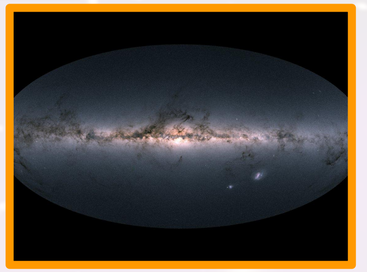
Euclid Legacy Science
and the Italian contribution

Lucia Pozzetti (INAF - OAS Bologna)
Crescenzo Tortora (INAF - OACN)
Micol Bolzonella (INAF- OAS Bologna)
Margherita Talia (UniBo)

with the contribution of
Cappellaro, Botticella, Massari, Annibali, Fiorentino, De Lucia, Magliocchetti, Allevato, Decarli, Castellano

Legacy Science Working Groups



Supernovae and Transient

led by E. Cappellaro, I. Hook, & C. Tao

Milky Way and Resolved Stellar Population

led by A.Ferguson & S. Larsen (2 Italians WPs)

The Local Universe

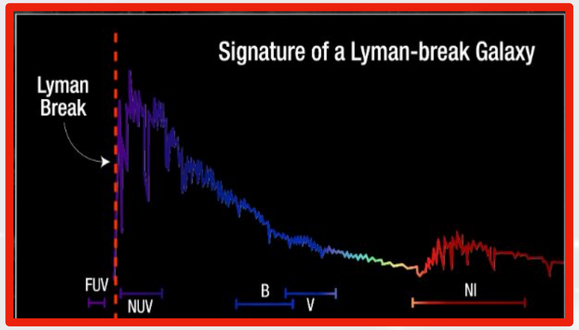
led by C. Conselice & L. Hunt (1 WP led by Italians)

Galaxy and AGN Evolution

led by J. Brinchmann, E. Daddi & A. Cimatti (6 WPs led by Italians)

Primeval Universe

led by J-G. Cuby & *S. Toft (1 Italian WP)*



Supernovae and the Milky Way

Crescenzo Tortora (INAF-OAC)

Local Universe SWG

Meeting Euclid nazionale, 20/01/2023

Supernovae and Transients Science Working Group

Coordinators: Isobel Hook, Enrico Cappellaro (Charling Tao)
~50 members … 20% italians

Euclid survey is not made for transients, but offers some chances in connection with LSST …

- Science cases: Supernova rate, Supernova cosmology, Environments of extragalactic transients, Near-infrared photometry for LSST transients
- Synergies with Rubin, to obtain optical-NIR light curves (Rubin-Euclid Derived Data Products)

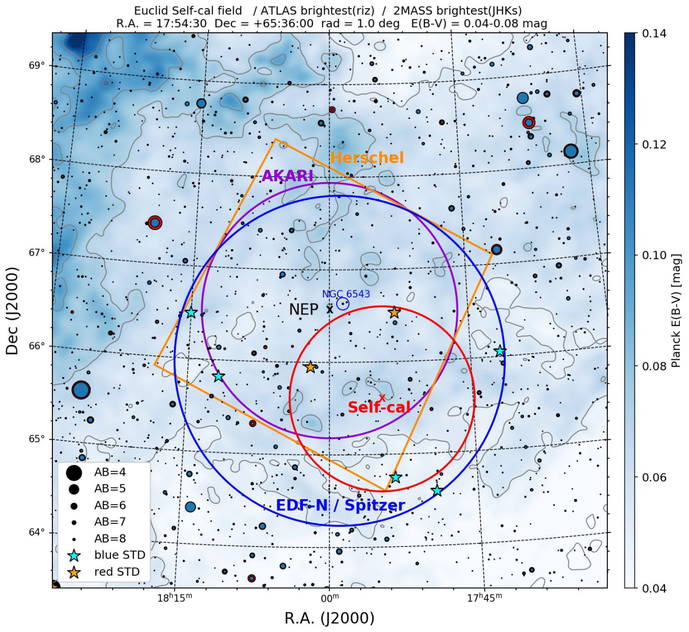
Recent activities:

- **Euclid: Searching for slowly evolving transients, e.g. pair-instability supernovae, with the Deep Survey (**Moriya et al. 2022)
- **Simulation of a SN search in the Self Calibration Field**
  2022 Oct.3 presentation of the opportunities/requirements to the EST

SN search in the Self Calibration Field

Hook, Cappellaro, Moriya, Botticella, Nugent, Della Valle, Brocato, Brescia, Cavuoti, …

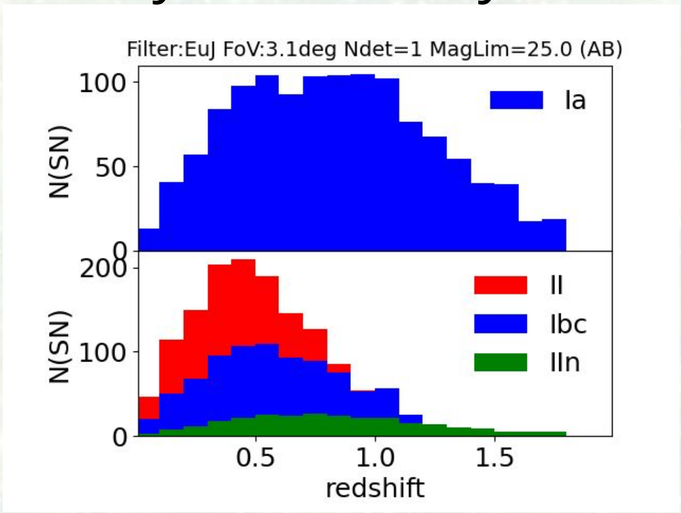
Self Cal Field: 1 sq. deg. radius
6 exp. in the first 8 weeks (“short survey”)
1 x month per 4 yr (“long survey”)
magnitude limit J=25, VIS=26 mag



Expected at **z>1**:
“short”: 10 SNe
“long”: > 500 SNe

Criticity: needed images reduced in a short time

“Long survey” NIR Survey Simulation



- Science case: cosmology & rates
- Euclid self-cal field is promising and NIR unique
- Deep Fields give additional opportunities

Next step: Test of transient detection in simulated NIR/VIS images

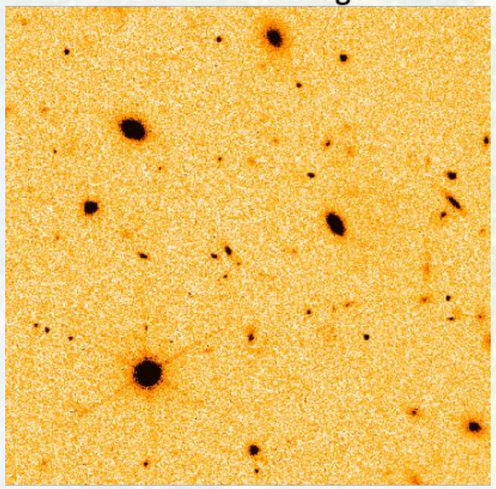
MW and Resolved Stellar Populations (MWRSP SWG)

Point-source photometry & Star/Galaxy separation WG

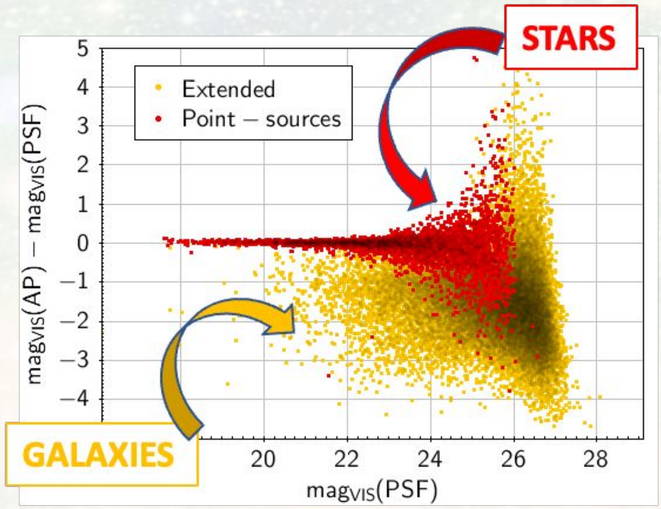
Slide by F. Annibali

Annibali, Fiorentino (co-leads)
Battaglia, Bethermin, Ferguson, Goldman, Jones, Lançon, Larsen, Martin, Massari, Nonino, Rashi, Voggel, Walton

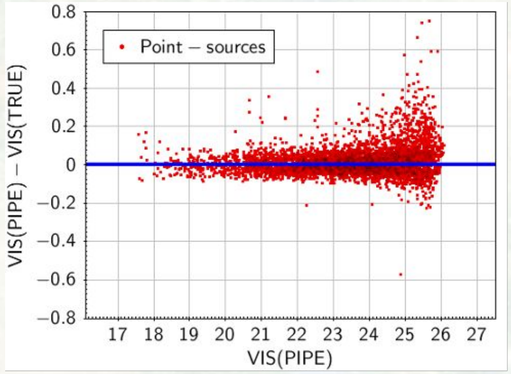
Simulated 1'x1'
EUCLID VIS image

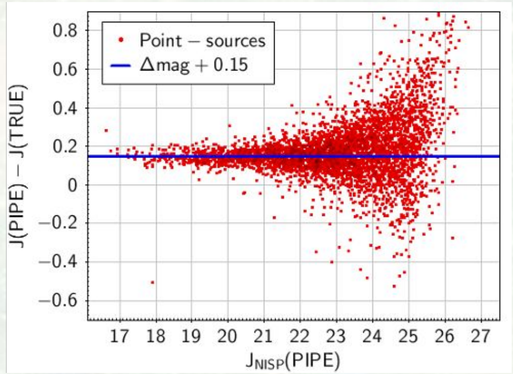


Star-galaxy separation:
e.g. POINT_LIKE_PROB > 0.1



Comparison of OU-MER output vs TRUE UNIVERSE fluxes





Goals:

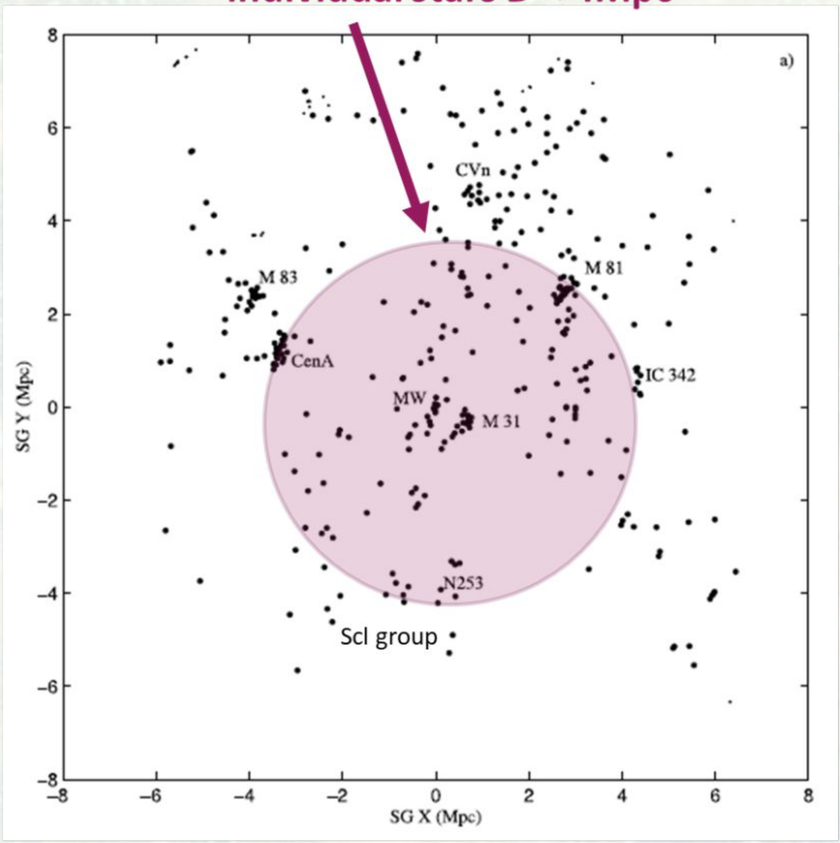
1. Test point-source photometry from Euclid OU-MER pipeline
2. Investigate diagnostics for an effective star/galaxy separation

MW and Resolved Stellar Populations (MWRSP SWG)

Stellar populations & variable stars with Euclid in the Local Universe

Slide by F. Annibali & G. Fiorentino

Nearby galaxies for which Euclid will resolve individual stars D < 4Mpc



Karachentsev et al. 2004

In low crowding, external regions of dwarfs out to 4 Mpc we aim to:

- Explore the sensitivity of Euclid Colour-Magnitude Diagrams (CMDs) to
  > Age and metallicity diagnostics: how well can we distinguish different populations?
  > Distance diagnostics: how far can we study resolved stellar populations in galaxies with Euclid? How will variable stars help us in improving distance determination?
- How well can we recover star formation histories?
- Explore the synergy with LSST survey at the Vera C. Rubin telescope (ugrizy bands)
- How will the MW component look like combining Euclid and Gaia (and other Galactic surveys)?
- Detect stellar streams (see SSH survey)

MW and Resolved Stellar Populations (MWRSP SWG)

MW globular clusters

Slide by D. Massari

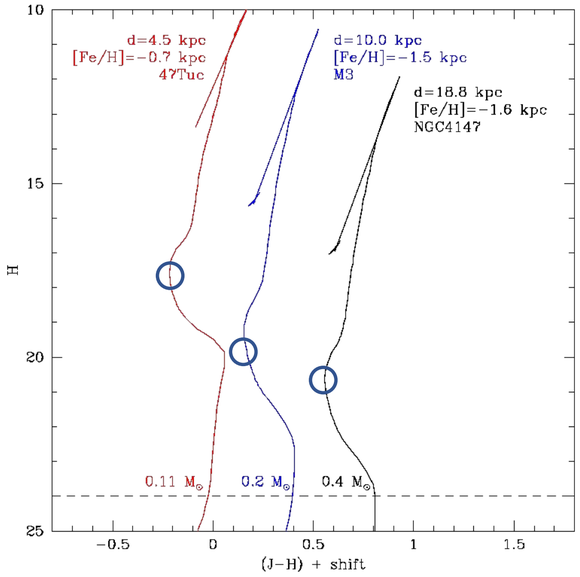
D. Massari (WP lead), Francesca Annibali, Antonio Sollima, Emanuele Dalessandro

Forecast: ~**26 GCs** in a Euclid footprint

Goal: Take advantage of Euclid wide field and depth to investigate the less crowded GCs outskirts

