Cosmic Origins
Program Analysis Group (COPAG)
Science Analysis Group 8 (SAG8)

Cosmic Origins Science with the WFIRST Archive

Sally Heap

COPAG-ExoPAG Mtg., Boston, MA

5 June 2014

SAG 8 Current members

SAG 8 Lead: Sally Heap/GSFC (me)

Other members to date

- Carter Chamberlain / Va Tech
- Caryl Gronwall / PSU
- Mario Juric / LSST
- Anton Koekemoer / STScI
- Jeff Kruk / GSFC
- Roy Lubit / RCN.com
- Tom McGlynn / GSFC
- Chris Stockdale / Marquette U.
- Harry Teplitz / IPAC

SAG#8 Charter: Cosmic Origins Science Enabled by the WFIRST-AFTA Data Archive

SAG #8 will:

- Solicit from the community the types of investigations that will be conducted
- Identify the kinds of data products that are valued and needed
- Analyze how the archive is to be used and scope the data requirements* necessary to conduct COR science investigations
- Consider what other assets or efforts may be needed to maximize the science return from the WFIRST archive (e.g., coordination of WFIRST-AFTA data with LSST, Euclid, or JWST)

* high-level science products, catalogs, archive interface design, calibration requirements, data accessibility and distribution, computing resources, and archive operations

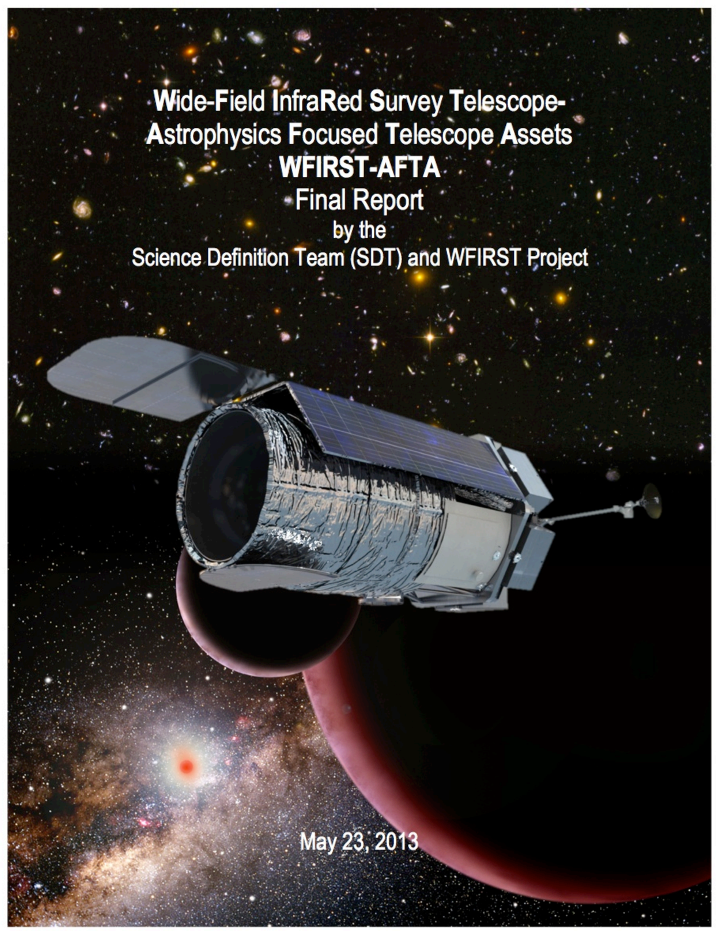
Cosmic origins science is part of the WFIRST program

- Existing observations: WFIRST observations obtained for other purposes, e.g. microlensing observations

- New observations: 25% of the WFIRST observing program (1 ¼ years) is for Guest Observers. Some observations will use exoplanet instruments

Either way, data in the WFIRST archive will be useful for cosmic origins science

Community input gathered by WFIRST SDT



Appendix A One Page Science Ideas

Wide Field Infrared Survey Telescope
(WFIRST-2.4)

A Collection of One Page Science Programs from the Astronomical Community

Version 1.0
Mar 2013

http://wfirst.gsfc.nasa.gov/

Community Members that Submitted 1-page Descriptions of Potential GO Science Programs in the 2013 SDT Report

Kailash Sahu

Scott Gaudi

04/30/2014 WFIRST-AFTA SDT Interim Report 15

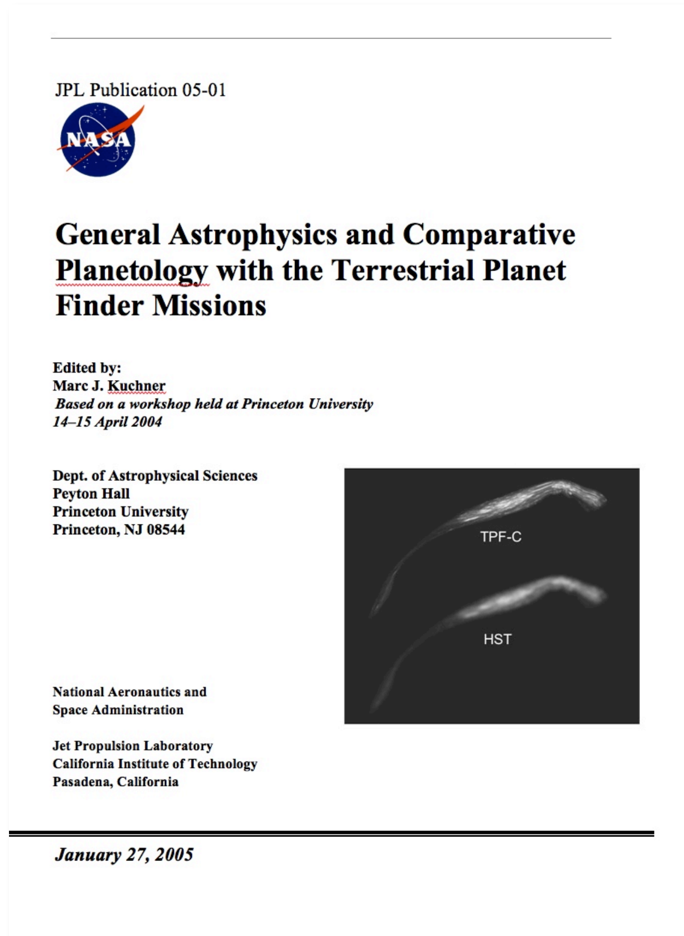
Cosmic Origins Science with Microlensing Observations

