



An Overview of the China Space Station Telescope

(a.k.a. the Xuntian Space Telescope/巡天空间望远镜)

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On behalf of the CSST team

The 32nd Texas Symposium on Relativistic Astrophysics

Shanghai, Dec 14, 2023

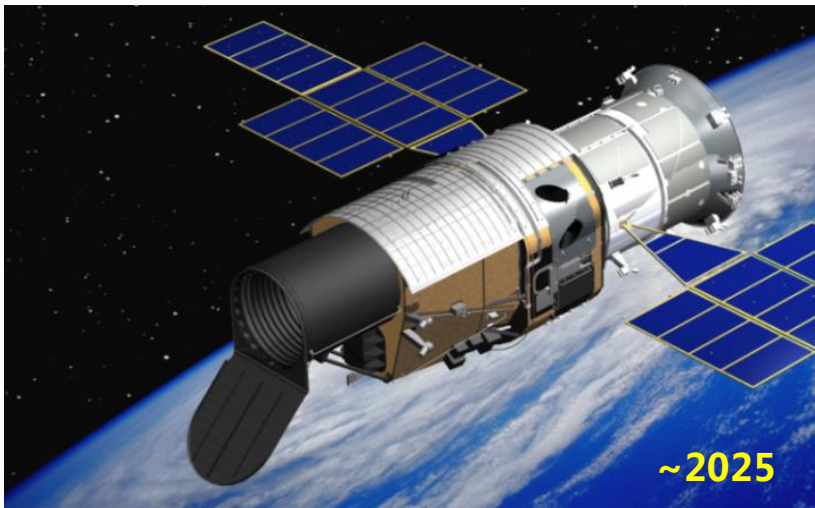


China Space Station Telescope

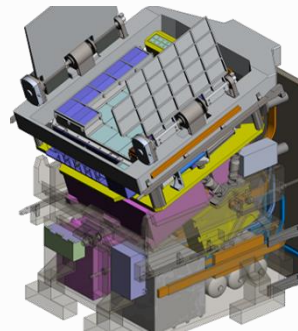
A serviceable 2m wide-field telescope in the same orbit as the China Manned Space Station.

First gen instr: Survey Camera (SC), Terahertz Receiver (THz), Multichannel Imager (MCI), Integral Field Spectrograph (IFS), Cool-Planet Imaging Coronagraph (CPI-C).

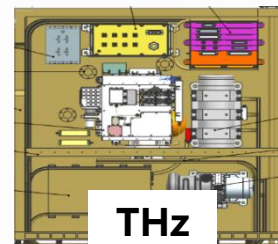
Mission: wide-area multiband imaging & slitless spectroscopic survey (7yr); other key programs & GO programs (2+yr).



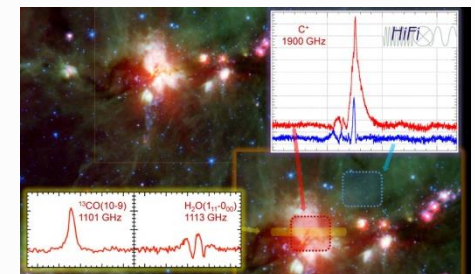
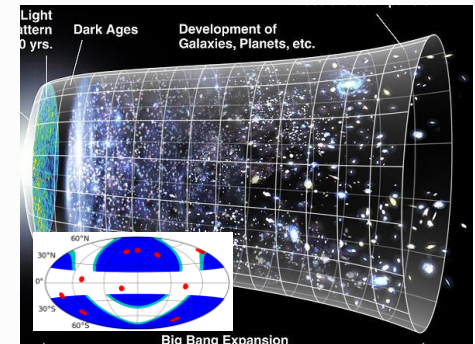
Zhan (2011, doi: [10.1360/132011-961](https://doi.org/10.1360/132011-961) ;
2021, doi: [10.1360/TB-2021-0016](https://doi.org/10.1360/TB-2021-0016))



Survey Cam



THz

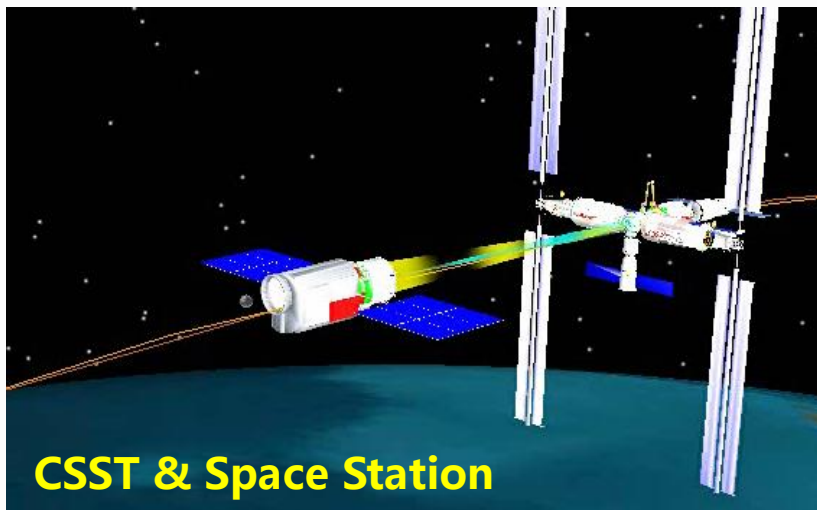


China Space Station Telescope

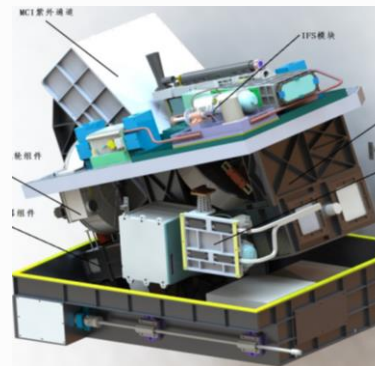
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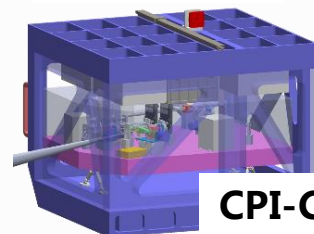
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MCI+IFS

