

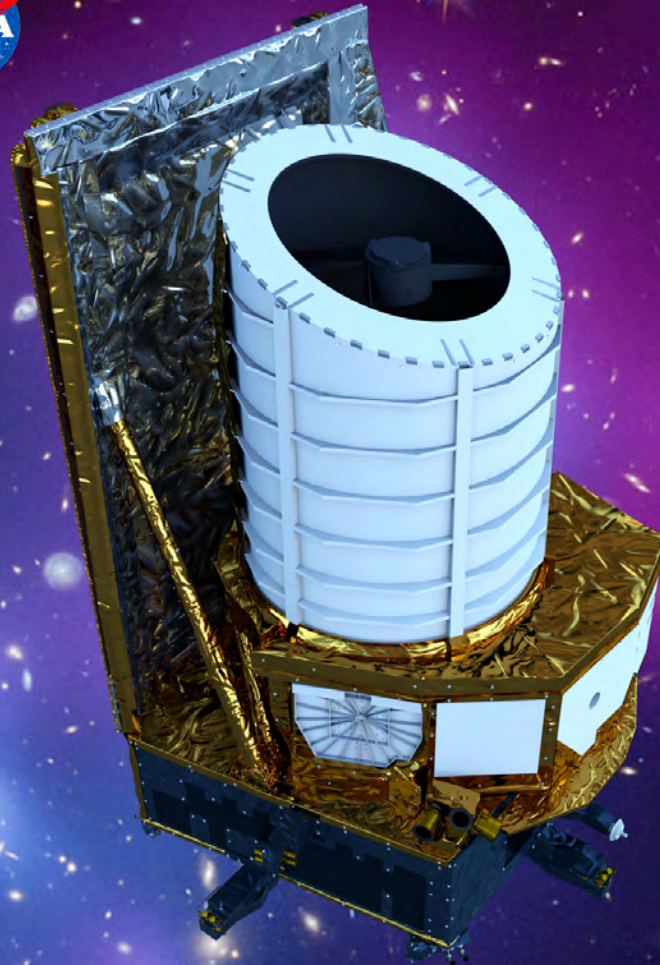
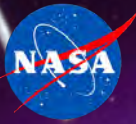


US Archival Science with Euclid

Harry Teplitz
and the ENSCI team

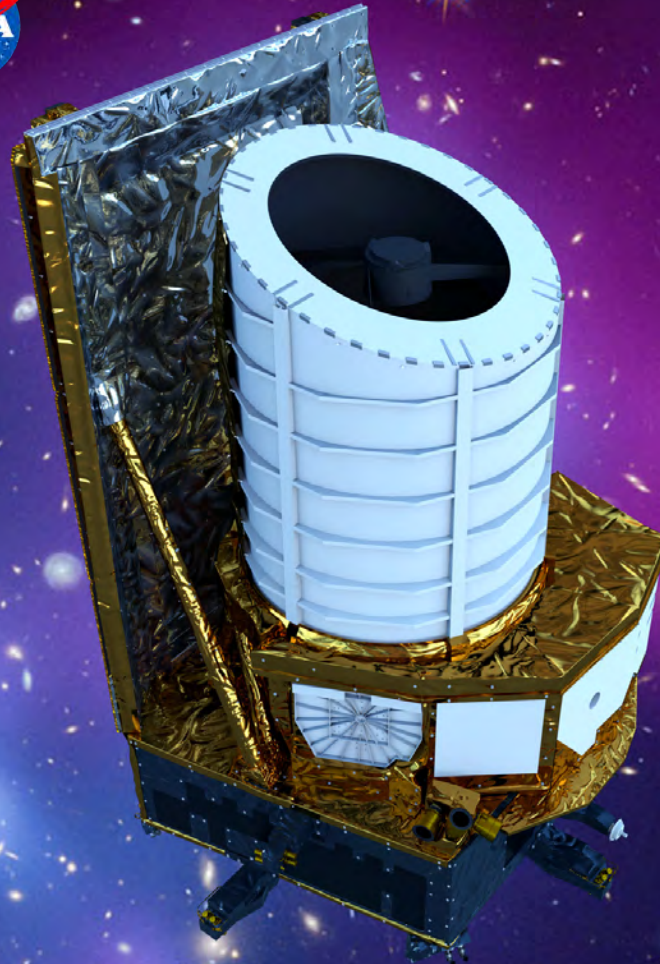
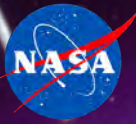


Caltech



Euclid

- Euclid is ESA M-class mission to study the geometry and nature of the dark Universe
 - Expected to launch in 2022
 - 6+ year lifetime at L2
- Euclid Consortium
 - International consortium of > 1,000 members who oversee development of the instruments, manage science operations and analyze data.



