WFIRST & AFTA Update

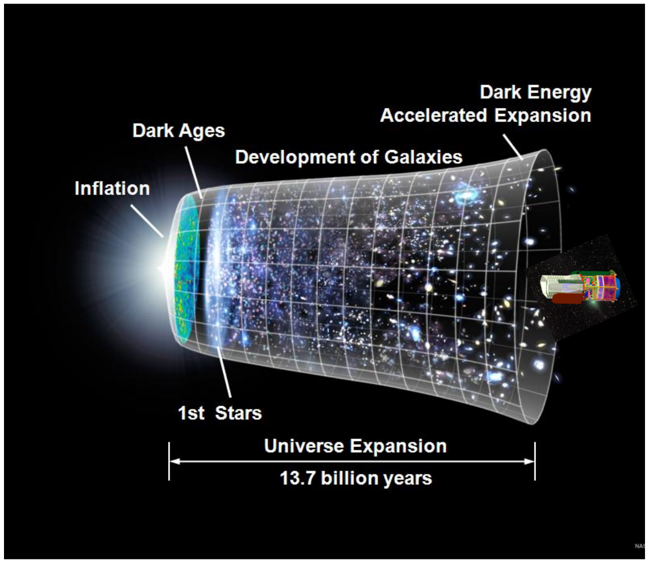
Neil Gehrels (GSFC) SDT Co-Chair
David Spergel (Princeton) SDT Co-Chair

AAAC

November 30, 2012

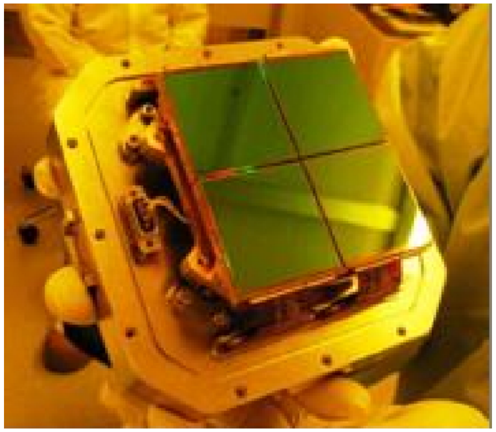
WFIRST Summary

- WFIRST is the highest ranked large space mission in 2010 US Decadal Survey
  - dark energy
  - exoplanet microlensing and coronagraphy
  - NIR sky for the community (GI program)



- Measurements:
  - NIR sky surveys for BAO & weak lensing
  - NIR monitoring for SNe & microlensing
  - Option coronagraph for exoplanet imaging

- Enabled by US-developed large format HgCdTe detectors



JWST HgCdTe Detector

WFIRST Activities

WFIRST

- 2010: WFIRST ranked 1st in large mission category by Astro2010
- 2011: Science Definition Team #1 formed to study WFIRST
- 2011: Nobel prize for acceleration of universe
- 2011: Free-floating planets detected by ground microlensing
- 2012: WFIRST science conference at Caltech (February)
- 2012: SDT #1 final report: arXiv 1208:4012

AFTA-WFIRST

- 2012 NASA announces receipt of two 2.4m telescopes (June)
- 2012 Ad-hoc science group considers applicability for WFIRST science
  - white paper: arXiv 1210.7809
- 2012 WFIRST-AFTA science conference at Princeton (September)
- 2012 SDT #2 formed to study using 2.4m telescope for WFIRST science
  - working with Project team at Goddard and JPL

Program to package & characterize HgCdTe IR detectors (govt, industry, academia)

Science Definition Team #2

Neil Gehrels, GSFC — Co-Chair
David Spergel, Princeton — Co-Chair

James Breckinridge, Caltech
Megan Donahue, Michigan State Univ.
Alan Dressler, Carnegie Observatory
Chris Hirata, Caltech
Scott Gaudi, Ohio State Univ.
Thomas Greene, Ames
Olivier Guyon, Univ. Arizona
Jason Kalirai, STScI
Jeremy Kasdin, Princeton
Warren Moos, Johns Hopkins
Saul Perlmutter, UC Berkeley / LBNL
Marc Postman, STScI
Bernard Rauscher, GSFC
Jason Rhodes, JPL
Yun Wang, Univ. Oklahoma
David Weinberg, Ohio State U.

