Euclid Quick Release 1 (Q1) Webinar

Euclid NASA Science Center at IPAC (ENSCI)
April 4, 2025

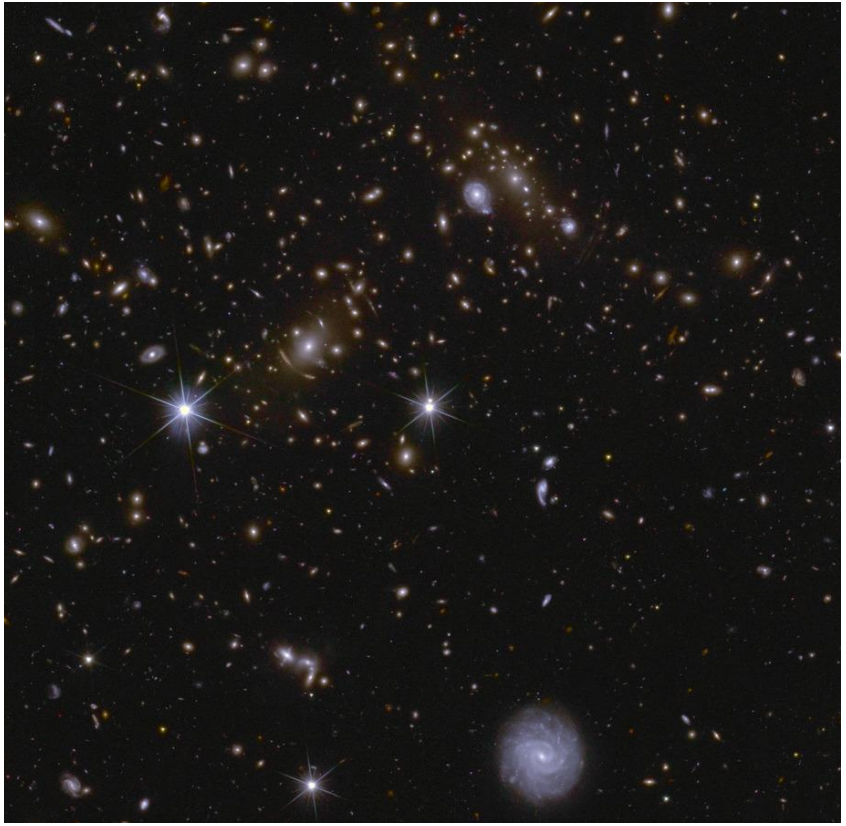
Webinar schedule

(All times are in Pacific time)

Presentations

- Introduction slides
  - What is Euclid
  - Data release schedule
  - What are the Q1 data products
  - How do you access data?
- IRSA overview
  - Web portal walkthrough
- Notebooks
- Advance questions
- Final thoughts

Questions



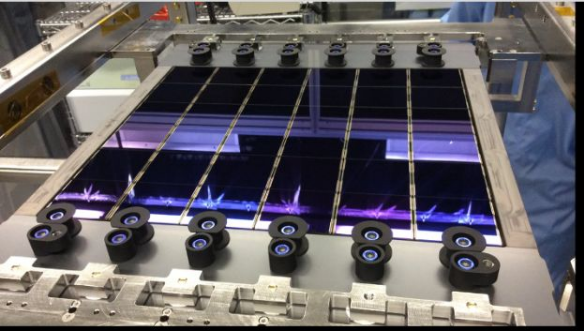
Euclid’s Deep Field South, Credit: ESA/Euclid/Euclid Consortium/NASA

What is Euclid?

Euclid

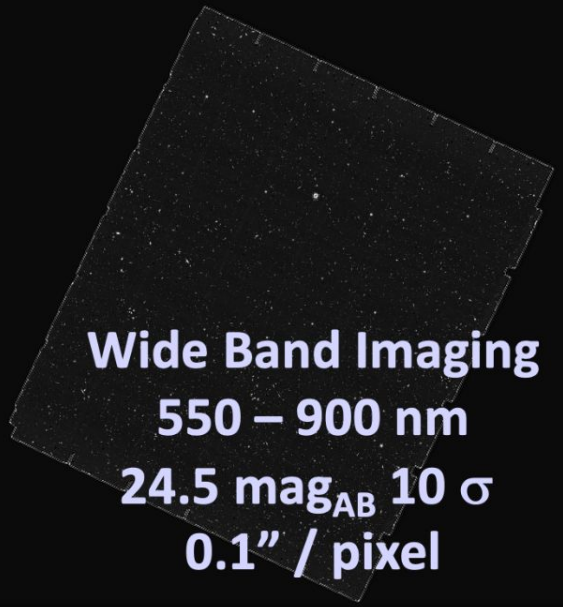
- NASA contributed 16 state-of-the-art infrared detectors
- Nominated three US science teams
- NASA established the Euclid NASA Science Center at IPAC (ENSCI) to support US-based investigators using Euclid data

- Euclid is ESA M-class mission to study the geometry and nature of the dark Universe
  - Launch: July 1, 2023
  - 6+ year lifetime at L2
- Euclid Consortium
  - International consortium of > 1,000 members who developed instruments, manage science operations and analyze data

