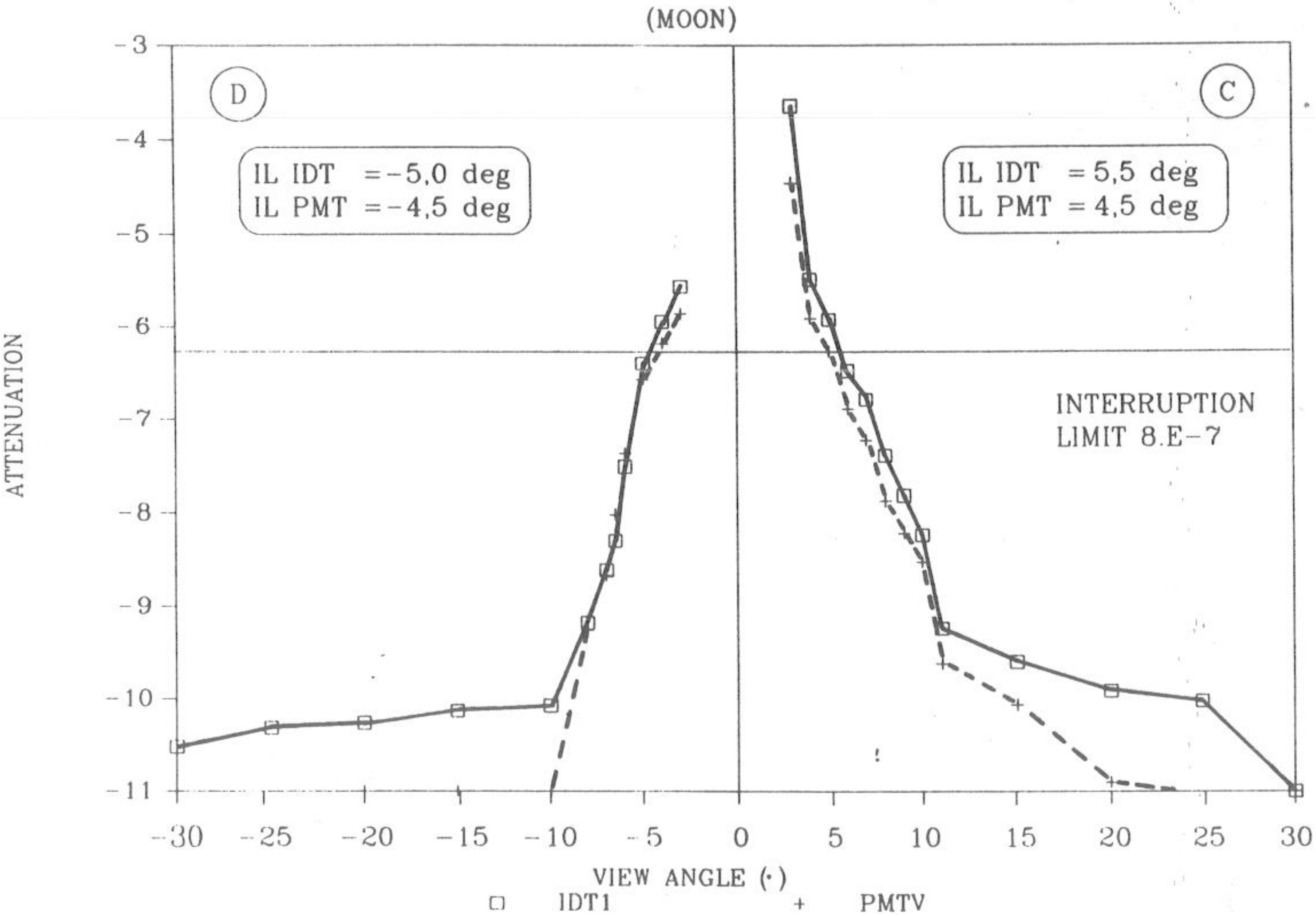
-P/L specification :
  direction (A+B): 24°
  direction (C+D): 13.5°

-<u>Conclusion:</u> Requirements for straylight rejection induced by a " full" Moon are met in both directions.


FOV —Y CASES AB IDT1/PMTV
(MOON)
B
IL IDT = -6,5 deg
IL PMT = -5,2 deg
A
IL IDT = 6,8 deg
IL PMT = 5,1 deg
INTERRUPTION
LIMIT 8.E-7
ATTENUATION
-3
-4
-5
-6
-7
-8
-9
-10
-11
-30
-25
-20
-15
-10
-5
0
5
10
15
20
25
30
VIEW ANGLE (°)
IDT1
PMTV

Date....................................

FOV -Y CASES CD IDT1/PMTV



Date..............................

Date ....

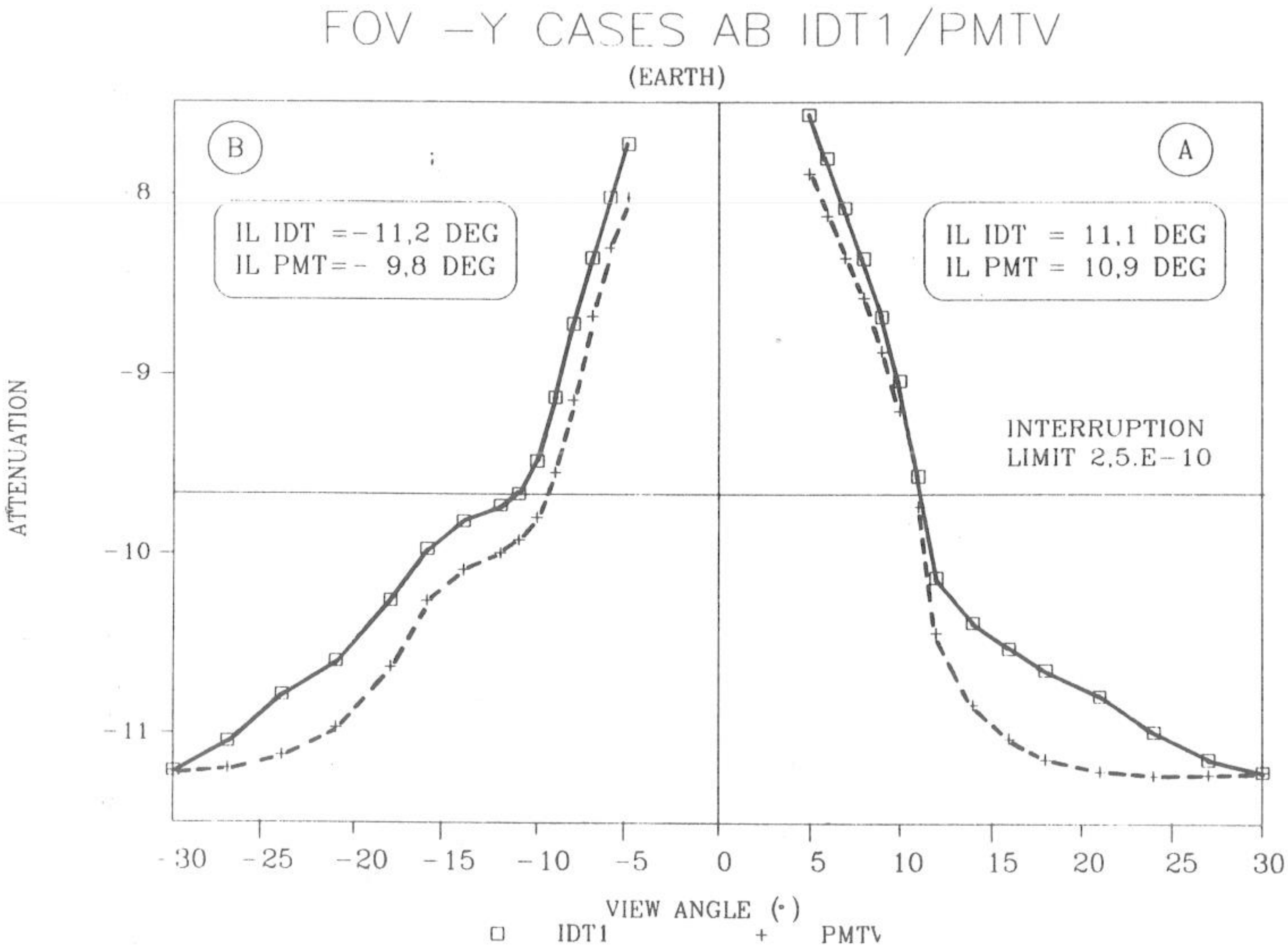
Earth aspects:

- The interruption limit angle corresponds to the angle for which straylight induced by the full Earth is 10 times the sky background (note:a "full" earth is a very conservative approach which will never occur !).
- Earth interruption limit angles are obtained by numerical integration. (Following data have to be considered as "preliminary ").

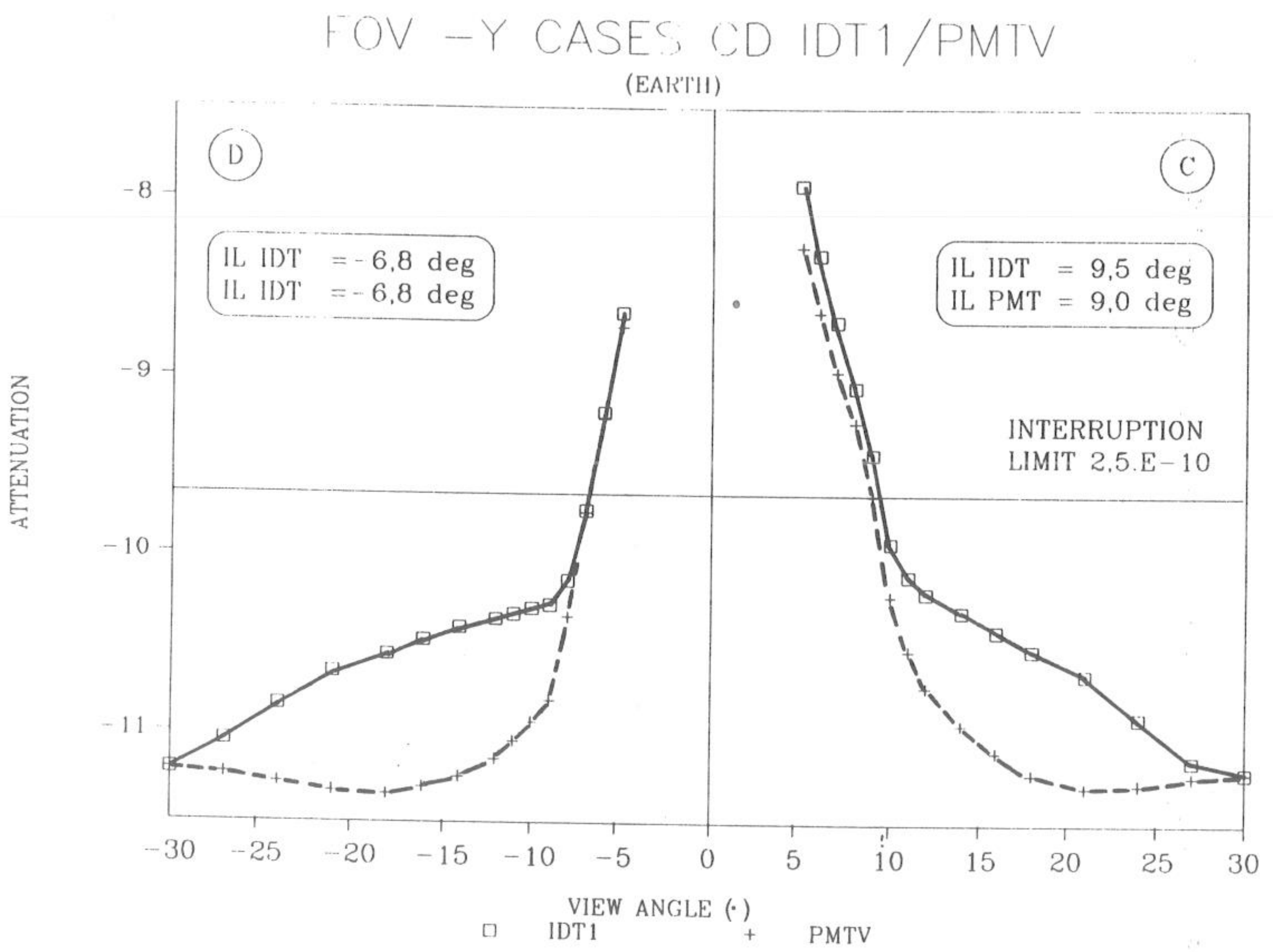
case	A	B	C	D
Baffle +Yp	11.1°	10.0°	8.0°	9.2°
Baffle −Yp	11.0°	10.4°	9.2°	6.6°

- Total interrupted angles are:
  - direction (A+B): 21.1° (baffle +Yp) 21.4° (baffle−Yp)
  - direction (C+D): 17.2° " " 15.8° " "

  Estimated accuracy on total interrupted angles: ≈ ± 3°
- P/L specification :
  - direction (A+B): 24°
  - direction (C+D): 13.5°
- For RTAD, there is a zone of 18° minimum between the two wiewing directions where straylight induced by the Earth is less than 10 times the sky background.


FOV -Y CASES AB IDT1/PMTV
(EARTH)
B
IL IDT =-11,2 DEG
IL PMT=- 9,8 DEG
A
IL IDT = 11,1 DEG
IL PMT = 10,9 DEG
INTERRUPTION
LIMIT 2,5.E-10
ATTENUATION
8
-9
-10
-11
-30 -25 -20 -15 -10 -5 0 5 10 15 20 25 30
VIEW ANGLE (°)
IDT1
PMTV

Date..........................


FOV -Y CASES CD IDT1/PMTV
(EARTH)
D
C
IL IDT = -6,8 deg
IL IDT = -6,8 deg
IL IDT = 9,5 deg
IL PMT = 9,0 deg
INTERRUPTION
LIMIT 2,5.E-10
ATTENUATION
-8
-9
-10
-11
-30 -25 -20 -15 -10 -5 0 5 10 15 20 25 30
VIEW ANGLE (·)
□ IDT1
+ PMTV

Date.....................................

-Conclusion: Requirements for straylight rejection induced by a " full" Earth are met in direction (A+B),but are marginally out of specification for case (C+D).

Miscellaneous:

-Inputs for in-orbit predictions:

As it is extremely difficult to get a reliable mathematical model at high attenuation for the HIPPARCOS case,it has been decided to rely on " Moon" measurements for the in-orbit predictions.

-Light-tightness:

No major problem identified during P/L straylight test; however a final check will be performed latter ,after integration of P/L and external baffles on the satellite.

CONCLUSION:

In spite of limited accuracy of straylight measurements in air, one has a good confidence that straylight requirements will be met in orbit.

Date

Annex V

PFM Phtometric Calibration Plans

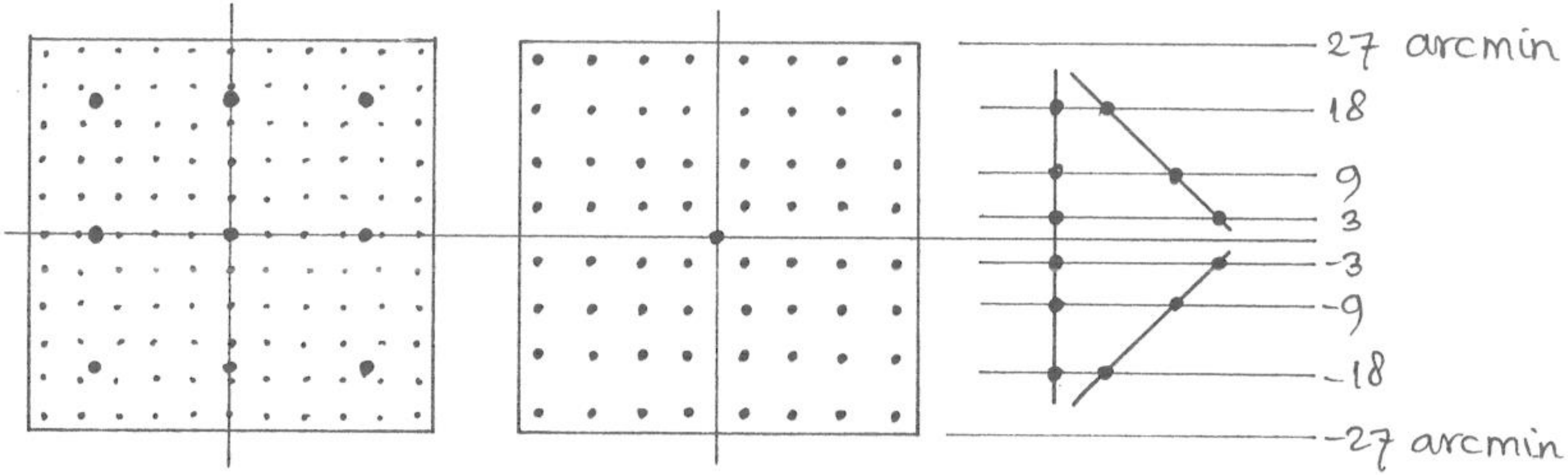
PROGRAM OF PHOTOMETRIC CALIBRATIONS

- PROGRAM AGREED BETWEEN SCIENTISTS/ESA/MATRA/IAL
- COLLIMATOR & P/L IN VACUUM AT IAL, LIEGE (B)
- COLLIMATOR PINHOLE Ø 5 μm

CHAIN	PARAMETER	FOV 1	FOV 2
MAIN DETECTOR	IFOV PROFILE	(3x3) pts x 1 λ x 2 IDTs	(3x3) pts x 1 λ x 2 IDTs
	DE RESPONSE*	(11x11) pts x 3 λs x 2 IDTs	(8x8) pts x 3 λs x 2 IDTs
	SPECTRAL RESP.	1 pt x 14 λs x 2 IDTs	1 pt x 14 λs x 2 IDTs
STAR MAPPER	SINGLE SLIT RESP.	6 pts x 2 slits x 2 λs	6 pts x 2 slits x 2 λs
	SPECTRAL RESP.	2 pts x 2 slits x 14 λs + 4 pts x 2 slits x 6 λs	2 pts x 2 slits x 14 λs

*PLUS MODULATION FACTORS $I_0 M_1 M_2$

LOCATIONS OF MEASUREMENT POINTS



nr. of pts	meshsize (arcmin)
3 x 3	18,00
8 x 8 + 1	6,75
11 x 11	4,91

LARGE SCALE VARIATION OF DETECTION EFFICIENCY

1. GEOMETRICAL RELATIONS BETWEEN GRID AND IDT
2. REQUIREMENTS ON DE HOMOGENEITY
3. ANALYSIS OF P/L(EM) DE MEASUREMENT DATA
4. CAUSES OF DE MEASUREMENT VARIATIONS ON EM
5. ANALYSIS OF IDT (PFM) DE MEASUREMENT DATA
6. CALIBRATION PROGRAM MEASUREMENT MATRIX

1. GEOMETRICAL RELATIONS BETWEEN GRID AND IDT

GRID TO IDT MAGNIFICATION FACTOR = 0,44

	grid	IDT	
FOV-size	21991 µm 3240 as	9676 µm	projected
IFOV ∅	250 µm 36,83 as	110 µm	$\frac{1}{2}$ energy
piloting step	8,182 µm 1,205 as	3,600 µm	1 LSB

2. REQUIREMENTS ON DE HOMOGENEITY

Ref.: MAT-HIP-6136(6) 15/6/86, page 3

- BASIC ACCURACY ASSESSMENT BASED ON QUADRATIC PLANE LARGE SCALE INHOMOGENEITY

$$L = \{1 - (\eta^2 + \zeta^2)/1{,}75\ 10^7\}/0{,}9 \quad \text{for } |\eta|, |\zeta| \leq 1620 \text{ (as)}$$

MEAN VALUE $\bar{L} = 1{,}0000$

DISPERSION $\sigma = 0{,}0702 \triangleq 7{,}02\ \%$

MAXIMUM $L = 1{,}1111$

MINIMUM $L = 0{,}7779$

- REQUIRED CALIBRATION ACCURACY 5% (RMS)