Euclid

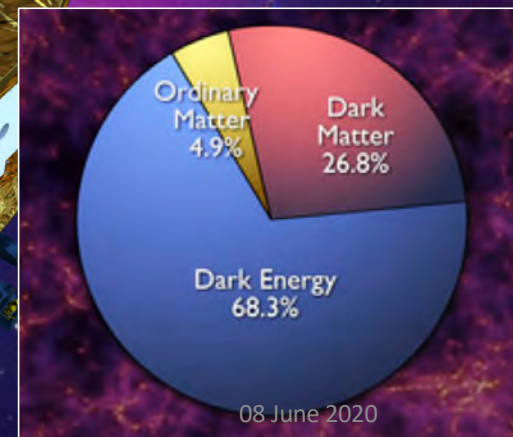
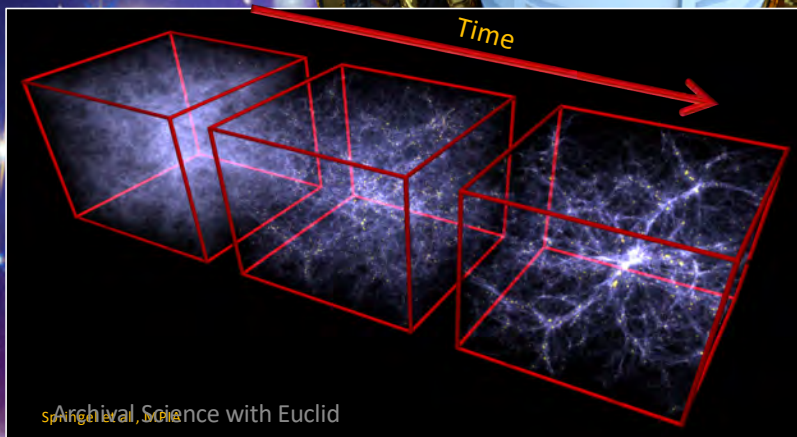
- Euclid is ESA M-class mission to study the geometry and nature of the dark Universe
 - Expected to launch in 2022
 - 6+ year lifetime at L2
- NASA contributed 16 state-of-the-art infrared detectors
- Nominated three US science teams
- NASA established the Euclid NASA Science Center at IPAC (ENSCI) to support US-based investigators using Euclid data



Dark Energy Science

Euclid optimized for complementary dark energy probes:

- *Weak Gravitational Lensing*: Imaging ~1.5 billion galaxies to probe growth of structures inferred from shape distortion caused by lensing. Requires Photometric redshifts [$\Delta z / (z+1) < 0.05$] of the weakly lensed galaxies
- *Galaxy Clustering*: This method measures the positions and grism redshifts of ~30 million galaxies. These data enable measurement of the cosmic expansion history through baryonic acoustic oscillations (BAO)





Euclid FAQ



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.

Release policy is TBD.