Proposed Science cases and coordinators

- Multiple populations (D. Massari)
- Binaries (E. Dalessandro)
- Open clusters (B. Goldman)
- Mass function (E. Dalessandro)
- Tidal tails (A. Sollima+P. Kuzma)
- MS knee age dependence as fct of metallicity (G. Fiorentino)
- Proper motions for outer halo GCs (P. Kuzma)
- Variability studies (G. Fiorentino)



The Local Universe with Euclid:

Past, present and future

Crescenzo Tortora (INAF-OAC)

Local Universe SWG

Meeting Euclid nazionale, 20/01/2023

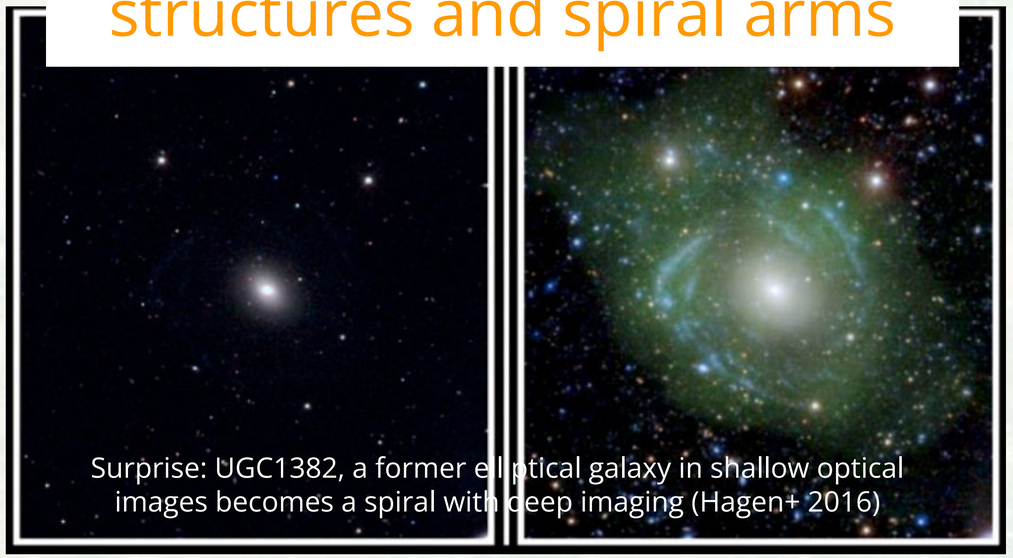
Why the Local Universe?

The Local Universe “is a complex situation” made by complex objects

Many dwarf galaxies difficult to discover

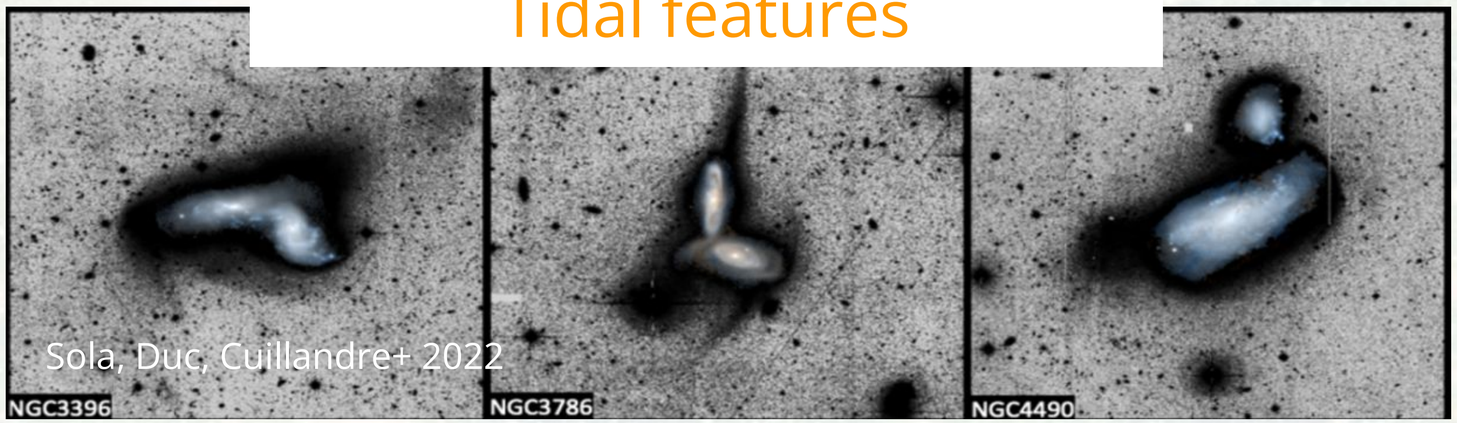
Ultra-diffuse galaxy NGC 1052-DF2
(van Dokkum+ 2015)

Undiscovered disk structures and spiral arms



Surprise: UGC1382, a former elliptical galaxy in shallow optical images becomes a spiral with deep imaging (Hagen+ 2016)

Tidal features



Sola, Duc, Cuillandre+ 2022

The Local Universe “is a complex situation” made by complex objects

Understanding the “complexity” of galaxy evolution

Hundreds of thousands of galaxies and their globular cluster populations (already known or discovered), for which we can measure in very detail stellar population maps, morphology, structural parameters, tidal features.

To constrain with an unprecedented precision the history of these galaxies, their interactions, mass accretion history, dark matter halos.

SWG organization

Leads: C. Conselice & **L. Hunt**

Renewal of the SWG leads, replacing Conselice (2023) and Hunt (2024)

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

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

WP-MORPH: Quantifying galaxy morphology (M. Huertas-Company)

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-FAR: Distance scale (S. Mei)

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

- Activities started in Jan 2021
- Around 100 people on the LU mailing list
- Monthly SWG telecons (roughly first Monday of the month) + other monthly telecon for each WP
- Redmine: https://euclid.roe.ac.uk/projects/local-universe-swg

SWG organization

Home My page Projects Help — Logged in as ctortora My account Sign out

Science Working Groups »
LUSWG

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+ Overview Activity Roadmap Issues Gantt Agile News DMS Documents Wiki Files Easy WBS Settings

Edit Watch •••

Welcome to the wiki of the Local Universe SWG

Coordinators: Chris Conselice, Leslie Hunt

This SWG develops the science cases for nearby galaxies with Euclid. Euclid's sensitivity, spatial resolution, and wavelength coverage make it an ideal facility to probe galaxy properties in detail, in particular dwarf and low surface-brightness galaxies. We also provide scientific requirements to the organizational units (OUs) and interact with them to ensure that the OU products can achieve our science goals. The individual Work Packages and proposed Key Projects are described below.

Our activities are closely linked with the SWGs MW-RSP and GAE.

LU SWG Wiki pages index

Start wiki page

- Euclid Consortium LU Splinters
- LU SWG telecons
- Pre-launch Key projects
- VDG telecons

Wiki

Start page
Index by title
Index by date

- Redmine: https://euclid.roe.ac.uk/projects/local-universe-swg

Italian contribution

The Italian community (mainly from INAF) is providing an important contribution within the LU-SWG with apical leading roles and contributions

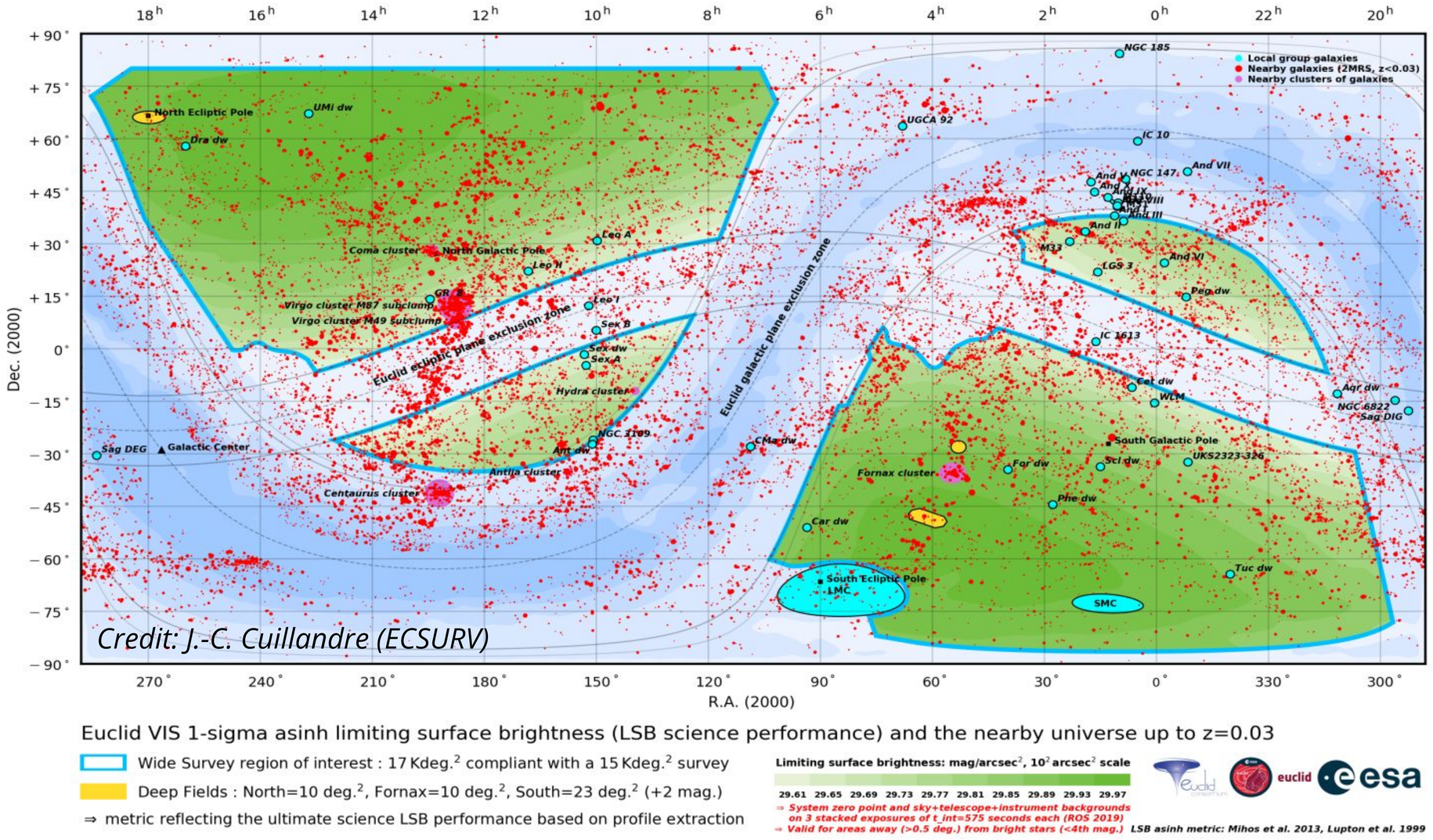
L. Hunt (SWG lead), C. Tortora & M. Scodeggio (WP leads), L. Hunt, C. Tortora, E. Iodice (PLKP coordinators)

M. Bolzonella, L. Bisigello, L. Pozzetti, R. Scaramella, M. Cantiello, A. Nucita, S. Cavuoti, M. Brescia, M. Nonino, F. Annibali, V. Testa et al.

Why Euclid?

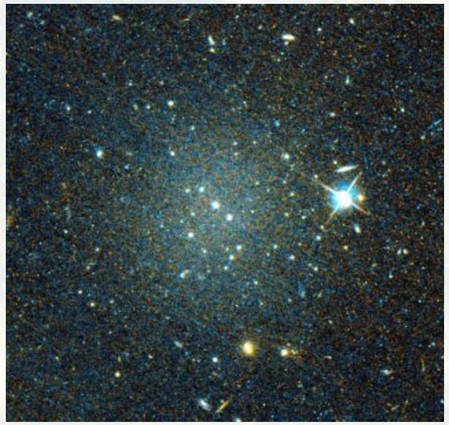
A vast sky area

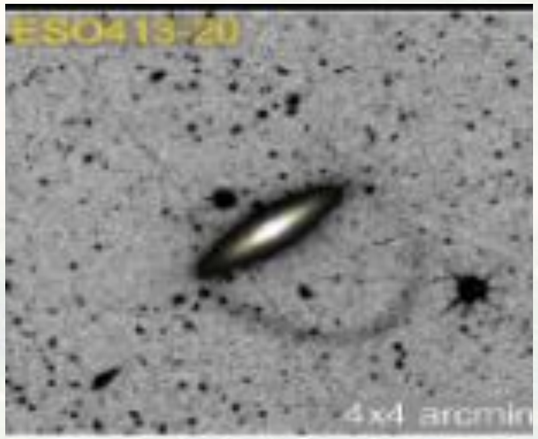
~19000 galaxies at D < 200-300 Mpc
(LUNE catalog, WP-PPZ, Tortora, Sorce)

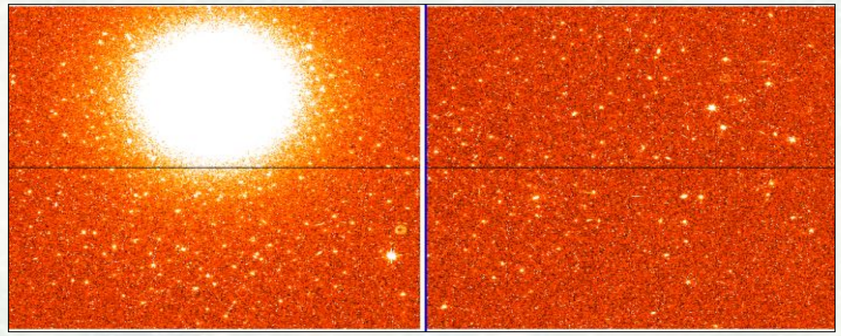


Spatial resolution

- Morphology of galaxies (dwarfs, UCDs, …)
- Resolve better tiny structures and tidal features
- Optimal for globular cluster selection





