Optical & Infrared Instrumentation Effort in ASIAA

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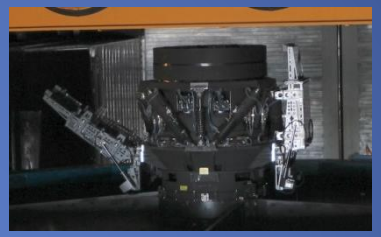
ASIAA OIR Projects

Completed

TAOS-1 (2004) --- **CFHT/WIRCam** (2005) --- **Subaru/HSC** (2013)

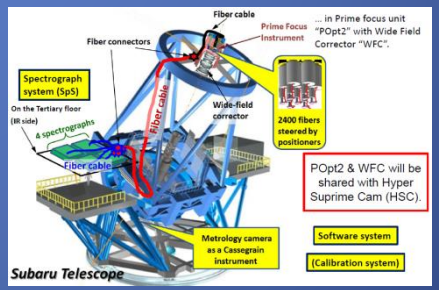


On-going

TAOS-2 (2017)

SPIROU (2017)

PFS (2019)

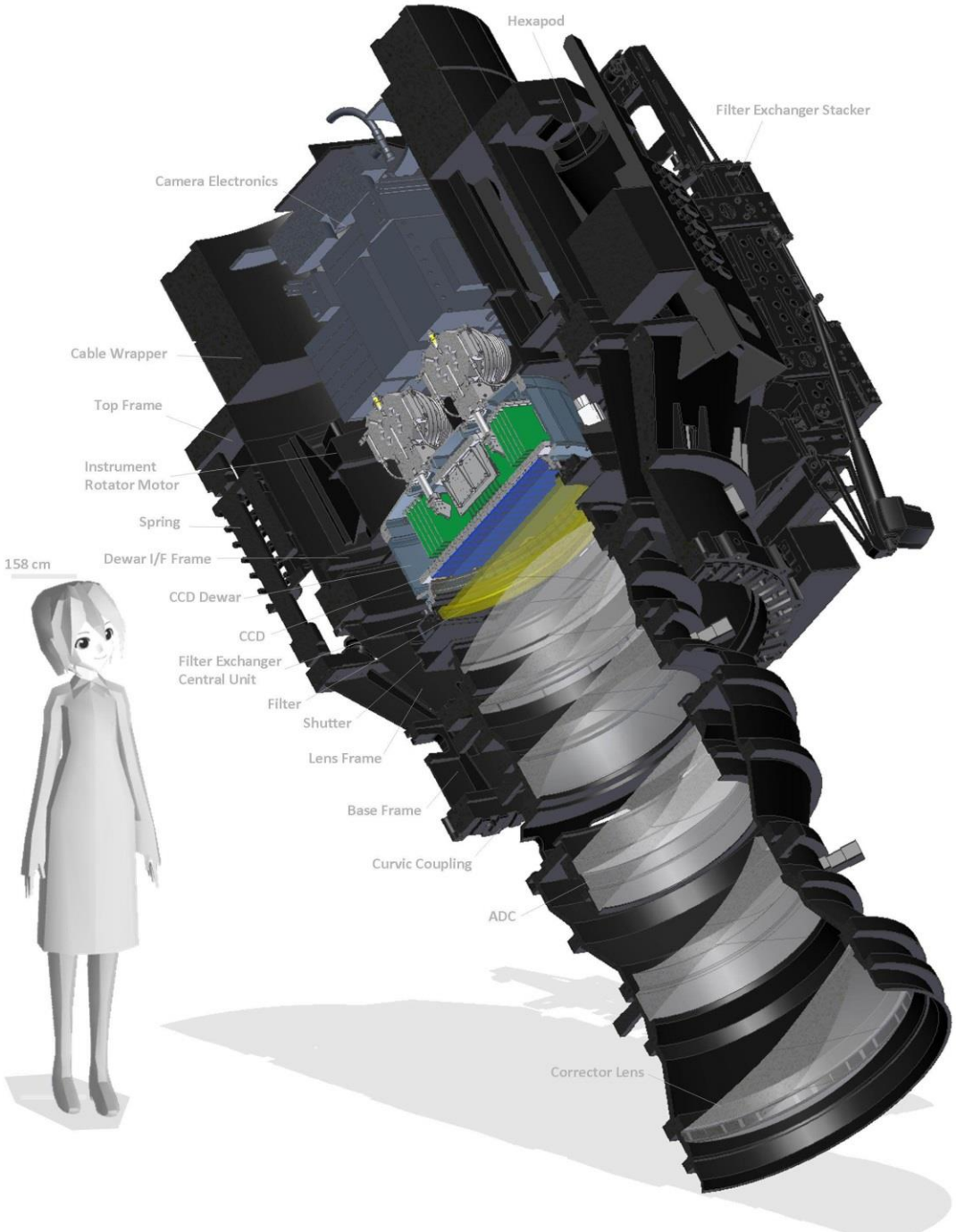


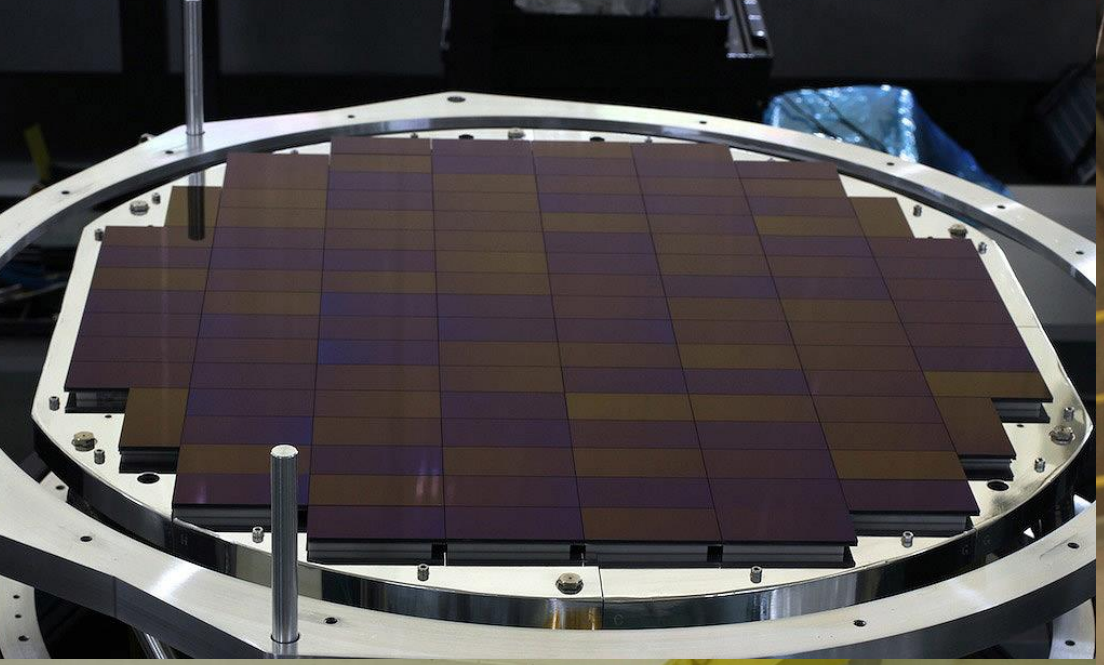
Development Strategy

