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esa estec

# HIPPARCOS

**MEETING HIPPARCOS:** HIPPARCOS INTER-CONSORTIA MEETING

**PLACE:** ESTEC

**REF.:** ESA-HIP-01127

**DATE:** 9.11.82

**PAGE:** (i)

**AGENDA**

see Annex 1

**PARTICIPANTS**

| | |
|---|---|
| **ESA** | L. Emiliani<br>M. Perryman (chairman) [signature]<br>M. Schuyer<br>R. Bonnefoy<br>K. van Katwijk<br>G. Ratier<br>R. Wills, S. Vaghi |
| **PRIME** | E. Zeis<br>J. Vivier |
| **co or sub contractor** | INCA: C. Turon, M. Huguenin [signature: C. Turon]<br>NDAC: E. Høg, L. Lindegren [signature: Erik Høg]<br>FAST: D. van Daalen, J. Le Gall [signature] D v Daalen |

1. Tranformation of coordinates.

a) Vivier presents the current MATRA approach on distortion based on the definition of three components, Large Scale, Medium Scale and Small Scale.

Definitions and requirements are summarized in the following table

inst. distortion $g(\eta, \xi)$

| | LS (2nd order polyn.) | MS $g - LS$ (averaging on squares) | SS $g - MS - LS$ |
|---|---|---|---|
| stability | 1 mas ($1\sigma$) over 24 h | 1 mas ($1\sigma$) over the orbital life | MAX value T.B.D. |
| knowledge after calibration | 1.7 mas ($1\sigma$) on-orbit calibration | 5 mas ($1\sigma$) on ground + 3 mas ($1\sigma$) after 2 months in orbit | |

b) a new text for Sections 6.1.2.8.9 and 6.1.2.8.10 has been agreed (Annex 2).

- MATRA and the Data Reduction Consortia have agreed to investigate, before PDR, the feasibility of describing the "large scale" contribution by an analytic function containing no more than 10 parameters. MATRA will, in particular, indicate the form of this analytic function (e.g. polynomial).

- The Data Reduction Consortia confirm that the dimensions 100 x 100 for the calibration points matrix shall be considered as an upper limit.

- MATRA and DR Consortia have agreed to confirm the value of 0.05 arcsec rms for the large-scale component accuracy at the end of commissioning.

c) Vivier briefly presents MATRA's current position on distortion, as described in the technical note "Payload distortion budget" MAT-HIP-03567 (28.10.82)

## 2. Chromaticity

- M. Schuyer presents the current status of the chromaticity problem (Annex 3).

- J. Vivier presents MATRA approach on chromaticity error, described in the technical note
"Chromaticity Budget" by J.M. Vivier and P. Hollier
(see also Annex 4).

- C. Turon presents statistics on existing photoelectric data for stars (see Annex 5).
More information on stars colours will be provided by the next Science Team meeting.

## 3. Veiling glare.

– M. Schuyer presents the current status of the veiling glare problem (Annex 6).

– C. Turon shows a table with data on stellar density (Annex 7) and stresses the ~~difficulty of using a rejecting criterion when stars are too near to each other in the compilation of the Input Catalogue, particularly in regions near the Galactic Plane.~~ differences in density in the galactic plane as compared to zones towards the poles. These should be taken into account when making estimations concerning the veiling glare effect. She also mentions the problem of observing visual binary stars separated by approximately 20" : veiling glare may be critical for their observability.

The available statistics on double stars is shown in the following table :

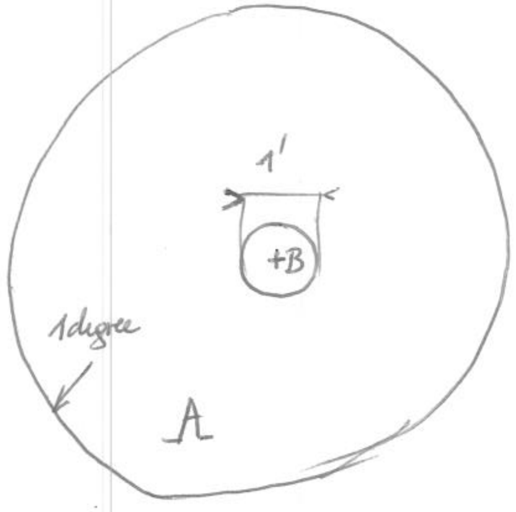
| ρ \ $m_A$ | < 8.5 | 8.5 – 9.5 | > 9.5 |
|---|---|---|---|
| < 0".6 | 1100 | 1900 | 3400 |
| 0".6 to 5" | 3400 | 5900 | 16500 |
| 5" to 20" | 3200 | 4100 | 18500 |
| > 20" | 4300 | 2000 | 3500 |

(source : Index Cat.)

