Thirty Second Meeting of the Hipparcos Science Team

ESOC, Darmstadt, 13-14 July 1993

Attendance:

HST: Prof. P.L. Bernacca, Dr M. Crézé, Prof. F. Donati, Dr. M. Grenon, Prof. E. Høg, Prof. J. Kovalevsky, Dr F. van Leeuwen, Dr L. Lindegren, Dr H. van der Marel, Dr F. Mignard, Mr C.A. Murray, Mr R.S. Le Poole, Dr H. Schrijver, Dr C. Turon.

ESTEC: M.A.C. Perryman

ESOC: D. Heger, A. McDonald, et al. (part time)

Consortia: D. Evans & C. Petersen (first day)

Unable to attend: Prof. M. Grewing

The HST was welcomed by Alan Smith (Head of Science Missions Division).

The agenda attached was adopted.

Actions agreed at the meeting are included at the end of the Minutes.

1. Satellite Status and ESOC Activities

Heger reported on the the status of the ESOC operations since the start of the year (Annex I). With the OBC1/OBC2 failures on June 24, it was expected that the satellite operations would have been formally terminated at this meeting. However, attempts to re-start were successful on 8 July, and progress was being made on getting back to routine uplinking to the satellite. Areas of concern were discussed (mainly concerning the OBC functioning, and the zero-gyro operations). van Leeuwen also noted that the thruster calibration was evidently very temperature dependent, and the the torques very orientation dependent, casting further doubt on the feasibility of zero-gyro operations given the present satellite status.

It was agreed that attempts to continue operations would continue until 15 August. If a useful fraction of data (say 5 hours per orbit) was not being returned, at NSL, by this time, it was jointly agreed that the mission operations would be terminated. It was also agreed that, if in ESA's opinion, future prospects looked very poor before that time, a decision to discontinue operations could be made by ESA with the HST's support. Perryman contacted ESA D/Sci, and this approach was given full support by D/Sci, along with the latter's message of congratulations and encouragement to the HST and to the Operations Team.

McDonald gave a report on the zero-gyro status and future planning (Annex II).

2. NDAC Report

Van Leeuwen presented the status of the RGO side of the NDAC processing (Annex III). All 2.5 years of data had now been processed, including photometry. Reports on calibrations, the instrument data base constructed at RGO, and the on-board clock drifts had been distributed to all HST members (Action 1).

Petersen reported on the development of the instrumental parameters. Lindegren reported on the preliminary results from the 31-month solution, and the changes in the accuracy distributions since the 18-month solution (no details attached). He also showed results of his study of the chromaticity development of the payload from the sphere solution. No long-term trends were evident, but there were shorter term trends, and variations in the overall scatter.

3. FAST Report

Kovalevsky reported results of the FAST iterated 18-month solution (Annex IV). The future schedule in FAST is as follows: end June to early September: first treatment of months 19-32; mid September to October: re-run of any RGC's plus new sphere (iterated 18-month plus 19-32 months first treatment); November to mid-December: comparison and discussion of 32-month solution, and new photometry for the full 32-months. A re-iteration of 36 months of data will take about 4-5 months.

4. TDAC Progress

Høg reported on the TDAC status (Annex V). The catalogues distinguished in Annex V were summarised. Final Tycho accuracies were now expected to be 30 mas at $T = 11$ mag, and 6 mas at $T < 9$ mag, in positions, parallaxes and proper motions. A preliminary photometric calibration of 2.5 years of data had been made by Grossmann. At AIT, transit identification run at three times real time, so that three years of data will take one year to process (this started three months ago). Perryman had asked whether additional computer resources would significantly affect the overall Tycho Catalogue schedule. No reply had yet been received from AIT. Astrometry now runs 50 times faster than real time; an iteration will presumably be needed.

Perryman noted that the present Tycho commitment was for completion of the final catalogue in 1997, and asked for clarification of what was driving this schedule, given that all TDAC tasks seemed to be in good shape. Perryman considered that there would be several serious difficulties for the overall project if the Tycho Catalogue were not completed at the same time as the main mission catalogue (completion of documentation, consistency of data between main mission and Tycho Catalogues, production of final data products). Bernacca pointed out that the present schedule called for the HST remaining in place until 1997, which had not been foreseen by Perryman. Høg was asked to reflect on whether an advanced schedule could be targetted (Action 2).

Crézé thought that the name Tycho Reference Catalogue was an unfortunate one; Lindegren concurred (Action 3).

5. Comparison Activities and Future Spheres

This section summarises the results and actions arising from the dedicated comparison meeting held on 12 July 1992 (attendees: LL, FvL, EH, FD, JK, HS, RleP, CM, HvdM). See also Annex VI (FAST) and NDAC/LO/148 of 5 July 1993 (NDAC). For sphere comparisons, see Action 4. For RGC comparisons, see Action 5. For attitude comparisons, see Action 6.

Global sphere approaches were discussed. Within FAST, Bernacca was pessimistic that something would now occur on the necessary timescales. Within NDAC, Lindegren was investigating what options might be possible. Bernacca suggested some possible pooling of resources, leading to a single globus-type solution. Perryman noted that this could only be an approved common project if completed by end-1995, i.e. in time for consideration with the other final spheres.

6. Double Stars

Lindegren reported on the data processing status in NDAC. Soderhjelm is starting to look at the more problematic cases, and reductions of these systems should start by end 1993. Lindegren expects to do most of the comparison work.

Kovalevsky outlined the organisation and current status within FAST. Italian participation involves CSATA (data condensation and non-single star recognition); IAS (double star reductions for simple cases and orbital systems); OATA (problem stars and comparison activities). ARI is responsible for double star astrometric parameters (IAS/OATA data) and astrometric double stars. CERGA is responsible for scientific supervision (Kovalevsky) and comparisons (Mignard). For multiple stars, CSATA, CERGA and OATA are all involved.

The FAST schedule calls for condensation of 18 months data (end June to August); non-single star recognition with 18 months data, condensation of 18–24 months and possibly 25–32 months data, and operational tests of IAS programs (September to mid-October); systematic treatment of double stars for 18 months data, and comparison with CERGA and NDAC solutions, plus possible treatment for 24 or even 32 months data (October to November). The schedule would be reviewed by the FAST Committee in December, and a decision made concerning the choice of the Italian or CERGA routes at that time. Bernacca felt that the problems experienced in the past due to funding difficulties in Italy should not be encountered in the future. HST members expressed concern that the schedule and data path was not more finalised. Kovalesvky was aware of these difficulties and would report back on the progress at the next HST Meeting.

Mignard reported on the results from the Double Star Working Group Meeting. The composition (Mignard, Soderhjelm, Kovalevsky, Bernstein, Dommanget, Lampens, possibly Lindegren and Pannunzio, with Perryman as observer) was approved by the HST. Other details are not included here. Good progress was made at the ESTEC meeting on 15 June, and problem cases were being investigated within NDAC and FAST. Some discussions took place on the possible role of the ground-based observing group led by Oblak. HST confirmed that the route was open to initiate observations of difficult systems. Grenon would supply further details of the group's capabilities (Action 7).

7. Working Group Reports

(a) Photometry Working Group: Evans reported on the status after the second meeting held in ESOC on 12 July. Major progress had been made with the availability of the revised standard from Grenon. Actions are reported separately. The next meeting will be held in Grasse/Nice on 14 October. No major problems had been identified, and Evans considered that completion of the photometry, including epoch photometry and merging, was consistent with the end 1995 target for all mission products. The goals and composition of the team (Evans, Mignard, Grenon, Grossmann, and Perryman as observer) were approved by the HST.

(b) Reference Frame Working Group: Kovalevsky reported on his proposal for the composition and conduct of this WG, which emerged following the Washington Meeting. The composition is Kovalevsky, Lindegren, Preston, Lestrade, de Vegt, Johnston, Hemenway (with Perryman as observer). The goals and schedule of the group was presented by Kovalevsky, and approved by the HST. Kovalevsky would take contact with each member following the meeting, explaining the proposed planning. Positions and proper motions (not parallaxes) would be made available for the task, and Kovalevsky would stress that the data must be restricted to the specific tasks concerned, and that no publication of preliminary data was foreseen.

(c) Documentation Working Group: Perryman outlined his proposed concept for this group, which would be responsible for developing recommendations for the formats in which the final data are to be published, as well as an accompanying two-volume supplement describing the satellite operations and the data analysis (see Annex VII). Perryman recommended that work on this should start promptly, and with a target completion date of end 1995 (products to appear with the final catalogue at end 1996). The proposed composition was: Perryman, van Leeuwen, Lindegren, Mignard, Schrijver, Turon. Bernacca also proposed to contribute effort.

8. INCA CD-ROM Demonstration

Turon gave a demonstration of the CD-ROM software developed for the Input Catalogue. HST approved development of similar products for the final mission products. A proposal would be developed between Turon and Perryman, probably involving the INCA CD-ROM software developer, Denis Priou (Action 8).

9. Preparation for Internal Proposal Evaluation and Data Policies

(a) Review of Internal Proposals: The following schedule for the review of internal proposals was established (Action 9): (i) Perryman and Turon to draw up a proposed list of evaluation criteria; (ii) Perryman would send out proposals to review team by end August; (iii) Turon would prepare details of overlap with 1982 proposals one month before the review team meeting; (iv) the meeting would take place in Meudon on 23(pm) and 24 (all day) November. HST members who intended to participate in the review were: Bernacca, Crézé, Grenon, Høg, Kovalevsky, Le Poole, Turon. Perryman would invite Consortia Steering Committee Chairman, and invite them to delegate a representative if these dates were not convenient. Turon was taking care of data handling (data to PIs) at Meudon. Høg was requested to inform all TDAC members of the opportunity to submit Tycho proposals (Action 10).

(b) A&A Hipparcos Issue 1994: It was agreed to target a series of papers to A&A concerning the results of Hipparcos based on the 18-month sphere solution (not the later solutions). Perryman would draft an announcement letter to the consortia leaders, which they could distribute internally. The schedule would be: proposals to be received by end September; reviewed by HST at the 33rd HST meeting at the end of October. Submissions would be targetted at end February 1994. Some papers predominantly HST-led could be considered.

(c) Discussion of papers submitted for publication: the unanimous recommendation of HST members concerning papers discussed is attached to these minutes.

10. Other Matters

(a) Minor Planets: A note from FAST (B. Morando, see also Annex VIII) was distributed to Mignard, Kovalevsky, Høg, Lindegren, van Leeuwen, and Turon. Further discussions will be held at the next HST meeting. The Documentation Working Group will consider the problem of the publication format for the minor planet data, probably along the lines proposed by Murray.

(b) ESOC Filing Key: Agreement was reached about the method of overcoming the problem within the DRC tape production software at ESOC. All consortia have accepted the approach suggested by J. Allan, namely that further processing should proceed using a new zero point for the frame counter, set for 1992. This reference time should be chosen to coincide with both perigee and a tape boundary. No change to the DDID format should be made because of this. In particular, the idea of using a status bit in, for example, the data catalogue file, should not be implemented.

ESOC will notify all DRCs, in writing, about the new reference time and the ground station time from which the new reference time is implemented. It will be the responsibility of each DRC to accommodate within their software any other methods of differentiating between the two reference times, as they see appropriate.

(c) Main Astrometric Catalogue Merging: Murray reported on the present status. He would send out a note on his results, and including his specific requests and recommendations (Action 11). One evident anomaly was that the FAST and NDAC variances were systematically different. The goal might be to have a magnitude-dependent multiplicative factor introduced into the weighting scheme.

(d) Schedule: HST strongly agreed to target completion of all mission products (or necessary preparatory work) by end 1995, with availability of these mission products at end 1996, i.e. leaving the entire year of 1996 availability for scientific exploitation, largely unencumbered by other tasks, thus: main catalogue (merged), annexes, TBD per cent of double stars, epoch photometry, definition of data products and data formats, catalogue introduction, 2-volume technical accompanying volumes, concepts for printed version, magnetic tape, CD-ROM, inclusion within CDS data base. The only uncertainties in this target schedule referred to the inclusion of the globus-type reductions, and to the Tycho Catalogue.

11. Next HST Meeting

The 33rd meeting of the HST will be held on 28–29 October 1993, at ARI, Heidelberg, following the next Double Star Working Group to be held at ARI on 27 October. Specific splinter sessions on other comparison activities will be decided upon at a later date, depending on the availability of new results.

M.A.C. Perryman, 15 July 1993

Distribution: HST, ESOC Participants

Discussion of Relevant Forms A and B
32nd HST Meeting, ESOC, 13-14 July 1993

ADHC002 (Jauncey, SN1987A): Only a general request to publish the details of the radio-optical registration has been received. It is not acceptable in this form. A draft paper detailing the results with and without the Hipparcos data, and detailing which Hipparcos data have been used, and how, must be submitted for review to the HST.

B12 (Lindegren, Proper Motions and Parallaxes): Accepted.

B13 (Høg, Tycho astrometry): Accepted. [In future, especially for refereed papers, it was requested to include visibility of other consortium workers].

B14 (Wielen, Parallax zero point): HST confirmed the position adopted at the FAST Steering Committee (see minutes thereof): i.e. only the methodology should be published in the Cambridge proceedings. The proposed tables should not be included. [HST members also made the following observations: (i) for such an end point of the Hipparcos data processing to be published with only a single author is neither representative, nor gives any visibility to collaborators on which such work rests; (ii) before such a validation paper is published, discussions of the results and implications should be discussed within the FAST Consortium on which such results will reflect].

B21 (Lenhardt, 18-month solution): sections 3.2, 3.3, 3.4 should not be included in this paper (note that results on radio stars, for example, are the subject of several internal proposals). Discussions on the system rotation should not be published at this time. It is not evident that the paper would be acceptable without these sections, since it would then add relatively little new information to that contained in the 1982 A&A papers. The paper might be more appropriate in the context of the forthcoming A&A collection (details of which will be distributed later in the year). [HST members also made the following observations: (i) for such an end point of the Hipparcos data processing to be published with only a single institute is neither representative, nor gives any visibility to collaborators on which such work rests; (ii) before such a paper is published, discussions of the results and implications should be discussed within the FAST Consortium on which such results will reflect].

B23 (Halbwachs: TICR star list). Accepted. However, HST considered that it may not be considered acceptable by the A&A referees as is, and might be more appropriate as a CDS Bulletin paper.

B26 (Bernstein, Double Stars). Accepted (in view of its concentration on methodology). Acknowledgements should be expanded into something that better reflects the contribution from other institutes. Section 8 should be suppressed from the present paper (perhaps to be considered in the context of the forthcoming A&A collection (details of which will be distributed later in the year).

Actions

Outstanding from HST 31:

31.14. FAST (Kovalevsky) to introduce grid residual mapping before final 18-month iterations are completed.

31.21. Crézé to consider facilitating the cross-indexing of ground-based data from SIMBAD with the Hipparcos output catalogue.

31.23. Kovalevsky to reflect on the problem of merging double star data for the next HST.

31.25. Turon to propose mechanism for updating and tracking of INCA updates.

31.26. Schrijver to produce note on his concept for a Last Look, including the role of the INCA updates maintained by Turon (see Action 31.25). This proposal would be commented on by Perryman before wider circulation to the HST.

From HST 32:

1. Mignard/Kovalevsky to implement major ground-station time shifts in minor planet treatment.

2. Høg to reflect on possibility of achieving Tycho Catalogue completion by end 1995, and justify schedule if considered implausible..

3. Høg to reflect on choice of name of Tycho Reference Catalogue.

4. Sphere solution actions:

   (a) complete 32-month comparisons (data until summer 1992 break), using V-I colours for all stars given by Grenon. Report due by December.

   (b) investigate colour discrepancy in NDAC/FAST reductions

   (c) follow/explain position/proper motion discrepancy in ecliptic regions.

   (d) investigate differences in variances revealed by Murray's study.

   (e) NDAC/FAST to list accepted orbit numbers in each solution.

   (f) Review use and values of global parameters in NDAC/FAST spheres.

5. RGC actions:

   (a) van Leeuwen to select 6 new RGC for study during the interval 18–32 months.

   (b) van der Marel to continue investigations into existing comparison data sets, and the 6 new comparison sets.

   (c) FAST to recompute certain RGCs to reject identified bad stars.

(d) NDAC to include quality indicator for each RGC (and for each star?).

(e) NDAC and FAST to provide lists of their problem RGCs.

(f) investigate in detail the error budget in the NDAC-FAST differences.

(g) compare each 18-month RGC with positions generated from the 32 month solution.

(h) NDAC/FAST to confirm use of 3rd/4th order instrumental polynomial, e.g. on the basis of the two sets of residual maps (see Action 31.14).

(i) compare grid-residual maps derived by FAST and NDAC.

6. Attitude actions:

(a) new comparisons to be undertaken for the new RGC's defined under Action 5(a).

(b) Høg to investigate use of mean NDAC+FAST attitude for Tycho.

(c) NDAC/FAST/Donati to explain the 100 mas body axis offset NDAC-FAST.

7. Grenon to supply details of the Oblak Ground-Based Double Star Observing Network: number of stars observed, status of reductions, schedule of availability for NDAC and FAST, number of stars observable per year in northern and southern hemispheres over the next 2-3 years, observing capabilities (magnitude range and separation).