3. ANALYSIS OF P/L(EM) DE MEASUREMENT DATA

Ref: RP-IAL-HIP-33(1) 30/1/87, page 43

6x6 MATRIX OF MEASUREMENT POINTS

MESH SIZE 2035 μm^* $\triangleq$ 681,4 as *ON IDT

MEAN VALUE $\bar{I}_o = 136339$ c/s

DISPERSION $\sigma = 16713$ c/s $\triangleq$ 12,26 %

- BEST FIT WITH QUADRATIC PLANE

CENTER VALUE $I_o = 124838$ c/s

DISPERSION $\sigma = 6994$ c/s $\triangleq$ 5,60 %

4. CAUSES OF DE MEASUREMENT VARIATIONS ON EM

- COLLIMATOR POINTING ERROR $\leq 50\,\mu m^{*} = 7{,}37$ as *ON GRID
  → DE LOSS ≈ 8% (ON SPECIFIED IFOV PROFILE)

  COMPARE WITH SPECIFIED IN ORBIT IFOV POINTING ERROR ≤ 3,73 as
  → DE LOSS ≈ 1% (ON SPECIFIED IFOV PROFILE)

- COLLIMATOR ILLUMINATION INHOMOGENEITY DUE TO INTERNAL VIGNETTING (NOW CORRECTED FOR PFM)

5. ANALYSIS OF IDT (PFM) DE MEASUREMENT DATA

Ref: MAT-HIP-8573 (5) 4/2/87, page 6

9×9 MATRIX OF MEASUREMENT POINTS

MESH SIZE 1075,5 μm* $\hat{=}$ 360,1 as *ON IDT

MEAN VALUE $\bar{L} = 0{,}9976$

DISPERSION $\sigma = 0{,}0274 \hat{=} 2{,}75\,\%$

- BEST FIT WITH QUADRATIC PLANE

CENTERVALUE $L = 1{,}0339$

DISPERSION $\sigma = 0{,}0126 \hat{=} 1{,}22\,\%$

6. CALIBRATION PROGRAM MEASUREMENT MATRIX

- P/L (EM) DE INHOMOGENEITY EXPLAINED
- IDT (PFM) DE EXTREMELY SMOOTH
- P/L (PFM) COLLIMATOR POINTING ERROR SIGNIFICANTLY REDUCED (SEARCH PER POINT)
- MATRIX OF 11x11 EXTREMELY DEMANDING IN VIEW OF EXPECTED DE HOMOGENEITY

$I_o(H,G)$ (cps)		GRID COORDINATE G (μ)					
		-10175	-6105	-2035	+2035	+6105	+10175
GRID COORDINATE H (μ)	-10175	159793 5851	140189 -72	131843 521	124751 -2375	121535 -6136	137069 4111
	-6105	164503 11442	132458 -5724	122294 -5752	117777 -4874	118553 -3445	134603 8016
	-2035	155984 659	136496 -2752	122904 -5009	114111 -7209	120512 1043	127170 4810
	+2035	163418 2685	138928 -4530	132732 1807	125329 2195	117673 -2413	130486 8707
	+6105	163943 -5343	149124 -1689	140828 3746	133065 4972	125483 1637	121379 -2962
	+10175	170549 -10434	166249 4937	154008 7625	145097 8901	143090 12339	104781 -25267

Table 4.5 Mesh of 6×6 count rates I_o obtained in the MP01. F1. 36 sequence.

mesh size $s = 2035\ \mu m \hat{=} 678{,}3$ as

mean $\bar{I}_o = 136339$

dispersion $\sigma = 16713$ ($\hat{=} 12{,}26\ \%$)

best fit with quadr. plane $\begin{cases} I_o(0,0) = 124838 \\ \sigma\ (res) = 6994 \quad (\hat{=} 5{,}60\ \%) \end{cases}$

modified

Large scale variations of Detection Efficiency

No of longitudinal and transverse interp. points for LS photocathode inhomog.
9.9.

Interpolation data for LS photocathode inhomogeneities (FM 2) IDT

	1	2	3	4	5	6	7	8	9
1	0.9393 0.9442	0.9641 0.9669	0.9724 0.9832	0.9818 0.9930	0.9968 0.9964	0.9942 0.9933	0.9886 0.9837	0.9618 0.9677	0.9610 0.9452
2	0.9608 0.9581	0.9776 0.9813	0.9865 0.9981	1.0221 1.0085	1.0292 1.0124	1.0008 1.0098	0.9840 1.0008	0.9714 0.9853	0.9747 0.9633
3	0.9904 0.9675	0.9778 0.9913	1.0109 1.0087	1.0244 1.0196	1.0259 1.0240	1.0369 1.0220	1.0093 1.0135	1.0133 0.9985	0.9794 0.9771
4	0.9724 0.9725	1.0175 0.9969	1.0313 1.0148	1.0229 1.0262	1.0224 1.0312	1.0174 1.0297	1.0268 1.0217	1.0109 1.0073	0.9997 0.9864
5	0.9665 0.9731	0.9872 0.9980	1.0097 1.0164	1.0274 1.0284	1.0630 1.0339	1.0238 1.0329	1.0302 1.0255	0.9940 1.0116	0.9550 0.9913
6	0.9477 0.9692	0.9909 0.9947	1.0043 1.0136	1.0366 1.0261	1.0268 1.0322	1.0430 1.0318	1.0274 1.0249	1.0194 1.0115	0.9631 0.9917
7	0.9696 0.9610	1.0143 0.9869	1.0032 1.0064	1.0231 1.0195	1.0116 1.0261	1.0333 1.0262	0.9927 1.0198	1.0020 1.0070	0.9809 0.9878
8	0.9550 0.9483	0.9760 0.9748	0.9848 0.9948	1.0002 1.0084	1.0177 1.0155	1.0263 1.0162	1.0433 1.0104	1.0134 0.9981	1.0051 0.9794
9	0.9309 0.9311	0.9589 0.9582	0.9645 0.9787	1.0001 0.9929	0.9708 1.0005	1.0059 1.0017	0.9966 0.9964	0.9917 0.9847	0.9590 0.9665

TABLE 1 - LSC PHOTO. INHOM.

mesh size $s = 1075{,}5\ \mu m \hat{=} 358{,}5$ as

mean $\bar{L} = 0{,}9976$

dispersion $\sigma = 0{,}0274 \hat{=} 2{,}75\ \%$

best fit quadr. plane $\begin{cases} L(5{,}5) = 1{,}0339 \\ \sigma(res) = 0{,}0126 \hat{=} 1{,}22\ \% \end{cases}$

Annex VI

Homogeneity Maps of PFM1/PFM2

MAT.HIP.06136
7
15.01.87
3

HIP174 3

	8	178	348	518	688	858	1028	1198	1368	1538	1708	1878	2048	2218	2388	2558	2728	2898	3068	3238	3408	3578	3748	3918	4088
8											9225	9332	9360	9349	9333										
178								9346	9311	9229	9242	9314	9482	9417	9281	9464	9333	9381							
348						9287	9274	9247	9339	9482	9331	9281	9418	9456	9441	9482	9493	9383	9131	9149					
518					9469	9154	9436	9388	9375	9502	9440	9485	9368	9467	9490	9455	9623	9427	9374	9563	9207				
688				9206	9148	9251	9354	9398	9530	9723	9813	9605	9596	9583	9554	9596	9675	9340	9337	9416	9438	9215			
858			9159	9073	9372	9393	9277	9431	9783	9594	9599	9510	9651	9504	9713	9526	9409	9495	9528	9507	9367	9341	9330		
1028			9159	9346	9440	9479	9489	9530	9782	9750	9650	9858	9759	9724	9618	9826	9727	9471	9531	9571	9472	9522	9277		
1198		9030	9183	9429	9420	9407	9487	9595	9720	9858	9751	9851	9831	9631	9710	9634	9843	9542	9477	9797	9486	9434	9476	9371	
1368		9079	9225	9326	9348	9509	9556	9613	9633	9861	9790	9573	9666	9763	9639	9758	9660	9492	9751	9532	9412	9260	9381	9394	
1538		8945	9280	9176	9441	9569	9647	9662	9735	9786	9720	9733	9626	9544	9724	9630	9718	9511	9622	9434	9654	9497	9277	9332	
1708	8955	9046	9077	9323	9536	9312	9428	9733	9723	9957	9716	9710	9411	9535	9879	9542	9680	9530	9777	9619	9399	9623	9279	9382	9446
1878	9091	9069	9314	9535	9596	9515	9674	9653	10002	9732	9780	9838	9565	9603	9580	9512	9673	9784	9762	9643	9667	9679	9439	9357	9388
2048	9149	8972	9200	9444	9329	9691	9529	9789	10119	9824	9726	9807	10015	9539	9414	9497	9741	9764	9600	9798	9707	9498	9660	9384	9417
2218	8946	9009	9271	9196	9551	9500	9635	9812	9874	9699	9871	9864	9668	9675	9683	9715	9856	9751	9929	9577	9574	9548	9479	9289	9315
2388	9091	9046	9120	9282	9439	9428	9509	9746	9872	9696	9747	9739	9767	9860	9823	9938	9743	9847	9802	9743	9579	9548	9481	9547	9342
2558		9330	9193	9239	9394	9366	9584	9903	9616	9918	9917	9992	9781	9876	9920	9728	9804	9687	9696	9787	9770	9659	9439	9436	
2728		8989	9317	9319	9209	9553	9536	9386	9768	9734	9915	9778	9886	9763	9830	9796	9724	9833	9818	9907	9579	9568	9393	9307	
2898		9033	8992	9237	9422	9326	9561	9780	9521	9787	9955	9905	9979	9921	9891	10007	9634	9732	9704	9555	9630	9496	9308	9293	
3068			9029	9080	9137	9366	9469	9689	9656	9885	9871	9735	9848	9910	9896	9902	9647	9919	9668	9448	9254	9425	9247		
3238			9052	9176	9132	9261	9234	9518	9546	9866	9698	9923	9825	9664	9963	9852	9591	9538	9730	9674	9549	9502	9518		
3408				9031	9095	9117	9470	9510	9582	9487	9736	9760	9808	9738	9848	9588	9647	9650	9628	9520	9582	9481			
3578					9054	9178	9361	9641	9725	9465	9488	9557	9747	9644	9753	9690	9636	9603	9518	9352	9486				
3748						9033	9310	9306	9733	9488	9632	9710	9387	9702	9829	9480	9496	9637	9692	9069					
3918								9128	9487	9298	9399	9411	9585	9513	9442	9730	9563	9500							
4088											9368	9143	9290	9369	9431										

Grid image

FIGURE 2.1/1 : HOMOGENEITY MAP MDA PFM1

ANNEX VI

HIP174 4

MAT.HIP.06136
7
15.01.87
4

	0	170	340	510	680	850	1020	1190	1360	1530	1700	1870	2040	2210	2380	2550	2720	2890	3060	3230	3400	3570	3740	3910	4080
0											9251	9272	9154	9111	9043										
170								9216	9121	9214	9202	9277	9386	9038	9407	9151	9221	9179							
340						9090	9166	9207	9419	9264	9236	9302	9298	9318	9372	9353	9231	9347	9168	9123					
510					9199	9271	9228	9172	9344	9217	9331	9323	9534	9225	9509	9363	9326	9353	9263	9262	9070				
680				9123	9003	9169	9241	9345	9321	9587	9411	9518	9554	9428	9530	9470	9476	9248	9219	9288	9211	9115			
850			8920	9103	9329	9360	9312	9447	9370	9520	9632	9526	9850	9689	9458	9468	9235	9305	9388	9476	9269	9197	8986		
1020			8749	9109	9209	9349	9370	9504	9456	9409	9797	9771	9865	9719	9593	9627	9432	9444	9311	9197	9343	9238	9110		
1190		8830	8893	9111	9244	9360	9389	9447	9740	9768	9834	9958	9742	9906	9802	9728	9626	9640	9608	9454	9132	9276	9253	9179	
1360		8824	8981	9085	9493	9336	9372	9610	9690	9807	9819	9864	9833	9839	9939	9688	9674	9778	9713	9581	9388	9408	9345	9180	
1530		8965	9124	9161	9195	9376	9527	9716	9810	9621	9775	9830	9709	9838	9802	9884	9769	9607	9787	9493	9290	9325	9201	9145	
1700	8676	8683	8913	9174	9321	9404	9753	9679	9885	9853	9805	9567	9800	9790	9752	9686	9842	9798	9690	9438	9582	9138	9222	9247	9126
1870	8674	9031	8859	9243	9326	9448	9603	9688	9860	9807	9798	9902	9982	9729	9830	9884	9919	9739	9512	9563	9286	8968	8841	8957	8900
2040	8726	8807	9145	9150	9264	9485	9462	9757	9678	9838	9848	9904	10189	10026	9813	9742	9875	9871	9528	9569	9154	9025	8936	8954	[illegible]
2210	8771	8836	8983	9225	9389	9427	9628	9527	9878	9944	9899	9828	10062	9681	9809	9953	9897	9866	9752	9434	9289	8988	9011	8755	[illegible]
2380	8719	8867	8985	9147	9084	9525	9498	9541	9626	9865	9936	9870	9842	9845	9997	9936	9848	9780	9771	9568	9231	8814	8592	8455	[illegible]
2550		8807	8792	9002	9436	9428	9527	9615	9905	9750	9880	9928	9789	9852	9904	9587	9968	9737	9703	9619	9419	8972	8945	8835	
2720		8739	8890	9154	9294	9359	9722	9427	9616	9620	9807	9770	9696	10039	9904	9851	9515	9557	9604	9621	9402	9205	9129	8911	
2890		8762	8939	8972	9290	9339	9590	9436	9568	9587	9703	9764	9814	9729	9660	9792	9859	9770	9590	9510	9555	9318	9118	9165	
3060			8879	8822	9154	9048	9355	9409	9439	9463	9587	9391	9755	9746	9837	9744	9555	9684	9714	9625	9634	9343	9342		
3230			8885	8973	9229	9209	9238	9470	9057	9349	9598	9568	9510	9800	9629	9754	9511	9462	9633	9480	9357	9396	9266		
3400				9003	8923	9309	9191	9385	9245	9386	9586	9717	9305	9525	9642	9576	9553	9455	9506	9550	9492	9408			
3570					9003	9053	9094	9215	9453	9532	9348	9518	9378	9522	9492	9527	9552	9430	9437	9444	9296				
3740						9025	8903	9170	9181	9430	9196	9179	9227	9348	9479	9498	9651	9507	9483	9404					
3910								9097	8996	8948	9003	9186	9267	9244	9381	9157	9334	9256							
4080											9076	9154	9189	9241	9158										

Grid image

FIGURE 2.1/2 : HOMOGENEITY MAP MDA PFM2

Annex VII

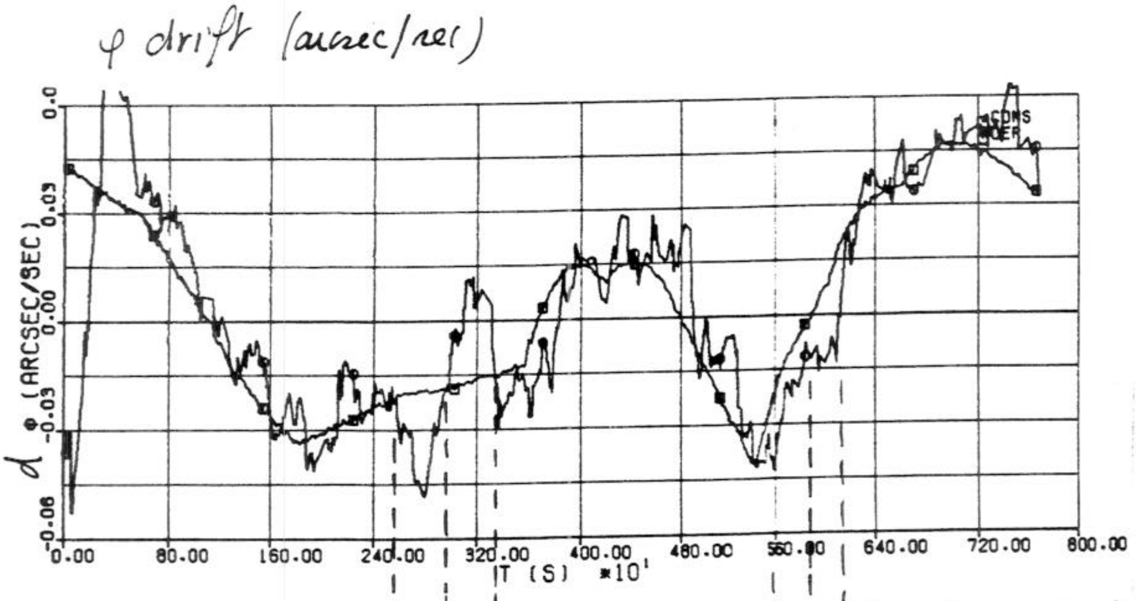
Thermo-Mechanical Distortion

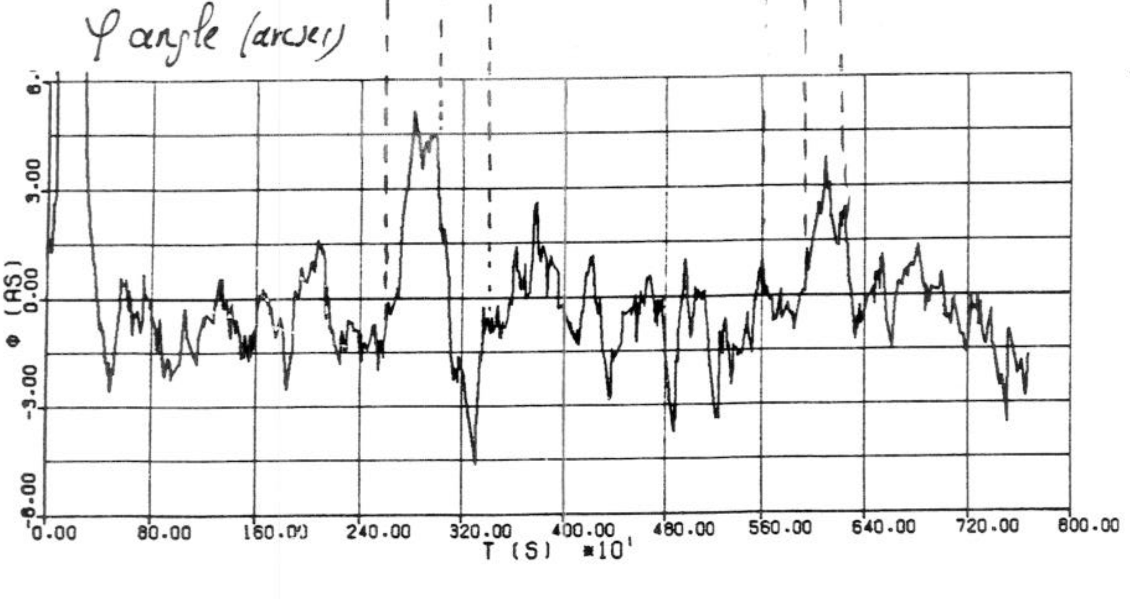
ANNEX VII

Page n° 3-2

DRIFT ERROR EFFECT

MATRA ESPACE





Date 20.5.87

MODEL THEORICAL APPROACH

1 axis filter

between 2 updates:

$$\Delta_{t_k}^{t_{k+1}} \alpha = \int_{t_k}^{t_{k+1}} [\underbrace{d + dist}_{\text{low freq command}} \underbrace{- \hat{d}}_{\text{drift estimate}}] \, dt$$

