The active galaxies of Euclid

Sotiria Fotopoulou on behalf of WP9

Lecturer

Lead: Classification for OU-PHZ

Co-Lead: Active Galactic Nuclei Working Package

https://www.euclid-ec.org/

Euclid sky coverage: 14,500 sq. deg.

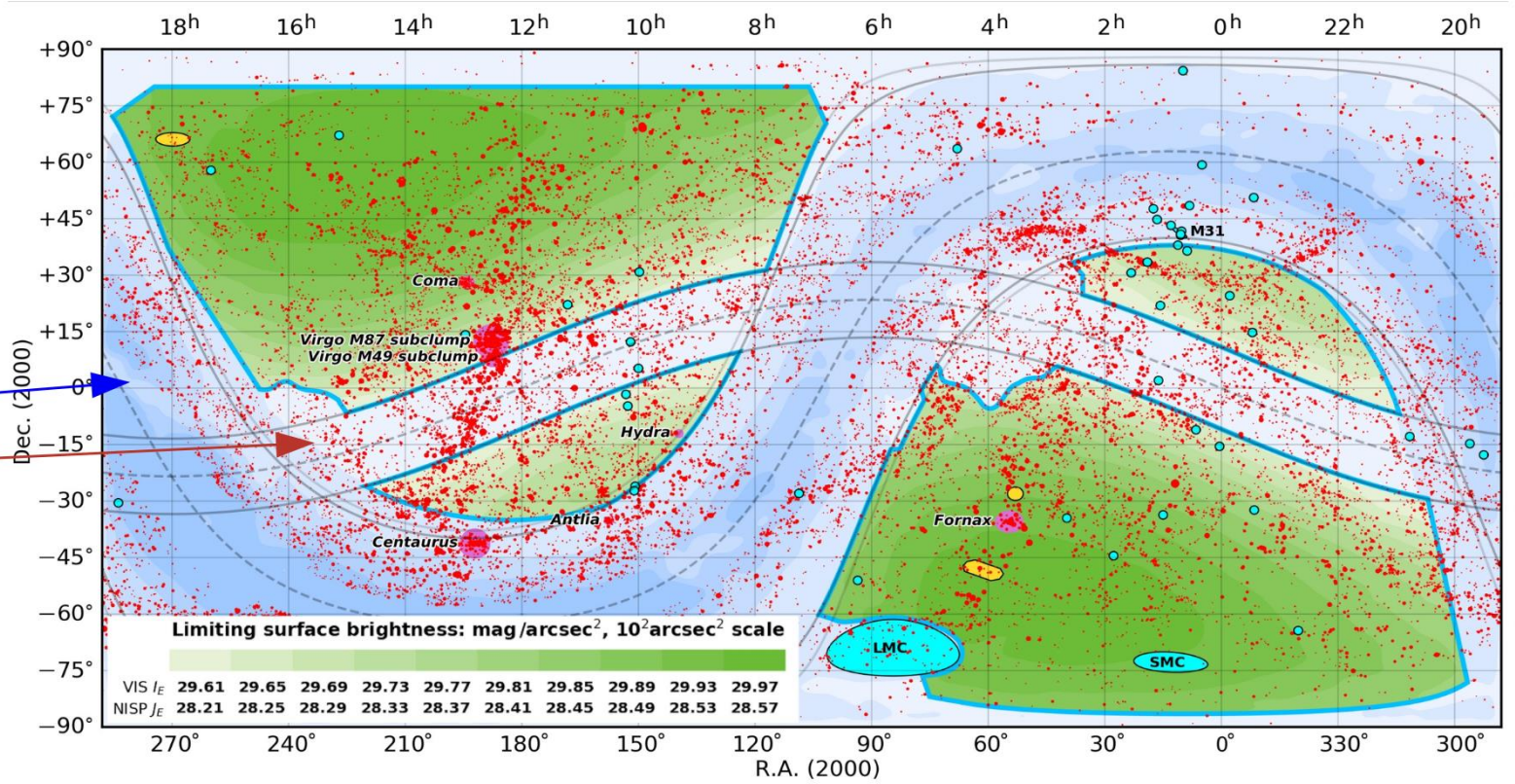
Perseus Galaxy Cluster Euclid-ERO

Euclid will achieve the impossible for HST and JWST:

- **Hubble ~ 1% sky / 30 yr**
- **Euclid ~ 35% sky / 6 yr**

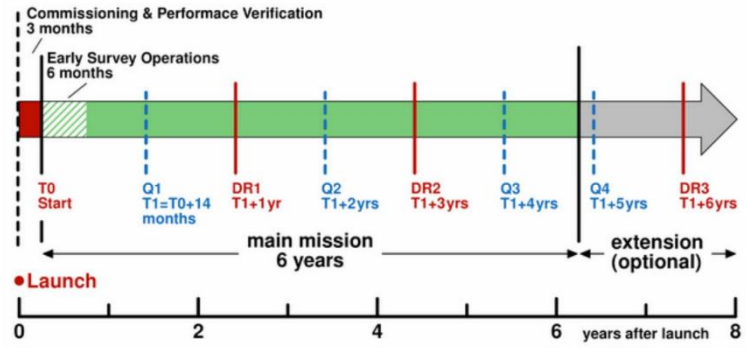
- **Euclid observes in < 1 month more than the entire 30 yr HST archive.**