3/4

Conclusions:

- MATRA to provide input on effect of reduction of IFOV
- INCA to investigate the feasibility of exploring, for programme stars, their ~~surrounding~~ regions in order to detect perturbing stars (see sketch below).
- data reduction Consortia to investigate usefulness of such information in their data treatment.
- ESTEC will continue studies on the veiling glare problem following the approach adopted until now (R. Wills' paper).




For a star $m_0$

- for A all stars brighter than <9
  - # number
  - position
  - magnitude
- for B all stars brighter than $m_0+4$ (or 5)
  - number
  - position (accuracy?)
  - magnitude

4|4

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# HIPPARCOS

MEETING HIPPARCOS

PLACE

REF.

DATE



| ACTION No EO- | DESCRIPTION (not more than 4 lines) | CLOSING DATE | ACTIONNEE Person/firm | INITIATOR Person/firm |
|---|---|---|---|---|
| 01127-01 | MATRA to analyse requirements on accuracy ~~?~~ of large-scale component during commissioning | 1 Feb. 83 | E. ZEIS | ESA MS |
| 01127-02 | NDAC and FAST to confirm accuracy requirements of large-scale component during commissioning | 1 Feb 83 | E. HØG<br>D. van DAALEN | ESA MACP |
| 01127-03 | MATRA to investigate form of large scale contribution | 1 Apr. 83 | E. ZEIS | ESA MS |
| 01127-04 | NDAC and FAST to assess feasibility of solving for 10 parameters in the large-scale contribution. | 1 Apr. 83 | E. HØG<br>D. van Daalen | ESA MACP |
| 01127-05 | INCA to investigate statistics of star colours presently available. | 2 Dec. 82 | C. TURON | ESA MACP |
| 01127-06 | MATRA to assess chromaticity maps (1) and related propagation (2) | 1 March '83<br>22 Apl '83 | J. VIVIER | ESA RB |
| 01127-07 | MATRA to assess coarse assessment / reduction of IFOV<br>Optimise IFOV size | 15 Jan '83<br>02 May 83 | E. ZEIS | ESA MS |
| 01127-08 | INCA to investigate feasibility of ~~surrounding~~ exploring surrounding regions in order to detect perturbing stars | ~~15 Jan '83~~<br>1-3-83 | C. TURON | ESA MACP |
| 01122-09 | NOAC to investigate usefulness of ~~such information~~ the knowledge of perturbing stars in surrounding regions in the data treatment | ~~15 Jan '83~~<br>1-3-83 | E. Høg | ESA MACP |

Signatures

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Annex 1

HIPPARCOS INTER-CONSORTIA MEETING

9 November 1982

AGENDA

10.00-12.30

(1) Transformation of coordinates - discussion of the ESA proposed text:

- concept of a reference star
- inclusion of frequency dependence
- time-varying component: number of parameters, temporal stability, precision of determination
- medium-scale component: grid specification, matrix size
- requirements on transverse component
- star mapper requirements
- geometric calibration

Present status of MATRA studies:

| | |
|---|---|
| - basic angle | J.M. Vivier |
| - distortion | " |

(2) Chromaticity:

| | |
|---|---|
| - review of status | M. Schuyer |
| - chromaticity budget | J.M. Vivier |
| - discussion | |

13.30-15.00

(3) Veiling glare:

| | |
|---|---|
| - review of status | M. Schuyer |
| - hardware optimisation | MATRA |
| - discussion | |

Annex 2

### 6.1.2.8.9 Transformation from Grid to Field Coordinates

The overall transformation from grid coordinates (as sensed by the detectors and their associated electronics) to field coordinates (i.e. angular coordinates in the object surface) shall account for all distortions due to the optical and detector systems, grid and photocathode irregularities, etc. The design shall allow this transformation to be reconstructed a posteriori, to permit the scientific data processing to meet the accuracy requirements stated in Section 6.1.2.1. To achieve this objective, the following shall be complied with for a star of B-V = 0.5 mag:

Primary Field of View

For each viewing direction, the longitudinal component of the transformation shall be described by the algebraic sum of two contributions. For the fundamental frequency of the signal and for the first overtone separately, the components of these transformations shall be defined as follows:

(a) a 'large-scale' contribution that shall be determinable from the reconstitution of successive great circles during the scientific data processing using observations over a period of 24 hours. It shall be described by an analytic function (the form of which shall be known before launch) containing no more than 10 parameters per viewing direction and per frequency, excluding the origin common to both viewing directions.