Wes Traub, JPL Ex-Officio
Rita Sambruna, NASA HQ Ex-Officio

AFTA
Astrophysics Focused
Telescope Assets

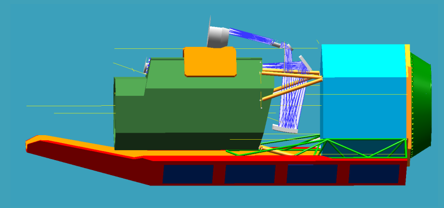

RESERVED
SDT MEMBERS

SDT Charter

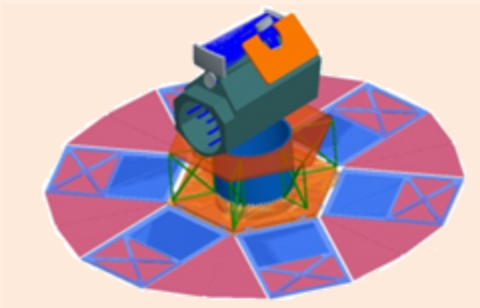
- Determine science requirements and key mission parameters
- Work with Project office to develop a Design Reference Mission using one of the 2.4m telescope assets
- Use telescope "as is"
- Maintain the technical viability for a 2022 launch
- Incorporate modularity in design and attach points to facilitate on-orbit servicing and I&V testing. Consider GEO orbit.
- Keep overall mission cost as low as possible
- Study including a coronagraph instrument as an option
- Study utilizing optical communication as an option

Design Concepts

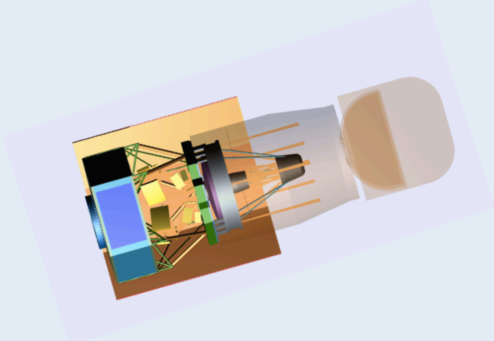
- **DRM1**
  - **1.3 meter off-axis telescope**
  - **Single channel payload**
  - **5 year mission**
  - **Atlas V Launch Vehicle**



- **DRM2**
  - **1.1 meter off-axis telescope**
  - **Single channel payload**
  - **3 year mission**
  - **Falcon9 Launch Vehicle**

