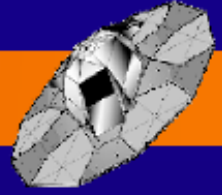
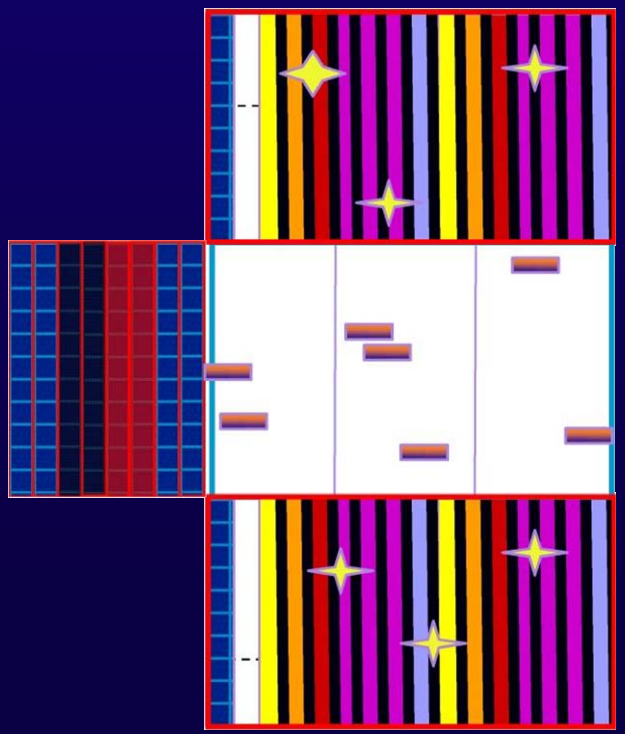