Launch:
on Soyuz
from Kourou,
French Guiana
in 2022



Mission Lifetime:
6+ years
@ L2

5



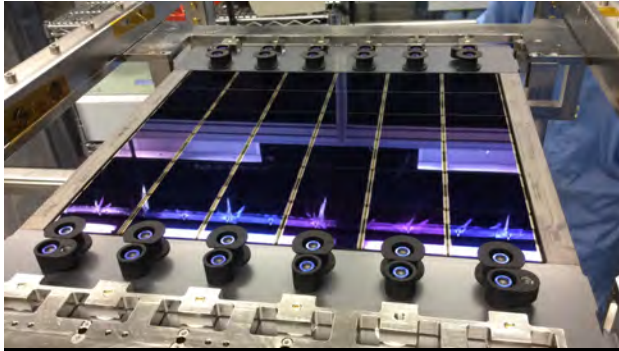
Aperture:
1.2m

08 June 2020

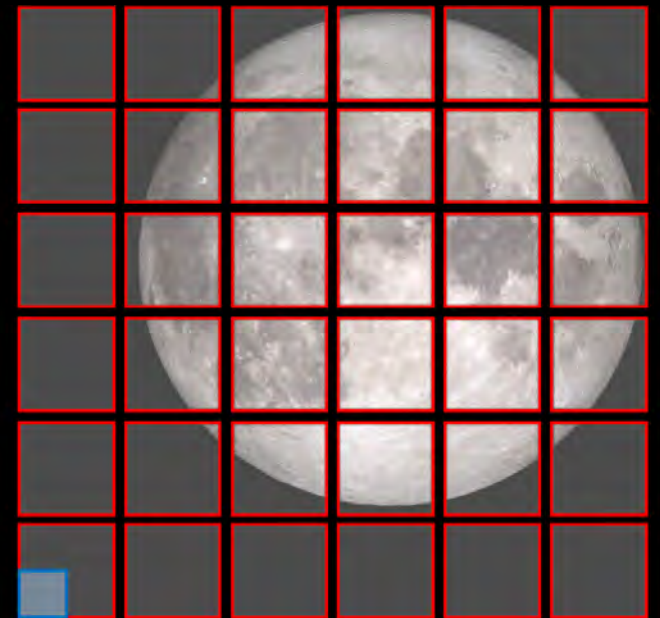


VIS

Shape Measurements ~
1.5 billion galaxies

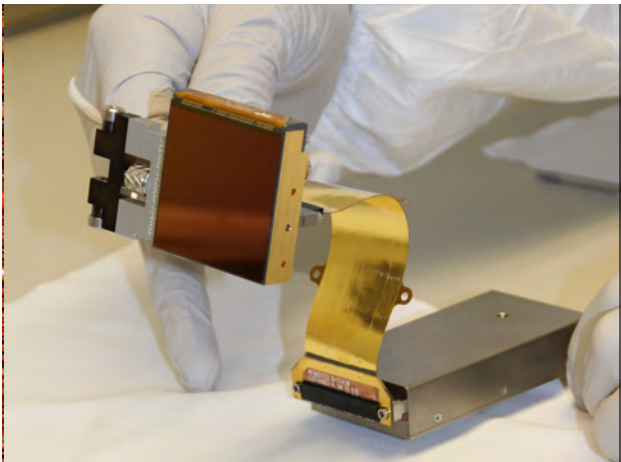


Wide Band Imaging
550 – 900 nm
24.5 mag_{AB} 10 σ
0.1" / pixel



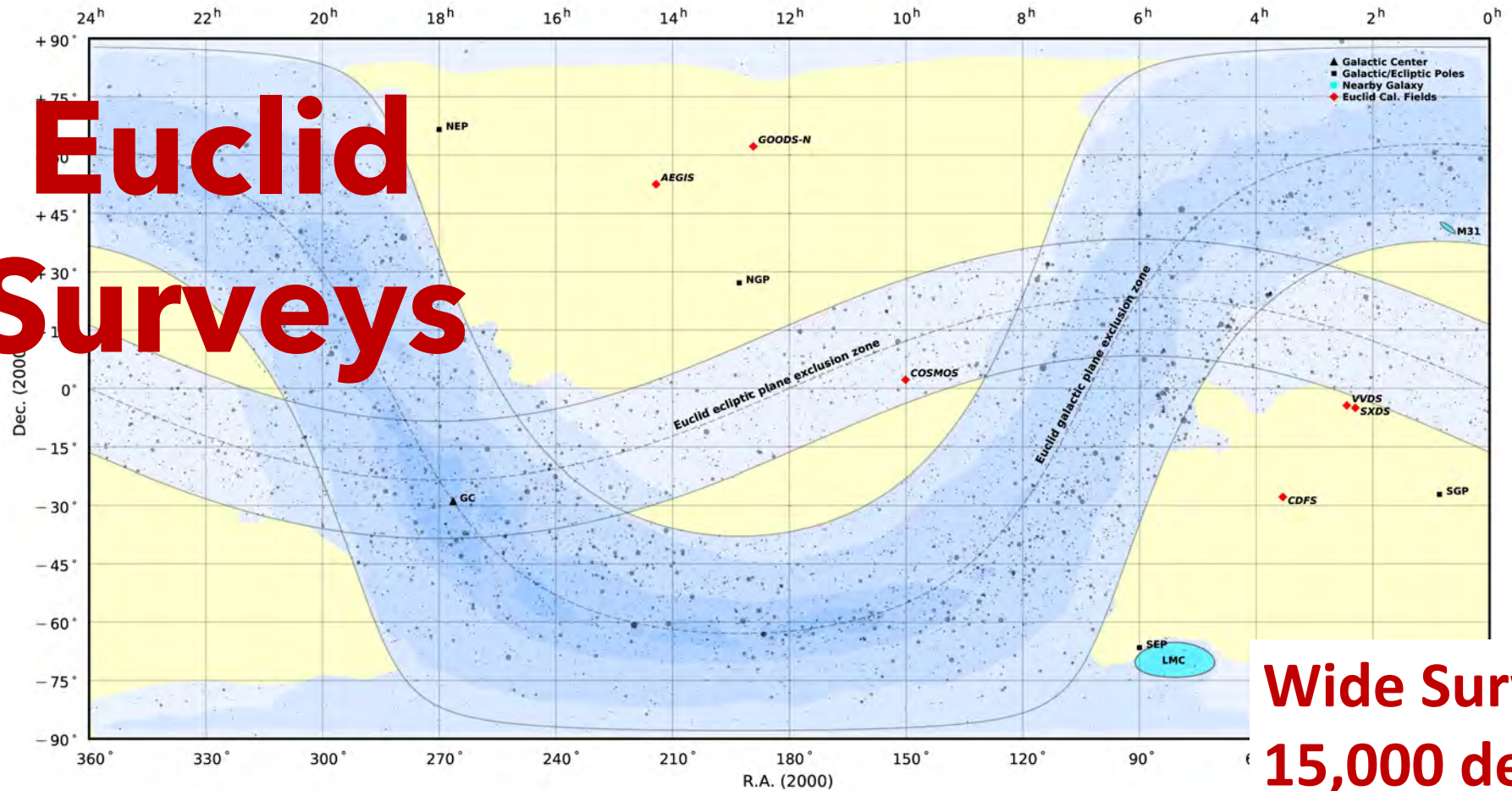