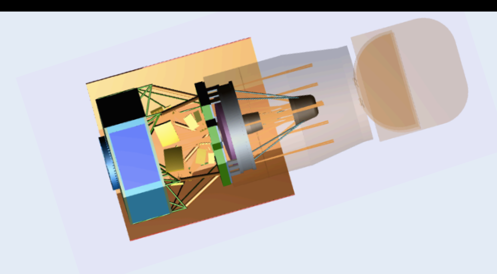


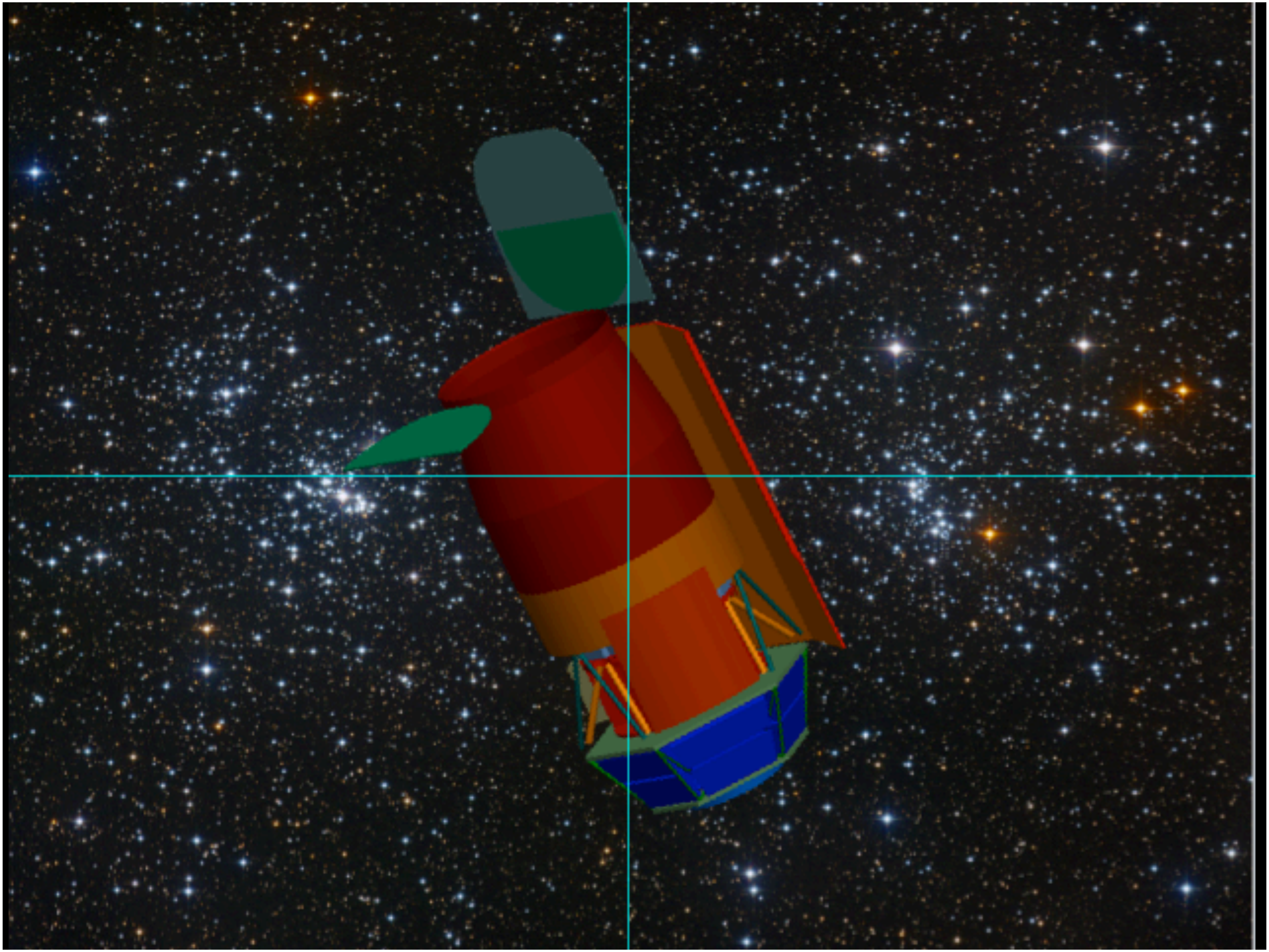
- **AFTA-WFIRST**
  - **2.4 meter on-axis telescope**
  - **1-channel payload + coronagraph**
  - **5 year mission**
  - **Falcone9 or Atlas V Launch Vehicle**



Design Concepts

- 2.4 meter on-axis telescope
- 1-channel payload + coronagraph
- 5 year mission
- Falcone9 or Atlas V Launch Vehicle