Euclid avoids:
- **Milky Way**
- **Ecliptic**



Scaramella et al., 2022

Timeline (Scaramella+22)
Launch: 1st July 2023
T0: Dec 2023?
T1 = Mar 2025 (50 deg2, Deep fields at wide depth)
DR1 = Mar 2026 (2,500 deg2)

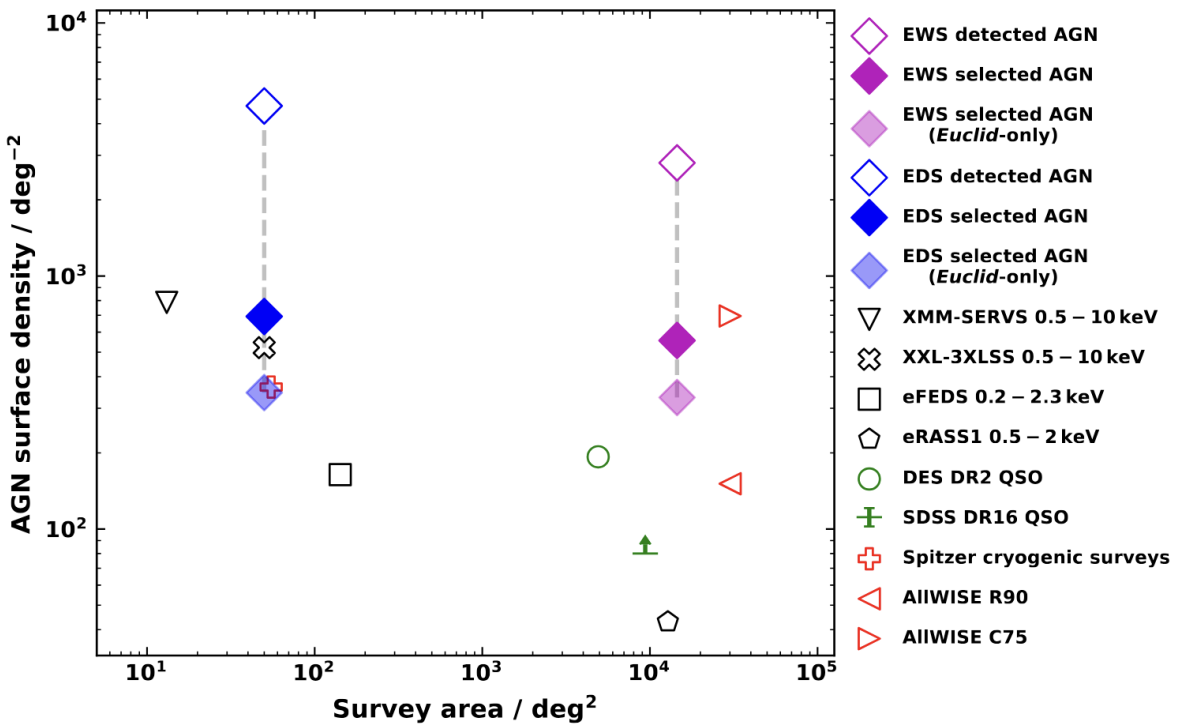


- More than 10 Billion detections
- Peta-bytes of images
- 100s of TB of catalogs

Euclid Preparation – AGN number density

- **Selwood et al., 2024**
  - Observed X-ray AGN density (Fotopoulou et al., 2016)
  - Realistic assumptions on
    - SEDs
    - Redshift
    - E(B-V)
  - Euclid observing strategy
  - 2 x10^3 AGN / sq. deg.
  - Far more detections than any X-ray survey

Euclid Collaboration: A&A, 693, A250 (2025)