<u>Introduction of a model:</u>

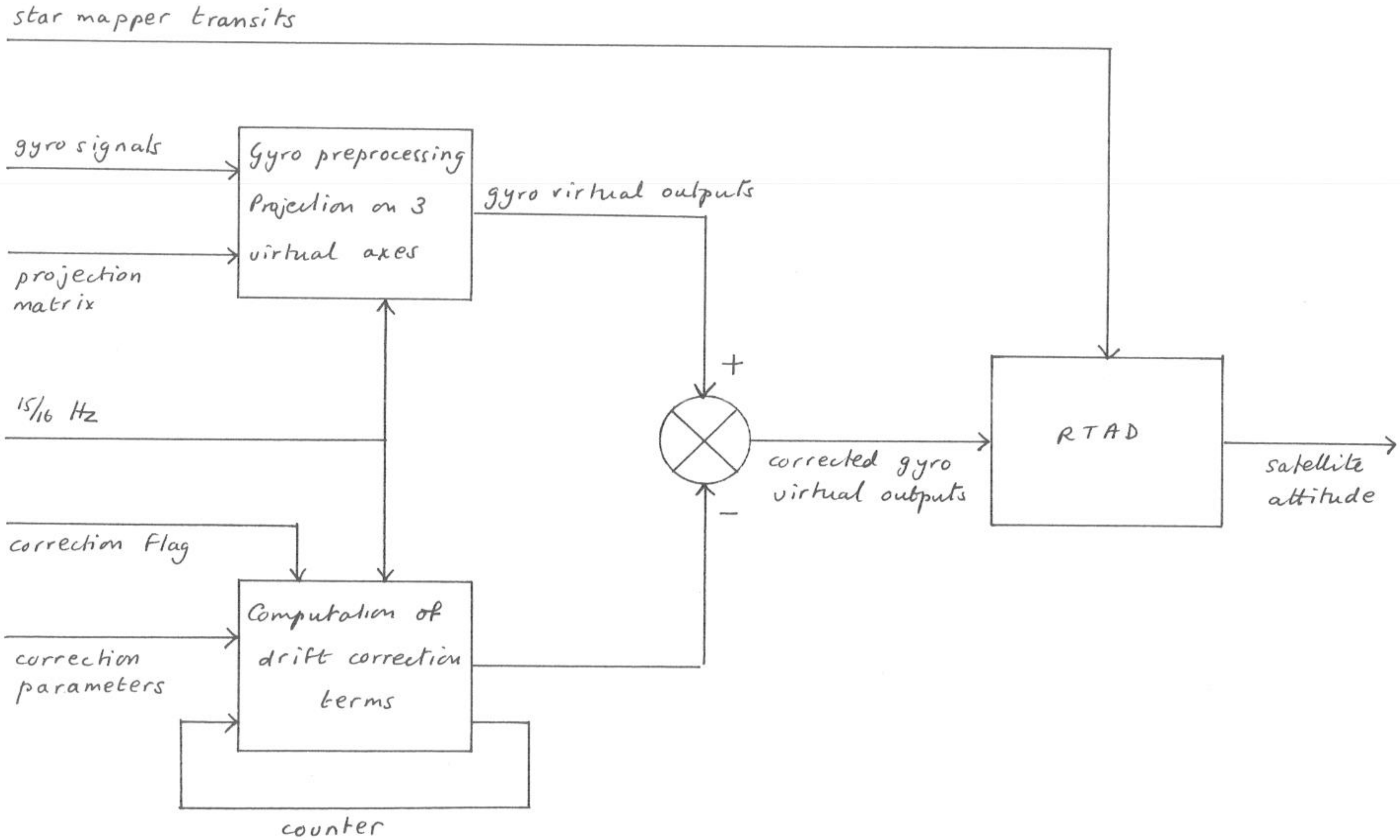
$$\Delta_{t_k}^{t_{k+1}} \alpha = \int_{t_k}^{t_{k+1}} [d + dist - d_{MOD} - \hat{d}] \, dt$$

$$d_{MOD} \text{ must minimize} \left[\int_0^{7680} (\underbrace{d}_{\text{random walk}} + \underbrace{dist}_{\text{thermal distorsion drift}} - \underbrace{d_{MOD}}_{\text{model drift}} - \underbrace{\hat{d}}_{\text{RTAD drift estimate}}) \, dt \right] \text{ for any skyslice.}$$

$E[d] = 0$

$$\Rightarrow \boxed{d_{MOD}(t) = dist(t)}$$

 Date 20-5-87

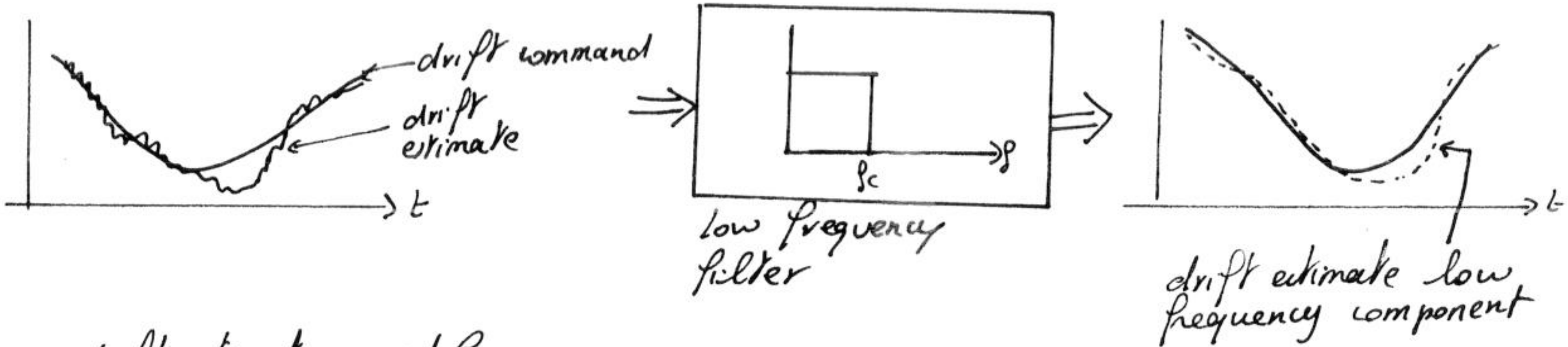

star mapper transits
gyro signals
projection matrix
15/16 Hz
correction Flag
correction parameters
Gyro preprocessing
Projection on 3 virtual axes
gyro virtual outputs
Computation of drift correction terms
counter
+
−
corrected gyro virtual outputs
RTAD
satellite attitude

THERMAL DISTORSION DETERMINATION

Sources

- RTAD drift estimate
- OGAR drift estimate
- others - theorical model ...

Ex:



RTAD drift estimate model

COMPOSED OF :

* dist = thermal distorsion
* $(drw)_{Lf}$ = low frequency random walk

} low frequency drift command

* d_{ERR} = low frequency ERROR.

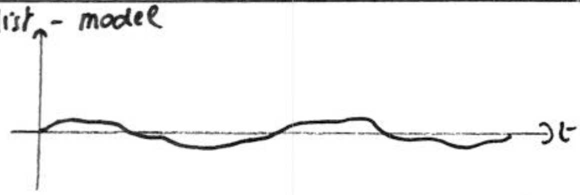
⇒ REMAINING COMMAND : $(drw)_{Lf} + (drw)_{gyro} + d_{ERR}$

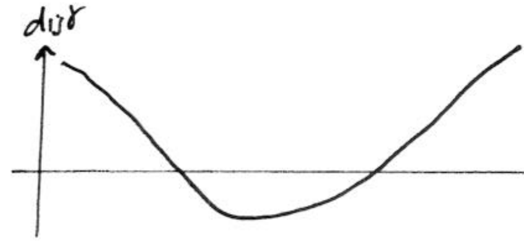
THERMAL DISTORSION A-PRIORI ESTIMATE

MATRA ESPACE

model	Without model

REMAINING THERMAL DISTORSION

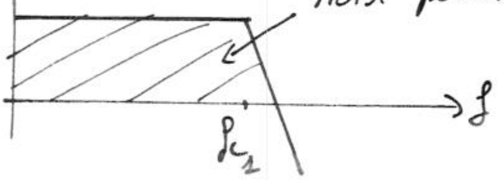


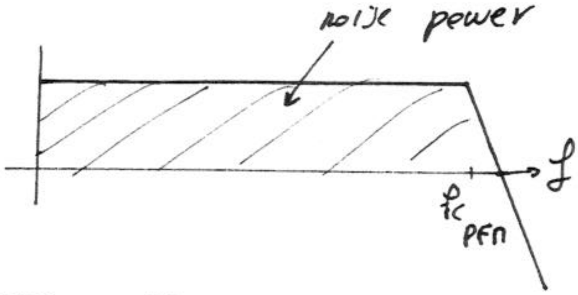


⇒ ADAPTED GAINS

PFM GAINS

bandwidth - noise





Reduction of RMAD noise

PFM noise

POINTING ACCURACY

Model:

RMS	0.94	0.59
MAX	3.24	3.50

Without model:

RMS	1.31	1.34
MAX	5.26	5.73

(simplified program)

Date 20.5.87

Annex VIII

Data Errors of Telemetry Data

ANNEX VIII

DATATION ERRORS OF TELEMETRY DATA

1. REQUIREMENTS

	on-board	on-ground
stability of datation	3.5 μsec per 10 sec	1.5 μsec per 5 min
absolute datation	4 μsec wrt TM frame	1 msec wrt UTC

Table 1: Summary of Overall Datation Requirements

2. INFLUENCES AFFECTING ON-GROUND DATATION ACCURACY

- PROPAGATION DELAY VARIATIONS DUE TO IONOSPHERIC AND WEATHER EFFECTS
- SATELLITE POSITION UNCERTAINTY DUE TO RANGING ERRORS
- LIMITATION IN GROUND STATION CLOCK RESOLUTION
- TELEMETRY TIME-TAGGING INACCURACY (DECODER PHASE-LOCK)
- GROUND STATION CLOCK DRIFT IN-BETWEEN LORAN-C UPDATES)

Error Source	Absolute	Relative (5 min)
ionosphere	0.15	± 0.1
position	± 0.2	± 0.02
clock resolution	± 0.2	± 0.2
station delay	± 0.05	± 0.05
decoder lock	± 0.4	± 0.4
subcarrier jitter	± 0.21	± 0.21
clock drift	± 10	± 0.01
Total error	± 11.2	± 1.0
Spec value	± 1000	± 1.5

Table 2: Summary of Worst-Case Datation Errors in μsec

ESA ESOC

ORBIT DATA COMPARISON (PROPOSAL)

1. DATA

ESOC CAN PRODUCE SIMULATED (BUT COMPLETELY REALISTIC) ORBIT AND ECLIPSE DATA IN DDID FORMAT FOR A 2 OR 3 DAYS PERIOD

2. COMPARISON

- AT A FEW SPECIFIED POINTS IN TIME THE CORRESPONDING SATELLITE POSITION VECTOR IS COMPUTED FROM DATA (BY DRC'S AS WELL AS ESOC)
- NOTE: ESOC CAN PROVIDE DRC'S WITH A SUBROUTINE FOR READING ORBIT AND ECLIPSE DATA FROM THE DDID RECORDS. IN THIS CASE THE COMPARISON IS LIMITED TO CHECKING CORRECT IMPLEMENTATION OF THE SUBROUTINE

3. SCHEDULE

- SIMULATED ORBIT AND ECLIPSE DATA FILES CAN BE DELIVERED BY OCTOBER 87
- READING SUBROUTINE (IF REQUIRED) CAN ALSO BE AVAILABLE BY OCTOBER 87
- SIMULATED ORBIT DATA CAN BE INCORPORATED IN DDID TEST TAPE BY BEGIN 88

DDID EVOLUTION

* COMMENTS ON PRESENT DDID (ISSUE 3) PLUS SEPARATE DATA DESCRIPTIONS (I. E. AOCS; PAYLOAD MONITORING & CCCM) ARE INVITED UNTIL END SEPTEMBER
* UPDATED AND COMPLETED ISSUE 4 CAN BE DELIVERED BY ESOC ONE MONTH PRIOR TO NEXT HST
* DDID ISSUE 4 SHOULD BE THE LAST FORMAL ISSUE (APART FROM MINOR MODIFICATIONS AND CLARIFICATIONS PERHAPS)
* COMMENTS ON ISSUE 4 SHOULD BE AVAILABLE BY NEXT HST (AT ESOC!) WHERE THEY CAN BE DISCUSSED WITH AVAILABLE EXPERTS

TEST TAPE STATUS

* NEW TEST TAPE WAS DISTRIBUTED IN JUNE:
  - TELEMETRY HEADERS
  - TIMING INFORMATION
* COMMENTS ARE WELCOME!
* ESOC WILL GENERATE REALISTIC IDT/SM COUNTS AND CORRESPONDING OBSERVATION REPORTS FOR ITS OWN SIMULATIONS
* THIS WILL BE READY BY DECEMBER 87
* WITH SOME EXTRA EFFORT ESOC WOULD BE ABLE TO PRODUCE REALISTIC PAYLOAD DATA IN DDID FORMAT ON A NEXT TEST TAPE
* SUCH A TEST TAPE COULD THEN BE DISTRIBUTED BY JAN/FEB 88

Annex IX

Numbering of Objects - Chromaticity Mode

Numbering of Objects for Payload Calibration in Chromaticity Mode

Proposal

(a) Uplinked stars in PSF for RTAD:

original INCA number (as usual)

(b) Blue-dispersed star image:

INCA number + 10^6

(c) Red-dispersed star image:

INCA number + 2.10^6

i.e. object 104319 INCA
≡ 1104319 blue image } chrom
≡ 2104319 red image } mode

NB: since $2^{16} = 65536$, presumably INCA running numbers will be coded by ESOC, INCA and NDAC/FAST in 3 (or 4?) bytes, providing a range of

$2^{24} = 16{,}777{,}216$

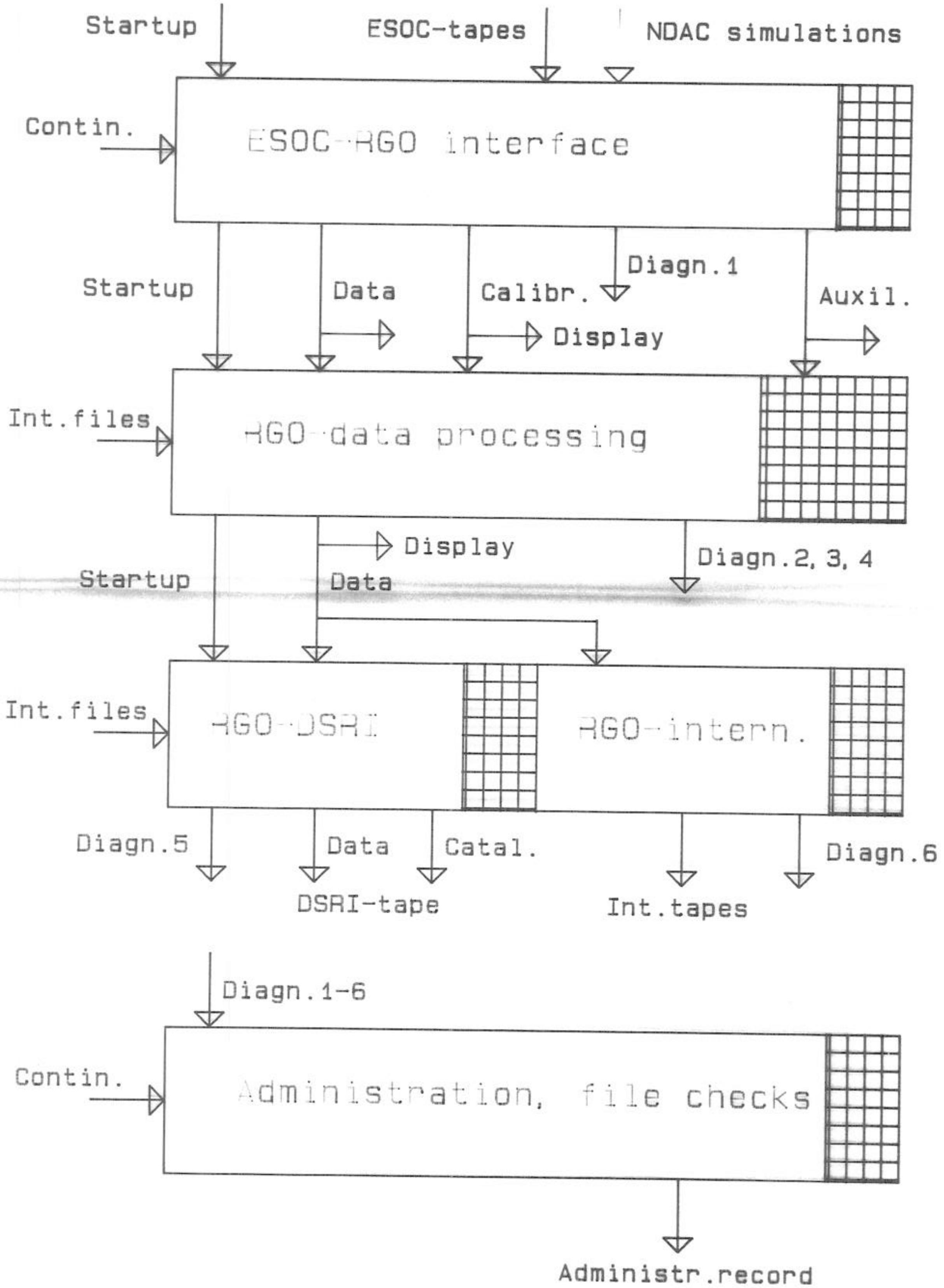
MACP, 14/7/87

Annex X

RGO/NDAC Status

Annex X

RGO/NDAC data flow diagram



Data display facilities

1. SIGMEX 6164 : high resolution screen
   "intelligent device"
   use : IDT, main grid, attitude

2. Pericom : medium resolution screen
   use : Star mapper, calibr.

3. HP7475A : Hardcopy device, 6 pens
   use : reference plots, calibr.

4. Canon laserp.: Hardcopy device
   use : reference plots, calibr.

Plotting interface : GKS, version 7.2

Devices can be interchanged

HIPPARCOS Attitude Reconstitution

Star Mapper data processing

Input data : 250 compressed B and V counts
Scanning velocity
Single Slit Response Functions
Predicted crossing time
Predicted intensities
Data decompression law

Main problems: Detecting and/or resolving multiple transits (45%)

Finding undisturbed sky

Set acceptance criteria

Positional accuracies for single transits

CNT at 600Hz	S.D. (mas)
>1200	3.1
1200 - 400	5.8
400 - 150	9.0
150 - 65	15.6
65 - 40	21.4
40 - 25	28.8
25 - 18	37.1
18 - 12	46.7
12 - 10	62.7

Star Mapper reduction

Reduction methods	:	Maximum likelyhood (FAST) Iterative least squares (NDAC)
Position determination	:	B and V signals individually B and V signals combined
Photometry	:	Fit of single slit resp.functions Fit of single slit resp.functions
Sky determination	:	Pre-selected points around transit all non-transit points used
Multiple transits	:	Reject if recognized accounted for in reduction
Statistical tests	:	Unit weight variance tests on star signal and background Star signal significance tests External comparison magnitudes Internal comparison magnitudes
Applications	:	Accepted transits to attitude photometric calibration and catalogue updates sky measures to IDT photometry

Star Mapper comparison data

Source : NDAC/RGO simulation software

1. Photon-counts and transit data file

   For each transit: 2*250 counts, extracted in telemetry frame units

   Reference to star catalogue for transit star.

   Relative transit time, SM used

   Slitgroup, branch, FOV, crossing speed

2. Star catalogue file

   Identifier, RA, DEC, B, V

3. Parasitic star transits file

   All transit times and magnitudes of the parasitic star crossings

4. Multiple SM crossing data file

   Cross-reference table for parasitic star crossings within SM counts extracts.

Annex XI

GCR Comparison Status

ANNEX XI

DUT/HvdM

STATUS OF THE GCR COMPARISON

- LEVEL I COMPARISON (45 %)
  - ■ LUND DATA REDUCED BY COPENHAGEN AND DELFT
  - □ EXCHANGE OF FORMATTED FILES WITH RESULTS
  - □ CERGA DATASET III (WITHIN 2 OR 3 MONTHS)

- LEVEL II AND III COMPARISONS
  - ■ PROPOSAL WITH THE PRINCIPLES, METHODS AND DATA EXCHANGE FORMATS READY, OPEN FOR COMMENTS
  - □ TRY OUT ON THE RESULTS OF A LUND OR CERGA DATASET (LEVEL I)

PRINCIPLES, METHODS AND DATA EXCHANGE FORMATS

- COMPARISON ON IDENTICAL RGC'S (AS BEFORE, SEE HST FEB. 1987)

- ABSCISSAE:
  - RANDOM ERRORS DEPEND ON THE SET OF STARS TO BE SOLVED: ACTIVE/PASSIVE & REWEIGHTING INFLUENCE THE RESULTS
  - SYSTEMATIC ERRORS (DUE TO NOT SOLVING THE TRANSVERSAL COMPONENTS) ARE NOT VERY DIFFERENT

  PROBABLY THE DIFFERENCE NDAC-FAST < TRUE ERRORS, BUT HOW MUCH?
- INSTRUMENTAL PARAMETERS: DIFFERENT MODELS ⇒ CONVERSION

- DATA EXCHANGE

  AT MOST 4 FILES: ABSCISSAE, INSTRUMENT AND ATTITUDE, AND POSSIBLY L.S. RESIDUALS

  THE FILES CONTAIN ALSO THE TRUE VALUES (IF AVAILABLE)

  ATTITUDE FILE HAS THE SAME FORMAT AS FOR THE OGAR COMPARISON.

