Euclid Legacy Science in the Local Universe (LU)

Leads: C. Conselice & L. Hunt

WP-PPZ: Physical parameters and photometric redshifts + resolved SEDs (M.Scodeggio & C.Tortora)

WP-FAR: Distance scale (S. Mei)

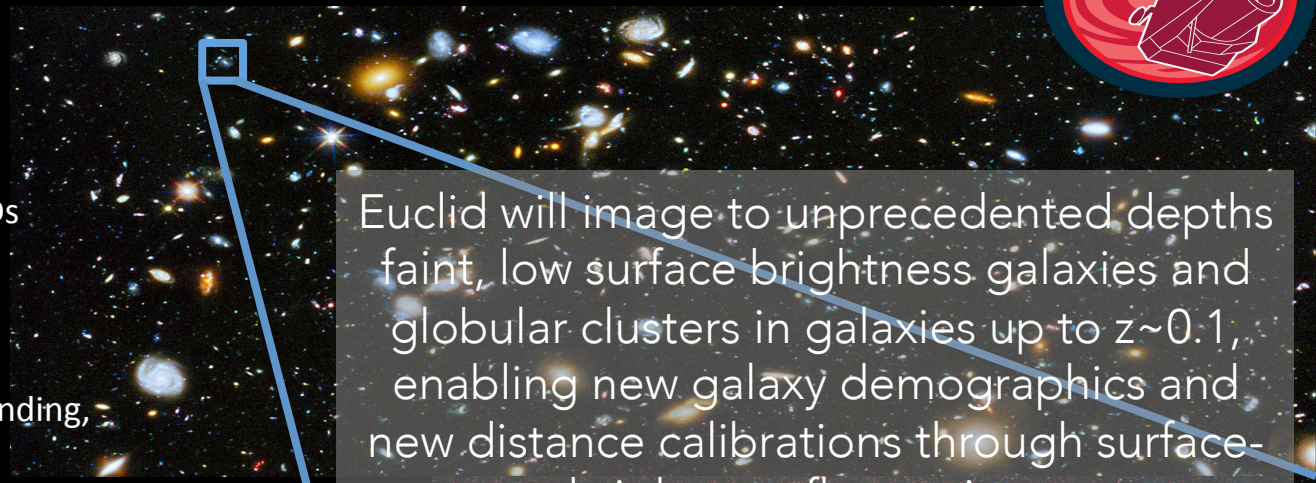
WP-DET: Point-spread functions, blending, and extended sources (M. Akhlaghi)

WP--MORPH: Quantifying galaxy morphology (M. Huertas-Company) recently conjoined with same WP in SWG Galaxy Evolution

WP-DWF: Low surface-brightness and dwarf galaxies (P.-A. Duc & R. Peletier)

WP-DIF: Low surface brightness issues, tidal features and diffuse light (F. Buitrago)