The transformation described by this component shall be stable to better than 0.001 arcsec rms for each point of the fields of view during any period of 24 hours. It shall be assumed that this component can be determined during the scientific data processing with an accuracy of 0.0017 arcsec rms.

The large-scale component of the transformation shall be known before launch with sufficient accuracy to demonstrate that it meets the above requirements.

(b) a 'medium-scale' contribution which is considered constant with time for the purposes of the data reduction. This contribution shall be described by a matrix of at most 100 x 100 calibration points per viewing direction, per detection chain and per frequency. One parameter per calibration point shall describe the mean contribution to this component from a zone surrounding the calibration point, these zones being equal and covering the field of view. This part of the transformation shall be known at the end of the commisioning phase with a precision of 0.003 arcsec rms per calibration point, and stable throughout the operational lifetime to within 0.001 arcsec rms.

Residuals of the transformation from grid to field coordinates not accounted for by the components defined above will not be corrected for in the data reduction process. Their contributions shall be compatible with the overall accuracy requirements of Section 6.1.2.1.

The transverse component of the transformation shall be known throughout the mission with sufficient accuracy to enable the above requirements on the longitudinal component of the transformation to be met.

Star Mapper Field of View

The distortions of both star mapper fields of view, their accuracies and their stabilities, shall be compatible with the attitude reconstitution requirements stated in Section 6.1.2.6.2, and with the astrometric requirements of the TYCHO experiment stated in Section 6.1.2.8.8.

The transformation from grid to field coordinates for the star mapper fields of view shall be known before launch with sufficient accuracy to demonstrate that it meets the above requirements.

### 6.1.2.8.10 Payload Calibrations

#### (a) Geometric Calibration

Primary Field of View

The matrices describing the medium-scale contribution of the transformation from grid to field coordinates (as defined in Section 6.1.2.8.9) shall be known prior to launch with an accuracy of 0.005 arcsec rms per calibration point.

The large-scale component of the transformation from grid to field coordinates shall be known at the end of commissioning with an accuracy of 0.05 arcsec rms (TBR).

Annex 3

# CHROMATICITY ERRORS

## 1. BACKGROUND

- CHROMATICITY ERROR IS DUE TO SENSITIVITY OF DISTORTIONS TO STAR SPECTRAL TYPE:
- A USEFUL ASSUMPTION IS THAT THE PHASE MEASUREMENT ERROR DUE TO CHROMATICITY IS PROPORTIONAL TO THE DEVIATION OF COLOUR INDEX B-V FROM $(B-V)_0 = 0.5$ MAG.
- CHROMATICITY IS EXPECTED TO VARY ACROSS THE INSTRUMENT FOV, DEPENDING ON THE VIEWING DIRECTION P OR F.
- MOREOVER, TIME CHANGES IN TEMPERATURE DISTRIBUTION, IRRADIATION, WILL INDUCE MISALIGNMENTS AND OPTICAL SURFACE DEFORMATIONS WHICH, IN TURN, WILL CAUSE TIME CHANGES IN CHROMATICITY.

Date

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

## 2. REVIEW OF ANALYSES AND SIMULATIONS

- CHROMATICITY ERROR PROPOSED TO BE SPLIT INTO 2 COMPONENTS:
  - ° CONSTANT CHROMATICITY, ENSEMBLE AVERAGE OVER FOV's AND MISSION DURATION;
  - ° VARIABLE CHROMATICITY, DEVIATION OF THE CHROMATICITY ERROR FROM THE ABOVE AVERAGE;
- CHROMATICITY ASSUMED TO BE INTEGRALLY PROPAGATED THROUGH GREAT CIRCLE REDUCTION;
- CONSTANT CHROMATICITY IS PROPAGATED TO ERRORS ON ASTROMETRIC PARAMETERS AS A CONSTANT BIAS:

  A NEW SET OF 'CO-EFFICIENTS OF IMPROVEMENT' IS COMPUTED THROUGH SIMULATIONS.
- VARIABLE CHROMATICITY IS TREATED AS A CENTERED RANDOM VARIABLE, THEREFORE PROPAGATED THROUGH THE USUAL COEFFICIENTS OF IMPROVEMENT;
- MEAN ERRORS ON ASTROMETRIC PARAMETERS:

$$(\sigma_{ai})^2 = (\sigma_i)^2 + (\sigma_i^{v})^2 + (C_i)^2$$

- GIVEN $\sigma_{ai}$ = 2.6 M.A.S., AND $\sigma_i$ (PHOTON STATISTICS), TOLERANCES ON CONSTANT AND VARIABLE CHROMATICITY CAN BE ALLOCATED,

  E.G., C=2.5 M.A.S., $\sigma_\eta^{v}$=2.32 M.A.S. ( $\sigma_i$ =2.26 M.A.S.)

