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# U.S. perspective on a U.S. contribution to Euclid

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NRC Committee to Assess U.S. Participation in Euclid

What do you see as the US contribution to Euclid? Is it likely to grow?



## Hardware:

1. **Reaction wheels-** finite/fixed contribution (improve efficiency/mass margin)
2. **NIR detectors-** initial purchase could grow into characterization, validation, integration into an FPA and instrument
3. Detector validation for WL (NIR and CCD)?

## Processing/Ground Segment:

1. US has capability to contribute to (or lead) any part, esp. NIR pipelines (e.g. WISE, Spitzer, HST, Herschel)
2. Secondary weak lensing shape analysis pipeline (WL is hard!)
3. Incorporation of ground based (esp. US-based PS2, DES, LSST) data

## Science

1. **Primary dark energy science**
2. Secondary ‘focused’ science (microlensing, SN, galactic plane) part of a modified or extended mission
3. **Other survey science/GO program-** *the potential of growth is limited only by the ingenuity of US scientists and the funding available to exploit the data*



# What would be the US role on the Science Team? [1 of 2]

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Euclid Science Team (EST), ESA convened team (12 people)

- Chaired by ESA project scientist Rene Laureijs
- 9 members from Euclid Consortium Board ECB (one deputized)
  - ECB is 20-member governing body of Consortium w/ 2 US observers
  - ECB/Consortium interacts w/ ESA for instrument delivery
- 2 Independent Legacy Scientists (Ivan Baldry and TBD)
- One slot would be added or assigned to US

**Only EST is recognized and interacts with ESA on scientific matters**

**EST responsible for “monitoring the correct implementation of the scientific objectives of the mission and in maximising its scientific return”:**

- Optimize instrument, spacecraft performance
- Optimize data reduction
- Acquire and use external data
- Data release
- EPO
- Publication policy



## US EST rep would:

- Bring US community perspective to EST discussions, and defend/safeguard US community interest
- Bring US-relevant news to attention of EST
- Help tap into US community expertise and resources as needed
- Participate in all EST activities and tasks
  - Define publication policy
  - Define data levels (e.g. level Q)
  - Optimize mission
- May take on additional duties suited to the scientific/engineering expertise of the particular person and geared toward US deliverables in hardware and data processing
  - This may require some shifting of responsibility in the EST and would require endorsement of a new Science Management Plan by the Science Programme Committee

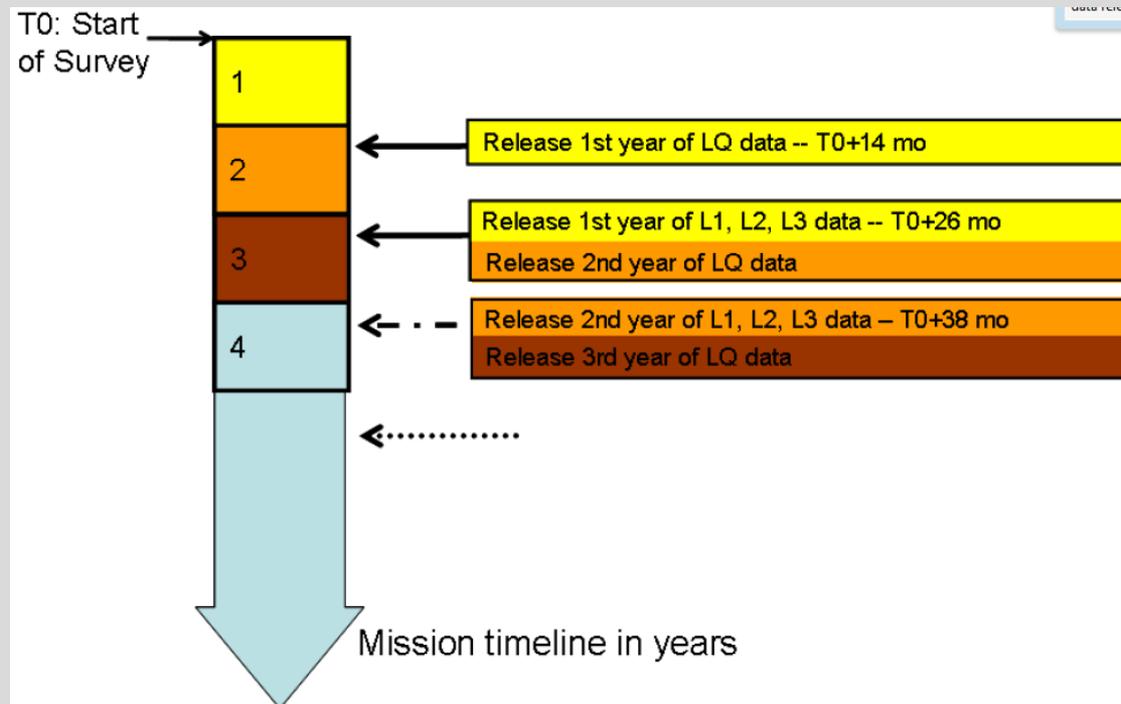
US EST rep **SHOULD** (but is not formally required to) integrate personal and US science efforts with the EC, and become fully engaged in the science exploitation of Euclid data – see slide 9



