WISH: Wide-field Imaging Surveyor for High-redshift

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http://wishmission.org

WISH Overview

WISH is a newly proposed Japanese space mission aiming at revealing the first-generation galaxies in the early universe. With a cooled 1.5m primary mirror and ~1000 arcmin^2 wide-field camera, WISH will conduct very deep and wide sky survey which have not been achieved by any ground-based telescopes. WISH should be a unique facility not only for the finding first-generation galaxies but also for various subjects including cosmological issues such as dark energy. Currently the development of the mission concept is being proceeded by the JAXA/ISAS WISH working group (PI: T. Yamada).

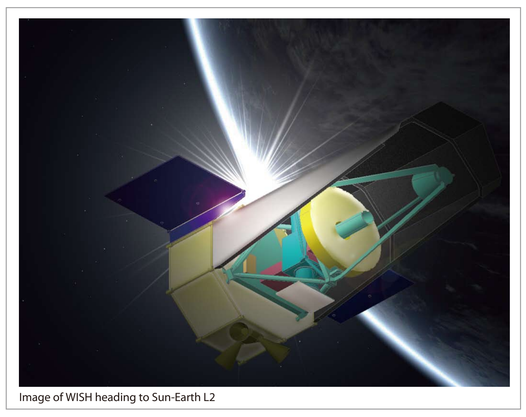
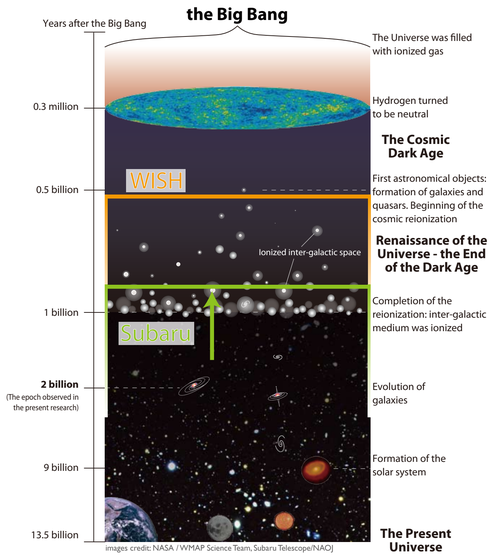


Image of WISH heading to Sun-Earth L2

Specifications

Primary Mirror Size:	1.5m
Field of View:	~1000 sq. arcmin
Pixel Scale:	0.15″
Detector:	32 2k x 2k HgCdTe
Wavelength:	1-5μm
Orbit:	Sun-Earth L2
Launcher:	Japanese HII-A
Launch date:	Late 2010s
Mission Lifetime:	~5 years at L2

Scientific Goals



WISH is a natural extension of very successful optical wide-field prime-focus imager of 8.2m Subaru Telescope in Hawaii, which have found many high-z galaxies (up to z~7).

* Finding First Generation Galaxies (up to z~15) via Extremely Wide and Deep Near-IR Surveys

* Study of the expansion history of the universe and properties of dark energy by using Type-Ia Supernovae luminosity in rest-frame near-IR
* Explore formation and evolution of galaxies via wide-field near-IR survey (stellar mass assembly, star formation history etc.)
* Finding afterglow of very distant Gamma-ray bursts

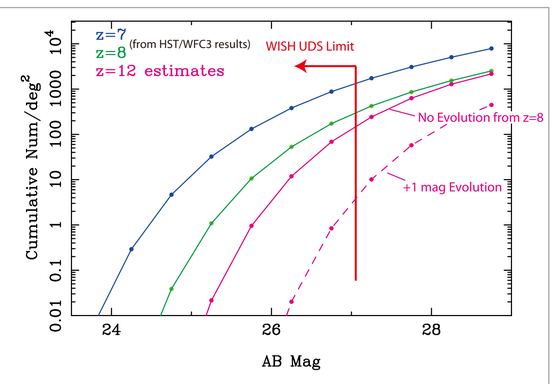
Wide-field NIR Survey is complementary to very deep (but narrow) observations by JWST / NIRCam, and WISH has a great synergy with Next-gen Extremely Large Telescopes as a target provider (feeding rare objects bright enough for spectroscopy with ELTs).

