# WFIRST Project Activities

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IPAC – Wide-Field IR Science
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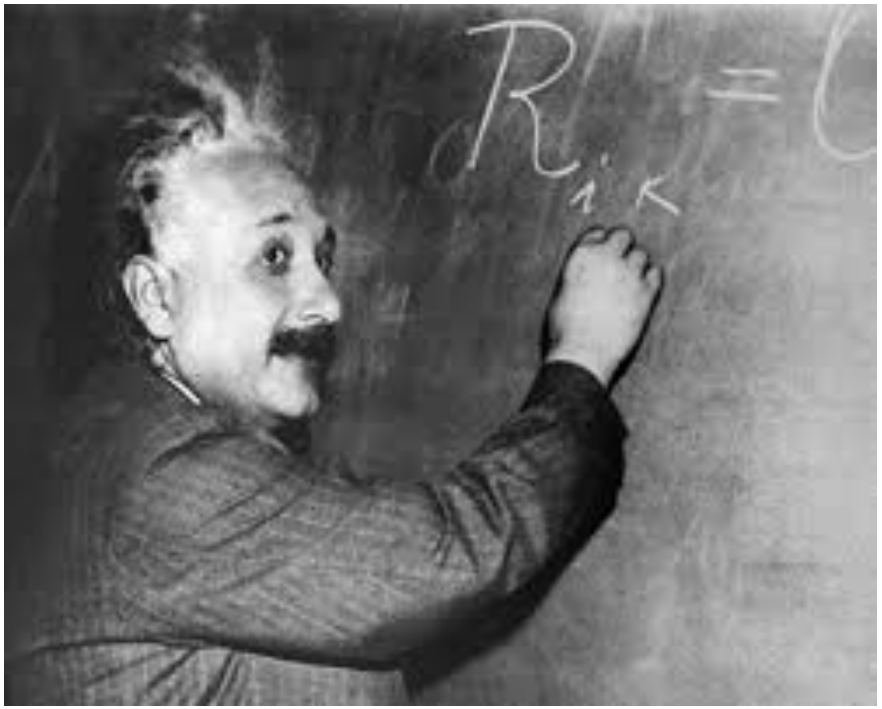
# Outline

- Project history
- Concept development and costing
- Scientific requirements flowdown
- GSFC-JPL-IPAC team
- Detector development
- Simulations
- Schedule to launch
- Science outreach


# General Relativity




Einstein General Relativity connection to WFIRST through
- field equations, cosmological constant
- gravitational bending of light (weak lensing, microlensing)

$$G_{\mu\nu} = (8\pi G/c^4)\, T_{\mu\nu}$$

# WFIRST History

**JDEM**

- 1998: Discovery of accelerated expansion of the universe
- 2006: 3 teams selected for study (ADEPT, DESTINY, SNAP)
- 2008: NASA & DOE formulate JointDEM as a strategic mission
- 2009: JDEM proposed to Astro2010

**MPF**

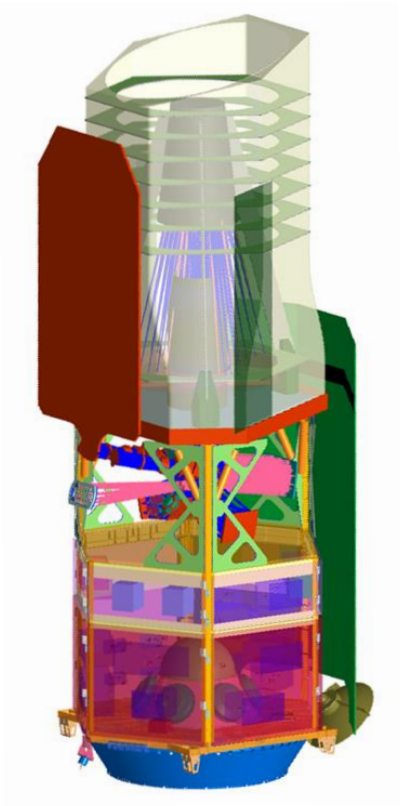
- 1998: Mather suggests space application of microlensing at Notre Dame
- 2004-2006: MPF proposed as Explorer and Discovery
- 2009: MPF proposed to Astro2010