8. Turon/Perryman to develop proposals for final data products on CD-ROM.

9. Turon/Perryman to prepare for proposal evaluation meeting (see minutes).

10. Høg to inform all TDAC members of the opportunity to submit Tycho proposals.

11. Murray to circulate note on astrometric parameter merging.

Thirty Second Meeting
of the
HIPPARCOS SCIENCE TEAM

ESOC, Darmstadt
Room H4

13-14 July 1993

Start of meeting: 09.00 (13 July)
End of Meeting: 16.00 (14 July)

AGENDA

13 July, 09.00-12.30

1. Satellite review and formal termination (Heger) (30 mins)

2. NDAC progress report + schedule (van Leeuwen/Lindegren) (30 min)
   - Calibration report + On-board clock report

3. FAST progress report + schedule (Kovalevsky) (30 min)

4. TDAC progress report + schedule (Hoeg) (30 min)

5. Comparison activities and summary of splinter session: (60 min)
   - 18-month sphere solution comparisons (Mignard/Lindegren)
   - attitude comparisons (Donati)
   - RGC comparisons (van der Marel)
   - future schedule

13 July, 14.00-18.00

6. Double star status:
   - in FAST (Kovalevsky) (30 min)
   - in NDAC (Lindegren) (30 min)

7. Hipparcos Catalogue publication/Working Group reports:
   - Photometric Working Group (status/formats) (Evans) (30 min)
   - Double Star Working Group (status/formats) (Mignard) (30 min)
   - Reference Frame Working Group (Kovalevsky) (30 min)
   - main astrometric catalogue merging (Murray) (30 min)
   - Formats Working Group (Perryman) (30 min)
   - Documentation Working Group (Perryman) (15 min)

8. Hipparcos Input Catalogue CD-ROM demonstration (Turon)

14 July, 09.00-13.00

9. Internal/Ad Hoc proposals:
   - evaluation procedures (roles of consortia/HST/DDRT)
   - criteria for evaluation (overlap, preparatory work)
   - data handling (Turon)
   - status of approved ad hoc proposals
   - new ad hoc proposals
   - discussion of pending papers proposed for publication
   - future publication strategy/A&A "issue"

10. Miscellaneous:
   - minor planet treatment
   - next HST meeting: date and place

ANNEX I

HIPPARCOS

OPERATIONS SUMMARY

DECEMBER 1992 - JULY 1993

ESOC

MOD

OPERATIONS SUMMARY

DECEMBER 1992 - JULY 1993

- S/C in 2-gyro control mode
  29-10-92 - 18-03-93
- 22-12-93 gyro 4 failed (not in control loop)
  gyro 2 anomaly; S/C sunpointing
- 23-12-93 power problems during perigee
- 06-01-93 2-gyro slew to 43 deg.
  2-gyro control mode
- 07-01-93 TCE test (7 heaters left active)
- 05-02-93 SM 1 switch-on to verify high
  high backgtround noise

OPERATION SUMMARY

DECEMBER 1992 - JULY 1993

▪ 16-02-93	OBC-2 load anomaly OBC-1 selected
▪ 18-03-93	gyro 2 failed S/C spin-up tp 0.24 rpm
▪ 23-03-93	gyro 3 switched off
▪ 30-03-93	power shortage (longer eclipses) P/L and hetaers switched off
▪ XX-04-93	antenna switch command anomaly
▪ 24-03-93	eclipse season ended

OPERATION SUMMARY

DECEMBER 1992 - JULY 1993

- 27-04-93 TCE test (4 heaters left active)
- 05-05-93 SM1/2 output channel anomaly
- 27-05-93 AOCS chain 1 anomaly
- 26-05-93 gyro 3 failed
- 12- 06-93 start of 0-gyro operations sunpointing
- 15-06-93 slew to 43 deg. and return to sun
- 24-06-93 OBC-1/OBC-2 failure
- 06-07-93 current mission end

2-Gyro RTAD performance

Summary

- **Interruption between 22/12/92 and 05/01/93, due to first gyro 2 partial failure**
- **Continued until 18/03/93, when gyro 2 failed completely**
- **Over complete period since last HST to end of 2-Gyro Operations:**
  - **38% good scientific data**
  - **35% visible data but RTAD not converged**
  - **27% lack of ground station coverage**

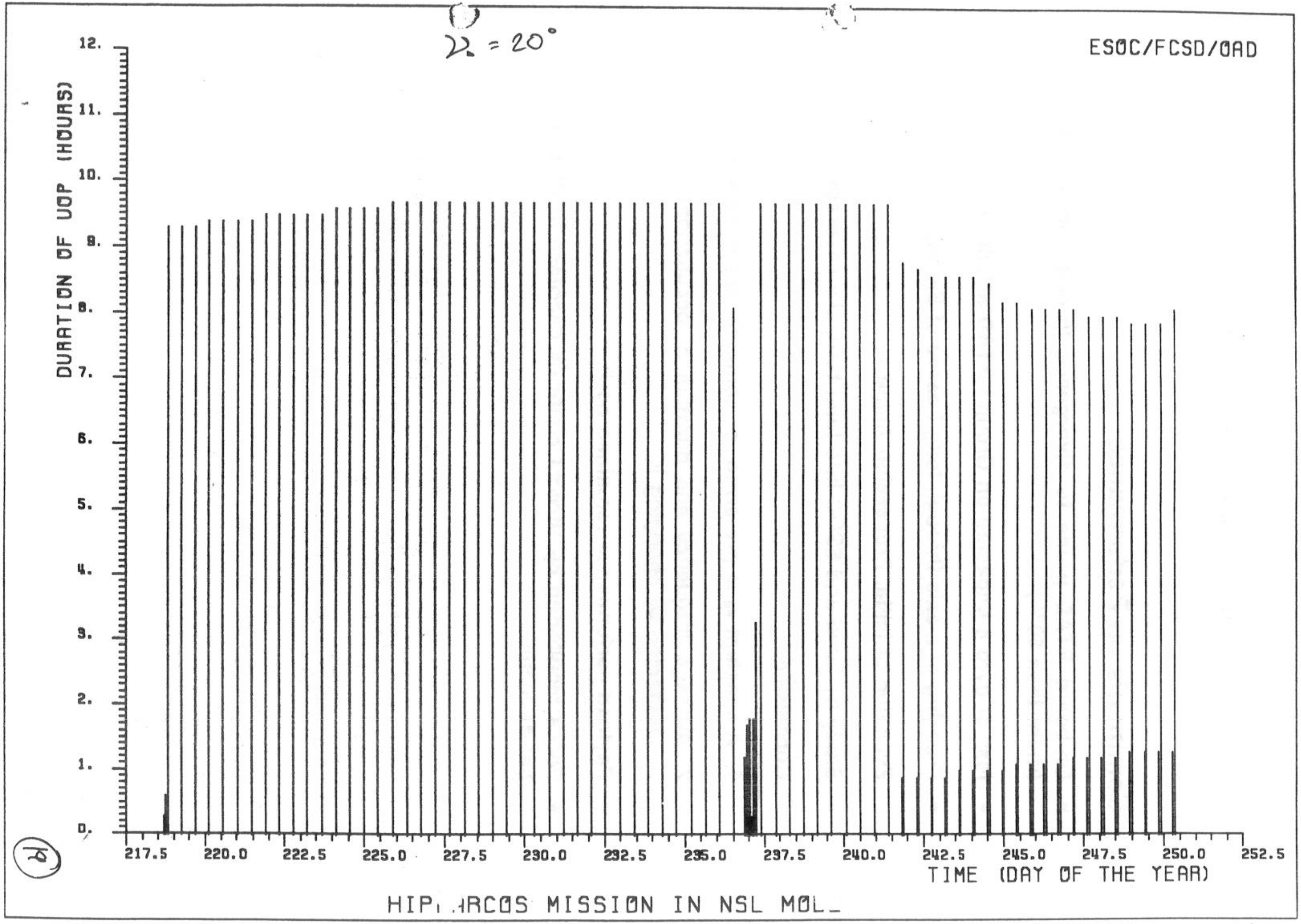
Comments on Performance

- **On-board RTAD prone to divergence through occultations (more than 50%)**
- **loss of gyro 4 impacted on Ground RTAD activities**
- **Freezing of z-axis through long Losses of Signal**

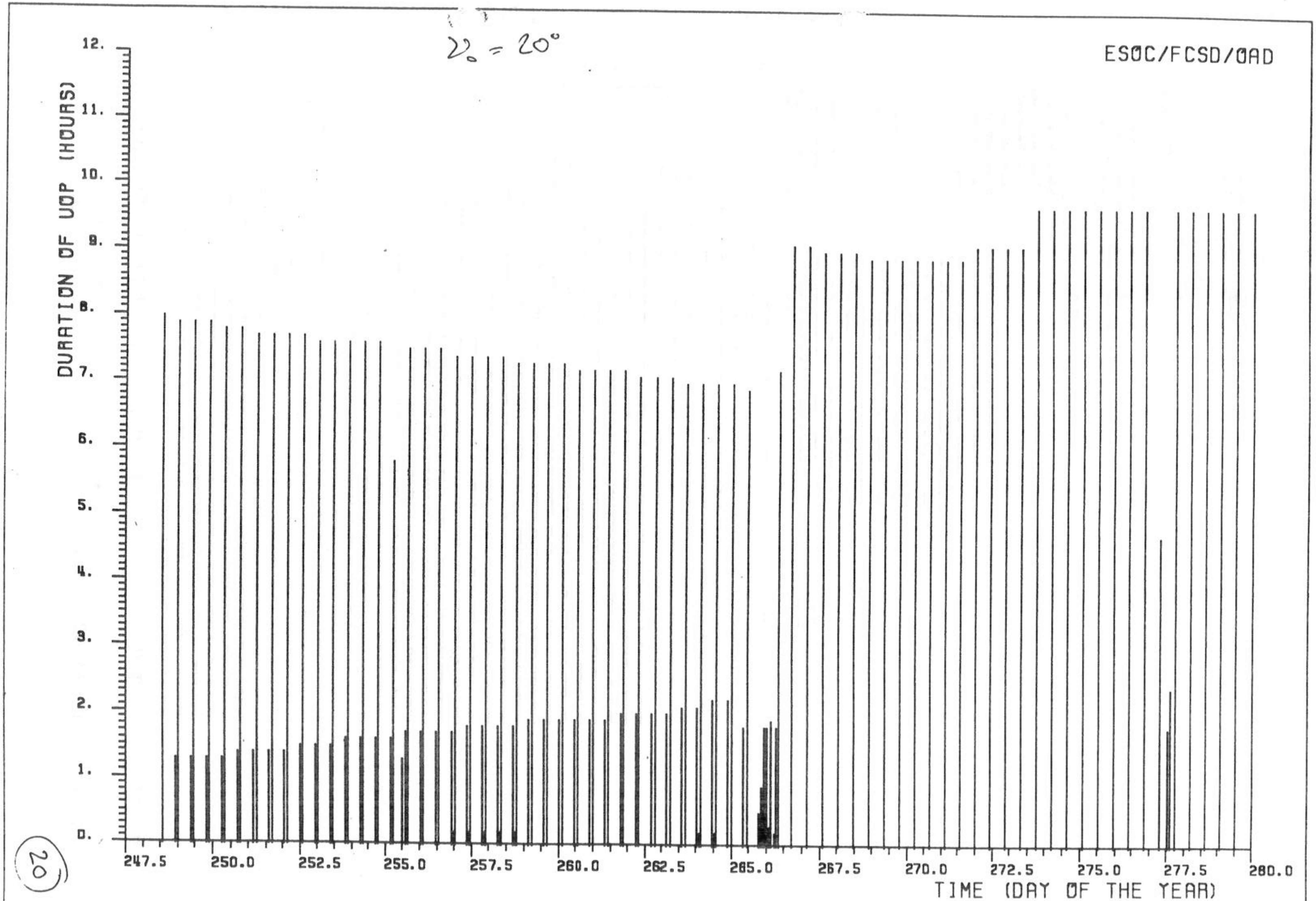
  Evolution of Initial Precession Angle ν_0
- **Study by Lund and ESOC into long term sky coverage**

  Conclusions

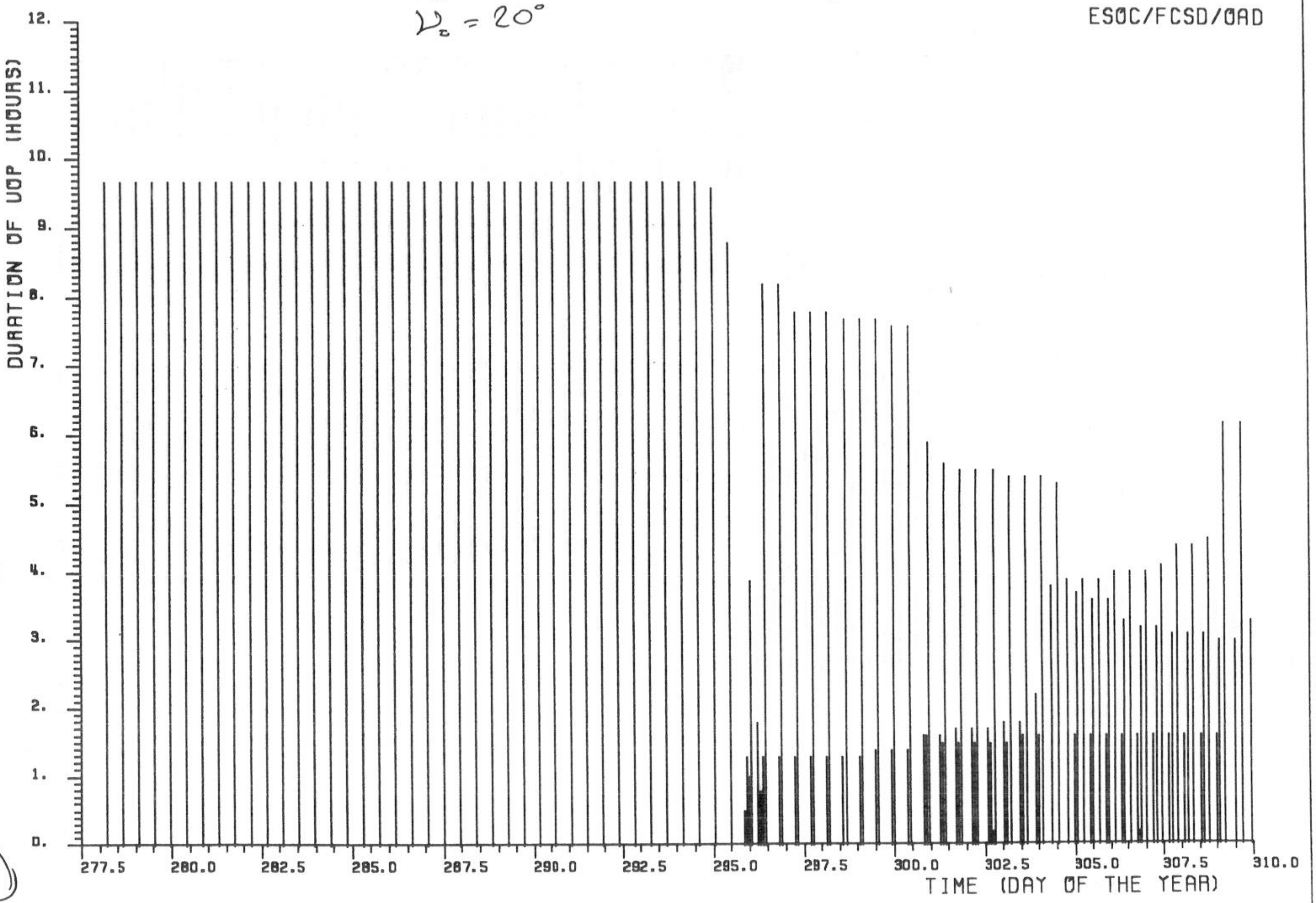
  1. **A constant ν_0 is preferred for complete sky coverage**
  2. **Average frequency and duration of occultations largely unaffected by changing ν_0**
- **Payload performance remained good**
- **Focus monitoring by Utrecht confirms decrease in differential de-focus.**



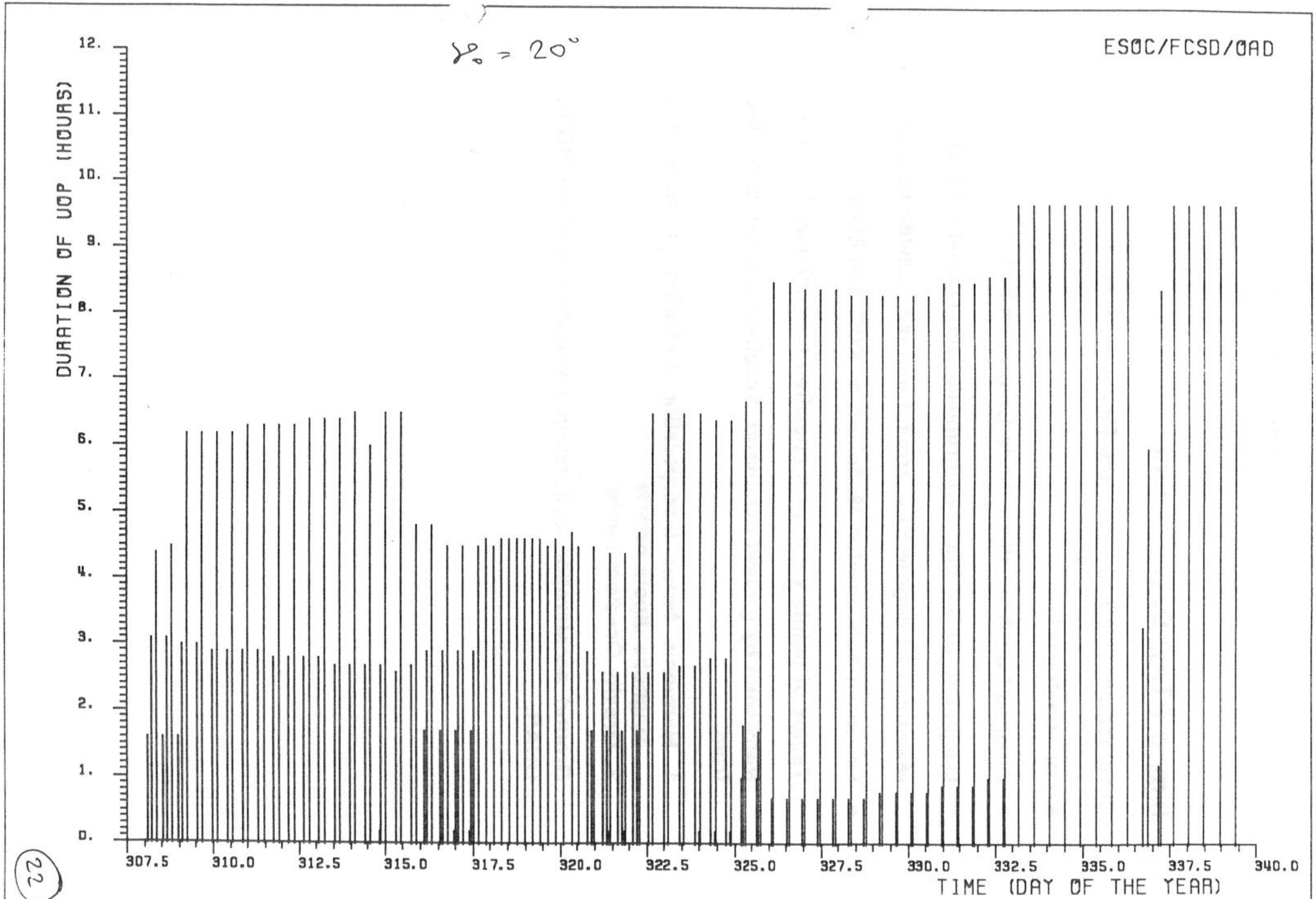
ESOC/FCSD/OAD
Ω = 20°
DURATION OF UOP (HOURS)
12.
11.
10.
9.
8.
7.
6.
5.
4.
3.
2.
1.
0.
217.5
220.0
222.5
225.0
227.5
230.0
232.5
235.0
237.5
240.0
242.5
245.0
247.5
250.0
252.5
TIME (DAY OF THE YEAR)
HIPPARCOS MISSION IN NSL MOL
19



HIPPARCØS MISSIØN IN NSL MØDE



HIP. ARCØS MISSIØN IN NSL MØ__



HIPPARCOS MISSION IN NSL MODE

0-gyro RTAD Development

Development at ESOC, RGO and MMS, 18/03/93 - 11/06/93

Major components:

- **Revised Sun Acquisition Mode Control on-board**

  Oscillating SAS 3 bias synchronised with Orbital Oscillators

  Maintains 43 degree SAA around perigee (outside eclipse)

- **On-board Acceleration Modelling by RGO and ESOC**

  Tables of points valid for a specified time interval (1 hour)

  Refreshed by ground command. Accelerations are predicted from:

  1. **Harmonic terms incorporating radiation pressure and magnetic dipole effects**
  2. **Gravity Gradient model**

  Ground acceleration calibration software based on NDAC OGAR.

