The Euclid MERge Processing Function

Erik Romelli, INAF – OATs
on behalf on the OU-MER team

7° Meeting Nazionale della collaborazione Euclid
Bologna, 30-06-2025

OU MER team

ITALY

WP5200 OU - MERa – OATS
- Erik Romelli (Lead)
- Samuele Galeotta (Dev-Lead)
- Marius D. Lepinzan

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- Marco Castellano
- Emiliano Merlin
- Fernando Caro
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- Adriano Fontana
- Paola di Mauro

Germany
- Martin Kuemmel (Lead)
- Daniel Hernández Lang
- Javier Gracia Carpio

France
- Herve Dole (Co-Lead)
- Elie Subrié
- Loic Morin
- Mermiam Ezziati
- Remi Cabanac

Spain
- Marc Huertas Company
- Hui Kong
- Tyann Dumerchat

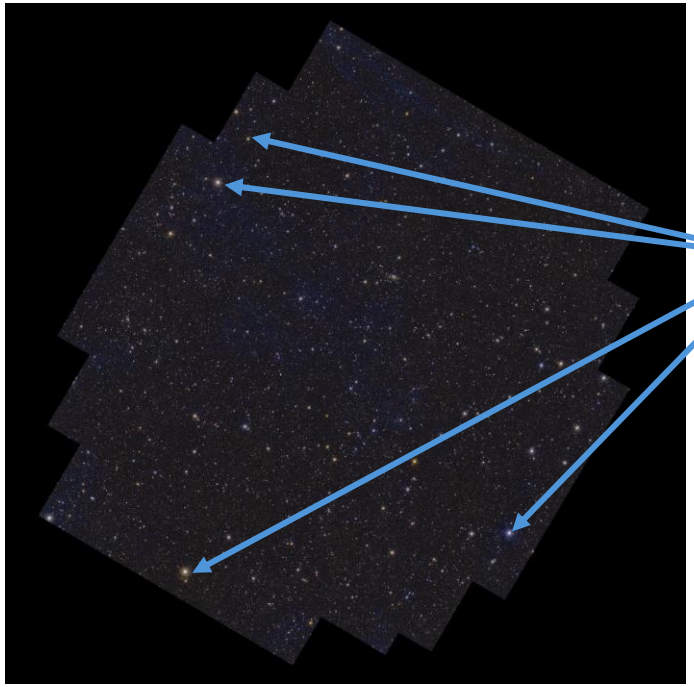
Canada
- Mike Welmsley

USA
- Yuedong Feng

OU MER definition and summary

MER is the cataloguing unit of the *Euclid* SGS

⇒ Responsible for the creation of the official source list

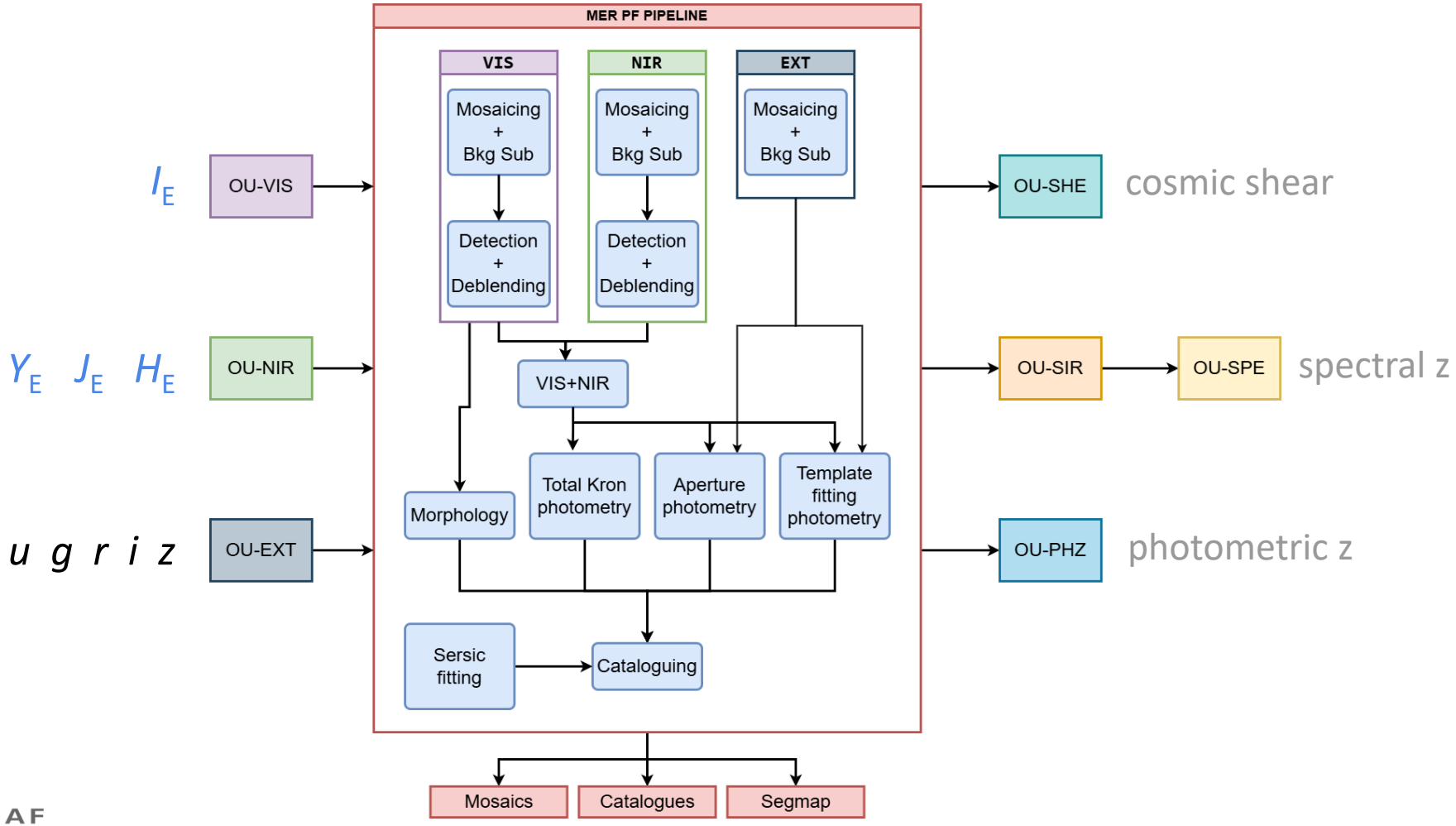


- Euclid unique ID
- Coordinates (R.A., Dec)
- Fluxes (I_E, Y_E, J_E, H_E, g, i, r, u, z)
- Morphology
- Flags