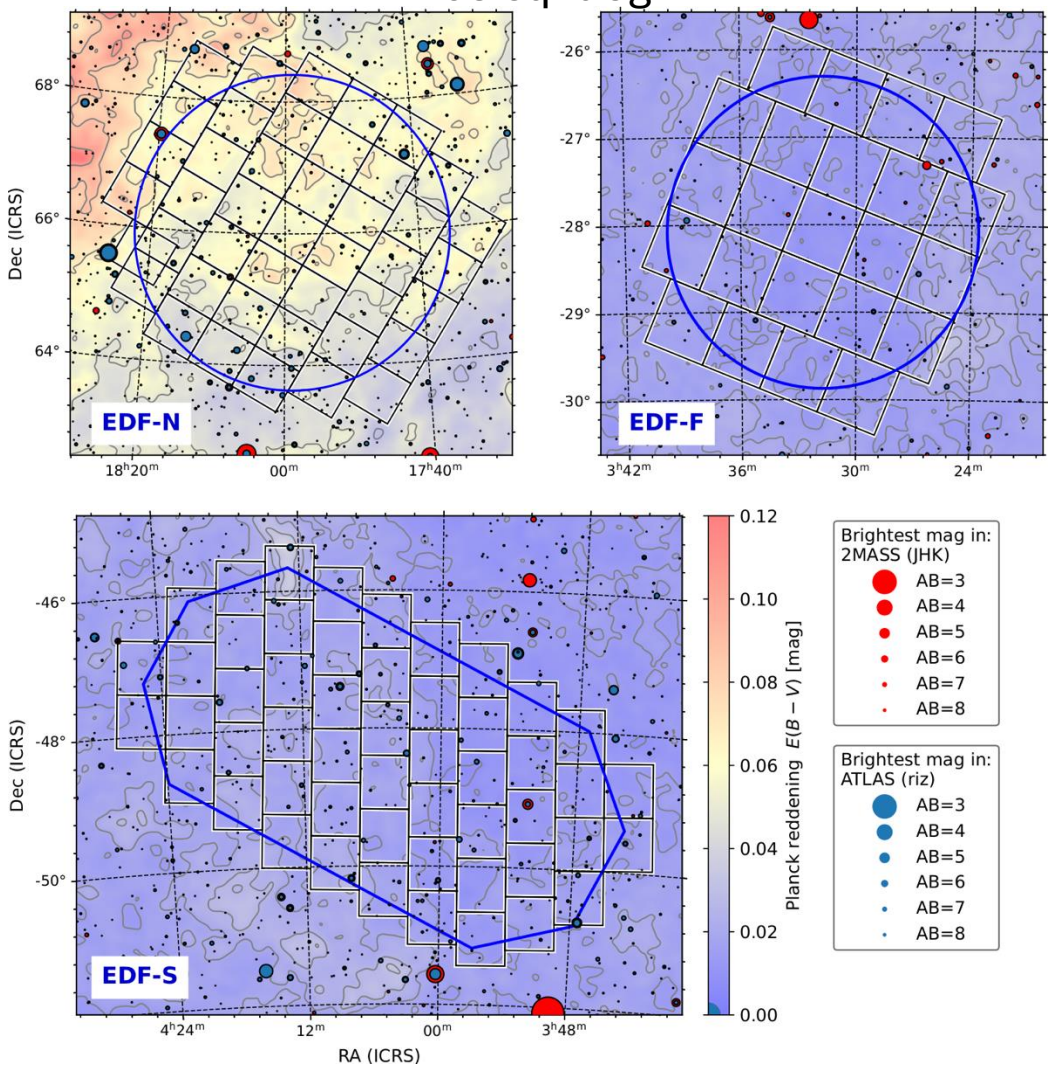


Euclid Quick Release 1 (Q1)

https://www.euclid-ec.org/science/q1/

- March 2025
  - Euclid Deep Field North
  - Euclid Deep Field South
  - Euclid Deep Field Fornax
- 30 million detections
- 26 million galaxies
- Access through ESA's Euclid Science Archive https://eas.esac.esa.int/sas

63 sq. deg.



EC: Aussel et al., 2025

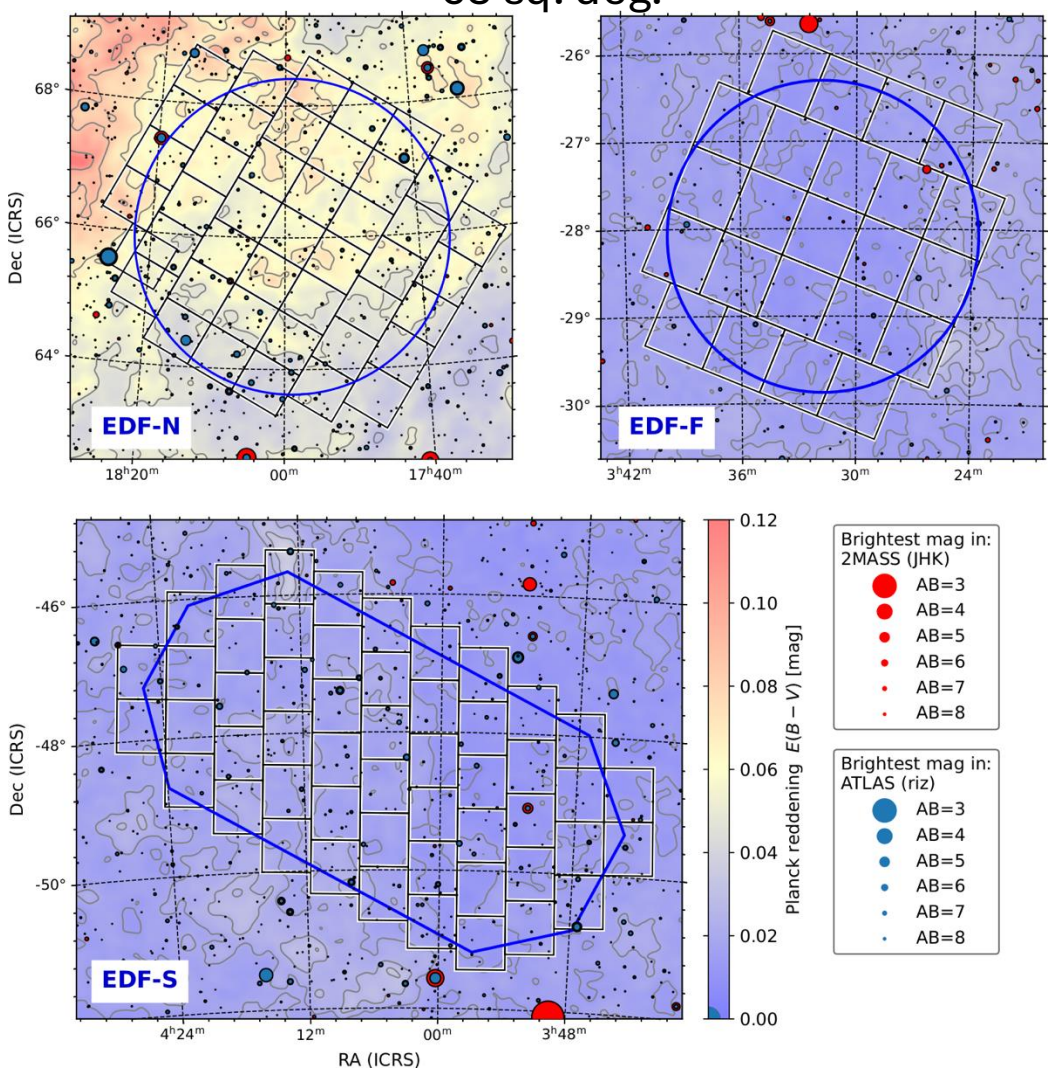
Euclid Quick Release 1 (Q1)

https://www.euclid-ec.org/science/q1/

- 39 papers [Mar ’25]
  - 7 technical papers
  - 32 science papers

- ADS [Jun ’25]:
  - ***“30k** total recent reads”*

63 sq. deg.