**NIRSS**

- 2009: NIRSS proposed to Astro2010
- 2009: 14 white papers submitted on wide-field IR survey science

**WFIRST**

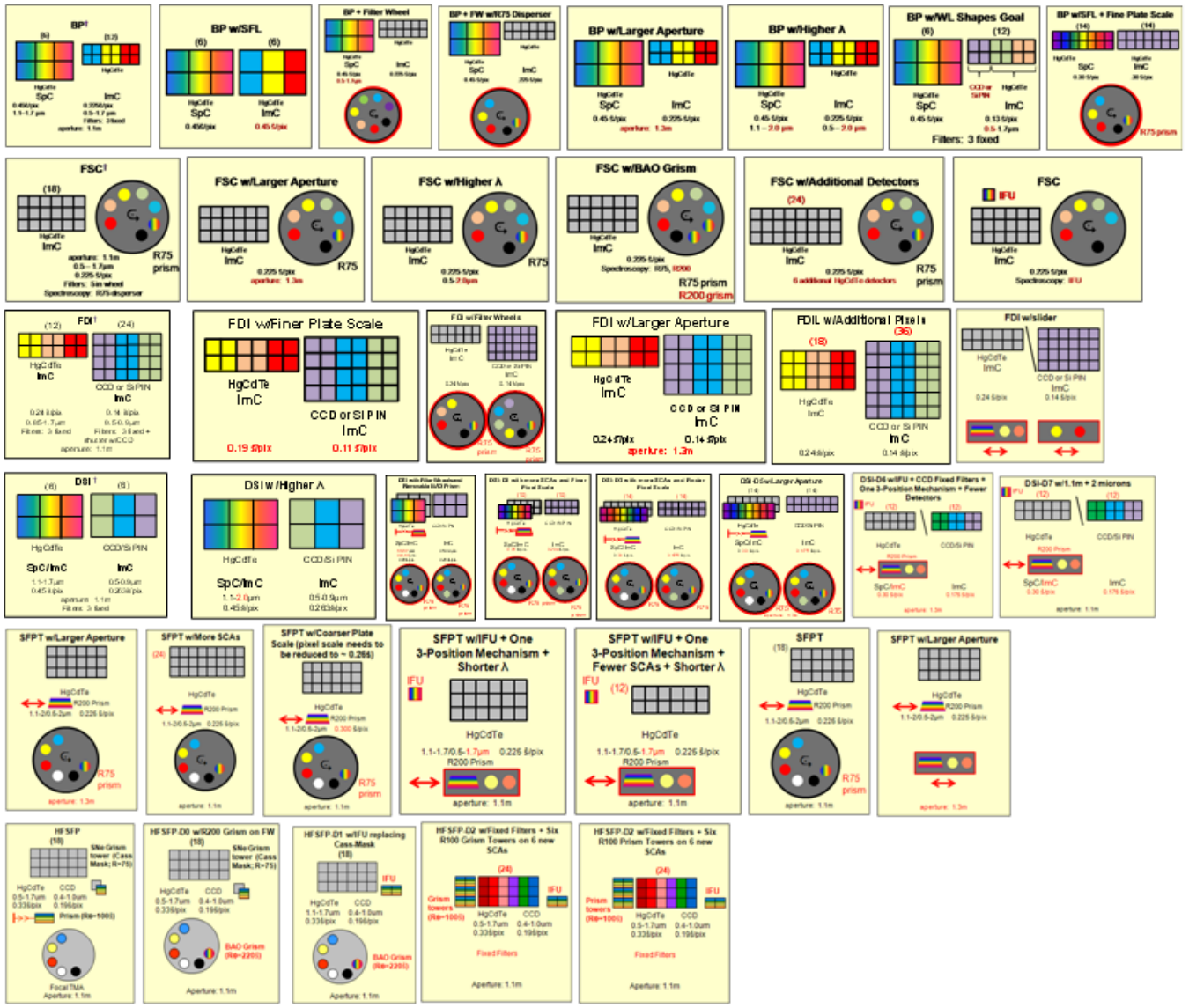
- 2010: WFIRST ranked 1st in large mission category by Astro2010
- 2011: Science Definition Team formed to study WFIRST
- 2011: Nobel prize for acceleration of universe
- 2011: Free-floating planets detected by ground microlensing
- 2012: WFIRST science conference at IPAC