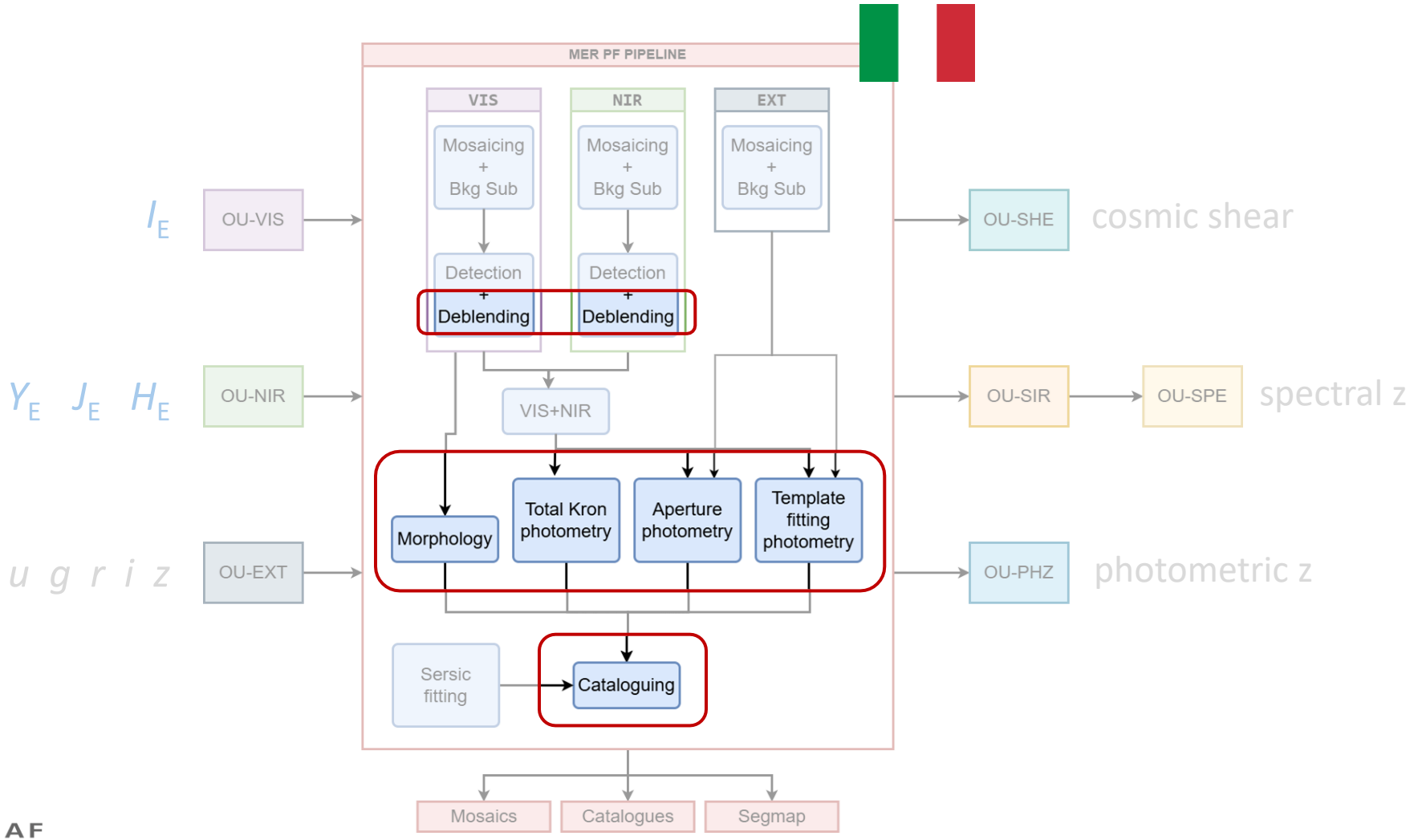
Credits: Esa/Euclid/Euclid Consortium/Nasa