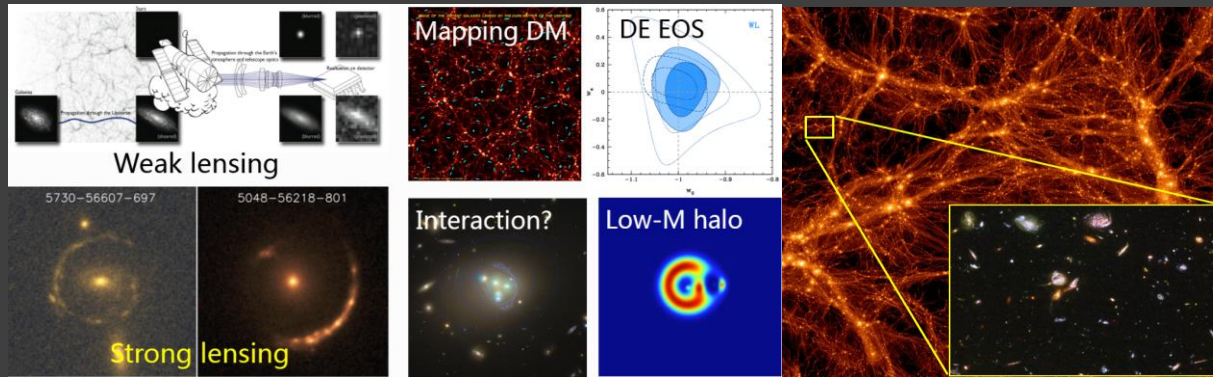


CPI-C



CSST Science

Cosmology



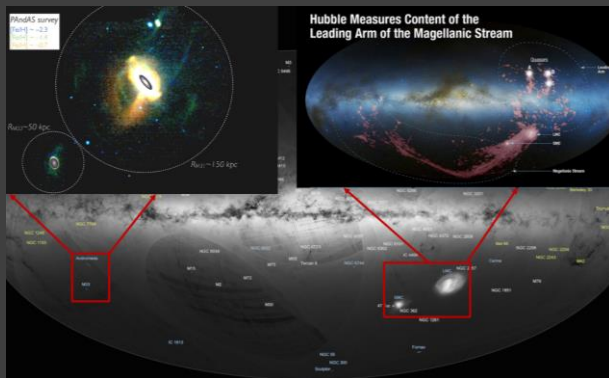
Mapping galaxy & dark matter distribution; probing evolution of LSS; measuring dark energy & dark matter properties; testing GR & cosmological model

Galaxy & AGN



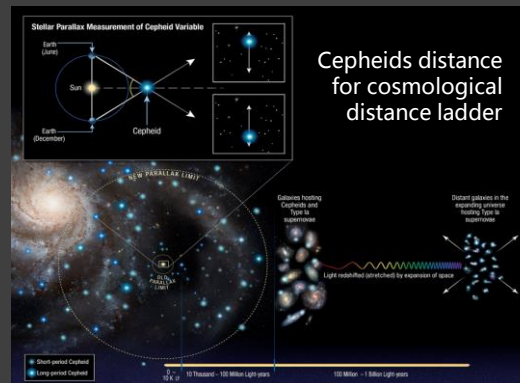
Constructing and studying complete galaxy & AGN samples

Nearby universe & Stars



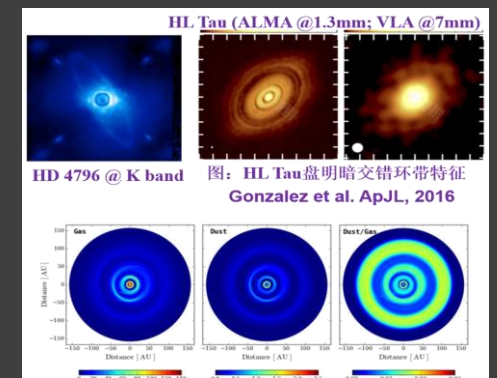
Structure & evolution of Milky way & nearby galaxies; studying stellar physics

Astrometry, solar sys & transients



Improving astrometry; detecting solar sys small bodies & transients

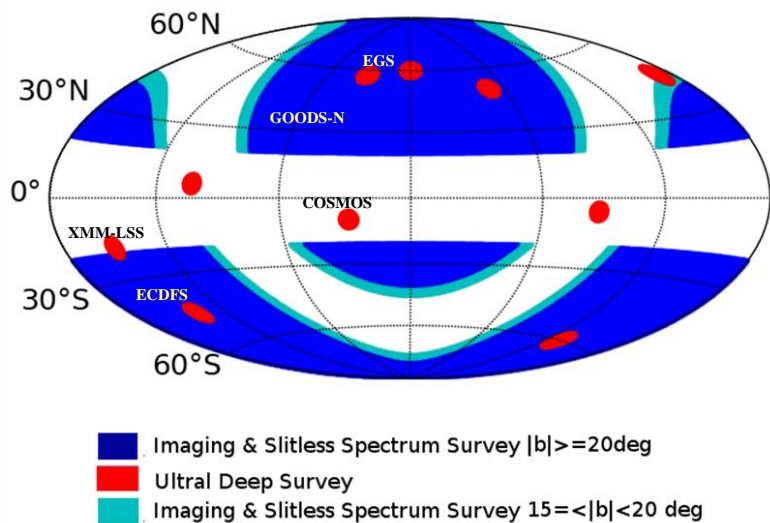
Exoplanet



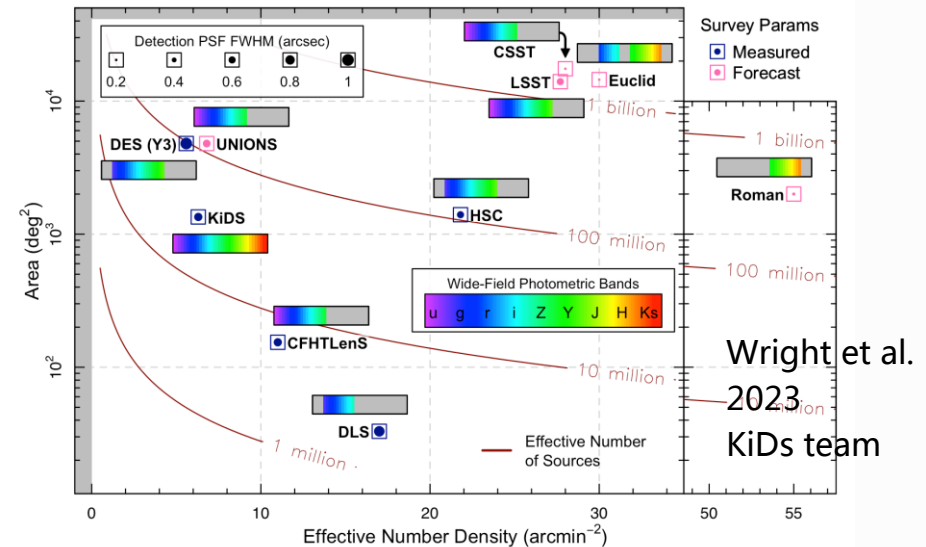
Direct imaging of exoplanets & protoplanetary disks

Survey Specifications

- **17500 \square° imaging** : 255-1000nm, ≥ 6 filters, avg $\geq 25.5^m$ (5σ , point source, AB mag)
- **17500 \square° slitless spect**: 255-1000nm, 3 bands, $R \geq 200$, $\geq 22-23^m$
- **400 \square° deep imaging & spect**: $\geq 1^m$ deeper than wide field
- **300 \square' XDF (MCI)**: simultaneous observation in 3 bands, $V \geq 30^m$