Sampling Strategy in MBP/RVF

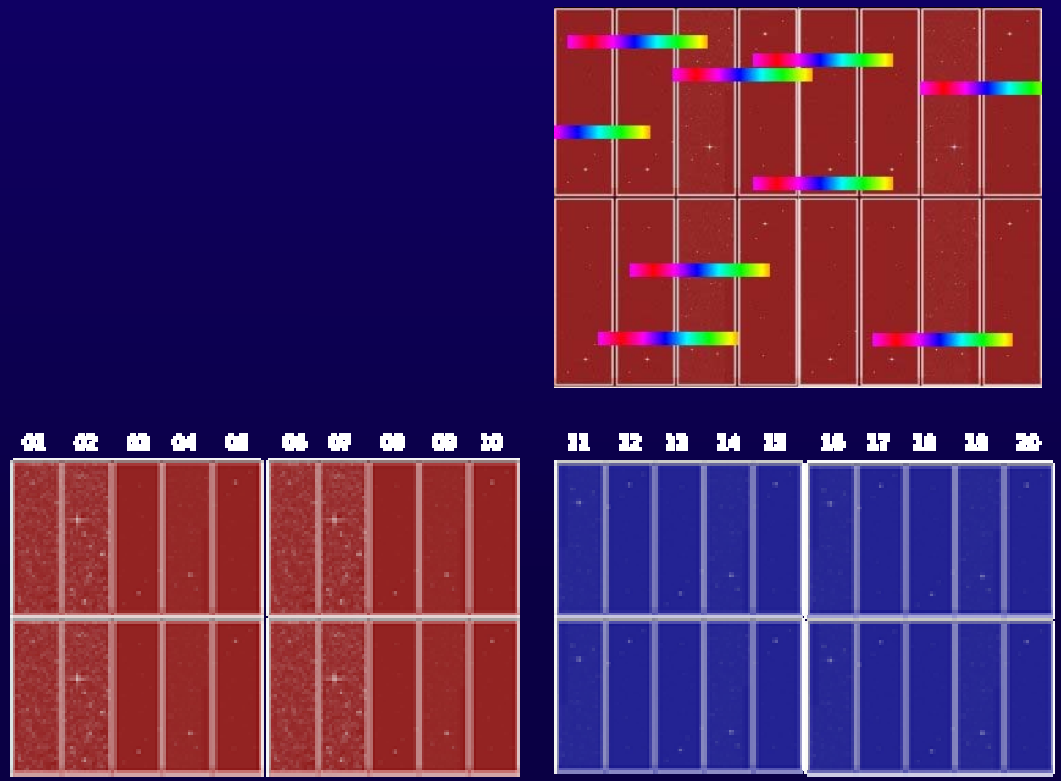
Fabien Chéreau – Observatoire de Paris

Major Design Change in 2004

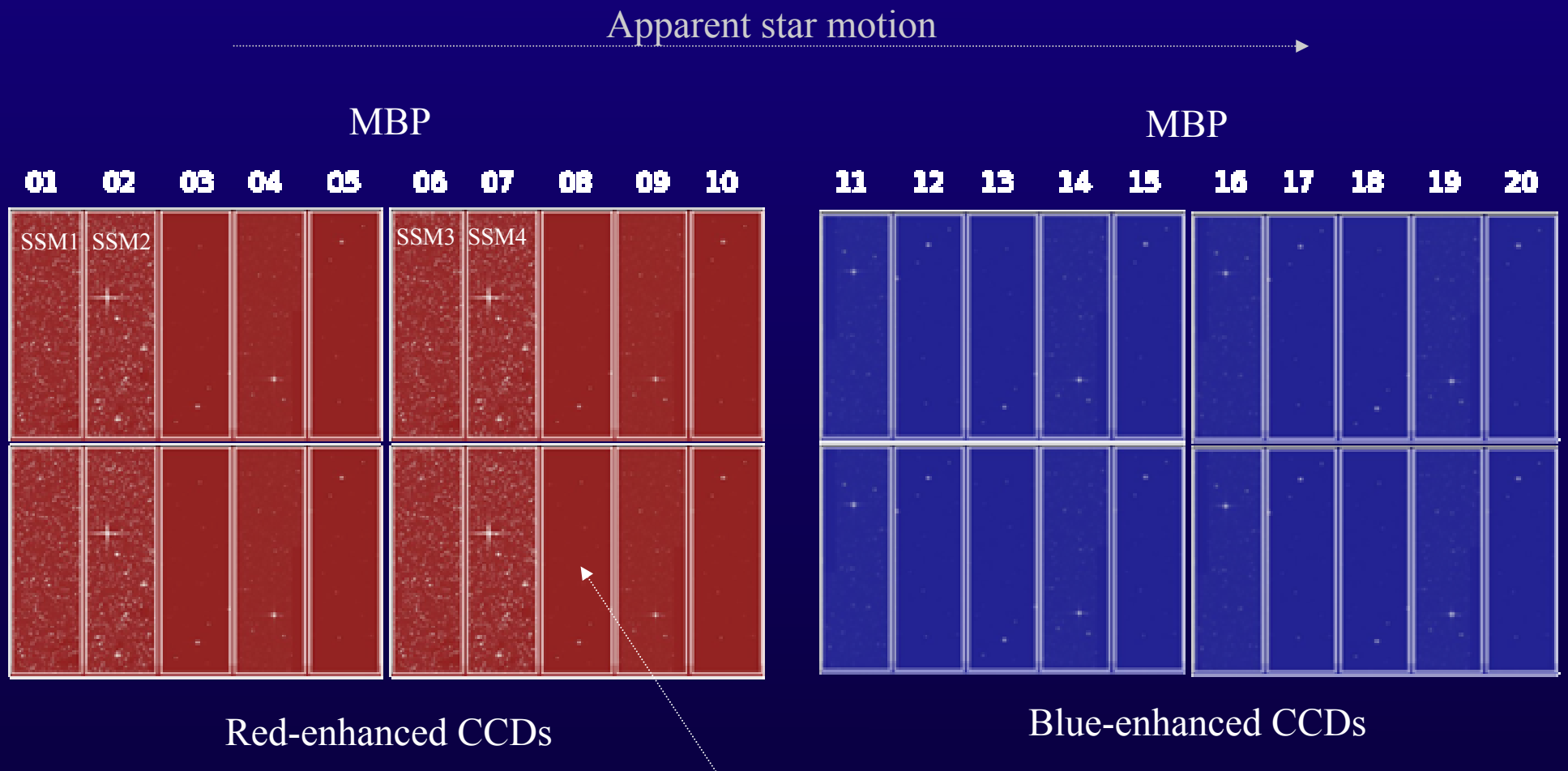
Old Design



New design

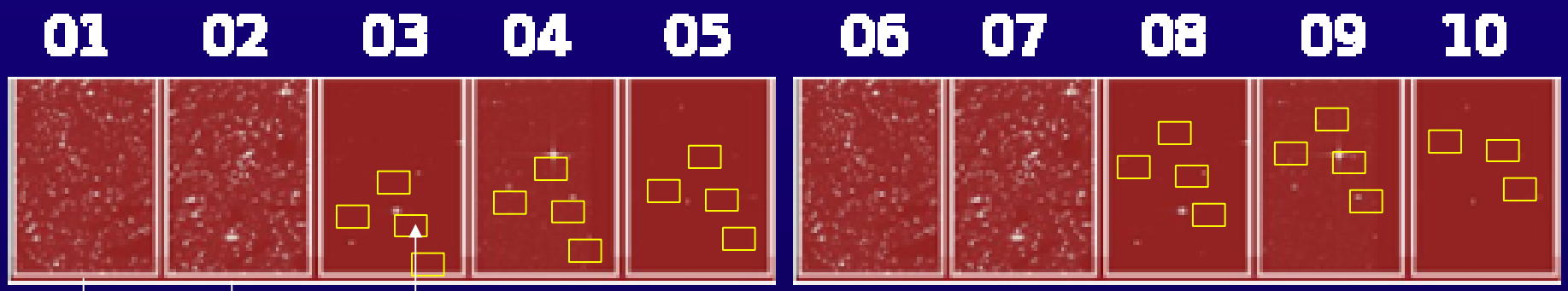