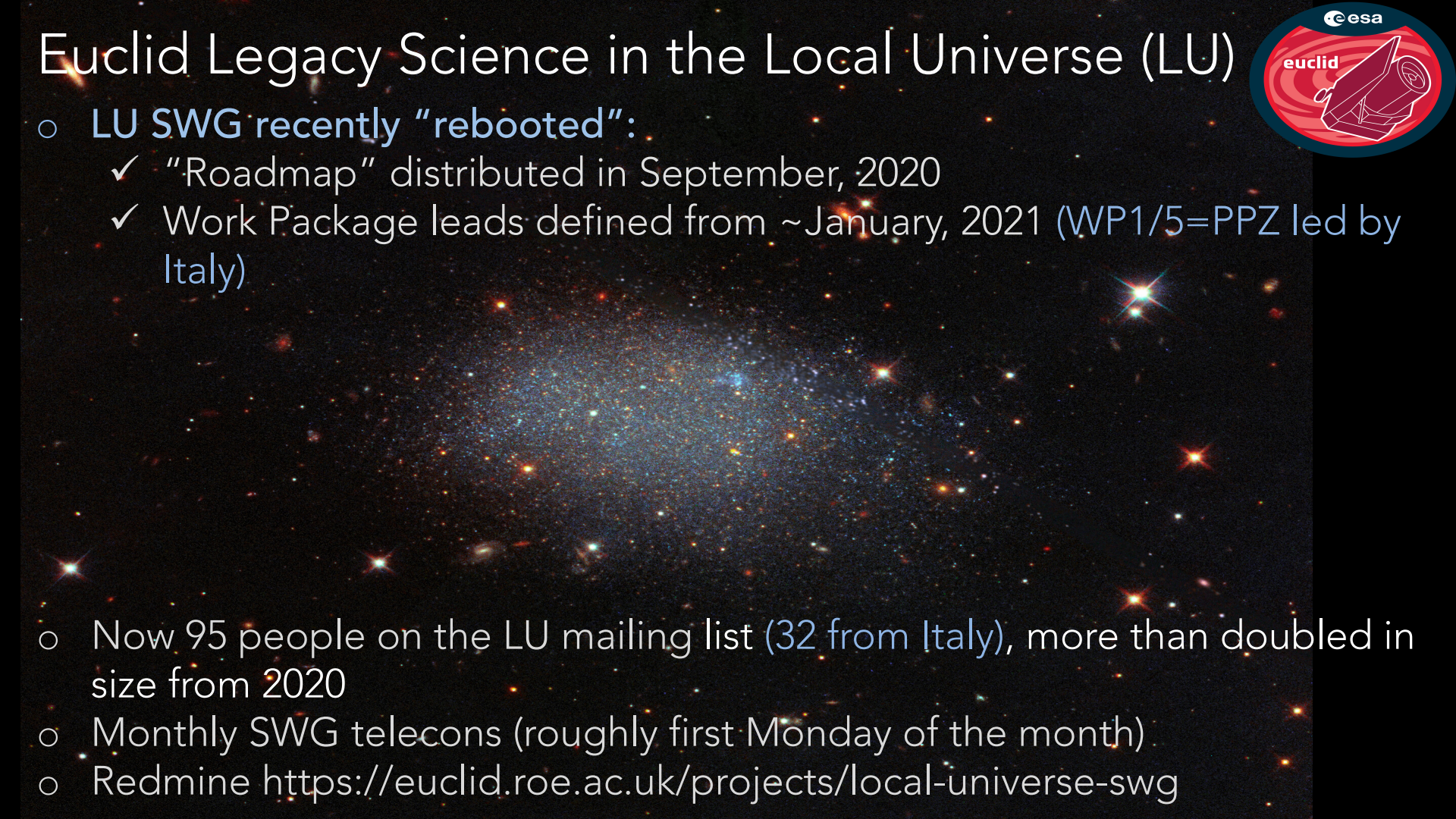
WP-ECGs: Extragalactic globular clusters (A. Lancon)



Euclid will image to unprecedented depths faint, low surface brightness galaxies and globular clusters in galaxies up to z~0.1, enabling new galaxy demographics and new distance calibrations through surface-brightness fluctuations.