- **On-board RTAD re-written by MMS**

  Integrates accelerations deriving Tait-Bryan error angles and body rates, corrected by star mapper updates.

- **Ground RTAD changed at ESOC**

  1. **Star mapper filtering improved with more cpu available**
  2. **Slit distinction over two partially functioning star mappers**
  3. **Full Sky Matching to determine NSL parameters at any attitude**
  4. **Attitude estimation incorporating OGAR-derived accelerations**
  5. **Intelligent re-setting of on-board state vector to decrease actuation durations**

  Demonstration to be provided

0-Gyro RTAD Performance

- **MMS simulations show poor performance for z-axis pointing**

  MMS believe problem lies with inhomogeneities in the sky coverage

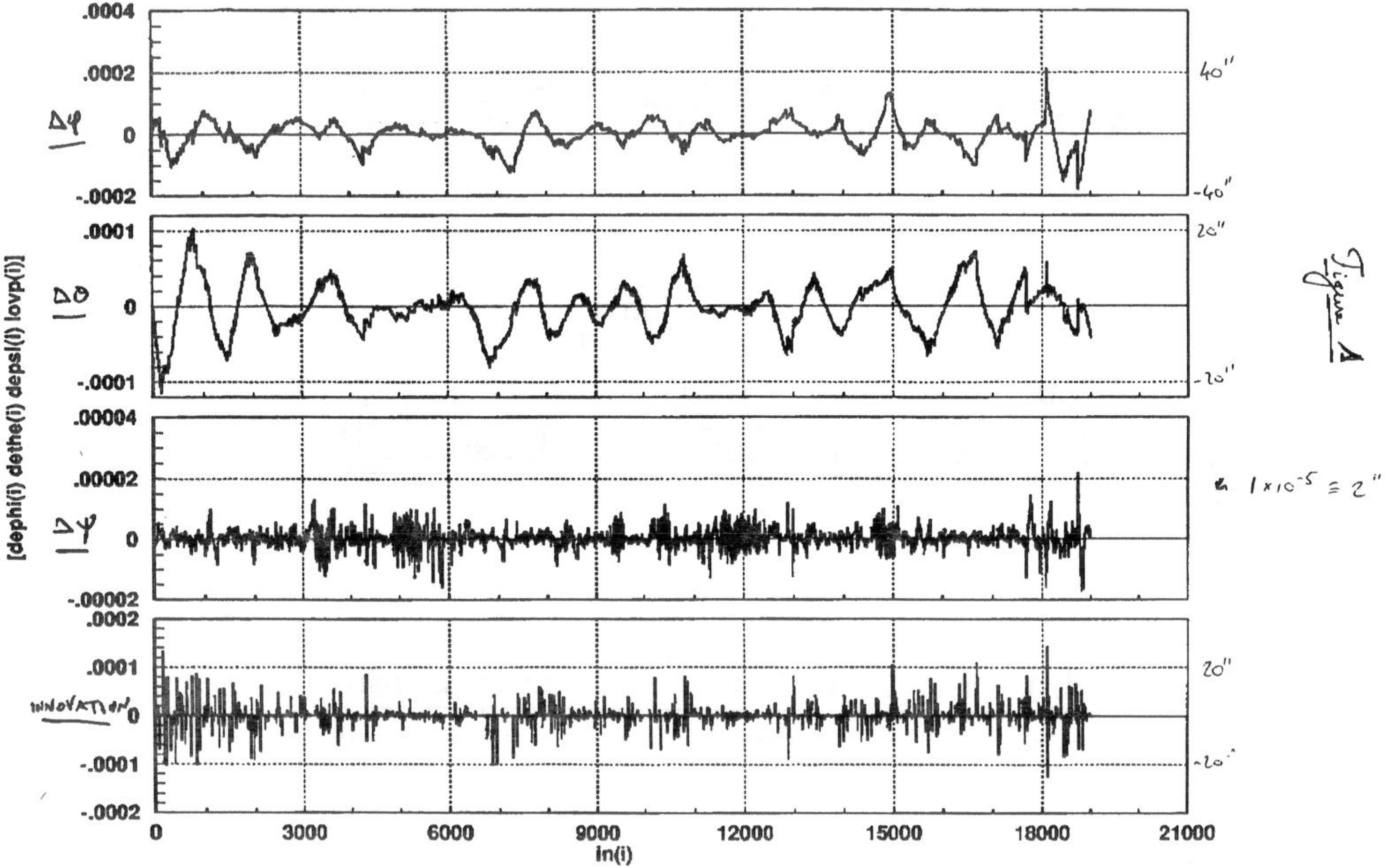
- **Simulation accuracy not yet achieved with spacecraft**

- **On-board RTAD prone to divergence (1 hour is maximum convergence achieved so far).**

  Divergence increase after actuation

  Thruster calibration requires updating

- **Experience with GRTAD giving more frequent "convergence" intervals**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.0002
0
-.0002
Δφ
40''
-40''
.0001
0
-.0001
Δθ
20''
-20''
.00004
.00002
0
-.00002
Δψ
1×10⁻⁵ ≡ 2''
.0002
.0001
0
-.0001
-.0002
INNOVATION
20''
-20''
[dephi(i) dethe(i) depsl(i) lovp(i)]
0
3000
6000
9000
12000
15000
18000
21000
in(i)

Figure A

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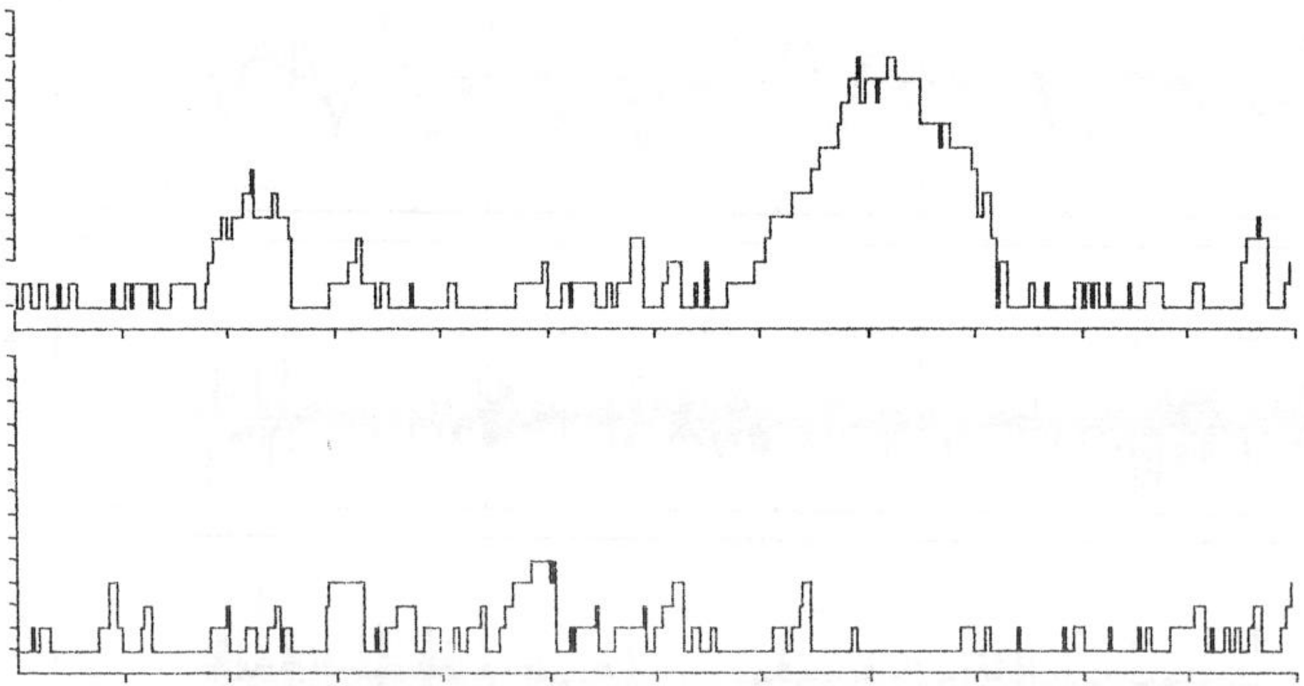

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D/S= 0 /SRCE=SRCA/GDGT/OPT= DP SC FS LI FI VA AL PKT.ID=HHR .HK / 0

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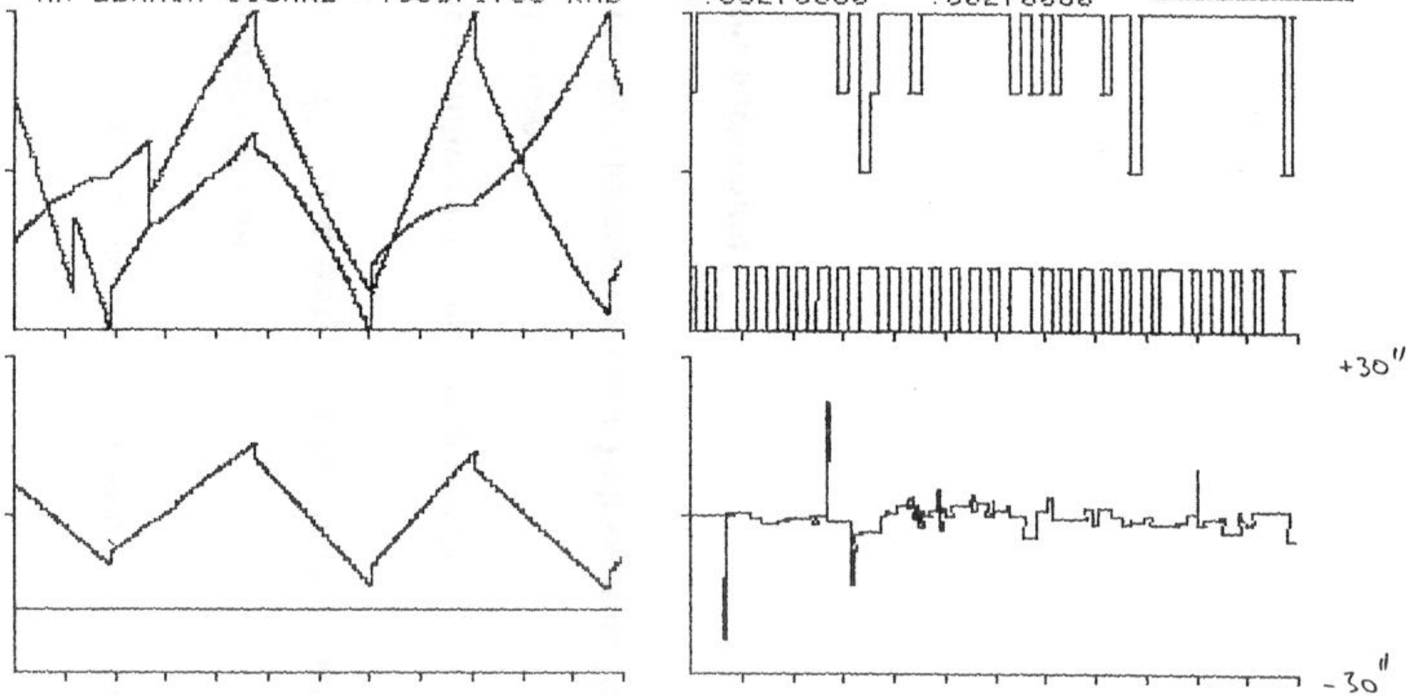
E043	NM YERROR SIGNAL	.00095408	RAD	-.00200000	.00200000	
N407	IDTS QUALITY	3		-1	3	
N404	IDTS FOV	1		0	5	
F203	OVERALL BACKGRND	2		0	2000	
B237	INNOVATION NEW	-.00002300	RAD	-.00015000	.00015000	
K251	MDE2 TYC2SHUTTER	2		0	10	
E044	NM ZERROR SIGNAL	-.00071705	RAD	-.00270000	.00270000	



93.175.12.03.00 TIME 93.175.13.03.00
AND/LIVE 2: 3730 DS: OPT:N INIT: VDEP: Y 12:17:48

0-gyro Operations

1. "Sloppy" SAM control (5 degrees) saves fuel through perigee
2. Correct spin rate from SM data
3. "Tight" SAM control (0.2 degrees) reduces transverse rates after perigee
4. GRTAD run to determine new NSL parameters
5. Switch to normal mode
6. Orbital Oscillators, Acceleration Model Points, and PSF up-linked
7. RTAD Initialisation performed