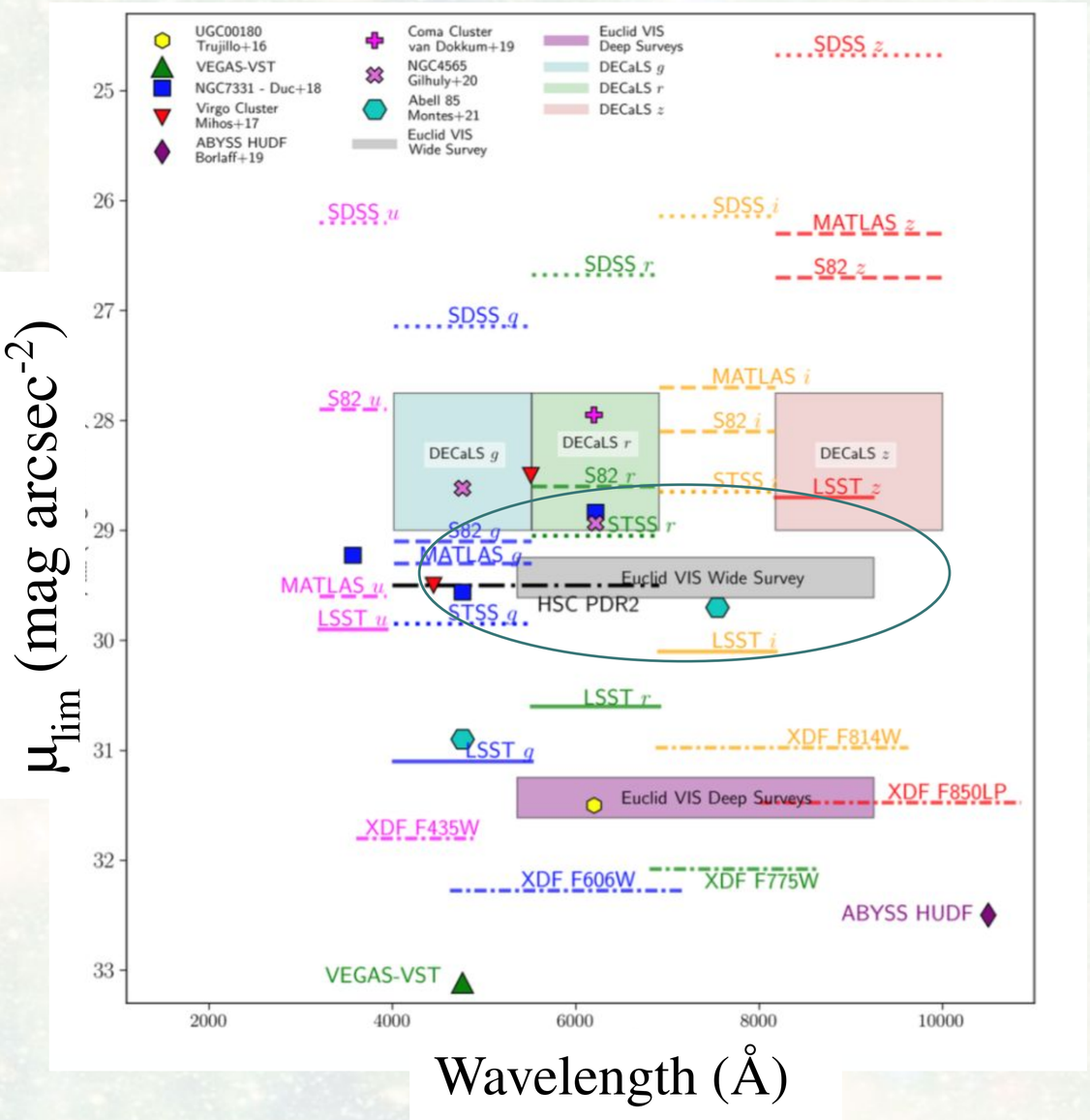


Euclid is a LSB “machine”

Taken from EC, Borlaff+ (2022, A&A, 657, 92)

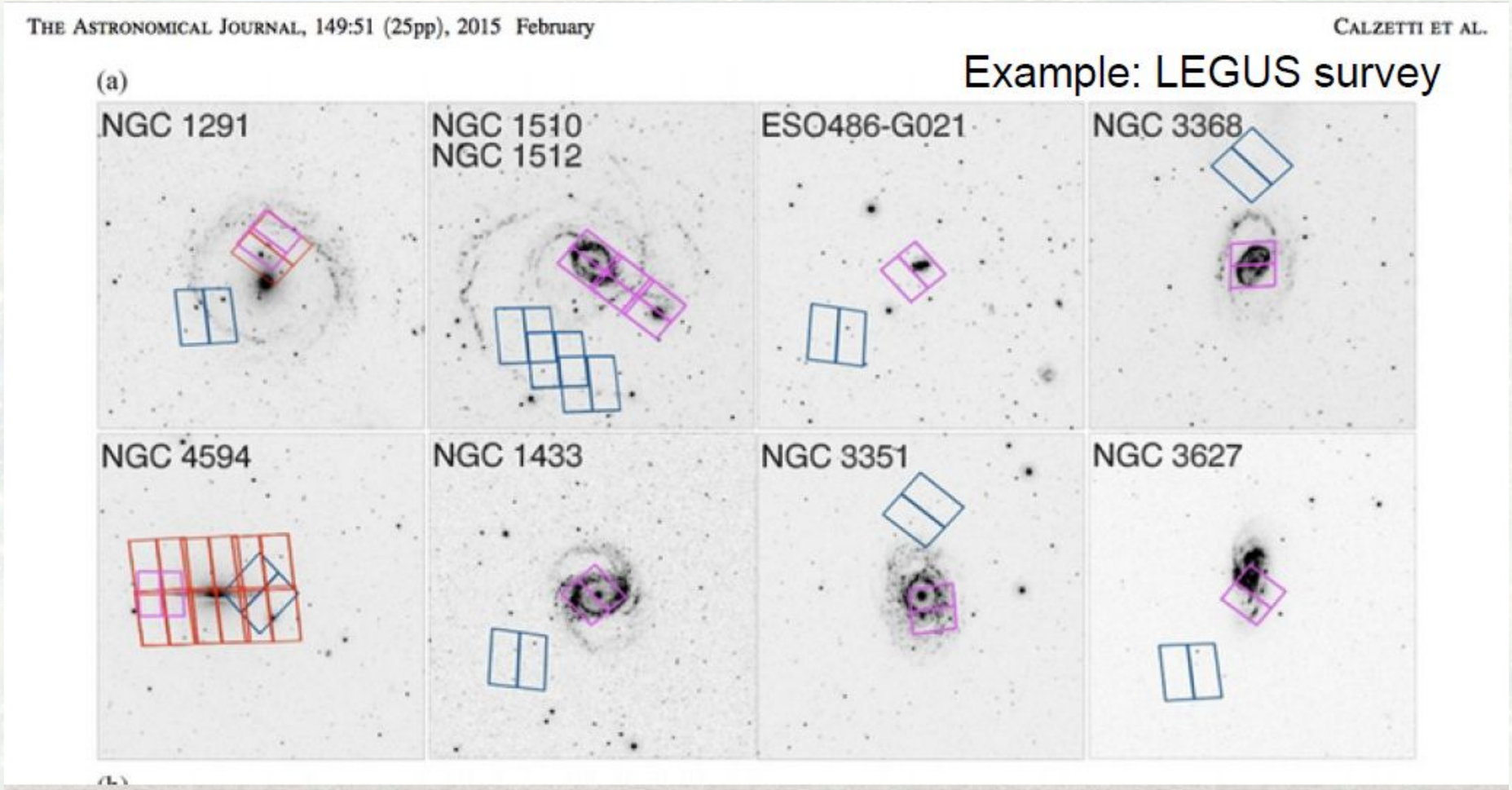
Comparison of the surface brightness limit (3σ, 10x10 arcsec^2) for the Euclid/VIS Wide Survey (and two magnitudes deeper for the Deep Fields), compared with a selection of deep optical and near-infrared surveys (as shown in legend)

Although a few surveys may go deeper, they do so over very small areas. Euclid will probe the LSB universe on a huge area of the sky, opening up a new parameter space for LSB science



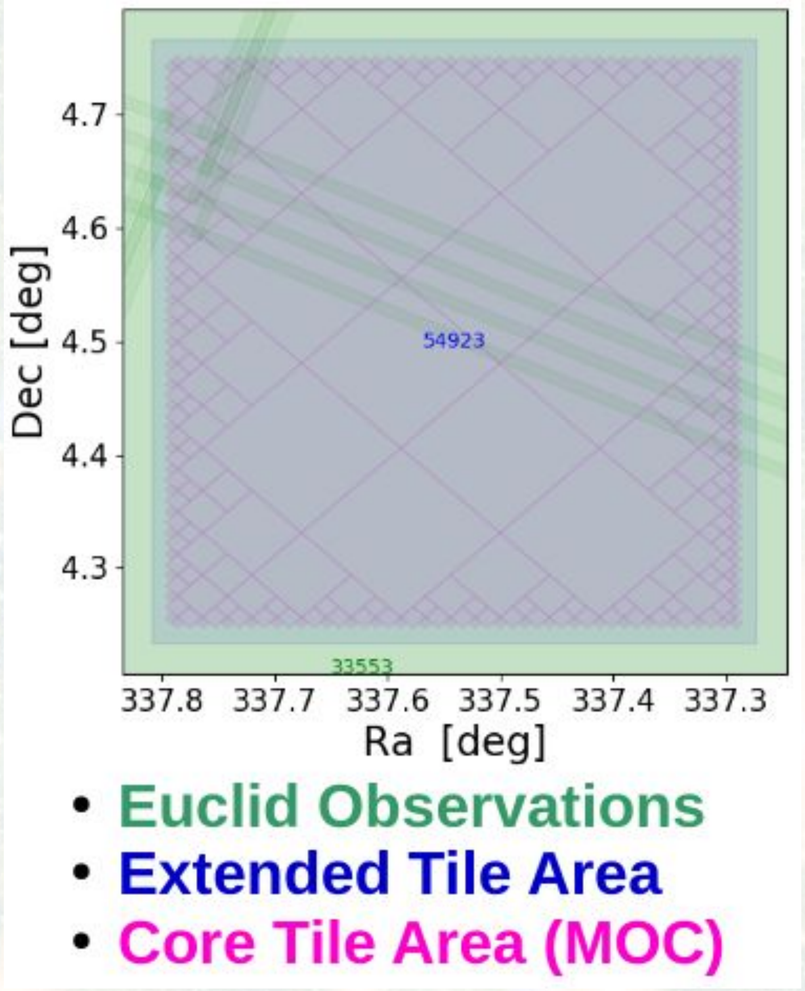
Large field of view

Perfect for local large galaxies!

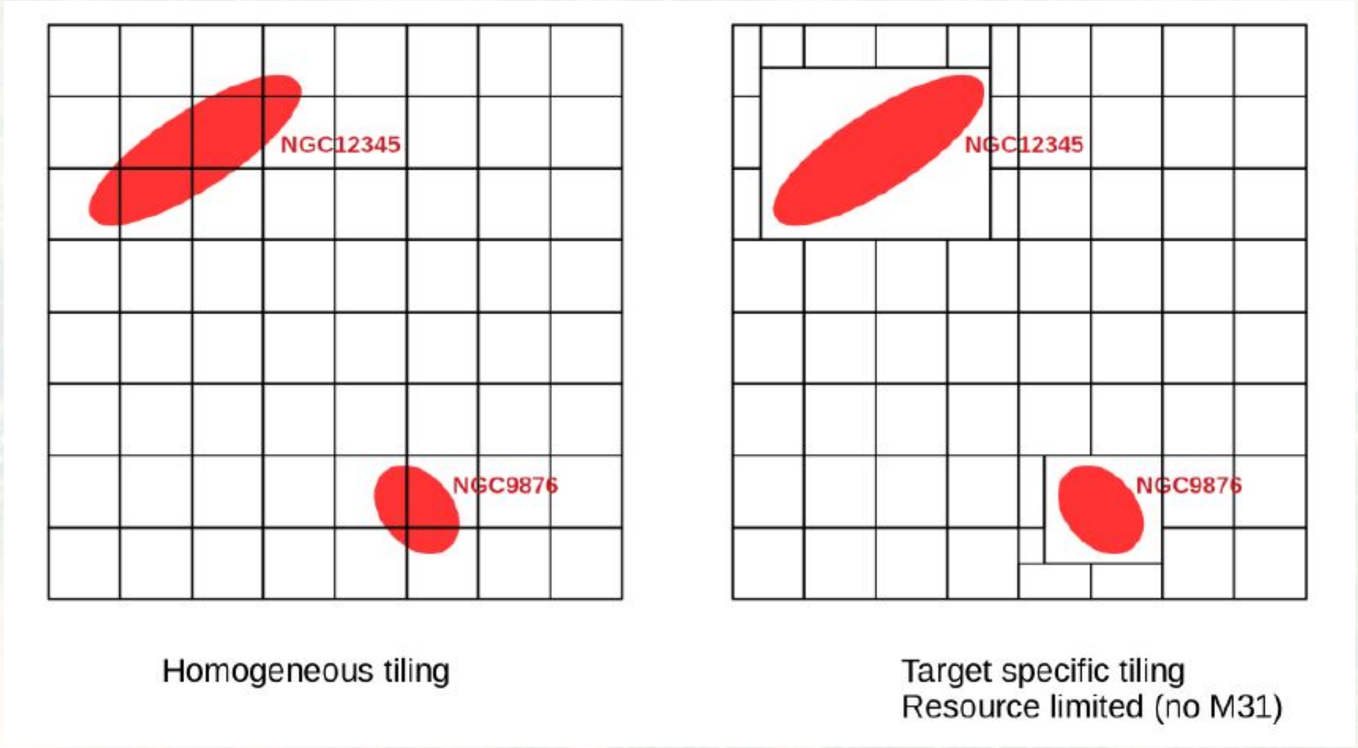


A major improvement wrt the small field of view of, e.g. HST

A unique “adaptive” tiling



- Euclid Observations
- Extended Tile Area
- Core Tile Area (MOC)



We are in contact with OU-MER, providing them a list of special large objects

How are we preparing for analyzing the Euclid data?

Past, present and the safe future

Crescenzo Tortora (INAF-OAC)

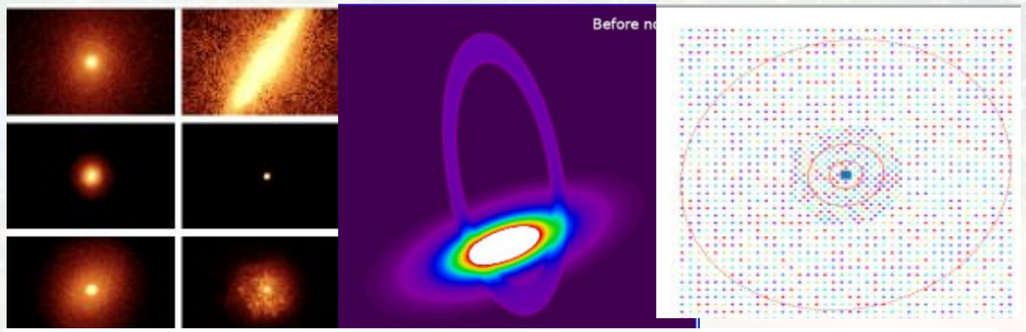
Local Universe SWG

Meeting Euclid nazionale, 20/01/2023

A workflow for data processing for nearby galaxies

WP-DET (Lead: M. Akhlaghi)

PHASE 1-2. Define science targets and create no-noise images



Sérsic, TNG, Horizon-AGN, tidal features, dwarfs, GCs, ...