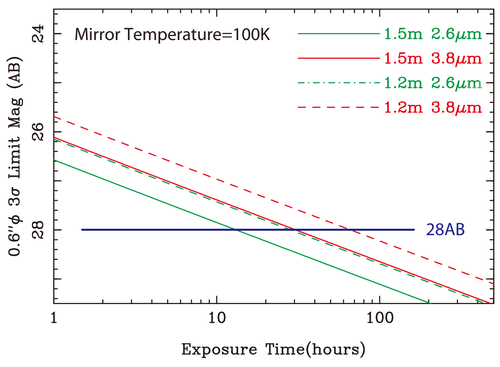
Survey Plan

	# of Filters	Limiting Mag.	Area
Ultra Deep Survey	3	28 AB	100 deg^2
Multi-Band Survey	5	27-28 AB	within UDS
Ultra Wide Survey	2-3	24-25 AB	1,000 deg^2

Why 1.5m Mirror?

In order to constrain the number density evolution of galaxies in the very early stage, statistically significant number of galaxies is required(=need wide-field), and we need to reach ~28 AB magnitudes (=need depth).

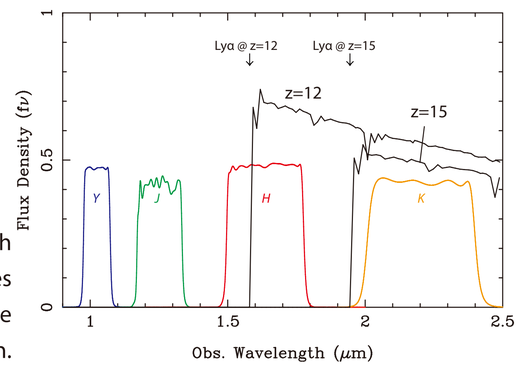




To achieve ~28 AB magnitudes with reasonable observing time (~a few x 10 hours), primary mirror should not be smaller than 1.5m. If the mirror is 1.2m, more than x2 observing time will be required. Also, it is required to cool the telescope and instruments so that thermal noise does not exceed zodiacal emissions; mirrors need to be <100K, camera (including filters) needs to be <80K and detectors should be ~40K.

Why 1-5μm?

We need to cover >2μm to detect redshifted UV emission from galaxies at z>12. Capability of observing at 2-5μm is essential to high-z galaxy studies.

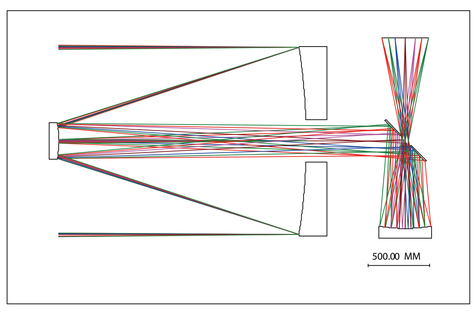


Model spectra of star-forming galaxies at z=12 and 15 with passbands of conventional near-IR filters. Because WISH does not suffer atomospheric absorption, we will optimize broad-band filters for high-z galaxy detection.

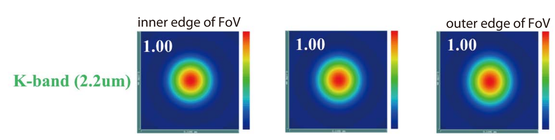
Current Development Status

Optics

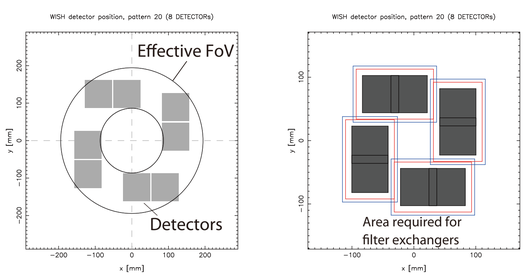
Light-weight ULE glass mirror as a heritage of Hinode (Solar-B) will be used.