  STANDARD FILE HEADER
- SPECIAL TESTS ON SIMULATED DATA (ONLY ONCE OR TWICE):
  1. WITH ERRORLESS OBSERVATIONS ⇒ MODELLING ERRORS DUE TO NOT SOLVING THE TRANSVERSAL COMPONENTS
  2. ALL DATA ERRORLESS ⇒ REMAINING SYSTEMATIC ERRORS

PRELIMINARY RESULTS GCR COMPARISON - I

simulation (Lund):

dataset I: 10.67 hours of observations, 1964 stars, σ_{star}=1"5, σ_{att}=0"1, h_{00} = 0.1 [slits], g_{01} = -50 [slits/rad]
typical for *First Treatment*

dataset II: FAST: as dataset I, but with σ_{star}=0.
NDAC: 10.67 hours of observations, σ_{star}=0"1,
σ_{att}, h_{00} and g_{01} as dataset I.
typical for *Final Iterations*

results:

	dataset I		dataset II	
	NDAC	FAST	NDAC	FAST
abscissae error[1]				
R.m.s. error [mas]	11.1	11.1	3.0	2.95
Max. error [mas]	60.4	-61.6	29.8	29.1
Number of slit errors	1384	1360	--	--
normalized observation error[2]				
before weight reduc.	1.428	1.427	1.008	1.005
after weight reduc.[3]	1.406	--	--	--

remarks:

[1] abscissae error $\equiv \frac{1}{n}\sum_{i=1}^{n}\psi_i - E\{\psi_i\}$, ($n \equiv$ number of abscissae)

[2] normalized observation error $\equiv \sqrt{\frac{1}{m-n}\sum_{i=1}^{m}\varepsilon_i^2/\sigma_i^2}$,

with m the number of observations, n the number of unknowns, ε_i the residual of the i'th observation after adjustment and σ_i the a-priori standard deviation.

[3] 443+75+59 weight reductions were done in the last 3 iterations (of a total of 6 iterations), the limit was 5σ.

error in the estimated instrumental parameters:

error ≡ $\hat{\rho} - E\{\rho\}$, computed at the upper right corner of the field of view. Units are [mas], [mas/mag] or [mas/6 hours].

		dataset I		dataset II		
		NDAC	FAST	NDAC	FAST	
half basis angle def.						
	(h00,c0)	-0.76	-0.01	-0.6	0.0	[mas]
t	(---,c1)		-0.10		-0.01	[mas/6 hours]
c	(d00,c2)	0.0	0.18	0.0	0.0	[mas/mag]
common fov def.						
x^1	(g10,a010)	0.12	0.39	0.10	0.10	[mas]
y^1	(g01,a001)	-1.28	-1.90	-0.23	-0.29	[mas]
x^2	(g20,a020)	0.26	0.27	0.06	0.05	"
x^1y^1	(g11,a011)	-0.07	-0.15	0.05	0.06	"
y^2	(g02,a002)	0.57	0.41	-0.13	-0.17	"
cx	(c10,a110)	0.65	0.08	-0.0	0.02	[mas/mag]
cy	(c01,a101)	0.33	1.06	-0.02	-0.10	[mas/mag]
x^3	(---,a030)		0.22		0.05	[mas]
x^2y^1	(---,a021)		0.23		0.08	"
x^1y^2	(---,a012)		-0.17		-0.11	"
y^3	(---,a003)		0.75		0.19	"
differential fov def.						
x^1	(h10,----)	0.38		0.77		[mas]
y^1	(h01,----)	4.77		1.52		"
x^2	(h20,----)	-0.31		-0.46		"
x^1y^1	(h11,----)	-0.75		-0.32		"
y^2	(h02,----)	-3.16		-0.80		"
cx	(d10,----)	1.10		0.21		[mas/mag]
cy	(d01,----)	-2.79		-1.01		[mas/mag]

$c \equiv B\text{-}V - 0.5$

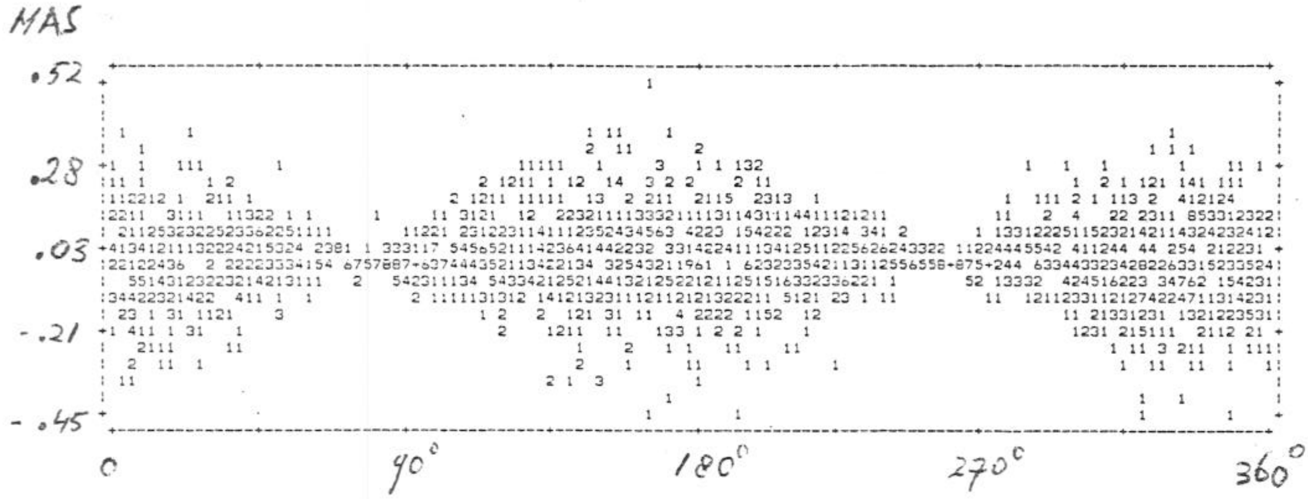
RESULTS (FAST) ON LUND DATASET "LOSIM3"

1. PROPERTIES OF THE RGC

- 1964 STARS: 1697 BRIGHTER THAN MAG 10
- 5 REVOLUTIONS, 10.67^h, 5 MAJOR GAPS (1504 FRAMES OCCULTED)
- 78300 GRIDCOORDINATES (OBSERVATIONS)
- ERROR IN OGAR ATTITUDE = 0"1,
  ERROR IN A-PRIORI STAR CATALOG = 1"5

2. VERIFICATION OF THE FORMULAE

- RUN WITH ERRORLESS OBSERVATIONS AND A-PRIORI DATA
- RESULTS ABSCISSAE: RMS .12 MAS
  MAX. .52 MAS



3. RESULTS ON THE STAR ABSCISSAE

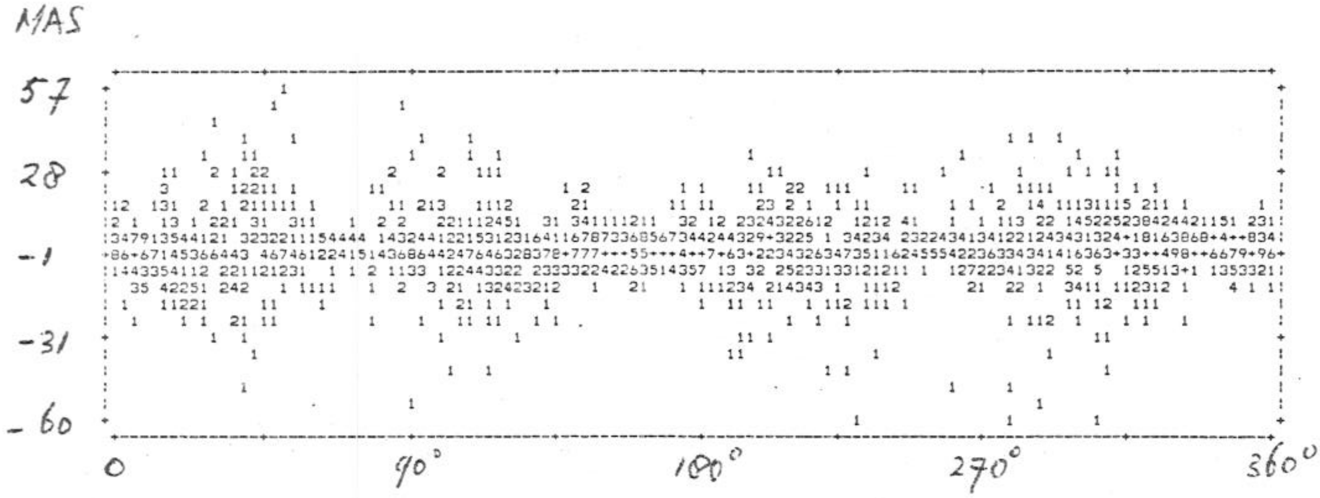
- SEVERAL COMBINATIONS WITH ERRORLESS A-PRIORI VALUES:

	RMS OGAR	RMS STARS	
PA	0	0	PERFECT A-PRIORI
I	0"1	0	ITERATION
F	0"1	1"5	FIRST TREATMENT

- ABSCISSAE ERROR:

	RMS	MAX	MODEL ERROR
PA	2.905	29.48	-
I	2.949	29.13	.51
F	11.134	-61.59	10.7

MODEL ERROR DUE TO NOT ESTIMATING TRANSVERSAL ATTITUDE AND STAR ORDINATES (VERIFIED BY SPECIAL TESTRUNS AND FORMULAE):



- RESULTS PER MAGNITUDE CLASS:

mag.	#stars	S_obs	S_att	S_instr	S_geom	Eps_PA	Eps_I	Eps_F
		COMPONENTS OF ST DEV			TOT ST. DEV	"TRUE" ERRORS		
2	1	0.52	2.36	0.14	2.42	2.53	2.28	27.7
3	4	0.42	2.11	0.18	2.15	1.75	2.08	4.8
4	12	0.53	2.30	0.20	2.36	1.47	1.62	12.9
5	28	0.55	2.15	0.18	2.22	1.40	1.43	8.9
6	52	0.65	2.16	0.18	2.25	1.34	1.35	11.2
7	223	0.95	2.18	0.18	2.38	1.54	1.62	11.1
8	480	1.38	2.18	0.18	2.58	1.97	2.03	11.3
9	638	2.08	2.20	0.18	3.03	2.66	2.71	10.7
10	395	3.09	2.23	0.17	3.81	3.29	3.29	11.5
11	102	4.96	2.31	0.17	5.47	5.75	5.78	11.1
12	28	8.32	2.61	0.18	8.72	7.96	8.23	14.0
13	1	8.49	2.02	0.16	8.72	7.16	7.39	6.0
	1964	2.49	2.21	0.18	3.33	2.91	2.95	11.1

4. RESULTS ON THE INSTRUMENT

- STANDARD DEVIATIONS: .26 MAS (Y^3), .20 MAS (Y^1) OR < .18 MAS IN THE UPPER RIGHT CORNER OF THE FIELD.
- ERRORS: SEE "PRELIMINARY RESULTS GCR COMPARISON - I"

5. SMOOTHING OF ATTITUDE DATA

- NOT SUCCESFULL; ATTITUDE NOT SMOOTH ENOUGH
  RMS ERROR SMOOTHED ATTITUDE > 100 MAS (709 B-SPLINES),
  MAX ERROR 640 MAS.
- EXPECTED IMPROVEMENT (FROM FORMAL STANDARD DEVIATIONS):
  MAG. 7 STAR: 1.3 ×
  MAG. 9 STAR: 1.1^6 ×

6. GRID STEP INCONSISTENCY HANDLING

STRAIGHTFORWARD COMPUTATION WOULD RESULT IN 523 INCONSISTENT STARS (4731 SLIT ERRORS, NOT COUNTING THE SLITERRORS DUE TO THE 1400 STARS WHICH ARE SHIFTED OVER MULTIPLE GRIDSTEPS).

CONSISTENT RESULTS WITH:

A. PREADJUSTMENT
   - SEQUENTIAL ANALYSIS & ADJUSTMENT OF A-PRIORI STAR ABSCISSAE AND ATTITUDE (RMS ERROR IN A-PRIORI INSTRUMENT = 20 MAS).
   - REFINED GRID STEP ESTIMATION; UPDATE STAR ABSCISSAE FROM FIRST OBSERVATION.

B. POSTADJUSTMENT (WITHOUT PREADJUSTMENT)
   - SEQUENTIAL ADJUSTMENT (WITH MORE ROBUST ATTITUDE ESTIMATION): TWO INTERNAL ITERATIONS WERE SUFFICIENT, NORMALISED OBSERVATION ERROR GOES FROM 25.8, VIA 2.17 TO 1.43
   - FRAME BY FRAME ANALYSIS (WORKS, BUT MORE INT. ITERATIONS)

PASSIVE STAR GRID STEP HANDLING HAS NOT BEEN USED.

Annex XII

Comparison – Future Plans

Present Status of the Level 1-3 Comparison Tasks

The following is a grid showing, for each comparison task, the data to be supplied, the person(s) responsible for reducing and comparing the data, and the corresponding due dates. An attempt to fill in the grids should be made at the HST meeting in July.

Notes:

(1) The procedure/format leaders should be from NDAC and FAST, and should be involved with the real data exploitation - i.e. they should be able to recommend and, when necessary implement, changes to the output format of the simulated or real data processing.

(2) Reference to the description of the contents and format of the data to be compared. These notes may need to be updated to take account of different data available at the different 'levels'. They should be incorporated as an Annex to the S/W CDR, and kept under configuration control by Perryman.

M.A.C. Perryman, 9 July 1987

NB: level 1 = data produced specifically for the relevant simulations
level 2 = data run through processing system from raw data simulations to the level of the relevant simulations
level 3 = flight data

The attached sheets were filled out in consultation with HST, 15/7/87

IDT

Procedure/format leaders (1): van Leeuwen/Fassino-Froeschle

Ref. note (2): Lindegren

	Data provided:	Due by:	Reduced by:	Due by:	Compared by:	Due by:
Level 1	Both NDAC/FAST have their own data available internally		Will not be reduced by the other consortium		not considered	—
Level 2	NDAC available with reconstructed attitude (10.7 hrs)	available	RGO Utrecht CNES	done end '87 (TBC) March '88 *	Perryman	ready
	FAST expected (Froeschlé) Oct/Nov 87	Oct/Nov '87	RGO Utrecht CNES	TBD		
Level 3			Kovalevsky/van Leeuwen to confirm that output will be available in agreed format		TBC	

* can be reduced by CSS at end '87, if the data is prepared by CNES. CNES reduction date depends on availability of CSS software.

SM

Procedure/format leaders (1): van Leeuwen/Canuto-Froeschle

Ref. note (2): van Leeuwen

	Data provided:	Due by:	Reduced by:	Due by:	Compared by:	Due by:
Level 1	RGO, ad hoc format	Available, and distributed to CSS & Utrecht	Utrecht *	Oct 87	van Leeuwen	
			RGO	available		
			CNES *	Oct 87		
Level 2	RGO	Available, both sets will be distributed Oct/Nov 87	RGO Utrecht CNES	✓ end 87 +	van Leeuwen	
	CERGA		RGO Utrecht CNES	✓ end 87 +		
Level 3					TBC	

* FvL to monitor

\+ CNES/CSS end '87 ; March '88 for CNES alone (as IOT)

ATTITUDE

Procedure/format leaders (1): Lindegren/van der Marel

Ref. note (2): Lindegren

	Data provided:	Due by:	Reduced by:	Due by:	Compared by:	Due by:
Level 1			NOT RELEVANT			
Level 2			AS FOR SM			
Level 3						

GCR

Procedure/format leaders (1): van der Marel/Petersen

Ref. note (2): van der Marel

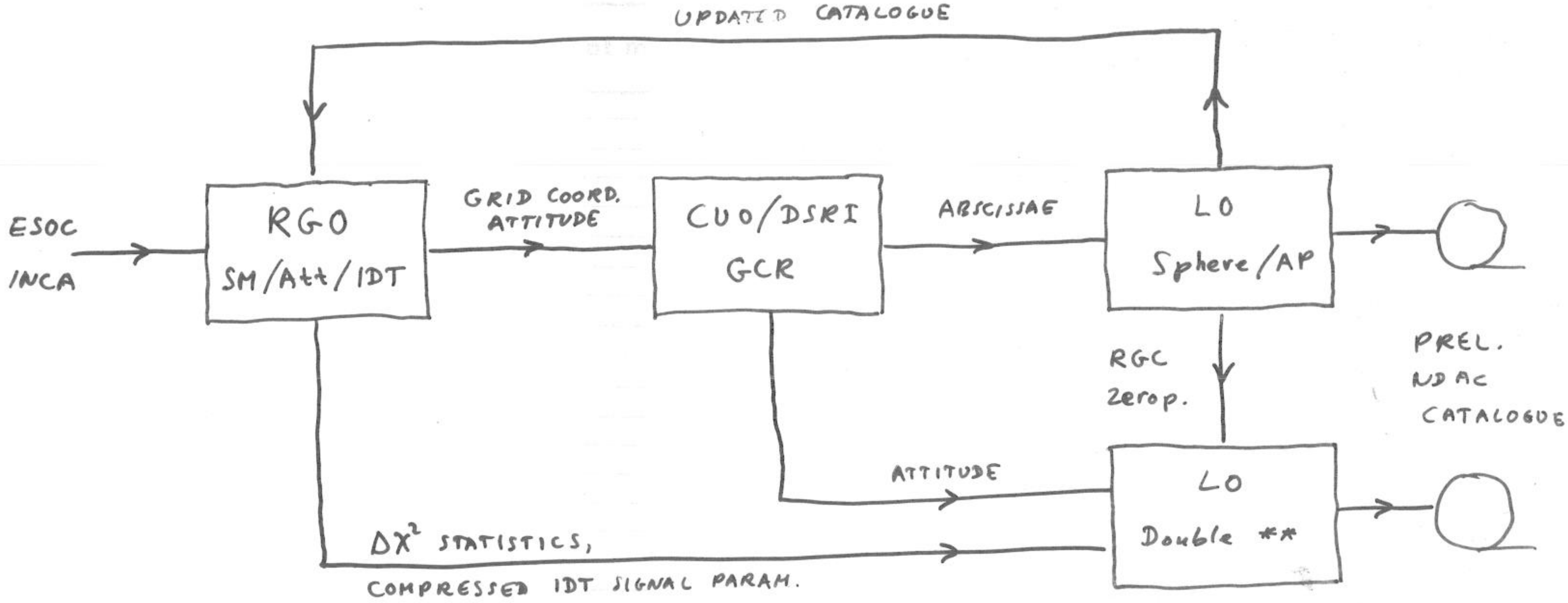
	Data provided:	Due by:	Reduced by:	Due by:	Compared by:	Due by:
Level 1	NDAC (Lund)	available	v.d. Marel Petersen	done done	v.d. Marel (a)	15 Oct (d)
	FAST (CERGA)	available	available in Delft/CUO (b)	Nov 87 Delft (c) Nov 87 CUO		
Level 2	RGO (Nov. 87)	Nov. 87	RGO/CUO Utrecht CNES	April 88 target April 88 target April 88 target	v.d. Marel and Penyman	May '88 target
	CERGA (Nov 87)	Nov 87	RGO/CUO Utrecht CNES			
Level 3						

(a) agree on comparison format, then data will be output for comparison
(b) Petersen has to write conversion s/w
(c) finalisation of s/w to be done, then comparison can be done
(d) v.d. Marel proposes to compare abscissae files only