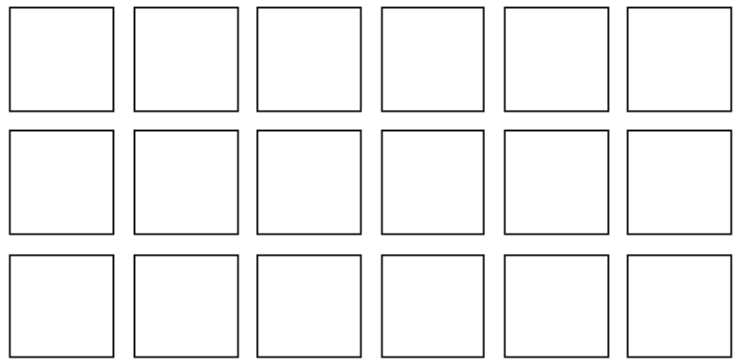




Field of View

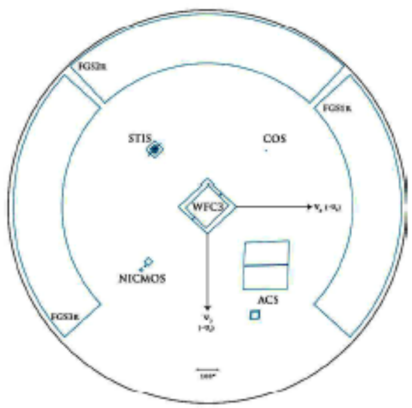
6x3 H4RG @ 0.11"/p, 0.28 sq.deg

0.425 wide°



288 Mpix

0.874°

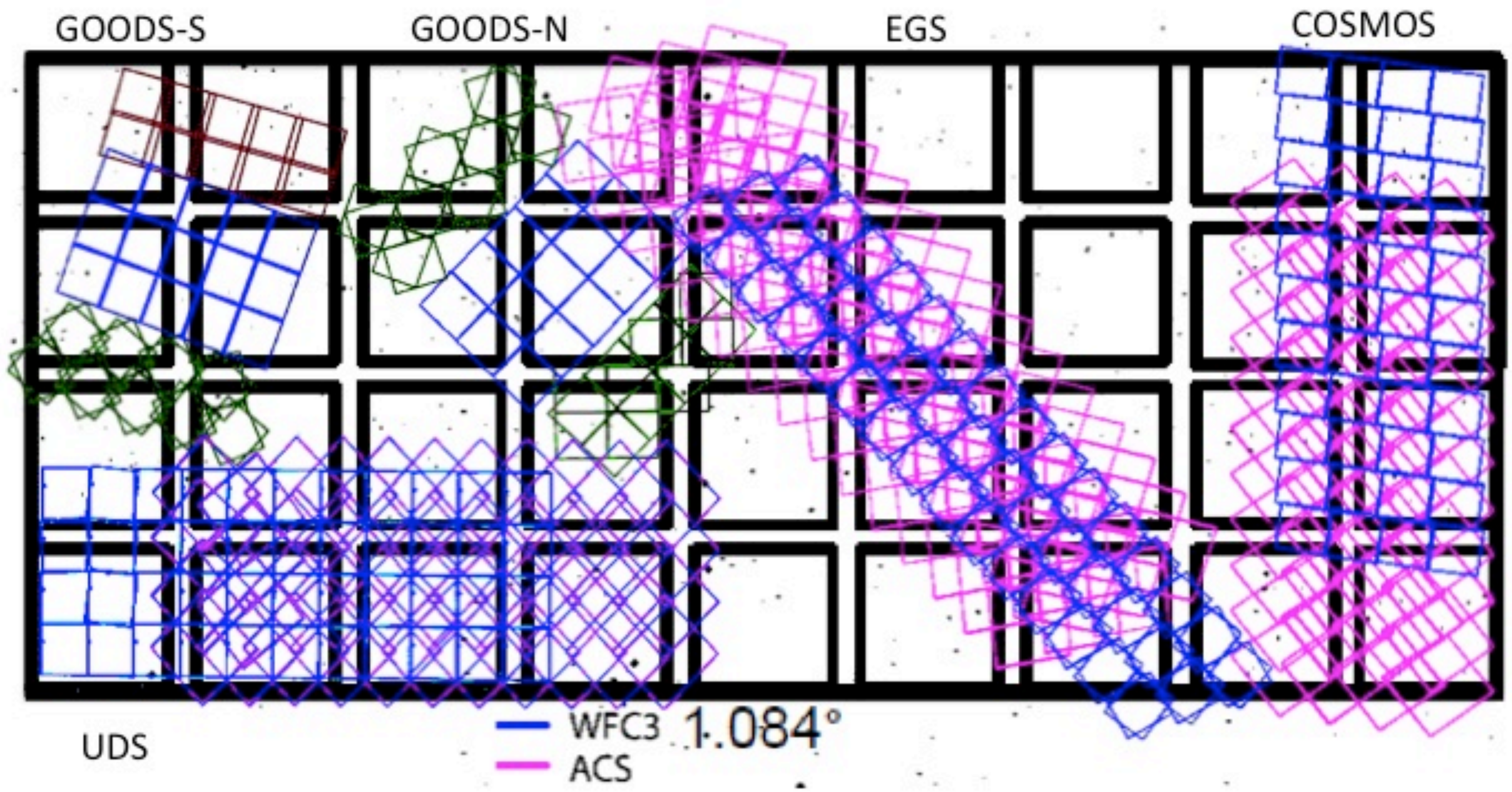


HST [all instruments]

JWST [all instruments]

Moon (average size seen from Earth)

CANDELS fields on DRM1 focal plane



from J. Kruk

Advantages of 2.4m Telescope

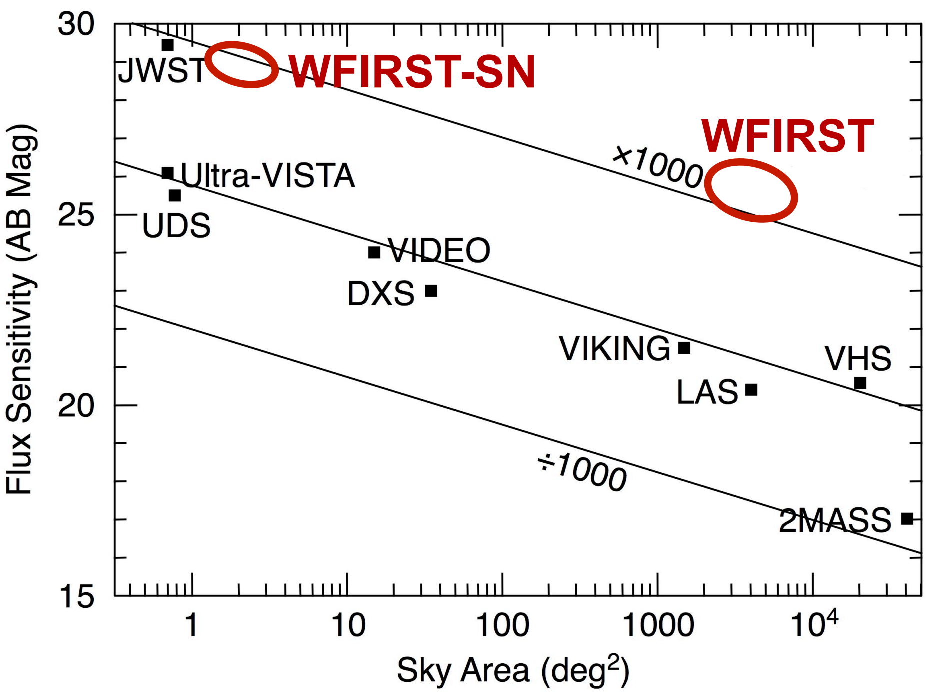
- All configurations studied have excellent science performance relative to Astro2010 goals:
  - DRM 1: Astro2010 prescription
  - DRM2: Low cost, but capable due to larger pixel count
- Gift telescope at no cost to NASA.
- Existing hardware.
- Telescope PSF is factor of 1.8 – 2.2 better than DRM 1 & 2
  - Angular resolution scales at ~ λ / D
  - Enables optional coronagraph
- Larger mirror gives factor ~2 better sensitivity (0.8 mag deeper)