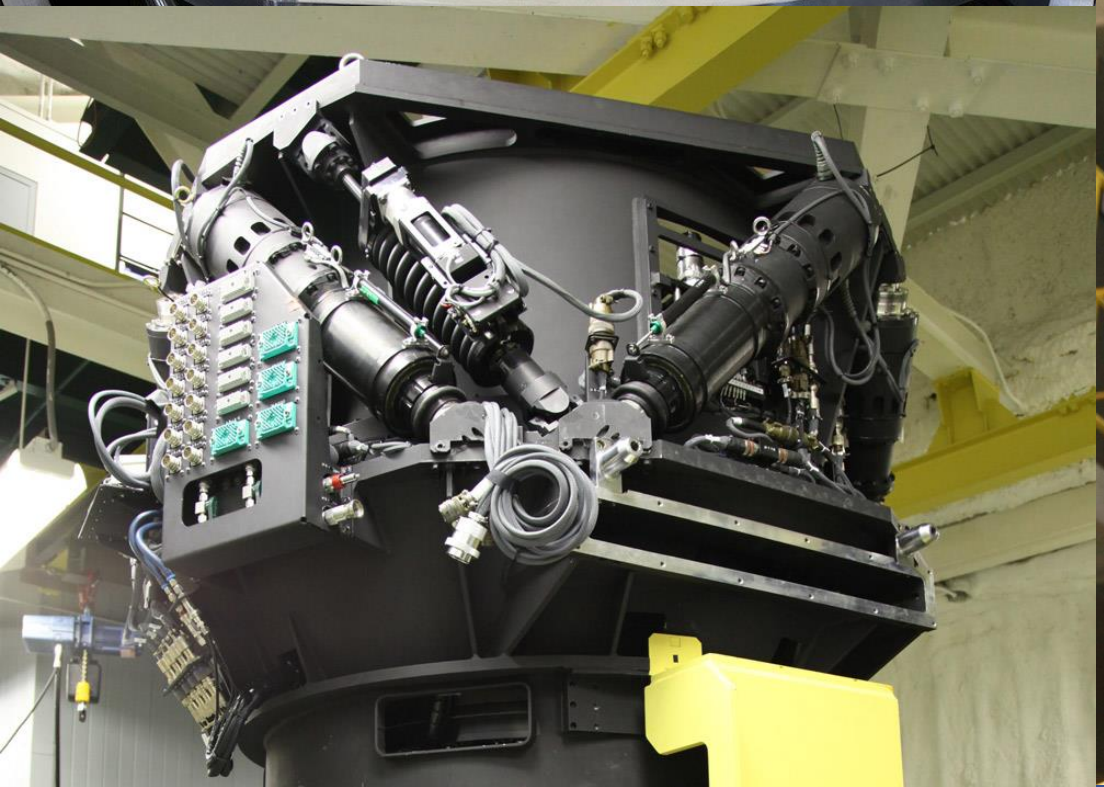
- Develop the instrumentation capability rather than build large telescopes considering the the budget and community size
- Collaborate with advanced telescopes with large aperture.
  - CFHT: WIRCam(2005), Flyeyes(2009), SPIRou(on going)
  - Subaru: HSC(2013), PFS(on going)
- Build small telescope systems
  - TAOS I (2005) & TAOS II (on going)
- Provide the access to the advanced optical/IR telescopes.