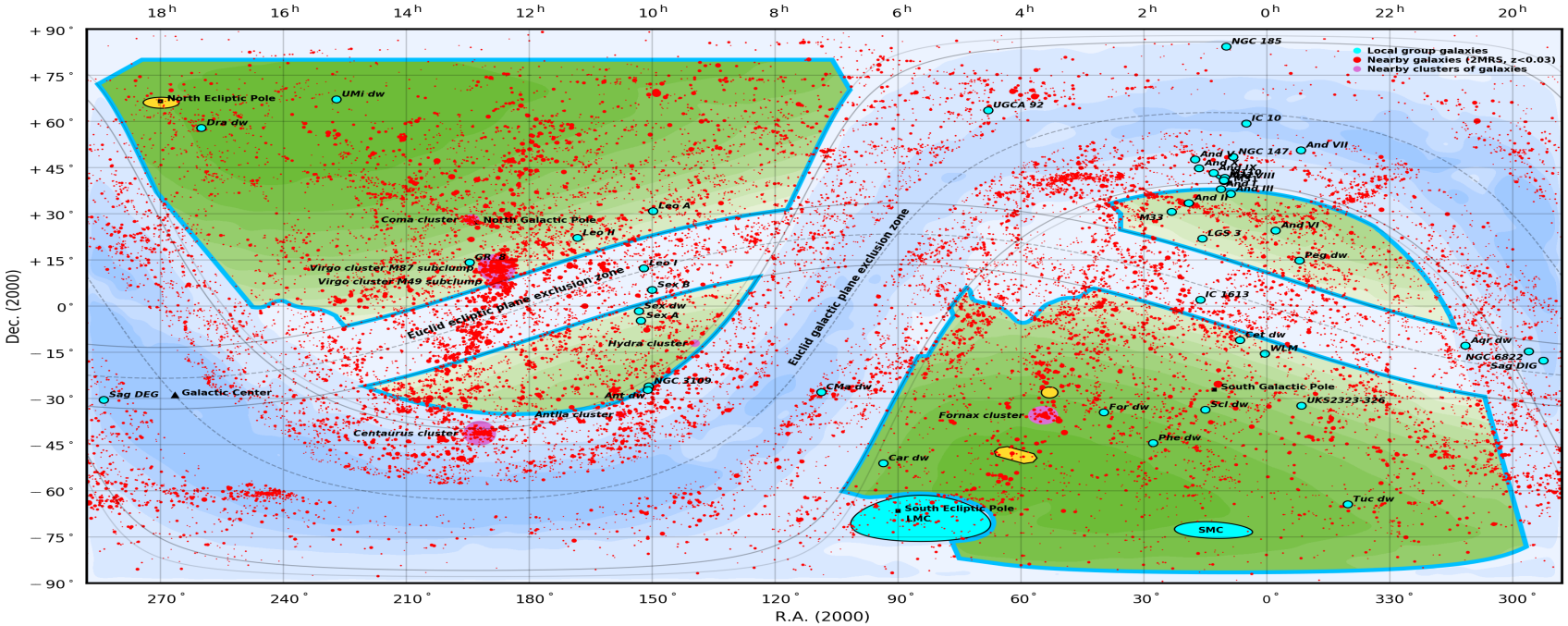
Euclid Legacy Science in the Local Universe (LU)

- **LU SWG recently "rebooted":**
  - ✓ "Roadmap" distributed in September, 2020
  - ✓ Work Package leads defined from ~January, 2021 (WP1/5=PPZ led by Italy)



- Now 95 people on the LU mailing list (32 from Italy), more than doubled in size from 2020
- Monthly SWG telecons (roughly first Monday of the month)
- Redmine https://euclid.roe.ac.uk/projects/local-universe-swg

Euclid will excel at both the point source and the diffuse emission for Local Universe science



Euclid VIS 1-sigma asinh limiting surface brightness (LSB science performance) and the nearby universe up to z=0.03

Wide Survey region of interest : 17 Kdeg.^{2} compliant with a 15 Kdeg.^{2} survey

Deep Fields : North=10 deg.^{2}, Fornax=10 deg.^{2}, South=23 deg.^{2} (+2 mag.)

⇒ metric reflecting the ultimate science LSB performance based on profile extraction

Limiting surface brightness: mag/arcsec^2, 10^2 arcsec^2 scale

29.61 29.65 29.69 29.73 29.77 29.81 29.85 29.89 29.93 29.97

→ System zero point and sky+telescope+instrument backgrounds on 3 stacked exposures of t_int=575 seconds each (ROS 2019)

→ Valid for areas away (>0.5 deg.) from bright stars (<4th mag.) LSB asinh metric: Mihos et al. 2013, Lupton et al. 1999

Credit: J.-C. Cuillandre (ECSURV)

Emphasis on Italian expertise for Local Universe legacy science

(slides thanks to Pietro Bergamini, Michele Cantiello, Massimo Meneghetti, Achille Nucita, Crescenzo Tortora)

"Physical Parameters and Redshift (PPZ)"
WP (leads: Crescenzo Tortora, Marco Scodeggio)

Objectives:

1. photometric redshifts and integrated stellar populations for galaxies at $z < 0.3$;
2. spatially-resolved stellar population maps for nearby galaxies

Test SED fitting algorithms with EURISKO (EUclid and Rubin photometry Inferred from SED fitting of Kids Observations)

Main contributors: C. Tortora, M. Bolzonella, ***L. Bisigello (paper on ML SED fitting on COSMOS15 sample submitted to ECPB)***

Reference sample of nearby galaxies with **LUNE** (Local Universe and Nearby galaxies in Euclid) "spatially-resolved" galaxies at distance < 200-300 Mpc (for future analysis, special tiling, detection algorithms, etc.)