Image processing by J.-C. Cuillandre, E. Bertin, G. Anselmi

Pipeline overview



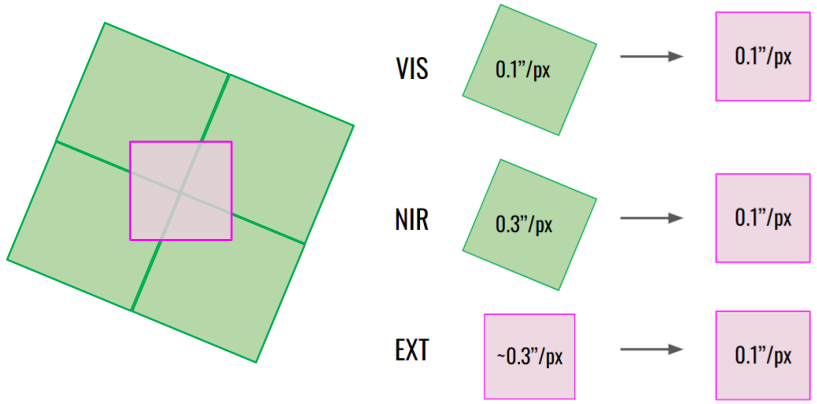
Pipeline overview

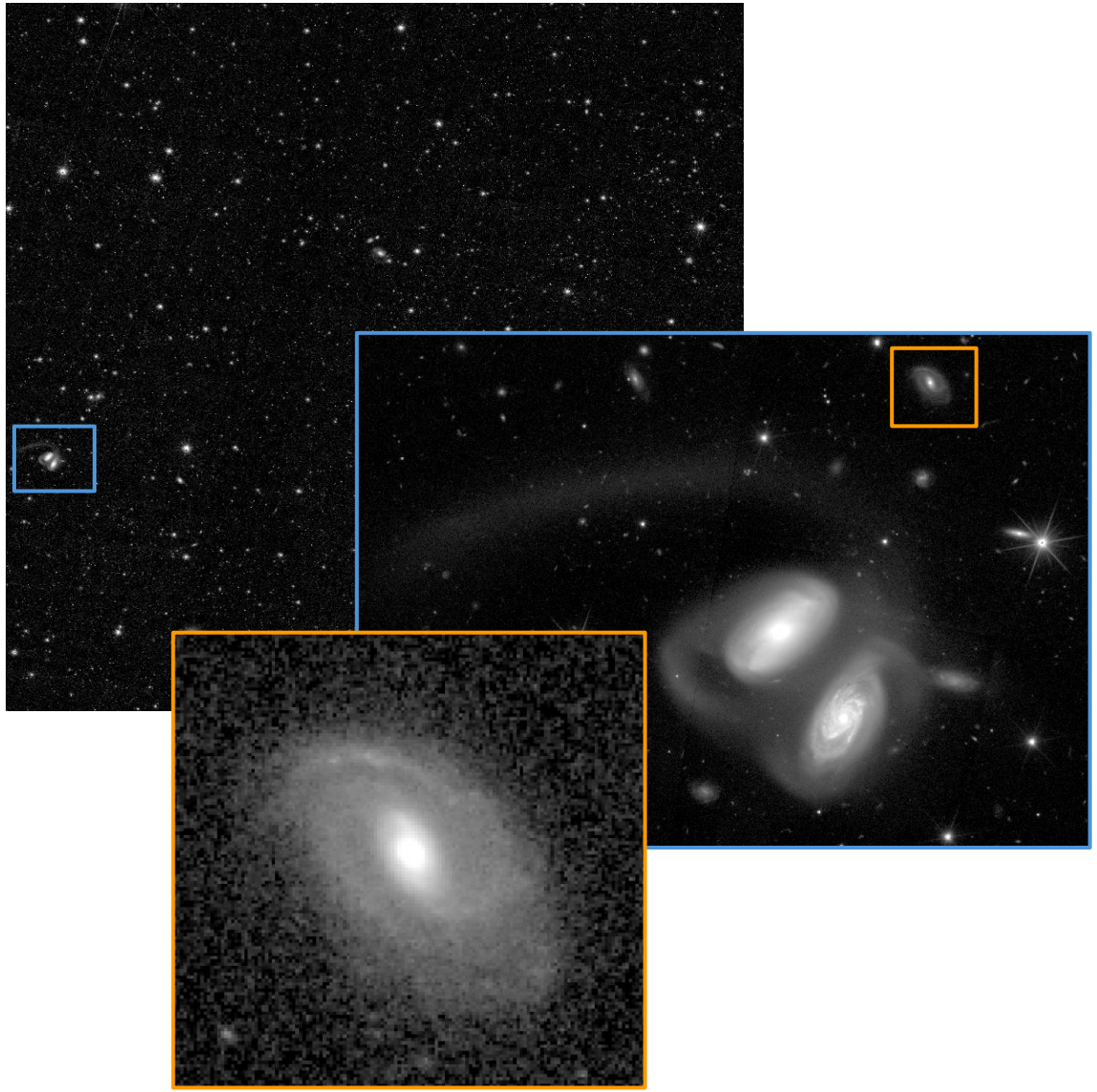


Products

Mosaics

- One product for each band
- Common pixel scale
- Common WCS





Catalogues

👀 Hands-on session – Wed 2 @ 16:00
Overview of the OU-MER Data Model

- One product for each tile
- ~120k sources
- 1000+ columns
- Complete description: Data Product Description Document

Photometry

- Kron total flux
- PSF-matched aperture photometry
- Template fitting photometry
- Sersic model fitting photometry

Morphology

- Non parametric (Concentration, Asymmetry, Smoothness)
- Sersic Model Fitting morphology
- Machine Learning morphology

Photometry Cookbook

Morphology Cookbook

Photometry Cookbook

Photometry

- OBJECT_ID
- RIGHT_ASCENSION
- DECLINATION
- DET_QUALITY_FLAG
- FLUX_DETECTION_TOTAL
- FLUX_<band>_<n>FWHM_APER
- FLUX_<band>_TEMPLFIT
- FLUX_VIS_TO_<band>_TEMPLFIT
- FLUX_<band>_SERSIC

- Colors

$$H-g = -2.5\ \log_{10}\left(\frac{\texttt{FLUX\_H\_2FWHM\_APER}}{\texttt{FLUX\_EXT\_G\_DECAM\_2FWHM\_APER}}\right)$$

- Total Fluxes

$$F_{H,\mathrm{tot}} = \texttt{FLUX\_DETECTION\_TOTAL}\left(\frac{\texttt{FLUX\_H\_2FWHM\_APER}}{\texttt{FLUX\_VIS\_2FWHM\_APER}}\right)$$