JDEM-Omega

# Over 80 Concepts Developed

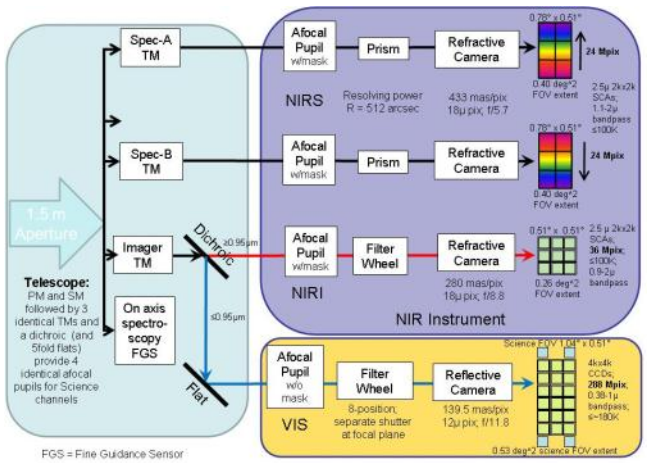
1. Benchmark Probe **(8 of 18 cases shown)**
2. Focal Single Channel Imagers **(6 of 11 cases shown)**
3. Focal/ Dichroic Imagers **(6 of 10 cases shown)**
4. Dichroic Spec/Imager **(8 of 10 cases shown)**
5. Single Focal Plane Transformer **(7 of 7 cases shown)**
6. Heterogeneous Focal Single Focal Plane **(5 of 5 cases shown)**



