

THE MISSION

A key objective of the WFIRST mission is to understand the nature of Dark Energy. It will do this via the use of multiple probes including Type Ia SNe.

Current constraints (Alam et al., 2016):

$$w_0 = -0.91 \pm 0.1$$

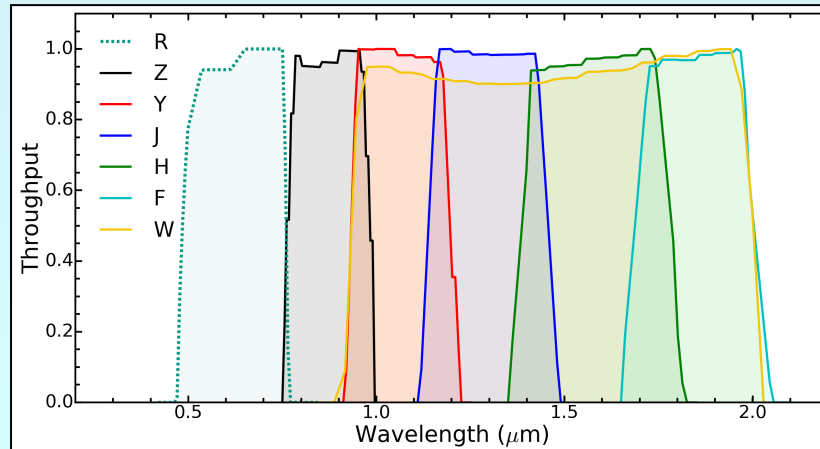
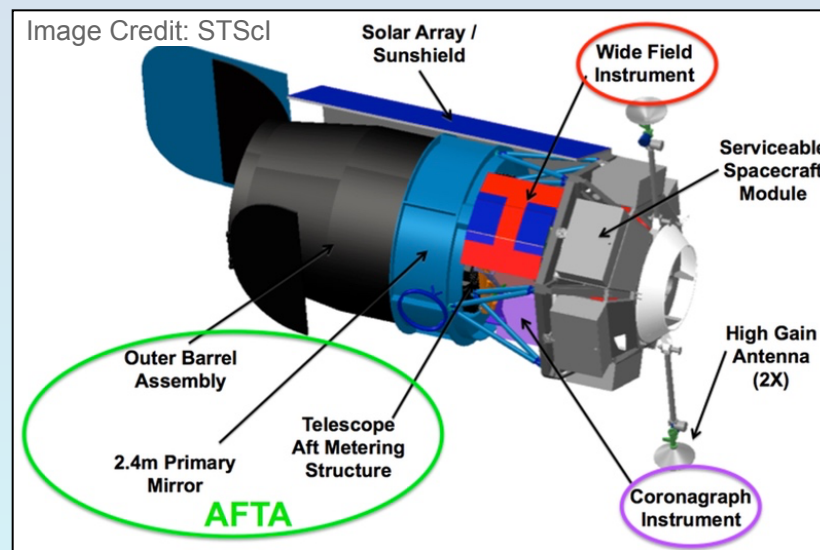
$$w_a = -0.39 \pm 0.34$$

Figure of Merit (FoM) = Area⁻¹ of the 95% confidence contour in the $w_0 - w_a$ plane.

Current FoM = 32.6 (Planck + BAO+SN)

WFIRST aims to increase FoM by factor of 10

INSTRUMENTS



Wide Field Channel (WFC):

Imager FoV: 0.28 deg²
Resolution: 0.11 arcsec/pixel
Pass band: 0.44 - 2.0μm
7 filters: R, Z, Y, J, H, F, W

Integral Field Channel (IFC):

FoV: 3" x 3"
0.05 arcsec/pixel
Spectral resolution: 70-225
Pass band: 0.42 - 2.0μm

Top figure: Overview of WFIRST's instruments
Bottom figure: Imaging filter band-passes

INITIAL SN SURVEY DESIGN

Duration: 6 month survey over 2 yrs.
Instruments: IFC spectra + WFC discovery imaging.