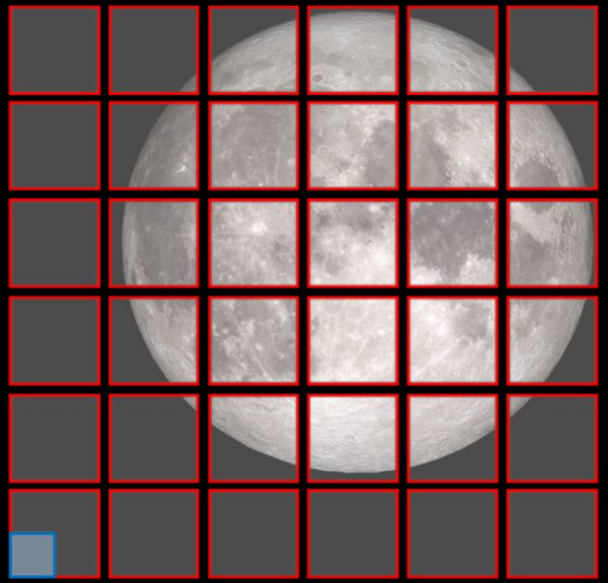


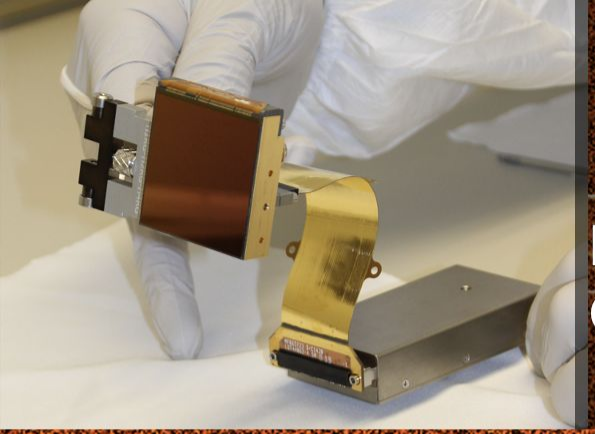
VIS

Shape Measurements ~ 1.5 billion galaxies



Wide Band Imaging
550 – 900 nm
24.5 mag_{AB} 10 σ
0.1” / pixel



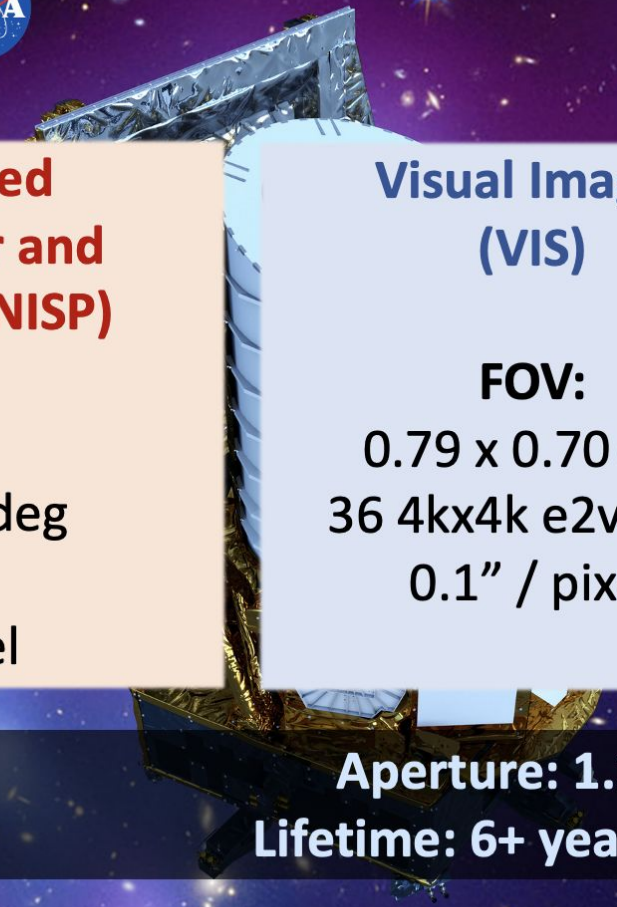


NISP

Photometric Redshifts: ~ 1.5 billion galaxies
Grism Redshifts: ~30 million galaxies
Hα 0.9 < z <1.8

- YJH Photometry 24 mag_{AB} 5σ
- Red Grism 1.206 – 1.892 μm
- Blue Grism 0.926 – 1.366 μm
  - deep field only
- R ~ 380 (0.5" source)
- 0.3" / pixel

Euclid Summary



Near-Infrared Spectrometer and Photometer (NISP)

FOV:
0.78 x 0.73 deg
16 H2RGs
0.3” / pixel

Visual Imager (VIS)

FOV:
0.79 x 0.70 deg
36 4kx4k e2v CCDs
0.1” / pixel

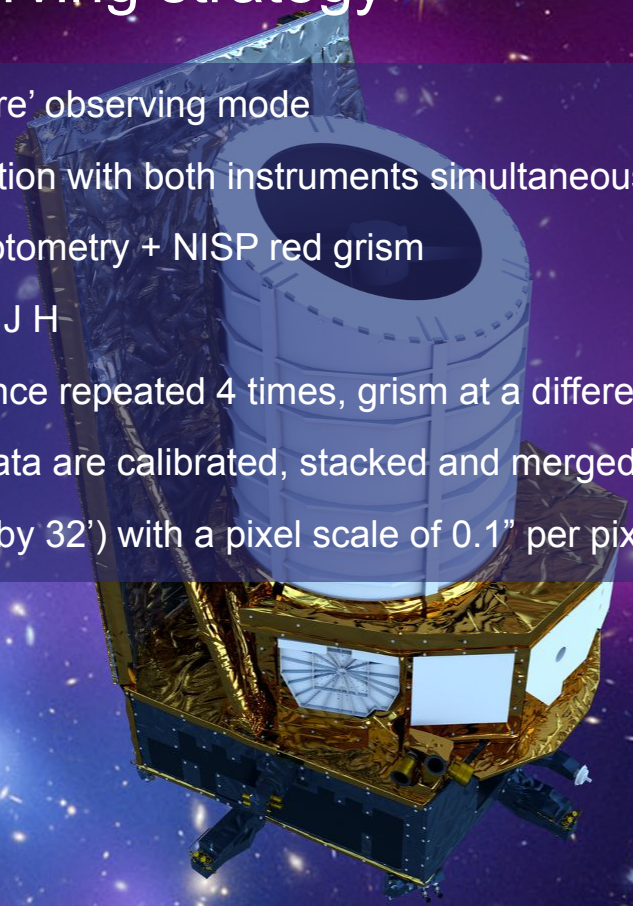
Ground-based data

Optical photometry will be shared by other surveys for essential photo-z estimates.