Date..........

## 3. FEASIBILITY OF CONSTANT CHROMATICITY IDENTIFICATION

- IDENTIFICATION COULD BE ATTEMPTED EITHER GLOBALLY, THE 'CONSTANT' BIAS BEING AN ADDITIONAL PARAMETER, OR AT THE LEVEL OF GREAT CIRCLE REDUCTION.

## 4. DISCUSSION AND CONCLUSIONS

- THE 'CONSTANT' AND 'VARIABLE' CHROMATICITY RELIES ON AN ALLOCATION FOR WHICH VERIFICATION METHODS STILL NEED TO BE DEVISED.
- ASSESSMENT OF TYPICAL CHROMATICITY MAPS COULD LEAD TO REVISE THE ABOVE CONCEPT (E.G. IF ERROR REMAINS CONSTANT ALONG ANY INDIVIDUAL FOV CROSSING); A DIFFERENT ANALYSIS OF COEFFICIENTS OF IMPROVEMENT COULD BE MORE APPROPRIATE.
- A CHECK OF THE ASSUMPTIONS OF PROPORTIONALITY OF ERROR TO (B-V) WOULD BE USEFUL.
- EFFICIENCY OF THE PROPOSED IDENTIFICATION PROCESSES WOULD BE ENHANCED BY:
  - IN-FLIGHT CALIBRATION USING 2 NARROW-BAND FILTERS;
  - A PRIORI KNOWLEDGE OF STAR COLOUR INDICES.

| ECLIPTICAL LATITUDE | NUMBER OF STARS Ni |
|---|---|
| 0° | 30 |
| 10° | 25 |
| 20° | 25 |
| 30° | 25 |
| 40° | 20 |
| 47° | 18 |
| 55° | 18 |
| 65° | 12 |
| 75° | 10 |
| 85° | 5 |

Figure 1 : DISTRIBUTION OF TEST POINTS ON THE SKY

| | New simulation Software | | Old simulation Software | Lindegren |
|---|---|---|---|---|
| | C | B | C | C |
| Position in longitude | 0.192 | 0.278 | 0.227 | 0.195 |
| Proper motion in longitude | 0.269 | 0.257 | 0.319 | 0.272 |
| Position in latitude | 0.156 | 0.205 | 0.138 | 0.157 |
| Proper motion in latitude | 0.223 | 0.283 | 0.198 | 0.225 |
| Parallax | 0.242 | 0.187 | 0.243 | 0.240 |

Figure 2 : GLOBAL AVERAGES ON THE CELESTIAL SPHERE COVERAGE

| Parameter | Attenuation factor |
|---|---|
| Position in Longitude | 0.278 |
| Proper Motion in Longitude | 0.257 |
| Position in Latitude | 0.205 |
| Proper Motion in Latitude | 0.283 |
| Parallax | 0.187 |

FIGURE 1 : AVERAGE VALUES OF THE CONSTANT CHROMATICITY ATTENUATION FACTORS

| C (marcsec) | $\sigma_\eta^V$ (marcsec) |
|---|---|
| 0.00 | 3.244 |
| 0.25 | 3.236 |
| 0.5 | 3.21 |
| 0.75 | 3.17 |
| 1.00 | 3.12 |
| 1.25 | 3.04 |
| 1.50 | 2.95 |
| 1.75 | 2.83 |
| 2.00 | 2.69 |
| 2.25 | 2.53 |
| 2.50 | 2.32 |
| 2.75 | 2.08 |
| 3.00 | 1.77 |
| 3.25 | 1.37 |
| 3.50 | 0.70 |
| 3.55 | 0.44 |
| 3.5835 | 0.00 |