In ecliptic coord.
Field selection for demo only

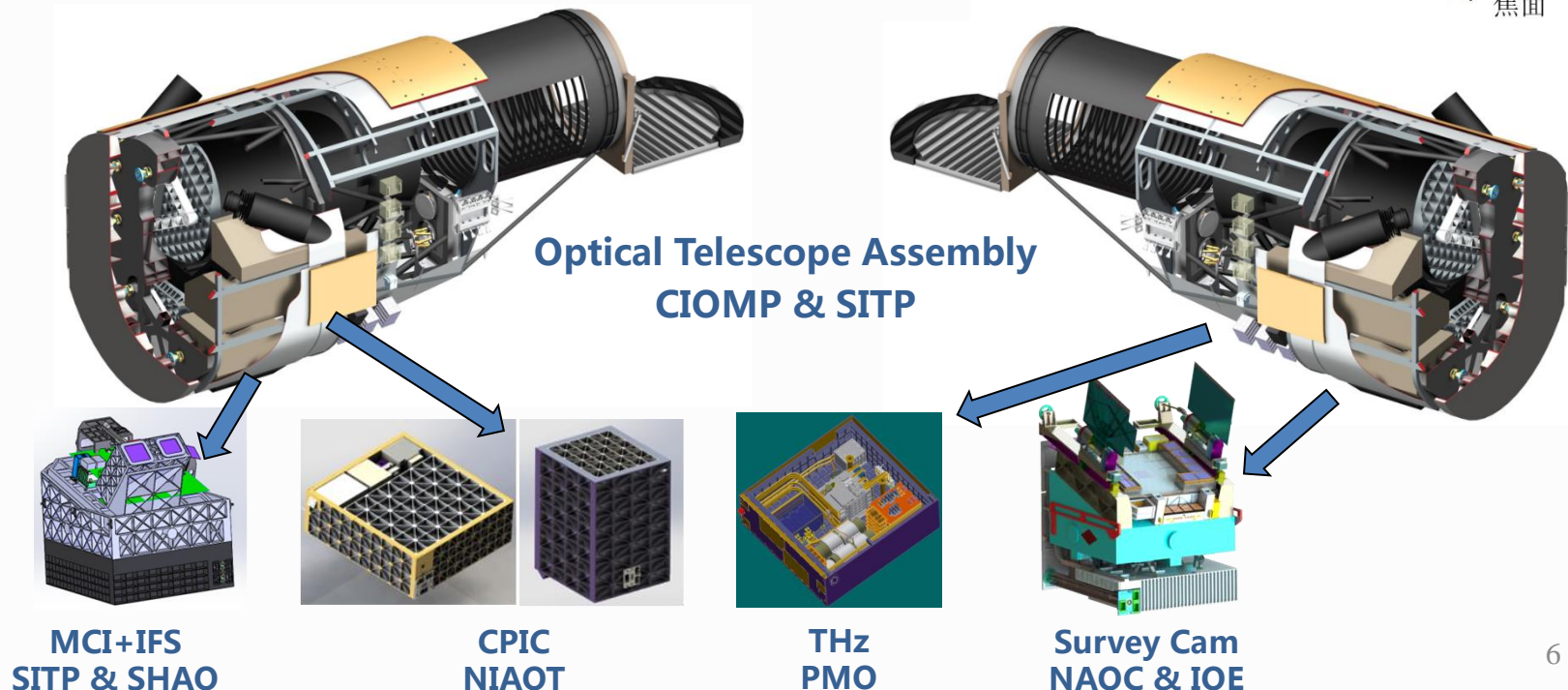
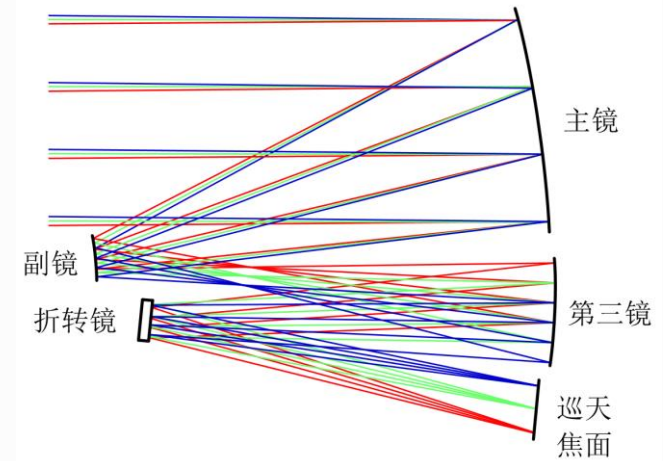