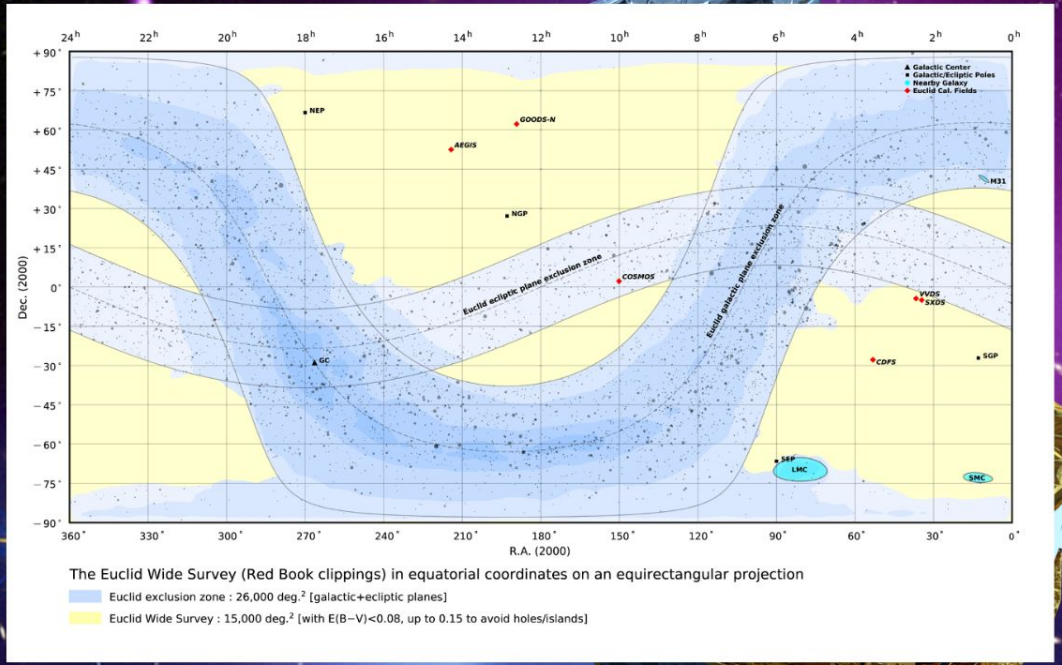
Aperture: 1.2 m
Lifetime: 6+ years at L2

Euclid Observing strategy

- ‘Step and stare’ observing mode
- Observe position with both instruments simultaneously, 4 point dither pattern
  - VIS photometry + NISP red grism
  - NISP Y J H
- Dither sequence repeated 4 times, grism at a different position angle
- All imaging data are calibrated, stacked and merged into background subtracted MER Mosaics (32’ by 32’) with a pixel scale of 0.1” per pixel



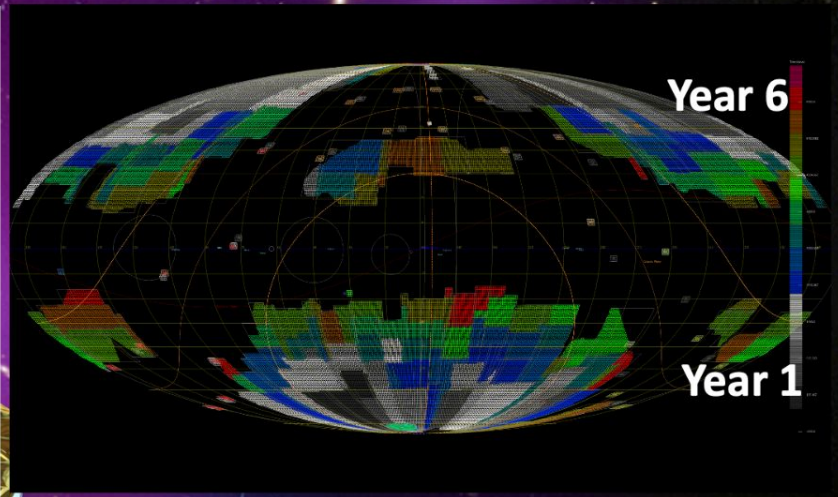
Euclid Surveys



The Euclid Wide Survey (Red Book clippings) in equatorial coordinates on an equirectangular projection

Euclid exclusion zone : 26,000 deg.^{2} [galactic+ecliptic planes]

Euclid Wide Survey : 15,000 deg.^{2} [with E(B−V)<0.08, up to 0.15 to avoid holes/islands]



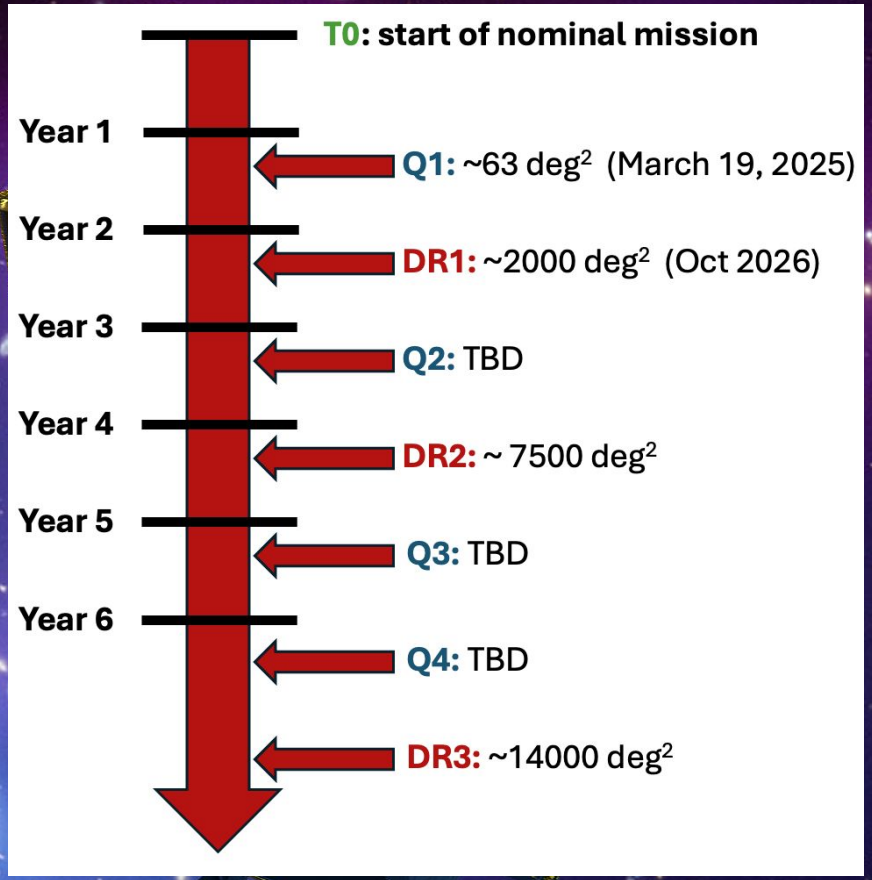
Wide Survey: ~14,000 deg^2, |b| > 30^o

3 Deep Fields:

- **EDF-N 20 deg^2 @ NEP**
- **EDF-S 23 deg^2 near SEP**
- **EDF-F (Fornax) 10 deg^2 CDFS**