Annex XIII

NDAC Interfaces

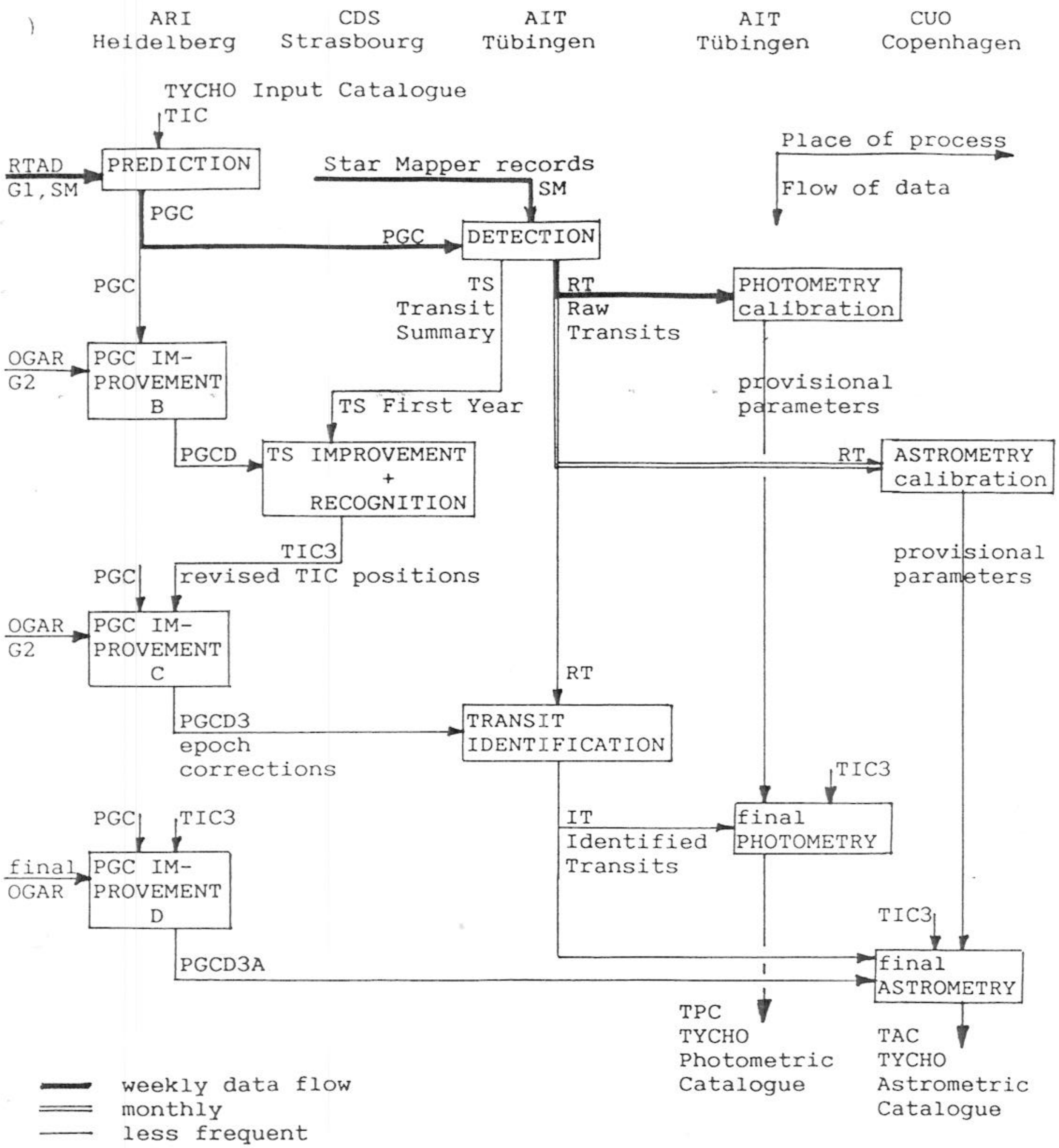
Annex XIII



NDAC INTERFACES (LL 87/07/15)

Annex XIV

TYCHO Developments



Legend: TIC = TYCHO Input Catalogue
RTAD = Real Time Attitude
OGAR = On-Ground Attitude
PGC = Predicted Group Crossing epoch
PGCD = PGC Difference = epoch corrections
TS = Transit Summary
G1,G2 = Geometric calibration parameters

Fig. 1. TDAC Data Flow

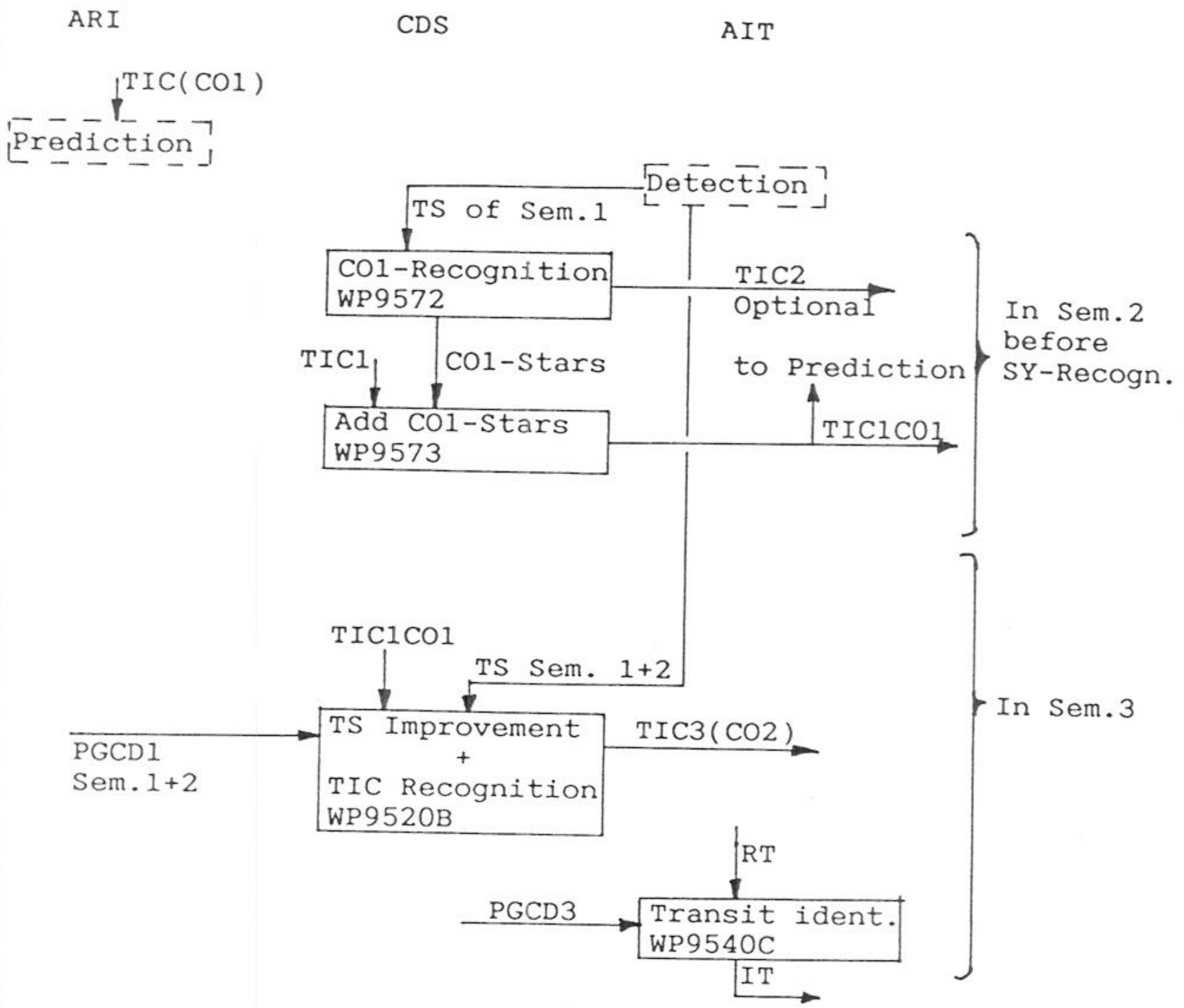
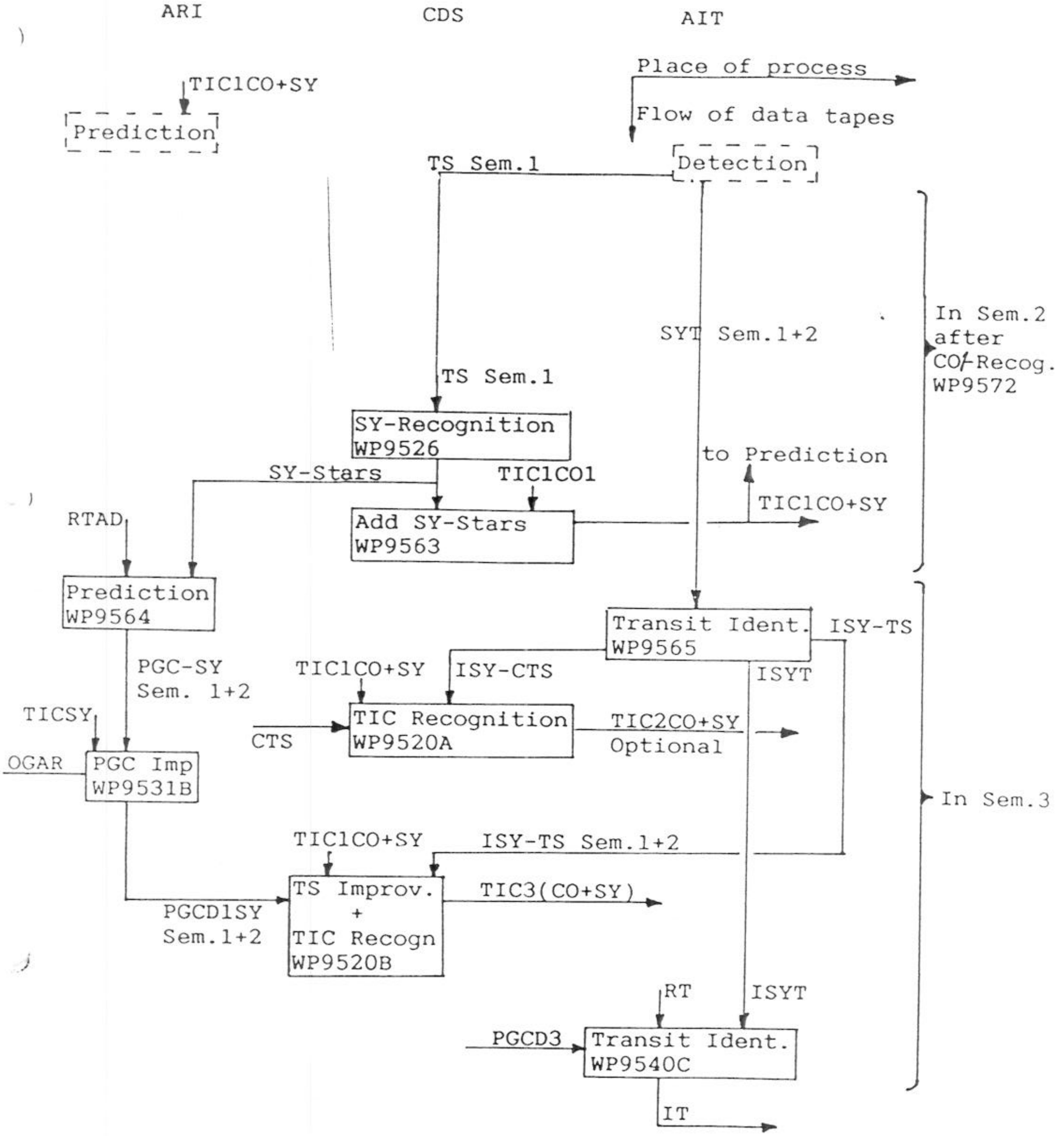


Fig. 3. CO1-Recognition based on semester No. 1 is a parallel process to SY-Recognition so that TIC1 + CO1-Stars + SY-Stars will be used for prediction after semester 2.

SY-Recognition is considered to be optional; CO1-Recognition is required and should therefore be completed first.



Legend: ---- "dashed boxes" contains processes from the main data flow on Fig. 2. Sort + Merges are not shown. See old Fig. 4 in TD071.

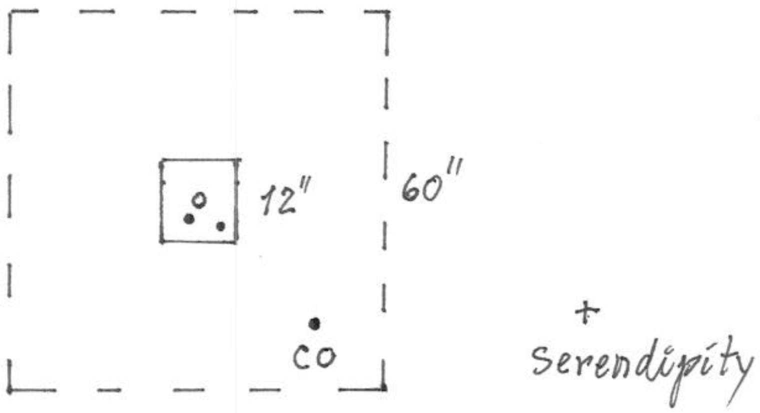
Fig. 4b. SY-Recognition based on Semester No. 1.
SYT, PGC-SY, ISY-TS and PGCD1SY are produced for Sem. 1+2.

file: tic3

<u>TIC3 Catalogue, format on microfiche</u> EH 87.07.09

TIC3 entry	region	star nr.	RA	Dec.	Comp. n	Comp. i	x	y	B	V	std.dev. xy	std.dev. B	std.dev. V	Cross ID	
1	-	-	-	-	1	1	-	-	-	-	-	-	-	-	
2	-	-	-	-	1	1	-	-	-	-	-	-	-	-	
3	-	-	-	-	0	1	5000	5000	-	0	-	-	0	-	not Tycho
4	-	-	-	-	2	1	-	-	-	-	-	-	-	-	} 2 comp
5	-	?	-	-	2	2	-	-	-	-	-	-	-	-	
6	-	-	-	-	1	1	-	-	-	-	-	-	-	-	
7	-	?	-	-	1	1	0	0	-	-	-	-	-	-	serendipity

- RA, Dec at observation epoch are in system J2000.
- Entry 5 shows a second component within a 1 square arcmin area centered on the TIC1 position which is seldom, $\lesssim$ 5%, but its inclusion ensures simpler and safer identifications for the user of the catalogue.
- x, y are relative rectangular coordinates: TIC3 - TIC1 (unit = 10 mas, zero = - 50 arcsec)
- 2000 000 stars on microfiche (~ 100 volumes) including all TIC1 stars. A tape includes further information.
- Proper motions for about 400 000 stars by older positions may be derived and should be given on separate microfiche.
- Entry 3: not observed by Tycho, hence n = 0. TIC1 data given
- Entry 4 and 5: two components observed by Tycho
- Entry 7: serendipity star, hence no relevant x, y



Annex XV

MAMA Results – INCA ATLAS

ANNEX XV

INCATLAS

MAMA

1) Resolution : pixel size : 10 μm × 10 μm
when scanning the plat[e]
by lanes of 1 cm (*)

2) Stored image : possible on-line compression
→ pixel size : 10, 20, 40, 80 μm.

3) Image visualization : color monitor : 512 × 512 ; one or 2^{2n} ($n = 1 \rightarrow 4$; $n = 2 \rightarrow 16$) ~~star~~ images can be visualized at once.

the "pixel size" mentioned for th[e] slides results from combination of 2) and [3)]. This [p]ixel size is that offered to the user lo[oking] at [t]he monitor.

4) Scanning speed :

- present (mid-87) : 10^5 pixels / second (10 μm acqu[isition])
(for one Schmidt plate : about 4 hours; 1.5 hour at 25 μm resolution)
- foreseen (1988) : $\gtrsim 2 . 10^5$ pixels / second (10 μm acqui[sition])
(for one Schmidt plate : about 2 hours; 1 hour at 25 μm resolution)

(*) 25 μm resolution is obtained by rotation of the optics.

5) <u>Coding</u>: a/ acquisition : 12 bits (→ 2 bytes)
b/ visualization: 8 bits (→ 1 byte)
(dynamics: 10 bits = 1024 levels)

6) <u>Storage</u>:
(1988) : • 3 × 500-Mbyte disks
• 6250 b.p.i tape unit
(2400-ft tape → ~ 150 Mbytes
3600-ft tape → ~ 200 Mbytes)
• (*)

ATLAS

Storage needed
(Giga byte)

	10'	20'	40'
40 μm	8	30	120
80 μm	2	8	30
160 μm	.5	2	8

120 000 stars

	10'	20'	40'
40 μm	6	24	100
80 μm	1.5	6	24
160 μm	0.5	1.5	6

whole sky

Scanning time

for one hemisphere (900 plates): ~ 1800 hours

(*) one optical disk *would* contain 1 Gigabyte
(hence, 1 Gpixel). {1 disk: ~ 500 $ (?)
recorder: ~ 50 k$ (?)

TEST FIELDS

1/ low density field (SERC field 620 : $4^h 20^m$ / $-12°$)

Slide

1,2 — 16 * each : 10' x 10' pixel : 80 µm

1	5	9	13
2	6	10	14
3	7	11	15
4	8	12	16

9.3	8.3	5.3	8.8
8.5	8.9	12.4	8.0
8.0	8.9	10.0	8.5 9.6
8.4	9.4	7.8	8.7

3 (cf. 13) — each : 10' x 10' pixel : 40 µm (b)

9	13
10	14

4, 5, 6 — star n. 6 5' x 5' pixel : 10 µm (b, y, b/w)

7 — same as 1,2

8 — star n. 6 10' x 10' pixel : 20 µm (b)

9 — star n. 3 10' x 10' pixel : 20 µm (b)

10 — same as 1, 2, 7

11, 12 — each : 20' x 20' pixel : 80 µm (b, b/w)

4	6
5	14

13 (cf. 3) — each : 10' x 10' pixel : 40 µm (b/w)

9	13
10	14

14	star n. 14	40' x 40'	pixel : 80 μm	(b.)
15	4 6 / 5 14	40' x 40'	pixel : 160 μm	(b/w)

2| L.M.C.

16	~ N.W. quarter	40' x 40'	pixel : 80 μm	(b.)
17	pan.	80' x 80'	pixel : 160 μm	(y.)
18	pan.	80' x 80'	pixel : 160 μm	(b./w.)
19	~ N.W. quarter	40' x 40'	pixel : 80 μm	(b./w.)

Comments:

4, 5, 6 — 4 companions of * 6 seem to form a typical pattern

7 → however, they are of $m_B \gtrsim 13/14$

8 — within 10' field, * 6 has a companio[n] of mag ~ 9.

9 — within 10' Field, * 3 has 3 companions (however, not brighter than * 10 [$m_B = 12.5$

10

11, 12 — and * 4 is not so lucky (a comp. of $m_B \sim 14$ in $10' \times 10'$ field; $m_B \sim 12$ requires 20')

13, 14 — * 4, 5, 14 require a field of $40' \times 40'$ to get comp. brighter than ~ 9.

15 — finally, a pixel size of 160 μm appears to be acceptable.

LMC: 16-19 — for crowded fields, the 160 μm pixel should be questioned.

things to do:
- magnitude calibration (down to ...?)
- identification of * in the LMC field
-

Annex XVI

INCA-ESOC Interface Summary

ANNEX XVI

INCA - ESOC Interface

Debrief from 13 July 1987 meeting

~

1 - Comments from ESOC on first version of IC1

- no problem of reading
- prepared : rapid access to the stars in an area of the sky
- missing : epoch and accuracy of positions
  reduction to J 2000
  flag for photometric standard stars
  observation parameter Q

2 - Status of major and minor planet ephemerides implementation

- no problem of reading the ephemerides sent by BdL
- agreement on computed positions in BdL and ESOC
- keep in mind : . parallactic effect ~~due~~ to satellite motion around the earth
  . E-term (will not be included in J 2000 ephemer
- transit times for minor and major planets should also be compared (ESOC - INCA - FAST - NDAC - TDAC)
  → A. Schütz submit a project for comparison by 30 Sept.

3 - Status of additional catalogue for ISPR

- agreement on the conclusions of the last meeting (18/2/87)
- acceptable levels | of variability | of duplicity : the same as for reference star

i.e : . variability : $\Delta m < 3$ magnitude.
. duplicity : primary $5 \leq B \leq 10$
secondary $B \leq 10$
separation $\rho < 23''$ TBC
magn. difference $\Delta m <$ TBD

- INCA will deliver an "Annex 1" along with the ISPR catalogue, including duplicity information on all ISPR sta (where known)
- ESOC will put the flag for duplicity.

4 - Status of PSF preparation work in ESOC / implementation of modulation algorithm

- more refined computation of the covariance matrix will be performed by A. Schütz — 15 August
- an ADD for the PSF preparation will be provided by A. Schütz — 15 Octobre
- it will be reviewed by M. Crézé — 15 Novembre

5 - Reporting from ESOC to INCA on the evolution of the modulation scheme.

- idea: gives the possibility to INCA to follow what is happening during the mission and verify that everything is as planned.

- M. Crézé will precise which parts of the PSF he would like to examine (time interval, periodicity, sampling): 30 Oct.

