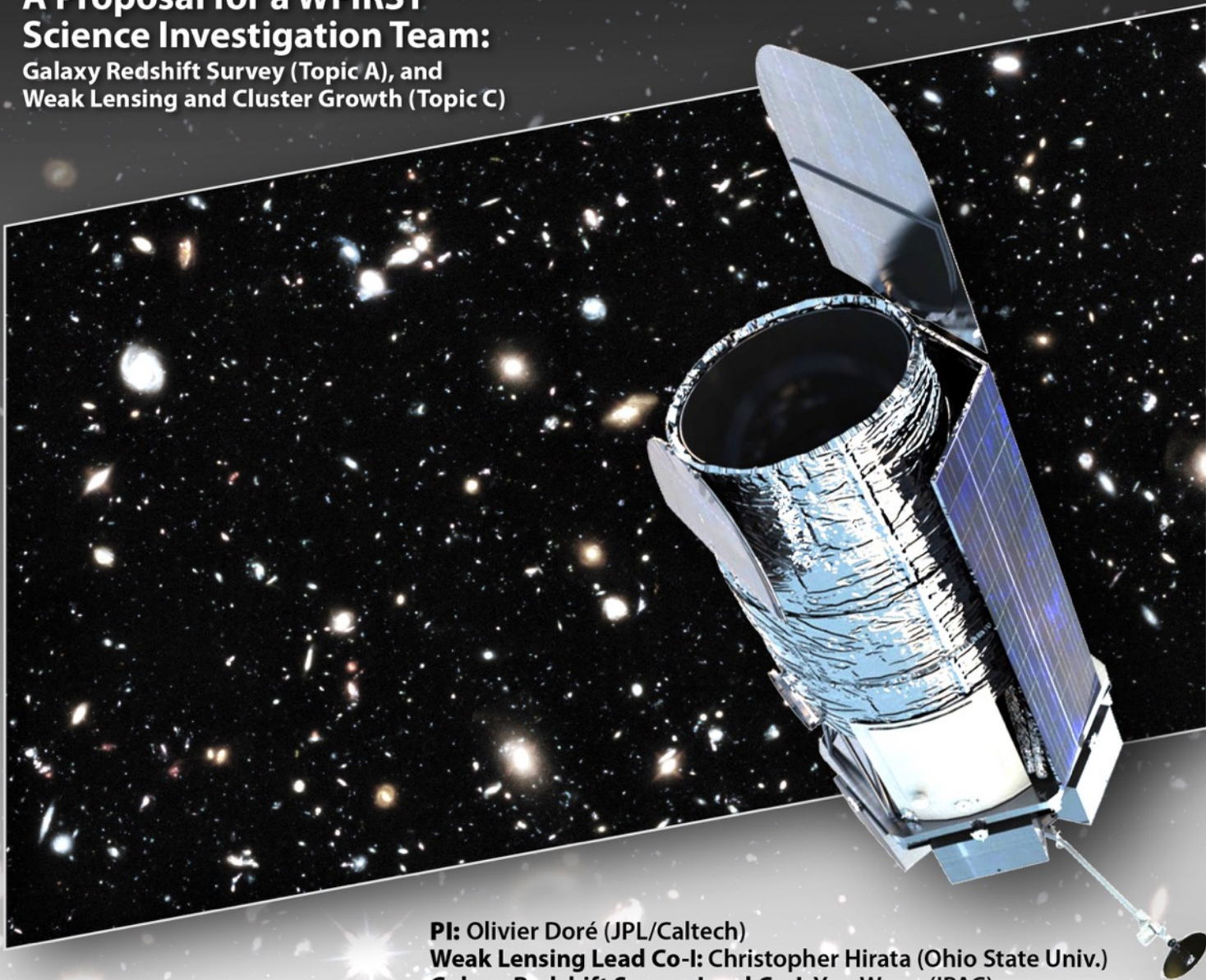# Cosmology
with the WFIRST
High Latitude Survey

A Proposal for a WFIRST Science Investigation Team:
Galaxy Redshift Survey (Topic A), and
Weak Lensing and Cluster Growth (Topic C)

PI: Olivier Doré (JPL/Caltech)
Weak Lensing Lead Co-I: Christopher Hirata (Ohio State Univ.)
Galaxy Redshift Survey Lead Co-I: Yun Wang (IPAC)
Cluster Growth Sub-lead Co-I: David Weinberg (Ohio State Univ.)