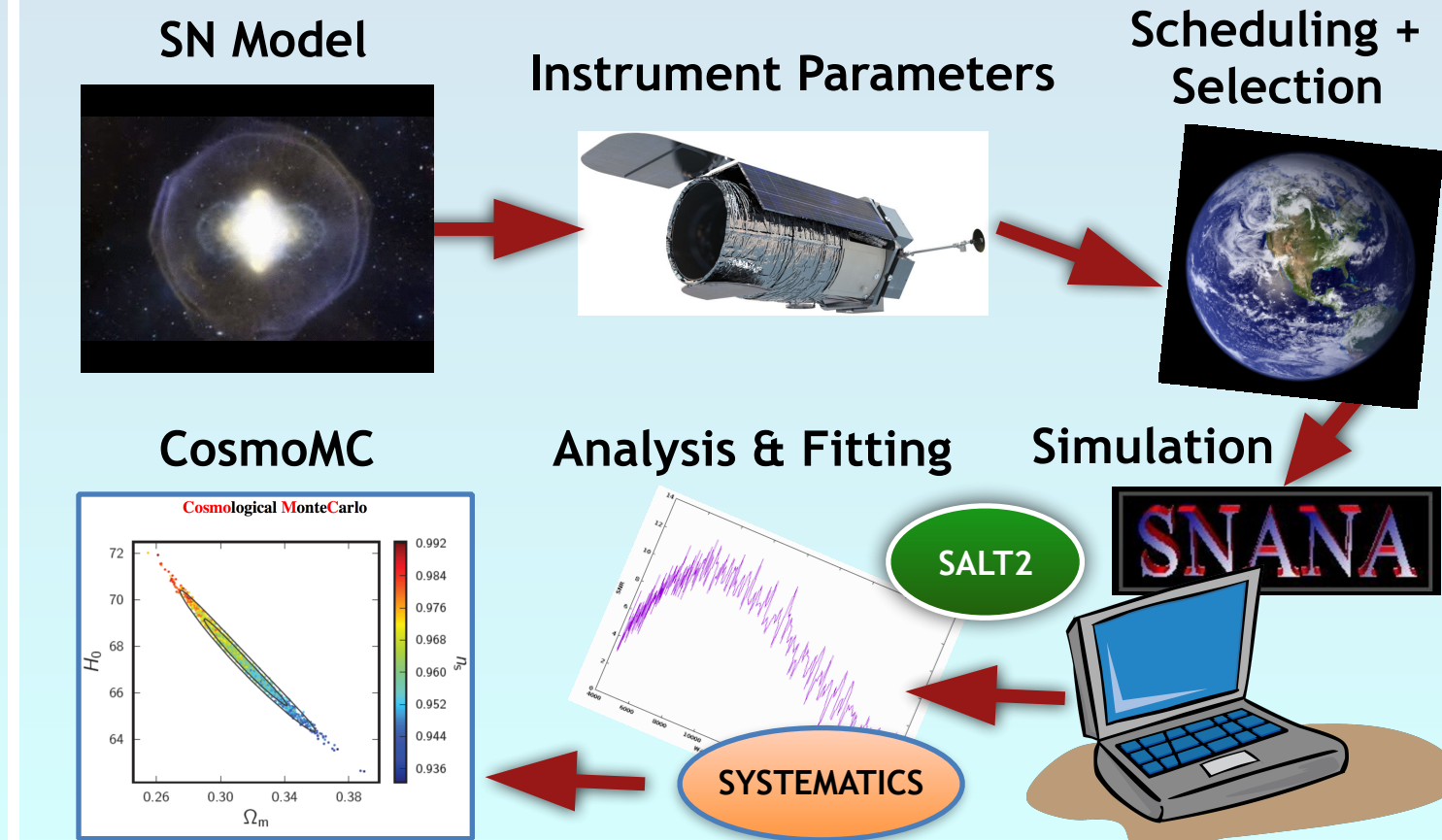
Each confirmed SN Ia will have 10 spectra: Cadence 5 rest frame days.