Spectro Instrument Overview



Sky Mapping :

MBP focal plane

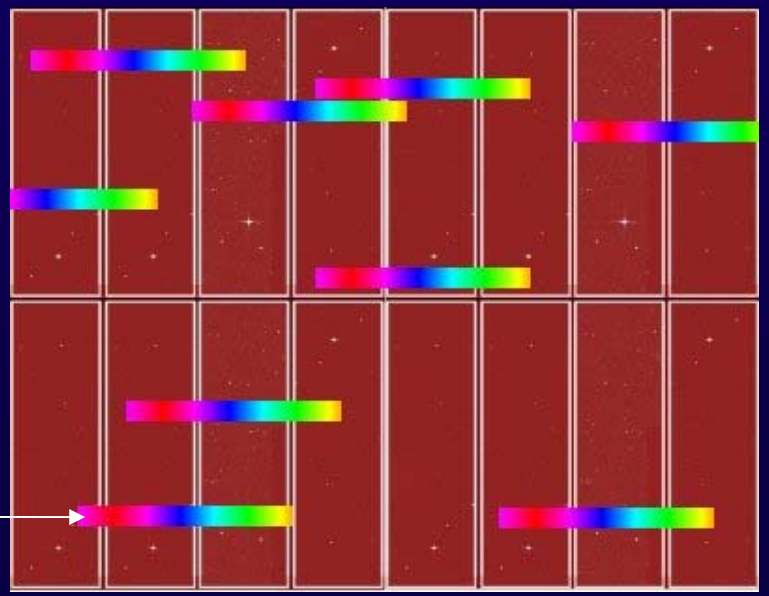


Objects transiting through the instrument (Cross-matching Algorithm)

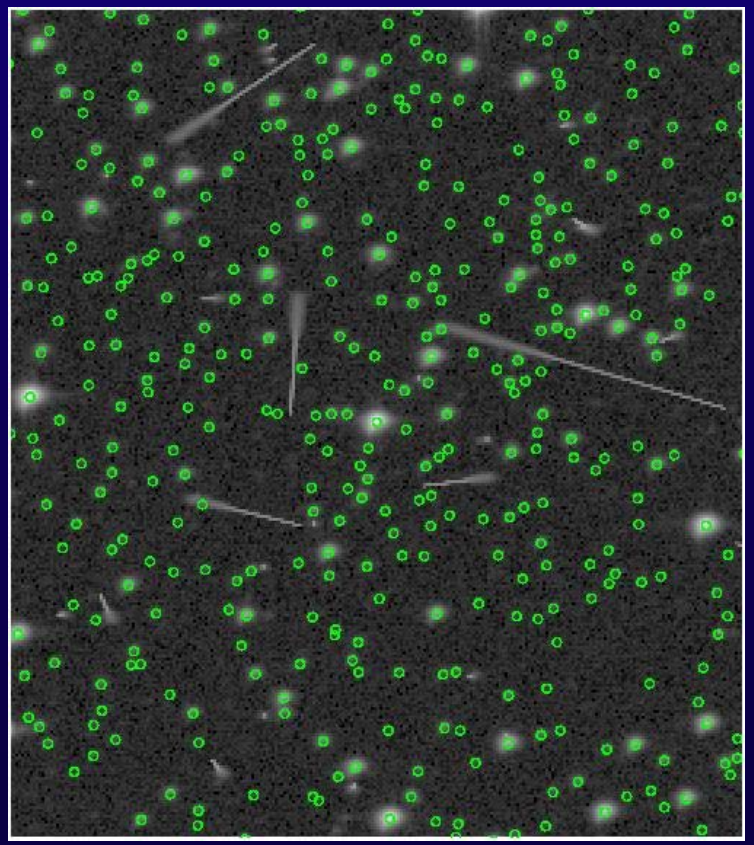
Allocation of windows in the MBP CCDs (Selection Algorithm)