Near IR Capabilities

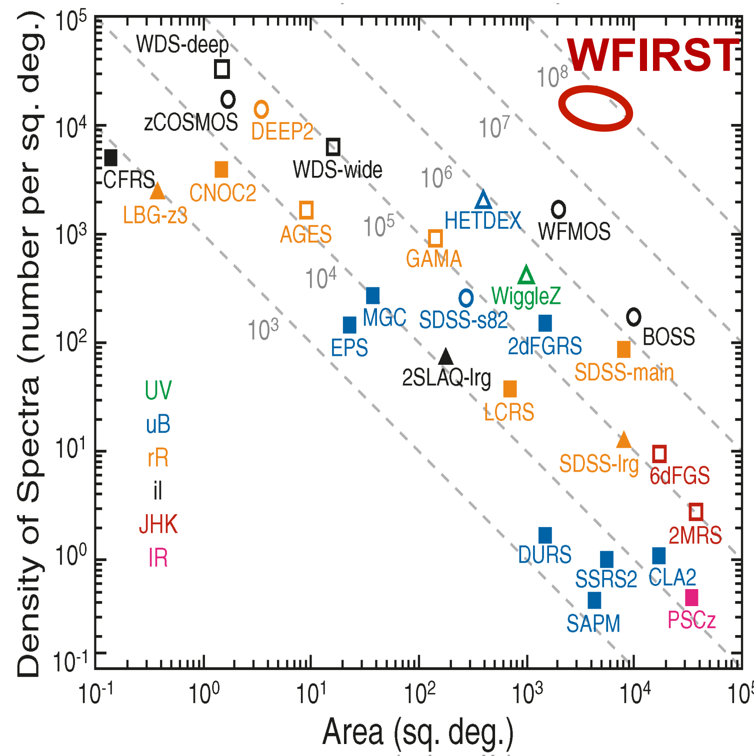
instrument	telescope	pixel scale	field of view	wavelength
WISE	0.4m	2.75 arcsec	47 arcmin	3 – 28 μm
ISO	0.6m	12 arcsec	3 arcmin	2.4 – 240 μm
Akari	0.7m	1.5 arcsec	10 arcmin	1.8 – 180 μm
Spitzer	0.85m	1.2 arcsec	5.2 arcmin	3 – 8 μm
Hubble/ NICMOS	2.4m	0.04 – 0.20 arcsec	0.2 – 0.9 arcmin	0.8 – 2.5μm
Hubble/WFC3 IR	2.4m	0.13 arcsec	2 arcmin	0.9 – 1.7 μm
AFTA-WFIRST	**2.4m**	**0.11 arcsec**	**25 x 52 arcmin**	**1.0 – 2.0 μm**