+ monthly 4 deg^2 Calibration Field

Data release schedule



For updates, please check: https://euclid.caltech.edu/page/data-release-timeline

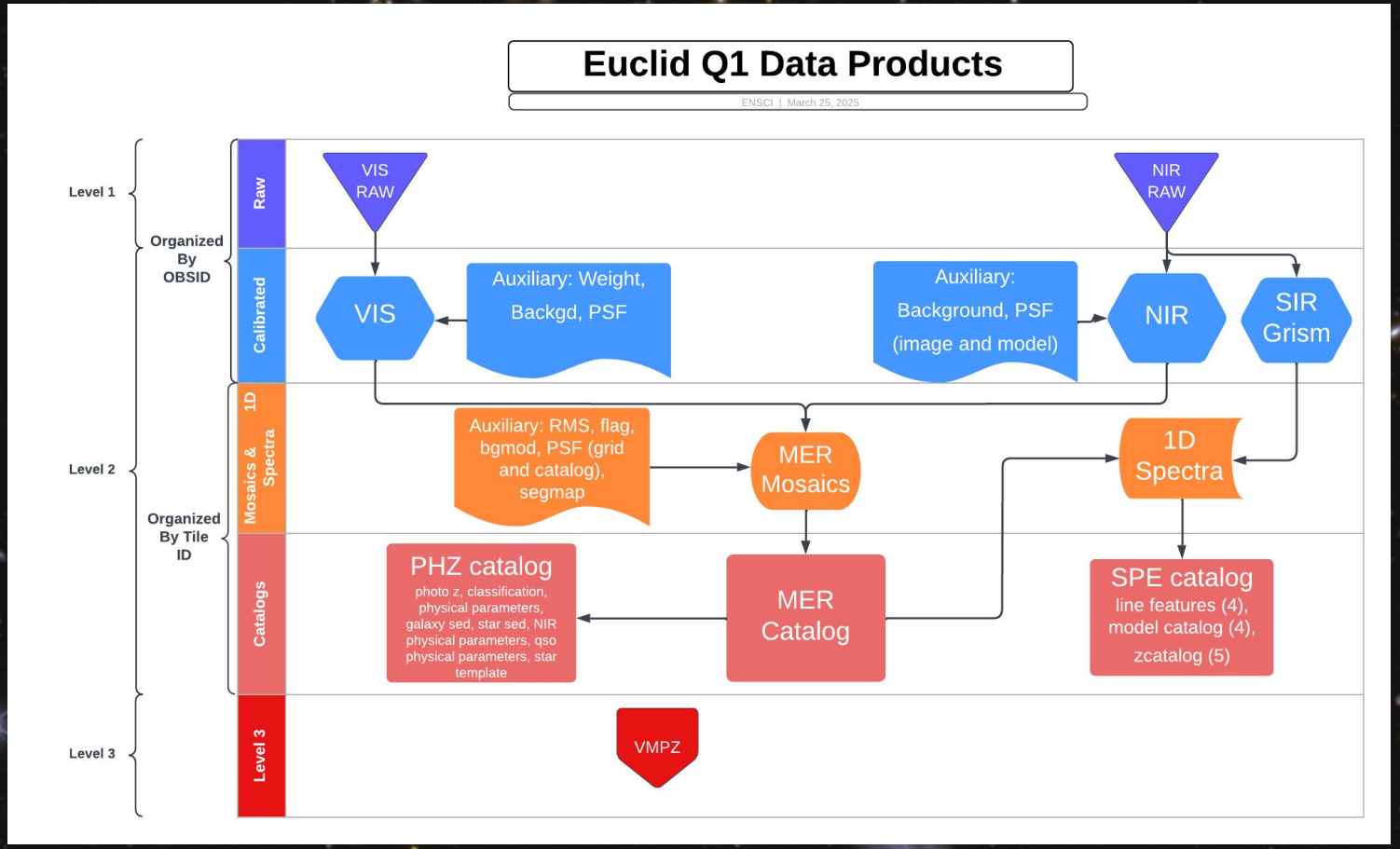
Q1 data products

Euclid Q1 summary

- Data were obtained on: July-September 2024
  - EDF-N (North) covering an area of 22.9 deg^2 with (ra, dec) = (269.733º, +66.018º)
  - EDF-S (South) covering an area of 28.1 deg^2 with (ra, dec) = (61.241º, −48.423º)
  - EDF-F (Fornax) covering an area of 12.1 deg^2 with (ra, dec) = (52.932º, −28.088º)
  - Lynds' Dark Nebula (LDN 1641) covering an area of 0.5 deg^2 with (ra, dec) = (85.750º, -8.394º)

Data products:

- Level 1
  a. raw frames from VIS and NISP instruments
- Level 2
  a. Calibrated VIS & NISP images
  b. 2D grism dispersed frames and combined 1D spectra
  c. Merged mosaics and catalogs
  d. Photometric redshift estimates
  e. Line measurements and redshifts from spectra
- Level 3
  a. visibility masks



For a detailed list of data products, please see the IRSA Euclid User Guide, ESA DPDD, or https://euclid.caltech.edu/page/data-products

