MegaCam
RED
Red Enhanced Detectors
... and Euclid
Advances in detector & coating technology over the past decade

Typical QE at -100°C, Deep depletion devices

Quantum Efficiency

Wavelength (nm)

DD astro broad  DD astro mid  DD astro ER  DD astro multi-2

e2v 42–90 deep depletion: pin, electrically, and mechanically 100% identical to 1998 version
Advances in filter technology over the past decade

DECam filters response used for MegaCam RED

Overall gain in zero−points: $u=0.2$, $g=0.1$, $r=0.4$, $i=0.5$, $z=0.6$ mag.
Full integration: fall 2013  
Matching Subaru’s performance: 0.1" gain

Not just a gain in absolute: the IQ will get far more uniform throughout the night
CFHTLS Wide depth vs image quality at fixed exposure times

The end result is a uniform depth for a survey designed with the median IQ

Optimization of the observing process (SNR QSO, 2013)

MegaCam IQ distribution

CFHTLS T0007 Wide: Depth as function of seeing
Planning with real weather statistics

10 years of MegaCam observing: 5 hours per night of validation PIs/LPs

Considering the past decade conditions, mapping a large contiguous sky area with limited slews lead to 6.3 hours per night of QSO validation.
Mapping the Euclid north galactic cap: 7,500 sq.deg. in g, r, i, z

<table>
<thead>
<tr>
<th>Filter</th>
<th>Extended sources SNR=7</th>
<th>Point sources SNR=5</th>
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</thead>
<tbody>
<tr>
<td>g</td>
<td>24.7</td>
<td>25.5</td>
</tr>
<tr>
<td>r</td>
<td>24.0</td>
<td>25.0</td>
</tr>
<tr>
<td>i</td>
<td>23.3</td>
<td>24.4</td>
</tr>
<tr>
<td>z</td>
<td>22.9</td>
<td>23.9</td>
</tr>
</tbody>
</table>

Depth requirements for the Euclid ground survey

<table>
<thead>
<tr>
<th></th>
<th>g</th>
<th>r</th>
<th>i</th>
<th>z</th>
<th>Intg.</th>
<th>Nights</th>
<th>Years</th>
<th>Fraction 6 Years</th>
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</thead>
<tbody>
<tr>
<td>MegaCam</td>
<td>1250</td>
<td>1000</td>
<td>1075</td>
<td>1800</td>
<td>5125</td>
<td>2064</td>
<td>5.7</td>
<td>94% (No venting)</td>
</tr>
<tr>
<td>MegaCam Vented</td>
<td>1041</td>
<td>819</td>
<td>926</td>
<td>1428</td>
<td>4214</td>
<td>1746</td>
<td>4.8</td>
<td>80% z' compromised</td>
</tr>
<tr>
<td>MegaCam RED</td>
<td>939</td>
<td>694</td>
<td>537</td>
<td>437</td>
<td>2607</td>
<td>1117</td>
<td>3.1</td>
<td>51% (x 1.6 MC vented)</td>
</tr>
</tbody>
</table>

Global time envelope

MegaCam RED could use bright time in extended observing runs (months)

Adding a u-band component (24.1 SNR=5) adds ~700 hours (+25%)
MegaCam RED: distribution of tasks in the CEA/CFHT project

MegaCam upgrade (MegaCam RED)

- CCD Testing
  - CCDs procurement
  - Test bench
  - Test & metrology
- Integration
  - Cryostat delivery
  - Integration Metrology
- Readout speed optimization
  - Test bench
  - Code optimization
- Filters
  - Procurement
  - New frames

40 CCDs image
Schedule at CEA IRFU: November 2013 – January 2016

Lancement du projet, board CFHT puis lancement Irfu – Mi novembre 2013

Banc de test opérationnel
Décembre 2014

Test des CCDs = 10 mois

Intégration, vérification et expédition du plan focal
Oct 2015 pour livraison janvier 2016
### CEA IRFU cost center