0-Gyro Main Problems

1. Temperamental OBC

2. SAM control at 43 degrees produces high transverse rates and inefficient in fuel usage

   Operational solution identified but not tested

3. Thruster calibration

   Do-able with increasing data collection

4. Torque calibration

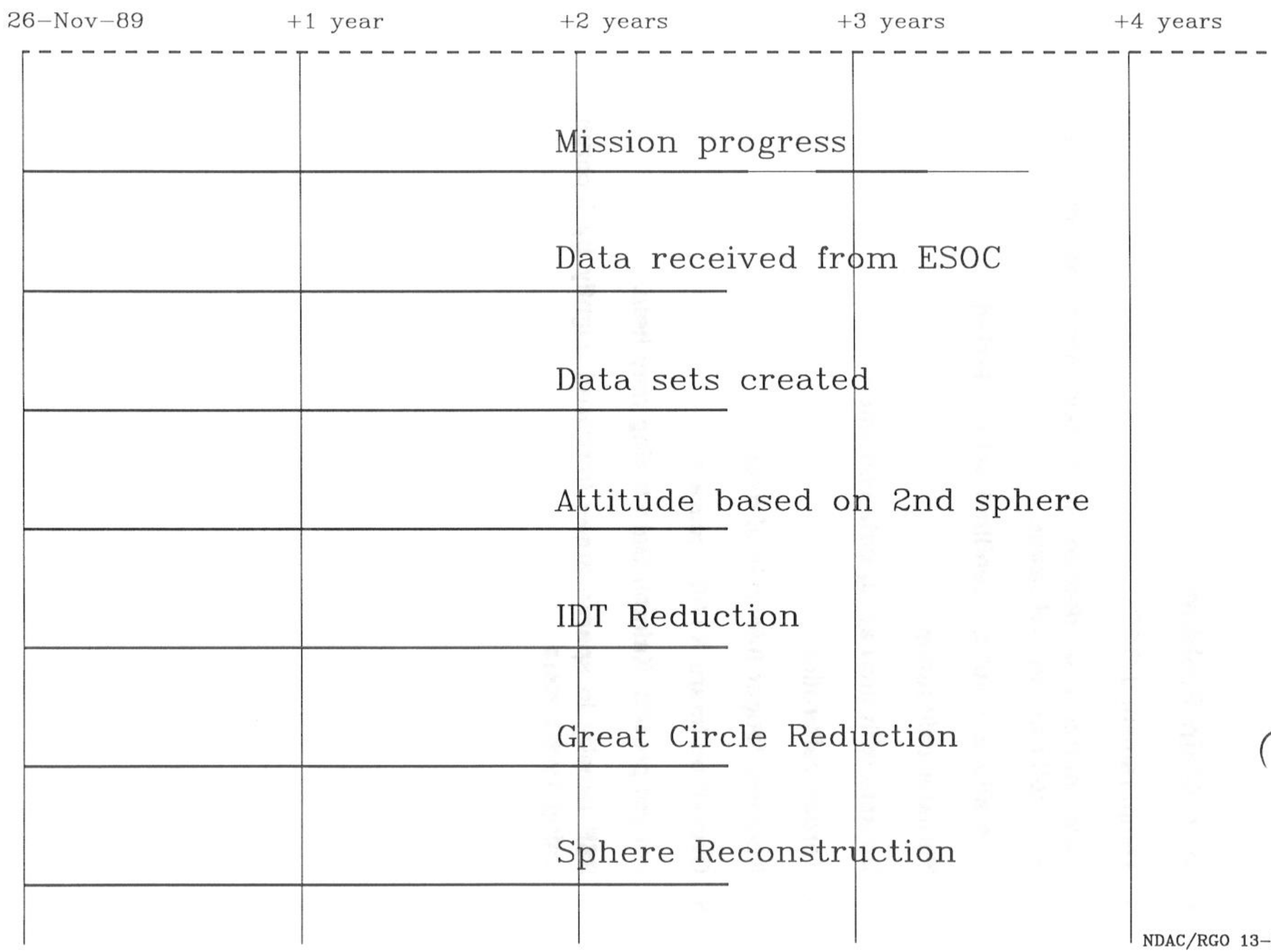
   Requires longer intervals of data

5. Overall on-board RTAD accuracy

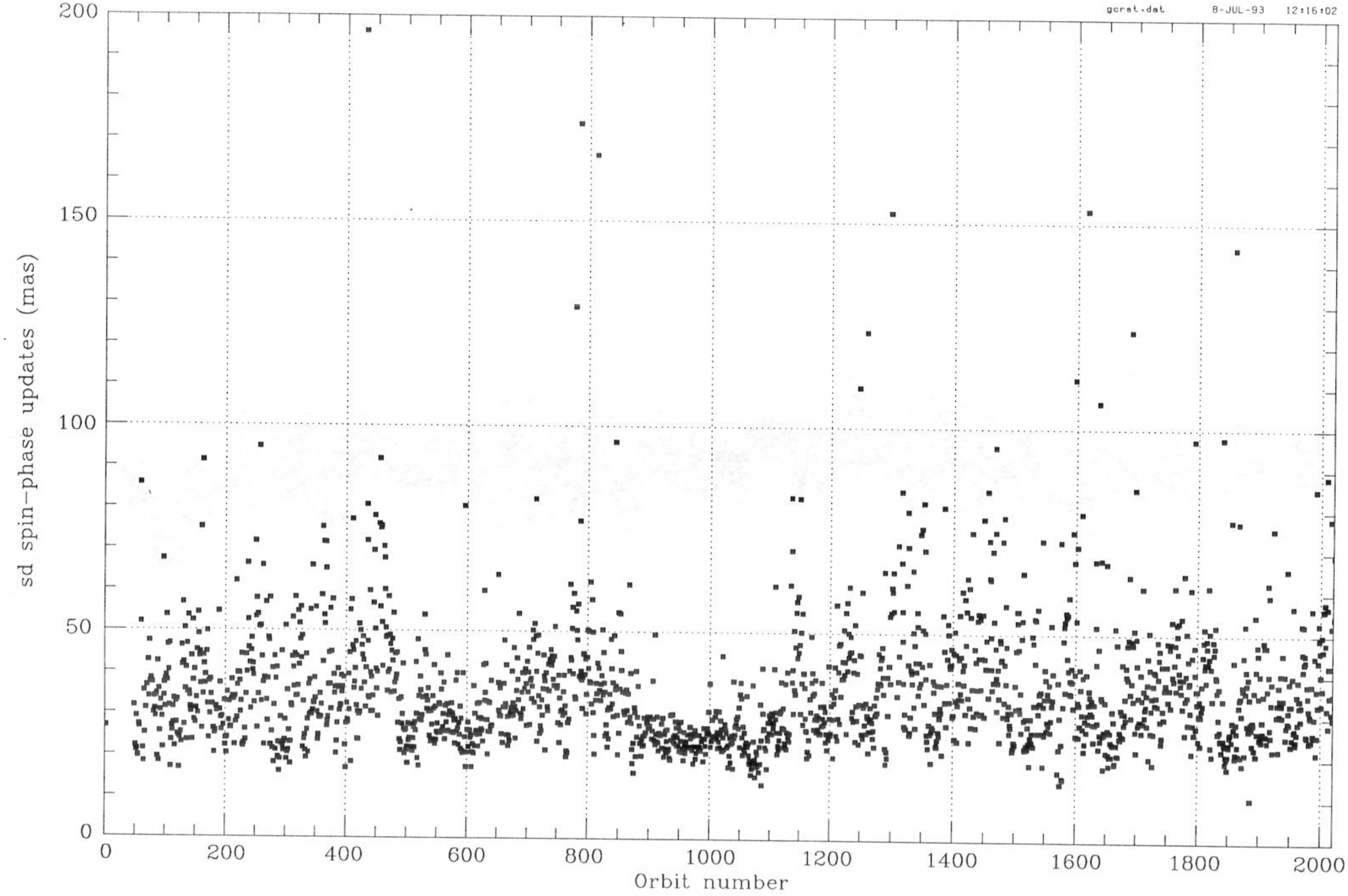
   not yet proven. Kalman Gain tuning may help.

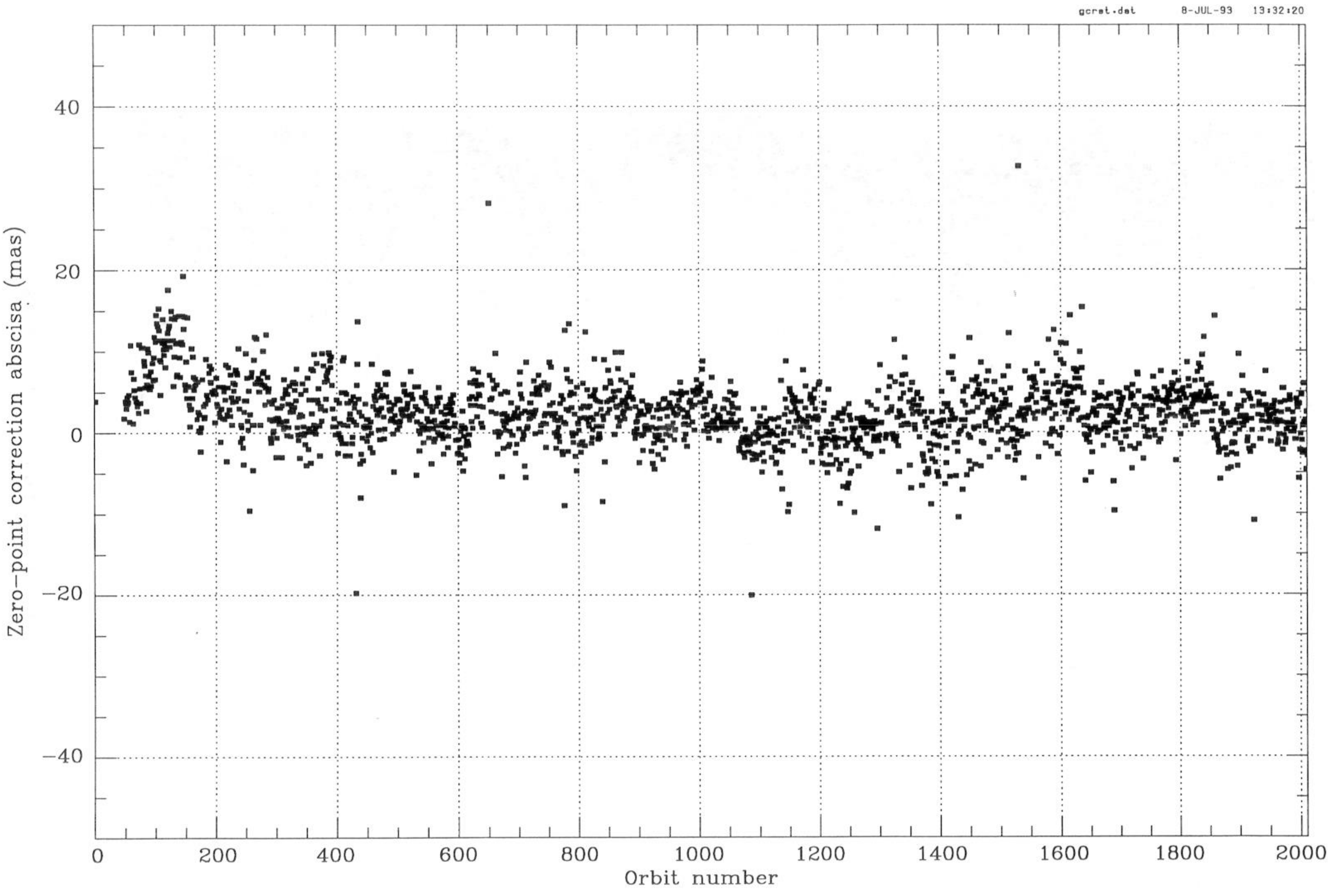
   PSF density in sparse areas improved slightly by incorporating Tycho stars

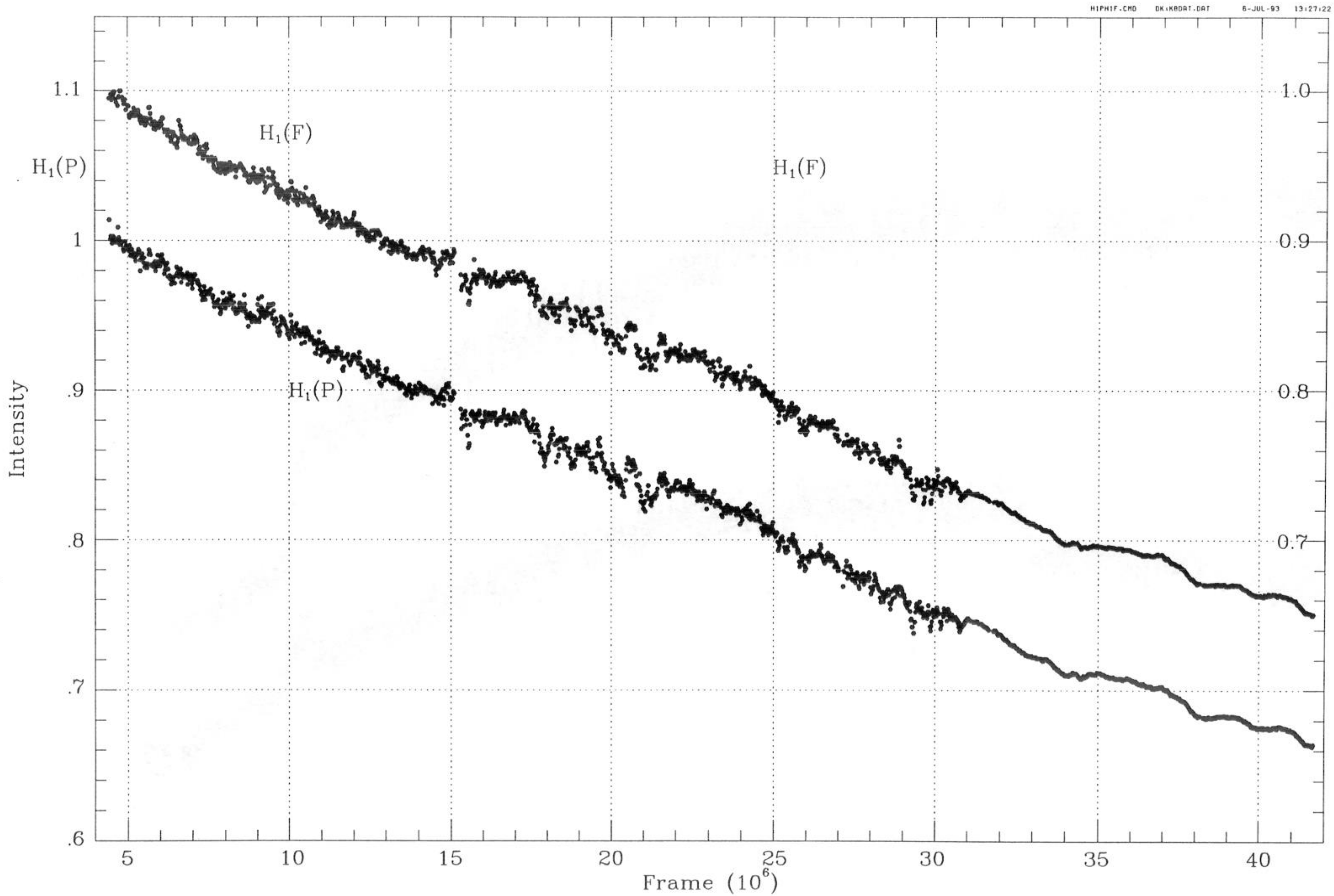
ANNEX III (NDAC)

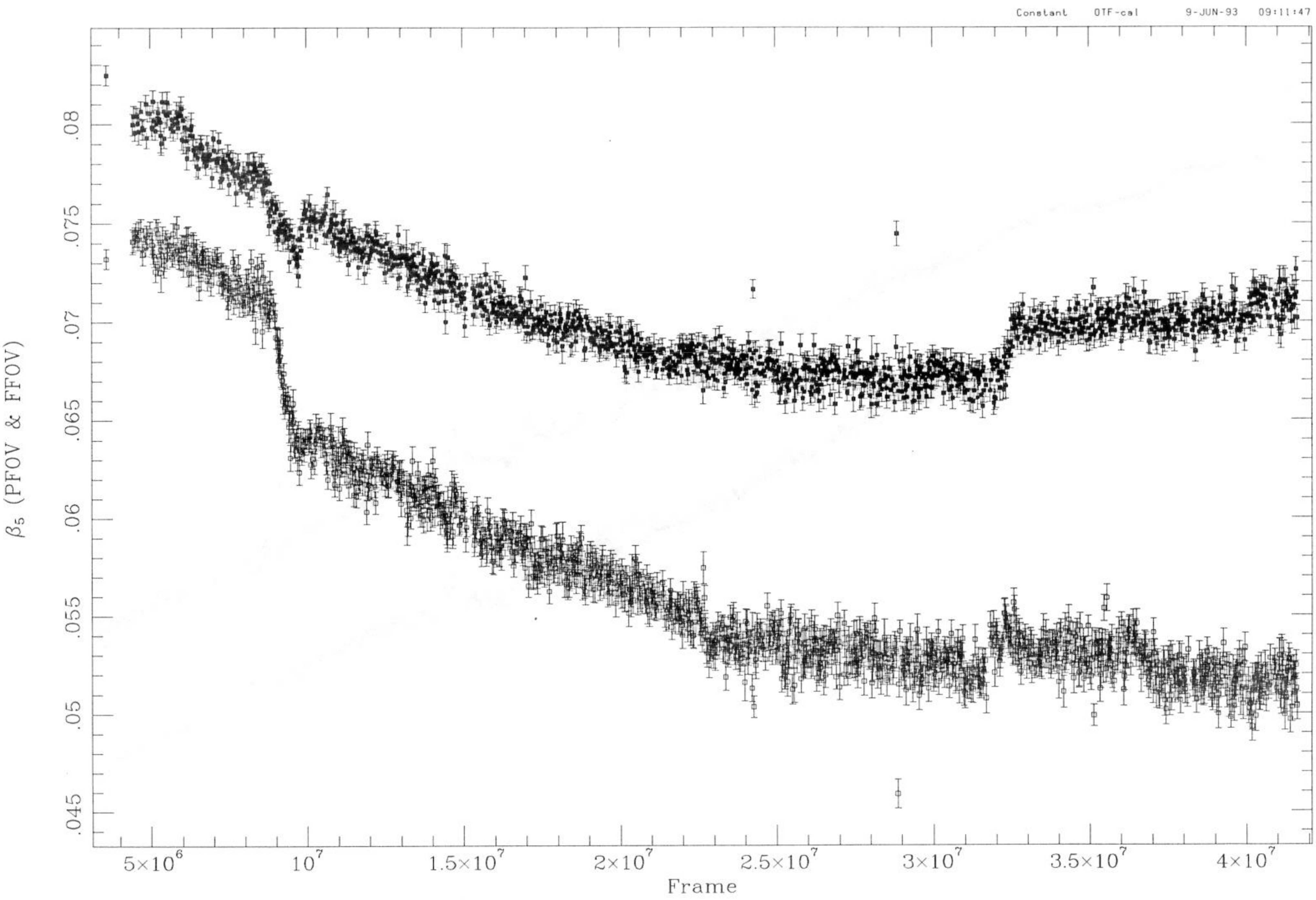


NDAC/RGO 13-Jul-1993

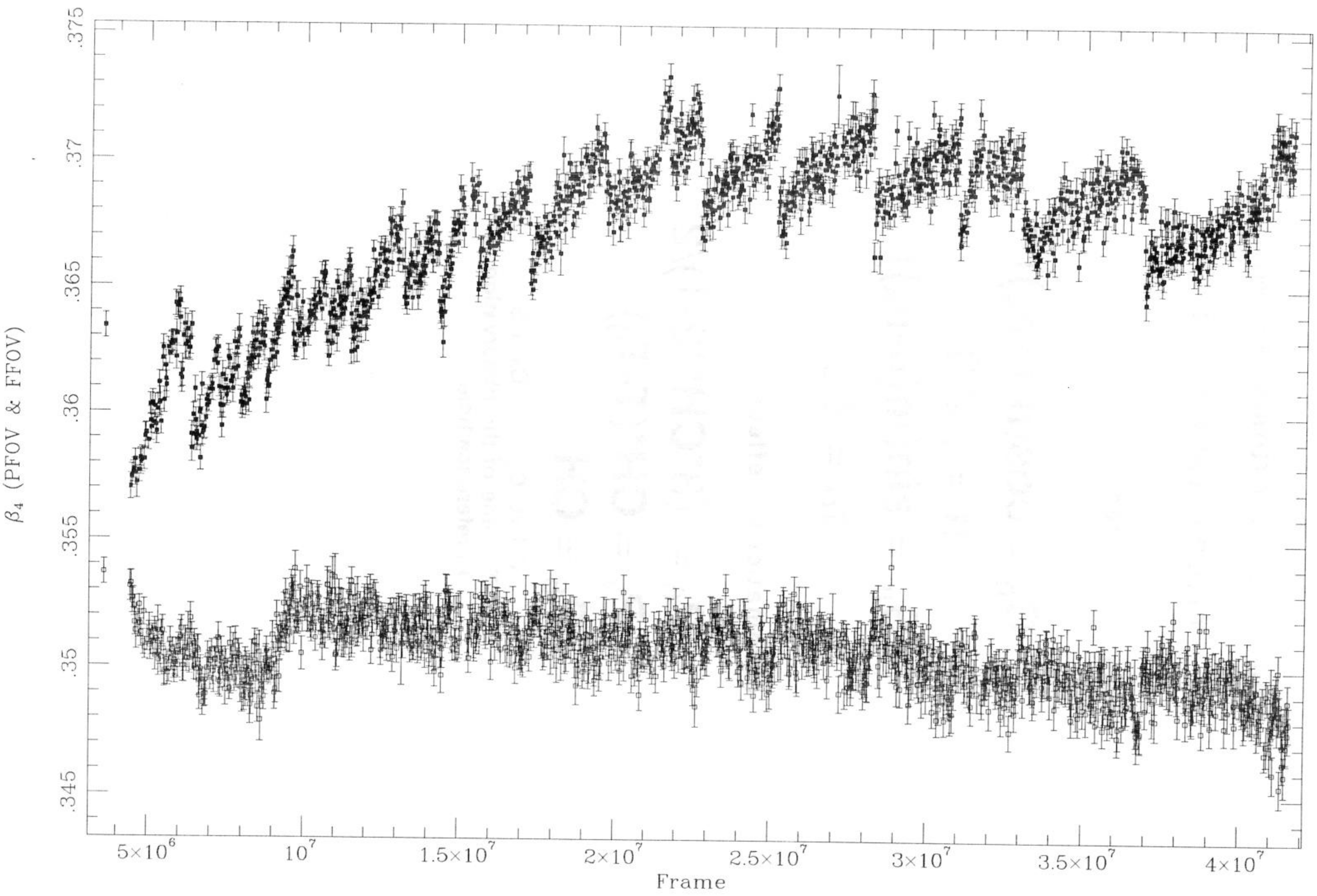

gcrat.dat 8-JUL-93 12:16:02
sd spin-phase updates (mas)
Orbit number
0
50
100
150
200
0
200
400
600
800
1000
1200
1400
1600
1800
2000


