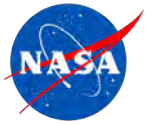
US Archival Science with Euclid

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 l oversee development of the instruments, manage science operations and analyze data.

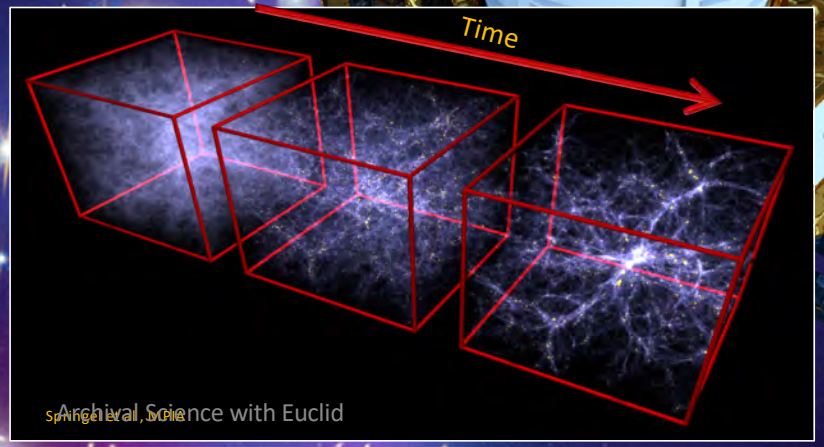
Euclid

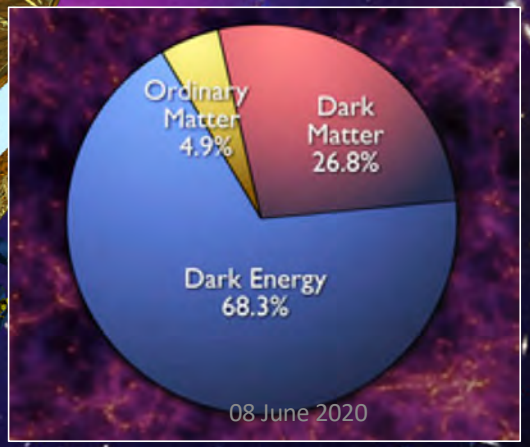
- Euclid is ESA M-class mission to study the geometry and nature of the dark Universe
  - Expected to launch in 2022
  - 6+ year lifetime at L2
- NASA contributed 16 state-of-the-art infrared detectors
- Nominated three US science teams
- NASA established the Euclid NASA Science Center at IPAC (ENSCI)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