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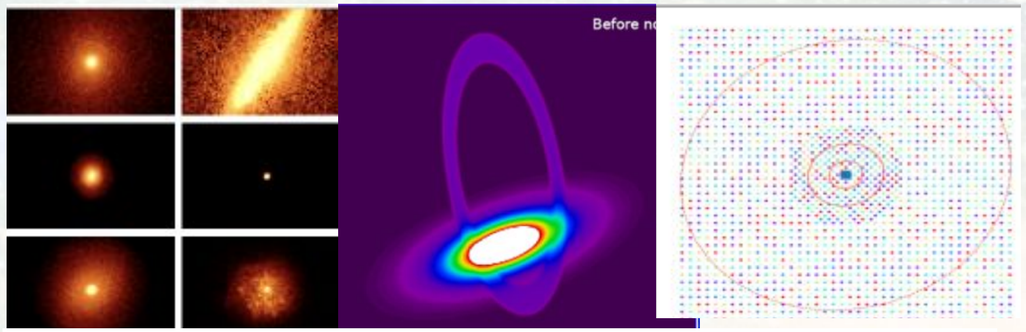
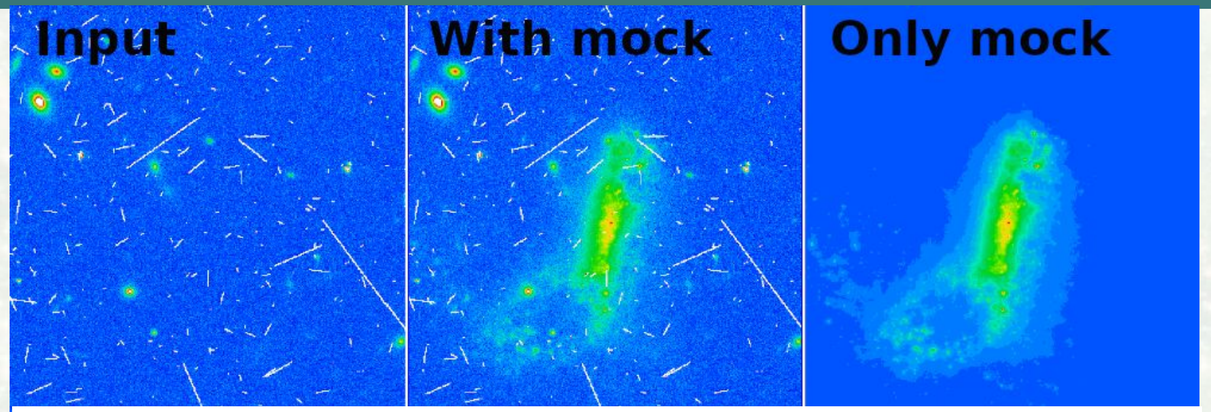


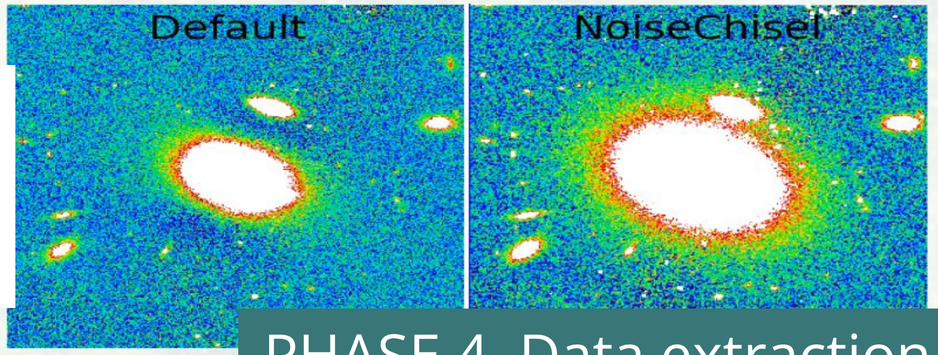
Sérsic, TNG, Horizon-AGN, tidal features, dwarfs, GCs, ...

PHASE 3. Insert these images in the Euclid pipeline



Mock galaxy from HorizonAGN inserted in OU-VIS processing steps

Pipeline implemented with NoiseChisel leads to an improved sky estimation for nearby objects

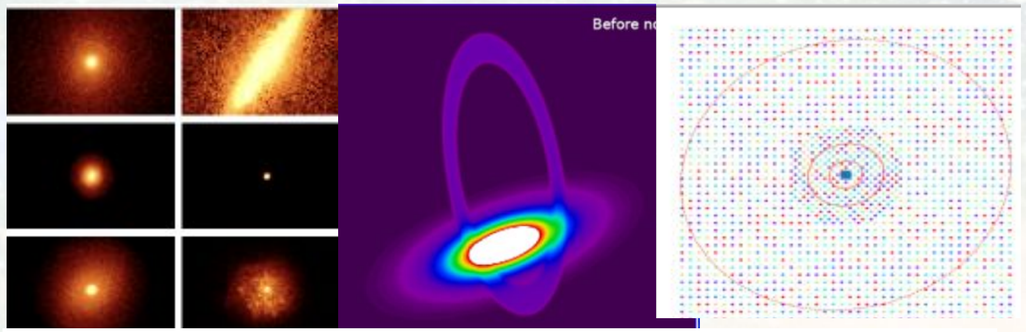


PHASE 4. Data extraction

A workflow for data processing for nearby galaxies

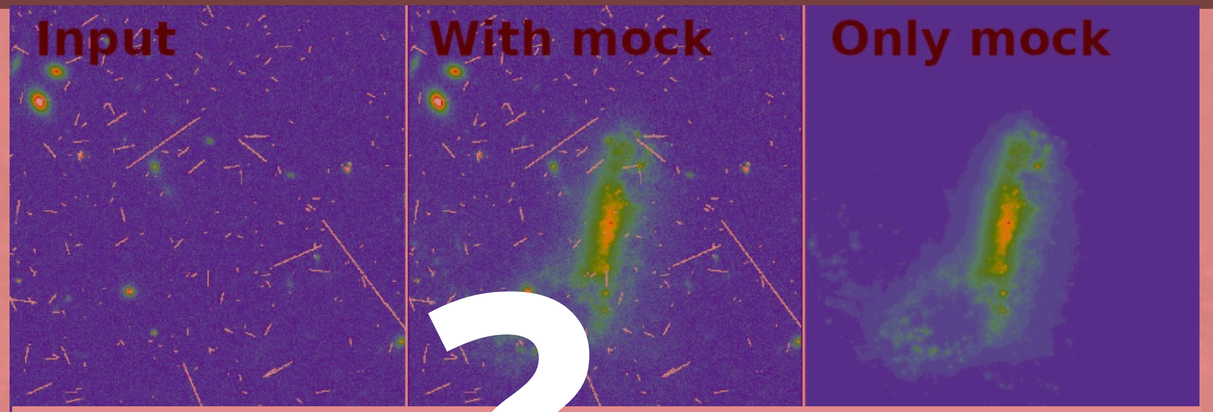
WP-DET (Lead: M. Akhlaghi)

PHASE 1-2. Define science targets and create no-noise images



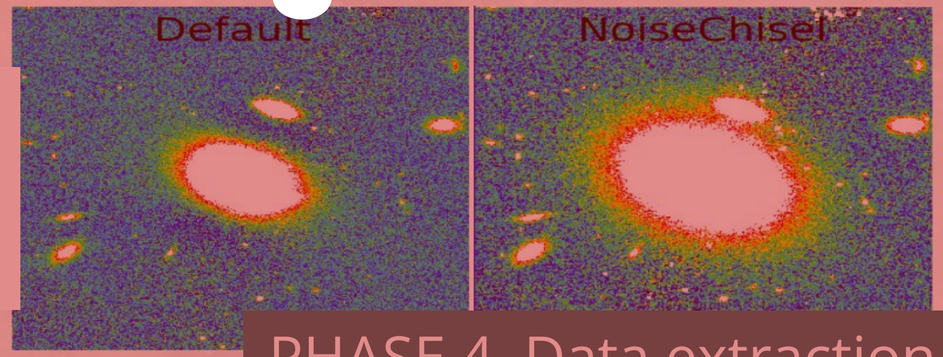
Sérsic, TNG, Horizon-AGN, tidal features, dwarfs, GCs, ...

PHASE 3. Insert these images in the Euclid pipeline



Mock galaxy from Horizon AGN inserted in OU-VIS processing steps

?



Pipeline implemented with NoiseChisel leads to an improved sky estimation for nearby objects

PHASE 4. Data extraction

PHASE 5. Data analysis

The rest of WPs involved

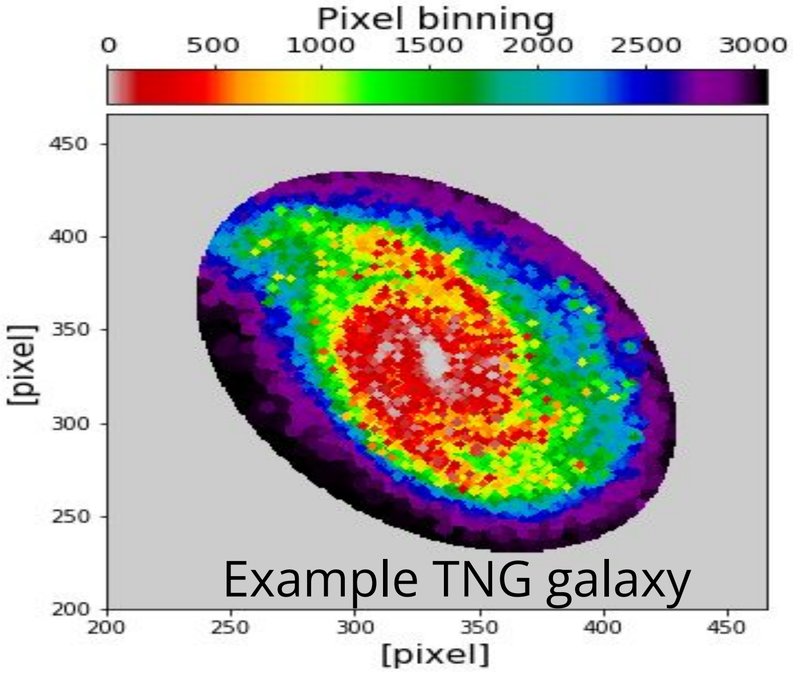
How good we are in:

- Recovering input parameters (stellar populations, structural parameters, etc.)
- Finding globular clusters, dwarfs, tidal features, etc. etc.

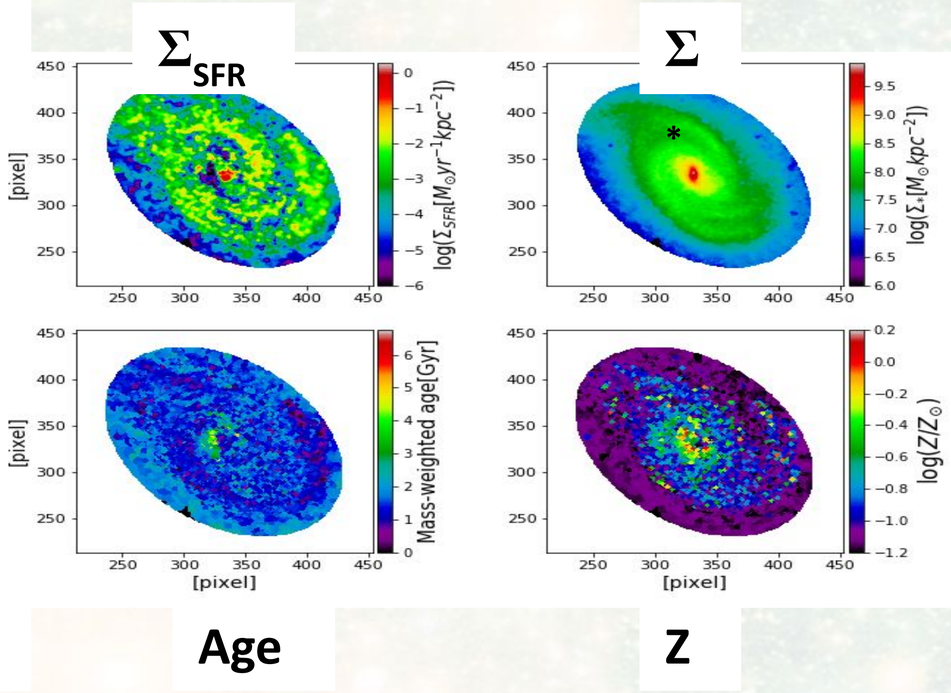
Stellar populations

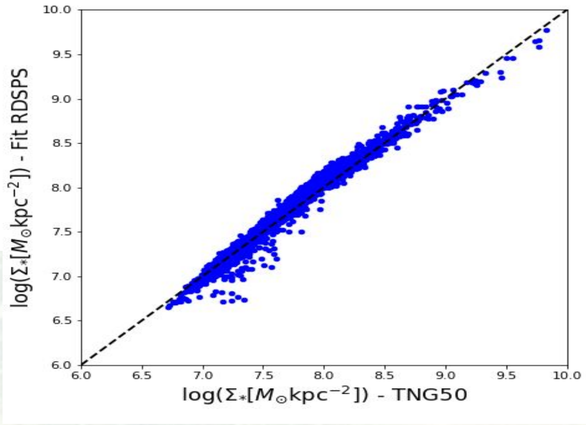
WP-PPZ (Leads: M. Scodeggio, C.Tortora)

piXedfit (Abdurro'uf)



SED fitting results





SED fitting methods (Abdurro'uf, Nersesian)

Machine learning (Cavuoti, Delli Veneri, Baes, Kovacic)

Structural parameters

WP-MORPH (Lead: M. Huertas-Company)

WP4 in GAEV

Morphology Challenge. We have compared the performances of different codes to recover structural parameters (results in Merlin et al. 2023 and Bretonniere et al. 2023).