gcret.dat 8-JUL-93 13:32:20
Zero-point correction abscisa (mas)
40
20
0
−20
−40
0
200
400
600
800
1000
1200
1400
1600
1800
2000
Orbit number


HIPHIF.CMD DK:KBDAT.DAT 6-JUL-93 13:27:22
Intensity
Frame (10^6)
$H_1(P)$
$H_1(F)$
$H_1(F)$
$H_1(P)$
1.1
1
.9
.8
.7
.6
1.0
0.9
0.8
0.7
5
10
15
20
25
30
35
40



Constant OTF-cal 9-JUN-93 09:11:47
β_5 (PFOV & FFOV)
.08
.075
.07
.065
.06
.055
.05
.045
5×10^6
10^7
1.5×10^7
2×10^7
2.5×10^7
3×10^7
3.5×10^7
4×10^7
Frame


.375
.37
.365
.36
.355
.35
.345
β_4 (PFOV & FFOV)
5×10^6
10^7
1.5×10^7
2×10^7
2.5×10^7
3×10^7
3.5×10^7
4×10^7
Frame

ANNEX IV
(FAST)

SPHERE RECONSTITUTION 18 MONTHS

GENERAL PARAMETERS

thermal effect

$$C_n = \cos(n(\eta-\eta_s))$$
$$n = 1,2,3$$
$$S_m = \sin(m(\eta-\eta_s))$$
$$m = 2,3$$

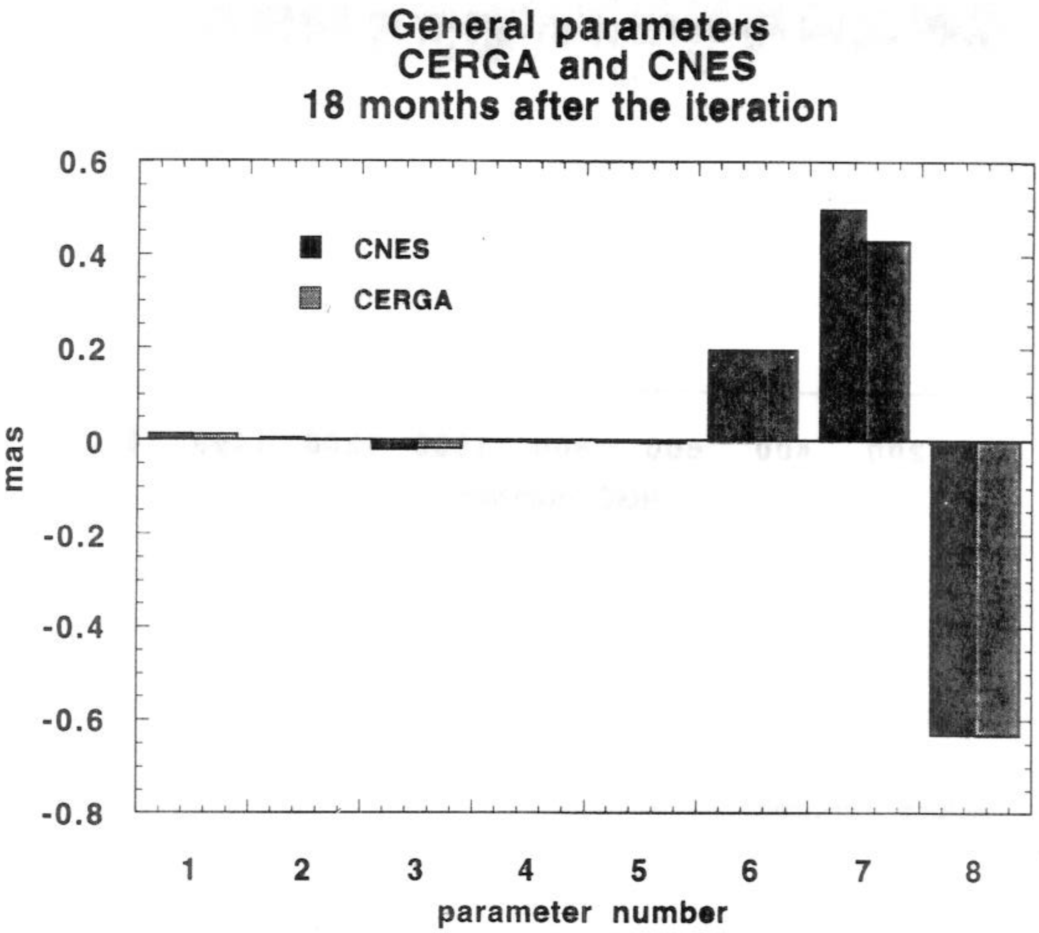
chromaticity effect

$$P_6 = (3*CH**2-1)/2$$
$$P_7 = CH*(T-T_0)$$
$$P_8 = CH$$

$CH = C - C_0$ $\quad C_0 = 0.5$

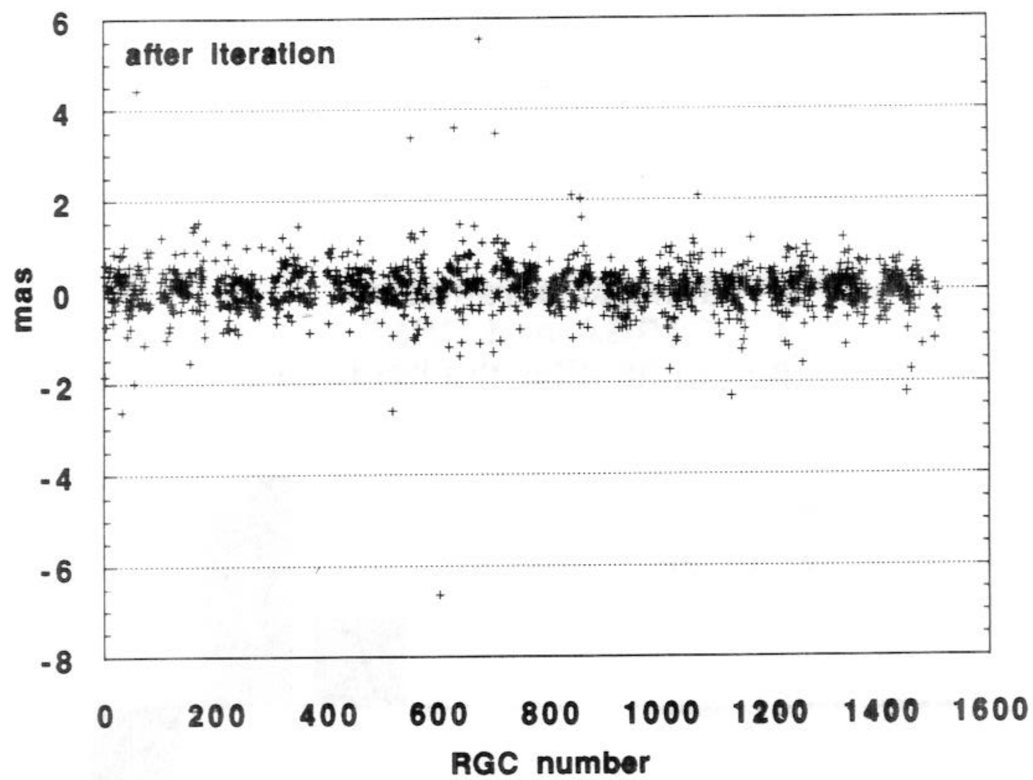
T time of the observation

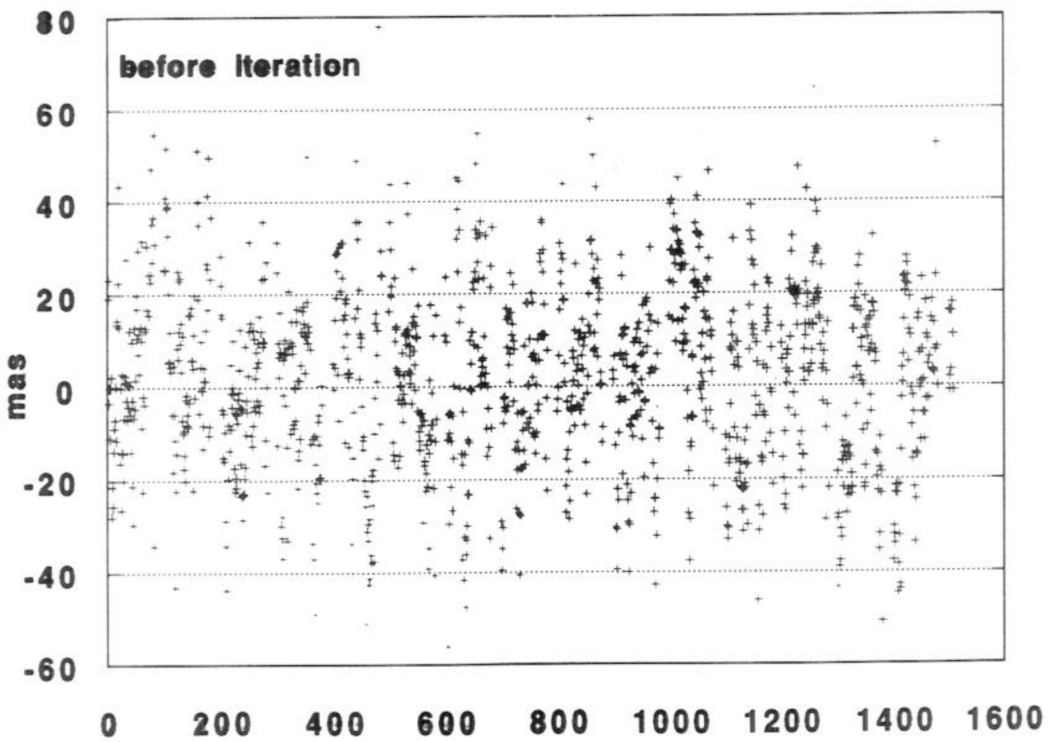
T_0 reference time


General parameters
CERGA and CNES
18 months after the iteration
0.6
0.4
0.2
0
-0.2
-0.4
-0.6
-0.8
mas
CNES
CERGA
1
2
3
4
5
6
7
8
parameter number