CSST is highly competitive and also
complementary to other projects

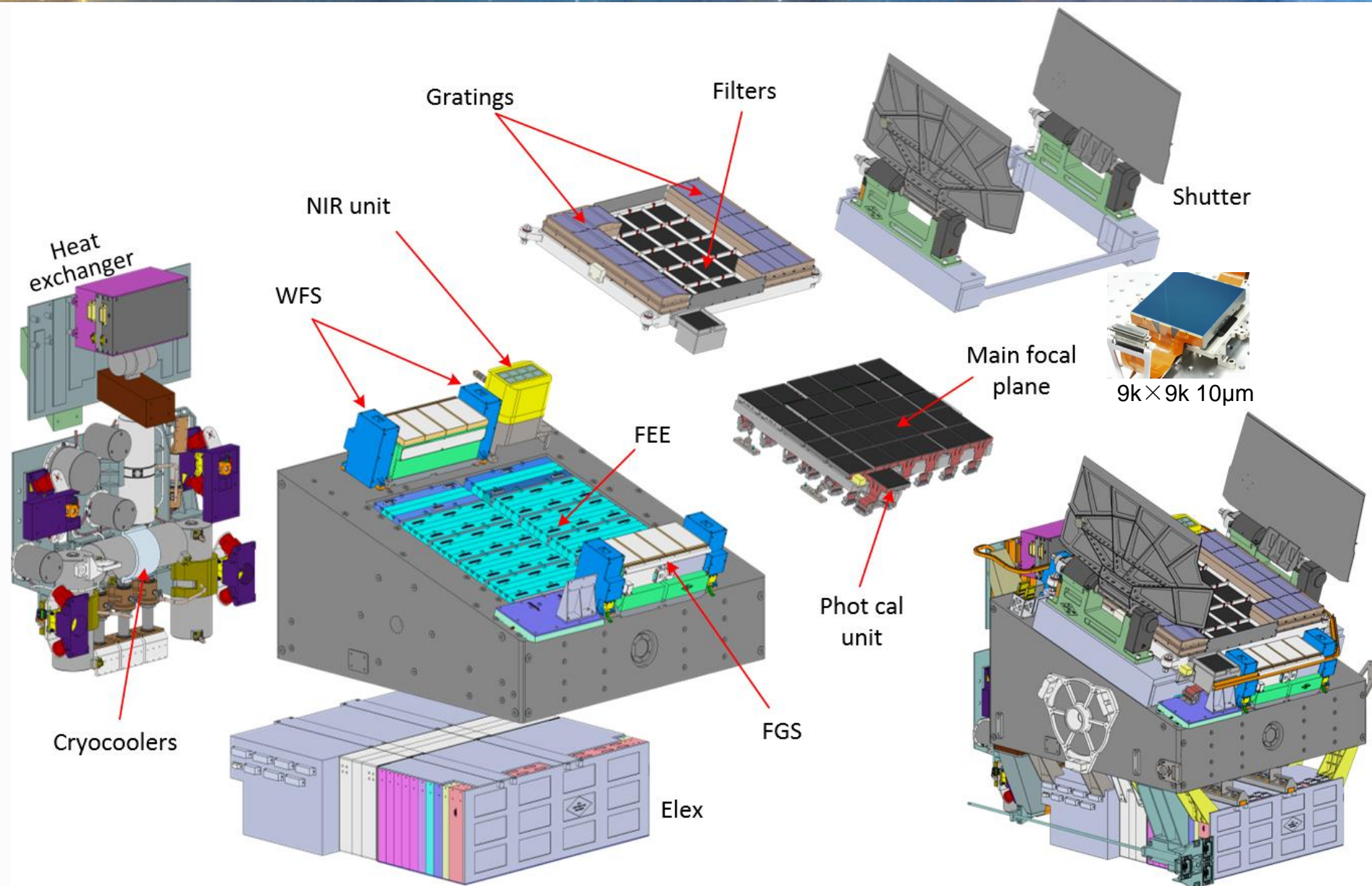
Telescope Design



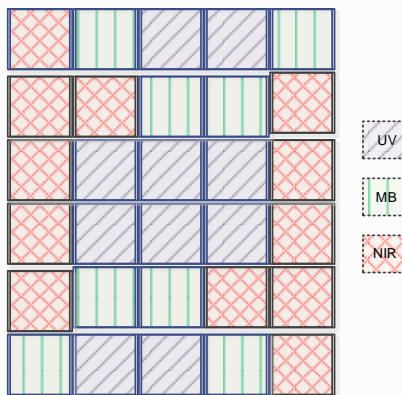
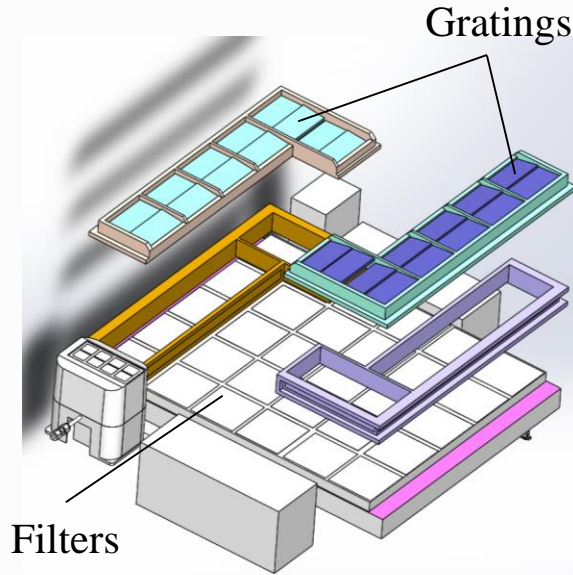
- ❑ Cook-type Off-axis TMA
- ❑ Serviceable while docking w/ the CSS
- ❑ Slew & LOS/roll: control-momentum gyro + Stewart platform + fast steering mirror (fold mirror) + vib control
- ❑ MCI, IFS & CPIC can observe in parallel



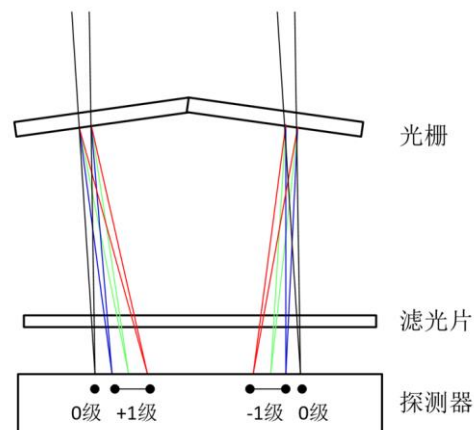
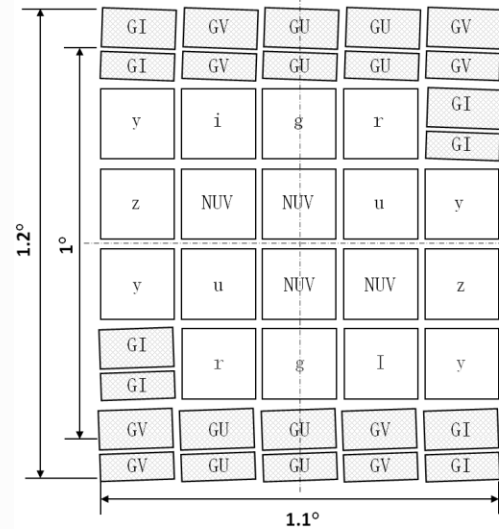
Survey Camera



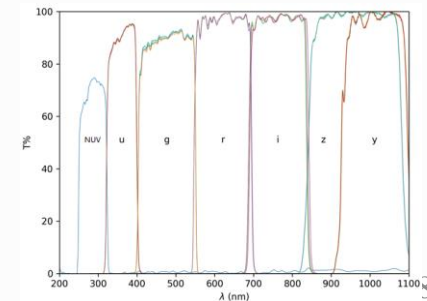
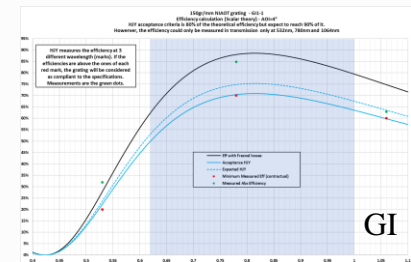
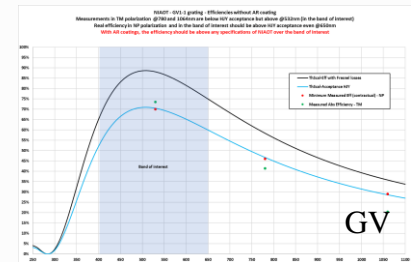
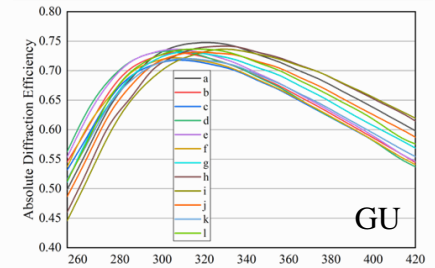
Survey Camera