Aperture:
1.2m

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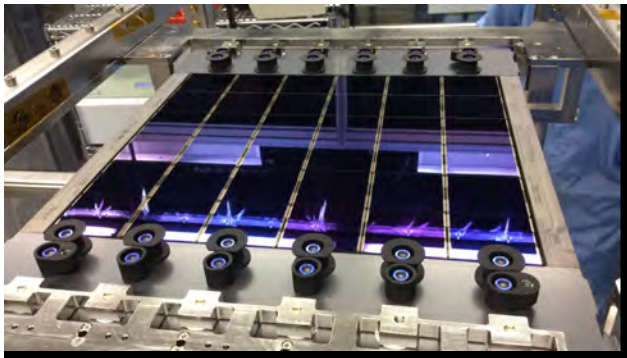
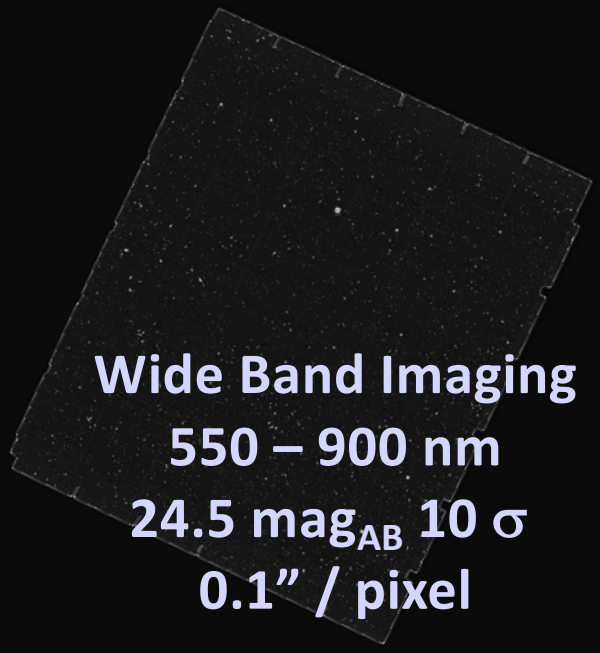
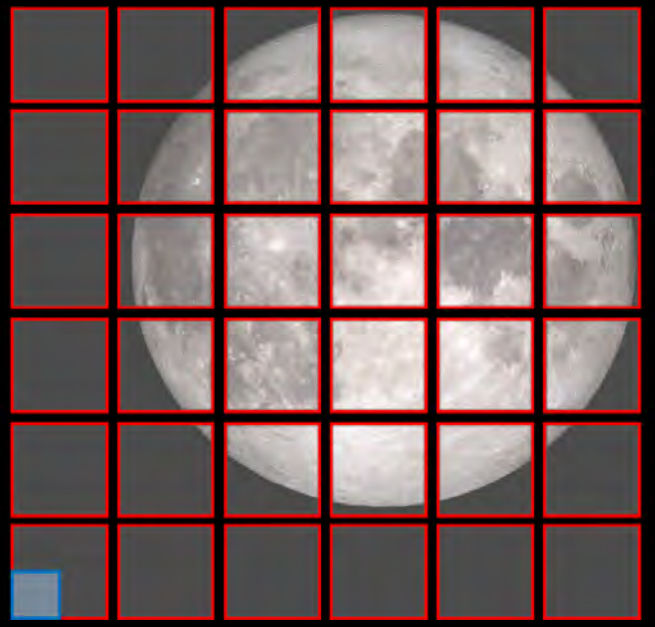