FIGURE 2 : POSSIBLE PAIRS OF CONSTANT/VARYING CHROMATICITY

Annex 4

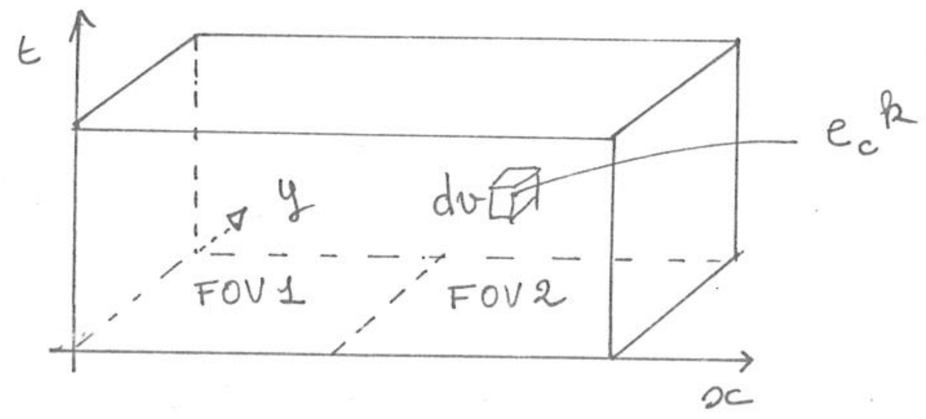


CHROMATICITY ERROR: $e_c^k = f(i, x, y, t)$

[position estimate error between a B-V star and B-V = 0.5 star]

with:
- $i$ : FOV index
- $x, y$ : field coordinates
- $t$ = time
- $k$ = color index

Representation:



<u>CHROMATICITY PARAMETER:</u>

Cc : mean value, over field . time : $\int_v e_c^k \, dv / \int dv$

Cv : sigma value, over field time : $\left[ \int_v \frac{e_c^{k^2} dv}{\int dv} - C_c^2 \right]^{1/2}$

<u>CHROMATICITY COMPUTATION:</u>

$$e_c^k(t) = \sum_j a_j \, e_j(t)$$

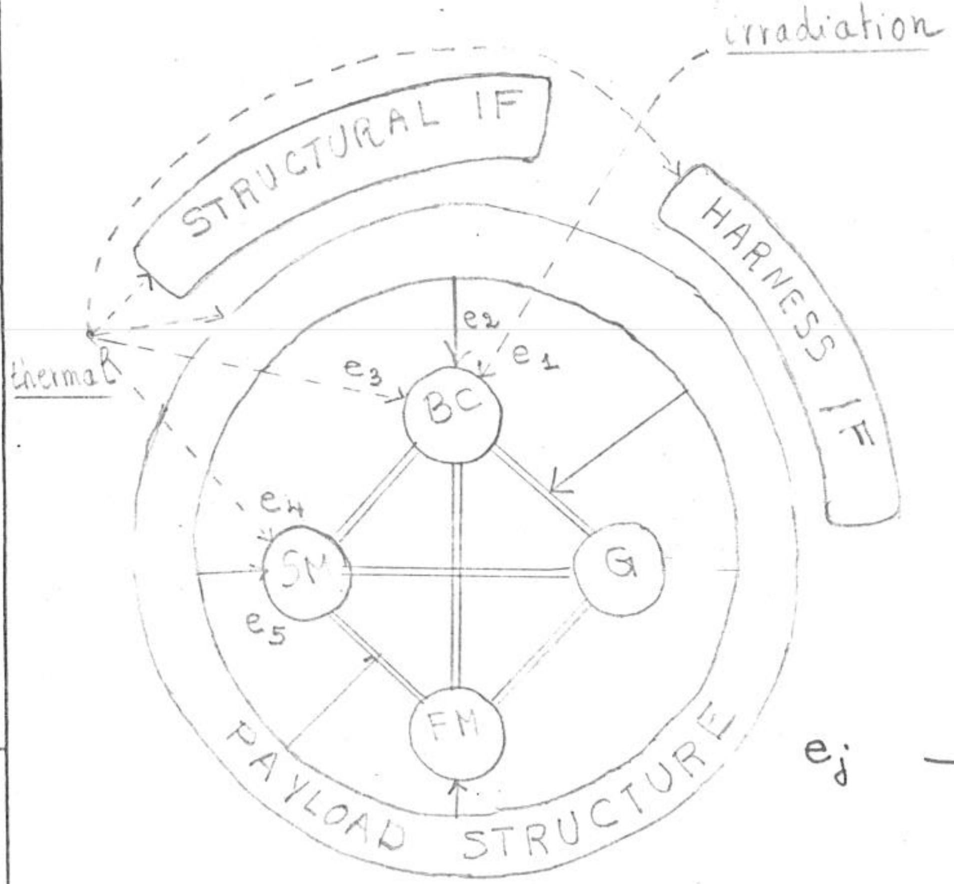
$j$ : stimuli index
$e_j$ : amplitude of j stimuli at t time
$a_j$ : "chromaticity distortion" sensitivity
$= a_j(x, y, i)$