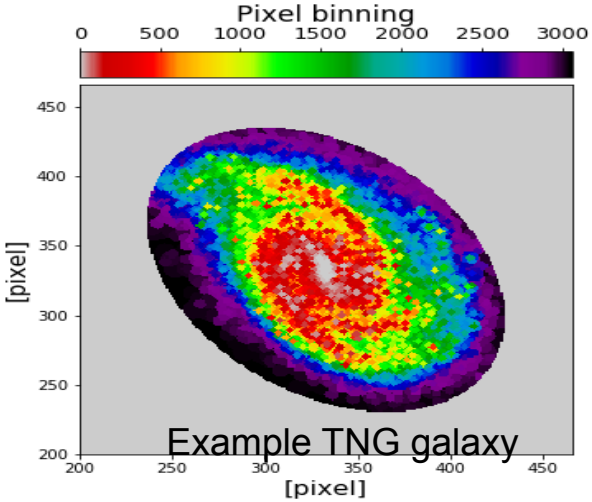
Main contributors: Jenny Sorce, Crescenzo Tortora, Leslie Hunt, …

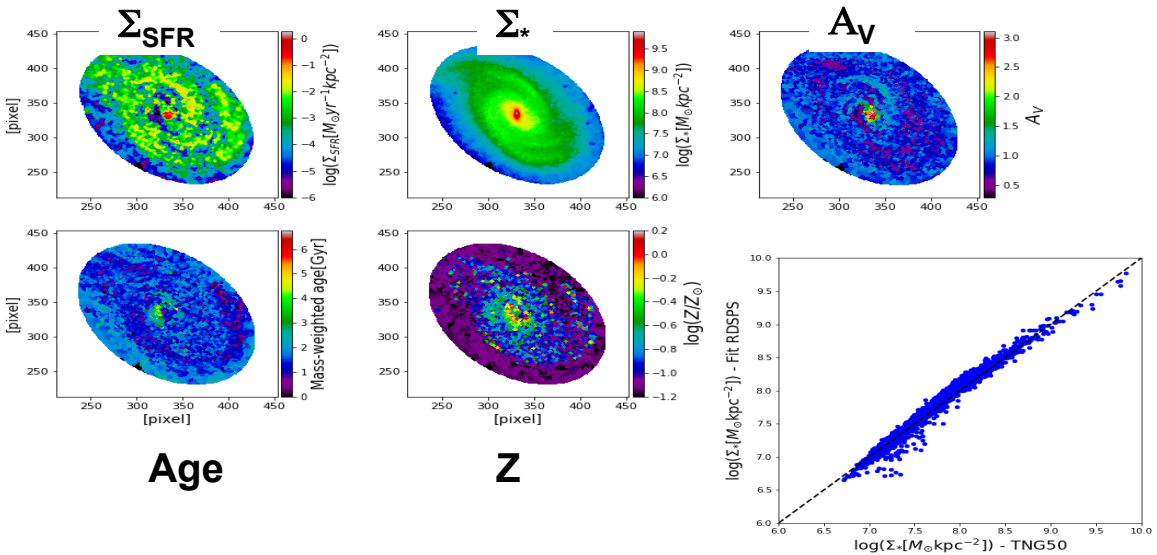
Redmine: https://euclid.roe.ac.uk/projects/swg-lu-wp1-5/
Wiki: https://wiki.cosmos.esa.int/euclid/index.php/SWG_LU_WP1/5

Deriving physical parameters from “pixels”

Main contributors: Abdurro’uf, Crescenzo Tortora, Micol Bolzonella

SED fitting





Machine learning (work in progress)

- Napoli’s group (Brescia, Cavuoti, Riccio)
- Bisigello
- Baes/Kovacic

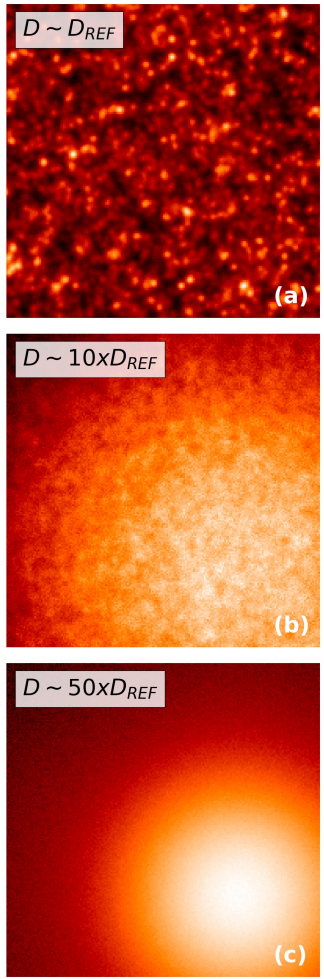
WP-FAR: Surface Brightness Fluctuations (SBFs)