Co-Is: Rachel Bean (Cornell), Peter Capak (IPAC), Tim Eifler (JPL), Shirley Ho (Carnegie-Mellon Univ.), Bhuvnesh Jain (Univ. of Penn.), Mike Jarvis (Univ. of Penn.), Alina Kiessling (JPL), Robert Lupton (Princeton), Rachel Mandelbaum (Carnegie-Mellon Univ.), Nikhil Padmanabhan (Yale), Lado Samushia (Kansas State Univ.), David Spergel (Princeton), Harry Teplitz (IPAC)

Collaborators: Andrew Benson (Carnegie Obs.), Katrin Heitmann (ANL), George Helou (IPAC), Michael Hudson (Univ. of Waterloo), Elisabeth Krause (Stanford), Hironao Miyatake (JPL), Eduardo Rozo (U. of Arizona), Mike Seiffert (JPL), Chaz Shapiro (JPL), Kendrick Smith (Perimeter Insti.), Masahiro Takada (Univ. of Tokyo), Anja von der Linden (Stony Brook Univ.), Naoki Yoshida (Univ. of Tokyo)

WFIRST
WIDE-FIELD INFRARED SURVEY TELESCOPE • EXOPLANETS • DARK ENERGY • ASTROPHYSICS

Olivier Doré
JPL/Caltech

Cosmology with the High Latitude Survey: SIT Team

Olivier Doré (PI)	*JPL/Caltech*
Chris Hirata (WL lead)	*Ohio State*
Yun Wang (GRS lead)	*IPAC*
David Weinberg (CL sub-lead)	*Ohio State*
Rachel Bean	*Cornell*
Andrew Benson	*Carnegie*
Peter Capak	*IPAC*
Tim Eifler	*JPL*
Katrin Heitmann	*ANL*
George Helou	*IPAC*
Shirley Ho	*LBL*
Michael Hudson	*Waterloo*
Bhuvnesh Jain	*Penn*
Mike Jarvis	*Penn*
Alina Kiessling	*JPL*

|	
Elisabeth Krause	*Stanford*
Robert Lupton	*Princeton*
Rachel Mandelbaum	*CMU*
Hironao Miyatake	*JPL*
Nikhil Padmanabhan	*Yale*
Eduardo Rozo	*Univ. Arizona*
Lado Samushia	*Univ. Kansas*
Mike Seiffert	*JPL*
Charles Shapiro	*JPL*
Kendrick Smith	*Perimeter Institute*
David Spergel	*Princeton*
Masahiro Takada	*Kavli IPMU Tokyo*
Harry Teplitz	*IPAC*
Anja von der Linden	*Brookhaven*
Naoki Yoshida	*Tokyo*

WFIRST-AFTA Dark Energy/Cosmology Roadmap

Supernova Survey

wide, medium, & deep imaging
+
IFU spectroscopy

2700 type Ia supernovae
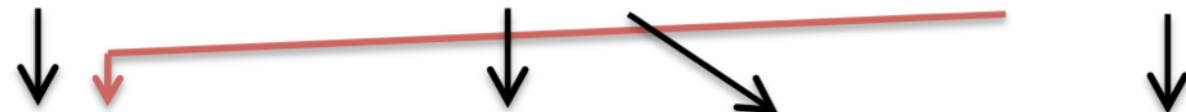z = 0.1–1.7

Saul Perlmutter & Ryan Foley's talks

standard candle distances
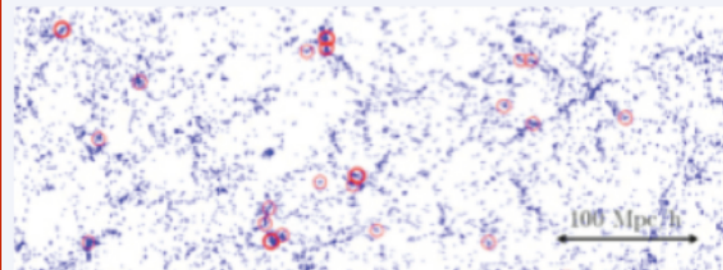z < 1 to 0.20% and z > 1 to 0.34%
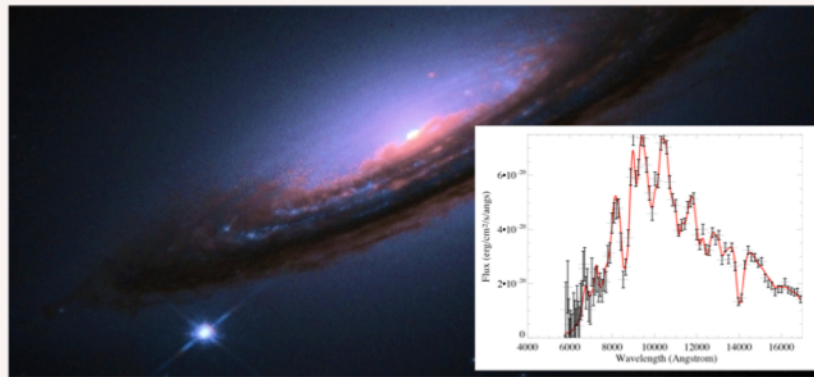
High Latitude Survey