NISP

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



- YJH Photometry 24 mag_{AB} 5 σ
- Red Grism 1.25 – 1.85 μm
- Blue Grism 0.92 – 1.30 μm
 - deep field only
- R ~ 380 (0.5" source)
- 0.3" / pixel

Euclid Surveys

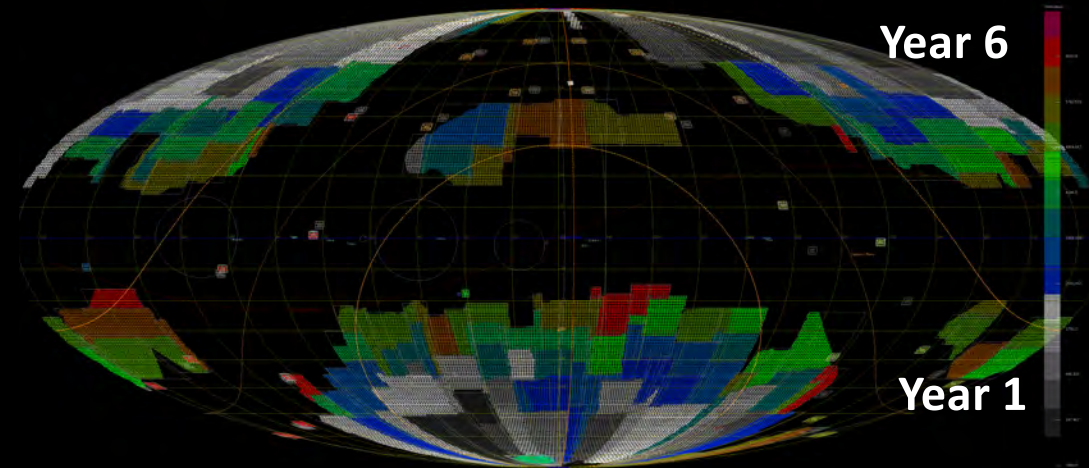


The Euclid Wide Survey (Red Book clippings) in equatorial coordinates on an equirectangular projection