(Michele Cantiello)

- SBFs: very accurate distance indicator (up to <5% uncertainty on single source) within~150Mpc, from space.
- Euclid H-band depth => 30-50 Mpc (it is hoped)

Very early development/testing stage:

1) Measure SBFs from simulated Euclid images:
   - "Euclidizing" HST immages?
   - Simulations of images with artificial SBF signal added on (see figure)
2) Produce an efficient (fast and semi-automatic) pipeline.
   To date the procedure is user-oriented, takes hours (or even days) for a single measure. Need to be made faster and less interactive (Machine Learning approach?)
3) Interest for SBF with VIS? Better resolution but larger intrinsic scatter.



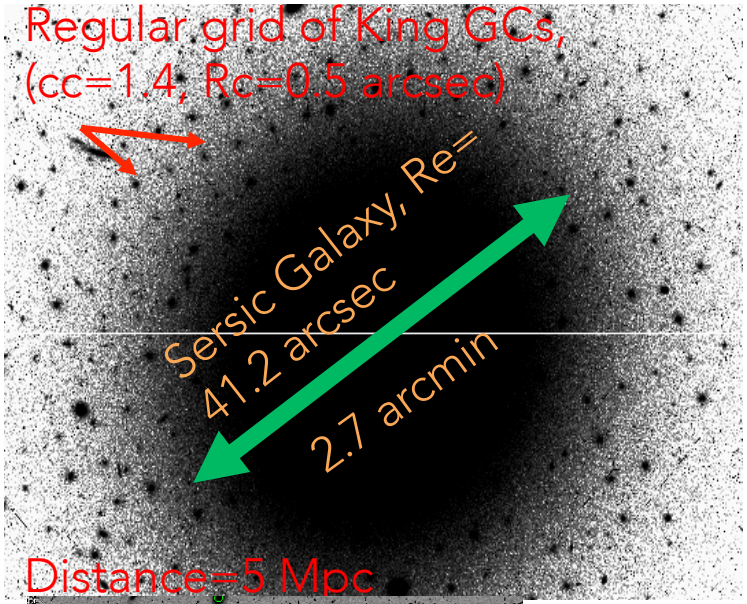
WP-DET: **Simulations** (Achille Nucita)

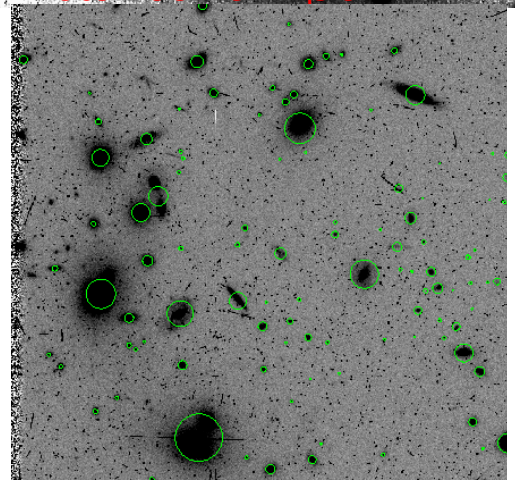
1) **Simulations of low surface brightness galaxies (LSBs) and extragalactic globular clusters (EGCs)** in Level 2 Data by adopting standard Sersic and King models, respectively .

GOALS: test our capabilities to detect such objects in the LU up to a distance of 25-30 Mpc

- Simulated VIS already tested for sanity checks (photometry and profiles). LSBSim on Euclid gitlab
- Data (minimum 4 FFP dithers) are then injected into the official OU-MER pipeline and the resulting output (catalogues and tiles) analyzed. A test run already performed and no issue raised.
- Full simulation and analysis by French group in progress

2) **Developing software for LSB detection.** Tests on Euclid VIS simulated images: OK, Tests on real *HST* images: OK, TO DO: fine tuning of all the method parameters.