# JDEM - WFIRST DRM Evolution

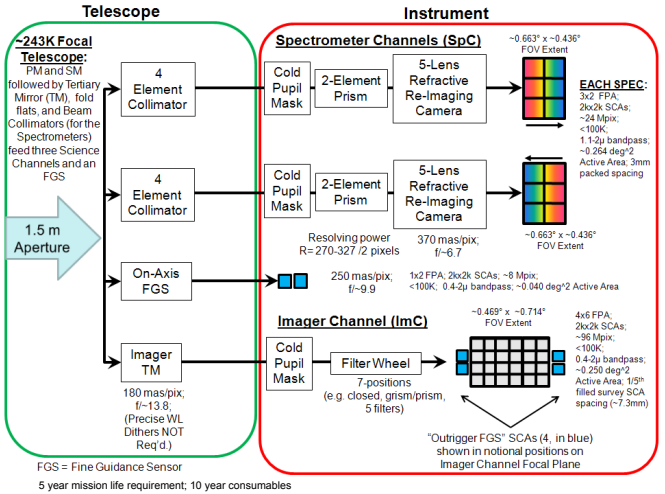
## IDECS 2009

BAO / RSD / SNe / WL / Surveys



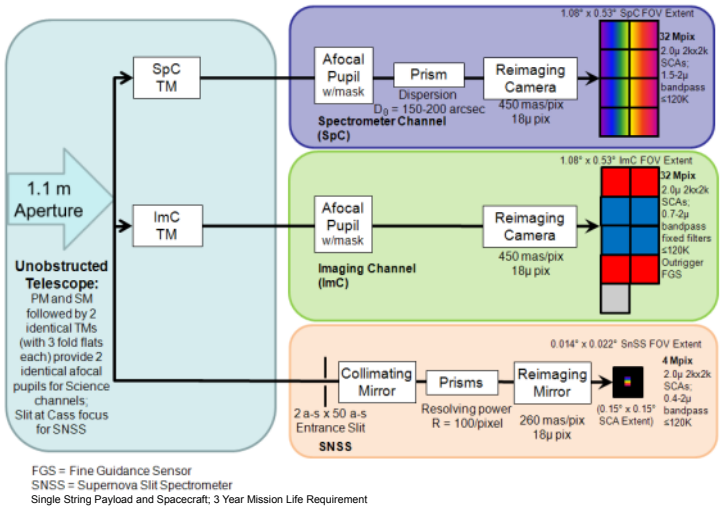

## JDEM Omega 2009

Micro-lensing / BAO / RSD / SNe / WL / Surveys / GI Program



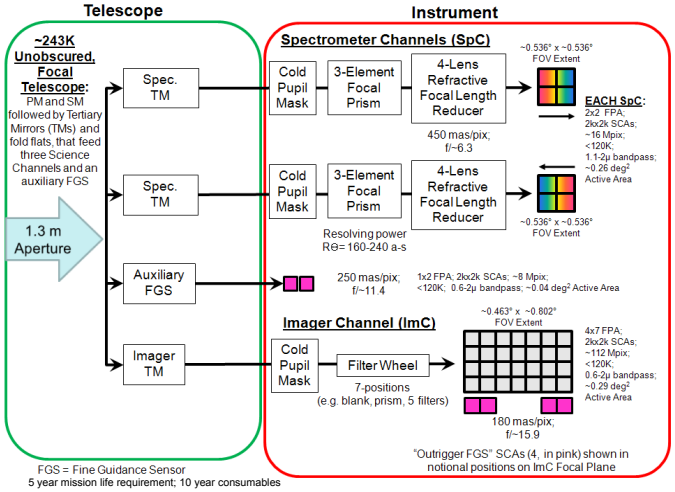

## Probe 2010

BAO / RSD / SNe / WL photo-Z's




## IDRM 2011

Micro-lensing / BAO / RSD / SNe / WL / Surveys / GI Program



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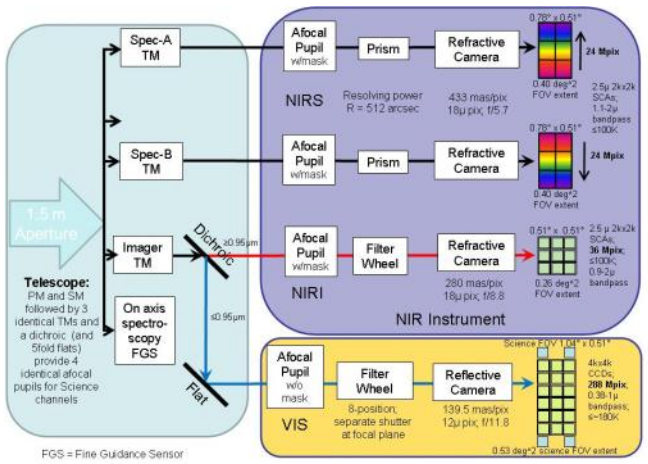


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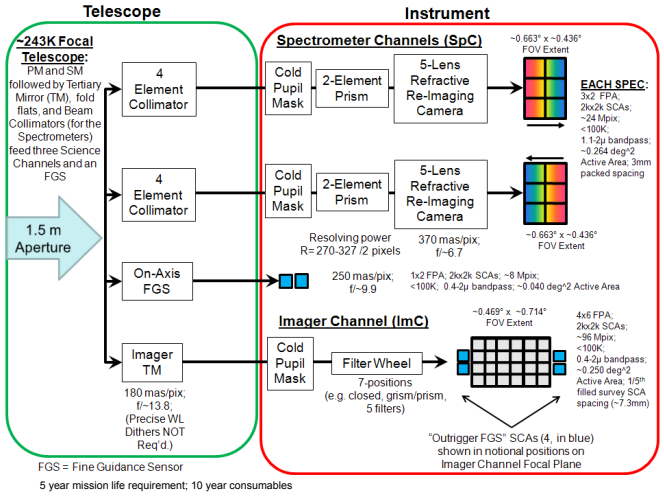


magnification

" / p

## IDRM 2011

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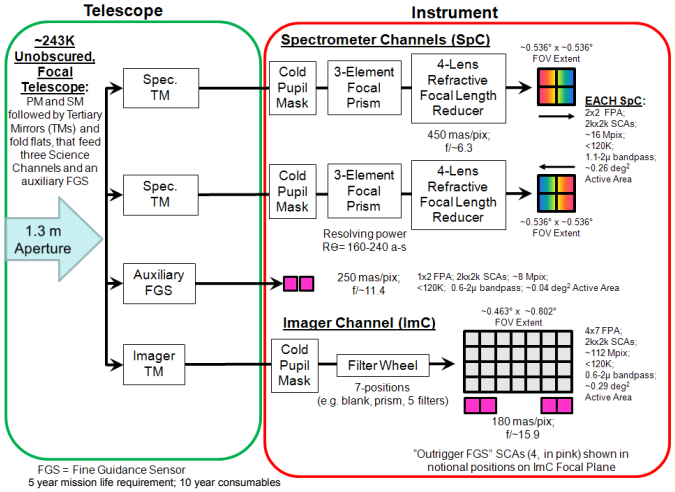