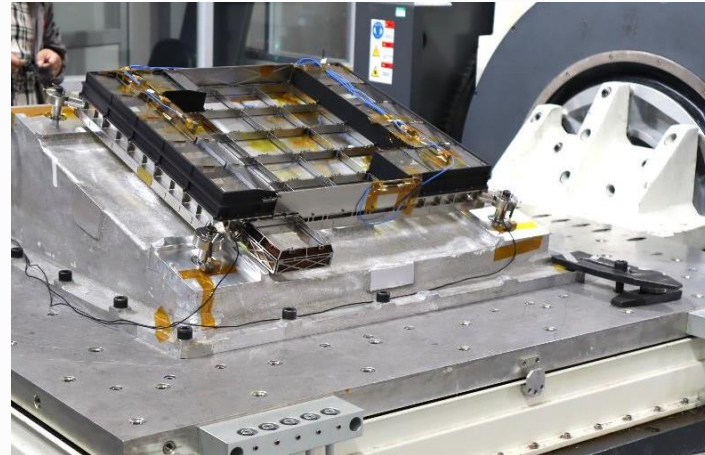
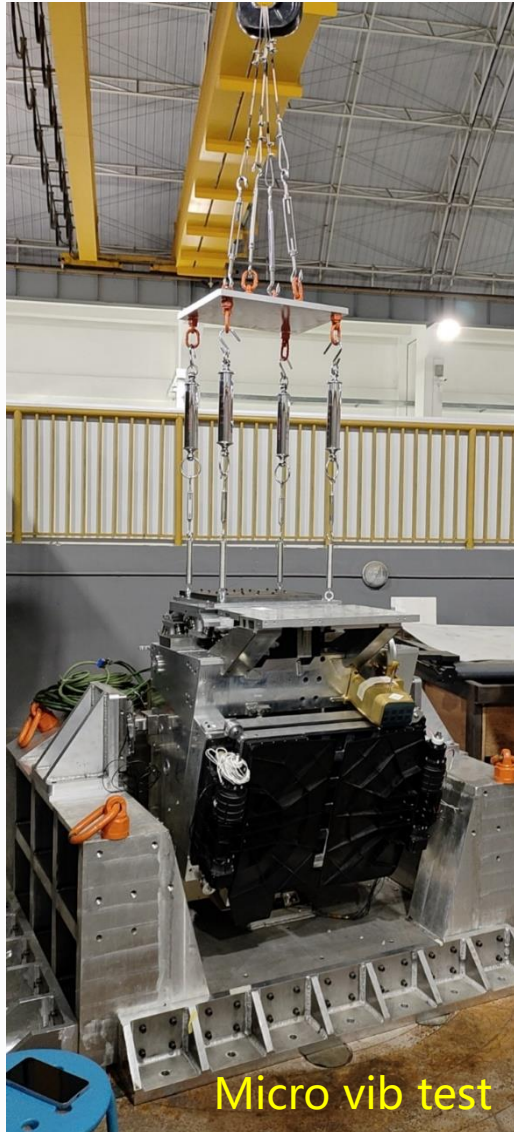
QE optimized for each band



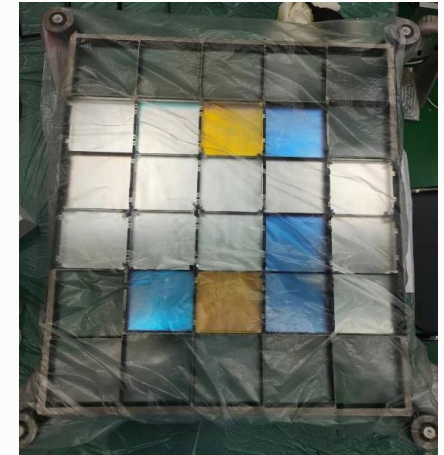
Slitless spectrograph



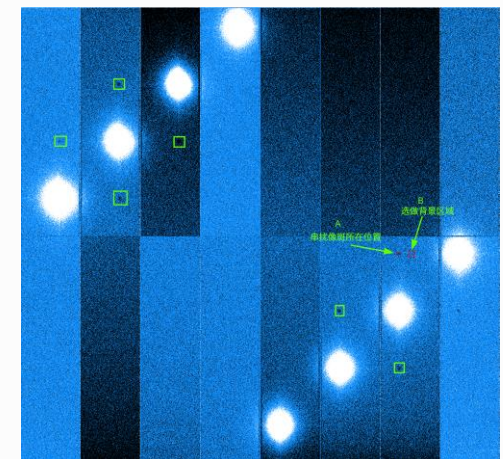
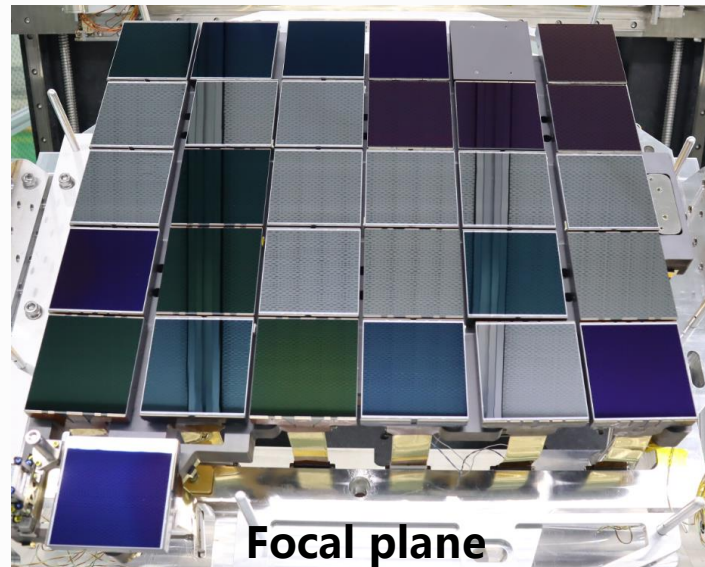
Survey Camera