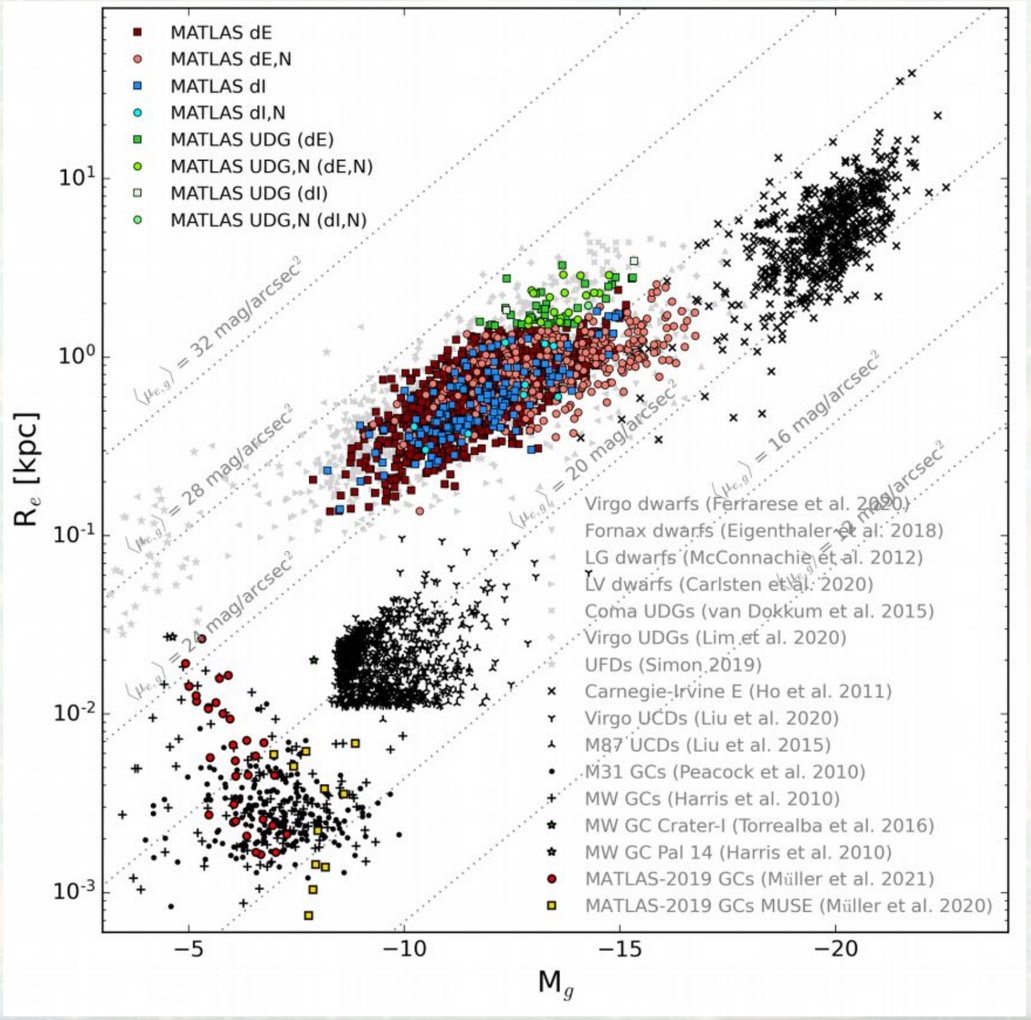
Merger challenge. Find a framework to identify mergers (not Euclid)

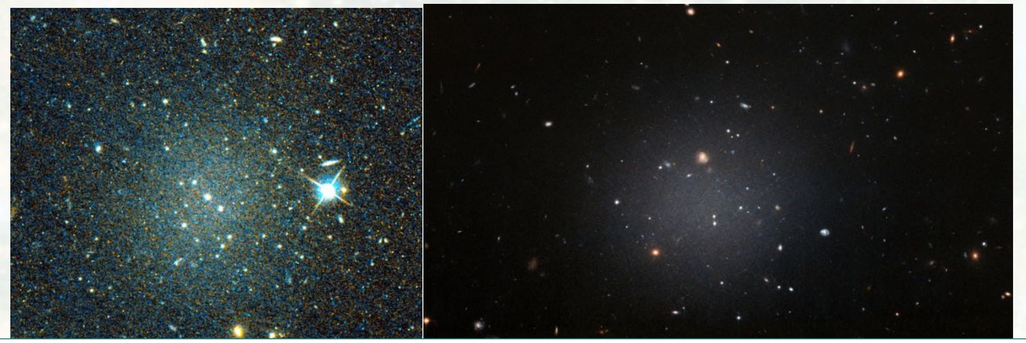
Euclid Zoo. An effort to classify galaxies at different redshifts. This classification is used to train neural networks.

Specialize these analyses for nearby galaxies

Low surface-brightness and dwarf galaxies

WP-LBG (Leads: P.-A. Duc & R. Peletier)





Hundreds of thousands dwarfs
and thousands of UDGs in Euclid/Rubin
(Habas+20, Marleau+21)

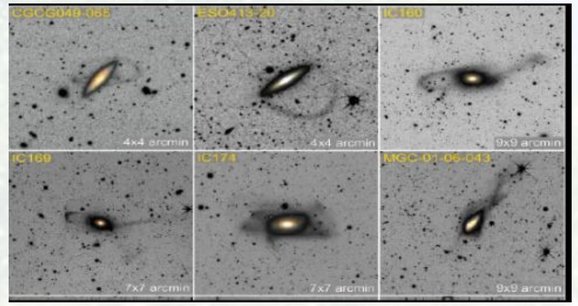
Dwarf galaxy simulations
(analytical Sérsic profiles and euclidized HST image)

Detection challenge

Different codes to be compared: MTObjects, SExtractor, NoiseChisel, ProFound, deep learning methods, etc

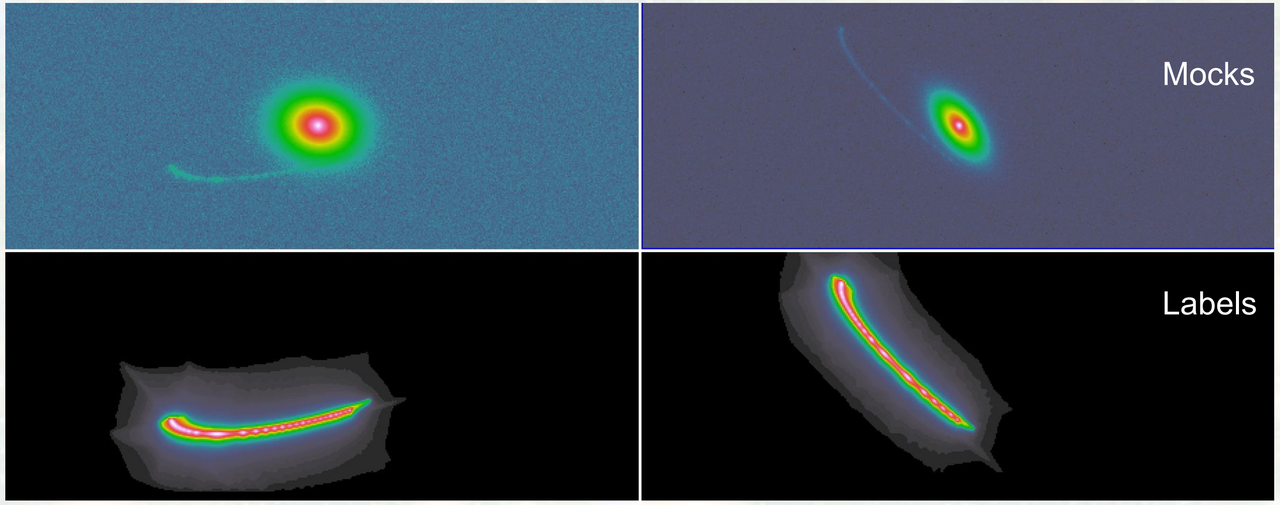
Low-surface brightness issues

WP-DIF (Lead: F. Buitrago)



Create tidal tail simulations and digest in VIS pipeline

- Parametric-derived simulations
- Use hydrodynamical simulations
- Use real images



Images created by Fernando Buitrago, using gnuastro (Akhlaghi 2019)

A challenge is planned for detection/classification/segmentation

Other goals: truncation radius, cirrus, diffuse light

Distance scale measurements

WP-FAR (Lead: S. Mei)

The calibration of Euclid Surface Brightness Fluctuation (SBF) observations. We will simulate the Euclid SBF calibration and compare it to stellar population predictions (Lead: S. Mei)

The simulation of galaxies images including SBF. We will simulate images for testing algorithms to measure Euclid Surface Brightness Fluctuation observations (Lead: M. Cantiello)

Development of algorithms for the measurements of Euclid SBF distances (Lead: M. Cantiello, S. Mei, J. Taylor)

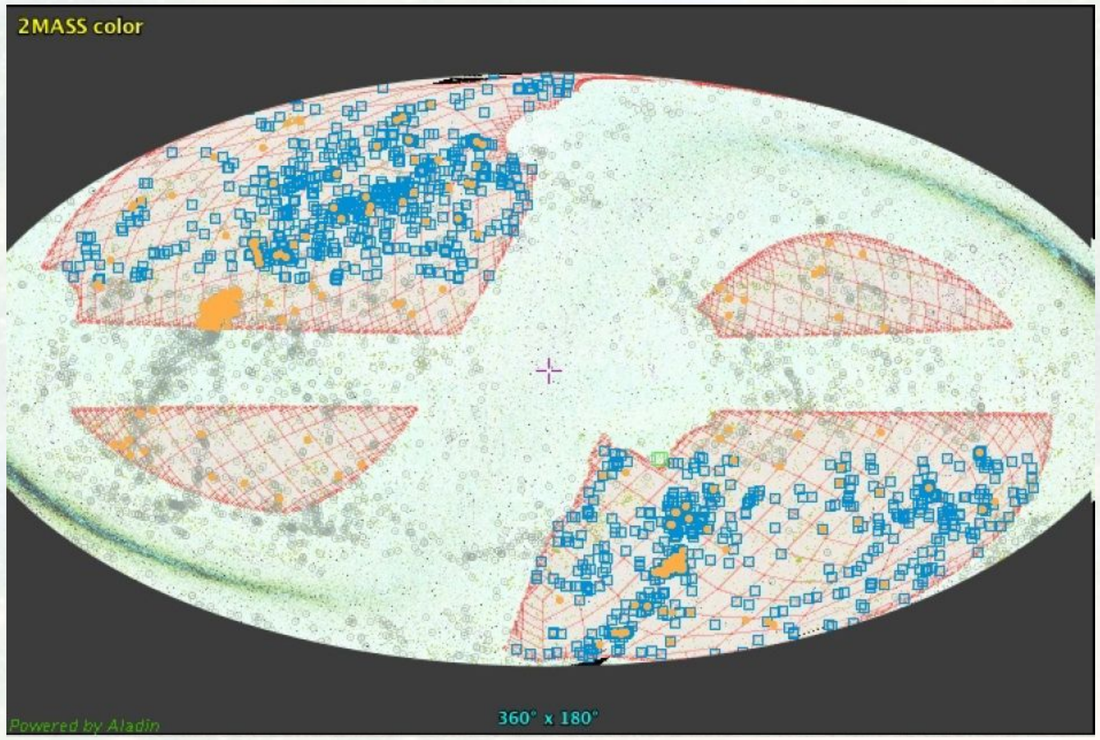
Tully-Fisher Distance measurements with Euclid (Lead: P. Salucci)

Fundamental Plane Distance measurements with Euclid (Lead: P. Salucci)

SNIa calibration by SBF (Lead: M. Della Valle)

Extragalactic globular clusters

WP-ECGs (Lead: A. Lançon)



Blue: galaxies with smallest NED-D distance <30 Mpc and M(B) < -15 (Simbad/CDS), in a pessimistic version of the Euclid footprint.

Orange: globular cluster systems in the compilation of Harris et al. (2013).

Up to 1 million EGCs at D < 75 Mpc

Issues: light from the host galaxy, GCLF dropping at bright end, …

Simulations ongoing to understand
- how well we can extract EGCs and
- how well we can measure their properties such as sizes

EGC science: number, structure, stellar populations, kinematics, relation wrt stellar population and galaxy structure, ….

PL Key-projects

Approved!

LU Key Project I: Opening Euclid's window on low surface brightness

Euclid will reach extremely low surface brightness levels (wide: ~29.5 mag/arcsec2, deep: ~31.5 mag/arcsec2, both at 3-sigma level, over 100 arcsec2 for VIS, see Borlaff et al. 2022, A&A 657, 92). This makes Euclid a powerful probe for low surface-brightness (LSB) astrophysics (including the Milky Way, Local Universe, galaxy evolution, galaxy clusters, weak lensing, and large-scale structure). But, achieving these surface brightness levels is only possible if the data are reduced by properly estimating the background, ensuring the reliable detection of all the photons gathered by Euclid. This Key Project is aimed at detection algorithms to optimize LSB science, in concert with OU-VIS, OU-NIR, OU-MER, and OU-SHE, as well as defining pre-launch the LSB science that can be performed with Euclid in the context of the Local Universe.

Designated project coordinators: **Enrica Iodice, Reynier Peletier, Leslie Hunt**

LU Key Project II: Simulating the Euclid View of the Local Universe

Euclid's superb spatial resolution and sensitivity, together with its near-infrared spectral coverage, will enable a vast variety of science themes for galaxies in the Local Universe. These include the detection of extragalactic globular clusters (ECGs) with unprecedented statistics; estimation of distances using surface- brightness fluctuations (SBFs) over a broad range of galactic populations; individually resolving on pixel scales spectral energy distributions to infer galaxy parameters such as surface densities of stellar mass and star-formation rate, as well as spatially resolved estimates of age, dust extinction and metallicity. Large galaxies requiring special tiling are of particular interest because of Euclid's wide field-of-view, and the impossibility of imaging them with comparable spatial resolution using current facilities, in particular in the near-infrared. This Key Project is focused on simulating nearby galaxy populations including their GC populations and intrinsic SBFs, as well as developing the algorithms that will be later used to analyze post- launch Euclid data in these contexts.

Designated project coordinators: **Johan Knapen, Crescenzo Tortora**

https://euclid.roe.ac.uk/projects/local-universe-swg/wiki/Pre-launch_Key_projects

PL Key-projects

Approved!

LSB science and proper data reduction

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PL Key-projects

Approved!