6 - Mecanisms for INCA updates of Input Catalogue (ESOC)

- the 12 March 87 note from A. Schütz seems obsolete
- improvements of data: to be gathered in 3-monthly updates
- major errors: kill the "old" star
  create a "new" one with a new IC number
- the parameters to be changed will be precised by A. Schütz in the ADD.

- Non-observed stars: a proposal will be made by J. van der Ha
  30 Sept.

7 - Selection and Flagging of refence stars (division of tasks between INCA and ESOC)

- stick to the conclusions of the last meeting (18/2/87): the flagging will be done by ESOC.
- the flagging of double stars implies that ESOC need the Annex 1.

8 - Variable stars: use of data supplied by INCA

- A. Schütz will check that these ephemerides are OK for him
  15 August

9 - Next release of Input Catalogue

- After next simulations, performed on "LS", to select "IC3"
- Scheduled for March 88
- Delivery to ESOC: IC3 + Annex 1
  ISPR + (Annex 1) ISPR

10 - Numbering of objects in chromaticity mode / dummy stars

See HST

11 - Any other business

- Remark from C. Turon on veiling glare on Titan and Europe due to Saturne and Jupiter: with the rules applied in the INCA simulations, Titan would be rejected - No problem with Europe.

Annex XVII

Publication of Input Catalogue

ANNEX XVII 264 character per star (example of printing)

-42 3307 40	HD 78058		09 02 53.5	-42 51 53	2 10.3 V1 F0			4 10.4 B16 6108 0 0 0 0 0 0 0	x
-65 1071 40	HD 78294		09 03 00.4	-66 11 53	4 10.2 V1 A1			4R10.3 B1616 54 0 0 0 0 0 0 0	G
-39 3176 40	HD 78115		09 03 06.4	-40 13 08	2 9.93V0 A1			3R10.23B06 6 55 0 0 0 0 0 0 0	
-65 1070 40	HD 78273		09 03 07.0	-65 42 54	3 9.2 V1 F5			1F 9.8 B1616141108 0 0 0 0 0 0 0	*
-61 1169 40	HD 78247		09 03 07.3	-61 41 54	4 10.1 V1 F2			4 10.6 B1616108 0 0 0 0 0 0 0	
-65-09032 60	OM 103		09 03 12.0	-65 53 36	4 10.45V0 K2			5 11.76B08 8130 0 0 0 0 0 0 0	x
-44 3386 40	HD 78148		09 03 19.1	-44 51 18	2 9.94V0 B8			4R10.20B06 6 99171 0 0 0 0 0 0	
+30-09034 60	G 47 -23		09 03 23.0	+30 29 18	3 10.69V0	-.138	-.220	1R11.89B02 2139118 0 0 0 0 0 0 0	*
-61 1171 40	HD 78310		09 03 24.1	-62 03 54	4 11.0 V1 B9			4R11.1 B1616 99171 0 0 0 0 0 0	x
-43 3315 40	HD 78185		09 03 29.1	-43 33 18	2 10.4 V1 F2			4 10.6 B16 6108 0 0 0 0 0 0 0	G
-65 1073 40	HD 78373		09 03 30.3	-66 16 55	4 8.7 V1 G8			4R 9.9 B1616 54 0 0 0 0 0 0 0	x
-50 2034 40	HD 78246		09 03 38.5	-50 36 24	2 10.55V0 B9			4R10.69B06 6 99171 0 0 0 0 0 0	
-47 3060 40	HD 78243		09 03 43.0	-47 27 02	2 9.09V0 M1			4 9.12B01 1167 0 0 0 0 0 0 0	
+36 1911 2	AG +35 892		09 03 46.0	+35 57 56	2 11.5 V1 F8	-0.011	0.015	4 12.1 B1815176 0 0 0 0 0 0 0	
-51 1871 40	HD 78309		09 03 50.9	-51 40 58	2 9.38V0 B8			4R 9.74B06 6 99171 0 0 0 0 0 0	
-42 3325 40	HD 78261		09 03 55.9	-42 26 31	2 10.1 V1 G5			1R10.4 B16 6184 0 0 0 0 0 0 0	*
-64 997 40	LTT 3356		09 04 04.9	-65 09 47	4 10.29V0	-.113	+.394	2 10.94B02 2139 0 0 0 0 0 0 0	
-47 3067 40	HD 78344		09 04 08.3	-47 34 01	2 8.99V0 09			1 10.08B01 1 69 85167 99 0 0 0 0 0	*
-45 3426 40	HD 78325		09 04 10.4	-45 23 54	4 10.4 V1 A7			3R10.9 B16 6 55 0 0 0 0 0 0 0	
-50 2048 40	HD 78357		09 04 13.4	-50 22 15	2 9.76V0 B3			4R10.17B06 6 99171 0 0 0 0 0 0	
-47 3070 40	HD 78345		09 04 16.4	-48 06 45	2 9.36V0 B1			2 10.27B01 1 69 85167 99 0 0 0 0 0	
-02-09045 60	I 21 29		09 04 30.0	-02 54 00	2 3			1 3 12.0 B19 8 21150 0 0 0 0 0 0 0	
+38-09045 60	G 115 -54		09 04 33.0	+38 52 18	3 3	-0.104	-0.303	1 12.2 B19 8139118 0 0 0 0 0 0 0	* x
-49 2182 40	HD 78403		09 04 37.5	-49 26 30	2 10.0 V1 F8			4 10.1 B16 6108 0 0 0 0 0 0 0	
-43 3337 40	HD 78384		09 04 39.6	-43 40 16	2 10.1 V1 F6			4 10.2 B16 6108 0 0 0 0 0 0 0	G
+51 1483 0	V* V UMA		09 04 44.0	+51 19 00	3 34M5			1 10.90B0910 64 0 0 0 0 0 0 0	*
-63 1091 40	HD 78569		09 04 47.6	-63 52 58	4 9.3 V1 F7			1F10.0 B1616141108 0 0 0 0 0 0 0	*
-49 2183 40	HD 78475		09 04 59.4	-50 10 38	2 10.4 V1 G5			1R10.7 B16 6184 0 0 0 0 0 0 0	*
-42 3338 40	HD 78457		09 05 03.7	-42 59 52	2 9.7 V1 G3			1R10.1 B16 6184 0 0 0 0 0 0 0	G
-52-09051 60	V* CX VEL		09 05 04.0	-52 09 12	3 11.05V04			2 30 9 94 0 0 0 0 0 0 0	
-63-09051 60	0631633102.00		09 05 04.0	-63 51 44	2 3			1 1R11.2 B19 8127 0 0 0 0 0 0 0	
+21 -9050 0	HD 78278		09 05 04.4	+21 46 03	4 10.6 V1 R.			1 12.0 B12 2 64179 0 0 0 0 0 0	*
+73 447 0	GJ 334.1		09 05 20.0	+73 36 48	3 10.09V0 K5	-.159	-.275	1 11.34B01 1 89132139181 54118 0 0	*
-42 3350 40	HD 78501		09 05 22.9	-42 41 34	2 9.3 V1 F5			4 9.8 B16 6108 0 0 0 0 0 0 0	x
-25-09055 60	CD -24 7738		09 05 28.0	-25 03 35	2 10. V2	-.271	+.073	1 1R 3819139 0 0 0 0 0 0 0	*
+01-09057 60	I 56 64		09 05 44.0	+01 33 25	2 3			1 5 11.4 B19 8 56 0 0 0 0 0 0 0	
+27 1715 3	BD +27 1715C	C	09 05 47.9	+26 52 21	2 10.3 V1			4R 3819 54 0 0 0 0 0 0 0	x
-46 3418 40	HD 78617		09 05 50.0	-47 05 00	4 10.4 V1 F6			4 11.4 B16 6108 0 0 0 0 0 0 0	x
-67 1037 40	HD 78818		09 05 50.0	-67 20 02	4 3 F2			4 10.3 B1916108 0 0 0 0 0 0 0	
-43 3360 40	HD 78596	AB	09 05 51.2	-44 03 19	2 10.4 V1 F2			4 10.6 B16 6108301 0 0 0 0 0 0	x
-08 2586 0	BD -08 2586		09 05 53.7	-08 46 20	2 9.6 V1			4R 3819 54 0 0 0 0 0 0 0	
-49 2196 40	HD 78651		09 05 56.2	-49 52 21	2 10.4 V1 Ap			3R10.7 B16 6 55 0 0 0 0 0 0 0	
-45 3451 40	HD 78628	AB	09 05 57.3	-46 15 35	2 9.3 V1 F2			4 9.9 B16 6108301 0 0 0 0 0 0	
+32-09060 60	MCC 539		09 06 00.0	+32 40 00	2 10.8 V1			1 1 38 9 92180191181 0 0 0 0 0	*
+67 577 3	GJ 335A	A	09 06 01.0	+67 20 20	4 4.9 V1 F6	-0.019	-0.077	1 5.3 B18 8 89176181 54 0 0 0 0 0	N
+67 577 4	GJ 335B	B	09 06 01.0	+67 20 20	4 8.4 V1 K2	-0.019	-0.077	1 8.2 B18 8 89197 54 0 0 0 0 0 0	N
-13-09061 60	BD -12 2803		09 06 05.0	-13 16 12	2 10.1 V1	+.067	-.167	1 1R 3819139 0 0 0 0 0 0 0	*
+01-09061 60	BD +02 2148		09 06 06.0	+01 39 47	2 3			1 5 10.8 B19 8 56 0 0 0 0 0 0 0	
+27 -9062 0	PLX 2181		09 06 09.9	+27 38 00	4 10.26V0 K6			1 11.50B01 1 92180191181 0 0 0 0 0	*
-46 3426 40	HD 78710		09 06 10.9	-46 42 33	2 10.1 V1 F3			4 10.2 B16 6108 0 0 0 0 0 0 0	
-42 3368 40	HD 78680		09 06 14.2	-42 57 09	2 9.7 V1 F2			4 10.1 B16 6108 0 0 0 0 0 0 0	G
-37-09063 60	CD -36 5386		09 06 17.0	-37 00 57	2 3			1 1R12.5 B19 8127 0 0 0 0 0 0 0	*
+67 577 2	ADS 7203C	C	09 06 19.6	+67 17 27	2 9.3 V1			4R 3819 54 0 0 0 0 0 0 0	* x
-48 2248 40	HD 78746		09 06 21.9	-49 14 57	2 8.7 V1 K2			1 9.9 B16 6184 0 0 0 0 0 0 0	*
-42 3373 40	HD 78706	AB	09 06 23.9	-43 08 49	2 10.0 V1 B9			4R 9.9 B16 6 99171301 0 0 0 0 0	G
+33 1814 0	GJ 336		09 06 29.0	+33 01 48	3 9.95V0	-.319	-.553	1 11.34B01 1 89 92100100139180191 17+	*
-29-09065 60	0985901038.00		09 06 29.0	-29 48 00	2 10.5 V1	-.153	+.095	1 1R 3819139 0 0 0 0 0 0 0	*
-43 3373 40	HD 78744		09 06 29.0	-44 11 38	2 9.63V0 B8			4R 9.71B06 6 99171 0 0 0 0 0 0	
-65 1081 40	HD 78911		09 06 29.2	-65 32 04	4 9.2 V1 G3			1R10.2 B1616184 0 0 0 0 0 0 0	*
-37 5492 20	HD 78740		09 06 39.5	-38 06 01	4 9.43V0 K0	+.151	-.216	1R10.20B06 6139184 0 0 0 0 0 0	*
+84-09068 60	0980253021.00		09 06 47.0	+84 23 05	2 12.21V0	-.527	+.412	1 1 13.75B08 8139 0 0 0 0 0 0 0	G
-34-09068 60	CD -34 5622		09 06 49.0	-34 38 11	2 10.28V0	+.268	-.250	1 1 11.58B01 1 93139 0 0 0 0 0 0	*
-46 3437 40	HD 78814		09 06 50.3	-47 02 02	4 10.4 V1 F2			4 10.9 B16 6108 0 0 0 0 0 0 0	x
-61 1185 40	HD 309564		09 06 54.7	-62 17 05	4 9.9 V1 F2			4 10.6 B1616108 0 0 0 0 0 0 0	x
-63 1097 40	HD 78964	B	09 06 54.7	-63 50 05	2 8.8 V1 G8			1F 9.7 B1616141308 0 0 0 0 0 0 0	* x
+64 723 2	HD 78363	B	09 06 55.4	+63 43 44	2 10.9 V1 A5			1R 3619 55308 0 0 0 0 0 0	G
+25 2053 0	HD 78585		09 06 58.0	+25 27 06	3 7.40V05M.			S1 3019 64 98185222 0 0 0 0 0	*
-37-09070 60	CD -37 5499		09 07 00.0	-37 50 00	2 11.09V0	-.190	+.235	1 1 12.19B08 8 93139 0 0 0 0 0 0	*
-63 1098 40	HD 78977	A	09 07 00.7	-63 50 05	2 8.8 V1 G8			1F 9.7 B1616141308 0 0 0 0 0 0 0	* x
-40 3200 40	HD 78832	AB	09 07 01.0	-40 30 24	2 9.7 V1 F2			4 10.1 B16 6108301 0 0 0 0 0 0	*
-30-09070 60	0631643041.00		09 07 03.0	-30 30 22	2 3			1 1R13.2 B19 8127 0 0 0 0 0 0 0	x-F
-41 3373 40	HD 78882		09 07 18.1	-41 19 59	2 10.40V0 B9			4R10.48B06 6 99171 0 0 0 0 0 0	
+46 -9075 0	G 115 -58		09 07 27.0	+46 35 00	3 12.08V0	-0.038	-0.267	1 12.54B01 1119183 54 0 0 0 0 0 0	*
-15 -9075 0	V* XX HYA		09 07 29.0	-15 23 54	2 34			1 10.50B0910 18 28 39 94 0 0 0 0	*
-46 3443 40	HD 78944		09 07 33.2	-46 37 05	4 9.7 V1 F8			2 10.8 B16 6108 0 0 0 0 0 0 0	
-26-09076 60	0631643019.00		09 07 34.0	-26 38 12	2 3			1 1R12.3 B19 8127 0 0 0 0 0 0 0	* x
-47 3110 40	HD 78963		09 07 36.9	-47 58 05	4 10.85V0 B9			4R10.94B06 6 99171 0 0 0 0 0 0	
-41 3383 40	LTT 3378	A	09 07 46.7	-41 54 41	2 3	-.126	+.227	1R11.0 B1918139311 0 0 0 0 0 0	*j
-41 3382 40	HD 78942		09 07 47.2	-41 23 47	2 10.5 V1 Ap			3R10.2 B16 6 55 0 0 0 0 0 0 0	
-43 3397 40	HD 78958		09 07 47.3	-43 41 02	2 8.97V0 B0			1 9.64B01 1 69 85167 99 0 0 0 0 0	* x
-47 3112 40	HD 79002		09 07 51.4	-47 43 36	2 10.22V0 B9			4R10.37B06 6 99171 0 0 0 0 0 0	
-43 3402 40	LS 1252		09 08 03.0	-43 30 30	2 10.02V0 B			2R10.52B02 2 85167 0 0 0 0 0 0	G
-42 3410 40	HD 79001		09 08 03.5	-42 22 11	2 9.7 V1 F3			4 10.1 B16 6108 0 0 0 0 0 0 0	
+46 -9082 0	GJ 336.1		09 08 10.0	+46 49 24	3 10.93V0 M0	-0.400	-0.014	1 12.34B08 8 89 92139180191181 54118	*
+15 1993 0	HD 78868		09 08 10.2	+15 09 53	4 10.5 V1 K0			4R11.7 B16 6 54 0 0 0 0 0 0 0	
-48 2274 40	HD 79062		09 08 19.3	-48 52 30	2 10.20V0 B9			4R10.26B06 6 99171 0 0 0 0 0 0	
-50 2109 40	HD 79102		09 08 32.4	-50 24 28	2 9.9 V1 F2			4 10.6 B16 6108 0 0 0 0 0 0 0	
-61 1195 40	HD 79188		09 08 33.7	-61 37 09	4 9.3 V1 G8			1R10.5 B1616184 0 0 0 0 0 0 0	*
-44 3485 40	CD -44 5195		09 08 46.6	-44 55 26	2 3 K5			4R 9.0 B1918 54 0 0 0 0 0 0 0	
-09-09088 60	V* VV HYA		09 08 48.0	-09 09 54	3 35Me			1 10.40B0910148 0 0 0 0 0 0 0	*
-30-09088 60	0631643042.00		09 08 48.0	-30 25 58	2 3			1 1R12.9 B19 8127 0 0 0 0 0 0 0	* x
-44 5197 20	CD -44 5197		09 08 49.9	-44 54 58	4 10.0 V1			4R 3819 54 0 0 0 0 0 0 0	G
-44 3486 40	LTT 3383		09 08 50.3	-44 53 00	2 3	0.229	-0.328	5R12.0 B19 8 54 0 0 0 0 0 0 0	x
-49 2243 40	LTT 3384		09 08 54.5	-49 33 57	2 3 G	-.217	+.125	2 11.0 B1918139 0 0 0 0 0 0 0	
-46 3461 40	HD 79155		09 08 57.0	-46 54 08	4 10.7 V1 F7			4 11.1 B16 6108 0 0 0 0 0 0 0	
-41 3412 40	HD 79115		09 08 58.9	-41 46 34	2 10.17V0 B8			4R10.36B06 6 99171 0 0 0 0 0 0	
-44 3489 43	HD 79170	AB	09 09 03.3	-45 06 12	2 10.30V0 K0			1 11.21B02 2 89 89132132181181184 54+	*
-13-09091 60	0985727067.00		09 09 04.0	-13 57 30	2 10.9 V1	-.035	-.178	1 2 3819139 0 0 0 0 0 0 0	
+28-09091 60	G 47 -28		09 09 06.0	+28 07 06	3 12.38V0 M:	-0.195	-0.443	1 13.95B08 8139 0 0 0 0 0 0 0	*
-20-09091 60	0985787059.00		09 09 09.0	-20 48 05	2 10.1 V1	+.342	+.024	1 2 3819139 0 0 0 0 0 0 0	*
-46 3466 40	HD 79198		09 09 16.1	-46 18 09	4 10.7 V1 F0			4 10.9 B16 6108 0 0 0 0 0 0 0	x
-16 2706 0	HD 79132	AB	09 09 26.1	-16 36 08	2 8.5 V1 A0			2 8.5 B16 6107301 0 0 0 0 0 0	
-46 3470 40	HD 79230	AB	09 09 26.9	-46 58 53	2 10.7 V1 F5			4 10.6 B16 6108301 0 0 0 0 0 0	
+15 2003 2	GJ 337B	B	09 09 35.5	+15 11 37	2 7.3 V1 G9	-0.522	0.242	S1 38 9 89222 54 0 0 0 0 0 0	G
-44 3503 40	LTT 3388		09 09 36.9	-44 18 41	2 3 K0	-.244	+.048	1R10.0 B1918139 0 0 0 0 0 0 0	*
-54-09097 60	CD -54 2622		09 09 41.5	-54 49 16	2 9.4 V1			1 1 38 9 93191 0 0 0 0 0 0 0	*
-47 3137 40	HD 79276		09 09 42.9	-47 52 04	2 10.2 V1 F5			4 12.3 B16 6108 0 0 0 0 0 0 0	
-39 3274 40	HD 79271		09 09 55.4	-40 07 11	4 8.6 V1 A0			2 8.4 B16 6107 0 0 0 0 0 0 0	
-41 3427 40	LTT 3389		09 09 57.7	-42 05 36	2 10.48V0	-.226	+.170	1 11.56B02 2 93191139 0 0 0 0 0 0	*
-49 2256 40	HD 79333		09 09 57.9	-49 47 41	2 10.4 V1 F0			4 10.7 B16 6108 0 0 0 0 0 0 0	
-45 -9100 0	0690752901.00		09 09 59.9	-45 25 58	4 10.96V0 B5			4R11.39B01 1 99171 0 0 0 0 0 0	
-43 3440 40	HD 79311		09 10 05.4	-43 25 29	2 10.1 V1 F0			4 10.5 B16 6108 0 0 0 0 0 0 0	x
-49 2257 40	HD 298285		09 10 14.0	-50 16 45	2 10.54V0 F.			4 10.81B01 1167 0 0 0 0 0 0 0	
-60-09103 60	CPD -60 1342		09 10 17.0	-60 47 00	2 10.5 V1	-.113	+.140	1 1R 3819139 0 0 0 0 0 0 0	*
-41 3438 40	HD 79347		09 10 21.1	-41 38 25	2 10.33V0 B9			4R10.40B06 6 99171 0 0 0 0 0 0	
+62 1058 2	09064 +61.50B	B	09 10 23.3	+61 37 03	2 3			5R 3919238308 0 0 0 0 0 0	G
-50-09105 60	V* DD VEL		09 10 32.0	-50 10 12	3 12.15V02			3 30 9 94186 0 0 0 0 0 0	G F
-67 1045 40	HD 79592		09 10 36.6	-68 03 17	4 9.1 V1 G5			1R10.3 B1616184 0 0 0 0 0 0 0	
-72-09106 60	0631613043.00		09 10 37.0	-72 22 18	2 10.93V0			1 1R 38 9127 0 0 0 0 0 0 0	x
-43 3452 40	HD 79417		09 10 40.3	-44 05 32	2 10.4 V1 F3			4 10.6 B16 6108 0 0 0 0 0 0 0	
-49 2261 40	HD 79461		09 10 44.7	-50 15 20	2 9.78V0 F5			4 10.21B06 6108 0 0 0 0 0 0 0	
-50 2134 40	HD 79462		09 10 45.5	-50 49 05	2 10.4 V1 F0			4 10.7 B16 6108 0 0 0 0 0 0 0	
-40 3267 40	HD 79436		09 10 47.3	-40 54 30	2 9.5 V1 F2			4 10.4 B16 6108 0 0 0 0 0 0 0	
-39-09108 60	0985461157.00		09 10 48.0	-39 38 00	2 11.3 V1	-.390	+.014	1 1 3819139 0 0 0 0 0 0 0	*
-50 2136 40	HD 79474		09 10 49.9	-51 06 45	2 10.1 V1 F7			4 10.6 B16 6108 0 0 0 0 0 0 0	
+53 1320 3	BD +53 1320C	D	09 10 59.0	+52 53 45	2 10.8 V1 K2			4R 3819 54 0 0 0 0 0 0 0	GN
+53 1320 4	HD 79210I	AB	09 10 59.7	+52 54 08	2 6.92V0 K7			1R 8.34B02 2197169 0 0 0 0 0 0 0	*j
-14 -9111 0	V* WX HYA		09 11 04.0	-14 10 54	3 9.50V04M3			1R 3019 98148 0 0 0 0 0 0 0	*
-39 3307 40	HD 79471		09 11 07.5	-40 10 15	4 8.8 V1 A4			4R 9.3 B16 6107 0 0 0 0 0 0 0	
-40 3273 40	CD -40 5020A		09 11 09.5	-41 14 51	2 10.66V0	-.150	+.109	2 11.50B08 8139 0 0 0 0 0 0 0	
-23 -9112 0	0610181404.00		09 11 11.9	-23 10 58	4 9.0 V1 CV			1 3819 64 0 0 0 0 0 0 0	*
-03-09112 60	BD -03 2616		09 11 12.0	-03 41 18	2 10.64V0	+.050	-.217	1 2 11.31B01 1139 0 0 0 0 0 0 0	G