<table>
<thead>
<tr>
<th>Systèmes</th>
<th>2014</th>
<th>2015</th>
<th>2016</th>
</tr>
</thead>
<tbody>
<tr>
<td>Banc de test</td>
<td>222</td>
<td>8</td>
<td>0</td>
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<tr>
<td>Integration Plan Focal</td>
<td>0</td>
<td>20</td>
<td></td>
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<tr>
<td>Garantie - assurance</td>
<td>0</td>
<td>17,4</td>
<td>0</td>
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<tr>
<td><strong>Missions</strong></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Relation industrielle</td>
<td>2,5</td>
<td>0,5</td>
<td>0</td>
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<tr>
<td><strong>CDD</strong></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Développement électronique</td>
<td>35</td>
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<td>0</td>
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<tr>
<td><strong>TOTAL</strong></td>
<td>259,5</td>
<td>45,9</td>
<td>0</td>
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<tr>
<td><strong>Options</strong></td>
<td></td>
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<tr>
<td>Nouvelles plaque froide</td>
<td>0</td>
<td>28,5</td>
<td>0</td>
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<tr>
<td>Métrologie mosaïque à froid</td>
<td>0</td>
<td>5,5</td>
<td>0</td>
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<tr>
<td><strong>TOTAL avec les options</strong></td>
<td>259,5</td>
<td>79,9</td>
<td>0</td>
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</table>

**Main d'œuvre CEA**

<table>
<thead>
<tr>
<th>2014</th>
<th>2015</th>
<th>2016</th>
</tr>
</thead>
<tbody>
<tr>
<td>60</td>
<td>257</td>
<td>174</td>
</tr>
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</table>

**Provision pour risque**

<table>
<thead>
<tr>
<th>2014</th>
<th>2015</th>
<th>2016</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>14,5</td>
<td>0</td>
</tr>
</tbody>
</table>

*Cours du dollar considéré 0,7637

$400k = $400k

$642k in-kind = $642k in-kind

**CFHT manpower estimate**

<table>
<thead>
<tr>
<th>FTE estimates</th>
<th>per month</th>
<th>duration (months)</th>
<th>man months</th>
</tr>
</thead>
<tbody>
<tr>
<td>Project management</td>
<td>0.2</td>
<td>27</td>
<td>5.4</td>
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<tr>
<td>CCD procurement</td>
<td>1</td>
<td>2</td>
<td>2</td>
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<tr>
<td>Filter procurement</td>
<td>1</td>
<td>2</td>
<td>2</td>
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<tr>
<td>Readout speed improvement -software</td>
<td>0.5</td>
<td>12</td>
<td>6</td>
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<tr>
<td>Readout speed improvement -hardware</td>
<td>0.5</td>
<td>13</td>
<td>6.5</td>
</tr>
<tr>
<td>MegaCam disassembly/shipping prep</td>
<td>2</td>
<td>0.4</td>
<td>0.8</td>
</tr>
<tr>
<td>MegaCam assembly</td>
<td>2</td>
<td>0.25</td>
<td>0.5</td>
</tr>
<tr>
<td>MegaCam test</td>
<td>2</td>
<td>0.5</td>
<td>1</td>
</tr>
</tbody>
</table>

**Total manpower (man months)** 24.2

---

**Task Name**

1. **Project management**
   - Duration: 583 days
   - Start: Mon 11/4/13

2. **CCD contract and procurement**
   - Duration: 46 days
   - Start: Mon 11/4/13

3. **Filter procurement and delivery**
   - Duration: 180 days
   - Start: Tue 1/7/14

4. **Readout speed improvement**
   - Duration: 280 days
   - Start: Mon 11/4/13

5. **PCB fabrication**
   - Duration: 20 days
   - Start: Mon 11/4/13

6. **PCB assembly**
   - Duration: 20 days
   - Start: Mon 12/2/13

7. **SLINK Interface development**
   - Duration: 120 days
   - Start: Mon 12/30/13

8. **Readout optimization/ test**
   - Duration: 120 days
   - Start: Mon 6/16/14

9. **MegaCam disassembly/shipping to CEA**
   - Duration: 10 days
   - Start: Mon 9/21/15

10. **MegaCam return**
    - Duration: 1 day
    - Start: Wed 1/6/16

11. **MegaCam reassembly**
    - Duration: 5 days
    - Start: Thu 1/7/16

12. **MegaCam test**
    - Duration: 10 days
    - Start: Thu 1/14/16
# CFHT cost center