LSB science and proper data reduction

Designated project coordinators: **Enrica Iodice, Reynier Peletier, Leslie Hunt**

Stellar populations, globular clusters and surface brightness fluctuations

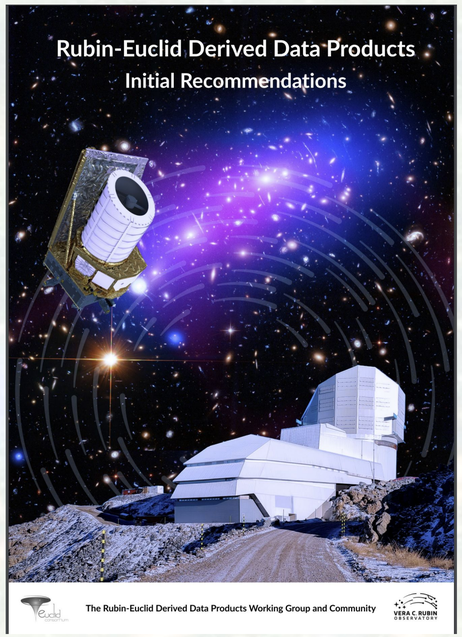
Designated project coordinators: **Johan Knapen, Crescenzo Tortora**

https://euclid.roe.ac.uk/projects/local-universe-swg/wiki/Pre-launch_Key_projects

What more?

The uncertain future

Rubin-Euclid DDP



Multi-wavelength information essential for stellar population derivation (both for galaxies and globular clusters)

Local Universe (LU)

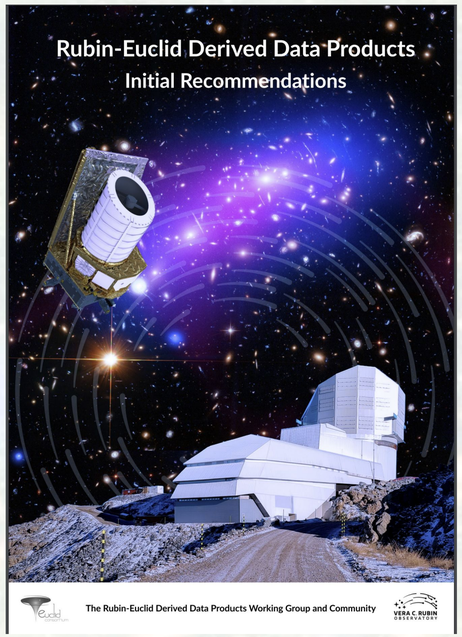
DDP-20-LU	B	P1+U1+YR	T1	Joint pixel processing of large image cutouts
DDP-21-LU	B	P1+U1+YR	T1	Nearby galaxies structure & morphological parameters
DDP-22-LU	B	P1+U1+YR	T1	Dedicated Low Surface Brightness pixel data reductions
DDP-23-LU	B	P1+U1+YR	T1	Multi-band merged catalog with compactness-sensitive measurements
DDP-24-LU	B	P1+U1+DR	T3	Multi-band merged catalog of objects without proper motion

https://arxiv.org/pdf/2201.03862.pdf

Not clear if and how all of this will be done!

Sharing the pixels for EDF-South (23 sq. deg.) will allow to develop methods and start with some science

Rubin-Euclid DDP



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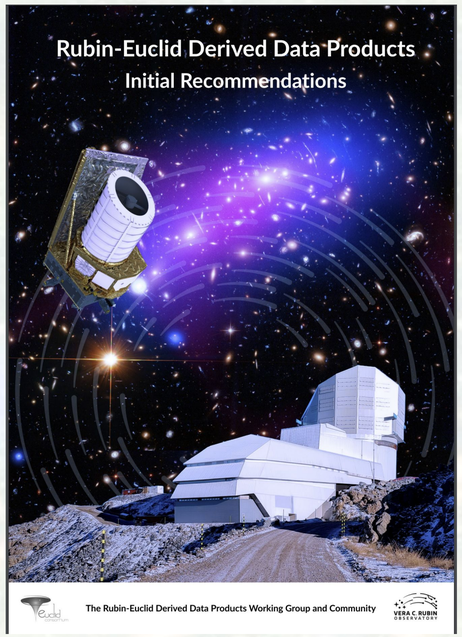

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Joining the pixels only in 2025 when the yr1 LSST data will be released!

Meanwhile? Dedicated requests of time, to obtain deep optical images for small samples of galaxies (e.g. VST)

VST-SMASH

The VST Survey of Mass Assembly and Structural Hierarchy

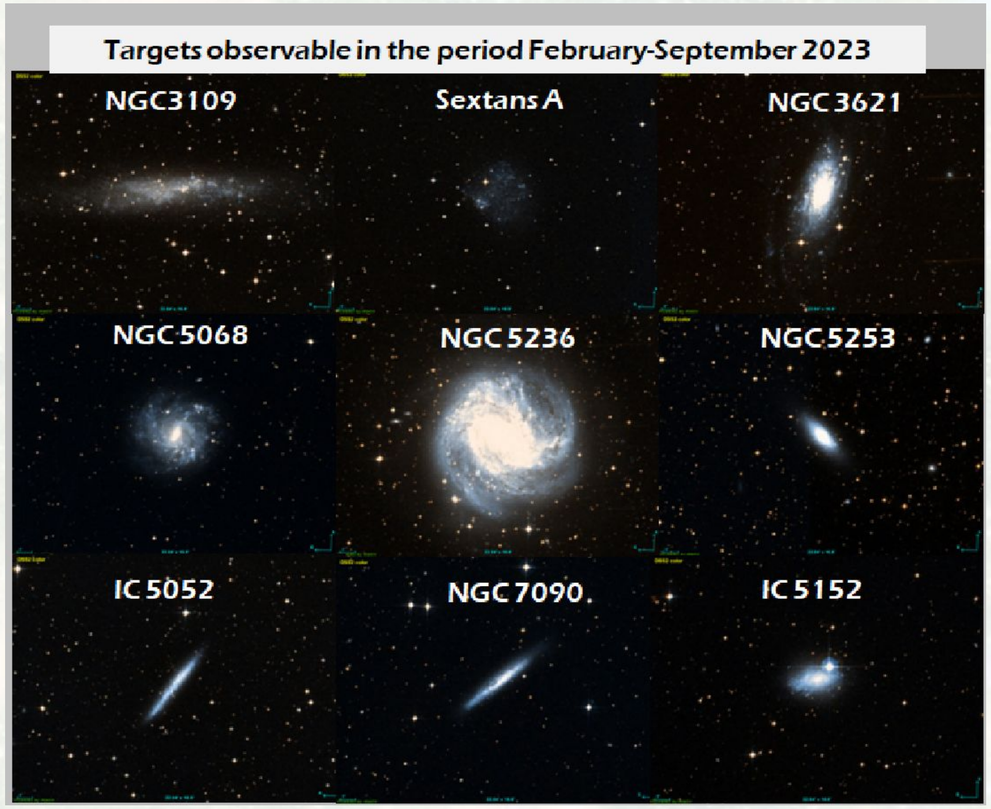
Tortora (PI), Hunt (co-PI), Iodice, Spavone, Bolzonella, Scaramella, Cantiello, Radovich, Napolitano, Testa, Nucita, Annibali, Belfiore, Schinnerer, Ripepi, Gatto, Akhlaghi

Awarded time:
20 nights with VST in g, r and i in this semester

Surface brightness limit:
≥ 29 mag arcsec^{-2} in g- and r-bands and shallower levels (~ 26 mag arcsec^{-2}) in i-band

Goals
LSB tidal features, satellites, star clusters, colour maps, etc.

Optical deep counterpart for Euclid NIR images (far before LSST will reach this specific depth)



Local galaxies at D < 11 Mpc
(Karachentsev et al. 2013)

INAF-EDGE: INAF Exploration of Diffuse Galaxies with Euclid

PI. L. Hunt

INAF grant approved to finance legacy science in the Local Universe (200 k€)

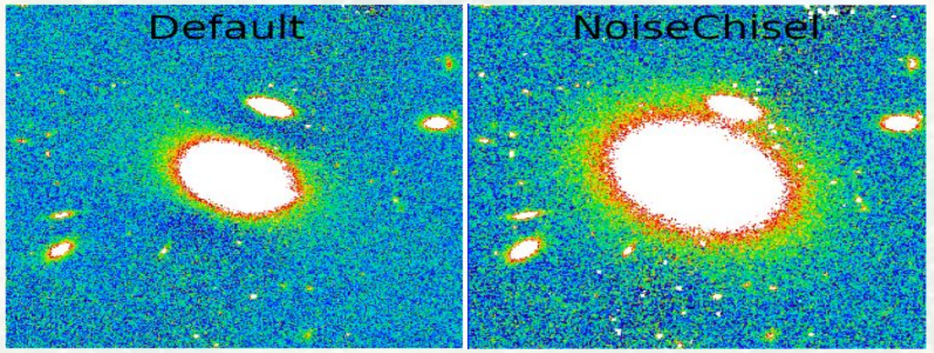
L. Hunt (PI), M. Cantiello, R. Scaramella, E. Iodice, C. Tortora, F. De Paolis, A. Nucita, V. Testa (co-Is)

And we will hire two post-docs who will work on low-surface brightness science and surface brightness fluctuation

Critical points on data extraction and pipeline usage

Vertical Discussion Group-LSB

Euclid has the capacity to do LSB/LU science and will provide the requested raw data



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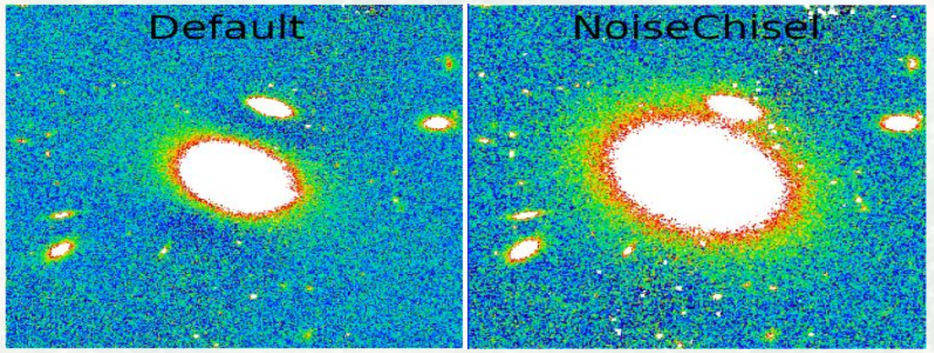

For some of the topics/science goals, the standard MER pipeline will not provide the optimized stacks and catalogs. We will not be able to update this standard pipeline nor run a parallel one at the SDCs

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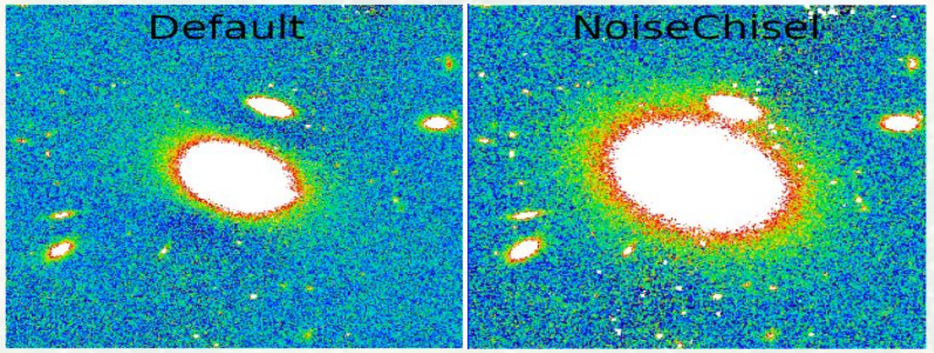

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We will then have to produce our own pipeline and find the relevant computing/human resources or narrow down our ambitions (studies on focused regions, limited number of targets, etc...)

Critical points on data extraction and pipeline usage

Vertical Discussion Group-LSB

The European Community HORIZON program could provide a solution!

We will then have to produce our own pipeline and find the relevant computing/human resources or narrow down our ambitions (studies on focused regions, limited number of targets, etc…)

Galaxy and AGN Evolution WG

led by J. Brinchmann, E. Daddi & A. Cimatti (6 WPs led by Italians)

- WP 1: Physical Parameter Estimates from Photometric SEDs [**Pozzetti**]
- WP 2: Physical parameter estimate from spectra [**Talia**]
- WP 3: Galaxy evolution in different environments [**Magliocchetti**, Sorce]
- WP 4: Galaxy morphology [Conselice, Huertas-Company]
- WP 5: Passive galaxies [**Moresco**]
- WP 6: Theoretical models [**de Lucia**]
- WP 7: Galaxy & AGN evolution and lensing [Richard, Sonnenfeld]
- WP 8: Multi-wavelength synergies [Béthermin]
- WP 9: Type 1 and type 2 AGN [Fotopoulou , **Allevato**]
- WP 10: High-z objects (4<z<7) [**Rodighiero**]
- WP 11: Distribution functions [**Zucca**]

GAE→ Physical Properties of galaxies: photometry

GAEV-SWG (WP1-WP11)
Pozzetti-Zucca

STRONG CONNECTION since many years with OU-PHZ+PPs (Bolzonella co-leader)

Strong involvement of the Italian community

Last activities and on-going work:

- **Strong connection with OU-PHZ+PPs** to give/receive feedback on pipeline/data model: pipelines is ready. Need to be tested.
- Reference sample still missing. Construction of the **reference sample** for photo-z and PPs using (simulated) **calibration fields and/or models**
- Italian Contribution to the **recommendations by Rubin-Euclid Derived Data Products** Working Group (DDP-WG): http://arxiv.org/abs/2201.03862
- Strong Italian contribution to Galaxy mock realistic catalog (photometry+PPs): Flagship1,2, MAMBO
- Italian-led **PLKP papers**: 5 out of 6 in WP1 and OU-PHZ using by-pass **simulated photometry** in various simulated galaxy catalog (MAMBO, GAEA, Flagship, etc)
- On going **tests** using ML techniques and OU-PHZ+PPs pipelines
- ~10 proposed **KP per Q1/DR1**