0.45

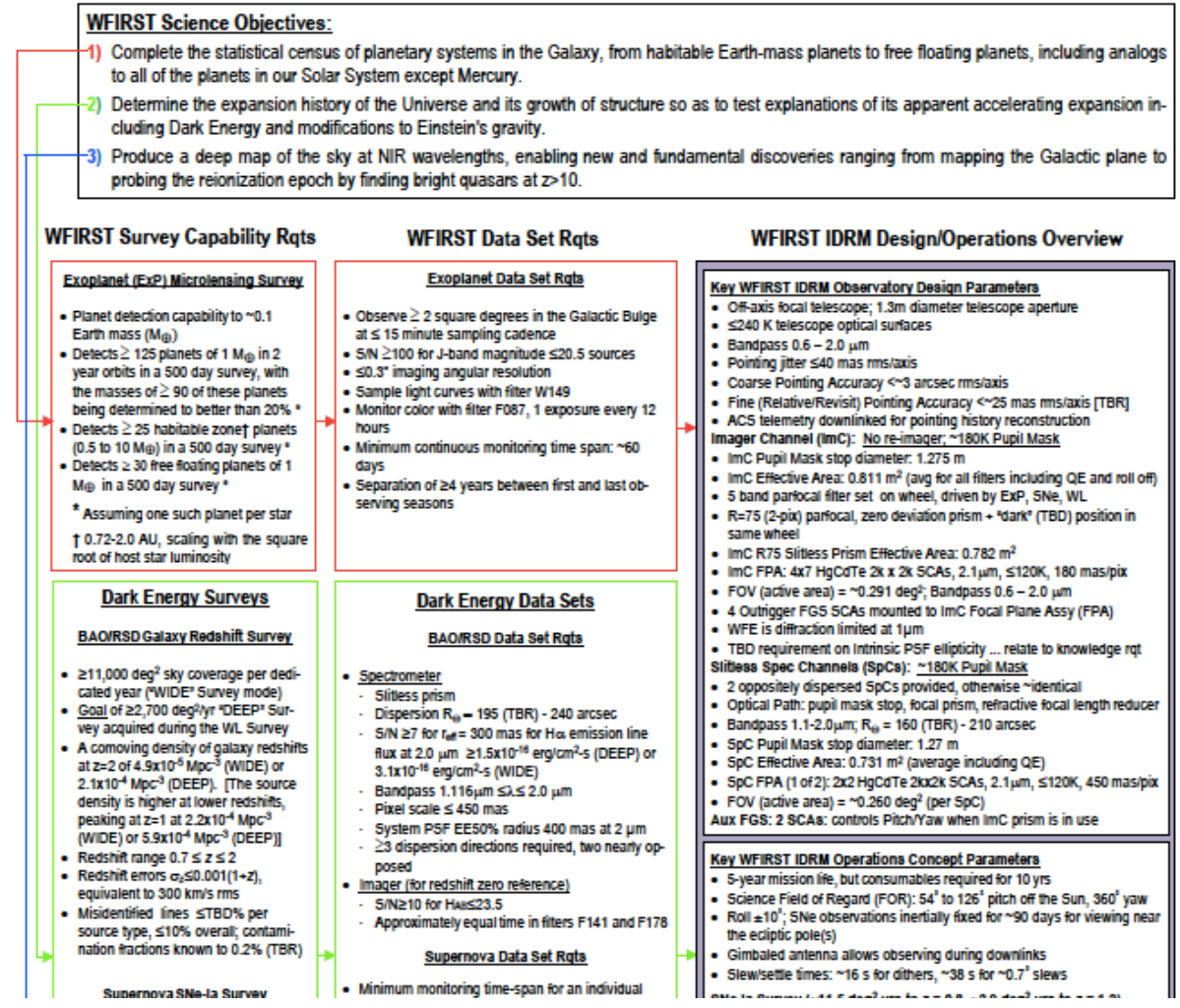
0.18

# Independent Cost Estimate

- Performed by Aerospace Corp
- CATE = Cost And Technical Evaluation
- Input was Interim Design Reference Mission
- Aerospace cost estimate is within 7% of $1.6B cost estimate from the Decadal Survey
- **"Project has presented a feasible technical design consistent with stated science goals"**