Filter & grating assembly in vib test



Filter assembly

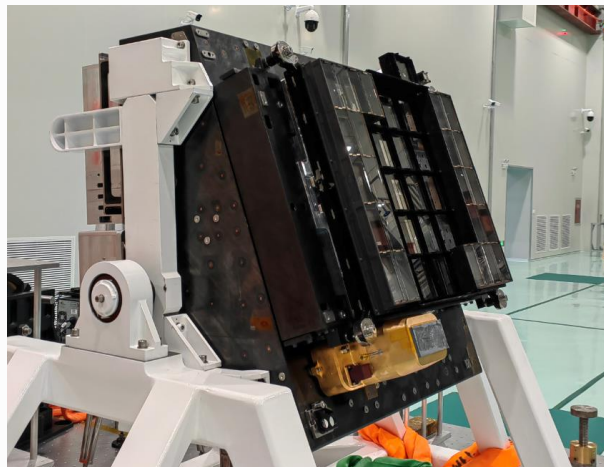


CCD+FEE xtalk < 10^{-4}

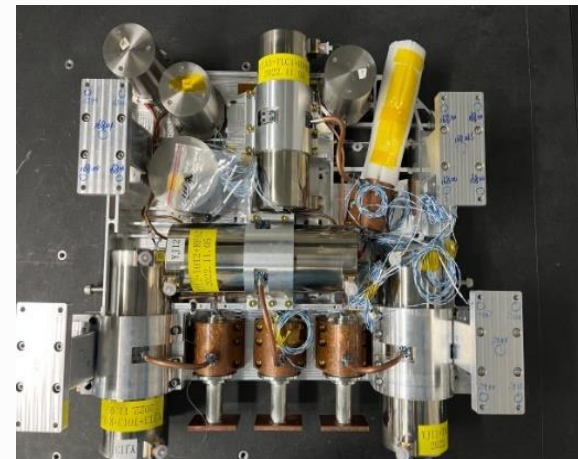
Survey Camera



AIT lab



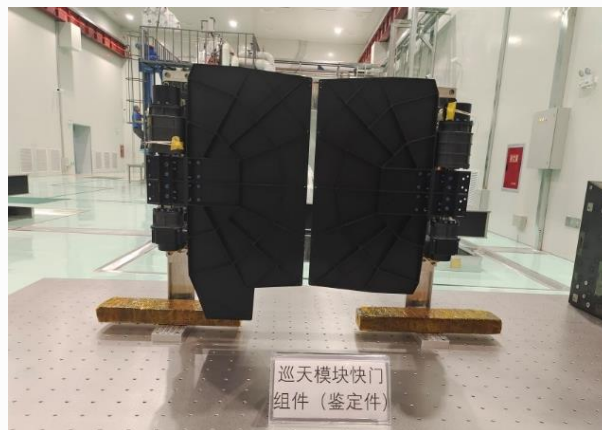
Assembling in progress



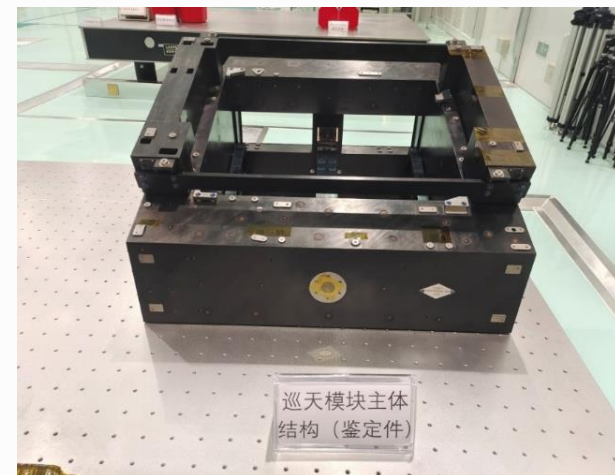
Cryocoolers



Electronics



Shutter



Comparison with Other Projects

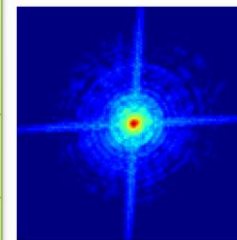
Project	Site/ orbit	Launch /op	FoV	R_{EE80}	Num pixels	Area	Wavelength	Num Filters	Spect
			deg ²	"	10 ⁹	deg ²	nm		
CSST	LEO	2025	1.1	0.15 0.074/pix	2.5	17500	255 —1000	7	yes
Euclid	L2	2023	0.56	0.23 pix lmt	0.6	15000	550—920	1	no
			0.55		0.07		1000—2000	3	yes
Roman	L2	2026	0.28	0.24	0.3	~2000	927—2000	4	yes
Rubin	Chile	2025	9.6	0.54	3.2	18000	320—1050	6	no

R_{EE80} : radius encircling 80% energy

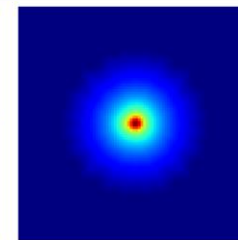
	CSST	HST/ACS WFC	Euclid VIS	WFIRST J
R_{EE50}	0.1"	0.06"	0.13"	0.12"
R_{EE80}	0.15"	0.12"	0.23"	0.24"