300 character per star

-27-00412 60 GJ 2013		00 41 12.0	-27 38 00	4 12.84VO
+25-00412 60 BD +24 105		00 41 12.9	+25 28 29	2
+64 -412 0 LS I +64 35		00 41 13.3	+64 11 18	2 11.38VO B1
-50 102 40 CD -50 176		00 41 15.7	-49 51 08	2 3 F5
-72 61 40 HD 4213		00 41 22.2	-71 49 31	4 10.32VO F6
-73 -414 0 0620053002.00		00 41 22.3	-73 39 28	4 11.97VO B6
+59 109 0 LS I +60 122		00 41 24.7	+60 00 21	2 10.11VO
-14-00415 60 I 119 28		00 41 33.0	-14 11 42	2 12.1 V1
+36-00416 60 BD +35 135		00 41 37.0	+36 29 42	2 10. V2
-48 79 40 HD 4212		00 41 40.6	-48 33 12	2 10.4 V1 F2
+05-00417 60 I 212 25		00 41 41.0	+05 37 06	2 12.0 V1
+63 -417 0 LS I +63 97		00 41 43.1	+63 38 03	4 10.60VO B1
+60 -417 0 LS I +60 123		00 41 44.3	+60 43 38	2 11.90VO B.
-10-00421 60 BD -11 132		00 42 07.0	-10 54 48	2 9.81VO
-19 111 0 GJ 31.2		00 42 07.0	-19 13 24	3 10.23VO7M2
-35 230 20 HD 4236		00 42 07.3	-35 21 30	4 10.9 V1 G6
+64 -421 0 LS I +64 38	AB	00 42 08.2	+64 07 12	2 10.69VO B1
-22 238 20 HD 4235		00 42 10.9	-21 52 30	2 9.5 V1 G0
+63 -422 0 LS I +63 100		00 42 12.7	+63 41 37	2 11.22VO B2
+06-00423 60 I 150 66		00 42 18.0	+06 06 00	2 3
+63 -423 0 LS I +63 101		00 42 18.0	+63 26 16	2 11.05VO B1
-08-00425 60 BD -08 133		00 42 30.0	-08 10 06	2 11. V2
-25 286 20 CD -25 286		00 42 32.1	-24 49 14	2 9.3 V1 G0
+63 -426 0 LS I +63 102		00 42 36.1	+63 04 46	2 10.50VO B0
-74 62 40 HD 4360		00 42 40.1	-73 46 32	4 10.10VO F0
+14-00427 60 G 32 -46		00 42 43.0	+14 05 24	3 9.79VO
+16-00427 60 G 33 -8		00 42 43.0	+16 42 42	3 9.97VO
+63 92 0 LS I +64 41		00 42 51.5	+64 07 47	2 10.68VO B2
+16-00429 60 G 33 -9		00 42 56.0	+16 42 00	2 10.61VO
+25-00429 60 0985349073.00		00 42 57.0	+25 47 41	2 10.5 V1
+62 -431 0 LS I +62 138		00 43 06.7	+62 57 55	2 11.78VO B.
-32 281 20 HD 4341		00 43 08.0	-32 18 31	4 10.2 V1 G5
-51-00432 60 0620145173.00		00 43 12.0	-51 54 00	2 11.91VO
-33 285 20 HD 4356		00 43 13.6	-33 25 32	4 10.3 V1 G3
+06-00433 60 I 212 26	AB	00 43 20.0	+06 04 24	2 12.6 V1
-42 249 23 HD 4378		00 43 25.2	-42 10 52	2 8.48VO K5
+64 -435 0 LS I +64 44		00 43 27.0	+64 06 28	2 10.50VO B2
+61 -435 0 LS I +61 166		00 43 27.3	+61 22 49	2 11.25VO B
-46 72 40 HD 4419		00 43 40.7	-45 47 16	2 9.8 V1 G8
+64 -437 0 LS I +64 45		00 43 41.2	+64 11 08	2 11.04VO B3
+03-00439 60 0985526069.00		00 43 52.0	+03 32 18	2 11.4 V1
+33-00439 60 G 69 -21		00 43 57.0	+33 33 12	3 10.35VO
+20 -440 0 UBV 635		00 44 00.9	+20 37 35	4 11.93VO
+61 -440 0 LS I +61 167		00 44 02.1	+61 52 19	2 12.10VO B.
-42 70 40 HD 4472		00 44 03.3	-41 59 43	2 9.6 V1 A+
+61 -441 0 LS I +61 168		00 44 08.0	+61 45 36	2 11.84VO B
+43-00442 60 G 172 -23		00 44 11.0	+43 22 36	3 3
-38 245 20 CD -38 245		00 44 11.2	-37 56 26	4 11.96VO
-34 280 20 HD 4485		00 44 13.3	-33 41 32	4 10.53VO A0
+43-00443 60 BD +42 171		00 44 18.0	+43 23 00	2 8.6 V1
-18-00444 60 BD -19 117		00 44 23.0	-18 47 41	2 10.58VO
-12 -445 0 BD -12 134		00 44 35.3	-12 09 03	2 11.6 V1 B0
+32 -445 0 HD 4489		00 44 37.0	+32 24 48	3 7.90VO5M.
-42 73 40 HD 4556		00 44 44.7	-42 25 54	2 9.5 V1 K1
-46 74 40 LTT 445		00 44 46.5	-45 40 27	2 3
+09 -448 0 HD 4539		00 44 53.6	+09 42 24	4 10.29VO A
+09-00449 60 0985466286.00		00 44 54.0	+09 32 00	2 10.9 V1
+14-00450 60 G 32 -49		00 44 59.0	+14 22 12	3 10.94VO
+62 -452 0 LS I +62 139		00 45 12.3	+62 43 03	2 11.40VO O7
+05-00452 60 I 212 27		00 45 13.0	+05 45 30	2 11.6 V1
-64 76 40 HD 4638		00 45 19.3	-64 09 34	4 10.7 V1 F0
+57 150 6 BD +57 150F	G	00 45 25.9	+57 30 29	2 8.9 V1
-33-00454 60 CD -33 302		00 45 27.0	-33 01 42	2 10.59VO
+16-00456 60 G 32 -50		00 45 36.0	+16 24 06	3 12.25VO
-05-00457 60 0980270072.00		00 45 40.0	-05 24 24	2 11. V2
-73 -457 0 UBV M 43590		00 45 40.3	-73 21 47	4 12.12VO A0
+04 123 2 BD +04 123B	B	00 45 42.7	+05 00 14	2 10.4 V1
-27-00457 60 CD -27 246		00 45 43.0	-27 11 36	2 10.80VO
-15-00458 60 0985766026.00		00 45 48.0	-15 11 30	2 10.5 V1
-14 142 0 G 270 -73		00 45 52.3	-14 22 47	4 10.85VO
-10-00459 60 BD -11 145		00 45 53.1	-10 57 32	2 10.8 V1
-54-00459 60 CPD -54 179		00 45 54.0	-54 29 00	2 10.86VO
+57 150 2 ADS 671C	C	00 45 57.3	+57 32 31	2 11.4 V1
-73 -460 1 AZV 26		00 46 01.3	-73 24 35	4 12.52VO B0
-73 48 40 HD 4725		00 46 02.5	-73 08 34	4 10.81VO F2
+57 150 9 GJ 34B	B	00 46 03.6	+57 33 03	2 7.5 V1 K7
+63 -461 0 UBV M 43230		00 46 05.9	+63 54 59	4 11.15VO B3
-01-00461 60 I 91 30		00 46 06.0	-01 39 24	2 3
+57 150 7 BD +57 150G	H	00 46 06.3	+57 43 53	4 8.6 V1
+57 150 3 BD +57 150C	D	00 46 07.3	+57 33 54	2 11.6 V1
-74 65 40 HD 4767		00 46 16.9	-74 17 35	4 11.0 V1 F7
+16 76 2 BD +16 76B	B	00 46 17.9	+16 41 15	2 12.6 V1
+16 76 3 BD +16 76C	C	00 46 22.1	+16 39 01	2 13.0 V1
+63 -464 0 LS I +63 106		00 46 23.1	+63 35 45	2 10.71VO B2
+57 150 4 BD +57 150D	E	00 46 24.1	+57 31 28	2 9.0 V1
+67-00464 60 G 243 -41		00 46 26.0	+67 40 48	3 10.42VO
+05 -465 0 GJ 35		00 46 28.8	+05 10 21	2 12.36VO DG
-24 343 20 CD -24 343		00 46 33.2	-24 15 32	2 9.6 V1 G0
-17 142 0 HD 4713		00 46 35.6	-16 39 34	4 10.0 V1 G0
-50 210 20 LTT 464		00 46 41.9	-50 24 40	2 3
-73-00467 60 PMMR 19		00 46 42.0	-73 28 10	2 12.2 V1
+19-00468 60 0985406078.00		00 46 48.0	+19 48 00	2 10. V2
+60 -468 0 LS I +60 124		00 46 49.2	+60 42 50	2 9.89VO B2
-32-00469 60 CD -32 318		00 46 55.0	-32 24 30	2 10.51VO
+59 -470 0 V* XY CAS		00 47 02.0	+59 50 24	3 34G4
+60 114 0 LS I +60 125		00 47 16.3	+60 37 52	2 9.87VO3B2
-74 67 40 HD 4862		00 47 17.9	-73 38 35	4 11.01VO B3
-61-00473 60 0620145176.00		00 47 18.0	-61 18 00	2 11.9 V1
+34 123 2 HD 4779		00 47 23.0	+35 22 54	3 9.00VO5M.
+59-00475 60 BD +58 118		00 47 28.0	+59 13 53	2 10.1 V1
-47 90 40 HD 4825	AB	00 47 29.3	-47 08 08	2 9.4 V1 G5
+49 215 3 BD +49 215C	B	00 47 33.9	+50 21 31	4 3 F7
-04 -476 0 G 70 -17		00 47 35.9	-04 41 59	4 11.29VO
-26 267 20 CD -26 267		00 47 37.9	-25 57 42	2 9.3 V1 F8
-73-00477 .60 PMMR 29		00 47 43.0	-73 34 10	2 12.0 V1
-30-00478 60 CD -31 305		00 47 48.0	-30 52 30	2 11.63VO
-31 306 20 CD -31 306		00 47 48.3	-30 15 55	4 12.45VO
+24-00479 60 0985350020.00		00 47 52.0	+24 32 41	2 11.1 V1
-62-00479 60 V* AE TUC		00 47 56.0	-62 54 12	3 12.00VO6
-50 216 20 LTT 485		00 48 02.0	-50 16 24	2 3
-73 -481 0 AZV 31		00 48 03.1	-73 11 58	4 12.49VO B2
-43 99 40 CD -43 234		00 48 13.6	-42 37 32	2 3 F8
+10-00482 60 G 1 -28		00 48 14.0	+10 05 24	3 10.50VO
+58 -484 0 GJ 38		00 48 17.9	+58 01 18	2 10.67VO M2
-73 -483 0 HD 4976		00 48 23.4	-73 24 37	4 11.02VO B6
+33 116 2 HD 4895		00 48.40.0	+34 06 18	3 8.40VO55
+60 -487 0 LS I +60 126		00 48 42.6	+60 44 25	2 3 B
+60 119 0 BD +60 119		00 48 48.4	+60 34 16	4 10.95VO B9
-74 69 40 HD 5030		00 48 51.9	-73 45 37.	4 11.18VO A0
+05-00489 60 0985526021.00		00 48 53.0	+05 31 12	2 10. V2
-74 70 40 HD 5045		00 48 54.1	-73 44 41	2 11.05VO B3
-11-00489 60 BD -11 160		00 48 56.0	-11 09 30	2 10.9 V1
+11-00489 60 0985466313.00		00 48 57.0	+11 39 00	2 10.5 V1
-34-00490 60 CD -34 316		00 49 00.0	-34 07 00	2 11.8 V1
-34 313 20 CD -34 313		00 49 02.7	-34 07 32	4 11.76VO
-44 105 40 HD 4989		00 49 06.2	-43 51 45	2 10.0 V1 K1
-72-00492 60 PMMR 37		00 49 12.0	-72 31 09	2 12.0 V1
+63 102 0 LS I +64 52		00 49 13.1	+64 24 40	2 10.00VO B1
+64 -493 0 UBV M 43231		00 49 18.9	+64 16 59	4 11.31VO B2
+20-00493 60 G 69 -27		00 49 20.0	+20 18 42	3 11.53VO
-72 -494 0 0620053090.00		00 49 23.5	-72 44 28	4 12.57VO A2
+06-00494 60 G 1 -30		00 49 26.0	+06 41 24	3 12.20VO

0.118	-0.018	1 13.84B08 8 89 0 0 0 0 0 0 0
		1 2R 9.1 B19 8150 0 0 0 0 0 0 0 F
		5 11.97B01 1171 0 0 0 0 0 0 0
		5 10.0 B1918220219 0 0 0 0 0 0 0 *
		4 11.5 B16 6108 0 0 0 0 0 0 0
		5 12.01B01 1 13 80 0 0 0 0 0 0 0
		4 10.49B01 1167 0 0 0 0 0 0 0
		1 1 38 9119183 0 0 0 0 0 0 0
+.233	+.029	1 2 3819139 0 0 0 0 0 0 0 *
		4 11.1 B16 6108 0 0 0 0 0 0 0 *
		1 1 38 9212 0 0 0 0 0 0 0
		4 11.32B01 1171 0 0 0 0 0 0 0 *
		4 12.53B02 2167 0 0 0 0 0 0 0
+.169	-.062	1 1R10.56B08 8139 0 0 0 0 0 0 0
+.303	+.175	1 11.70B00 0 64 89 92139180191181 54+*
		1R11.4 B16 6184 0 0 0 0 0 0 0
		4R11.18B01 1 99171 0 0 0 0 0 0
		4 10.3 B16 6176306 0 0 0 0 0 0 G
		4R11.87B01 1 99 0 0 0 0 0 0 0
		1 2R11.0 B19 8150 0 0 0 0 0 0 0
		4R11.75B01 1 99 0 0 0 0 0 0 0
-.097	-.168	1 1R 38 9139 0 0 0 0 0 0 0
		1 3819176 0 0 0 0 0 0 0 *
		4R11.16B01 1 99171 0 0 0 0 0 0 *
		4 10.48B06 6108 0 0 0 0 0 0 0
+.208	-.056	1R10.55B02 2139118 0 0 0 0 0 0
+.209	-.048	1R10.93B02 2139118 0 0 0 0 0 0 *
		4 11.25B01 1167 85 99171 0 0 0 0 *
0.045	-0.286	1 11.18B01 1 91119190118 0 0 0 0 0
+.167	-.067	1 1R 3819139 0 0 0 0 0 0 0 *
		4 12.26B02 2167 0 0 0 0 0 0 0 *
		4 11.8 B16 6176 0 0 0 0 0 0 0
		1 1 13.39B08 8 72 0 0 0 0 0 0 0
		4 12.3 B16 6176 0 0 0 0 0 0 0 *
		1 1 38 9212 0 0 0 0 0 0 0
		1 9.65B01 1 89 89132132181181184 54+* F
		4R11.03B01 1 99171 0 0 0 0 0 0
		4 11.93B02 2167 0 0 0 0 0 0 0
		1R11.0 B16 6184 0 0 0 0 0 0 0
		4R11.60B01 1 99 0 0 0 0 0 0 0 *
+.021	-.201	1 1 3819139 0 0 0 0 0 0 0
0.280	0.010	2 11.01B08 8139118 0 0 0 0 0 0 *
		2R12.42B02 2 85 0 0 0 0 0 0 0
		4 12.70B02 2167 0 0 0 0 0 0 0
		4R11.0 B16 6 54 0 0 0 0 0 0 0
-0.018	-0.350	4 12.35B02 2167 0 0 0 0 0 0 0
		1R11.3 B19 8139118 0 0 0 0 0 0
		1 12.75B08 8 46119158 57183127 0 *
		4R10.62B01 1 83 0 0 0 0 0 0 0 *
+.037	-.235	1 1 3819139 0 0 0 0 0 0 0
+.252	+.009	1 2 11.18B01 1139 0 0 0 0 0 0 0
		1 3119117143106 85150 0 0 0 0 0 0
		1 3019 64 98148185 0 0 0 0 0 0
		4R11.3 B16 6 54 0 0 0 0 0 0 0
-.040	-.186	2 11.0 B1918139 0 0 0 0 0 0
		1 10.08B01 1 21138150 0 0 0 0 0 0
+.152	-.137	1 2 3819139 0 0 0 0 0 0 0 *
+.122	-.182	2 11.83B02 2139118 0 0 0 0 0 0
		4R11.88B01 1 99 0 0 0 0 0 0 0
		1 1 38 9212 0 0 0 0 0 0 0
		4 11.3 B1616108 0 0 0 0 0 0 0 *
		4R 3819 54 0 0 0 0 0 0 0
+.209	-.041	1 1 11.52B01 1139 0 0 0 0 0 0 0 G
-.10	-.29	4R13.57B01 1118 0 0 0 0 0 0 0
+.181	-.122	1 1 38 9139 0 0 0 0 0 0 0
		1 12.41B01 1213 0 0 0 0 0 0 0
		4R 3819 54308 0 0 0 0 0 0
-.090	-.156	1 2 11.39B01 1139 0 0 0 0 0 0 0 G
+.191	+.034	1 2 3819139 0 0 0 0 0 0 0
+.028	-.202	2 11.34B01 1139118 0 0 0 0 0 0
		1 1 38 9 46 57 0 0 0 0 0 0
-.085	-.159	1 1R11.92B08 8139 0 0 0 0 0 0 0 *
		5R 3819 54 0 0 0 0 0 0 0 *
		1 12.33B01 1 80213 0 0 0 0 0 0 0 G
		4 11.27B01 1108 0 0 0 0 0 0 0
1.099	-0.527	1 8.9 B18 8 17 64 89180181197 54 0
		4R11.66B01 1 99 0 0 0 0 0 0 0 N
		1 1 11.5 B19 8 91119190 0 0 0 0 0 0
		4R 3819 54 0 0 0 0 0 0 0 *
		5R 3819 54 0 0 0 0 0 0 0 G
		4 11.7 B1616108 0 0 0 0 0 0 0 G
		5R 3819 54 0 0 0 0 0 0 0
		5R 3819 54 0 0 0 0 0 0 0 G F
		4 11.37B01 1171 0 0 0 0 0 0 0 G F
		4R 3819 54 0 0 0 0 0 0 0
0.270	-0.009	
1.226	-2.716	1R11.45B08 8139118 0 0 0 0 0 0 G
		1 12.91B01 1 68 89138152165 17181 54 *
		4 3819176 0 0 0 0 0 0 0 *
+.230	-.207	1 10.7 B16 6176 0 0 0 0 0 0 0
		1 11.9 B1918 72118139180 0 0 0 0 *
+.289	+.005	1 1 38 9213 0 0 0 0 0 0 0 *
		1 1 3819139 0 0 0 0 0 0 0
+.184	+.046	2R10.29B01 1 85171 0 0 0 0 0 0 *
		1 2 11.07B01 1139 0 0 0 0 0 0 0
		1 10.62B0910 18 94186 0 0 0 0 0 0
		2R10.37B01 1 85167171 0 0 0 0 0 *
		2R10.98B01 1 85104 0 0 0 0 0 0
		1 1 38 9 72 0 0 0 0 0 0 0
		1 3019 64 98185 0 0 0 0 0 0 *
+.192	-.139	1 1R 3819139 0 0 0 0 0 0 0 *
		1R10.9 B16 6184301 0 0 0 0 0 0 *
+.132	-.259	2 9.0 B1918108 0 0 0 0 0 0 0 *
		2 12.16B01 1139118 0 0 0 0 0 0 N
		4 3819176 0 0 0 0 0 0 0
		1 1 38 9213 0 0 0 0 0 0 0
+.014	-.203	1 2 12.07B01 1139 0 0 0 0 0 0 0
		1 38 9119183 0 0 0 0 0 0
+.215	-.046	1 1 3819139 0 0 0 0 0 0 0 *
		2 3019 18 39 94 0 0 0 0 0 0 *
+.179	-.145	1 12.1 B1918139 0 0 0 0 0 0 0
		1 12.78B01 1 80213 0 0 0 0 0 0 0 *
+.264	+.076	5 11.0 B1918220219 0 0 0 0 0 0 0
1.502	0.377	1R11.29B01 1139118 0 0 0 0 0 0
		1 12.06B08 8 17 68 89 91139180181 54+*
		1 11.15B01 1 80104213 85 0 0 0 0 0
		1 3019 64 91183 98185 0 0 0 *
		5R12.2 B1918 54 0 0 0 0 0 0 0
		4R11.25B01 1 54 0 0 0 0 0 0 0 G
+.221	-.094	1 1 11.29B01 1104213 0 0 0 0 0 0 0 G
		1 3819139212 0 0 0 0 0 0
		1 11.03B01 1 80104213 85 99 0 0 0 *
+.217	-.038	1 1 38 9 57 0 0 0 0 0 0 0 *
		1 1 3819139 0 0 0 0 0 0 0 *
		1 1 38 9119 0 0 0 0 0 0 0 *
		4 38 9183 0 0 0 0 0 0 0 *
		1R11.0 B16 6184 0 0 0 0 0 0 0
		1 1 38 9213 0 0 0 0 0 0 0 *
		2R10.57B01 1 85167 99171 0 0 0 0 0
0.258	-0.132	4R11.76B01 1 99 0 0 0 0 0 0 0
		1 12.97B01 1139118 0 0 0 0 0 0 0
0.005	-0.290	2R12.65B01 1 80 0 0 0 0 0 0 0 *
		4R12.72B01 1118 0 0 0 0 0 0 0