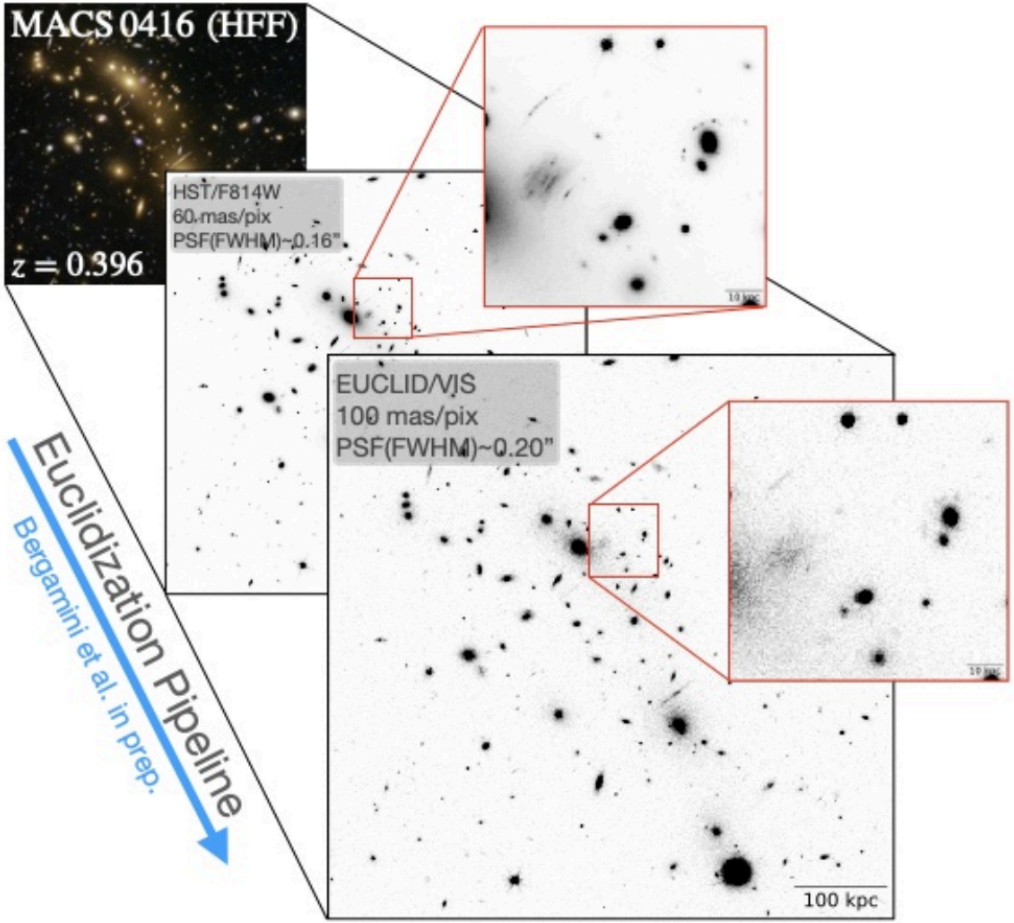


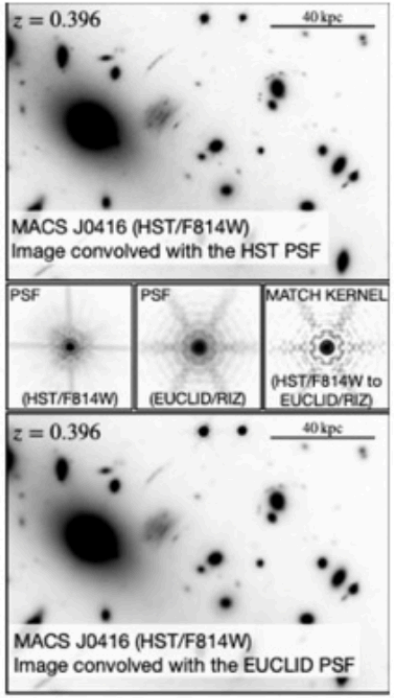


HST Hydra field

EUCLIDIZATION OF HST IMAGES

P. Bergamini, M. Meneghetti, SLWG





HST2Euclid: a python code to "Euclidize" HST images.