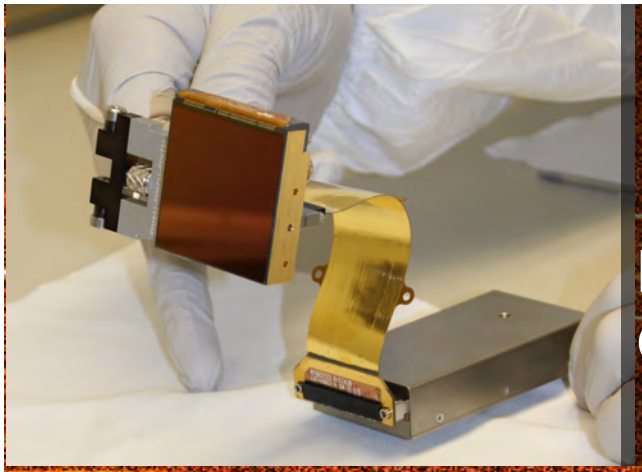
VIS

Shape Measurements ~ 1.5 billion galaxies



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



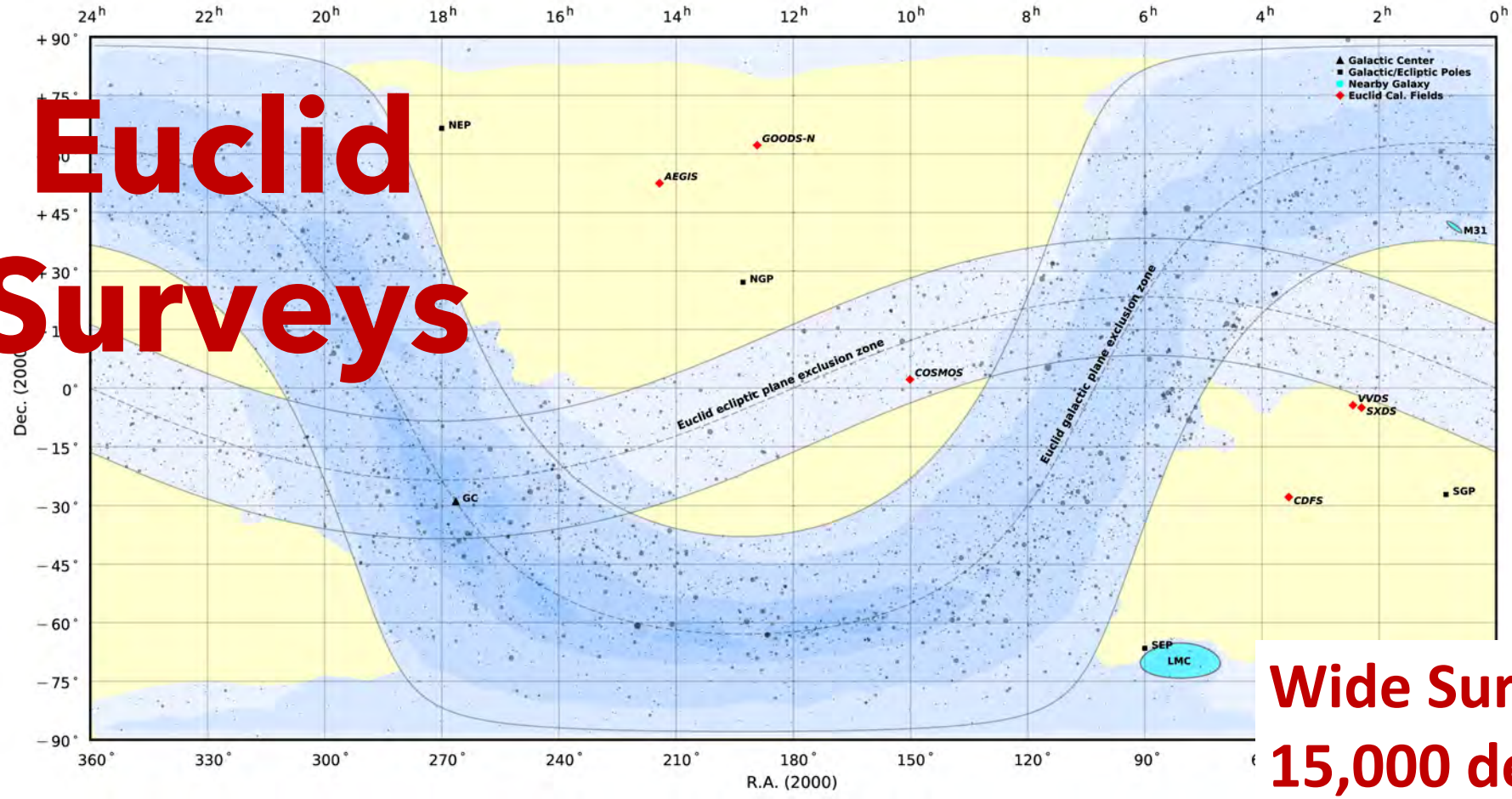


NISP

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 1.25 – 1.85 μm
- Blue Grism 0.92 – 1.30 μm
  - deep field only
- R ~ 380 (0.5" source)
- 0.3" / pixel