<table>
<thead>
<tr>
<th>CFHT cost estimate</th>
<th>Qty</th>
<th>Price</th>
<th>Cost</th>
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<tbody>
<tr>
<td>Test cryostat</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Driver PCB</td>
<td>2</td>
<td>500</td>
<td>1000</td>
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<tr>
<td>SHARC PCB</td>
<td>2</td>
<td>250</td>
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<tr>
<td>Readout PCB</td>
<td>2</td>
<td>300</td>
<td>600</td>
</tr>
<tr>
<td>Parts/cables/connector/chassis</td>
<td>lot</td>
<td>1000</td>
<td>1000</td>
</tr>
<tr>
<td>Next gen SLINK</td>
<td>1 pair</td>
<td>1000</td>
<td>1000</td>
</tr>
<tr>
<td>Computer</td>
<td>1</td>
<td>1000</td>
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<tr>
<td>Contingency</td>
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<td></td>
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<table>
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<td>u</td>
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<td>70000</td>
<td>70000</td>
</tr>
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<td>g</td>
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<td>35000</td>
<td>35000</td>
</tr>
<tr>
<td>r</td>
<td>1</td>
<td>35000</td>
<td>35000</td>
</tr>
<tr>
<td>i</td>
<td>1</td>
<td>35000</td>
<td>35000</td>
</tr>
<tr>
<td>z</td>
<td>1</td>
<td>35000</td>
<td>35000</td>
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<tr>
<td>Y</td>
<td>1</td>
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<td>19000</td>
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<td><strong>Subtotal</strong></td>
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<table>
<thead>
<tr>
<th>CCDs</th>
<th>CCD42-90 science grade DD G1-AM2</th>
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<th>Cost</th>
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<tr>
<td></td>
<td></td>
<td>40</td>
<td>47500</td>
<td>1900000</td>
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<tr>
<td><strong>Subtotal</strong></td>
<td></td>
<td></td>
<td></td>
<td><strong>1900000</strong></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Travel</th>
<th>Integration &amp; test @ CFHT</th>
<th>Qty</th>
<th>Price</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Meeting @ CEA</td>
<td>2</td>
<td>6200</td>
<td>12400</td>
</tr>
<tr>
<td></td>
<td>Meeting @ e2V</td>
<td>3</td>
<td>500</td>
<td>1500</td>
</tr>
<tr>
<td><strong>Subtotal</strong></td>
<td></td>
<td></td>
<td></td>
<td><strong>26300</strong></td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Shipping to and from CEA</th>
<th>Qty</th>
<th>Price</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2</td>
<td>2000</td>
<td>4000</td>
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<tr>
<td><strong>Subtotal</strong></td>
<td></td>
<td></td>
<td><strong>4000</strong></td>
</tr>
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</table>

**Total cost (USD)**: **2169000**
MegaCam RED: a CEA/CFHT project building on CFHT’s strengths

MegaCam RED grand total: CEA+CFHT: $2,569,000

Low risk
Low complexity
No MegaCam for 3 months in 15B
High scientific return potential
Superb 0.6” survey machine
Large established community

Project lead: J.-C. Cuillandre
Project manager CEA: R. Granelli
Project manager CFHT: K. Ho
Inst. scientist CEA: O. Boulade
Co-I Canada: R. Carlberg
Co-I France: Y. Mellier
Megacam RED Science
Megacam RED QE
Every band gets Better