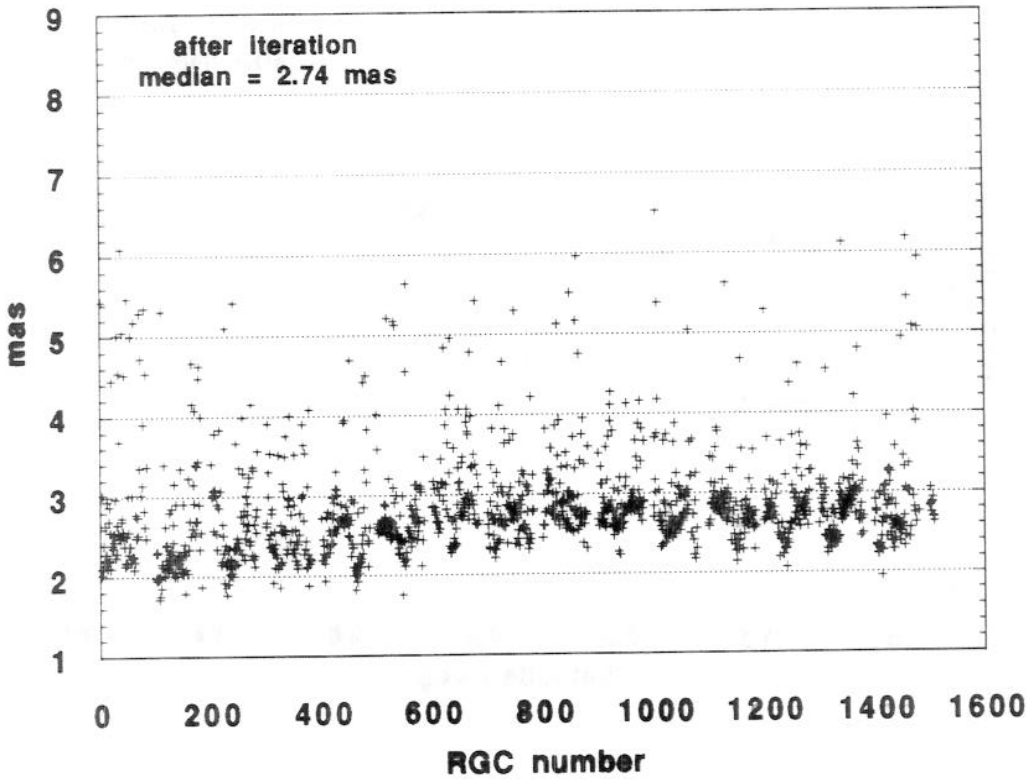
CERGA SOLUTION

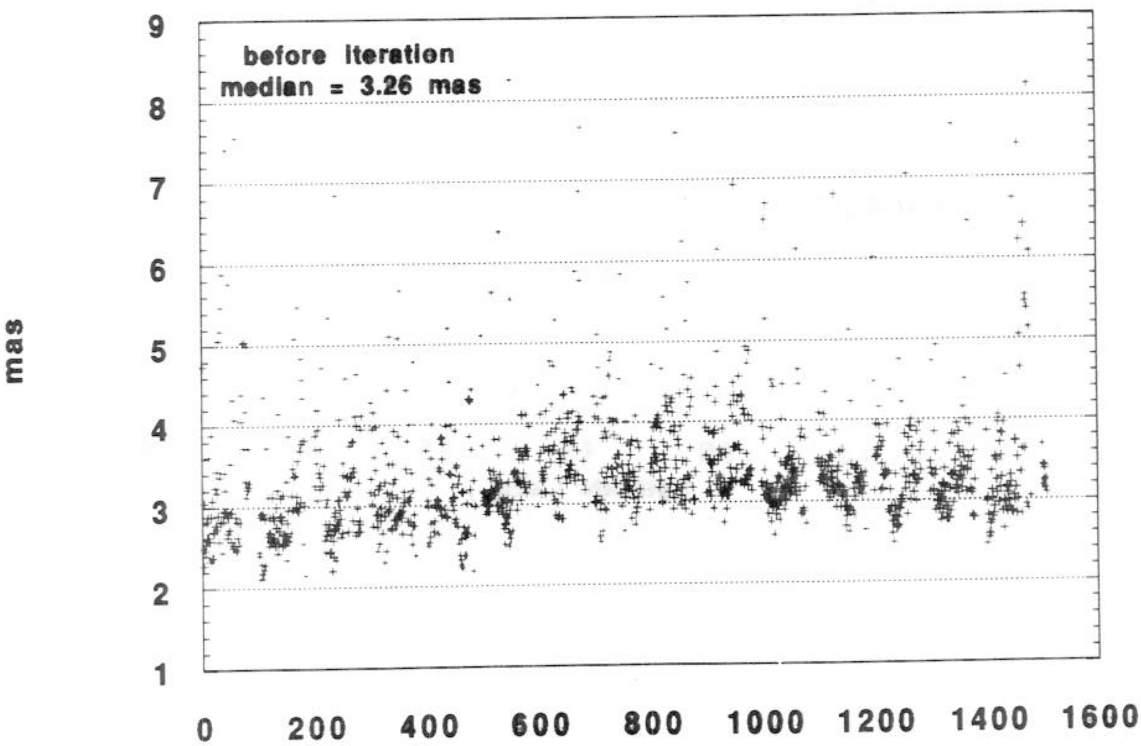
RGC ORIGINS



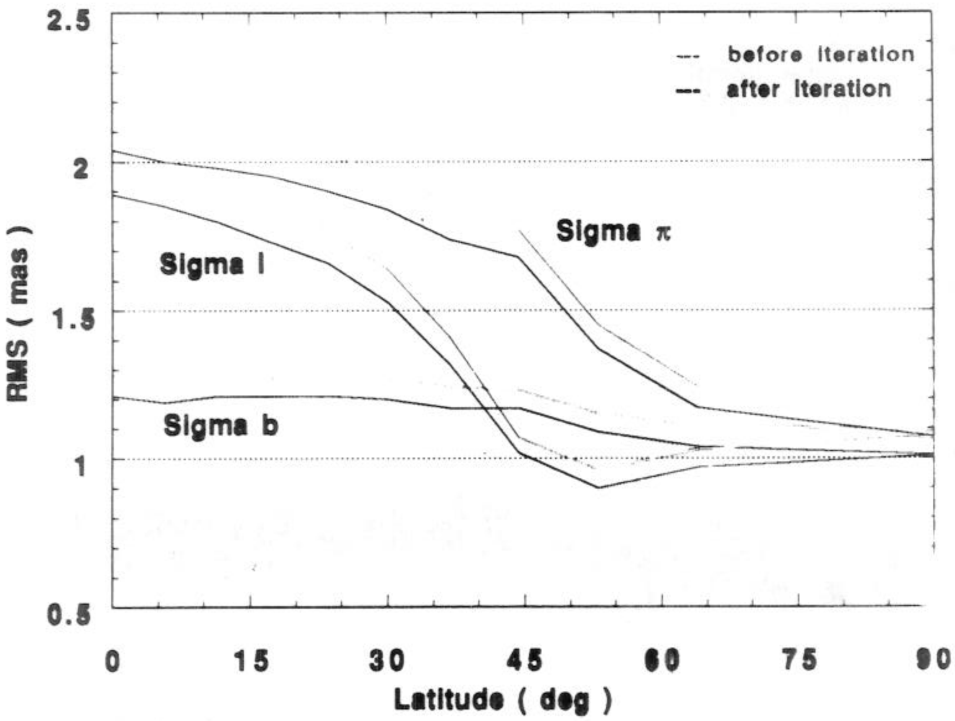


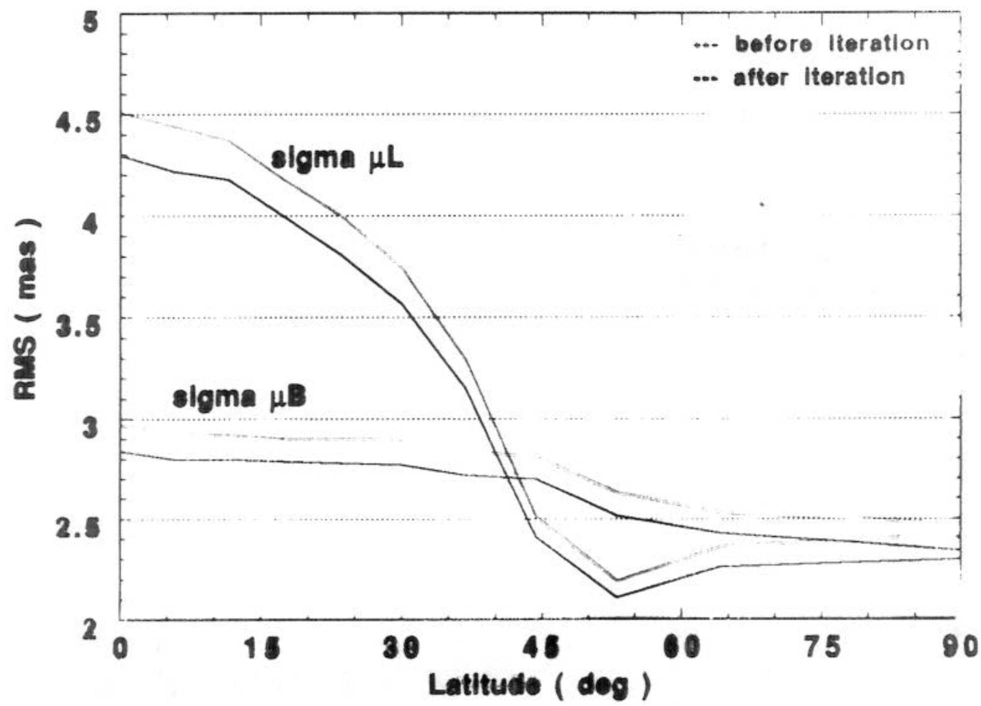
CERGA SOLUTION
RMS of residuals for each RGC

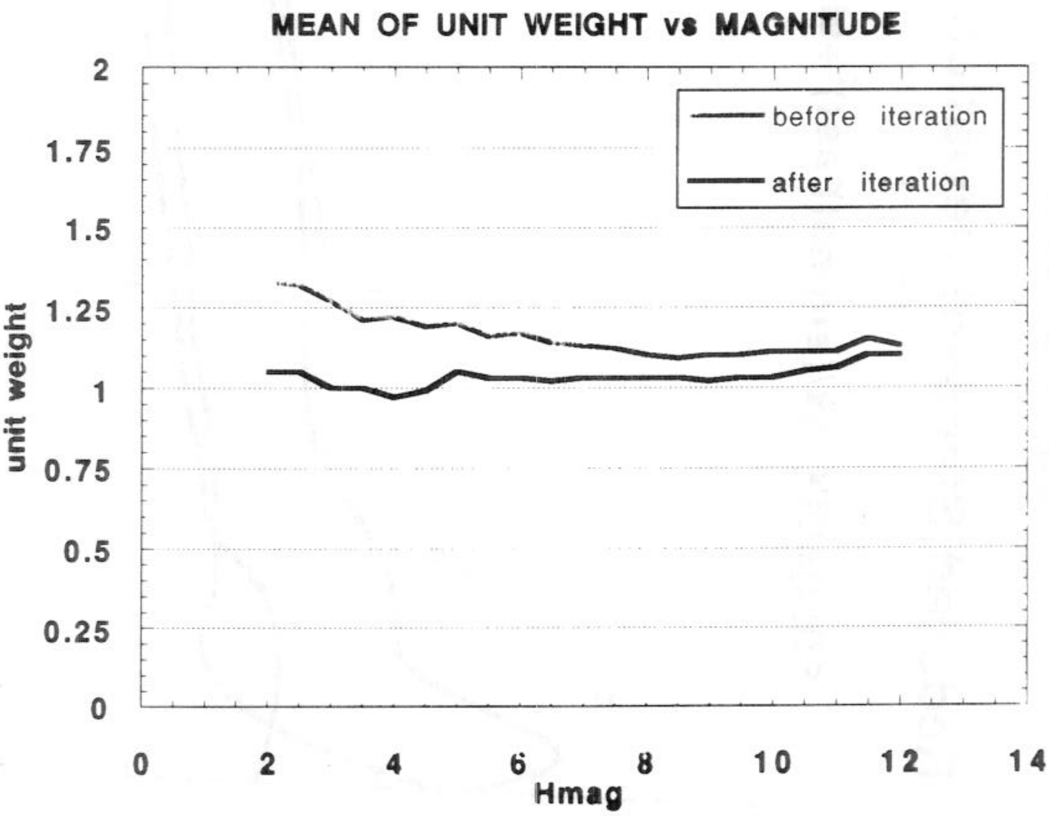


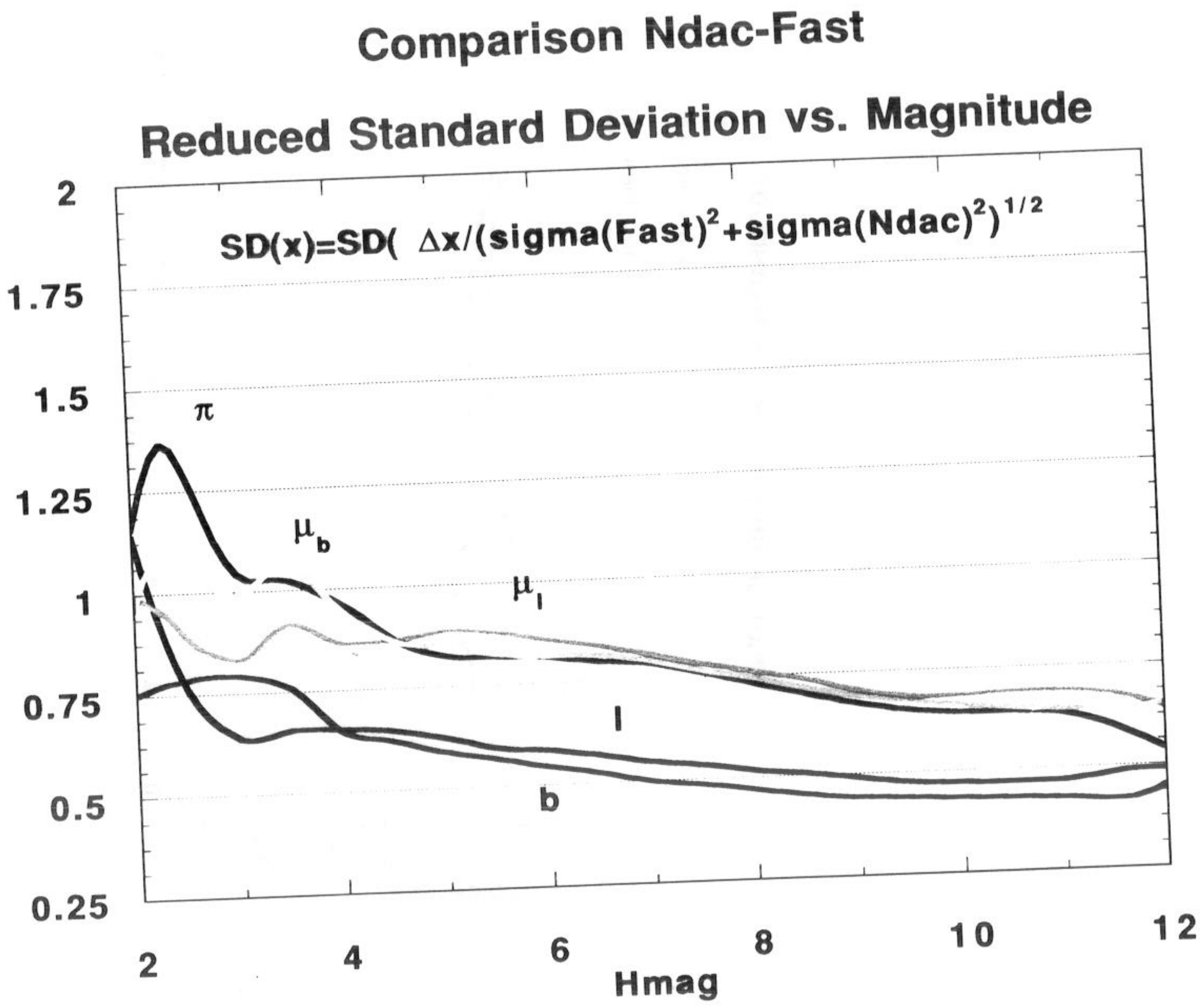


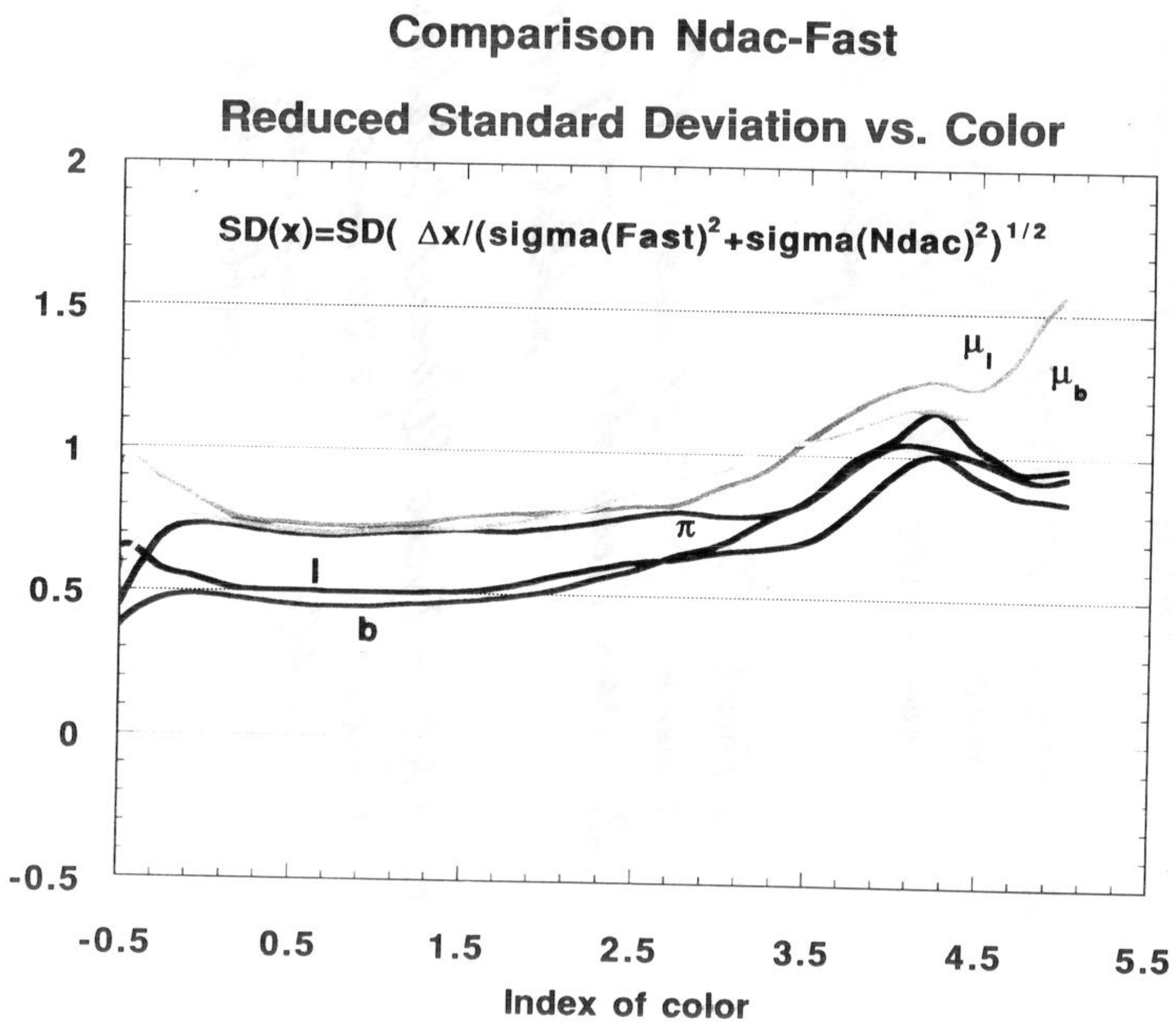
Variation of RMS with Latitude
18 months 8< Hmag < 10






MEAN OF UNIT WEIGHT vs MAGNITUDE
before iteration
after iteration
unit weight
2
1.75
1.5
1.25
1
0.75
0.5
0.25
0
0
2
4
6
8
10
12
14
Hmag


Comparison Ndac-Fast
Reduced Standard Deviation vs. Magnitude
SD(x)=SD(Δx/(sigma(Fast)²+sigma(Ndac)²)^1/2
2
1.75
1.5
1.25
1
0.75
0.5
0.25
π
μb
μl
l
b
2
4
6
8
10
12
Hmag


Comparison Ndac-Fast
Reduced Standard Deviation vs. Color
SD(x)=SD(Δx/(sigma(Fast)²+sigma(Ndac)²)^1/2
2
1.5
1
0.5
0
-0.5
-0.5
0.5
1.5
2.5
3.5
4.5
5.5
Index of color
μ_l
μ_b
π
l
b

~~1994~~ ANNEX V

Tycho catalogues

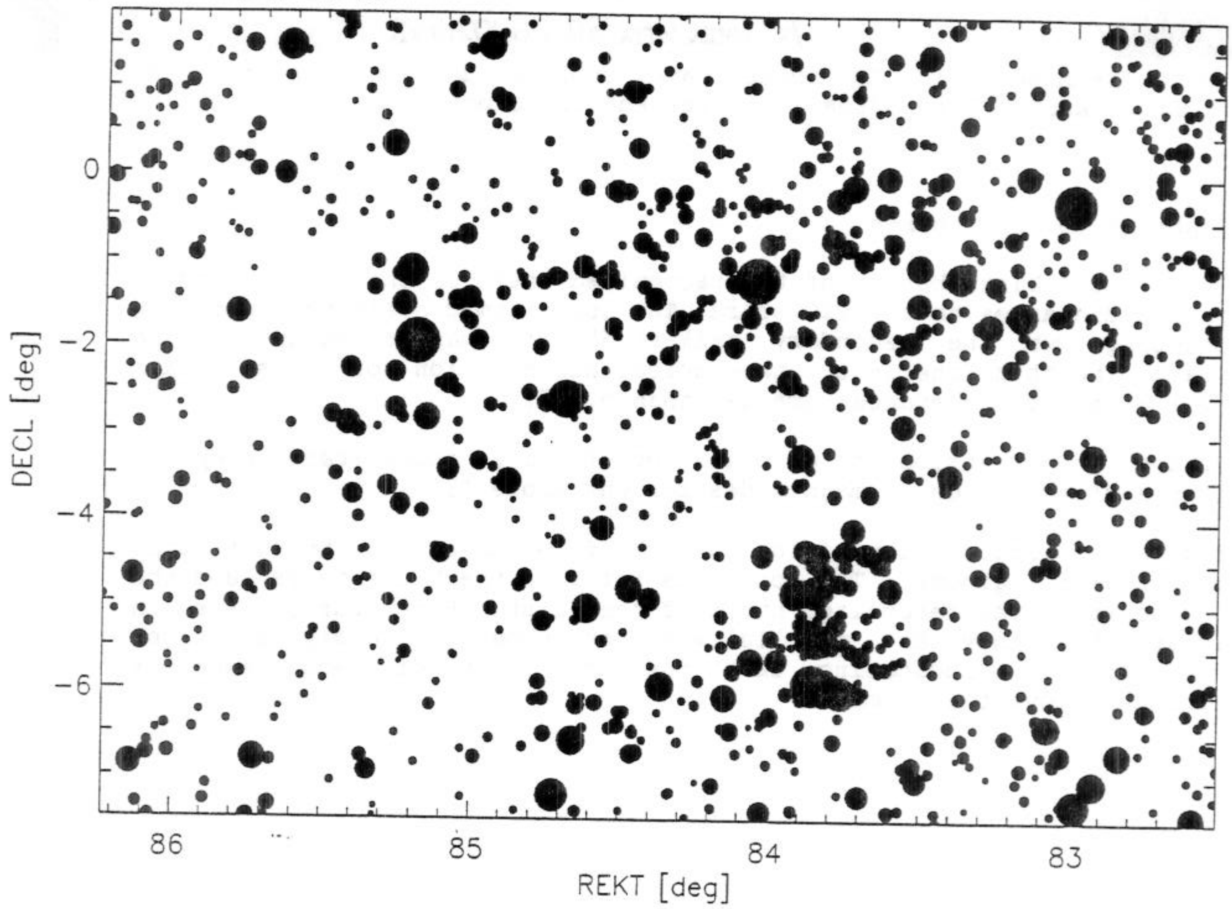
1. TIC = Tycho Input Catalogue
   3 mio. stars ± 1 arcsec
   GSC + INCA 1989, available