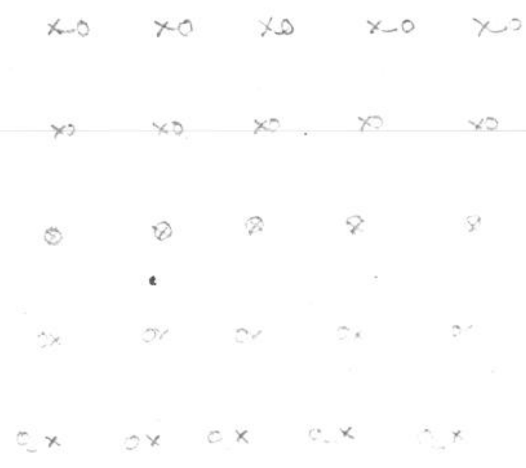
<u>hyp:</u> contributions are decorrelated

$$C_c = \Sigma_j \, \overline{a_j} \cdot \overline{e_j} \qquad (1)$$

$$C_v^2 = \Sigma_j \, \sigma^2 a_j \left(\sigma^2 e_j + \overline{e_j}^2\right) + \overline{a_j}^2 \sigma^2 e_j \qquad (2)$$

① $\overline{a_j}$, $\sigma_{a_j}$ are estimated through a se itivity study



$e_j \longrightarrow \overline{a_j}, \sigma_{a_j}$

MECHANICAL MODELS

BC : 2300 nodes

SM :

P. structure: 600 nodes

SIGNAL MODEL

② $\overline{e_j}$, $\sigma_{e_j}$ are estimated through a temporal analysis.

every stimuli can be decomposed into 3 classes:

| Class | $\overline{e_j}$ | $\sigma_{e_j}$ |
|---|---|---|
| 1. Constant<br>supposed issued from random process | $E_j$ | |
| 2. Stationnary and zero mean<br>with random phase shift | 0 | $E_j / \sqrt{2}$ |
| 3. deterministic | $\alpha_j E_j$ | $\beta_j E_2$ |

for irradiation $\alpha_i = 0.61$
$\beta_i = 0.53$

($E_j$ is the max value)

| | $C_c$ | | | $C_v$ | | |
|---|---|---|---|---|---|---|
| | $\bar{a}_j$ | $E_j$ | $\bar{a}_j\ E_j$ | $\sigma a_j$ | $E_j$ | $\sigma a_j \cdot E_j$ |
| NOM.CHROMA. | | | 0 | | | 0.18 |
| ΔX SM/BC | $3.6\ 10^{-3}$ | 274 | 0.99 | $5\ 10^{-4}$ | 274 | 0.14 |
| POLISHING BC | | | 1 | | | |
| SM | | | 1 | | | |
| FM | | | 1 | | | |
| ΔT BC | 0.02 | 2 | 0.04 | 0.26 | 2 | 0.52 |
| ΔTX SM | 0.15 | 0.2 | 0.03 | 0.17 | 0.2 | 0.03 |
| ΔTY FM | 0.15 | 0.2 | 0.03 | 0.17 | 0.2 | 0.03 |
| GRAREL. BC | 0.06 | 1 | 0.06 (0.05) | 0.33 | 1 | 0.33 (0.39) |
| IRRAD. BC | $2/D_o$ | $D_o$ | 2 (0.1) | $6.5/D_o$ | $D_o$ | 6.5 (0.18) |

RESULTS:

$C_c = 3.2$ mas

$C_v = 5.4$ mas

Annex 5

# Statistics on photoelectric existant measurements

M. Mermillod 5/11/82

- Total number of measured * — 101 124 *

- Total number of field stars — 78 476 *

- Among fiel * brighter than $m_v = 12.5$

| | | |
|---|---|---|
| . UBV meas. | 50 | 857 |
| . Genève or Strömgren | 13 | 473 |
| . other systems | 4 | 111 |
| | 68 | 441 * |

but only 32 915 with $m_v \leq 9$

(CSI: 150 000 * with $m_v \leq 9$)