WFIRST NIR Surveys

NIR Imaging Surveys

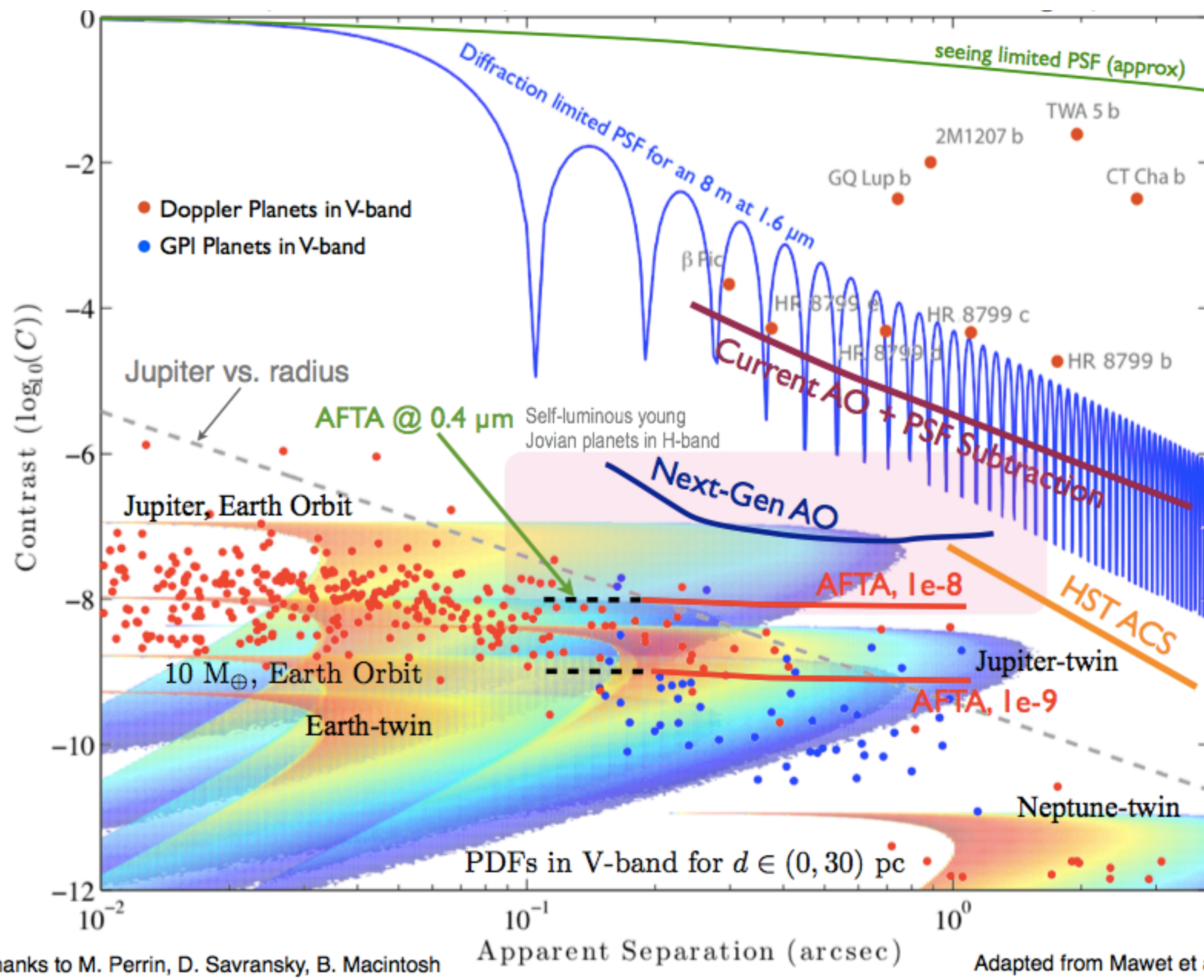


NIR Redshift Surveys



WFIRST provides a factor of 100 improvement in IR surveys

Coronagraph Science



hanks to M. Perrin, D. Savransky, B. Macintosh

Adapted from Mawet et al. 2012

from
J. Kasdin

Study Schedule

- SDT Meetings
  - Nov 19-20, 2012 GSFC
  - Jan 10-12, 2013 JPL / Caltech
  - Mar 14-15, 2013 GSFC
  - plus weekly telecons

- Report due April 30, 2013

- Independent cost estimate by end April

- AAS evening public session in Long Beach - Jan 8, 2012

Summary

- WFIRST & AFTA
  - The most pressing fields in astrophysics require a near infrared survey capability.
  - WFIRST can satisfy all of the observational requirements of Astro2010

- WFIRST is technologically mature

- New Science Definition Team studying use of 2.4m telescope for WFIRST science.
  - Existing telescope, free to NASA
  - Exquisite imaging & sensitivity
  - Optional coronagraph included in study

- Report due on April 30, 2013