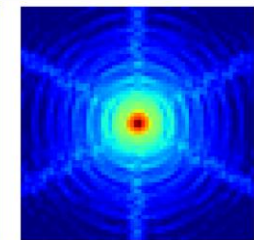
Dynamic sims: $R_{EE80} \sim 0.13''$



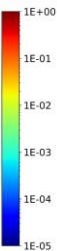
HST



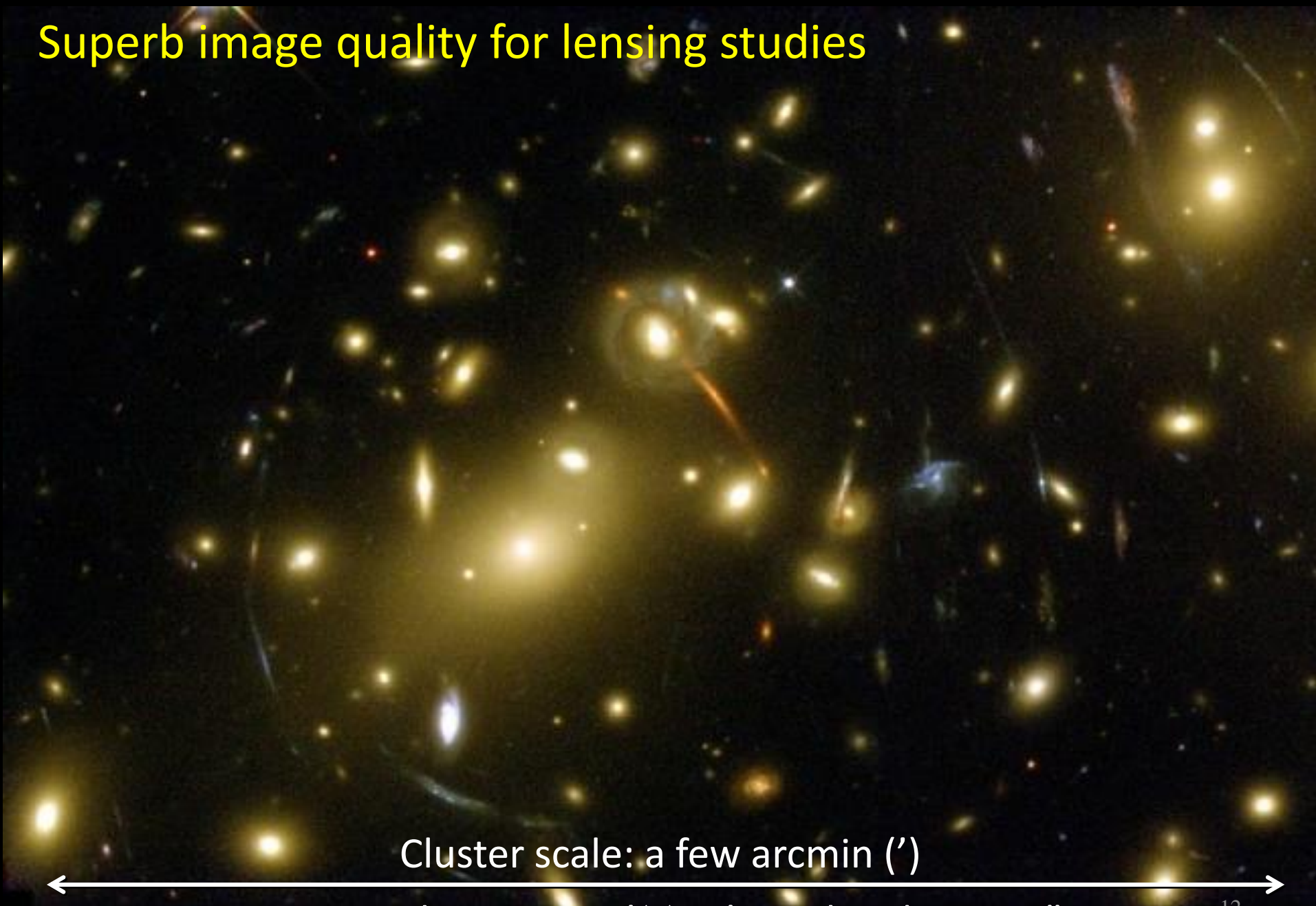
CSST



Euclid



Superb image quality for lensing studies

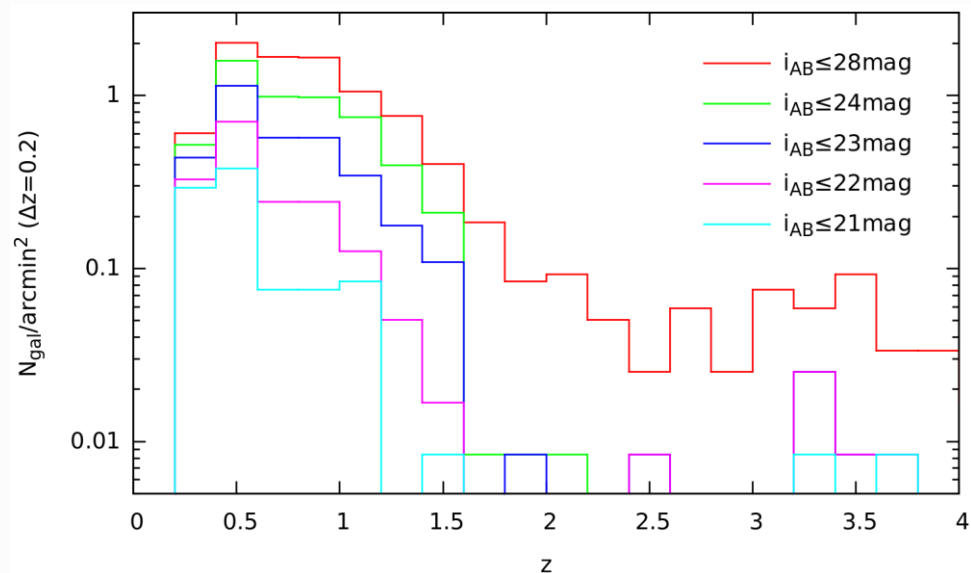
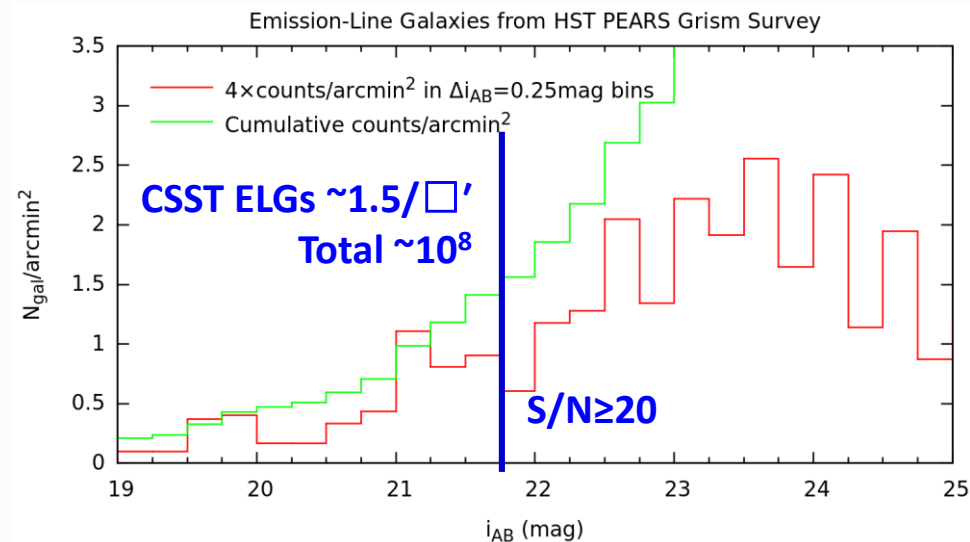
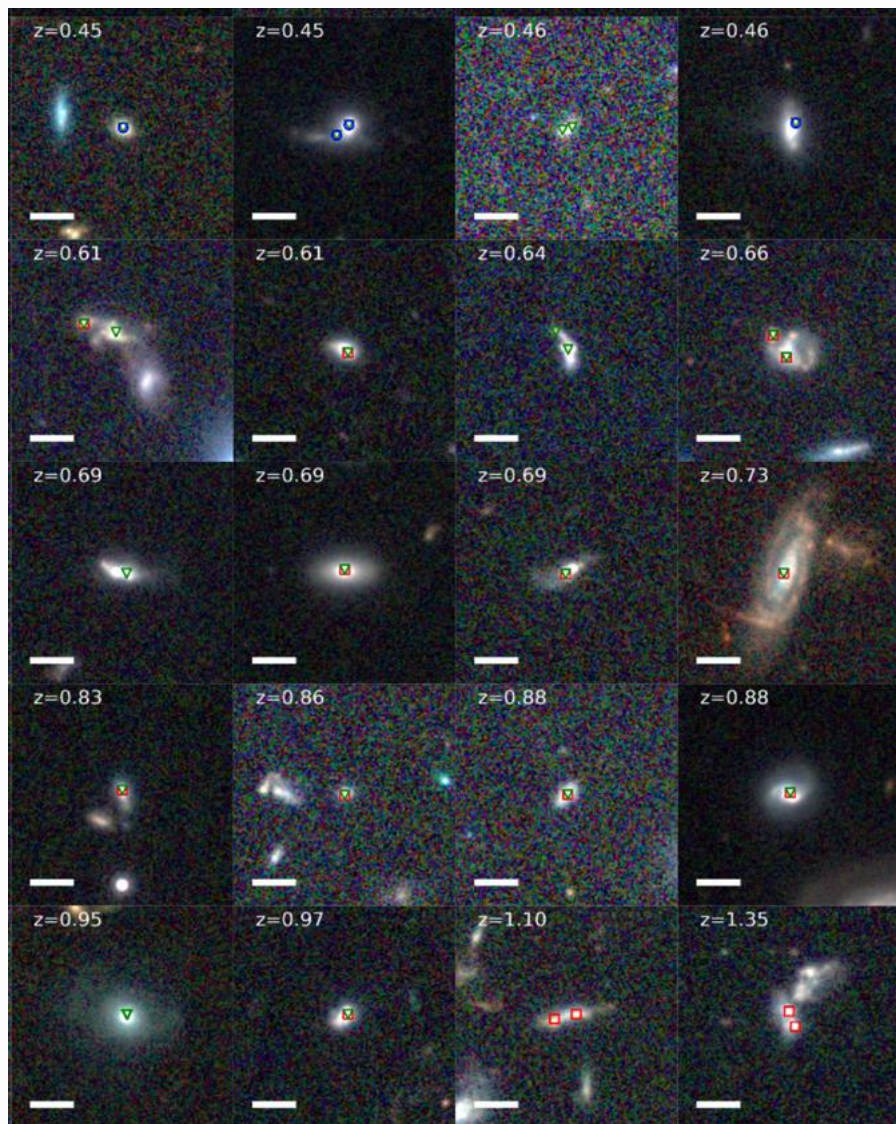