Imaging for discovery and SN peak brightness.

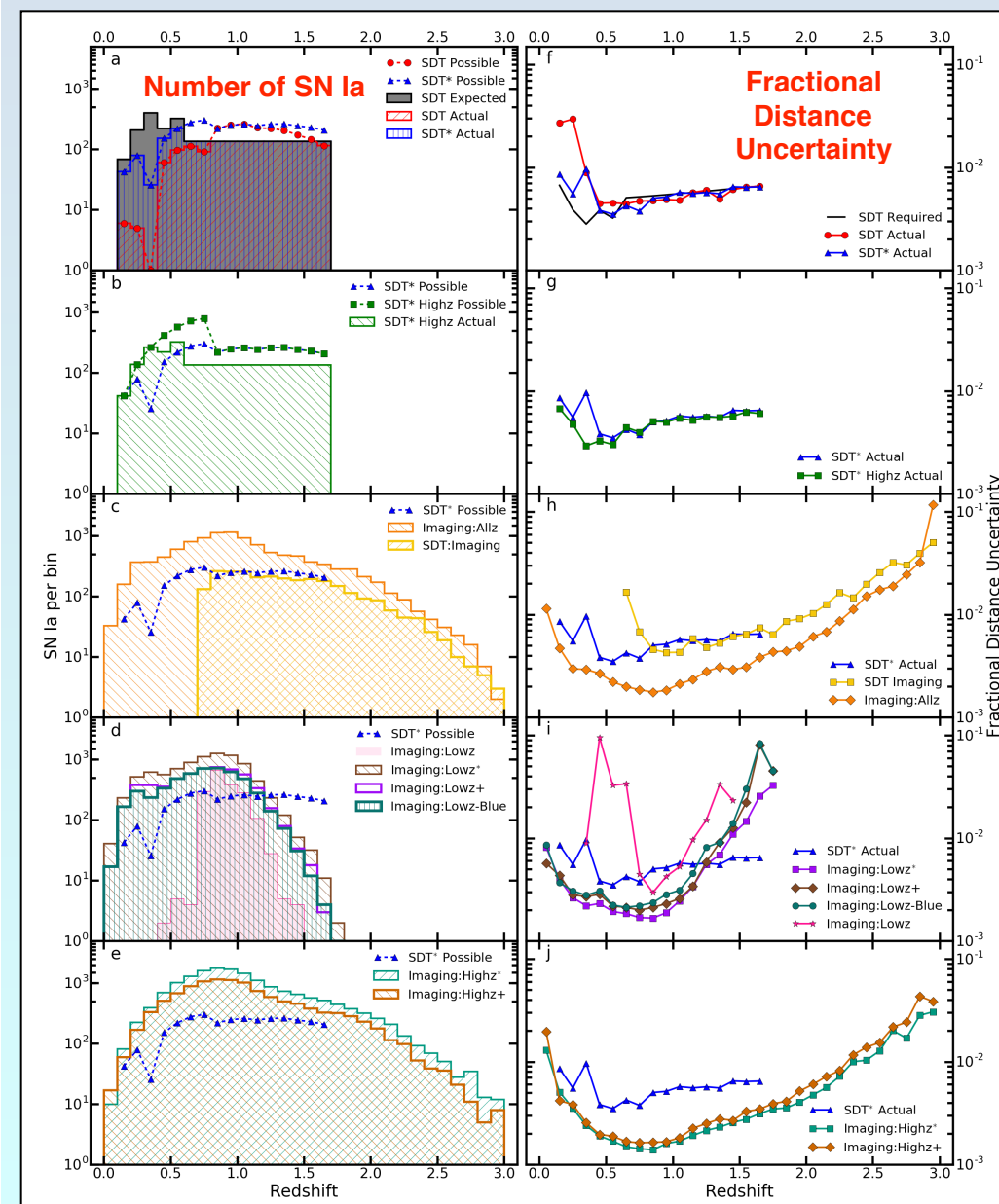
Tier Name	Redshift Range	FOV (deg ²)	Filters	Depth (mag)
Shallow	0.1 - 0.4	27	Y, J	-22
Medium	0.4 - 0.8	9	J, H	-25
Deep	0.8 - 1.7	5	J, H	-26

SUPERNOVA SIMULATIONS

Flow chart for simulated SN surveys. Light curves and spectra created using SNANA + SALT2.