- Starts with HST images in the spectral range of the Euclid bands (one or more HST filters can be combined)
- Convolve with a kernel to transform the HST PSF into the Euclid PSF
- Degrade to Euclid resolution and add noise to match the required limiting magnitude and S/N

EUCLIDIZATION OF HST IMAGES

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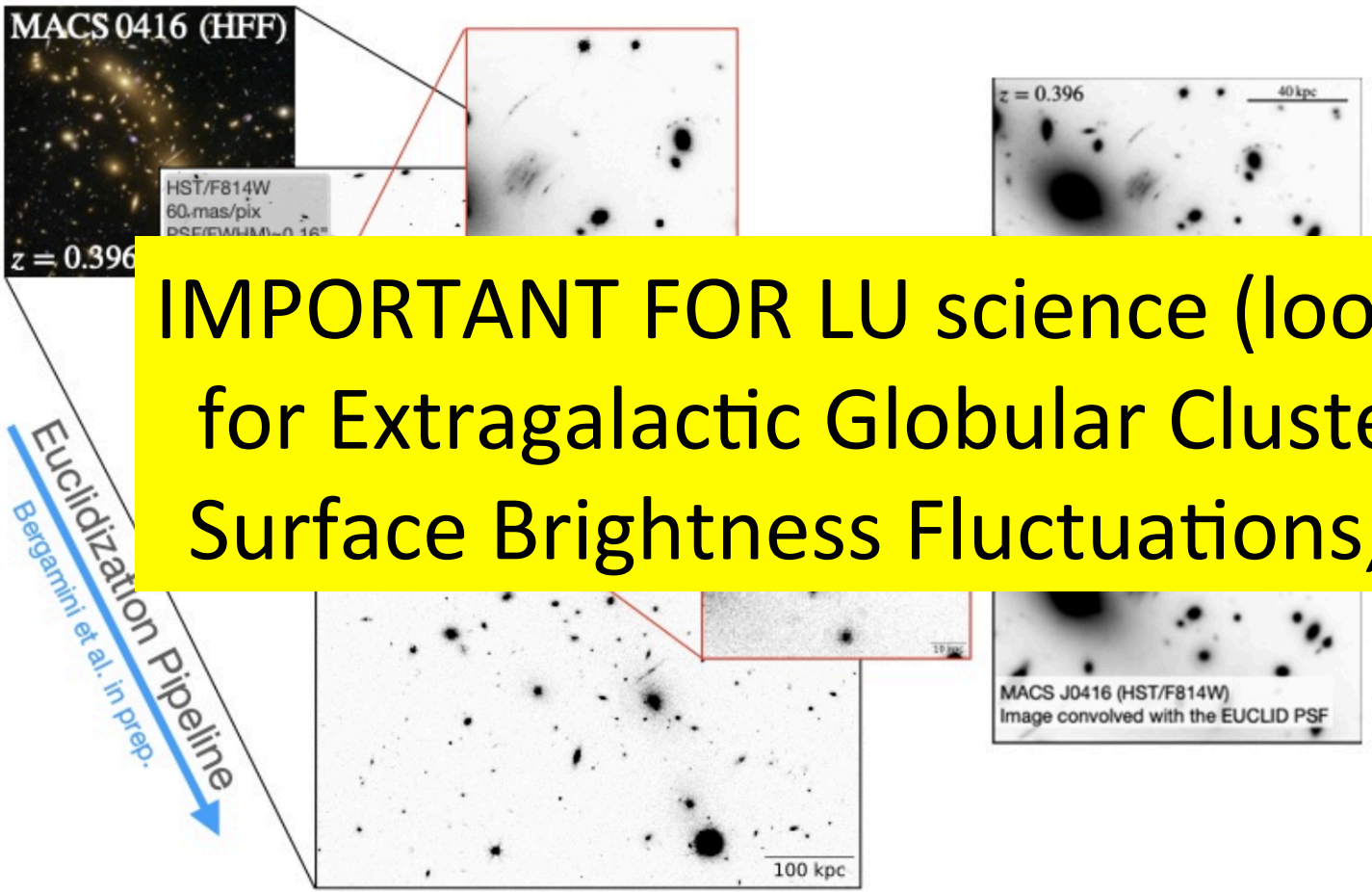