Allocation of spectra windows in the RVS CCDs

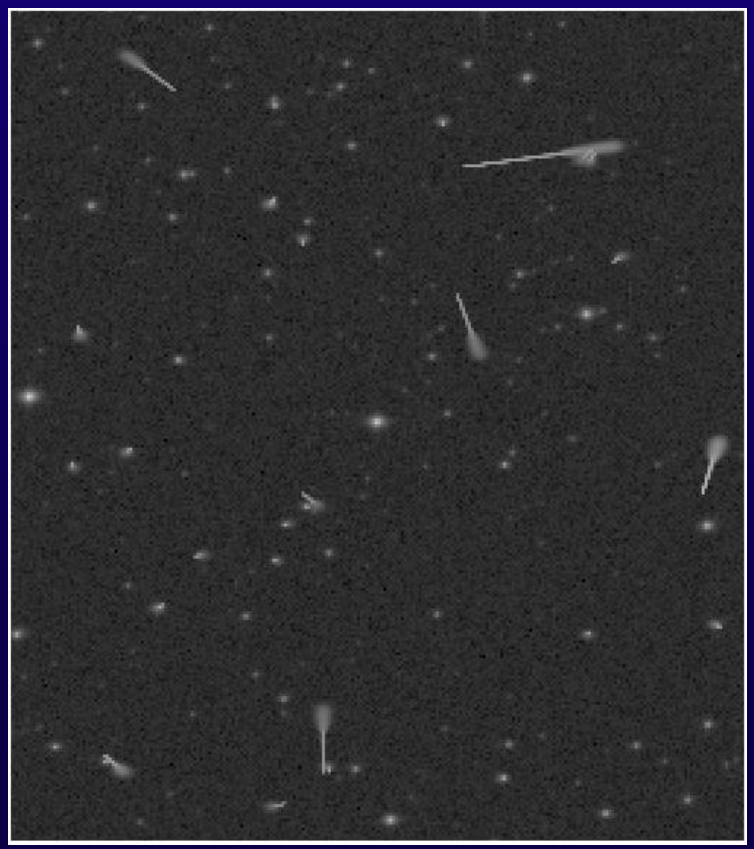
RVS focal plane



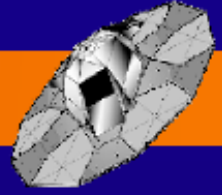
The Goal : Determine the MBP/RVF optimum windows size and binning.



SSM1-2 Detections



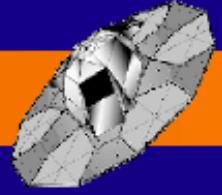
RVF



Not a trivial question :

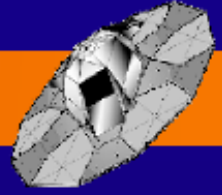
- What does “optimum” mean?
  - Obtain the best magnitude precision for the maximum of stars from a mission point of view.
  - Need the definition of an “objective function” which evaluates performances for a given window size and binning.

- Problem studied in Gaia-JdB-014 by Jos De Bruijne, Frédéric Arenou and Fabien Chéreau.



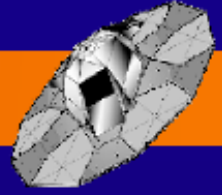
Procedure :

- Need to :
  - 1. Set parameters that can be fixed to define a representative case for MBP.
  - 2. Model the on-board processing.
  - 3. Model the on-ground processing performed on the data windows.
  - 4. Create the objective function from 1, 2 and 3.



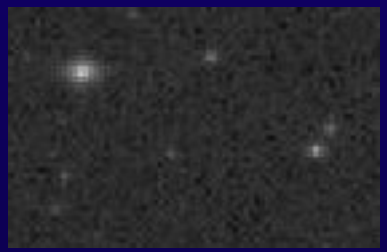
1 – Definition of a representative case :

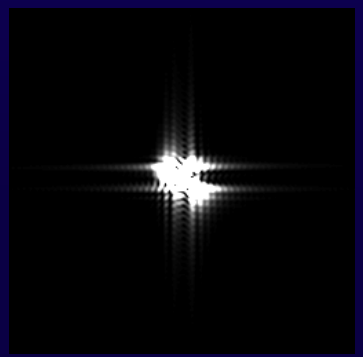
- Some parameters need to be chosen to be representative of a typical MBP CCD.
  - Wavelength.
  - Position in the focal plane.
  - Distortions.
  - AC velocity.
  - Star magnitude.
  - Background brightness.
  - etc..