11 SN SURVEY STRATEGIES INVESTIGATED



IFC + IMAGING

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IMAGING ONLY

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3 Tier Survey:
Shallow: YJ
Medium: JH
Deep: JH

2 Tier Survey:
Medium: JH
Deep: JH

3 Tier Surveys:
YJ, JH, JH
RZYJ, RZYJ, YJHF

2 Tier Surveys
RZYJ, RZYJ
RZYJHF, RZYJHF
BVRIYJ, BVRIYJ
YJ, YH

2 Tier Surveys
RZYJ, YJHF
RZYJHF, RZYJHF

SYSTEMATIC UNCERTAINTIES

Uncertainties in our understanding of SNe and instrumentation impact the use of Type Ia SNe as cosmological probes.

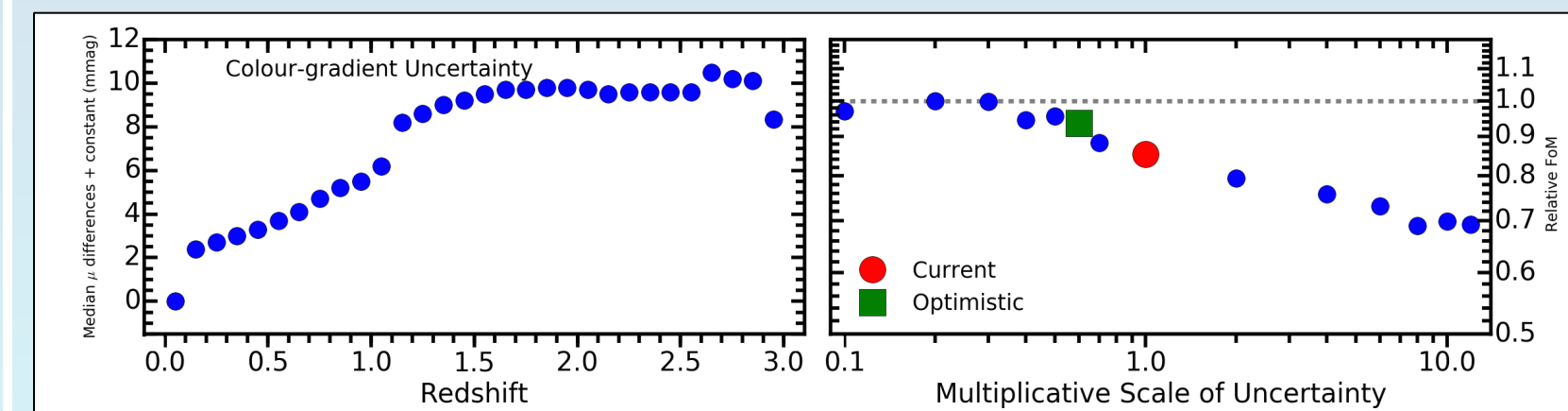
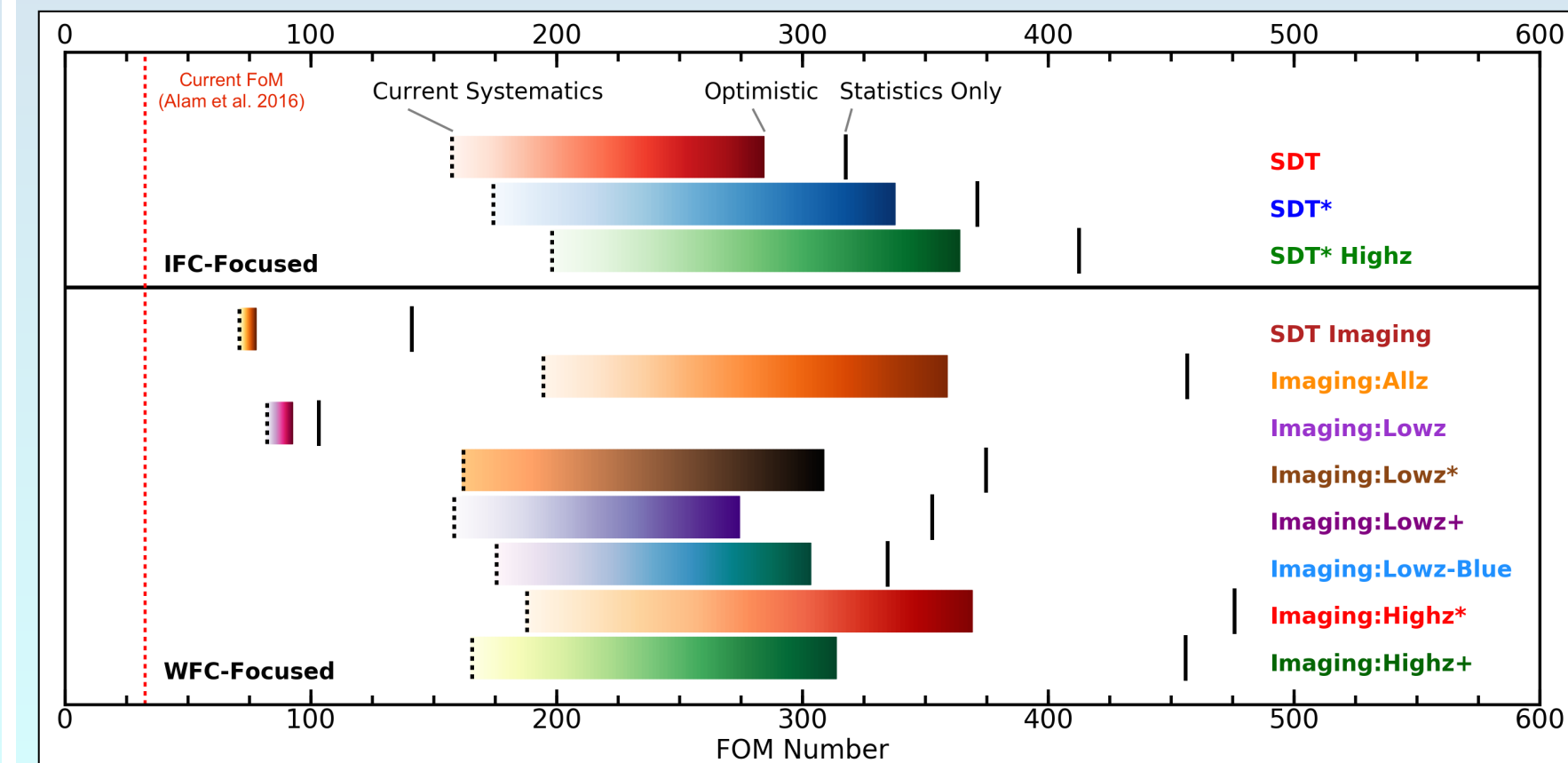


Figure Left: Median μ difference with redshift for data with and without a color gradient. Figure Right: Multiplicative scale of the color gradient uncertainty and its effect on the statistical FoM.

Systematics investigated and included in our analysis:
Color gradient, Non-linearity, Zero-point uncertainty, CC SN contamination, Intrinsic scatter, Color + stretch population, Host galaxy SN luminosity

DARK ENERGY TASK FORCE FIGURE OF MERIT

The most successful IFC-focused and WFC-focused strategies have comparable FoM values. The largest FoM is ~ 370.



We continue to optimize our simulations.