<table>
<thead>
<tr>
<th>Camera/CCD</th>
<th>u</th>
<th>g</th>
<th>r</th>
<th>i</th>
<th>z</th>
<th>Y</th>
</tr>
</thead>
<tbody>
<tr>
<td>MegaCam e2v</td>
<td>55%</td>
<td>85%</td>
<td>80%</td>
<td>55%</td>
<td>25%</td>
<td>0%</td>
</tr>
<tr>
<td>MegaCam e2v AM2</td>
<td>60%</td>
<td>90%</td>
<td>90%</td>
<td>90%</td>
<td>65%</td>
<td>15%</td>
</tr>
<tr>
<td>PS1/2 MIT/LL</td>
<td>0%</td>
<td>50%</td>
<td>85%</td>
<td>95%</td>
<td>90%</td>
<td>40%</td>
</tr>
<tr>
<td>DECam LBNL</td>
<td>20%</td>
<td>70%</td>
<td>85%</td>
<td>90%</td>
<td>85%</td>
<td>20%</td>
</tr>
<tr>
<td>HSC Matsushita</td>
<td>15%</td>
<td>85%</td>
<td>95%</td>
<td>90%</td>
<td>75%</td>
<td>15%</td>
</tr>
<tr>
<td>LSST (e2v base)</td>
<td>25%</td>
<td>85%</td>
<td>92%</td>
<td>90%</td>
<td>65%</td>
<td>15%</td>
</tr>
</tbody>
</table>

No other current or planned camera has comparable u band response. A unique capability for at least a decade.
Dome venting will improve IQ
Site Figure of Merit: natural seeing (TMT site testing data) $M^2/\text{clear IQ}^2$

<table>
<thead>
<tr>
<th>Location</th>
<th>Visible</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tololo</td>
<td>0.343</td>
</tr>
<tr>
<td>Mauna Kea* (TMT)</td>
<td>0.675</td>
</tr>
<tr>
<td>Armazones</td>
<td>1.000</td>
</tr>
</tbody>
</table>

Has interesting implications for DECam vs CFHT
CFHT Megacam-Red: Everyone wins

- Dome venting (at last):
  - Conservatively, Subaru quality images
  - Possibly better.

- Chip upgrade: no losers
  - i band gain is 2.5x science speed (with IQ)
  - Low cost, low risk in the single most used capability of CFHT.

- Important to keep CFHT productive
A Wide Field ugriz survey now

- Along with DES provides the first ever deep, all high latitude sky imaging, CFHT: unique u band.
- Science is very broad
  - Milky Way tomography (u implements [Fe/H])
    - 30x volume of SDSS in north
    - Hot stars (WDs, OB stars in other galaxies)
  - Galaxy clusters (photo-z, strong lenses, Planck)
    - w indicator, cluster physics, galaxy environments at redshift
  - Galaxy evolution (with u band SFR, drop-outs)
    - Study to z~3, vast increase beyond SDSS low z.
  - AGN: search for the rare in the sky
    - Fainter than SDSS at z~6+, TMT/E-ELT relevant for IGM
  - Weak lensing (better IQ?, better photo-z with u)
    - First glimpse of Euclid science
  - Supernovae* (SNLS to z~1.1)
    - Add-on survey? DE and Sne science, metal evolution
  - The biggest possible legacy dataset
  - Participation in the international all-sky OIR mapping program.
Opportunities for collaboration with other telescopes

- Subaru, PS & DES (efficiency, calibration)
- CHIME (low res HI mapper, BAO) LOFAR?
- MS-DESI Spectra ~BigBOSS (2019)
- eROSITA soft x-ray (Russia has north)
- Possible route into LSST
- Targets for JWST (2018)
- Euclid
A significant CFHT time decision
Euclid Ground @ CFHT

Adding u band adds 0-25% more time.
Euclid analysis needs to be re-evaluated with u
Total is ~3.5 yrs, 100% allocation if at Subaru IQ
Should leave some time for PI science (leveraging)
CFHT Survival Issues

• National astronomy programs elsewhere are sacrificing 4m telescopes
• Survivors (AAT) are largely survey dedicated.
• In Canada, NRC supports:
  – TMT funding request for 2014 (first light 2022)
  – SKA request expected in 2016
  – No short term transformation opportunity
  – Important to keep CFHT for students, PDFs
CFHT and MegaCam RED in the Euclid era

Y. Mellier
Digging the dark in the Planck universe

• Why a Universe in accelerating expansion? Origin: dark energy ? modified gravity ?

• When did the DE-DM transition happen?

→ Distinguish DE, MG, DM effects by:
  • Using >2 independent probes (Euclid=5)
  • Tracking signatures on
    • Geometry of the Universe:
      o Weak Lensing, Galaxy Clustering,
    • History of structure formation:
      o WL, Redshift-Space Distortion, Clusters of Galaxies

→ Need: control very accurately systematics.