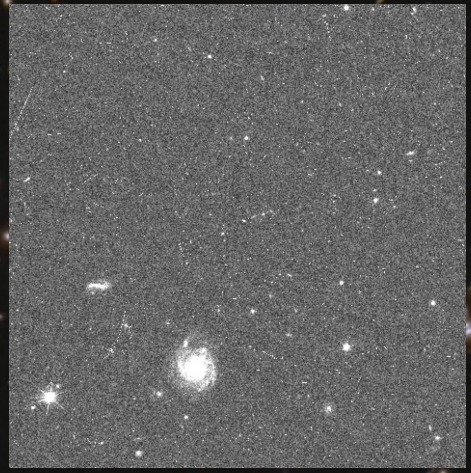
VIS and NIR

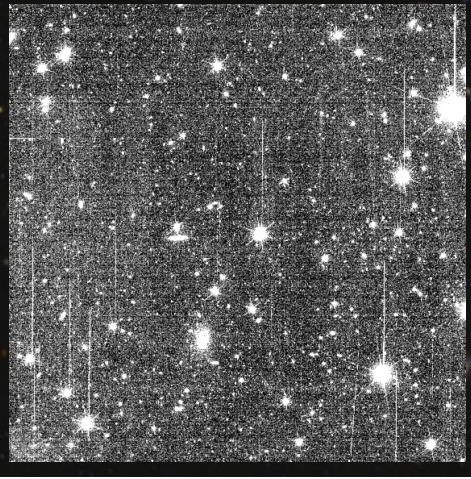
VIS products (Euclid Collaboration - McCracken et al. 2025)

- Calibrated frame -calibrated frame for each dither exposure, science frame (SCI), the RMS map (RMS), and the flag map (FLG).
- Background calibrated frame model map - The background model map associated with each calibrated frame.
- Weight map - The weight map associated with each VIS calibrated frame.
- PSF - PSF FITS file.

NIR products (Euclid Collaboration - Polenta et al. 2025)

- Calibrated frame - calibrated frame for each dither exposure, science frame (SCI), the RMS map (RMS), and data quality flags (DQ).
- Background - These are multi-extension FITS files with 48 extensions, covering all 16 detectors and 3 filters (Y, J, and H).
- PSF - PSF FITS files, with one file per filter.

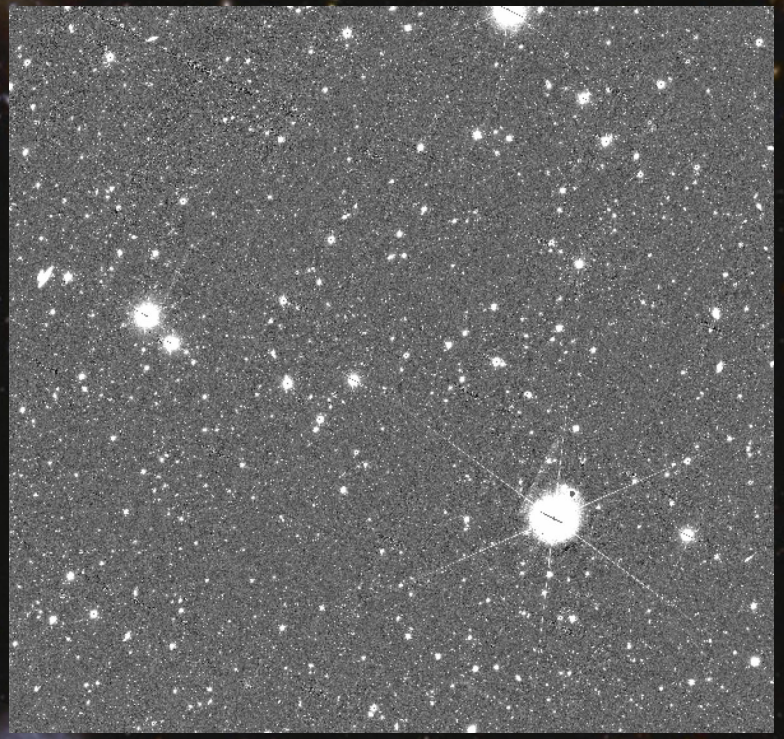




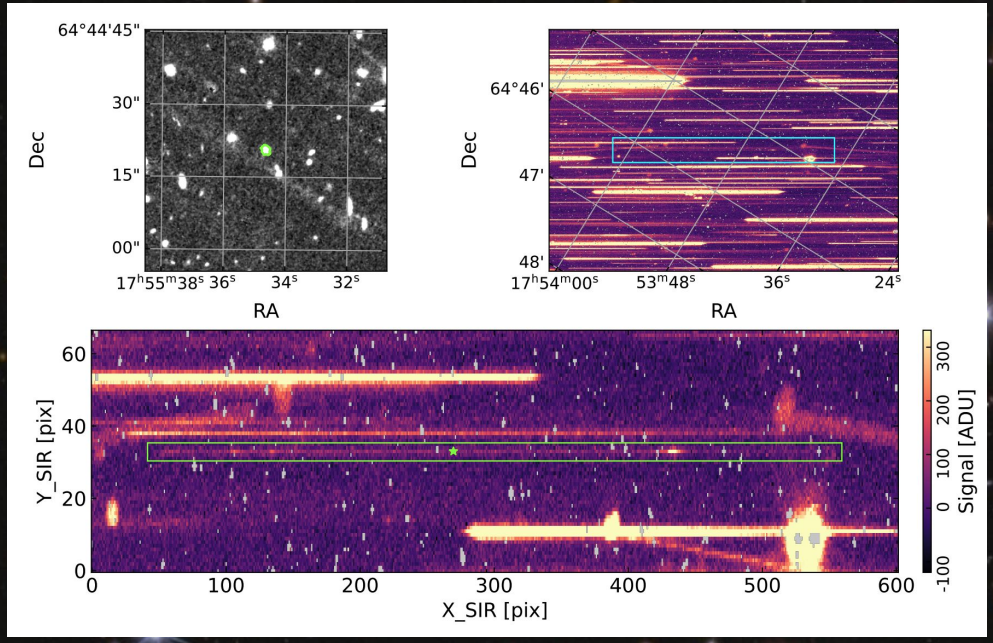
MER products

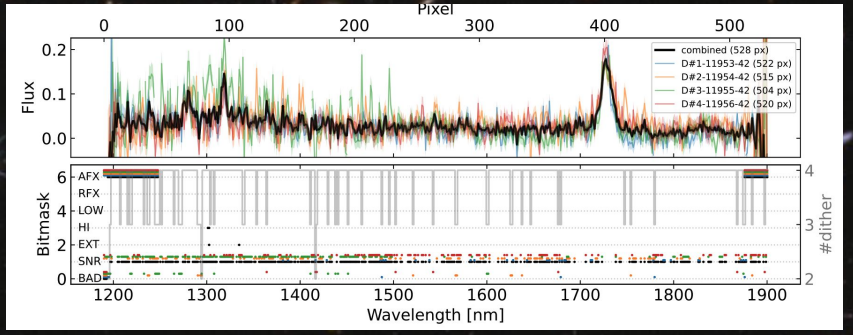
Euclid Collaboration - Romelli et al. 2025