EC: Aussel et al., 2025

Q1 AGN papers

- 7 / 32 (22%) AGN papers
- AGN Identification
- Initial characterization
- A lot more on the way!

- **The Active Galaxies of Euclid** (Matamoro-Zatarain et al. 2025)

Photometry based:
- **Optical and near-infrared identification and classification of point-like X-ray selected sources in Q1** *(Roster et al. 2025).*
- **Extending the quest for little red dots to z<4** *(Bisigello et al. 2025).*
- **First study of red quasars selection** *(Tarsitano et al. 2025).*

Morphology based:
- **AGN identification using diffusion-based inpainting of Euclid VIS images** *(Stevens et al. 2025).*
- **First Euclid statistical study of AGN contribution fraction** *(Margalef-Bentabol et al. 2025).*
- **First Euclid statistical study of galaxy mergers and their connection to Active Galactic Nuclei** *(La Marca et al. 2025).*

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Teresa Matamoro

The Active Galaxies of Euclid
[Matamoro et al. 2025]

- Definitive Euclid-AGN paper

- Q1:
  - three sky areas
  - 63 deg^2
  - 30 million sources
- Matched 30M Euclid:
  - X-ray to mid-IR

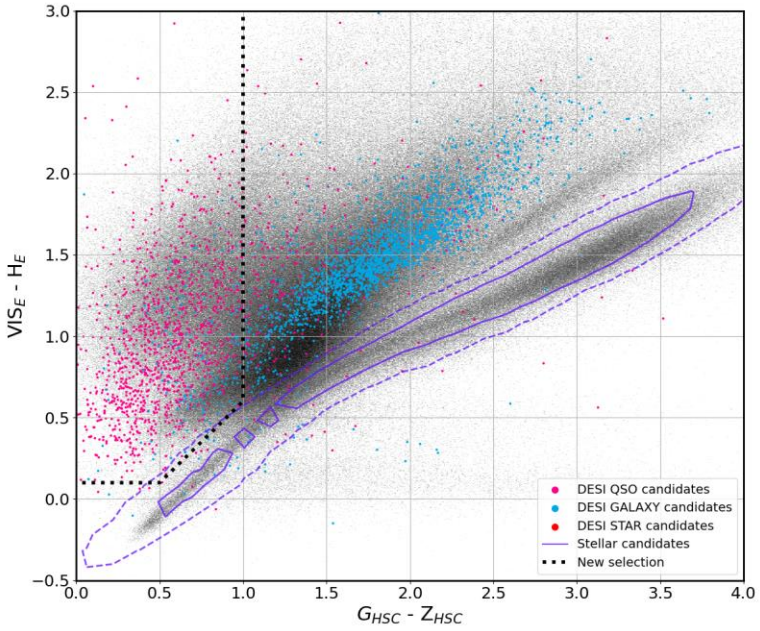
- Invaluable resource

Field	Data set	Sources in field	No. matches	Reference
EDF-N	GALEX	225 685	52 663	This work
	Gaia	192 109	43 253	RE25
	WISE-AllWISE	487 397	266 029	This work
	Spitzer	11 378 352	7 573 476	BL25
	DESI	110 459	24 922	This work
	SDSS	326	18	This work
EDF-S	GALEX	225 268	58 093	This work
	Gaia	130 647	35 263	RE25
	DES	4 258 555	3 197 960	This work
	WISE-AllWISE	352 135	268 281	This work
	Spitzer	13 060 965	8 913 816	BL25
EDF-F	GALEX	778 194	230 466	This work
	Gaia	46 500	14 682	RE25
	DES	4 258 555	1 330 109	This work
	WISE-AllWISE	232 079	147 389	This work
	Spitzer	5 328 489	3 705 597	BL25

Teresa Matamoro

The Active Galaxies of Euclid [Matamoro et al. 2025]

- Novel & **fast** data association ~ 100 TB
- **New** AGN selection criterion



With Mark Taylor

DES, Gaia, LSDR10, GALEX, WISE

Second catalogue data directory

Tile 1 | Tile 2 | Tile 3 | Tile 4 | Tile N

Step 1

Reduced version of second catalogue

Tile_1.fits | Tile_2.fits | Tile_3.fits | Tile_N.fits

Step 2

Create summary of second catalogue

Tile_1.fits | Tile_2.fits | Tile_3.fits | summary.txt

reduced_file_name.fits , [healpix range] , /path/to/original/file

Euclid data directory

Euclid_moc.fits

Step 3

smaller_euclid_catalogue.fits

OBJECTID, RA, DEC, HPIX

Step 4

List of matched files' directories

Catalogue file location
0 /path/to/file/tractor_1.csv.gz
1 /path/to/file/tractor_2.csv.gz
2 /path/to/file/tractor_3.csv.gz

Association file

Eu_id , Eu_RA , Eu_DEC , Eu_HPIX , Catalogue_HPIX_range , Catalogue_file , Catalogue_file_location