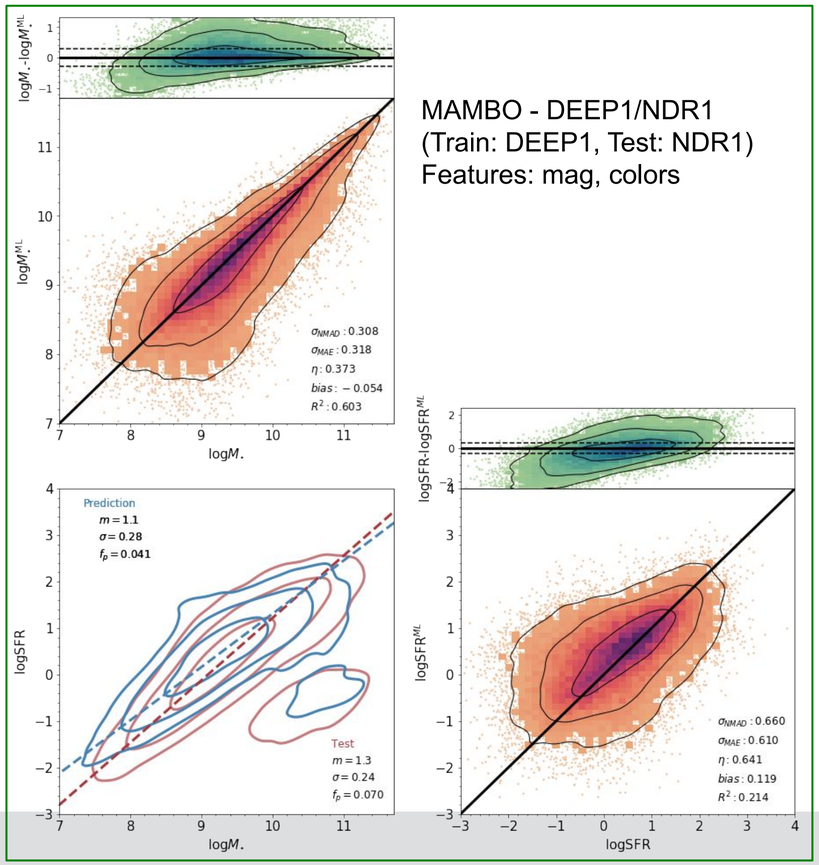
GAE→ Physical Properties of galaxies: photometry

GAEV-SWG (WP1-WP11)
Pozzetti-Zucca

STRONG CONNECTION since many years with OU-PHZ+PPs/classification (Bolzonella co-leader)

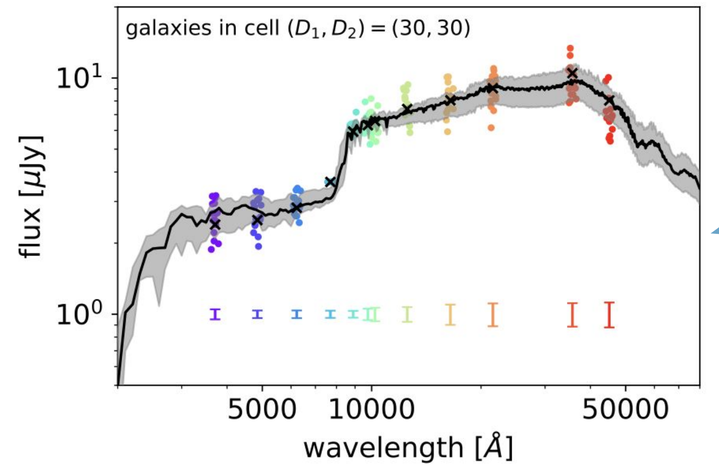
Tests on the OU-PHZ+PPs pipelines (PHOSPHOROS + NNP(P)Z, SOM) and other ML techniques using galaxy mock catalogues

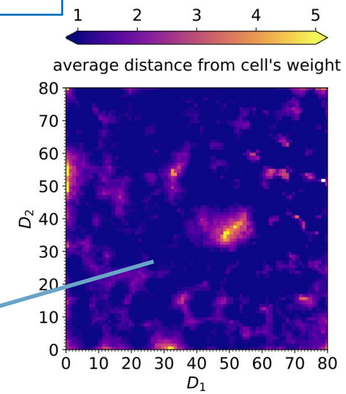
Recovering of Physical Properties relations (SFR-M*, M*-Z, age-M*)with ML (NNPPZ/Random Forest/CNN)

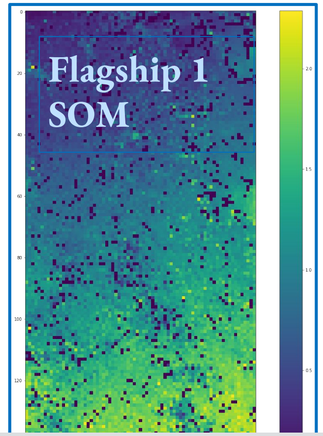


Testing SOM to find peculiar SEDs.

Davidzon+22:







ISSUE:

- pipeline NNP(P)Z available only few weeks/months ago

→ test and preparation of the reference sample and use of PDF(PPs) just started

GAE→ Physical Properties of galaxies: photometry

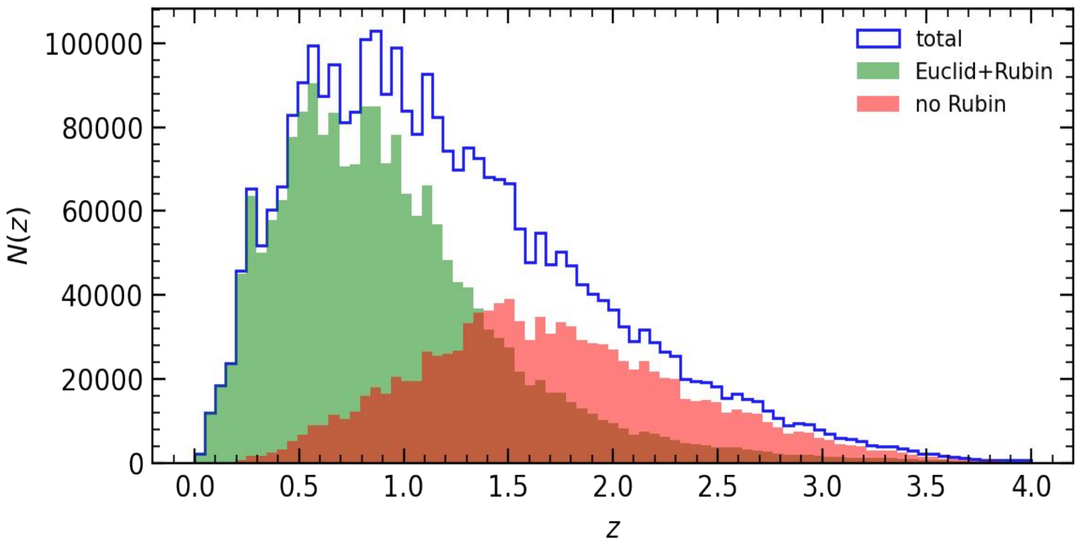
GAEV-SWG (WP1-WP11)
Pozzetti-Zucca

STRONG CONNECTION since many years with OU-PHZ+PPs/classification (Bolzonella co-leader)

ISSUES:

- available ground-based photometry: effect of Rubin-Euclid DDP is not negligible (see right panel)
- **No clear agreement with OUs on the use of the pipelines for PL-KP (on a voluntary basis)** → too high commitments for italians to run local pipelines not allow to lead/work on papers
- Not yet available an official pipeline for Distribution Functions from OU-LE3 → Use of private/public codes for Q1/DR1 ?
- **lack of computing and storage resources → need of National/international organization**
- **difficulties to use Euclid Archive**

The DDP-CC-1 (photometry source exchange for point sources and galaxies detected in all r,i,z and Y,J,H bands across both catalogs above 5σ) implies that at time of the first DRs many sources will not be exchanged…



Euclid + LSST 1Y + DDP-CC-1

Blue: Sample with H_E<24

Red: subsample with r_{LSST}, $i_{LSST,}$ or z_{LSST} with S/N<5

Green: subsample that with allowed source exchange

⇒ 20-30% of the sources at the H_E=24 limit will not be exchanged at the time of the Euclid DR2 (10-15% in DR3 with LSST 4Y) [I_E selection much less affected]

GAE→Physical Properties: spectra (SF/ETGs)

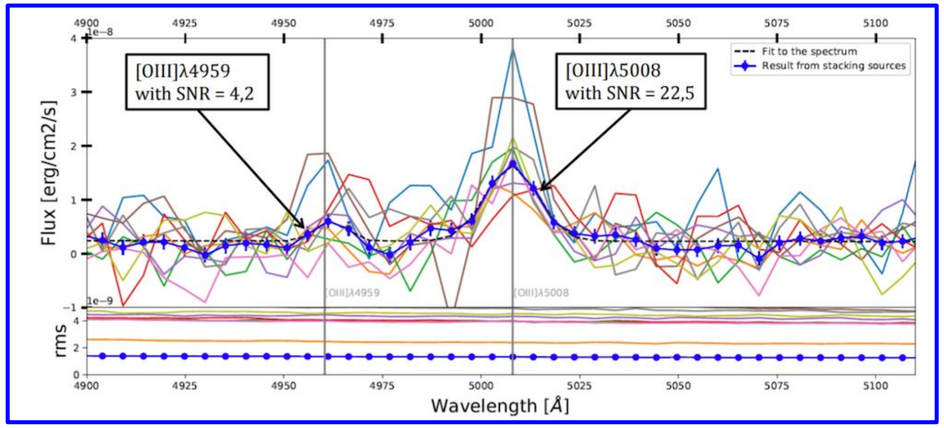
GAEV-SWG (WP2-WP5)
Talia-Moresco

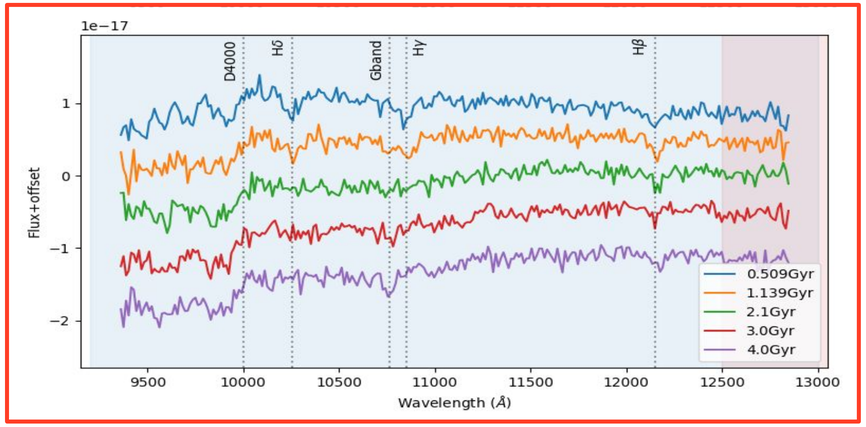
OU-SIR; OU-SPE

Last year activities and on-going work:

- bypass simulations of **Euclid spectroscopy** to test performances and stacking techniques;
  - forecasts on number counts and scaling relations

Italian-led PLKP papers: **3 (out of 4) in WP2** from L. Gabarra+22 **1 (out of 3) in WP5** from M. Moresco+ in prep.





ISSUES:

- **lack of paper-oriented (wo)man power**: most of WP members are not willing to lead a paper (often because of OUs commitments). Maybe this will change when actual data arrive?
- **lack of realistic simulations**: e.g. still today we do not know the effects of de-contamination on scientific forecasts; most of forecasts are based on (few) bypass simulations (when we have them) not validated against TIPS+SIR
- **lack of computing and storage resources**
- **difficult communication with OUs**: there is not a clear way for SWGs to ask for things (data, simulations, catalogues…) from the OUs; most of the time it is just a matter of “knowing the right person”
- **confusion on where informations and data are stored** (related to the previous point)

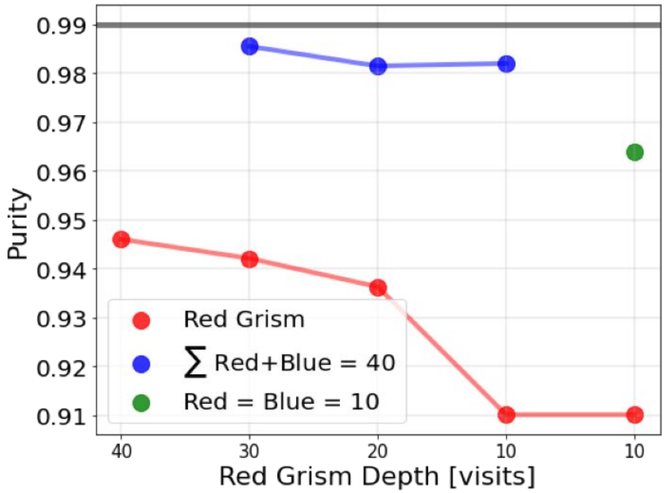
IST Blue grism

Inter-Science working group Taskforce: Blue Grism

Italian co-leader: **M. Talia (UniBo)** ~40% italian members

Last year activities and on-going work:

- got approval for additional BG observations over the Completeness & Purity Calibration (CPC) fields
- on-going work on:
  - the assessment of the best BG/RG ratio
  - the verification of the calibration plan for the BG
  - the updated forecasts of number counts



ISSUES:

- **lack of realistic simulations, especially for the verification of the calibration plan**
- **difficult communication with OUs**: there is not a clear way to ask for things (data, simulations, catalogues…) from the OUs; most of the time it is just a matter of “knowing the right person”
- **confusion on where informations and data are stored** (related to the previous point)

slide by Magliocchetti

Galaxy Evolution as a Function of Environment

(125 members - Coordinators: M. Magliocchetti & J.Sorce)

PLKP 3.1: Codes for Environment Detection and Characterization

8 foreseen papers (2 Italian Lead)

PLKP 3.2: Galaxy Evolution as a Function of Environment

13 foreseen papers (5 Italian Lead)

Q1/DR1 KPs: 21 proposed papers so far (2 Italian Lead)

Huge Criticality: lack of computing resources.

Already very hard to run codes for environment detection on simulations which only cover 5 sq degrees. Euclid deep will be 10 times wider. Euclid large 5000 times wider.

IMPOSSIBLE TO CARRY OUT ALL THE PROPOSED SCIENCE

IF COMPUTING RESOURCES ARE NOT FOUND

WP6: Theoretical Models

Coordinator: Gabriella De Lucia (INAF – OATs)

Goal: discuss feedback from/to data relevant for SWG (and beyond)

Info: https://euclid.roe.ac.uk/projects/geswg/wiki/Theoretical_models

Available: 5 different mocks, based on different techniques, containing a common set of physical properties plus additional "Euclid-like" properties (e.g. photo-z, emission lines, etc. - with contributions from people in SWGClusters).

Distributed to the entire consortium, being used beyond SWG (also OUL3).

Ongoing/next steps:

- Dedicated mocks that preserve large-scale structure (relevant for environmental analysis and proto-cluster). Activity led by O. Cucciati and based on GAEA+Millennium.
- Dedicated mocks for deep fields. Activities (not focused on Euclid) ongoing in Trieste with the GAEA model (P-Millennium, coupling with PINOCCHIO). Information to construct merger trees from Flagship DEEP will be available.