- BGSUB-MOSAIC - FITS file containing the primary, merged, background-subtracted mosaic.
- RMS - FITS file containing the mosaic RMS noise data set.
- FLAG - FITS file containing the mosaic flag data set.
- BGMOD - FITS file containing the subtracted background model.
- CATALOG-PSF - FITS file containing the mosaic PSF CATALOG model.
- SEGMAP - Map showing the connected pixels of the objects detected on the corresponding MER Detection Mosaic Product. The object id numbers in the segmentation map coincide with the id numbers in the object catalog.



Spectra



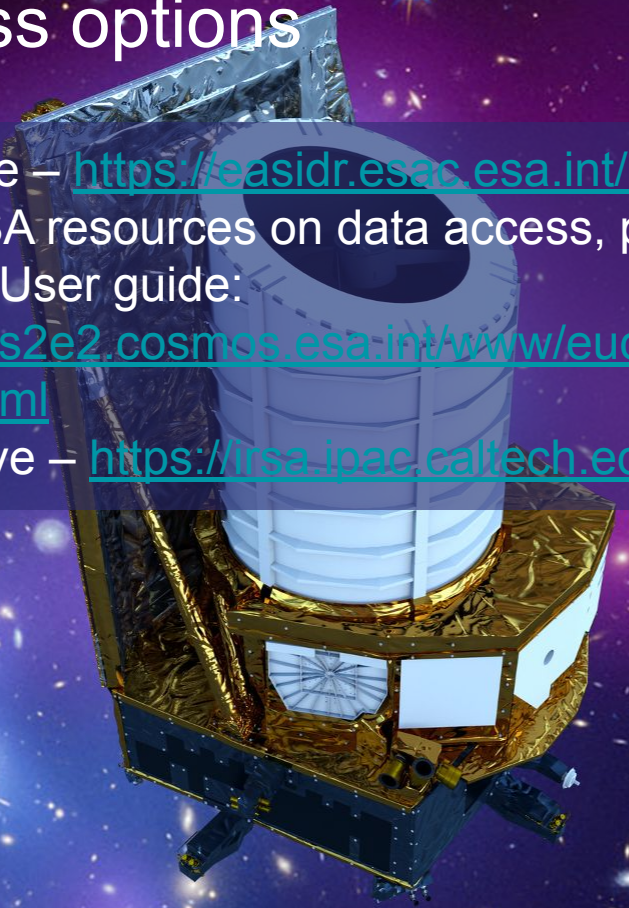


Euclid Collaboration: Copin et al. (2025)