# Requirements Flowdown

- Substantiation that WFIRST can achieve NWNH science
- Traces science requirements from top level objectives



# Workshare Assignments

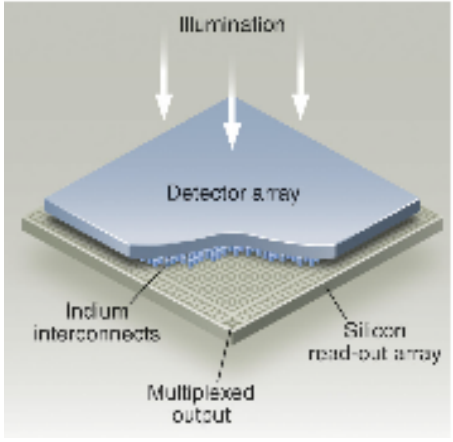
- WFIRST Project resides in Exoplanet Exploration Program (ExEP) at JPL and is managed by GSFC
- WFIRST Project work is joint effort between GSFC and JPL
- GSFC responsibilities
  - Project management
  - System engineering
  - Instrument & spacecraft management

- JPL responsibilities
  - Telescope design & implementation
  - Participate in system engineering
  - Data center (IPAC)
- HQ program oversight
  - Program Executive: Lia LaPiana
  - Program Scientist: Rita Sambruna

# Detector Program

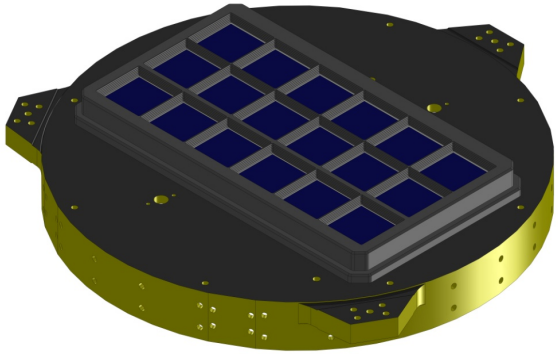
- H2RG detectors
  - H >> HAWAII = HgCdTe Astron. Wide Area IR Imager
  - 2 >> 2048 x 2048 pixels
  - R >> reference rows & columns to correct bias fluctuations
  - G >> guiding function, selectable window for guide star
- H1Rs used on HST. H2RGs developed first by SNAP team and then for JWST
- Goals of WFIRST program
  - Larger mosaics than JWST
  - Silicon carbide support structure
  - H4RG development

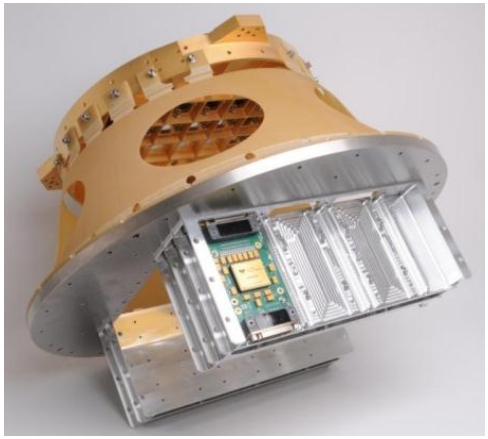
Sensor Chip Assembly

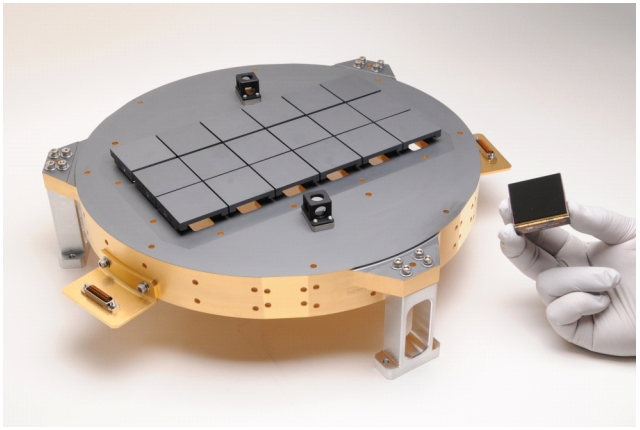


# Detector Array EDU

- Development of 3x6 HgCdTe Engineering Development Unit detector array at GSFC







**EDU Focal Plane Array**

- Silicon carbide mounting of HgCdTe detectors is under development and will be space qualified with EDU