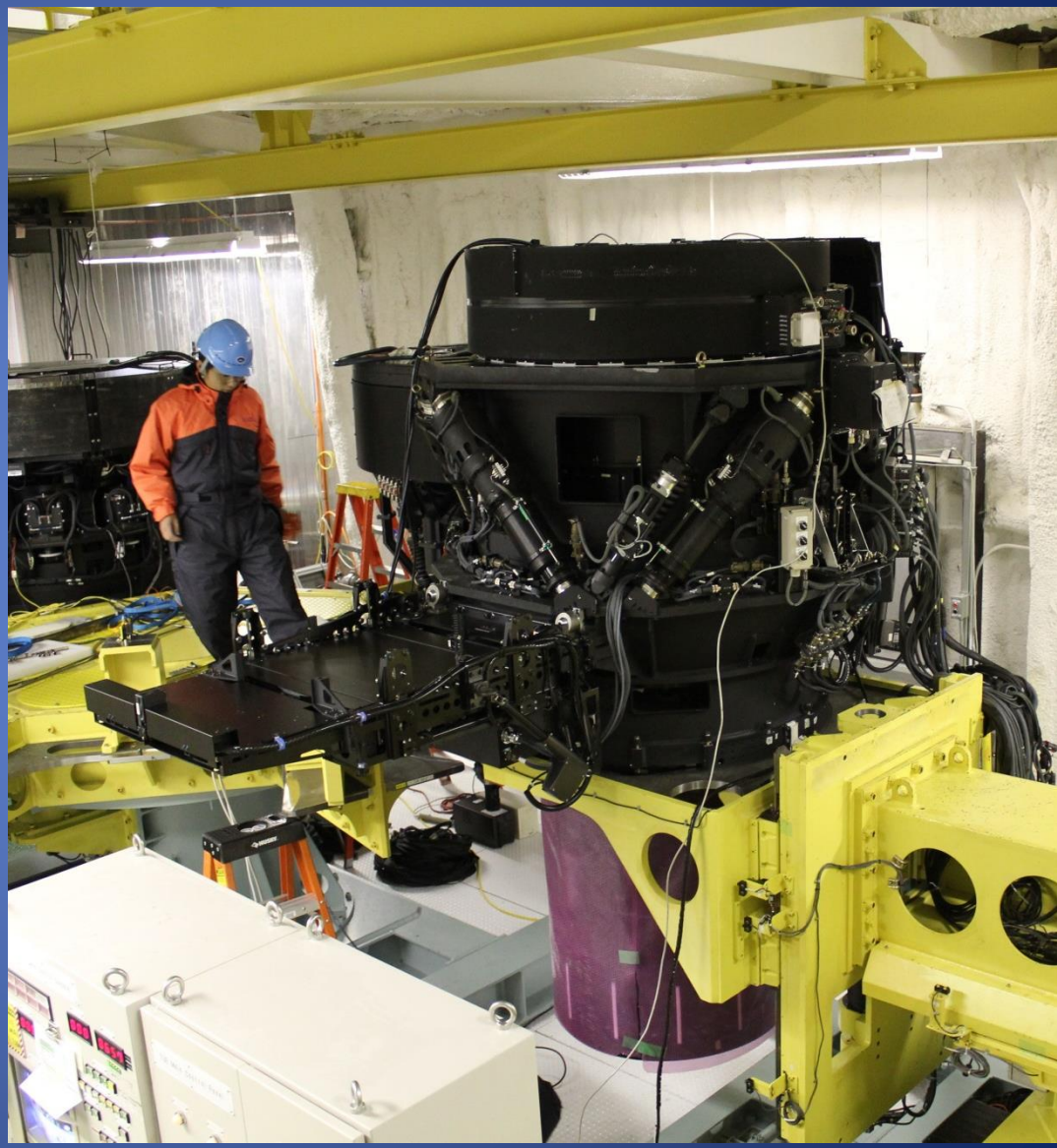
Subaru collaboration

- Started from 2008 for the development of Hyper SuprimeCam
  - ASIAA is responsible for the filter exchanger unit, CCD procurement & test, WFC test system
- HSC Hardware delivered to Hawaii in late 2012
- HSC started science operation in March 2014
- Prime Focus Spectrograph started from 2010
  - ASIAA is responsible for the metrology camera and most work of the Prime Focus Instrument
- Help on the detector upgrade of MOIRCS