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 1 BD+65  1938  HD 225010 B   00 00 03.708+65 49 19.66  ~    ~  S   -.001  +.020 AA DD S  7.41 B  7.33 V 7 S R A2V      |  1                                             23575+65.32B  R 15.2  70 0  10938
 2 BD+82   748  HD 225019     00 00 05.387+82 41 41.71  ~    ~  S   +.006  -.001 AA DD S  7.4  B  7.2  V 7 S R A0       |  2                                                           R          0      1
 3 BD+59  2819B HD 240479 B   00 00 09.227+59 40 57.70  ~    ~  S   -.006  +.001 AA DD S 10.41 B 10.22 V 7 S R A0       |  3                                             23576+59.24B  R 10.1 290 0  21028
 4 BD+79   799  HD 225020 A   00 00 09.339+80 00 13.63  ~    ~  S   +.043  +.021 AA DD S  8.3  B  7.7  V 7 S R F2       |  4                                             23576+79.43A  R  ~     0 0      2
 5                          B 00 00 12.003+80 00 29.35 .22 .17  S   +.035  +.027 AA DD S 10.6  B       V 7 S R          |  5                                             23576+79.43B  R 16.9  23 0
 6 BD+01  4820A HD 225028 AB  00 00 13.165+01 51 10.58  ~    ~  S   +.054  -.092 AA DD S  7.8  B  7.7  V 7 S R G0       |  6     3                                       23576+01.354B R          0 108983
 7 BD+81   841            AB  00 00 33.758+82 22 42.09  ~    ~  S   -.014  -.005 AA DD S  9.9  B  9.8  V 7 S R B3       |  7                                             23582+82..6AB R          0      3
 8 BD+32  4756                00 00 43.850+32 34 03.24  ~    ~  S   +.038  -.002 AA DD S       B  8.80 V 7 S R F0V:+... |  8 TW  AND EA    8.96 K 11.26 1    4.1227                  R          0  53603
 9 CD-29 18946  HD 225118     00 01 07.014-28 40 21.43  ~    ~  S   +.260  -.150 AA DD S  9.02 B  8.24 V 7 S R G8V      |  9                                                           R          0 166024     LTT   12
10 BD+60  2664B             B 00 01 12.12 -15 40 20.0   ~    ~  S                AA DD S 11.0  B 10.7  V 7 S R          | 10                                             23589+60.17B  R 10.9 164 0
11 CD-30 19809  HD 225137     00 01 38.578-30 24 43.56  ~    ~  S   +.020  +.010 AA DD S  7.06 B  7.14 V 7 S R B8V      | 11     9                                                     R          0 192345                CL    20  12
12 CD-26 16890                00 01 43.212-26 11 27.97  ~    ~  S   -.124  -.159 AA DD S  9.35 B  8.60 V 7 S R G5       | 12                                                           R          0 166028     LTT   15
13 CD-47 14785  HD 225208     00 01 50.669-47 20 48.90  ~    ~  S   +.286  +.050 AA DD S 10.66 B  9.80 V 7 S R K0V      | 13                                                           R          0 214950     LTT   18
14 CD-45 15233                00 01 53.12 -45 44 12.5   ~    ~  S   +.229  -.004 AA DD S 12.59 B 11.62 V 7 S R          | 14                                                           R          0            LTT   17
15 BD-11  6194  HD 225212     00 01 56.545-10 47 15.85  ~    ~  S   -.004  -.003 AA DD S  6.60 B  4.97 V 7 S R K3Iab:   | 15    13          5.20 K  5.44 3      ~                      R          0 147066
16 CD-37 15492  HD 225213     00 02 27.850-37 36 11.68  ~    ~  S  +5.663 -2.288 AA DD S 10.00 B  8.56 V 7 S R M4V      | 16                                                           R          0 192348   1 LHS    1
17 CD-36 16162  HD 225297     00 02 28.828-36 17 40.39  ~    ~  S   +.205  +.067 AA DD S  8.26 B  7.73 V 7 S R G0V      | 17                                                           R          0 192349     LTT   22
18 BD+44  4548                00 02 30.20 -15 16 40.4   ~    ~  S   +.880  -.155 AA DD S 11.43 B  9.95 V 7 S R M2       | 18                                                           R          0          2 LHS 1014
19 BD+56  3142  HD         2  00 02 30.249+57 29 27.75  ~    ~  S   +.036  +.075 AA DD S  8.9  B  8.6  V 7 S R F5       | 19                                                           R          0  21069
20 BD+67  1599  HD         1  00 02 32.243+67 33 42.73  ~    ~  S   +.007  +.009 AA DD S  8.8  B  7.6  V 7 S R K0       | 20                                                           R          0  10963
21 BD+29  5059B HD         4 A 00 02 34.967+30 03 04.19 ~    ~  S   -.028  -.031 AA DD S  8.21 B  7.78 V 7 S R F0       | 21                                             00000+29.46A  R  ~     0 0  53627
22 BD+44  4550  HD         3 A 00 02 35.002+44 57 03.62 ~    ~  S   -.030  -.012 AA DD S  6.78 B  6.71 V 7 S R A1Vn     | 22                                             00000+44.40A  R  ~     0 0  36042
23 CD-68  2378  HD        55  00 02 47.980-68 06 12.07  ~    ~  S   -.167  -.514 AA DD S  9.55 B  8.48 V 7 S R K5V      | 23                                                           R          0          3 LHS 1015
24 BD+45  4408A HD        38  00 03 01.681+45 32 09.36  ~    ~  S   +.880  -.155 AA DD S 10.4  B  8.8  V 7 S R K2       | 24                                                           R          0  36046  4A LHS 1016
25 BD-15  6542A             A 00 03 21.429-14 42 39.07  ~    ~  S   -.007  -.023 AA DD S 10.08 B  9.57 V 7 S R G0       | 25    24          6.72 K  9.22 3      ~      00008-14.59A  R          0 147080
26              HD       826  00 10 23.432+15 44 32.23  ~    ~  S                AA DD S       B 11.1  V 7 S R WC       | 26                                                           R          0                       NGC   40  32
27 BD+26    43  HD      1795  00 19 46.301+26 43 07.74  ~    ~  S   -.013  -.021 AA DD S       B  7.70 V 7 S R M3e      | 27 T  AND M      8.39 H 13.50 3  280.4399                    R          0  73930
28 BD+37    58A HD      1967 A 00 21 23.020+38 18 02.31 ~    ~  S   -.010  -.018 AA DD S  9.36 B  7.39 V 7 S R S...     | 28 R  AND M      6.75 H 14.28 3  409.2000 00187+38..2A        R          0  53860
29 BD+61    67                00 21 38.809+61 33 48.91  ~    ~  S   -.002  -.001 AA DD S  9.12 B  8.78 V 7 S R A0Ib     | 29                                                           R          0  11170                NGC  103  65
30                            01 23 44.45 -12 34 33.4   ~    ~  S                AA DD S 11.5  B       V 7 S R B9V      | 30                                                           R          0                       NGC  129 105
31              HD      2890  02 23 37.876+15 23 45.23  ~    ~  S                AA DD S       B  7.80 V 7 S R M...     | 31 TU AND M      8.48 H 12.28 3  316.0601                    R          0
32 BD+31   641B HD 281160 A   03 41 00.185+31 57 51.29  ~    ~  S   +.009  -.020 AA DD S 10.40 B  9.93 V 7 S R A0V      | 32                                             03379+31.48A  R  ~     0 0  56671                IC   348   4
33 BD+31   641A             B 03 41 00.864+31 57 44.21  ~    ~  S   +.004  -.022 AA DD S 10.54 B 10.02 V 7 S R A2       | 33                                             03379+31.48B  R 11.4 129 0                       IC   348   5
34                            03 50 33.543-12 55 34.34  ~    ~  S                AA DD S 12.70 B 11.90 V 7 S R F0       | 34                                                           R          0                       IC   348   6
35 BD+41  4651                22 55 46.021+42 28 07.38  ~    ~  S   -.003  +.012 AA DD S       B  8.80 V 7 S R M4ae...  | 35 TV AND SRB    9.51 H 10.39 3  113.8000                    R          0  52542
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D.1/Page  1                                  Version du 10 Juillet 87
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 1 BD+65  1938   HD 225010 B   00 00 03.708+65 49 19.66  ~   ~  S  -.001 +.020 AA DD S  7.41 B  7.33 V 7 S R A2V
 2 BD+82   743   HD 225019     00 00 05.387+82 41 41.71  ~   ~  S  +.006 -.001 AA DD S  7.4  B  7.2  V 7 S R A0
 3 BD+59  2819B  HD 240479 B   00 00 09.227+59 40 57.70  ~   ~  S  -.006 +.001 AA DD S 10.41 B 10.22 V 7 S R A0
 4 BD+79   799   HD 225020 A   00 00 09.339+80 00 13.63  ~   ~  S  +.043 +.021 AA DD S  8.3  B  7.7  V 7 S R F2
 5                         B   00 00 12.003+80 00 29.36 .22 .17 S  +.035 +.027 AA DD S 10.6  B       V 7 S R
 6 BD+01  4620A  HD 225028 AB  00 00 13.165+01 51 10.58  ~   ~  S  +.054 -.092 AA DD S  7.8  B  7.7  V 7 S R G0
 7 BD+81   841             AB  00 00 33.758+82 22 42.09  ~   ~  S  -.014 -.005 AA DD S  9.9  B  9.8  V 7 S R B8
 8 BD+32  4756                 00 00 43.850+32 34 03.24  ~   ~  S  +.038 -.002 AA DD S       B  8.80 V 7 S R F0V:+...
 9 CD-29 18946   HD 225118     00 01 07.014-28 40 21.48  ~   ~  S  +.260 -.150 AA DD S  9.02 B  8.24 V 7 S R G8V
10 BD+60  2664B            B   00 01 12.12 -15 40 20.0   ~   ~  S              AA DD S 11.0  B 10.7  V 7 S R
11 CD-30 19809   HD 225187 .   00 01 38.578-30 24 48.56  ~   ~  S  +.020 +.010 AA DD S  7.06 B  7.14 V 7 S R B8V
12 CD-26 16850                 00 01 43.212-26 11 27.97  ~   ~  S  -.124 -.159 AA DD S  9.35 B  8.60 V 7 S R G5
13 CD-47 14785   HD 225208     00 01 50.669-47 20 48.90  ~   ~  S  +.286 +.050 AA DD S 10.66 B  9.80 V 7 S R K0V
14 CD-45 15233                 00 01 53.12 -45 44 12.5   ~   ~  S  +.229 -.004 AA DD S 12.59 B 11.62 V 7 S R
15 BD-11  6194   HD 225212     00 01 56.545-10 47 15.85  ~   ~  S  -.004 -.003 AA DD S  6.60 B  4.97 V 7 S R K3Iab:
16 CD-37 15492   HD 225213     00 02 27.850-37 36 11.68  ~   ~  S +5.663 -2.288 AA DD S 10.00 B  8.56 V 7 S R M4V
17 CD-36 16162   HD 225297     00 02 28.828-36 17 40.39  ~   ~  S  +.205 +.067 AA DD S  8.26 B  7.73 V 7 S R G0V
18 BD+44  4548                 00 02 30.20 -15 16 40.4   ~   ~  S  +.880 -.155 AA DD S 11.43 B  9.95 V 7 S R M2
19 BD+56  3142   HD         2  00 02 30.249+57 29 27.75  ~   ~  S  +.036 +.075 AA DD S  8.9  B  8.6  V 7 S R F5
20 BD+67  1599   HD         1  00 02 32.243+67 33 42.73  ~   ~  S  +.007 +.009 AA DD S  8.8  B  7.6  V 7 S R K0
21 BD+29  5069B  HD         4 A 00 02 34.967+30 03 04.19 ~   ~  S  -.028 -.031 AA DD S  8.21 B  7.78 V 7 S R F0
22 BD+44  4550   HD         3 A 00 02 35.002+44 57 03.62 ~   ~  S  -.030 -.012 AA DD S  6.78 B  6.71 V 7 S R A1Vn
23 CD-68  2378   HD        55  00 02 47.980-68 06 12.07  ~   ~  S  -.167 -.514 AA DD S  9.55 B  8.48 V 7 S R K5V
24 BD+45  4408A  HD        38  00 03 01.681+45 32 09.36  ~   ~  S  +.880 -.155 AA DD S 10.4  B  8.8  V 7 S R K2
25 BD-15  6542A            A   00 03 21.429-14 42 39.07  ~   ~  S  -.007 -.023 AA DD S 10.08 B  9.57 V 7 S R G0
26               HD       826  00 10 23.432+15 44 32.23  ~   ~  S              AA DD S       B 11.1  V 7 S R WC
27 BD+26    43   HD      1795  00 19 46.301+26 43 07.74  ~   ~  S  -.013 -.021 AA DD S       B  7.70 V 7 S R M3e
28 BD+37    58A  HD      1967 A 00 21 23.020+38 18 02.31 ~   ~  S  -.010 -.018 AA DD S  9.36 B  7.39 V 7 S R S...
29 BD+61    67                 00 21 38.809+61 33 48.91  ~   ~  S  -.002 -.001 AA DD S  9.12 B  8.78 V 7 S R A0Ib
30                             01 23 44.45 -12 34 33.4   ~  ~   S              AA DD S 11.5  B       V 7 S R B9V
31               HD      2890  02 23 37.876+15 23 45.23  ~  ~   S              AA DD S       B  7.80 V 7 S R M...
32 BD+31   641B  HD 281160 A   03 41 00.185+31 57 51.29  ~   ~  S  +.009 -.020 AA DD S 10.40 B  9.93 V 7 S R A0V
33 BD+31   641A            B   03 41 00.864+31 57 44.21  ~   ~  S  +.004 -.022 AA DD S 10.54 B 10.02 V 7 S R A2
34                             03 50 33.543-12 55 34.34  ~   ~  S              AA DD S 12.70 B 11.90 V 7 S R F0
35 BD+41  4651                 22 55 46.021+42 28 07.38  ~   ~  S  -.003 +.012 AA DD S       B  8.80 V 7 S R M4me...
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ADD.2/Page  1                                         Version du 10 Juillet 87
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     variability   mag max   mag min      P          CCDM no      id.  ρ    θ   add  SAO     Gliese Luyten NGC/IC

 1                                                  23575+65.32B   R  15.2  70  0  10938
 2                                                                 R            0      1
 3                                                  23576+59.24B   R  10.1 290  0  21028
 4                                                  23576+79.43A   R   ~     0  0      2
 5                                                  23576+79.43B   R  16.9  23  0
 6      3                                           23576+01.35AB  R            0 108983
 7                                                  23582+82..6AB  R            0      3
 8  TW  AND EA     8.96 K 11.26 1   4.1227                         R            0  53603
 9                                                                 R            0 166024       LTT   12
10                                                  23589+60.17B   R  10.9 164  0
11      9                                                          R            0 192345                  CL    20   12
12                                                                 R            0 166028       LTT   15
13                                                                 R            0 214950       LTT   18
14                                                                 R            0              LTT   17
15     13          5.20 K  5.44 3      ~                           R            0 147066
16                                                                 R            0 192348    1  LHS    1
17                                                                 R            0 192349       LTT   22
18                                                                 R            0           2  LHS 1014
19                                                                 R            0  21069
20                                                                 R            0  10963
21                                                  00000+29.46A   R   ~     0  0  53627
22                                                  00000+44.40A   R   ~     0  0  36042
23                                                                 R            0           3  LHS 1015
24                                                                 R            0  36046   4A  LHS 1016
25     24          6.72 K  9.22 3      ~            00008-14.59A   R            0 147080
26                                                                 R            0                         NGC   40   32
27  T   AND  M     8.39 H 13.50 3   280.4399                       R            0  73930
28  R   AND  M     6.75 H 14.23 3   409.2000        00187+38..2A   R            0  53860
29                                                                 R            0  11170
30                                                                 R            0                         NGC  103   65
31  TU  AND M      8.48 H 12.28 3   316.0601                       R            0                         NGC  129  105
32                                                  03379+31.48A   R   ~     0  0  56671                  IC   348    4
33                                                  03379+31.48B   R  11.4 129  0                         IC   348    5
34                                                                 R            0                         IC   348    6
35  TV  AND SRB    9.51 H 10.39 3   113.8000                       R            0  52542
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