Euclid data | Catalogue data

Step 5

Combined_table_of_matched_files.fits

DONE ONCE

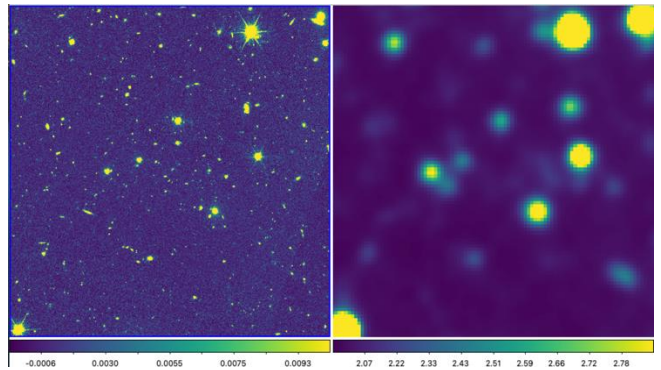
Step 6

Sources_in_Euclid_region.fits

Euclid_catalogue.fits

Step 7

Matched_catalogue.fits



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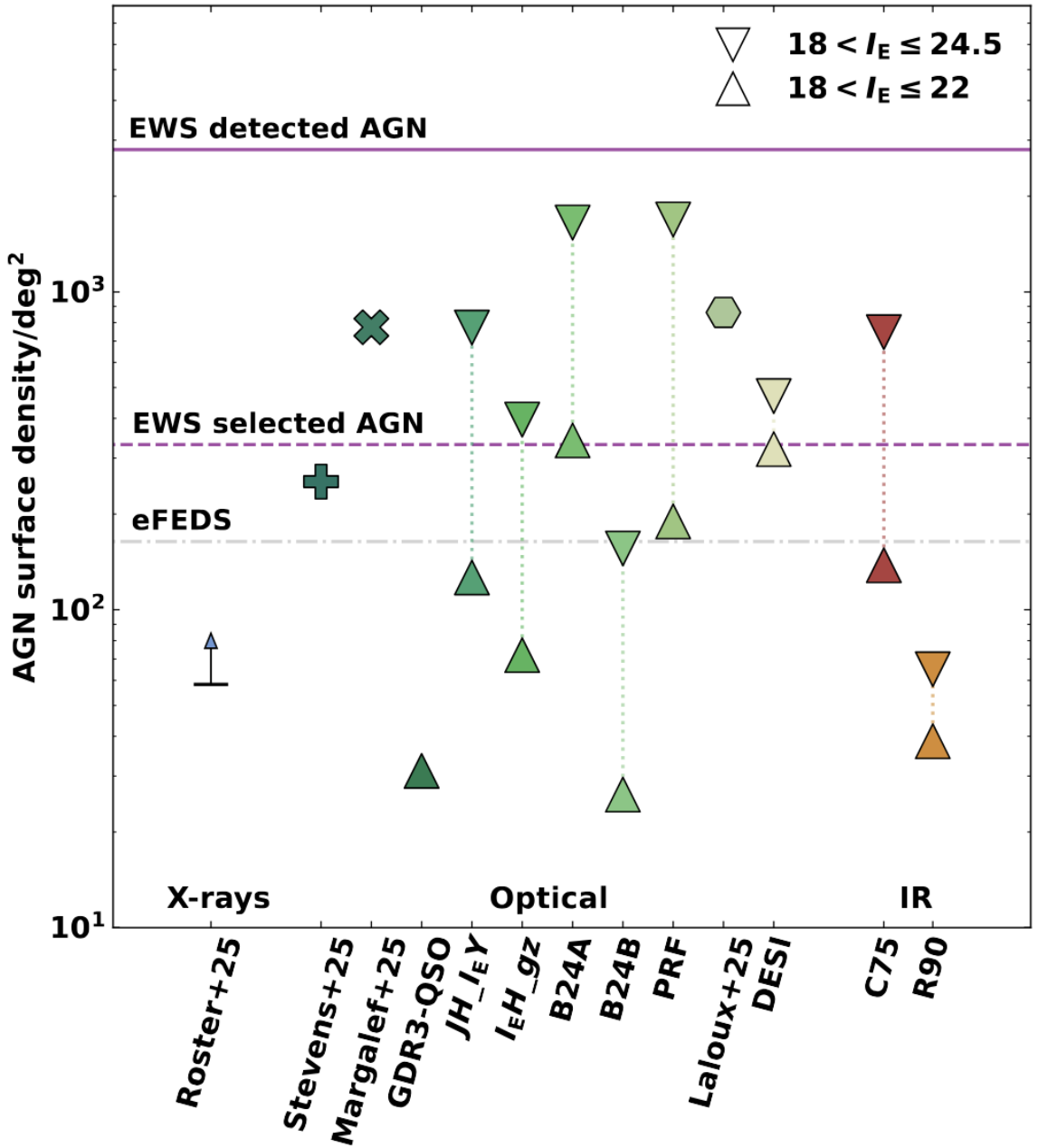
The Active Galaxies of Euclid [Matamoro et al. 2025]

- 15 colour selections
- 2×10^5 AGN candidates
- 3 500 AGN / sq. deg.
  - in agreement with predictions