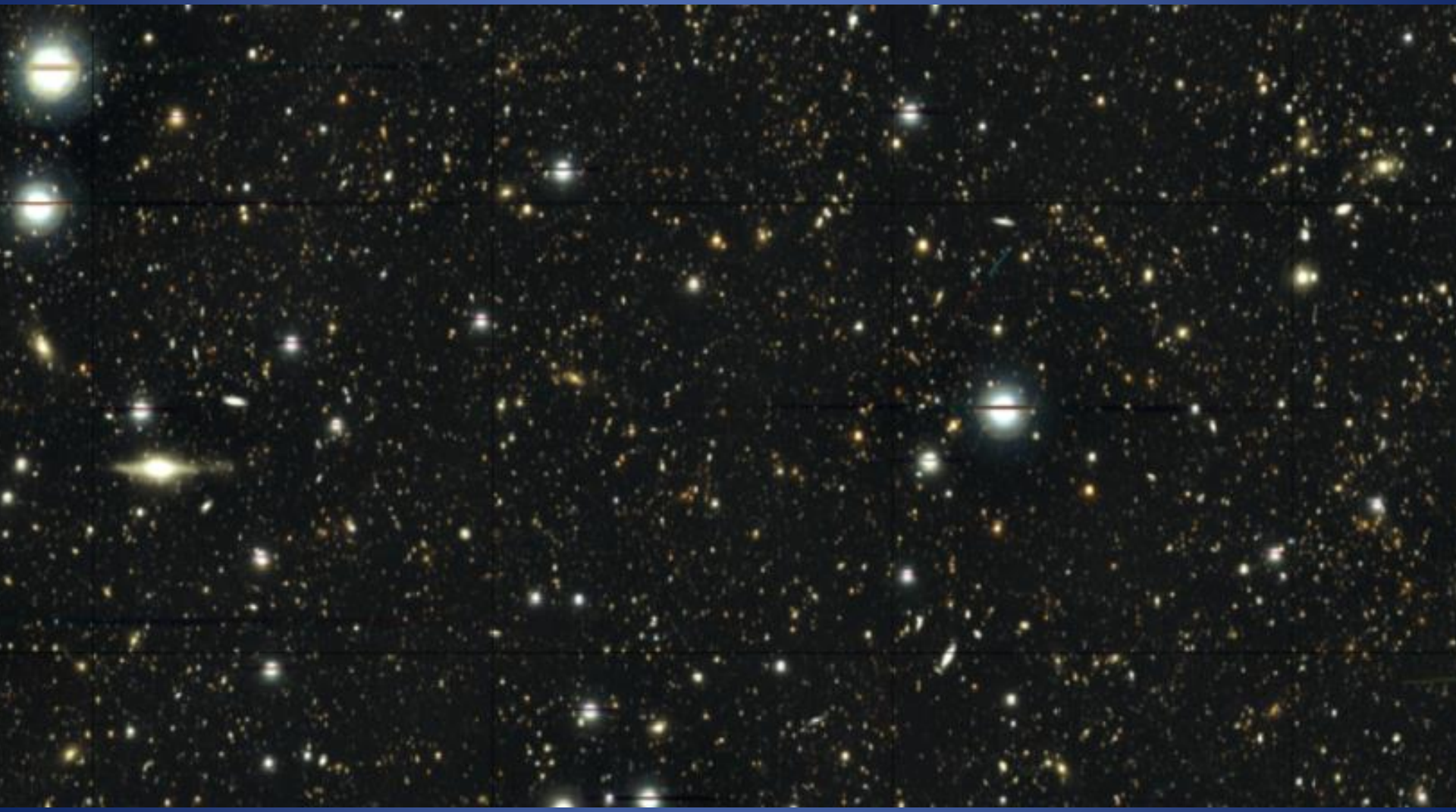

Hexapod
Filter Exchanger Stacker
Camera Electronics
Cable Wrapper
Top Frame
Instrument
Rotator Motor
Spring
Dewar I/F Frame
158 cm
CCD Dewar
CCD
Filter Exchanger
Central Unit
Filter
Shutter
Lens Frame
Base Frame
Curvic Coupling
ADC
Corrector Lens