- Magnitudes

$$m_{\mathrm{AB}} = -2.5\log_{10}\left(F_{\mu\mathrm{Jy}}\right) + 23.9$$

Examples using Aperture photometry

Processing status

SGS processing milestones

Quick Release 1 (March 2025)

Euclid Collaboration: Romelli et al

Q1 data come with some *caveats*:

MER Release Notes

v11.0.1

355 tiles - 63.1 deg²

Data Release 1 (Late 2026)

No major updates w.r.t Q1

Bug fixes and performance improvements

WIDE + DEEP processing

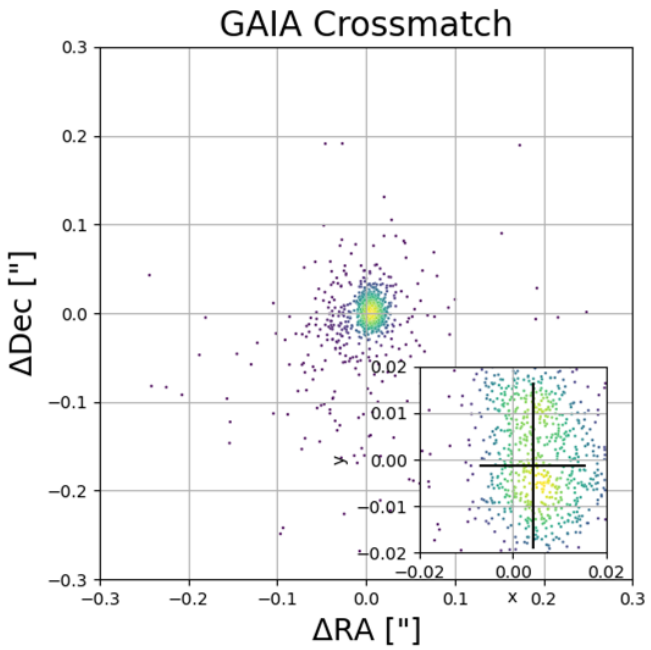
v11.3.1

~10k tiles - ~1900 deg²

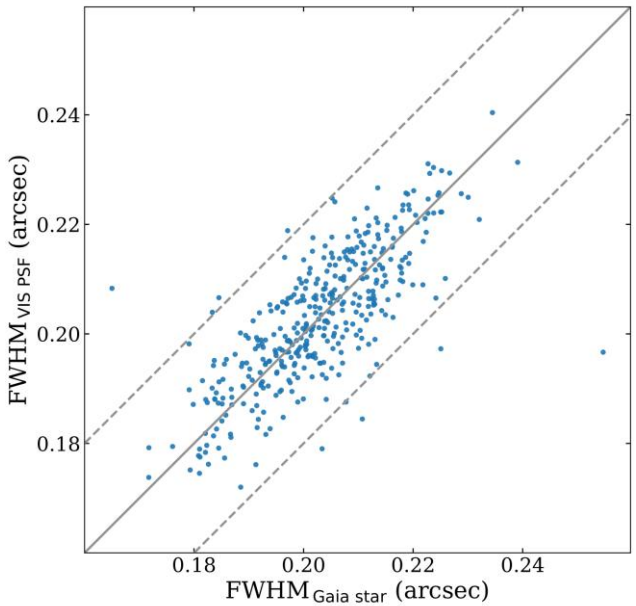
Gaia Validation

Validation of one MER tile