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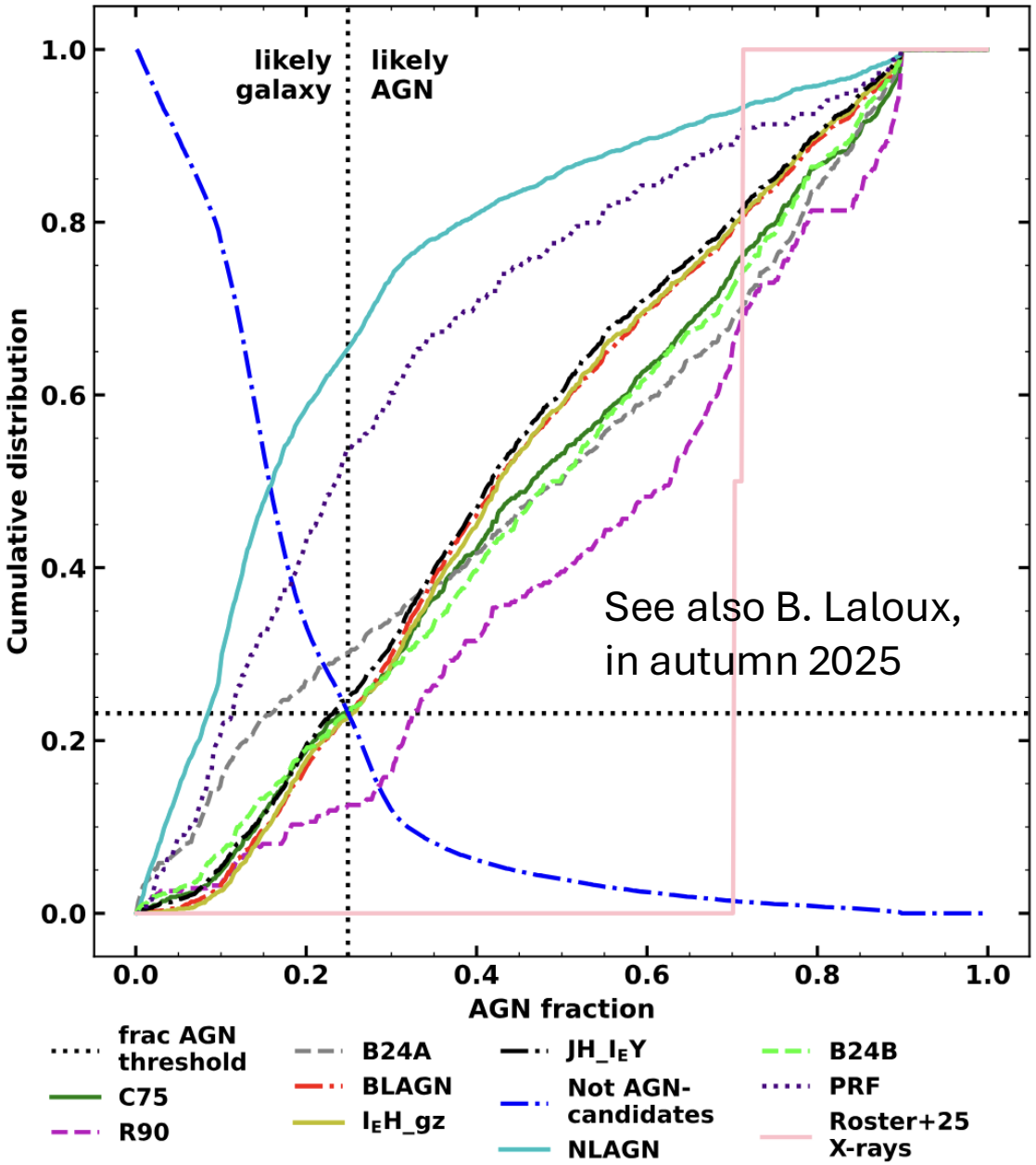
The Active Galaxies of Euclid [Matamoro et al. 2025]

- 15 colour selections
- 2×10^5 AGN candidates
- 3 500 AGN / sq. deg.
  - in agreement with predictions
- SED decomposition
  - Matamoro+25
  - Laloux, in prep.



The Active Galaxies of Euclid [Matamoro et al. 2025]