# What are the Euclid plans for data release?

From internal Euclid Science Management Plan 7/2011  
Public data release (Consortium members have immediate access)

- Data levels: Level E (external data), Level S (simulations), Level 1 (unpacked and edited telemetry), Level Q (quick-release data), Level 2 (data with instrumental signatures removed, calibrated data), Level 3 (science-ready data products).
- first Level Q data release takes place 14 months after the start of the survey
- the first complete data release with products from all level occurs 12 months later (i.e. 26 months after the start of the survey)
- Subsequent releases yearly





# What do you see as the relationship between Euclid, WFIRST and the goals of the decadal survey?

- Neither WFIRST or Euclid alone can meet all the goals of the decadal survey
  - **Observing time limited** in ~ 5years
  - e.g., WFIRST IDRM gets 2700 of 4000 recommended square degrees WL or 300 million of 2 billion galaxies
- Disparate goals require a wide range of capabilities and sufficient survey time
  - Properly complementary Euclid and WFIRST can provide this
  - Together the missions will maximize progress on NWNH goals

- Euclid primary mission also allows going beyond the *observational* goals of WFIRST to other *scientific* goals outlined in NWNH Panel Reports:

Euclid Goals (Red Book):

- How did the universe begin?
- Why is the universe accelerating?
- What is dark matter?
- What are the properties of neutrinos?



1. DE FoM
2. Growth/GR
3. DM/neutrinos
4. Inflation

# What do you see as the relationship between Euclid and WFIRST?



- Euclid and WFIRST should be largely complementary in capability
  - Some overlap in capability is acceptable, but as envisioned in NWNH, WFIRST will have *unique* capabilities not duplicated by Euclid or LSST
  - Independent, complementary approaches towards difficult and ambitious science is desirable, even necessary, to maximize progress
  - ~10 years of observing time is needed to properly address NWNH goals
  - Together Euclid and WFIRST can advance the observational **AND** the theoretical goals of NWNH
  - WFIRST SDT tasked with addressing this question
- Slightly phased (2019/2022) approach may prove beneficial
  - WFIRST can benefit from early Euclid observations and attack most compelling/difficult questions
  - tune WFIRST observing strategies based on early data from Euclid
  - Longer baseline enhances WFIRST ( $\mu$ lensing)
  - High quality WFIRST data may enhance Euclid science return (WL)
- In studying DE, FoM does not tell the whole story
  - Multiple probes from multiple observatories with different possible systematics are necessary

# What do you see as the relationship between Euclid and various US-led ground based surveys?

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- Euclid (and WFIRST) *require* ground-based data over their entire (WL and galaxy evolution science) survey area for photo-z's
- Ground-based spectra for calibration also required
- The photometric quality of the ground-based data will play a key role in the accuracy of dark energy constraints
- DES in the south (end eventually LSST)
- PS2, HSC (Subaru) in north
- BigBOSS, PFS spectroscopic data
- “ingestion”, analysis, and use of these data sets is not trivial
- US can help or lead here

# What should US science participation in Euclid look like



- US is *capable* of leadership in all areas of primary and secondary Euclid science
- Competition is not scientifically beneficial, esp. in highly constrained fiscal environment
  - Coordination with Euclid Consortium (EC) is best
  - Shared leadership should be sought
  - Some areas *should be* duplicated (e.g. weak lensing shape measurement) and results compared
- Active US Euclid community should be engaged
  - Should ensure eventual data access (and funding) for US community via archive
- Work through EC and Consortium Board (not just ESA) to ensure optimal science output



# Conclusions

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US participation in Euclid will:

- Enhance the mission
- Allow US scientists to participate in cutting edge DE research (and possibly other NWNH endorsed areas) ahead of WFIRST
- Allow all the goals of the NWNH report to be addressed
- Provide a lasting legacy data set to the US community





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<b>DE Technique</b>	<b>NWNH Main Report</b>	<b>WFIRST IDRM 5 yr mission</b>	<b>WFIRST IDRM 5 yr Dark Energy*</b>
WL Galaxy Shapes	2 billion	300 million (1 yr)	600 million (2 yr)
BAO Galaxy Redshifts	200 million	60 million (1 yr)	120 million (2 yr)
Supernova SNe-Ia	2000	1200 (1/2 yr)	2400 (1 yr)