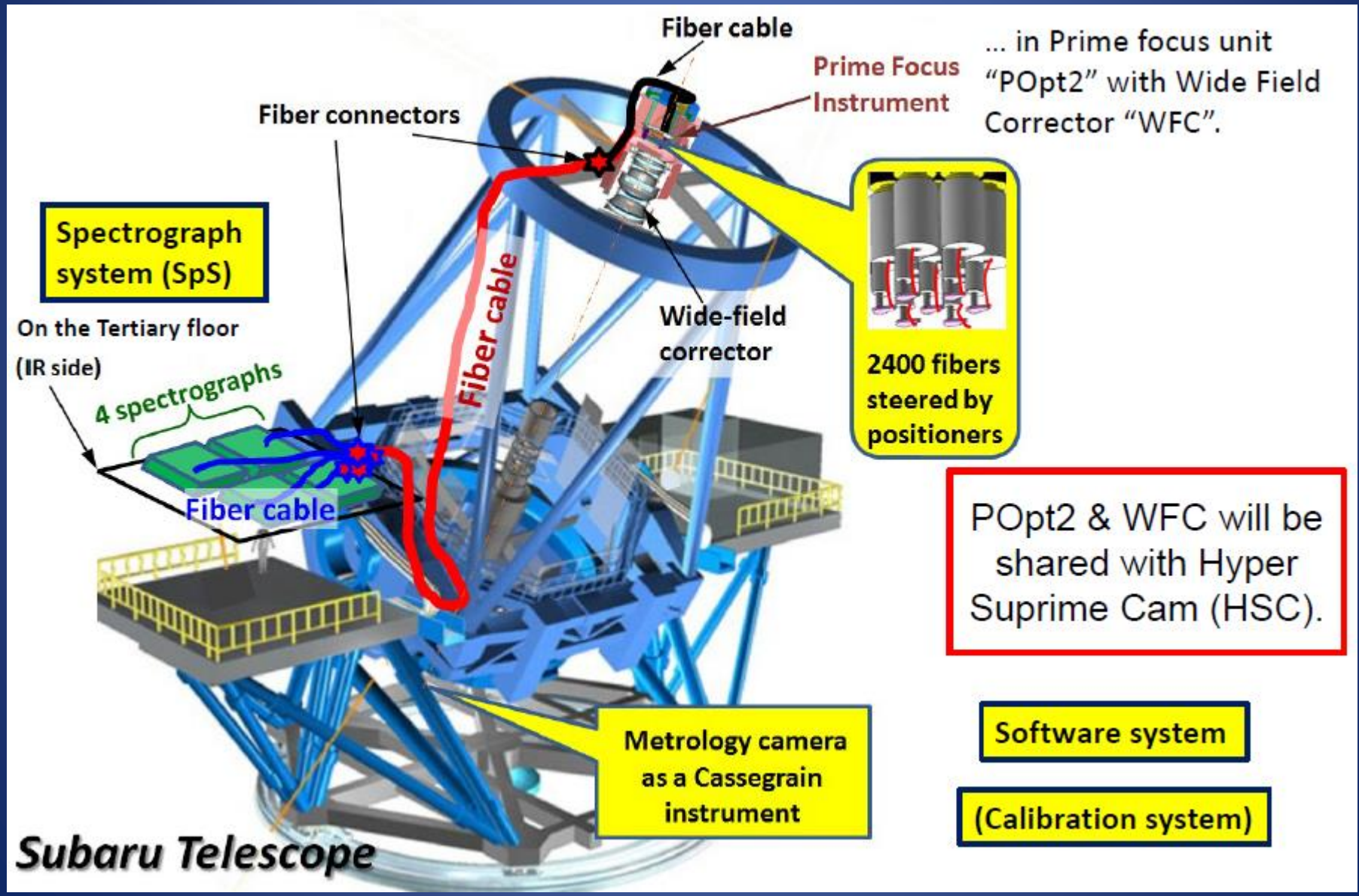




First data release of HSC SSP



Prime Focus Spectrograph

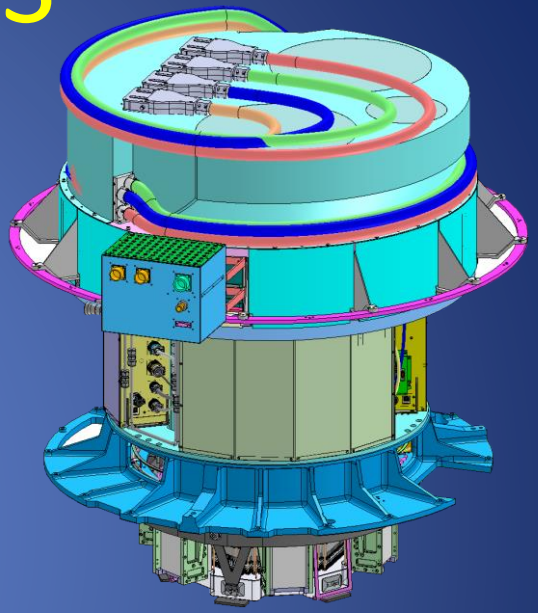


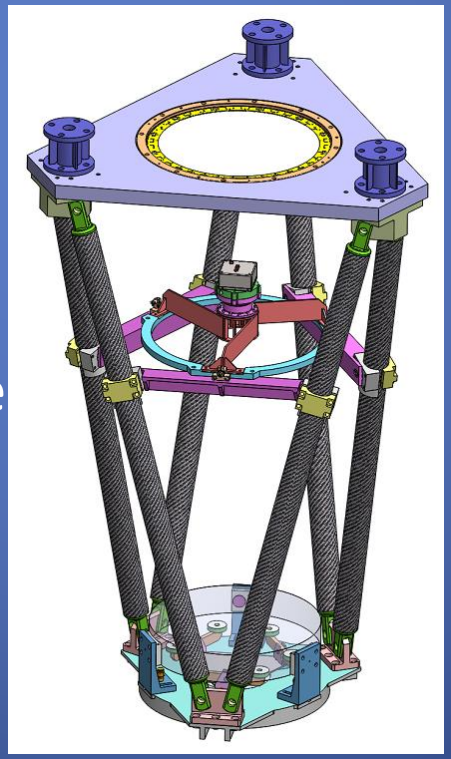
Key Parameters of PFS

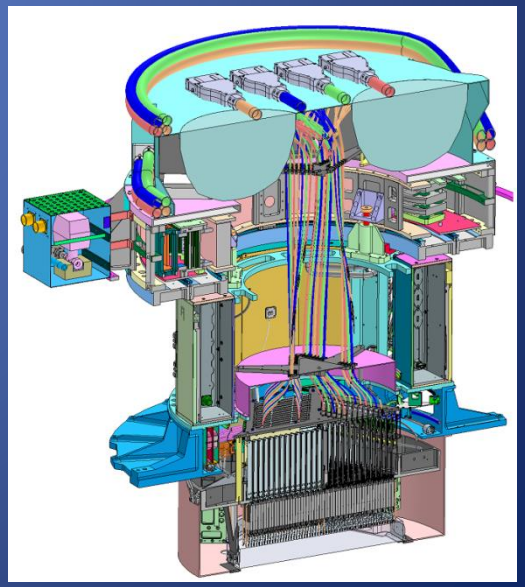
Optical configuration		WFC → Field Element → Microlens → Fiber	
Mech. configuration		POpt2 + PFI	
Input F/# to Fiber		2.8	With microlens