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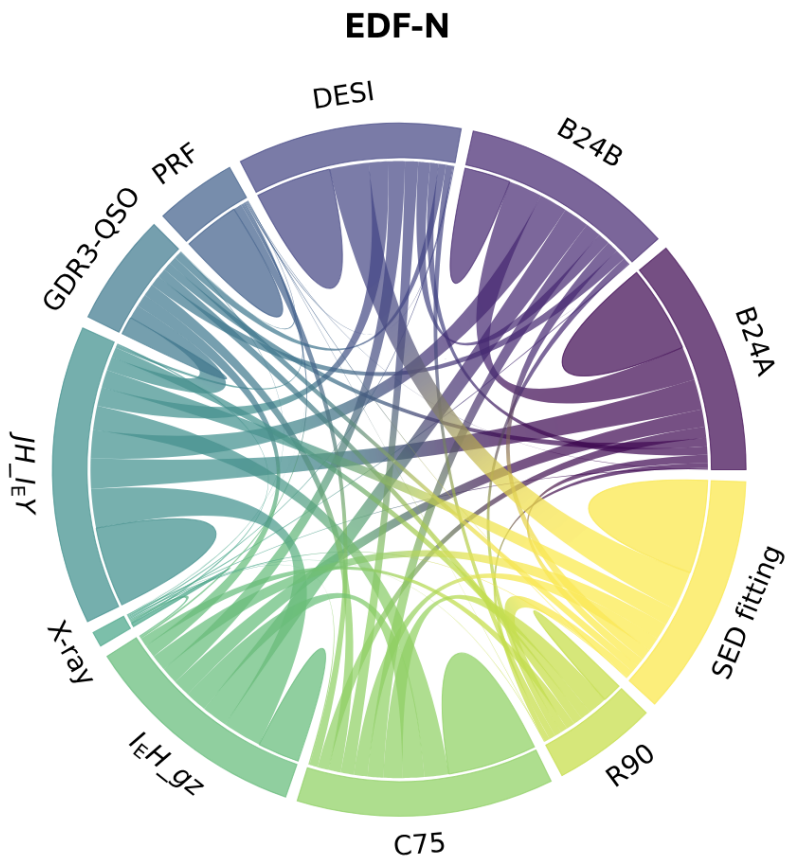
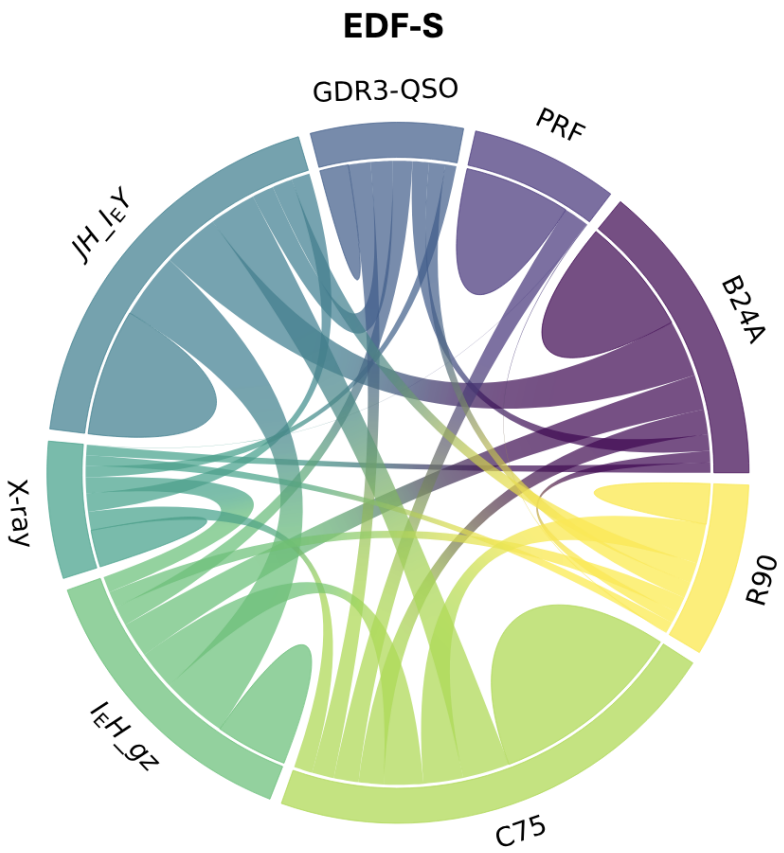
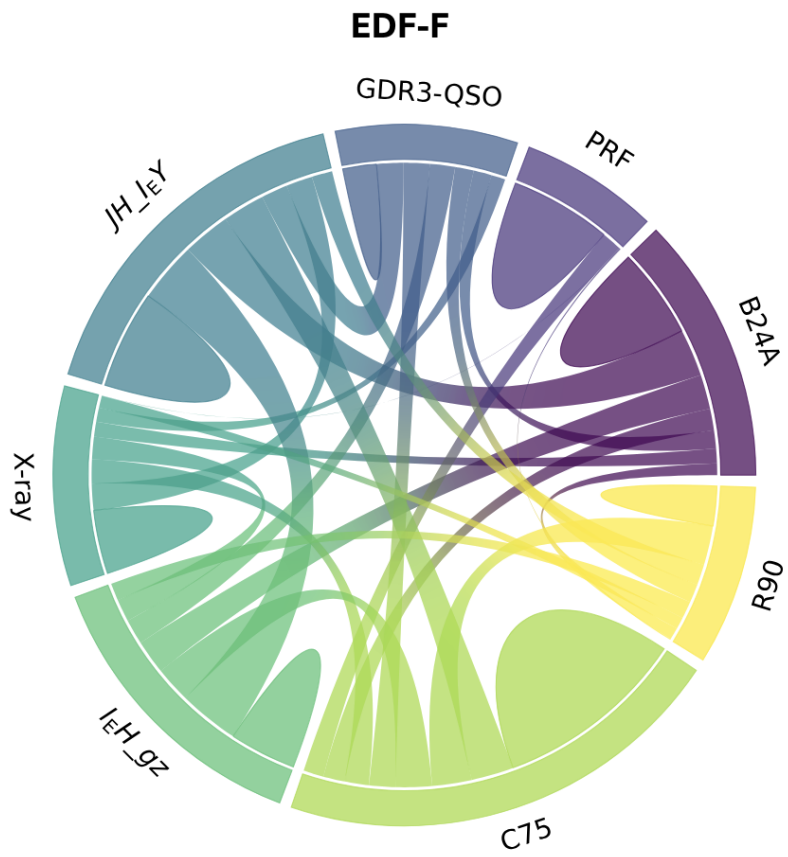