Transition very late, can be explored with visible+NIR telescopes → Euclid
50 million galaxies with redshifts

1.5 billion sources with shapes, 10 slices

Source plane $z_1$

Source plane $z_2$

Euclid

CFHT UM, May 8, 2013
Visible + NIR data needed for Euclid

• Weak Lensing: redshifts of $2 \times 10^9$ sources to
  o Slice the universe
  o Control contamination by intrinsic alignments of galaxies

• Redshifts of Euclid clusters: (60,000 clusters, 5,000 giant arcs) → synergy with Planck and eROSITA

• Redshifts of sources and lenses needed at least in the range $0.2<z<2$ → Photo-z necessary, but with both Optical+NIR data

Euclid
Euclid: mission implementation
Euclid mission baseline: Launch in 2020

### SURVEYS In ~6 years

<table>
<thead>
<tr>
<th>Area (deg²)</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wide Survey</td>
<td>15,000 deg²</td>
</tr>
<tr>
<td>Deep Survey</td>
<td>40 deg²</td>
</tr>
</tbody>
</table>

#### PAYLOAD

<table>
<thead>
<tr>
<th>Telescope</th>
<th>VIS</th>
<th>NISP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Field-of-View</td>
<td>0.787×0.709 deg²</td>
<td>0.763×0.722 deg²</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Capability</th>
<th>Visual Imaging</th>
<th>NIR Imaging Photometry</th>
<th>NIR Spectroscopy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sensitivity</td>
<td>24.5 mag</td>
<td>24 mag</td>
<td>24 mag</td>
</tr>
<tr>
<td></td>
<td>10σ extended source</td>
<td>5σ point source</td>
<td>5σ point source</td>
</tr>
</tbody>
</table>

Shapes + Photo-z of \( n = 1.5 \times 10^9 \) galaxies and z of \( n = 5 \times 10^7 \) galaxies

Possibility other surveys: SN and/or \( \mu \)-lens surveys, Milky Way?

Ref: Euclid RB Laureijs et al arXiv:1110.3193
Euclid: telescope and instrument

Stabilisation: pointing error \(x,y\) axes = 25mas over 700 s.

FoV: Common visible and NIR FoV = 0.54 deg\(^2\)

**VIS:**
- Large area imager – a 'shape measurement machine'
- 36 4kx4k CCDs with 12 micron pixels
- 0.1 arcsec pixels on sky
- Bandpass 550-900 nm – narrow band channel
- Limiting magnitude for wide survey of \( \text{magAB} = 24.5\) for 10\(\sigma\)
- Data volume = 520 Gbit/day

**NISP:**
- 16 2kx2k H2GR NIR detectors, 0.3 arcsec/pixel
- 3 NIR filters: H, J, H, 4 Grisms (2 « B»; 2 « R »)
- Lim. mag: \(\text{AB} = 24.0\); 5 \(\sigma\) pt source
- Data volume: 180 Gbit/day
Simulation of M51 with VIS

Euclid will get the resolution of Sloan Digital Sky Survey but at $z=1$ instead of $z=0.05$. Euclid will be 3 magnitudes deeper → Euclid Legacy = Super-Sloan Survey
Forecasts: Euclid cosmology programme

Assume systematic errors are under control

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Modified Gravity</th>
<th>Dark Matter</th>
<th>Dark Energy</th>
<th>FoM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Euclid primary (WL+GC)</td>
<td>0.010</td>
<td>0.027</td>
<td>0.015</td>
<td>0.150</td>
</tr>
<tr>
<td>Euclid All</td>
<td>0.009</td>
<td>0.020</td>
<td>0.013</td>
<td>0.048</td>
</tr>
<tr>
<td>Euclid+Planck</td>
<td>0.007</td>
<td>0.019</td>
<td>0.007</td>
<td>0.035</td>
</tr>
<tr>
<td>Current (2009)</td>
<td>0.200</td>
<td>0.580</td>
<td>0.100</td>
<td>1.500</td>
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<tr>
<td>Improvement Factor</td>
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<td>30</td>
<td>&gt;10</td>
<td>&gt;40</td>
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Ref: Euclid RB arXiv:1110.3193