- 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:
15,000 deg²
 $|b| > 30^\circ$

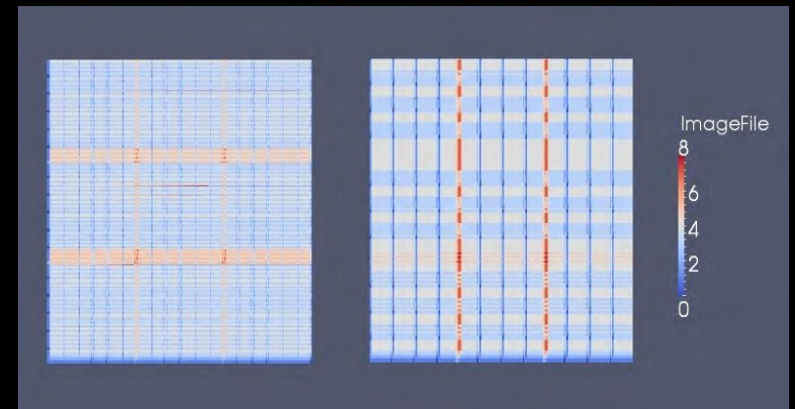
Euclid Surveys



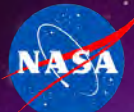
3 Deep Fields:

- EDF-N 10 deg² @ NEP
- EDF-S1 20 deg² near SEP
- EDF-S2 10 deg² CDFS

+ monthly 4 deg² Calibration Field



"Step & Stare" Coverage



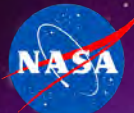
“Legacy” Science

Euclid surveys of the extragalactic sky will enable unprecedented advances in many other areas of astrophysics, including

- Reveal the structure and history of the Milky Way Halo
- Probe Galaxy Evolution using emission-line galaxies
- Link stellar mass to Dark Matter using clustering statistics
- Discover the most luminous galaxies at high-redshift
- Study quasars at high- and low-redshift

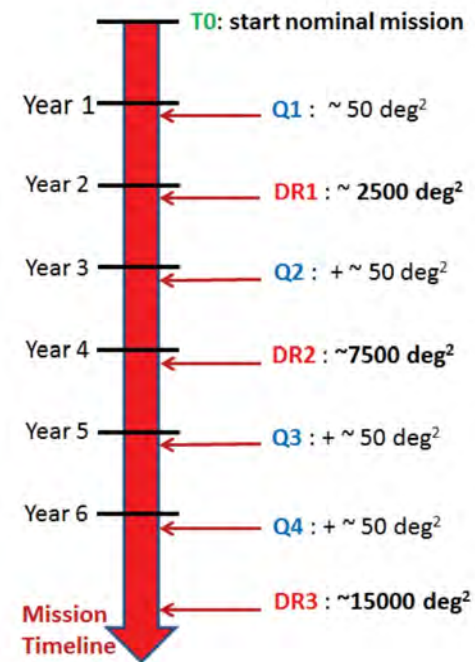
Euclid data will also be used in combination with other surveys

- Facilitate photometry in lower spatial resolution surveys using Euclid’s space-based imaging to resolve source confusion
- Provide vital redshift information to multi-wavelength studies
- Improve our understanding of Dark Energy



- Data will be public within about 2 years of acquisition
- ESA will serve public Euclid data through the Euclid Science Archive System
- The same data (or a subset) will also be available at the NASA/IPAC Infrared Science Archive (IRSA)
- Euclid will be “big data”
 - Petabyte-scale data products acquired from spacecraft
 - Significant ground-based supporting optical imaging data (release policy is TBD)

Euclid Public Data Releases





US Archival Research with Euclid

- Science content of archive will be enormous (petabyte scale)
- Huge variety of US community archival science
- NASA will support archival research through the ADAP program
 - Expect a flood of proposals after first public data release
 - Spitzer and WISE were each ~40% of ADAP in their first year