Criticality: lack of human resources dedicated to next steps and exploitation of provided theoretical information (included for PLKPs).

WP9 - Type 1 & 2 AGN

Co-leads: V. Allevato (IT), S. Fotopoulou

- Current status:
  - Strong involvement of the Italian community (**54% of Italian members**);
  - Very active WP: lot of progress and lot of telecons in 2022!
  - **7 PLKP papers ongoing** mainly focused on AGN selection criteria by using spectroscopy and photometry;
  - **Analysis of AGN Euclid-like spectra** (in coordination with WP2/OU-SPE/OU-SIR) in terms of line flux and z estimates;
  - **Mock catalogs of AGN** available (e.g. SPRITZ) and more under construction based on different methodologies.

- Criticality:
  - Lot of expertise but lack of manpower. **Few PLKP papers will be submitted before launch**;
  - The simulated AGN spectra still do not include contamination and blue grism configuration;
  - Short time frame to be ready for QR1/DR1??

Primeval Universe

lead by* J-G. Cuby & *S. Toft

- PUWG-LBGs Lyman Break Galaxies [Bowler, Oesch]
- PUWG-QSOs Quasars [Mortlock, Banados]
- PUWG-THE Theory [Dayal, **Ferrara**]
- PUWG-LENS Lensing [Cooray, Serjeant]
- PUWG-CIB Cosmic Infrared Background [Kashlinsky]

Plans and criticalities

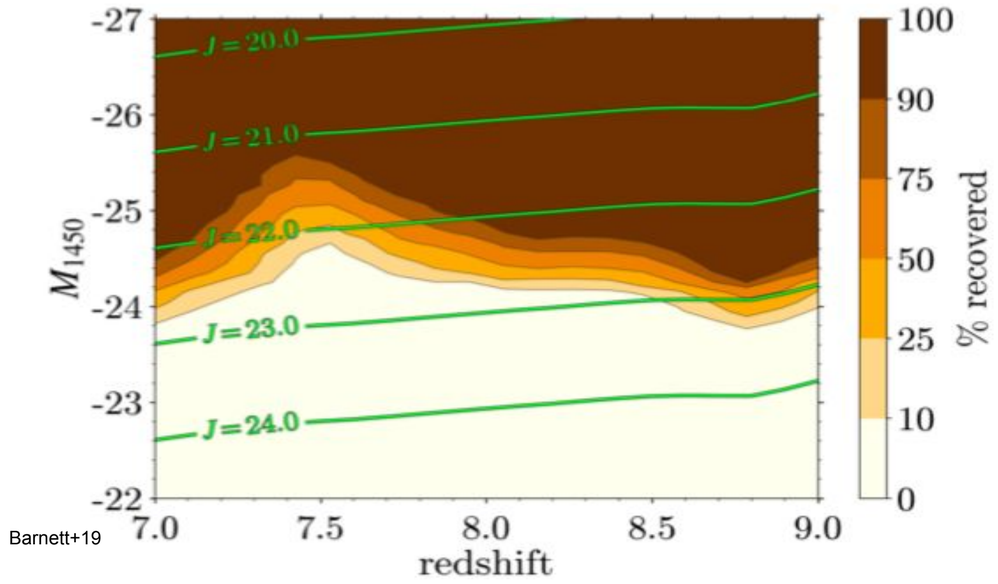
- A criticality for the Italian community: **little involvement** (14 members over 76 total), **the manpower dedicated to SGS activities has little time left for SWGs**
- Completely **lack of communication (telecons)** from the SWG leaders, only telecon within WPs

- PU needs to plan activity not only EDFs, but also for the Euclid Auxiliary Fields (CDFS, COSMOS, SXDS, VVDS, CANDELS-AEGIS, CANDELS-GN) that will have deep observations and lots of ancillary data

- Need of good simulations to test effect of contamination from dwarf stars, compact ellipticals, etc.

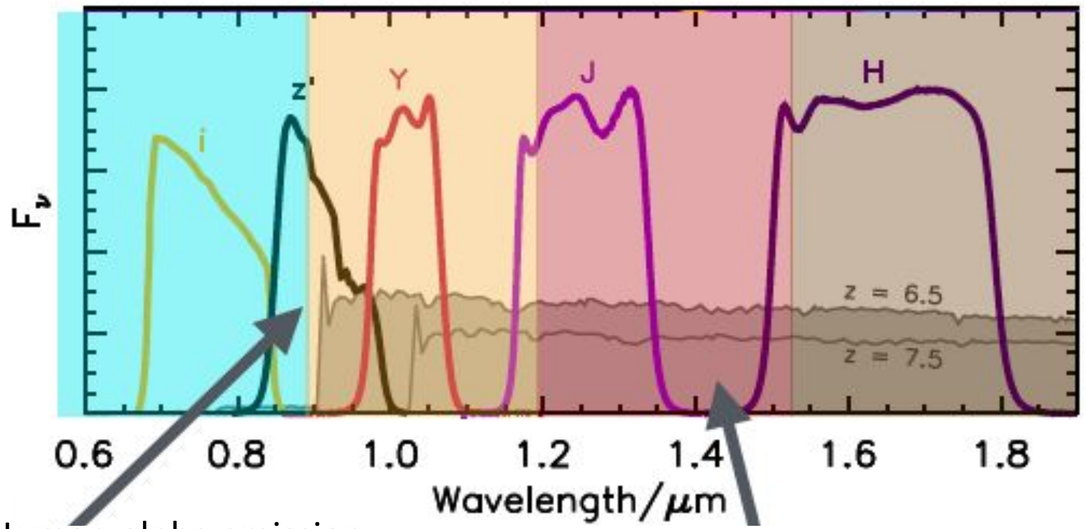
- Need to understand the selection function and whether the Euclid pipeline will deliver the best possible data for PU science (e.g., which is the best detection band? Is photometry best suited for high-z science?)

Selection of high-z QSOs and LBGs



Barnett+19

(a) *Euclid* data only.



Lyman-alpha emission

Lyman-break galaxy

Quasars at z > 8 can be selected from Euclid photometry alone. Selection at 7 < z < 8 is improved by the addition of z-band data from ground

More than 100 quasars at 7.0 < z < 7.5, 25 quasars beyond the current record of z = 7.5, including >8 beyond z = 8.0.

VIS-filter dropouts: z~7
Y-filter dropouts: z~8
J-filter dropouts: z~9

2000-5000 LBGs in the Euclid Deep Fields

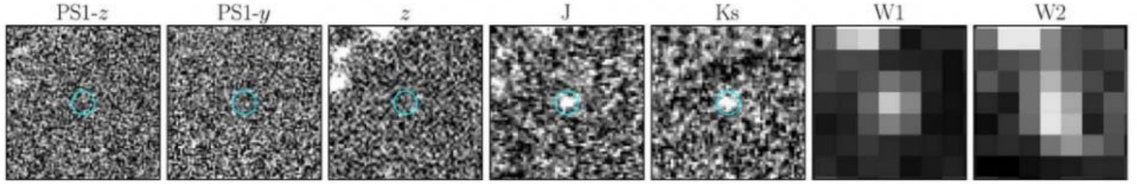
Blue grism spectroscopy will detect Lyman-alpha at z=6.5-9 (up to 6000 in the EDFs)

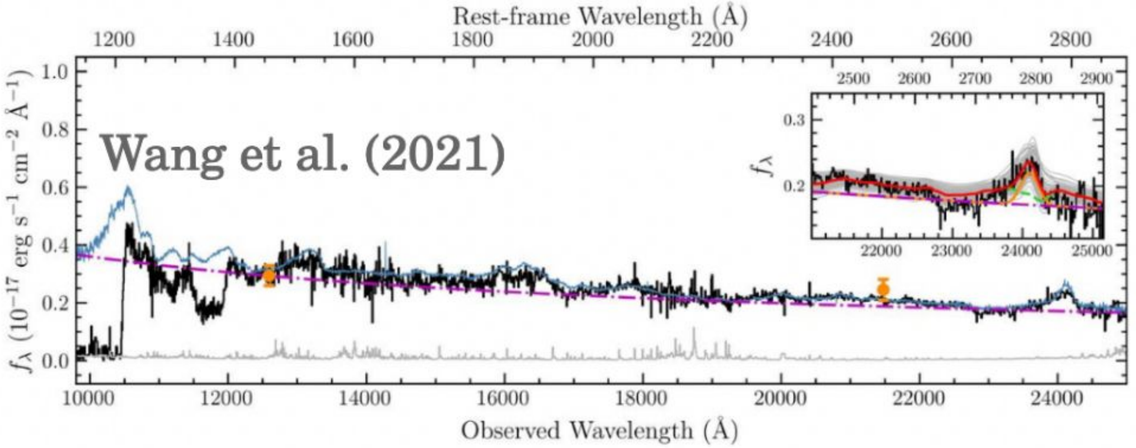
Marco Castellano – PU SWG

Very high-z QSO in Euclid

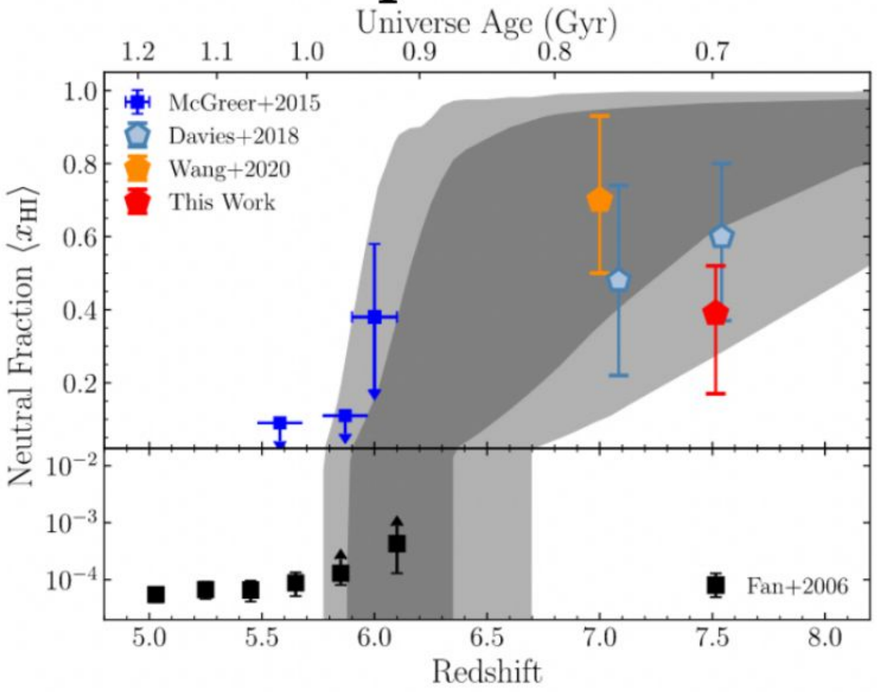
R. Decarli, PU SWG - Quasars

So far, quasars detected up to z~7.5 via dropout techniques





Euclid can push the frontier to z~9



Excellent for:

- black hole seeds,
- signposts of early LSS,
- IGM neutral fraction through reionization

Very high-z QSO in Euclid

R. Decarli, PU SWG - Quasars

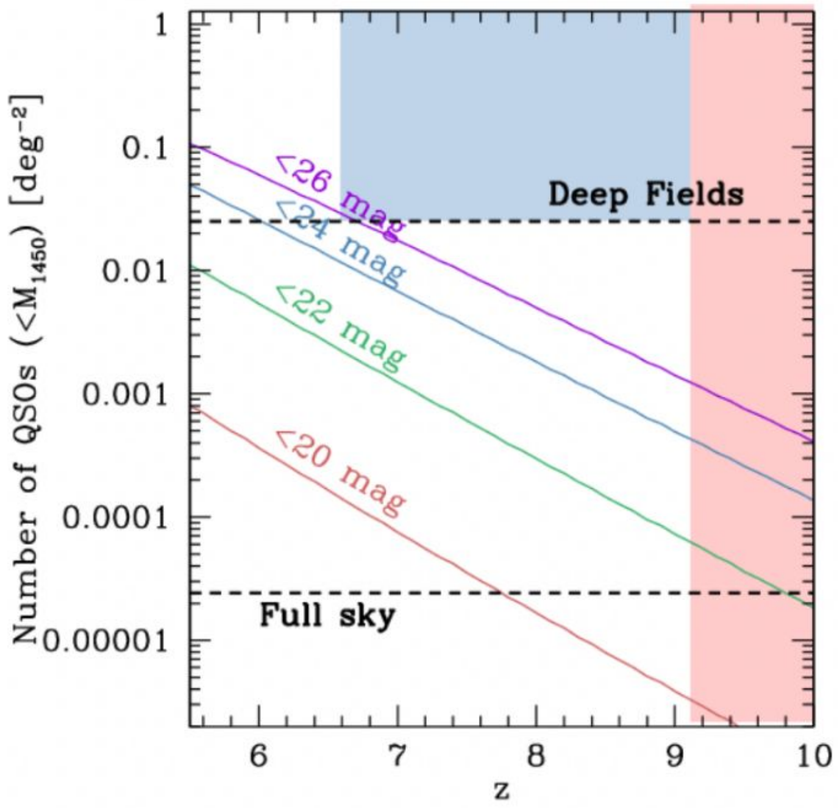
Current activity:

- Refinement of selections
  + pipeline of follow-up obs

- Preparatory runs with NOT and GTC

- Estimates of number density vs mag, z

- Predictions for Blue/Red grism detections



Legacy Science Working Groups:

Conclusions & Issues

+ *Strong involvement of Italian community to SWGs.*
+ *Many PL-KP italian leaders and many Q1/DR1 KP. proposed.*
+ *Contribution to the creation/validation of realistic galaxy mock catalogs for Cosmology & Legacy Science.*
+ *Contribution to build/test/run "local" pipelines for PL-KP.*

BUT

- **Lot of work also for cosmology but not always taken into account desiderata/requirements for Legacy Science.**
- **Total lack in Euclid of a SPV for Legacy Science.**
- **No clear agreement within EC on the use of the pipelines within OUs/SDC with mocks (only on a voluntary basis and locally).**
- **Too high commitments for italians within SGS and to run local pipelines do not allow to lead/work on papers.**
- **Lack of realistic spectra simulations.**
- **No clear information on when the processed data will be made available in the Euclid Archive and poor knowledge of how to retrieve massive data (since additional legacy pipelines have to be run autonomously).**
- **Lack of computing and storage resources for PL-KP/KP→ need of National/international coordination.**