Annex 6

# SUMMARY OF VEILING GLARE ANALYSES

| | | | | |
|---|---|---|---|---|
| | ESA-HIP-00326 | SAD-HIP-912 | MAT-HIP-00876 | MAT-HIP-3374 |
| NATURE | ANALYSIS AND M.C. SIMUL. | ANALYSIS | ANALYSIS | MATRA ILS SIMULATIONS |
| ASSUMPTIONS | | | | |
| • IFOV PROFILE $\zeta(r)$ | UN. WISC. $\rightarrow \phi 180\ \mu m$ | UN. WISC. $\rightarrow \phi 120\ \mu m$. | UN. WISC. $\rightarrow \phi 90\ \mu m$. | UN. WISC. $\rightarrow \phi 90\ \mu m$. |
| • PERTURBING STARS | SINGLE (ANAL.); CUMUL. (SIM.) | SINGLE | CUMULATED | PROGR. STARS (SIMUL.) + CUMUL. (ADD. DEAD TIME) |
| • STAR DISTRIBUTION | ALLEN | (ALLEN) $D = 10^{-3.85+0.45B} (°)^{-2}$ | SAD-HIP-912 | SAD-HIP-912 |
| • REJECT CRITERION FOR DEAD TIME | NONE | $f \equiv 10^{0.4\Delta B} \times \zeta(r) \leqslant 0.02$ | $r \leqslant 0.5$ mm/1 mm; $\Delta B \geqslant 0-4$ | r, $\Delta B$ OPTIMISED (SIMUL.)<br>$f = 0.005\ (B_0 = 9)$ (DEAD<br>$f = 0.02\ (B_0 = 12)$ TIME) |
| • PHASE ERROR | FRESNEL (FUNDAM.) | CRAMER-RAO (2 HARM.) | FRESNEL (FUNDAM.) | FRESNEL (FUNDAM.) |
| • IMPROVEMENT | N.A. | N.A. | GREAT CIRCLE: NONE<br>FINAL: ADDED D. TIME | GREAT CIRCLE: $(1.45/2)^{\frac{1}{2}}$<br>FINAL: ADDED D.TIME |
| RESULTS | B=9 / B=12<br>$\sigma_{\Delta\eta}$: 4 / 25<br>$P(\sigma \geqslant 1)$: 5.8% / 60%<br>$P(\sigma \geqslant 4)$: – / 24% | B=9 / B=12<br>T(B): 0.7% / 13.9%<br>S(B): 75% 0.5% / 16% | B=9 / B=12<br>D.T.: 3% 9% / 3% 9%<br>$\sigma_{\Delta\eta}$: 0.12 0.06 / 2 1<br>$\Delta\sigma_a$: 0.08 0.1 / 0.8 0.6 | B=9 / B=12<br>D.T.: 6% / 24%<br>$\sigma_{\Delta\eta}$: 0.4 / 2 |
| SUGGESTIONS | N.A. | • IDENTIFICATION OF V.G. COMPONENT<br>• INPUT CATALOGUE<br>• OBSERVING STRATEGY | • CALIBR. OF IFOV PROF.<br>• 'DOUBLE STAR PROCESS.' | NONE |

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

# VEILING GLARE ANALYSES. DISCUSSION OF ASSUMPTIONS

## SENSITIVITY PROFILE

NEW MEASUREMENTS ALLOW TO DISTINGUISH VEILING GLARE FROM IFOV PROFILE PROPER.

PAYLOAD VEILING GLARE PROFILE INCLUDES IDT TOGETHER WITH OTHER EFFECTS SUCH AS 'GHOST IMAGES', ETC.

## PERTURBING STARS

ASSUMPTION OF SINGLE PERTURBING STAR IS NOT SUFFICIENT:

CUMULATED EFFECT OF FAINTER STARS IS SIGNIFICANT (SEE MATRA HIP/EZ/CC/987)

## REJECTION CRITERIA FOR DEAD TIME

DEAD TIME CAN ONLY BE DECLARED IF IT IS PREDICTABLE.

FOR ERROR ASSESSMENT, ASSUMED REJECTION CRITERIA ARE BASED ON AN UPPER LIMIT FOR THE VEILING GLARE ERROR ( $f$ >0.01-0.05).

Date ..........

# VEILING GLARE ANALYSES - DISCUSSION OF RESULTS

## PHASE MEASUREMENT

MATRA SIMULATIONS OPTIMISE MEAN ERRORS ON ASTROMETRIC PARAMETERS, REJECTING MEASUREMENTS WITH EXCESSIVE ERRORS ('DEAD TIME'); OVERALL STATISTICS LOOK SATISFACTORY.

HOWEVER, INDIVIDUAL CASES CAN BE MUCH WORSE, WITH A SIGNIFICANT PROBABILITY (ESA-HIP-00326, SAD-HIP-912).

## COEFFICIENTS OF IMPROVEMENT

FOR PERTURBATIONS IN THE IMMEDIATE NEIGHBOURHOOD, ABSCISSA ERROR IS THROUGHOUT THE MISSION OF THE FORM:

$$\frac{s}{2\pi} f \sin\left[2\pi \frac{d}{s} \cos(\theta_i - \theta_v)\right]$$

$\theta_V$ FIXED; GENERALLY $2\pi \frac{d}{s} \gg 2\pi$

$\theta_I$ ANGLE (STAR MERIDIAN, SCAN DIRECTION)

THERE IS NO A PRIORI REASON TO CONSIDER ABSC. ERROR AS A CENTERED VARIABLE;

THE RESULTING BIAS COULD BE IMPORTANT. THIS POINT MUST BE ASSESSED BY SIMULATIONS.