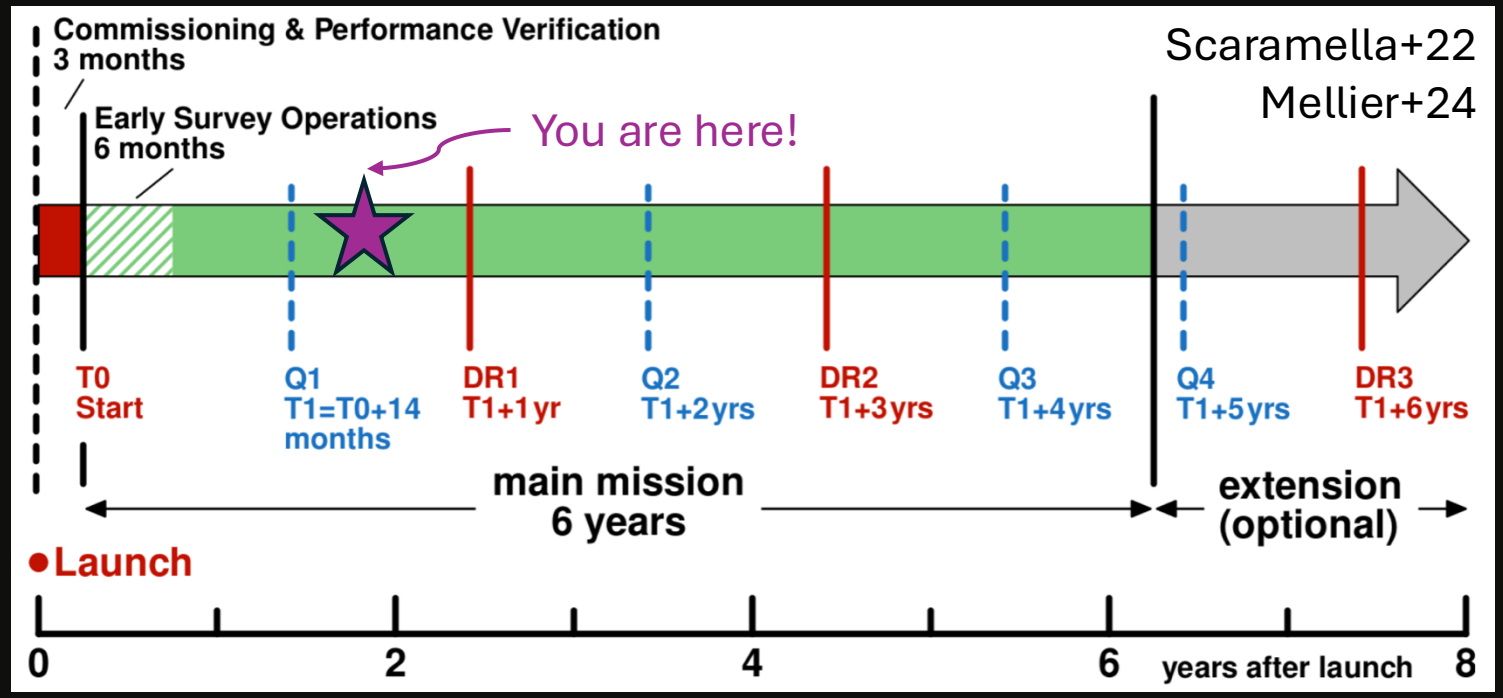




Stay tuned for DR1

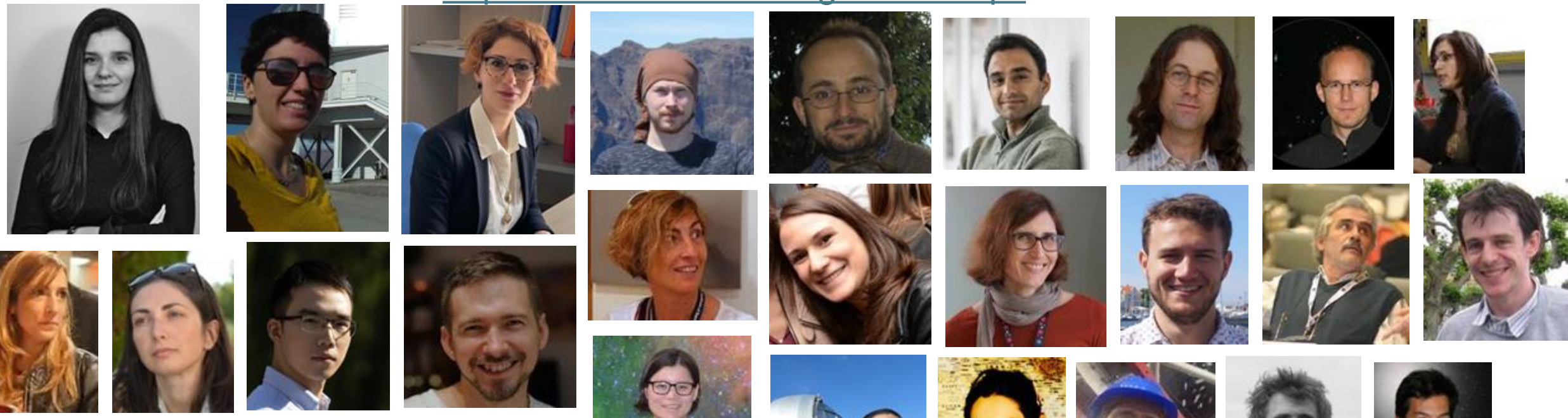
Q1 x 30!

- 2k sq.deg.
- 900 million detections
- 7 million AGN!



Thanks to the efforts of our team!

https://www.euclid-ec.org/science/q1/



and to all Euclid consortium members