spectroscopic: galaxy redshifts

16 million Hα galaxies, z = 1–2
1.4 million [OIII] galaxies, z = 2–3

imaging: weak lensing shapes

380 million lensed galaxies
40,000 massive clusters

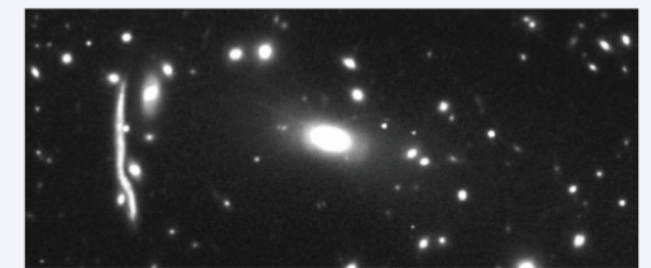**standard ruler**

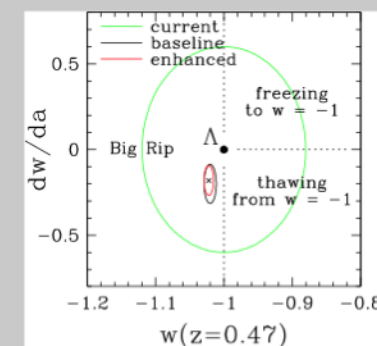| distances	expansion rate
z = 1–2 to 0.5%	z = 1–2 to 0.9%
z = 2–3 to 1.3%	z = 2–3 to 2.1%

dark matter clustering
z < 1 to 0.21% (WL); 0.24% (CL)
z > 1 to 0.78% (WL); 0.88% (CL)
1.1% (RSD)

history of dark energy
+
deviations from GR

$w(z)$, $\Delta G(z)$, Φ_{REL}/Φ_{NREL}

Cosmology with the High Latitude Survey: SIT Deliverables (I)

- (D1) Full requirement flow-down.

- (D2) Forecasts of the cosmological performances of the HLS.
  - ➡ Joint WL, RSD, BAO forecasts and systematics w/ CosmoLike

- (D3) Simulated imaging and spectroscopic data sets.
  - ➡ Synthetic photometric and spectroscopic data-sets, either public or data challenges.

- (D4) Prototype imaging and spectroscopic pipeline.

- (D5) Calibration strategies.

- (D6) A strategy for the determination and calibration of photometric redshifts.

Cosmology with the High Latitude Survey: SIT Deliverables (II)

- (D7) A detailed operations concept for the HLS Imaging and Spectroscopy program:
  - ➡ Detailed operations concept extending SDT13 and SDT15

- (D8) Development of methods for modeling and interpreting the cosmological measurement anticipated from WFIRST.

- (D9) Simulated light cone observations.

- (D10) Pilot survey proposals with associated figures of merits.

- (D11) A prioritized program of observations from other facilities.

- (D12) Broad engagement with the cosmological community.
  - ➡ Committed to put all our softwares on Github

Summary

- The HLS Cosmology Science Investigation Team is committed to a broad range of deliverables.

- There is a strong overlap between these deliverables and work going in the other projects, in particular LSST-DESC.

- There is strong overlap in team members between the SIT team and DESC.

- From a SIT point of view, we expect to:
  - ➡ Learn from the LSST-DESC developments.
  - ➡ Identify how to make a positive use of these thematic and personnel overlaps.
  - ➡ Identify how to maximize the scientific returns of WFIRST in the era of LSST.
  - ➡ Identify how to maximize the impact of WFIRST data in the cosmology community.