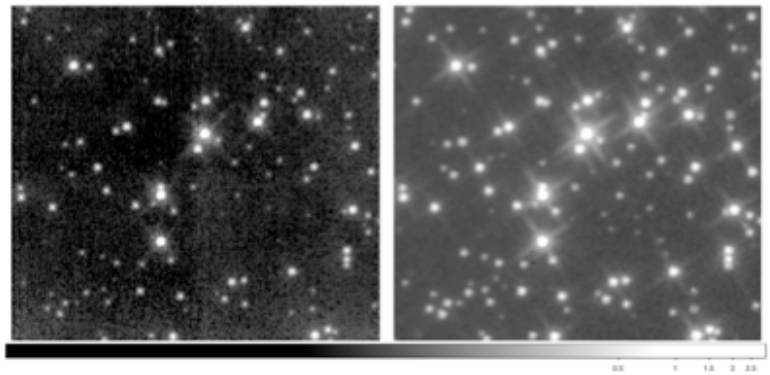
# SDT with H4RG Array

3 Feb 2012

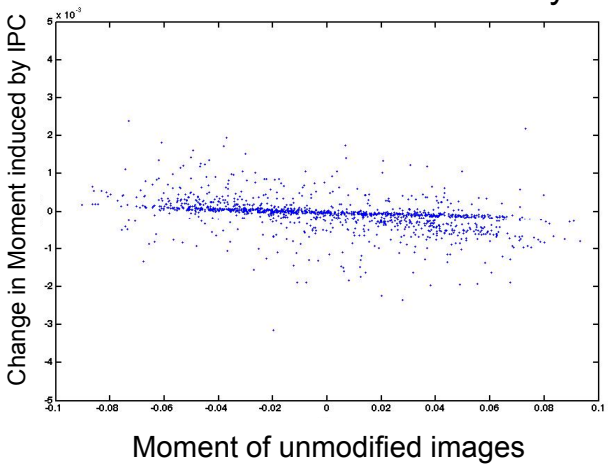
# HgCdTe Performance Studies

- Potential issues with HgCdTe capabilities for WL shapes
  - Interpixel capacitance (IPC)
  - Persistance
  - Linearity & reciprocity
- Laboratory test program in place to assess issues (JPL, Caltech, Goddard, Teledyne, STScI, U Hawaii)
- Preliminary results are encouraging

Riess – HST WFC3 Linearity Study



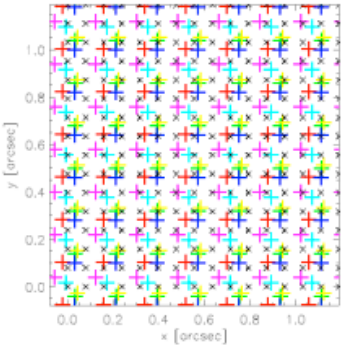
Marchant et al. – IPC Study



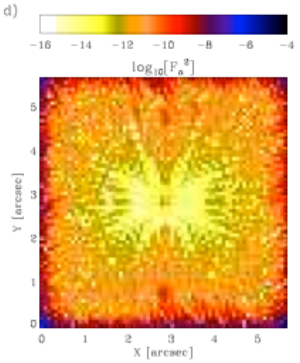
# Simulations

- Pixel scale study for WL at JP/Caltech (Rhodes, Hirata, Rowe)
  - Shapelet simulations, image combination software, dithering study
  - Results show that 0.18 "/pixel of WFIRST Imager is adequate for WL
  - WL image simulation software will be available to community via IPAC