2. TICR = TIC Revision
   1 mio. ± 60 mas
   1 year Tycho obs. 1992
   publish list ?

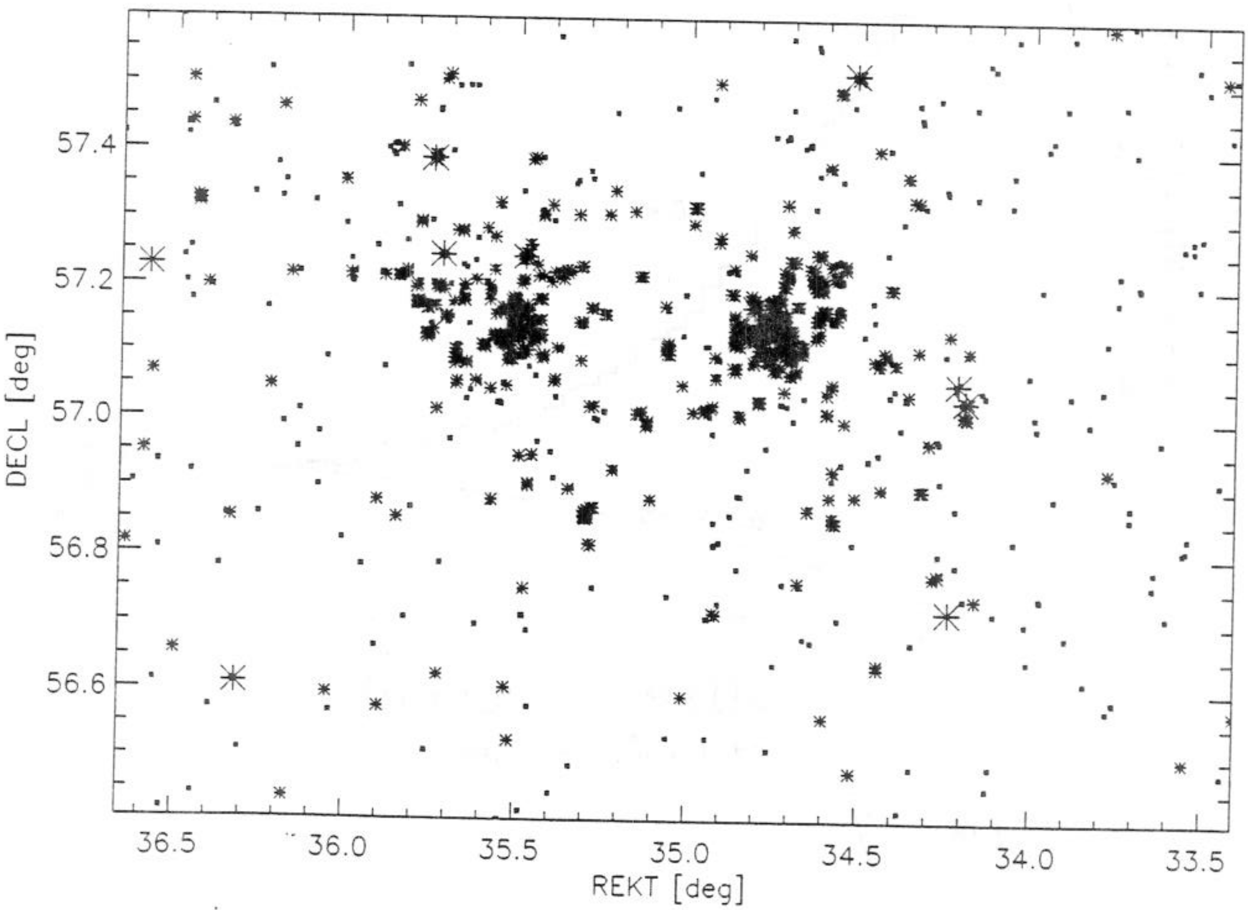
3. Final TC
   1 mio. ± 30 mas at 11^m
   2.5 years Tycho obs. pos., p.m., π
   publish 1997

4. TRC = Tycho Reference Catalogue
   1 mio. ± 30 mas
   TC + AC ± 2.5 mas/yr
   publ. 1998

TICR : Orion



h and χ Per



INCA Database", in "Databases and on-line data in Astronomy", M. Albrecht and D. Egret (Eds.), Kluwer Publ., Dordrecht.

Captions to the figures

Figure 1 : Distribution of the recognized stars of the list according to the distances to the TIC stars. The logarithmic scale was used for pointing out the secondary peak at 5", that was generated by false stars. The thin line is the theoretical distribution of false stars (valid only for distances smaller than 5.25").

Figure 2 : Distribution of magnitude of the selected stars, compared to the distribution of magnitudes for the whole TIC.

Figure 3 : Distribution of the number of observations by the star mapper slit groups. The big dots refer to the TIC entries, and the histogram to the recognized stars of the list. Both curves are in logarithms; they are parallel when the number of transits is larger than about 47, indicating that the efficiency of recognition is constant above this limit.

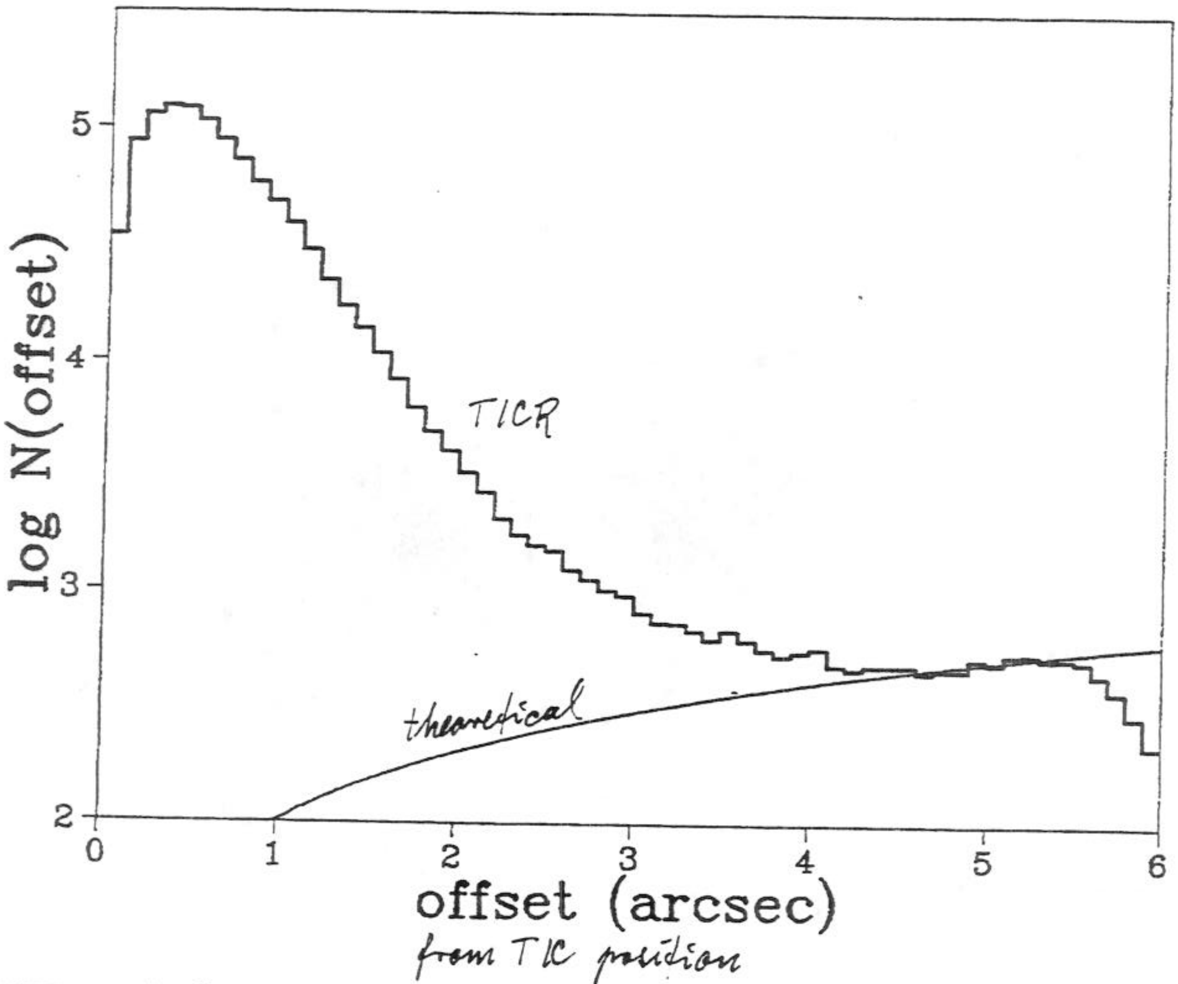


Fig. 1

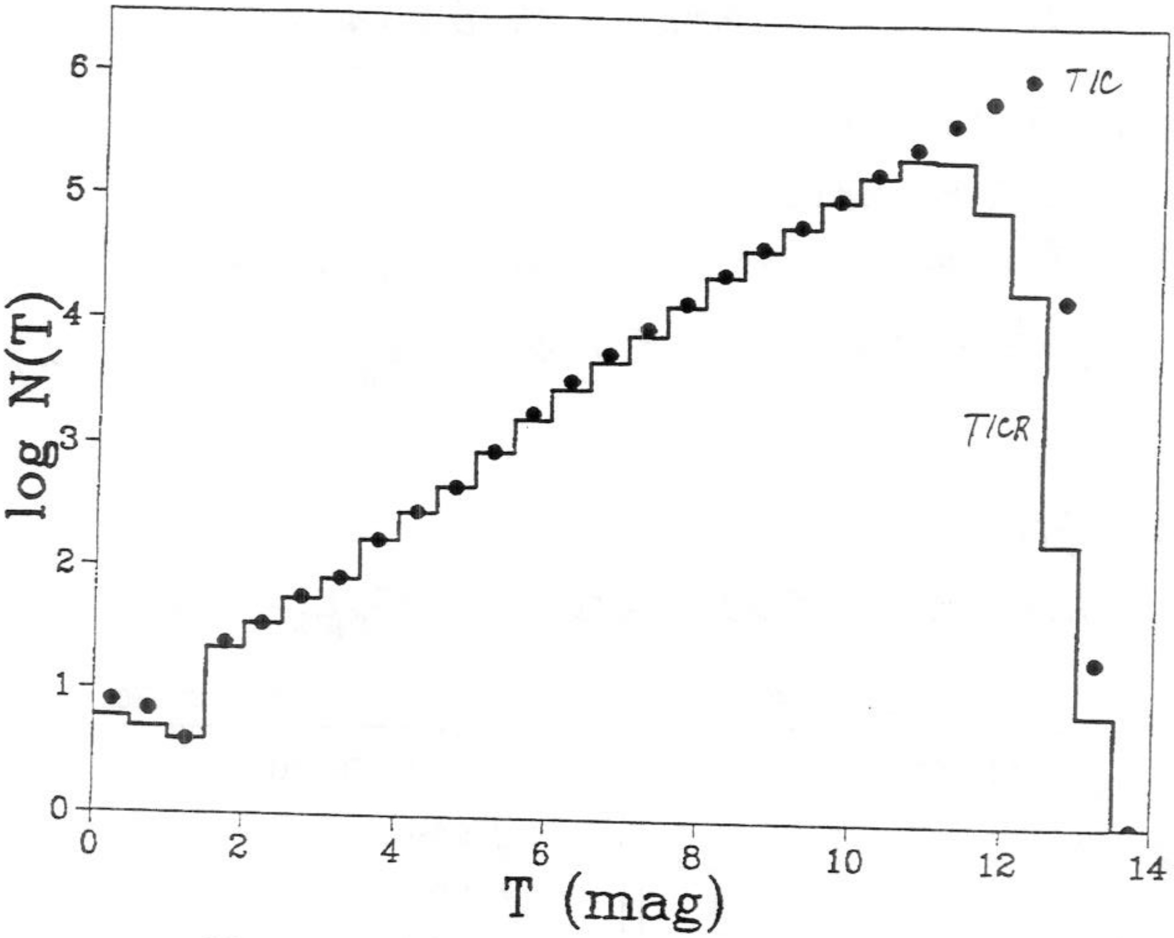


Fig. 2

R351 02/07/93

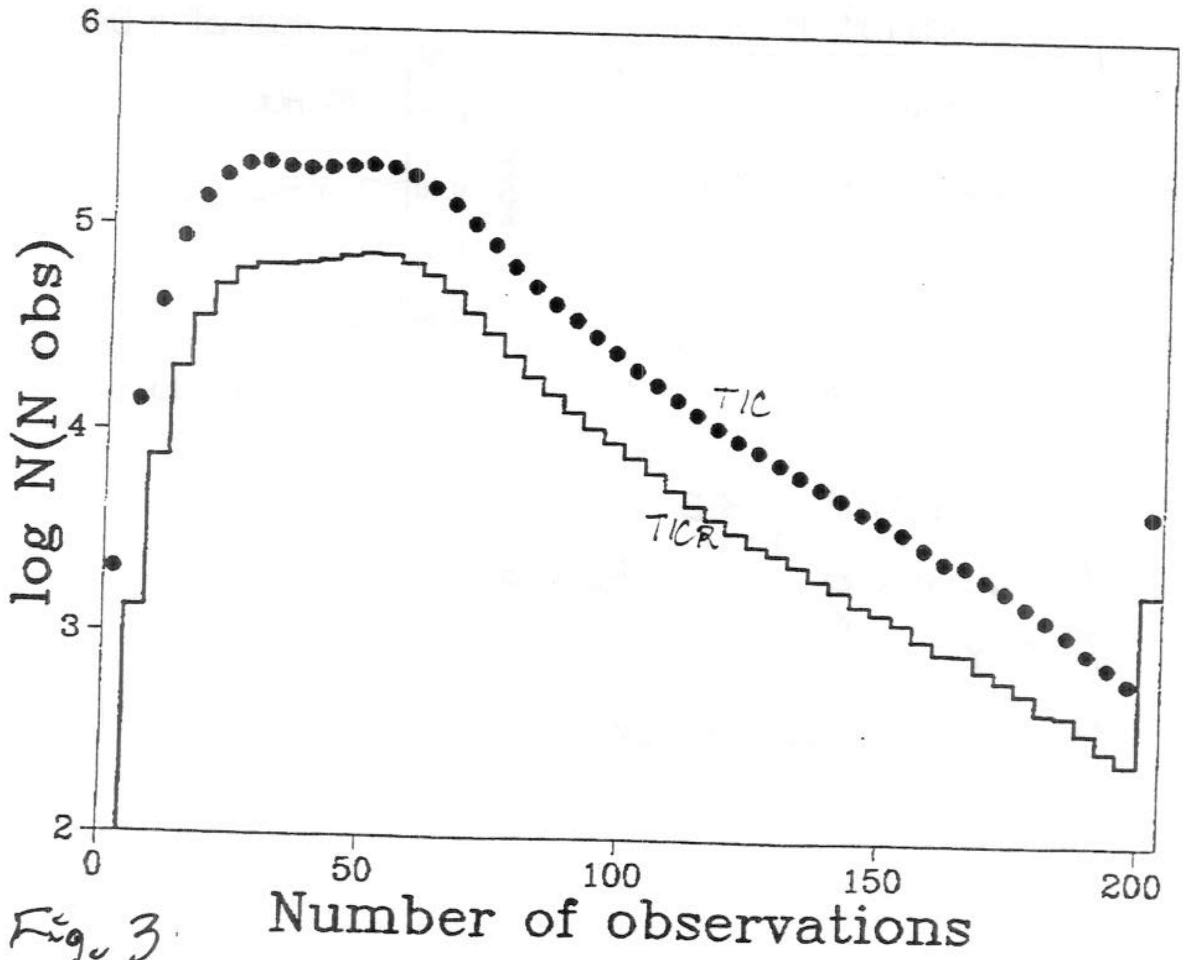


Fig. 3

R351 06/07/93

TICR 10^6 stars ± 60 mas

Single transits:

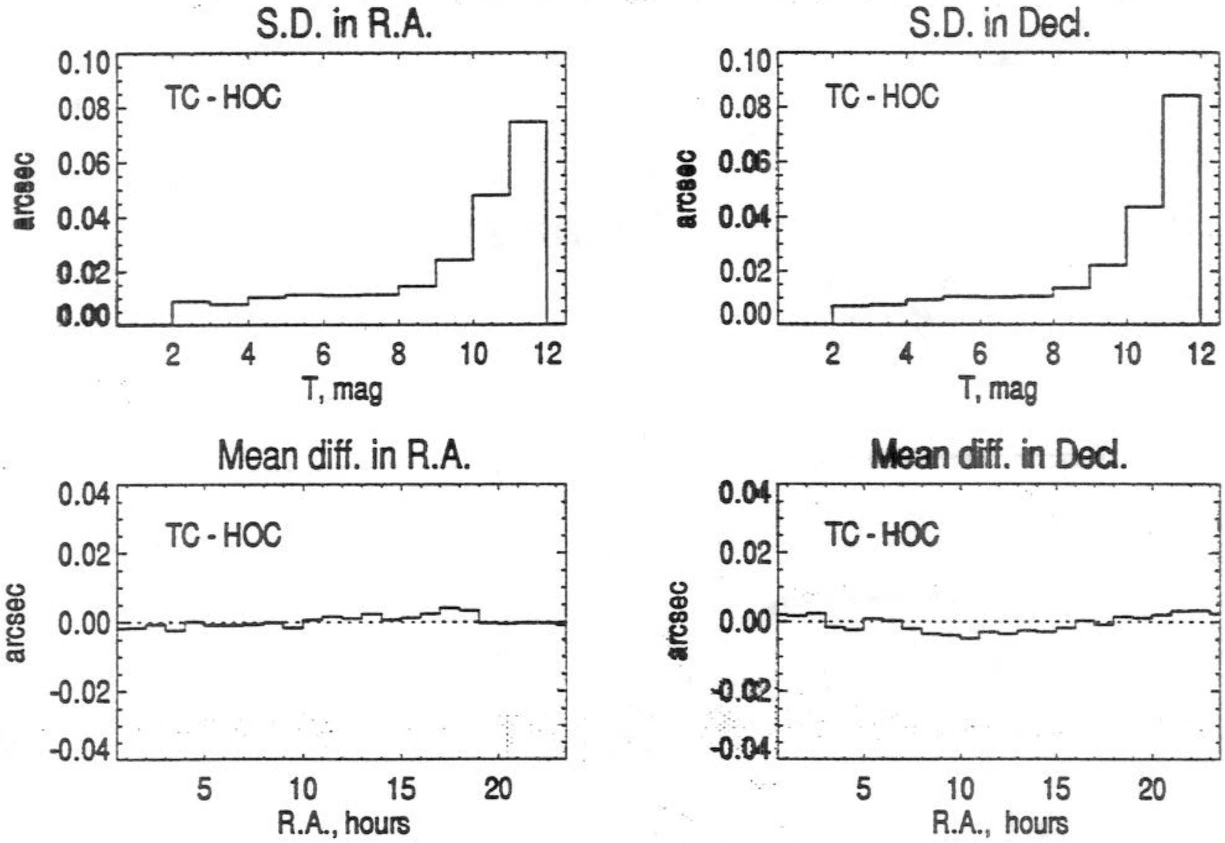
photon noise

\+ attitude noise 27 mas , 50 mas !

systematics < 5 mas/mag (B-V, m)

Positions:

4 months 23000 stars $m_{obs} \geq 20$



Final Tycho pos.:

T = 11 mag ± 30 mas

T < 9 6

Syst. $\pm$ few mas

ANNEX VI

FAST/NDAC SPHERE COMPARISON

(18 months- iterated solution)

1. Input Data

For these comparison we use:

The iterated Fast solution, it contains the 5 parameters for 93612 stars observed on orbits 1 to 1336 (1177 RGC) Seven RGC are canceled because the smoothing solutions in great circle treatment are not available

Of the 118393 objects observed the following numbers were rejected for several reasons:

658	less than 6 observatios per star
39	no HIC number
12874	recognized as double by Fast tests (F. Mignard)
4241	Chi2 test on the star residuals
146	less than 6 distinct epochs of observation
5002	pm/parallax correlation higher than 0.6
1523	formal parallax error greater than 4mas
144	formal pm rms greater than 15 mas/year
144	grid step problem
10	negative parallax less than 30 mas

The Ndac solution is the run 136 and contains 102411 stars Of the 115412 stars observed 13001 were rejected but not with the same criteria (Lindegren E-mail 1992-11-23)

The new intersection of the two data sets contains 90630 stars. The Ndac data set wese received in equatorial system and transformed in ecliptical coordinates.

2- Comparison of star positions and proper motions

All comparisons are referred to the mid-epoch of observation (J1990.75). We have applied the Ndac proper motions to calculed the star positions.

Let $[\mathbf{R}]$ be the infinitesimal rotation matrix between the two systems and $[\dot{\mathbf{R}}]$ be the derivative form.

We have:

$$[\mathbf{R}] = \begin{bmatrix} 1 & \gamma_0 & -\beta_0 \\ -\gamma_0 & 1 & \alpha_0 \\ \beta_0 & -\alpha_0 & 1 \end{bmatrix}$$

$$[\dot{\mathbf{R}}] = \begin{bmatrix} 0 & \dot{\gamma} & -\dot{\beta} \\ -\dot{\gamma} & 0 & \dot{\alpha} \\ \dot{\beta} & -\dot{\alpha} & 0 \end{bmatrix}$$

where α_0, $\beta 0$, $\gamma 0$, α', β', γ' are small angles

we have for each common star two equations:

$$\mathbf{dX} = [\mathbf{R}]\ \mathbf{dY}$$

$$\mathbf{d\dot{X}} = [\dot{\mathbf{R}}]\ \mathbf{dY} + [\mathbf{R}]\ \mathbf{d}\ \dot{\mathbf{Y}}$$

where $\mathbf{dX}$ and $\mathbf{d\dot{X}}$ are the position and velocity vectors of Fast stars, $\mathbf{dY}$ and $\mathbf{d\dot{Y}}$ are the same for the Ndac catalogue.

The adjustment, using the least square method, give the following results

α_0 = **15.571 +/- 0.007 mas**

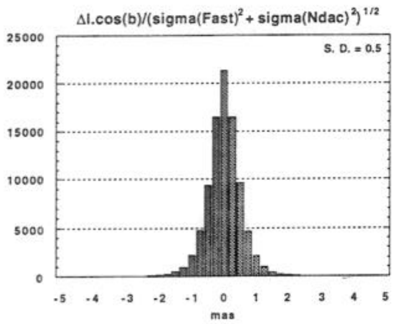
$\beta 0$ = **8.153 +/- 0.007 mas**

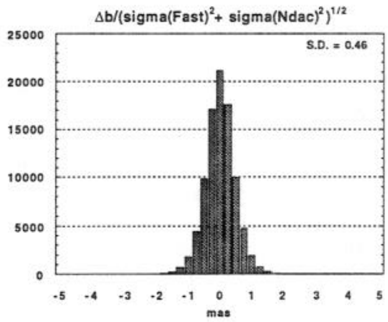
$\gamma 0$ = **-15.980 +/- 0.008 mas**

α' = **0.66 +/- 0.01 mas /yr**

$\beta' = -1.84$ +/- 0.01 mas /yr
$\gamma = 6.30$ +/- 0.01 mas /yr
correlation coefficients < 0.07

The position and proper motion differences, after application of rotation between the two systems, have been analyzed as fonction of position, magnitude and color . Nothing has been found
The histograms gives the normalized differences of the longitude and latitude components :

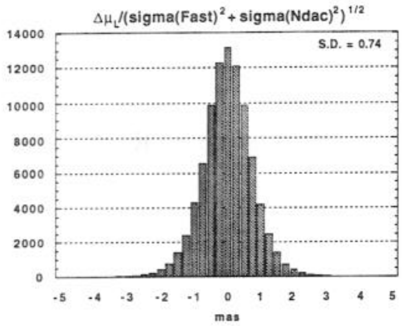


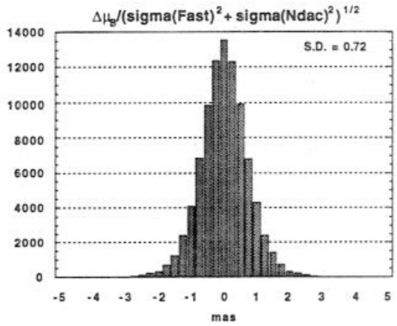


If we compare the position difference on the sky for each star we have the following statistics:

position difference	number of stars	
<10 mas	90443	
10< pos.diff <30	160	
30< pos.diff <70	5	
....		
1190< pos.diff <1350	22	(grid step error)

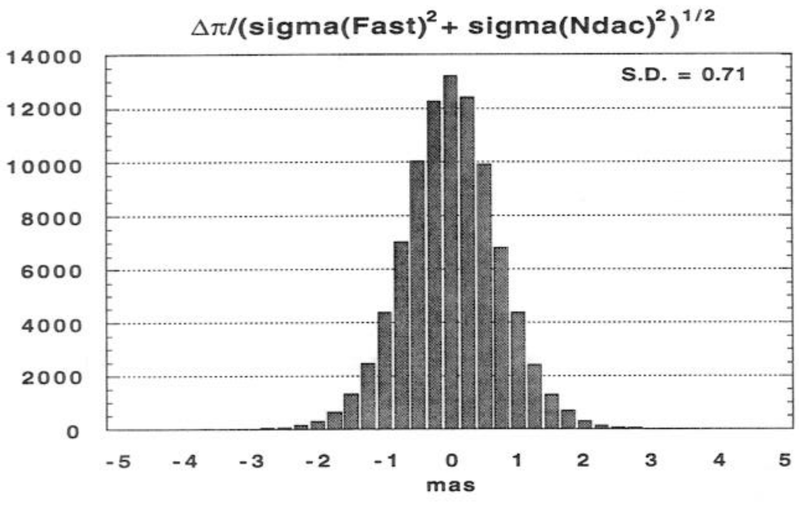
The histograms give the normalized differences of the proper motions in longitude and latitude:





3- Comparison of parallaxes

The parallax differences have been analyzed versus position on the sky,magnitude and color. Anything remarkable has been found.
The histogram gives the normalized differences of the parallaxes



For the two distributions of parallaxes (Fast and Ndac) the mean and rms are now respectively, 4.69 +/-6.33 and 4.69+/-6.32 mas,and the number of negatives parallaxes is for Fast 5977 and 6331 for Ndac.

4- Comparison of reduced standard deviation

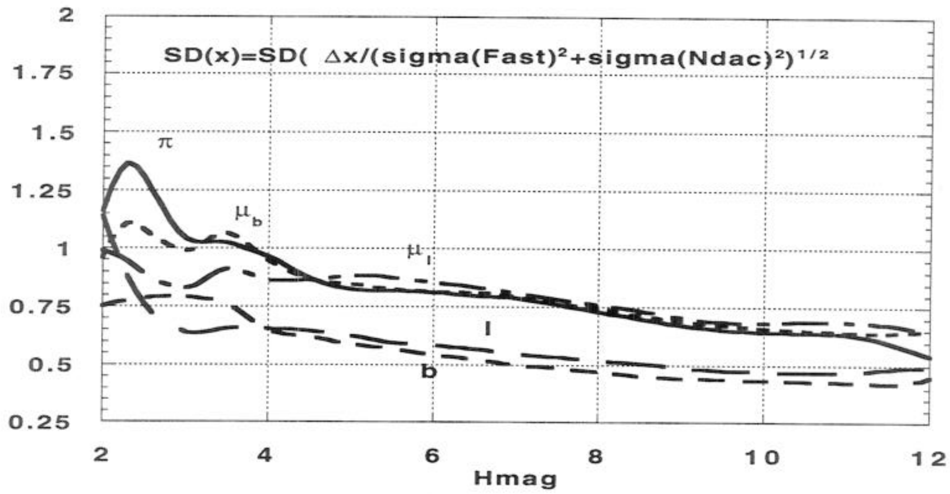
versus magnitude

For each class of magnitude and for each astrometric parameter, we compute the reduced standard deviation of the star distribution

$$SD(x) = SD(\Delta x/(sigma(Fast)^2+sigma(Ndac)^2)^{1/2}$$

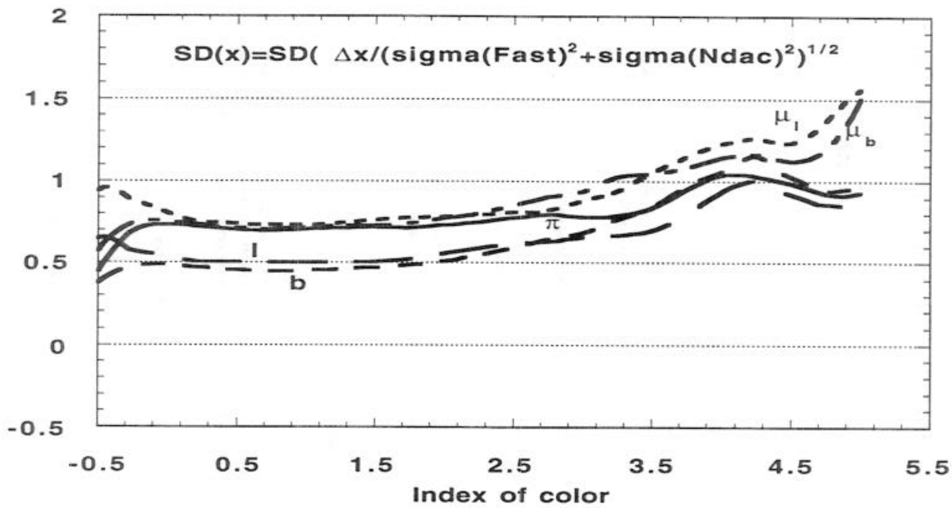
$$\Delta x = \Delta l.cos(b), \Delta b, \Delta pm$$

The following graph gives the variation of each standard deviation
For the magnitute greater than 4 and for all parameter, the reduced standard deviations are now inferior to 1. For the longitude and latitude the reduced standard deviations are much inferior to 1.



versus color

The same graph , for the color index, is plotted



For index color greater than 3.5, it appears that normalized standard error is to large. (> 1.) The calibration is not so good for this large index color.

Hipparcos Mission Summary

Volume I: The Hipparcos Satellite in Orbit

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Hipparcos Mission Summary

Volume II: The Construction of the Hipparcos Catalogue

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Appendices

ANNEX VIII

REPORT ON THE ACTIVITY OF THE TASK MINOR PLANETS AND SATELLITES

The data obtained from the one year sphere solution were first used to test the software. The one and a half year solution available in November 1992, was then used for a preliminary reduction of the observations of the minor planets.

The 8 frames of one transit were used to determine the longitude on the RGC for the middle of the transit, so that each transit gives one observation. Forty eight planets were observed in 1.5 years, some of them only three times one of them 18 times. The O-C for each planet are thus based on a few number of data, yet on the whole they show fairly good distributions with a peak near zero. The O-C for the total set of observations for all the planets have a distribution with a means equal to -3 mas and a σ equal to 138 mas. This result comes from the fact that 5 or 6 planets observations display peculiar behaviour. Finer studies of the distribution of the O-C on periods of the order of about 10 hours show systematic errors that seem related to the rotation period of the planet concerned (typically 7 hours) but the amplitude, which sometimes reaches 30 mas, is too high to be explained by an uncertainty in the photocentre correction. Further studies are needed. Orbital corrections for a given planet using a least square fit lead generally to very small residuals but only the rms associated with the orientation parameters of the orbit are good.

The rotation of the Hipparcos sphere relative to a dynamical system of reference based on the minor planets observations has been determined but the precision on the results suffers from the fact that the observations are but a few and poorly distributed.

The magnitude of the minor planets, obtained from the modulation curves, were corrected for distances and compared to earth based models. Discrepancies will have to be explained.,

As far as he satellites are concerned, 14 observations of Europe and 10 observations of Titan were obtained but no O-C were computed.

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HESTROFFER D., 1993. Inertial frame determination from Hipparcos observations of minor planets in Developments in Astrometry and their Impact on Astrophysics and Geodynamics, I. I. Mueller and Kolaczek (eds.), 19-24.

MORANDO B., MIGNARD F., 1993. Hipparcos photometry of minor planets in Developments in Astrometry and their Impact on Astrophysics and Geodynamics, I. I. Mueller and Kolaczek (eds.), 25-30.

MORANDO B., HESTROFFER D. 1993. Some problems related to the reduction of the observations of the minor planets by Hipparcos. IAU symposium 160 (under press).

HESTROFFER D. 1993. Dynamical frame determination. IAU symposium 160 (under press).

Actions proposed at geometry splinter session 12-7-93

1. Sphere solution

32 months until summer 1992
Reductions to use V-I
for all stars given by Grenon

(a) New, 2.5 year comparison

NDAC already complete
FAST by October.

Report - December

NDAC/FAST

(b) Colour discrepancy. NDAC - FAST.

(c) Explain position/pm differences in ecliptic region

(d) Comparison between variances.

(e) List orbit numbers in each solution.

~~(e) Agree on rejection criteria of~~

(f) Review global parameters

~~(f) Include some double stars~~

FUL to select great circles

2. Great circles

(a) Sample one per 2/month over last year

(b) H van der M to continue analysis of existing comparisons.

(c) FAST to recompute certain RGCs to reject bad stars.

(d) NDAC to include quality estimate for each RGC. (star)

(e) NDAC + FAST to give independent lists of problematic RGC's.

(f) Investigate in depth the error budget in NDAC-FAST differences.

(g). Compare each RGC with positions generated from 2.5 year solution

Instrument 3rd/4th order poly

3. Attitude

(a) New comparisons for same RGC's as 2(a)

(b) Høg to investigate practicability of using NDAC + FAST for TYCHO.

(c) Explain the 100 mas body-axis offset NDAC - FAST