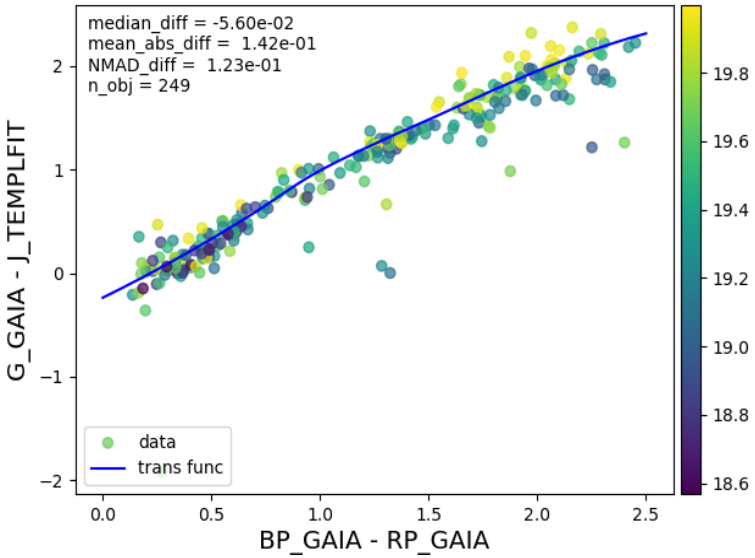
Astrometry



PSFs



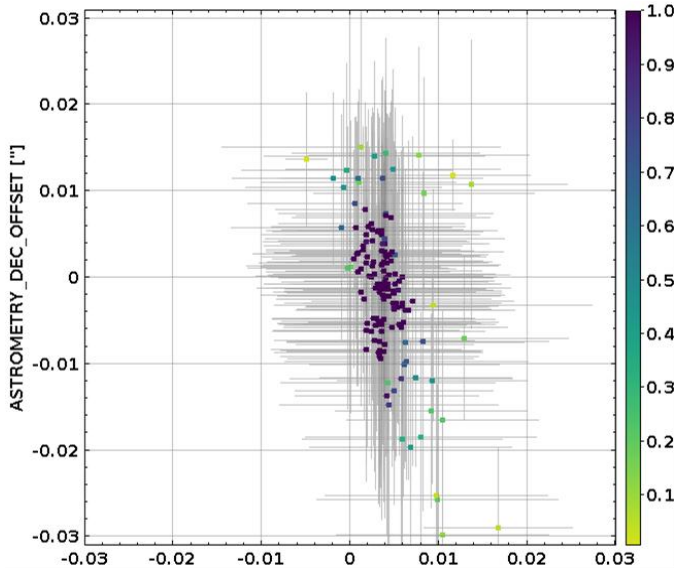
Photometry



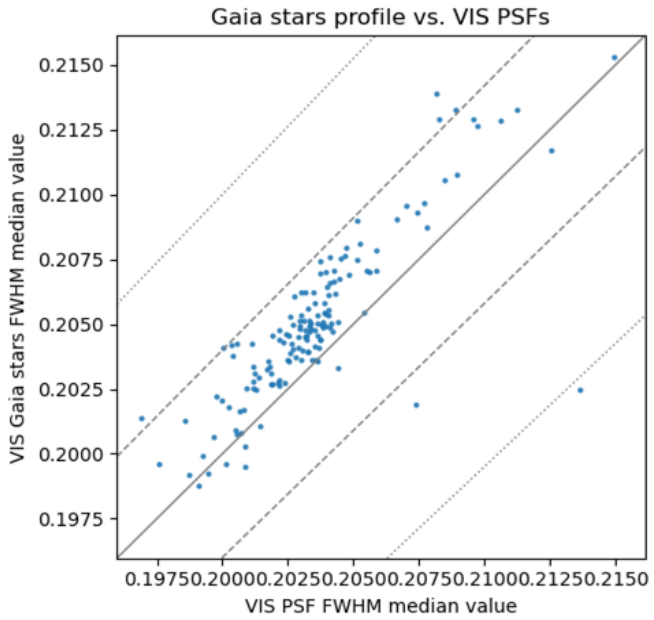
Gaia Validation

Validation of a Skypatch (collection of tiles) – EDF-S from Q1

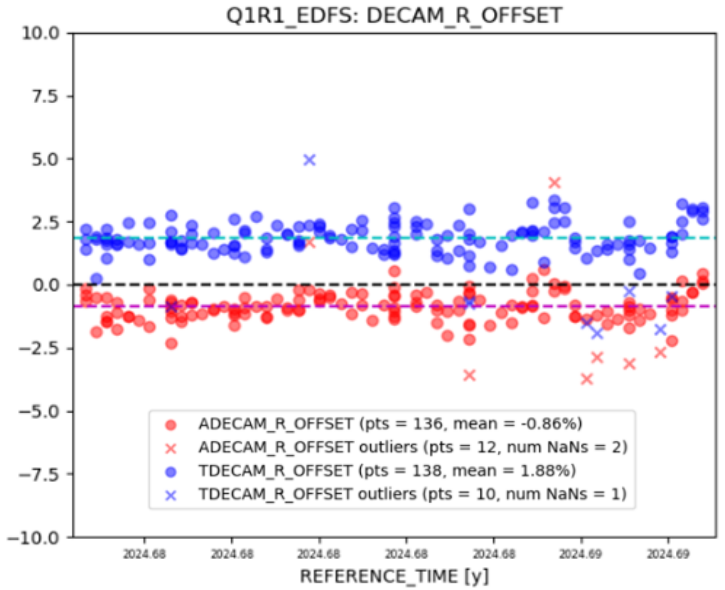
Astrometry



PSFs



Photometry



Towards DR2

DR2 planned updates and new features

Photometry and flagging

Validation of extended objects

Improve/update of POINT_LIKE_PROB and SPURIOUS_PROB

Improve bright star masking

Morphology

Improve (if possible) CAS measurements

Disk+Sersic fitting

Pipeline

Re-design of the DEEP processing