Euclid Surveys



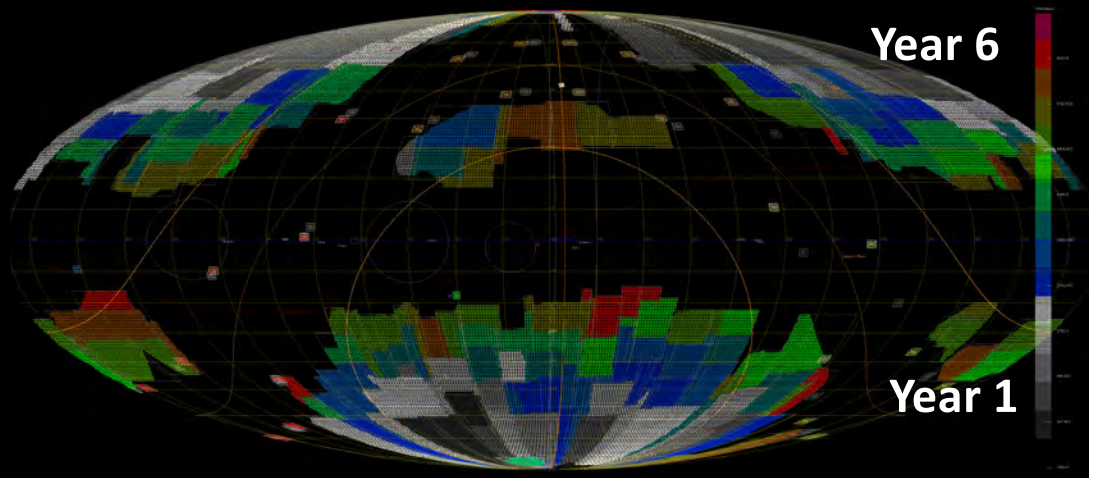
The Euclid Wide Survey (Red Book clippings) in equatorial coordinates on an equirectangular projection

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 deg^2
|b| > 30^o

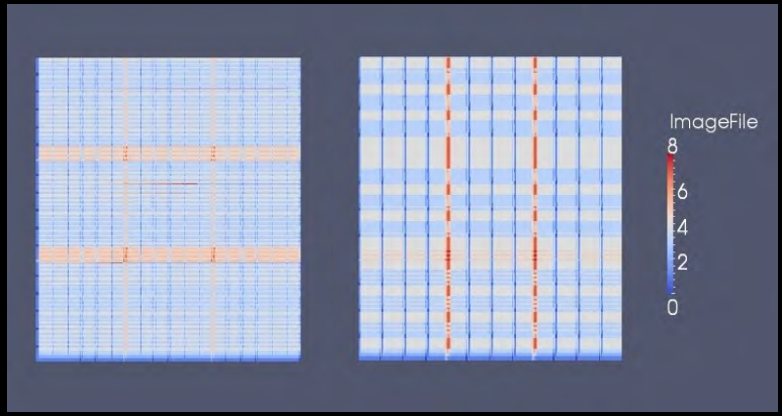
Euclid Surveys



3 Deep Fields:

- EDF-N 10 deg^2 @ NEP
- EDF-S1 20 deg^2 near SEP
- EDF-S2 10 deg^2 CDFS

+ monthly 4 deg^2 Calibration Field



"Step & Stare" Coverage

“Legacy” Science

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

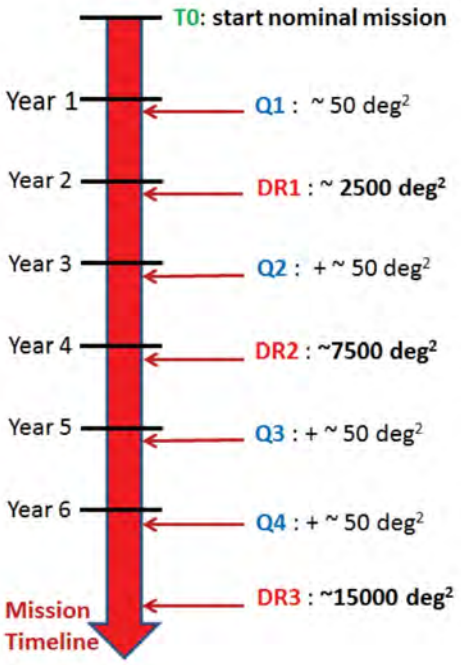
- **Reveal the structure and history of the Milky Way Halo**
- **Probe Galaxy Evolution using emission-line galaxies**
- **Link stellar mass to Dark Matter using clustering statistics**
- **Discover the most luminous galaxies at high-redshift**
- **Study quasars at high- and low-redshift**