Cluster scale: a few arcmin (')

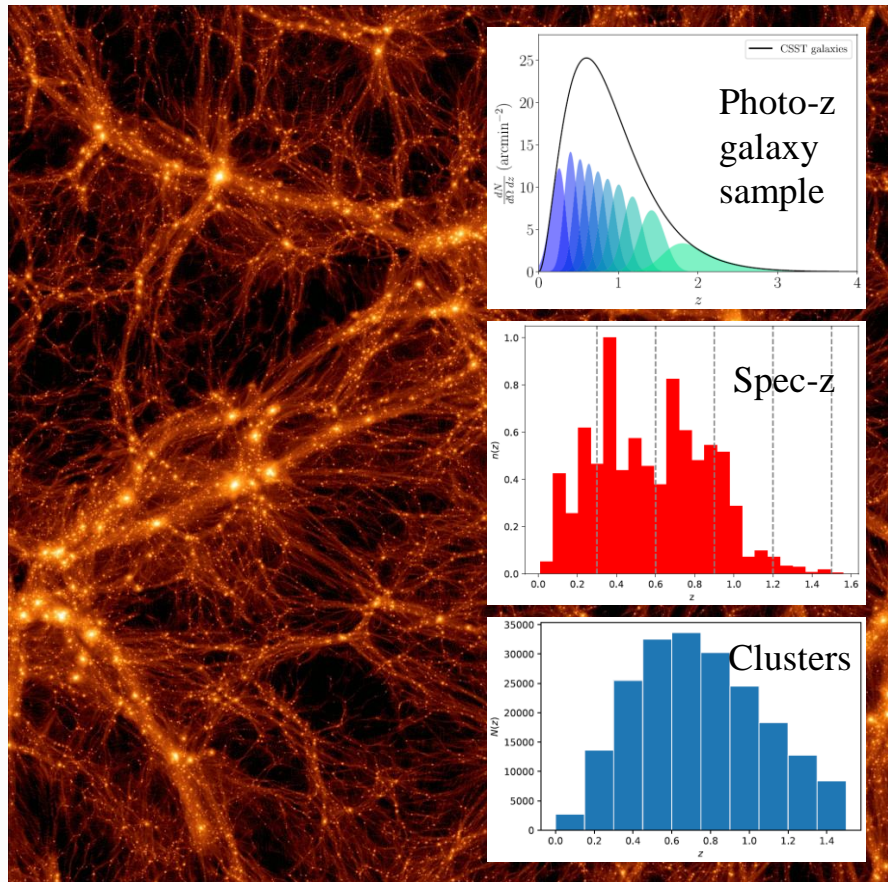
CSST SC detector: $11' \times 11'$, pixel scale $0.074''$

ELG Sample for Large-Scale Structure

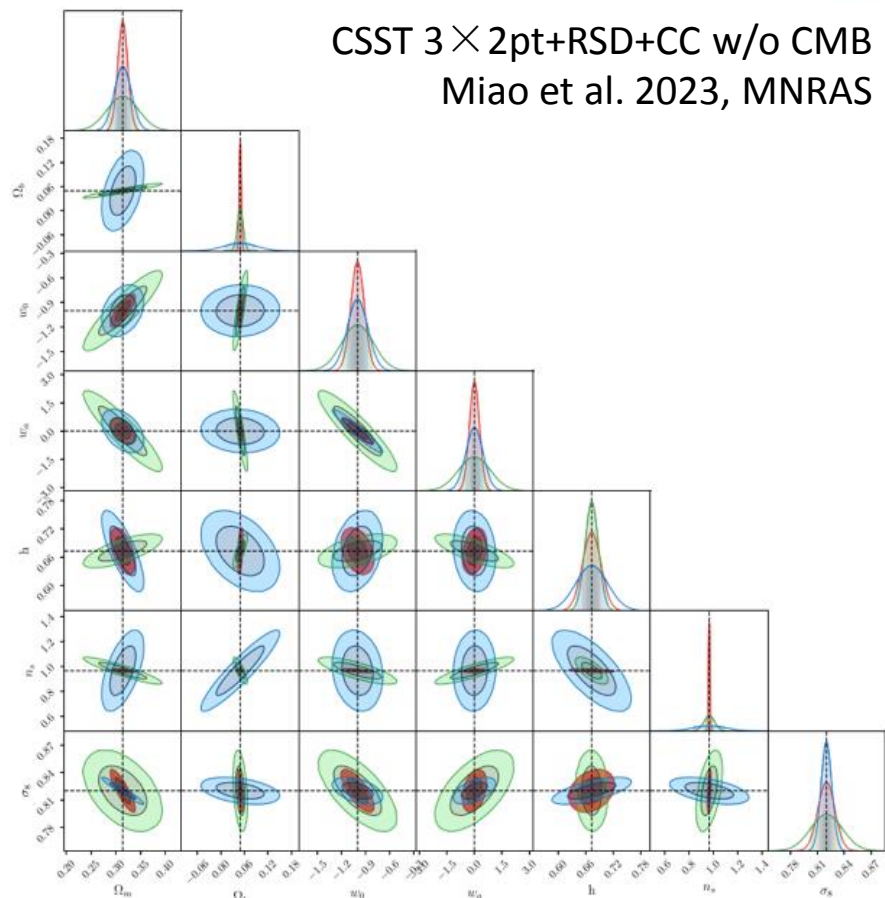
Checking with HST PEARS Survey: $120/\square'$, 550-1050nm, $R \simeq 69-131$, $i_{AB} \lesssim 28^m$



Forecast with CSST



CSST will utilize multiple probes for cosmological studies



Constraints: Ω_m 1%, Ω_b 2%, σ_8 0.2%, h 0.3%, n_s 0.004, w_0 0.045, w_a 0.17

Thank you!



CSST will be a powerful facility for cosmology and many areas of astrophysics.
The team is working hard on the hardware, software, and science preparation.
Collaborations are very much welcome!