RMS with and w/o Poisson noise in all bands

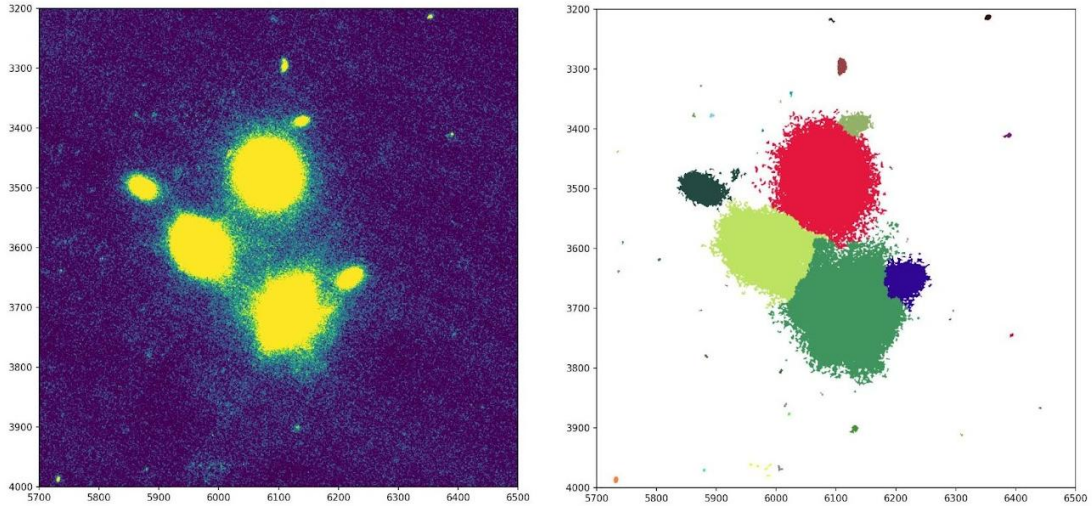
New deblending algorithm

Parent Redmine issue: #31676

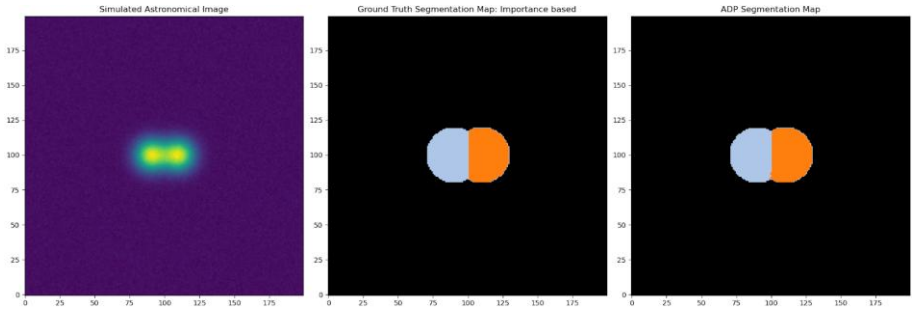
Deblending with ADP

Courtesy of M.D. Lepinzan & F. Tomba

- Advanced Density Peak (ADP) identifies cluster centers, borders, and performs hierarchical merging in the density probability (3D clustering)
- Natural extension to structured grids by treating neighboring pixels as nearest neighbor (2D debleding)
- Tests on-going on synthetic segmentation maps and Q1 data



Simulated image | Sim. segmap | ADP segmap



Q&A