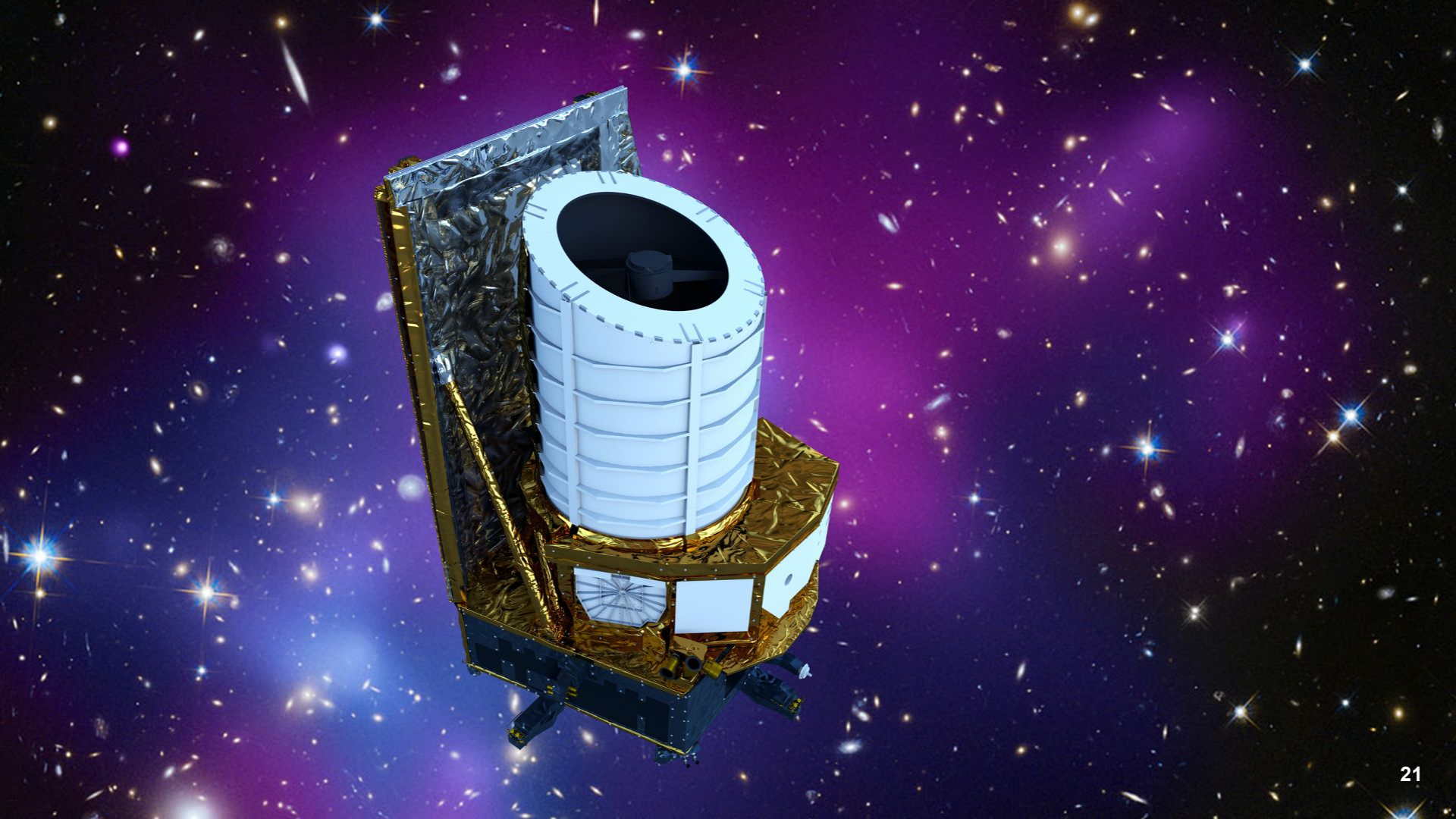
How to access Euclid data

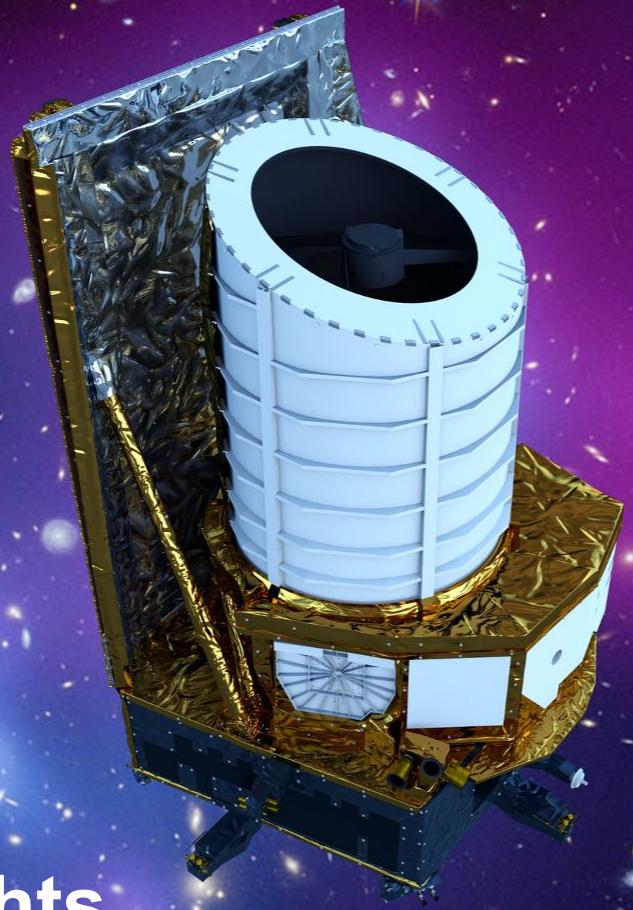
Data access options

- ESA archive – https://easidr.esac.esa.int/sas/
  - For ESA resources on data access, please refer to the ESA Public User guide: https://s2e2.cosmos.esa.int/www/euclid_iscience/Public_User_Guide.html
- IRSA archive – https://irsa.ipac.caltech.edu/Missions/euclid.html



IRSA overview





Final thoughts

Advance questions (1)

- How to do cutouts of MER images:
  - IRSA Euclid data explorer
  - IRSA image server cutouts
  - Python – use Cutout2D from astropy
- How to access spectra:
  - S3 bucket with IRSA
  - Python notebook (IRSA)– euclid.objectid_spectrafile_association_q1
  - IRSA browsable directories
  - ESA archive ADQL (sedm.spectra_source) click the link (select the source_id)
- How do I do a bulk download of Q1 data from IRSA?
  - IRSA slides
- What intermediate data products are available?
  - No intermediate data products beyond what is in Q1 are available.
- Do we have access to the Euclid pipeline to reprocess data?
  - No, ESA has not made the pipeline public.

Advance questions (2)

- Please describe the PSF models
  - What PSF models are available :
    - **NIR:** PSF image (.fits) and model (.psf) made for each dither pointing with one PSF for each detector. The PSFs are made using SExtractor+PSFex from Bertin et al. 2011. Details in “Euclid collaboration: Polenta et al. 2025”)
    - **VIS:** a PSF grid for each detector at each dither pointing. The PSFs are made using SExtractor+PSFex from Bertin et al. 2011. Details in “Euclid collaboration: McCracken et al. 2025”)
    - **MER:** takes PSF products from NIR and VIS and propagates them into MER mosaic grid as catalog PSF and grid PSF. Details in “Euclid collaboration: Romelli et al. 2025”

- When are future data releases and what areas on the sky will be observed?
  - See slide in this presentation and our web page
  - It is not public currently which regions on the sky will be available in each data release, but we are working with them to understand when that information will be available.

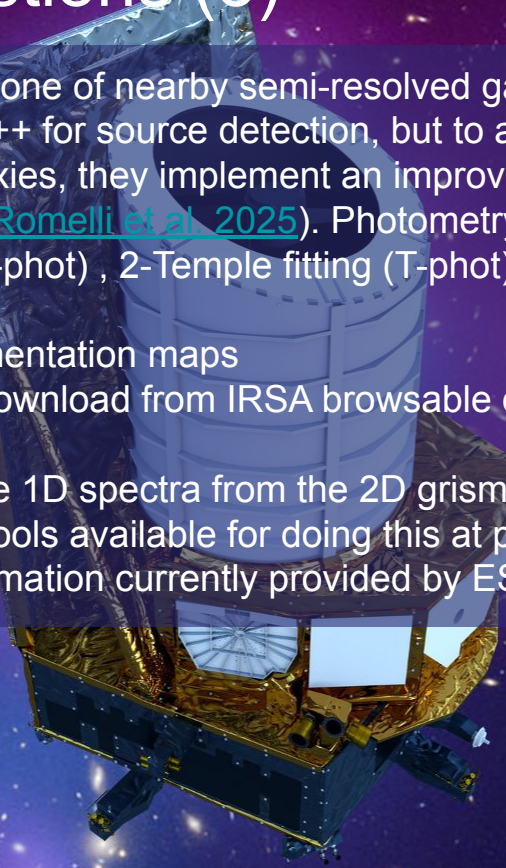
- Is the LDN 1641 processing the same?
  - Yes, these data are processed in the same way as the other pointings, though there are limitations to the data.
    - Background subtraction pipeline
  - See Euclid Collaboration: Aussel et al. 2025