pixel configuration



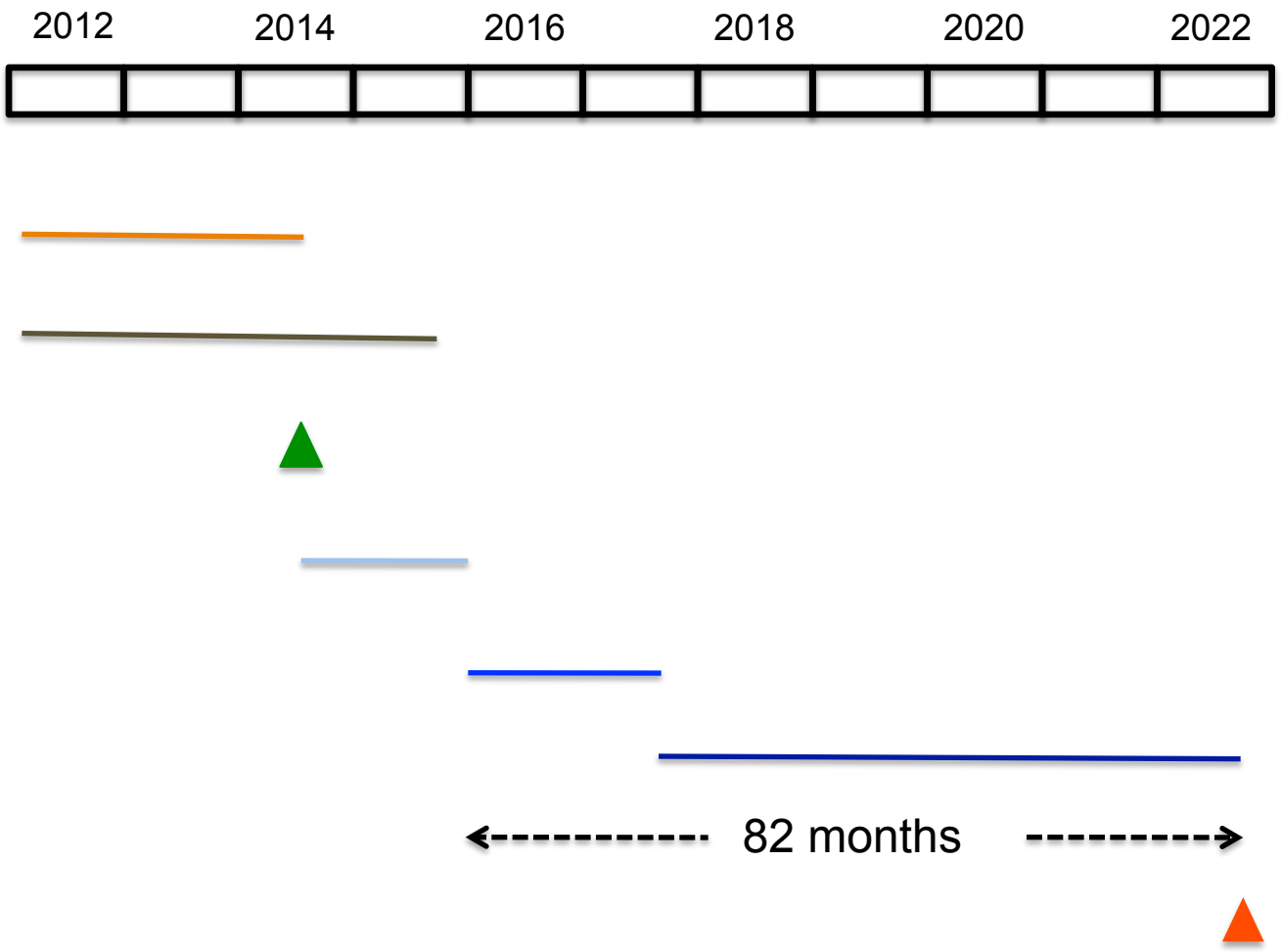

residuals




Rowe, Hirata & Rhodes 2011

- Sky tiling sims for BAO & SNe at GSFC (Kruk)
- Microlensing sims at Notre Dame/OSU (Bennett, Rhie, Gaudi)

# WFIRST Schedule Forward



# Science Outreach

- Science calculators and estimators being deployed to the community through IPAC
- WFIRST booth developed and displayed at conferences
- IPAC Conference
- WFIRST "Meeting-In-A-Meeting" June 12-13  AAS in Anchorage
- Need for a brochure