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**

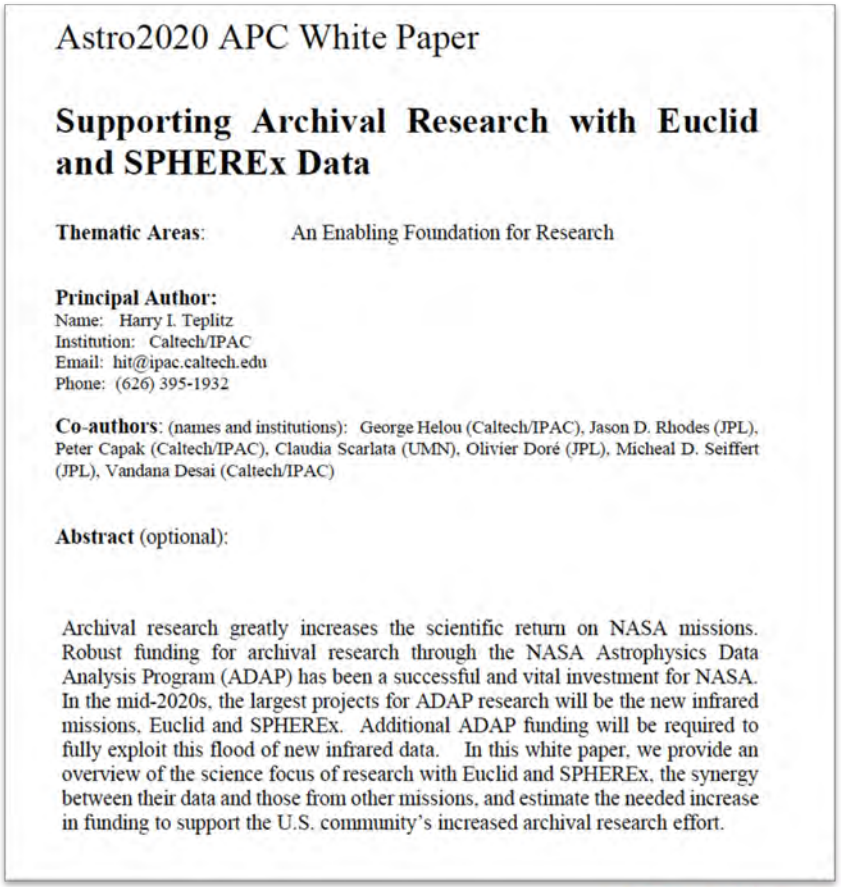
- Data will be public within about 2 years of acquisition
- ESA will serve public Euclid data through the Euclid Science Archive System
- The same data (or a subset) will also be available at the NASA/IPAC Infrared Science Archive (IRSA)
- Euclid will be “big data”
  - Petabyte-scale data products acquired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