Astro2020 APC White Paper

Supporting Archival Research with Euclid and SPHEREx Data

Thematic Areas: An Enabling Foundation for Research

Principal Author:

Name: Harry I. Teplitz
Institution: Caltech/IPAC
Email: hit@ipac.caltech.edu
Phone: (626) 395-1932

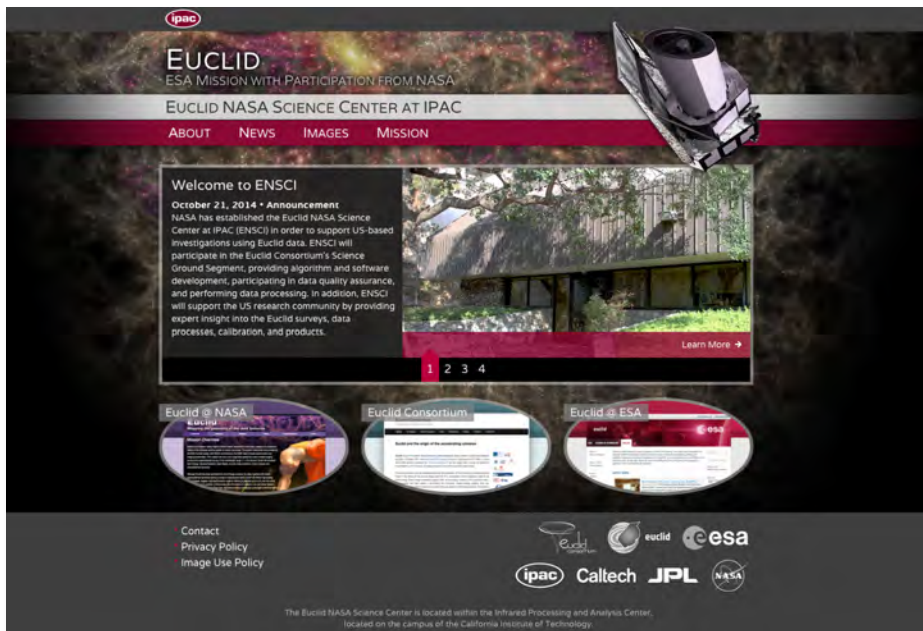
Co-authors: (names and institutions): George Helou (Caltech/IPAC), Jason D. Rhodes (JPL), Peter Capak (Caltech/IPAC), Claudia Scarlata (UMN), Olivier Doré (JPL), Micheal D. Seiffert (JPL), Vandana Desai (Caltech/IPAC)

Abstract (optional):

Archival research greatly increases the scientific return on NASA missions. Robust funding for archival research through the NASA Astrophysics Data Analysis Program (ADAP) has been a successful and vital investment for NASA. In the mid-2020s, the largest projects for ADAP research will be the new infrared missions, Euclid and SPHEREx. Additional ADAP funding will be required to fully exploit this flood of new infrared data. In this white paper, we provide an overview of the science focus of research with Euclid and SPHEREx, the synergy between their data and those from other missions, and estimate the needed increase in funding to support the U.S. community's increased archival research effort.



Euclid NASA Science Center at IPAC (ENSCI)



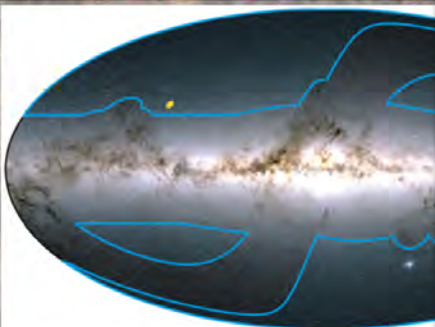
- Web portal
 - News
 - Links
 - helpdesk
 - Science team info (members, papers, press releases)
 - Data / mission tools
- Regular contact with community
 - AAS
 - Webinars like this one



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Astro2020 science white papers about Euclid
Euclid Technical Details
Euclid Data Release Timeline
Recent Euclid-US Publications
US Science Participation