Advance questions (3)

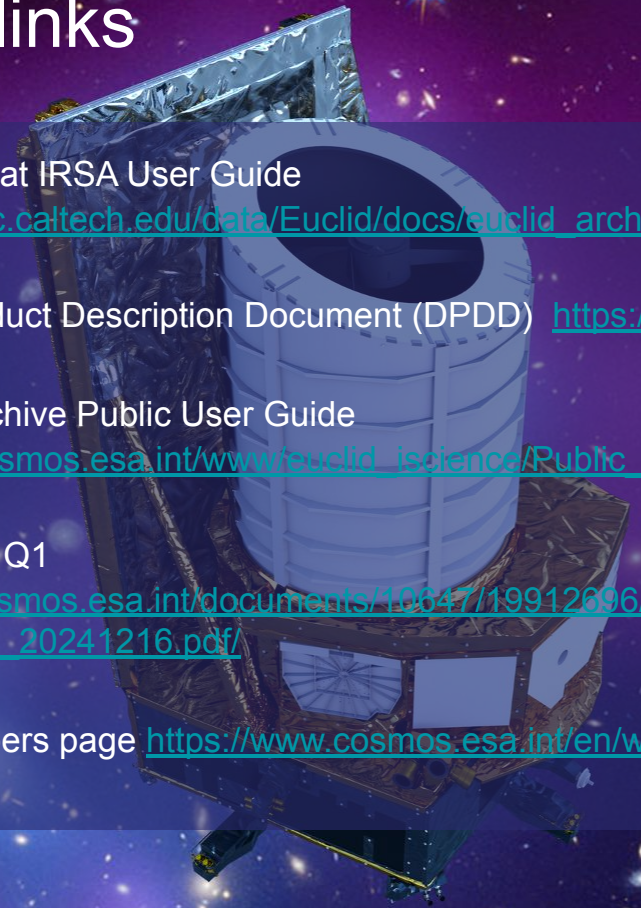
- How is photometry done of nearby semi-resolved galaxies?
  - MER uses SE++ for source detection, but to avoid false detections around large, extended galaxies, they implement an improved detection scheme in SE++ (Euclid collaboration: Romelli et al. 2025). Photometry is done in various ways: 1-Aperture photometry (A-phot) , 2-Temple fitting (T-phot), 3-Model fitting (SE++)

- How to access segmentation maps
  - Available for download from IRSA browsable directories

- How can I extract the 1D spectra from the 2D grism dispersed frames?
  - There are no tools available for doing this at present. There is no easy way to do this based on information currently provided by ESA.

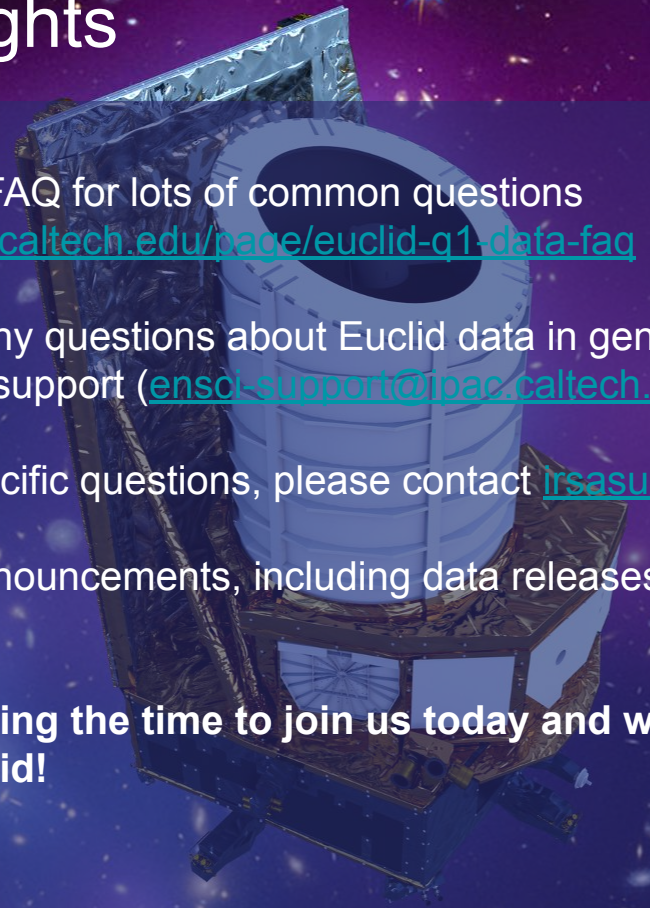


Important links



- Euclid Archive at IRSA User Guide https://irsa.ipac.caltech.edu/data/Euclid/docs/euclid_archive_at_irsa_user_guide.pdf
- ESA Data Product Description Document (DPDD) https://euclid.esac.esa.int/dr/q1/dpdd/
- ESA Euclid Archive Public User Guide https://s2e2.cosmos.esa.int/www/euclid_iscience/Public_User_Guide.html
- ESA memo on Q1 https://www.cosmos.esa.int/documents/10647/19912696/EUCL-ESAC-CR-9-001_list_products_science_archive_1_1_20241216.pdf/
- ENSCI Q1 papers page https://www.cosmos.esa.int/en/web/euclid/euclid-q1-data-release

Final thoughts



- Visit our Q1 FAQ for lots of common questions https://euclid.caltech.edu/page/euclid-q1-data-faq
- If you have any questions about Euclid data in general feel free to contact our helpdesk for support (ensci-support@ipac.caltech.edu)
- For IRSA specific questions, please contact irsasupport@ipac.caltech.edu
- For future announcements, including data releases, please sign up for our ENSCI mailing list

Thank you for taking the time to join us today and we hope you do incredible science with Euclid!