Current optical design by Dr. Y. Ikeda (photocoding) achieves Strehl ratio of ~1.0 all over the field of view.

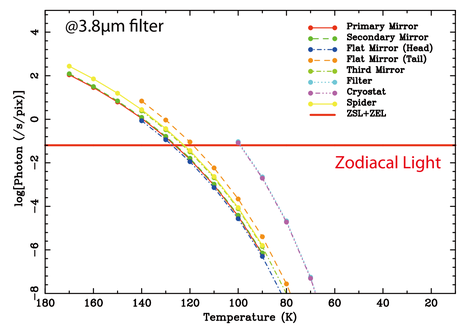


Focal Plane



WISH focal plane has a donut-like shape. Four clusters of eight 2k x 2k detector arrays will be placed and area per shot is ~840 sq.arcmin. We have verified that with this configuration uniform survey depth can be achieved by dithering telescope pointings.

Thermal Design

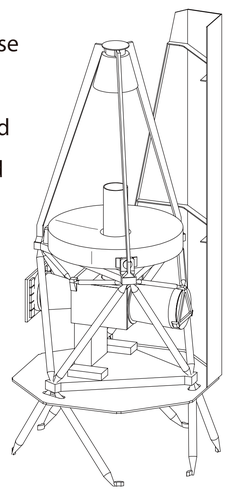


Expected thermal photons from telescope components as a function of temperature.

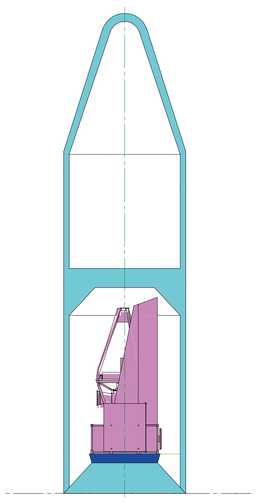
The entire telescope system will be cooled down passively (i.e., without cryocoolers) with radiators and Sun shields. The absence of cryocoolers has a large benefit to suppress the vibration of the telescope, and to achieve this cooling we require thermally stable environment of the S-E L2 orbit. Preliminary analyses of thermal design are underway.

Telescope Structure

WISH is a very simple, single-purpose space telescope mission. The total weight of the telescope is estimated to be about 1.3t, and it can be fiited to the 'dual-launch' with the Japanese HII-A rocket.

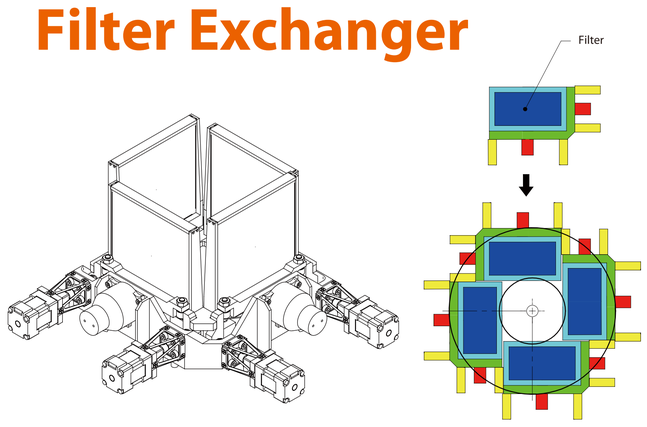


Telescope structure



Fairing of HII-A

Filter Exchanger



More than 4 broad-band filters (and possibly narrow-band filters) will be installed for each cluster of detectors. Current design of the filter exchanger and placement plan of exchangers are shown above.

WISH Development Team

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