The location of the fields that will be covered by Euclid's wide (blue) and deep (red) map based on data from ESA's Gaia mission. The sky is shown in the Galilean bright horizontal band corresponding to the plane of our Milky Way galaxy. (Euclid Consortium Survey Group)

Astro2020 decadal survey will set the priorities for astronomy and astrophysics in the coming decade. Here we list the Astro2020 white papers that are relevant to Euclid. Of the 573 Astro2020 science white papers, 63 are relevant to Euclid, linked below:

- Astro2020 science white papers about Euclid (11)
- Astro2020 science white papers mentioning Euclid (52)

1. Predicting H α emission line galaxy counts for future galaxy redshift surveys, by Alexander Merson, Yun Wang, Andrew Benson, Andreas Faist, Daniel Masters, Alina Kiessling, Jason Rhodes, MNRAS, 474, 177 (2018)

2. The clustering of galaxies in the completed SDSS-III Baryon Oscillation Spectroscopic Survey: constraining modified gravity, by Eva-Maria Mueller, Will Percival, Eric Linder, Shadab Alam, Gong-Bo Zhao, Ariel G. Sánchez, Florian Beutler, MNRAS, 475, 2122 (2018)

3. The clustering of galaxies in the completed SDSS-III Baryon Oscillation Spectroscopic Survey: constraining modified gravity, by Eva-Maria Mueller, Will Percival, Eric Linder, Shadab Alam, Gong-Bo Zhao, Ariel G. Sánchez, Florian Beutler, MNRAS, 475, 2122 (2018)

4. Elucidating Λ CDM: Impact of Baryon Acoustic Oscillation Measurements on the Hubble Constant Discrepancy, by Addison, G. E.; Watts, D. J.; Bennett, C. L.; Halpern, M.; Hinshaw, G.;

Astro2020 White Papers relevant to Euclid

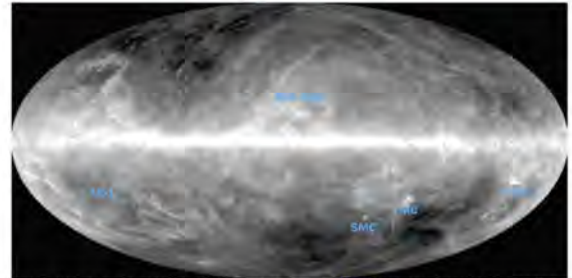
Science Team Papers

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L2 Background Estimator

Background Model



You can specify coordinates by selecting a position on the above all-sky map, a Montage-generated mosaic of the IRAS 100 micron data from Schlegel et al. (1998, ApJ 500, 525).

Version 4, Aug 15, 2017.

This tool gives optical-to-infrared background estimates for observations from the Earth-Sun L2 Lagrangian region, the future site of the James Webb Space Telescope (JWST) and Euclid. Backgrounds as seen from Earth's orbit are also available. The service can also be accessed by an [HTTP program interface](#).

The estimates for zodiacal brightness depend on the date. The user may select "Day" (of year), or "In Viewing Zone", which will give the median value for times in the year that the object is in a typical spacecraft viewing zone. See the [Help](#) page for details.

NOTE: Version 4 contains a newer estimate of zodiacal light and a more precise model for galactic starcounts. See the [Help](#) page for details. Version 1 can be accessed from the button (single location) or with table column "obsvr" set to "1" (table upload).

Single Location Upload Table

Coordinate/Object: _____

Wavelength: 2.0 (0.5 to 1000.0 microns)

Year: 2019 (see below)

Day (1 to 366) In Viewing Zone

Observing Location: Earth-Sun L2 Earth

Note: Dates for L2 are Day 274, 2018 (Oct 1) to Day 120, 2029 (Apr 30). The zodiacal value depends on the location obtained from a spacecraft ephemeris, currently a prediction for JWST limited to that time range.

Version of code: Version 4 Version 1

Coordinate Examples: [19h17m32s 11d56m02s Equ J2000](#) | [46.5377 -0.2516 gal](#) | [M 31](#) | [222.9824 -60.2877](#)
Default Coordinate System: Equatorial J2000

[Submit](#) [Reset](#) [Help](#)





ENSCI Helpdesk:

ensci-support@ipac.caltech.edu

Website:

<https://www.euclid.caltech.edu>

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