- Sahu: Detecting neutron stars and black holes through microlensing (A-18)
- Gaudi: Proper motions and parallaxes of disk and bulge stars → kinematics & structure of the bulge (A-19)

Cosmic Origins science with exoplanet instruments: coronagraph

Chapters on:

- Comparative planetology
- Circumstellar disks
- Stars
- Galaxies and AGN
- Cosmology


JPL Publication 05-01

General Astrophysics and Comparative Planetology with the Terrestrial Planet Finder Missions

Edited by:
Marc J. Kuchner
Based on a workshop held at Princeton University
14–15 April 2004

Dept. of Astrophysical Sciences
Peyton Hall
Princeton University
Princeton, NJ 08544

National Aeronautics and Space Administration

Jet Propulsion Laboratory
California Institute of Technology
Pasadena, California

January 27, 2005

Cosmic Origins science with exoplanet instruments: IFU spectra

ORIGINS

	Key Observation	Improvement over DRM1	Section
What were the first objects to light up the universe, and when did they do it?	Detect early galaxies and quasars for follow-up by JWST, ALMA, and next generation ground-based telescopes	***~10x increase in high z JWST target galaxies*** ***Very high-z supernova***	**2.3.1** A-43, A-45, A-46 **B-5**
How do cosmic structures form and evolve?	Trace evolution of galaxy properties	*1.9x sharper galaxy images*	A-31, A-32, A-39 A-47, **B-13**
What are the connections between dark and luminous matter?	High resolution 2000 sq. deg map of dark matter distribution and still higher resolution maps in selected fields Dark Matter distribution in dwarfs to rich clusters	*Double the number density of lensed galaxies per unit area.* *Capable of observing 200-300 lensed galaxies/arcmin^2* *Astrometry of stars in nearby dwarfs*	A-25, A-26, A-33 A-35, A-36, A-37 A-38, A-50
What is the fossil record of galaxy assembly from the first stars to the present?	Map the motions and properties of stars in the Milky Way + its neighbors Find faint dwarfs	*3x increase in photometric sensitivity + 9x increase in astrometric speed* *JWST follow-up*	A-21, A-22, A-25 A-26, A-27, A-28 A-29, A-30, **B-19**
How do stars form?	Survey stellar populations across wide range of luminosities, ages and environments	**IFU spectroscopy** *3x more sensitive + 1.9x sharper galaxy images*	A-11, A-12, A-13 A-14, A-15, A-16 A-47, **B-8, B-11**
How do circumstellar disks evolve and form planetary systems?	Image debris disks	**Coronagraph**	2.5.2
How did the universe begin?	Measure the shape of the galaxy power spectrum at high precision; test for signatures of non-Gaussianity and stochastic bias	*Higher space density of galaxy tracers; higher space density of lensed galaxies*	2.2

UNDERSTANDING THE COSMIC ORDER

	Key Observation	Improvement over DRM1	Section
How do baryons cycle in and out of galaxies, and what do they do while they are there?	Discover the most extreme star forming galaxies and quasars		2.3.4
What are the flows of matter and energy in the circumgalactic medium?			
What controls the mass-energy-chemical cycles within galaxies?	Study effects of black holes on environment	**IFU Spectroscopy**	A-34
How do black holes grow, radiate, and influence their surroundings?	Identify and characterize quasars and AGNs, black hole hosts Use strong lensing to probe black hole disk structure	*Excellent match to LSST sensitivity* *1.9x sharper images*	A-41, A-43, A-48
How do rotation and magnetic fields affect stars?			
How do the lives of massive stars end?	Microlensing census of black holes in the Milky Way		A-18
What are the progenitors of Type Ia supernovae and how do they explode?	Study supernova Ia across cosmic time Detect SN progenitors in nearby galaxies	**IFU Spectroscopy**	**B-7**
How diverse are planetary systems?	Detect 3000 cold exoplanets and complete the census of exoplanetary systems throughout the Galaxy.	*60% increase in the number of Earth size and smaller planets detected by microlensing, improved characterization of the planetary systems*	2.5.1, 2.5.2.3 A-6, A-7, A-8 **B-15, B-17**

Further information

- Contact information:
  Sally.Heap@NASA.gov

- Web page(s):
  - COR.gsfc.nasa.gov
  - WFIRST.gsfc.nasa.gov

WFIRST-AFTA SDT Final Report (May 2013)

(includes the 1-page science ideas)

WFIRST-AFTA SDT Interim Report (Apr 2014)