FOR PERTURBATIONS COMING FROM THE OTHER VIEWING DIRECTION, ONE COULD EXPECT A STATISTICALLY CENTERED DISTRIBUTION. CLASSICAL 'IMPROVEMENT COEFFICIENTS' WOULD THEN APPLY.

## DEAD TIME

UNACCEPTABLE PHASE ERRORS ARE MOSTLY CAUSED BY FAINTER STARS VERY CLOSE TO, OR INSIDE, THE IFOV; SUCH PERTURBATIONS ARE UNPREDICTABLE.

Date..........

# VEILING GLARE ASSESSMENT (CONCLUDED)

## SUGGESTIONS FOR IMPROVEMENT

- 'DOUBLE STAR PROCESSING': AN EXAMPLE IS THE IDENTIFICATION AT THE LEVEL OF PHASE EXTRACTION, OUTLINED BY LINDEGREN IN SAD-HIP-912; METHOD IS LIMITED BY PHASE DIFFERENCE (SHOULD BE 90 DEG.) AND MAGNITUDE DIFFERENCE OF PERTURBING STARS.
- IDENTIFICATION CAN BE IMPROVED BY CALIBRATION OF IFOV AND VEILING GLARE PROFILES.
- AVOID 'INTERRUPTION' OF GREAT CIRCLES BY INTRODUCING IN THE OBSERVING PROGRAMME UNPERTURBED STARS, TO THE NECESSARY EXTENT.
- INVESTIGATION OF POTENTIALLY PERTURBING STARS, AS PART OF INPUT CATALOGUE PREPARATION.
- IMPROVE IDT.

## CONCLUSIONS

- SEE MINUTES OF MATRA/ESTEC MEETING.

## Conclusion on veiling glare

. The statistical analysis is performed so far has been considering the overall P/L IFOV sensitivity profile including the two following effects :

1) Perturbations from stars in the zone near IFOV center (IFOV size effect) - (refer to figure 1).
2) Perturbations from stars in the zone remote from center (veiling glare effect). The IFOV radius is defined at 50%. The veiling glare effect starts at about 2 times the IFOV radius, where the attenuation is about 1%, for the measured tube with 30" IFOV diameter.

. Such an analysis shows (refer to HIP/EZ/CC/987) :

- major perturbing effect is the IFOV size effect, due to unidentified fainter neighbouring stars.
- veiling glare effect contributes only to 30% of perturbed measurements for mag 12 and much less for brighter stars. In addition this effect is due to stars brighter than the observed star and therefore the perturbation can be predicted from Input Catalogue and its effect minimized through operational constraints (observation strategy, constraints on programme star selection for mag $>$ 9).

. Further analysis has shown that reduction of veiling glare by a factor of 5 (e.g. IDT improvement) would provide a limited improvement on resulting perturbations.

. On the contrary, optimization of the IFOV size between IDT pointing error and IFOV size effect induced error, may give a significant improvement and therefore shall be undertaken. MATRA states that this task will be planned early in B2 (to be discussed).

. However, even if the veiling glare effect has been proven statistically small it will prevent the observation of faint stars in the vicinity of brighter stars. This effect must be assessed by Input Catalogue, and could be reduced by the proposed IDT improvement.

Annex 7

# Some remarks about stellar density

| | magn. range | mean density | plane density | poles density | ratio plane/po[les] |
|---|---|---|---|---|---|
| | $m_v \leq 9$ | 3.7 | 6.8 | 1.4 | ~4 |
| | $m_v \leq 13$ | 150 | 400 | 50 | 8 |
| * O | $m_v \leq 9$ | .003 | .038 | 0 | ∞ |
| * B | $m_v \leq 9$ | .01 | .11 | .001 | 100 |

⇒ the constant density is a very rough approximation.

The situation will be largely worse in the galactic plane, much better towards the poles.

⚠ Some spectral types are more concerned than others

Some remarks

[illegible] density

magn. mean [illegible] poles [illegible]
range [illegible]

m ≤ 5 [illegible] 4.4

m ≤ 15 [illegible] 50

10 m ≤ 3 [illegible] 0 [illegible]

* 6 m ≤ 3 [illegible] .11 .004 10[illegible]

[illegible] is a very rough [illegible]

This model will be largely worse [illegible] the galactic plane, much better [illegible] the poles.

All [illegible] spectral types are more concerned than others