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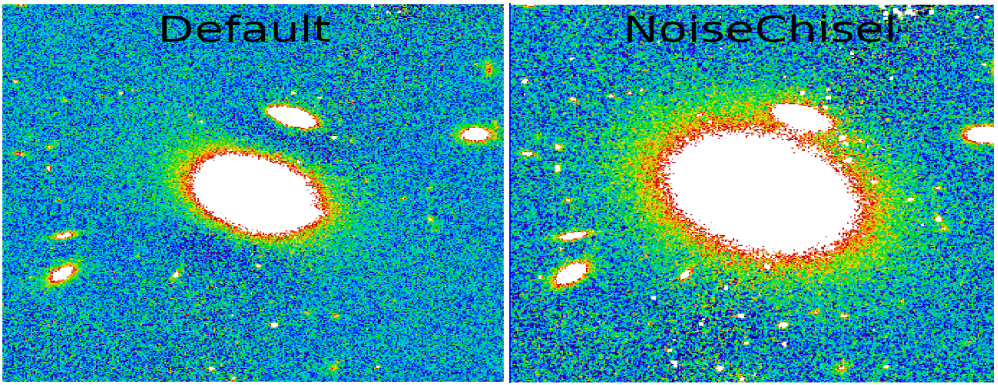
IMPORTANT FOR LU science (looking for Extragalactic Globular Clusters, Surface Brightness Fluctuations, …)

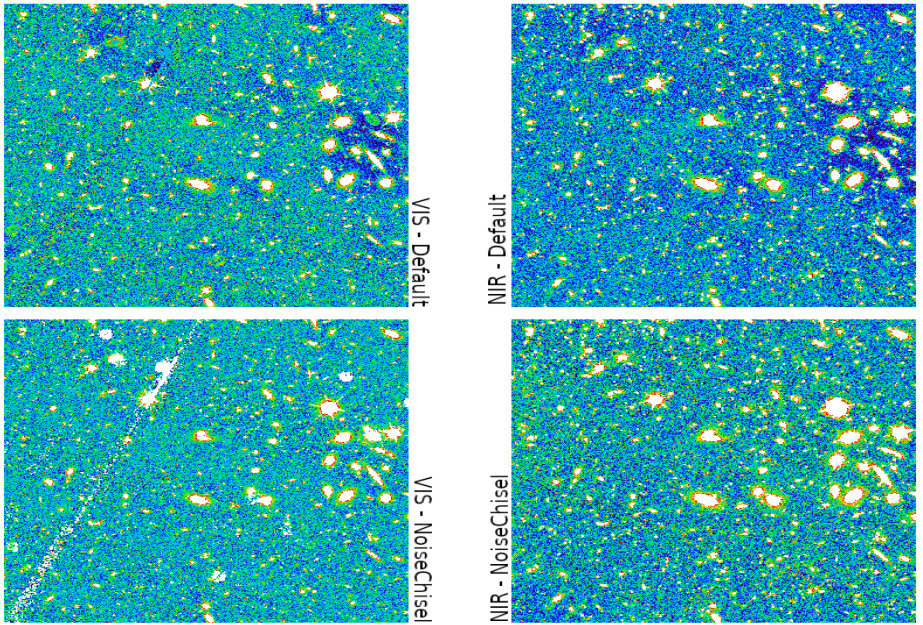
WP-DET: Local Universe Science Challenge

Local universe objects/features are arguably the most tricky objects in all-sky surveys, and are not contained in current simulations

One large galaxy in VIS



Pipeline implemented with NoiseChisel leads to an improved sky estimation for nearby objects (VIS implementation in progress, **NIR we hope soon**)



A larger field of view in VIS & NISP

For more, see https://wiki.cosmos.esa.int/euclid/index.php/Local_universe_science_challenge **Credit M. Akhlaghi**

From fitting of stellar SEDs and photometric redshifts, to quantifying galaxy morphology, from GCs to low surface brightness and distance scales, Euclid and Euclid/Italy will offer new frontiers for Euclid legacy science. Stay tuned!

Please drop me an email if you want to join the LU SWG (leslie.hunt @ inaf.it), thanks!