Assume systematic errors are under control
Euclid Legacy

- 12 billion sources, 3-σ
- 50 million redshifts;
- A mine of images and spectra for the community for several decades;
- A reservoir of targets for JWST, GAIA, E-ELT, TMT, ALMA, Subaru, VLT, ngCFHT, etc…
- Synergy with LSST, e-ROSITA, SKA

<table>
<thead>
<tr>
<th>Objects</th>
<th>Euclid</th>
<th>Before Euclid</th>
</tr>
</thead>
<tbody>
<tr>
<td>Galaxies at 1&lt;z&lt;3 with precise mass measurement</td>
<td>~2x10^8</td>
<td>~5x10^6</td>
</tr>
<tr>
<td>Massive galaxies (1&lt;z&lt;3))</td>
<td>Few hundreds</td>
<td>Few tenss</td>
</tr>
<tr>
<td>Hα Emitters with metal abundance measurements at z~2-3</td>
<td>~4x10^7/10^4</td>
<td>~10^4/~10^2 ?</td>
</tr>
<tr>
<td>Galaxies in clusters of galaxies at z&gt;1</td>
<td>~2x10^4</td>
<td>~10^3 ?</td>
</tr>
<tr>
<td>Active Galactic Nuclei galaxies (0.7&lt;z&lt;2)</td>
<td>~10^4</td>
<td>&lt;10^3</td>
</tr>
<tr>
<td>Dwarf galaxies</td>
<td>~10^5</td>
<td></td>
</tr>
<tr>
<td>T_{eff} ~400K Y dwarfs</td>
<td>~few 10^2</td>
<td>&lt;10</td>
</tr>
<tr>
<td>Lensing galaxies with arc and rings</td>
<td>~300,000</td>
<td>~10-100</td>
</tr>
<tr>
<td>Quasars at z &gt; 8</td>
<td>~30</td>
<td>None</td>
</tr>
</tbody>
</table>
Gravitational arcs and rings in Euclid

Euclid Legacy: after 2 months

(66 months planned)
Euclid: ground based data and MegaCam RED option
Ground Based Data: photo-z with Euclid

Requirements:
accuracy = 0.05x(1+z)

→ 4 optical band needed
→ u-band not needed.

Visible data obtained from ground based telescopes
Ground Based Data: photo-z

- South: consolidated:
  - DES data deep enough in g,r,i,z. Suits Euclid needs;
  - EC will reprocessed DES data after the 1yr-proprietary period

- North: Not consolidated:
  - Pan-STARRS: CCD procurement problems, less time allocated to Euclid. If Canada in, then PS still needs 8 M USD from Euclid;
  - MegaCam-RED: looks promising C+F project → RECOMMENDED by Euclid Board → Canada interested?
  - HSC/Subaru → Conflicts with PFS?
Data release model: Euclid + ground

Year -3

Yr -1 Ground DR1 ready (2500 deg$^2$)

Yr+1 Ground DR2 ready (7500 deg$^2$)

Yr +3 Ground DR3 ready (15000 deg$^2$)

T-3 start ground based observations (<2017)
All Euclid pointings set

T-0 start Euclid nominal mission (2020)

Year 1
Q1 : ~ 50 deg$^2$

Year 2
DR1 : ~ 2500 deg$^2$

Year 3
Q2 : + ~ 50 deg$^2$

Year 4
DR2 : + ~ 5000 deg$^2$; Total ~7500 deg$^2$

Year 5
Q3 : + ~ 50 deg$^2$

Year 6
Q4 : + ~ 50 deg$^2$

Mission Timeline
DR3 : + ~ 7500 deg$^2$; Total ~15000 deg$^2$
MegaCam RED, Euclid and Canada

• What could be the contribution of Canada?
  o Participation to MegaCam RED survey (grey + dark) time for ~7yrs
  o MegaCam RED survey archived at CADC
  o Participation to the processing of the MegaCam RED survey

• Interesting option:
  o Canada leads a survey comprising some photometric data that are not essential to Euclid, but most useful for MegaCam RED stand alone science:
    → u-band?
    → Euclid to meet 0.03x(1+z) accuracy on photo-z.