Euclid Public Data Releases



US Archival Research with Eucild

- 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

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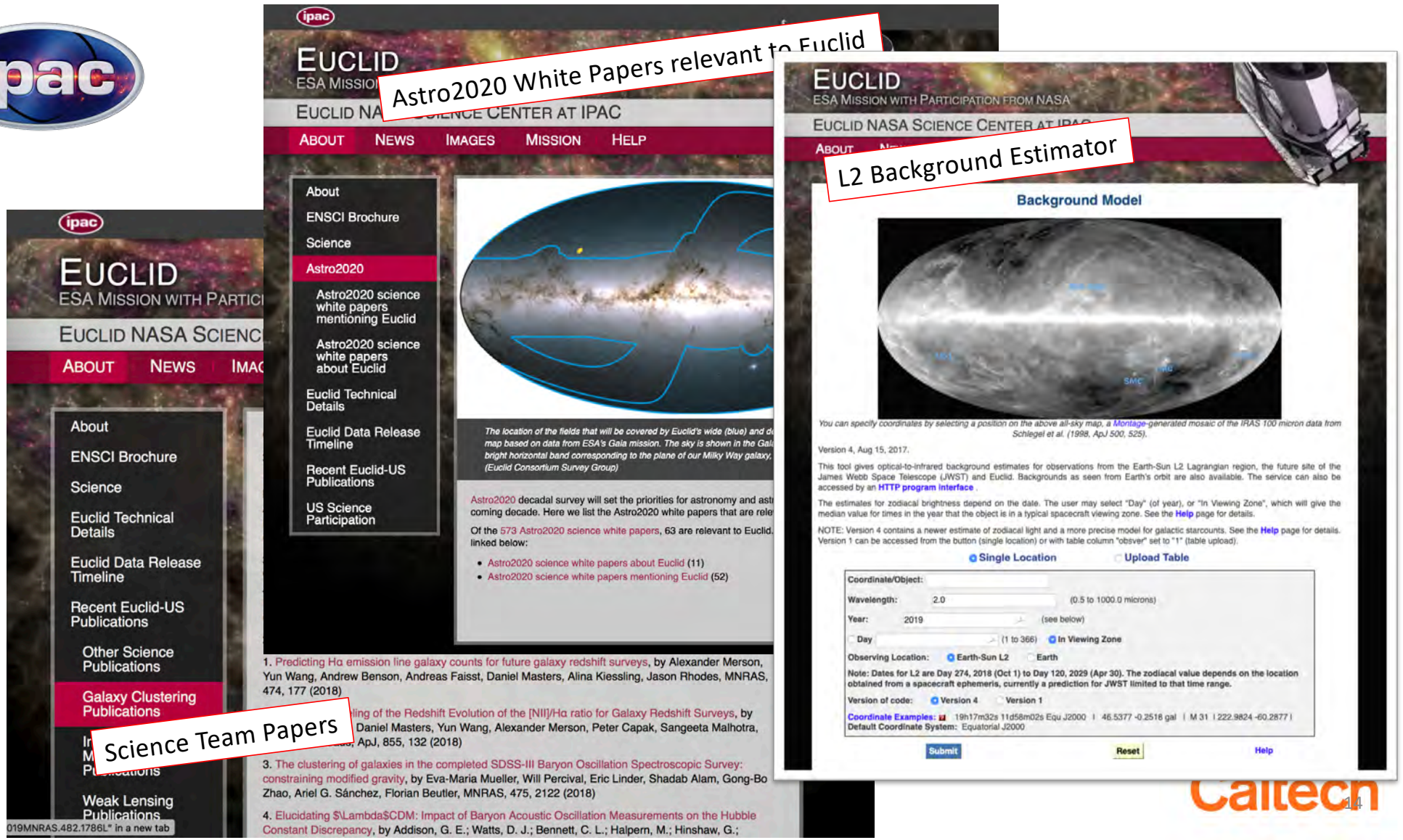
Abstract (optional):

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


Astro2020 White Papers relevant to Euclid
L2 Background Estimator
Science Team Papers
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ESA MISSION WITH PARTICIPATION FROM NASA
EUCLID NASA SCIENCE CENTER AT IPAC
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NEWS
IMAGES
MISSION
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About
ENSCI Brochure
Science
Astro2020
Astro2020 science white papers mentioning Euclid
Astro2020 science white papers about Euclid
Euclid Technical Details
Euclid Data Release Timeline
Recent Euclid-US Publications
US Science Participation
Other Science Publications
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Weak Lensing Publications
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