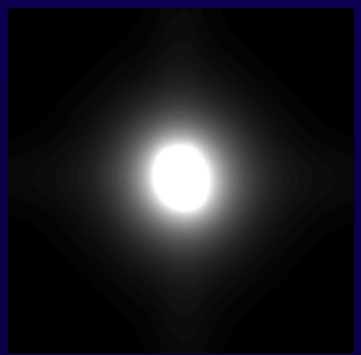


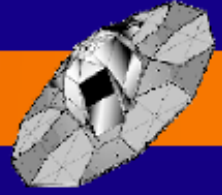
2 - On-board modelling : CCDs

- Add CCD effects (MTF) to optical PSF from Astrium :
  - Pixel integration.
  - Across-scan velocity smearing.
  - Optical distortions.
  - Charge Diffusion.
- -> Software PSFMaker-0.4 used in Gibis.



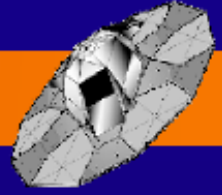






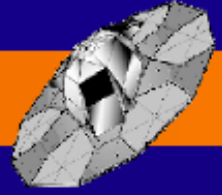
2 - On-board modelling : algos

- Model of detection + cross-matching algorithms behaviour in SSM1-SSM2.
  - Precision on position.
  - Completness (% detections)
- Model of selection algorithm behaviour :
  - Number of windows allocated for a given star density and windows shape. (Currently being refined by F. Arenou)



3 – Modelling the on-ground processing :

- Using our tools (from 2) we can generate simulated windows in the conditions of the representative case defined in 1.
- The precision on the flux obtained by PSF fitting on the simulated windows is then computed using statistical formulas from OBD-FA-?.
  - Precision on star magnitude.
  - Precision on background magnitude.



4 - The objective function :

- From 1, 2 and 3 we can derive a formula giving the average star magnitude precision for a given window size, binning, star density and number of transits.

$$\sigma_{mag} = f(windowSize, binning, density, nbtransits)$$

- The objective function is defined as the star magnitude precision integrated on the whole sky.
  - Integration using the nominal scan law and a galaxy model.

$$F = \int_{sky} f(windowSize, binning, density(p), nbtransits(p)) \partial p$$

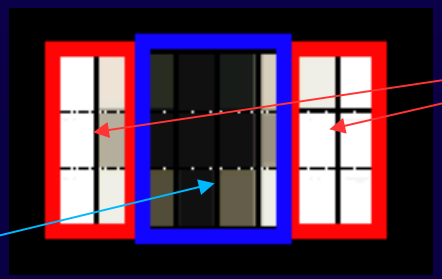
Results :

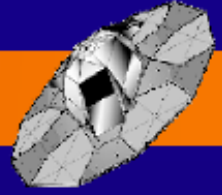
- 8x1 samples windows.
- 1x3 pixels binning.

- A lot of work for a simple result.
  - Close to what was proposed before (8x4 in CUO-117), but now it is justified!

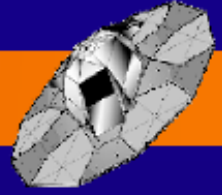
RVF specific case :

- In OBD-FC-02 a question was still open :
  - Use windowing+binning OR Fully read out the CCD?
- Answer : windowing is also recommended in RVF :
  - 8x3 windowing + 1x3 binning in RVF -> close to optimum. Precision at the end of mission much better than when reading the whole CCD without binning.
  - Also optimizes simple aperture photometry for on-board estimation of RVF flux. (Needed for the RVS selection law)





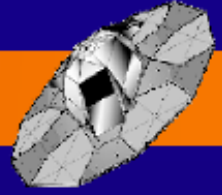
- Still one issue with background estimation.
  - With use of windowing, only star local background is downloaded, not a sky map.
  - Need to clarify specifications.
  - How does background vary in RVF band?



Magnitude precision in RVF :

- Average at 50000 star/deg^2 :

mag_{RVF}	$\sigma_{PSFfitting}$ 1 transit	$\sigma_{PSFfitting}$ mission	$\sigma_{Background}$ 1 transit	$\sigma_{Aperture}$ 1 transit
10.0	0.0033	0.00034	1.757	0.1751
15.0	0.0372	0.00392	0.389	0.1782
16.0	0.0662	0.00697	0.352	0.1849
17.0	0.1270	0.01338	0.333	0.2110
18.0	0.2681	0.02826	0.324	0.3110
19.0	0.6135	0.06466	0.320	0.6274
20.0	1.4762	0.15561	0.318	1.4780



Future work :

- Continue the exploitation of this new result :
  - Update specifications & documents.
  - Update on-board algorithms.
- Extend the study to brighter stars.
- Concerning RVF :
  - Issue with background to solve.