# of science fibers		2394	Min. ~2350 [TBC] fully operational at delivery
# of fixed fiducial fibers		96	~50-50 split to intlvd & prmtr
Input fiber core diameter		127um	~1.1 arcsec w/ microlens
Field of view		1.3 deg	Hexagonal , ~1.4 deg on chord
Positioner pitch		8mm	
Positioner patrol field		9.5mm diameter	
Reconfiguration time		~60-70 sec	
AG camera	Number	6 (one on each side of hex. Field)	One on each side of hex. field
	Format	1K x 1K CCD, 13um pixel size	5.5 sq. arcmin per camera
	Sensitivity	S/N=100 in 4 sec for r`=18.5 (AB)	>=1 star per camera

ASIAA's Role in PFS

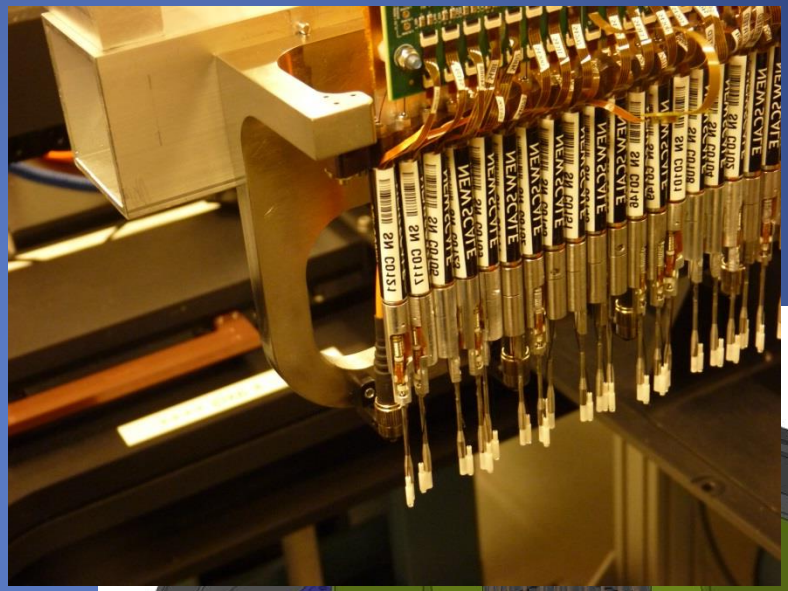
- Prime focus Instrument:
  - Major structures, electronics, cameras
  - System Integration and Test
  - Control software
- Metrology camera
  - The whole subsystem
    - Software and hardware

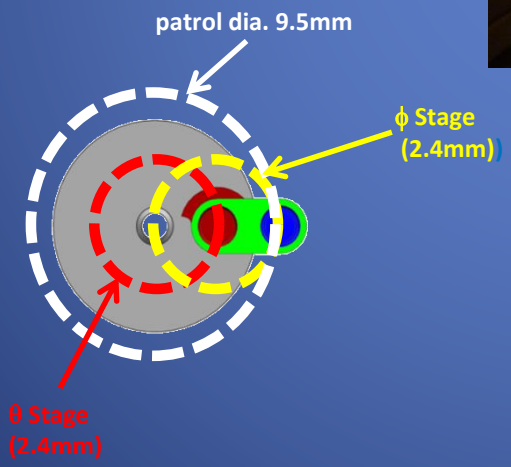


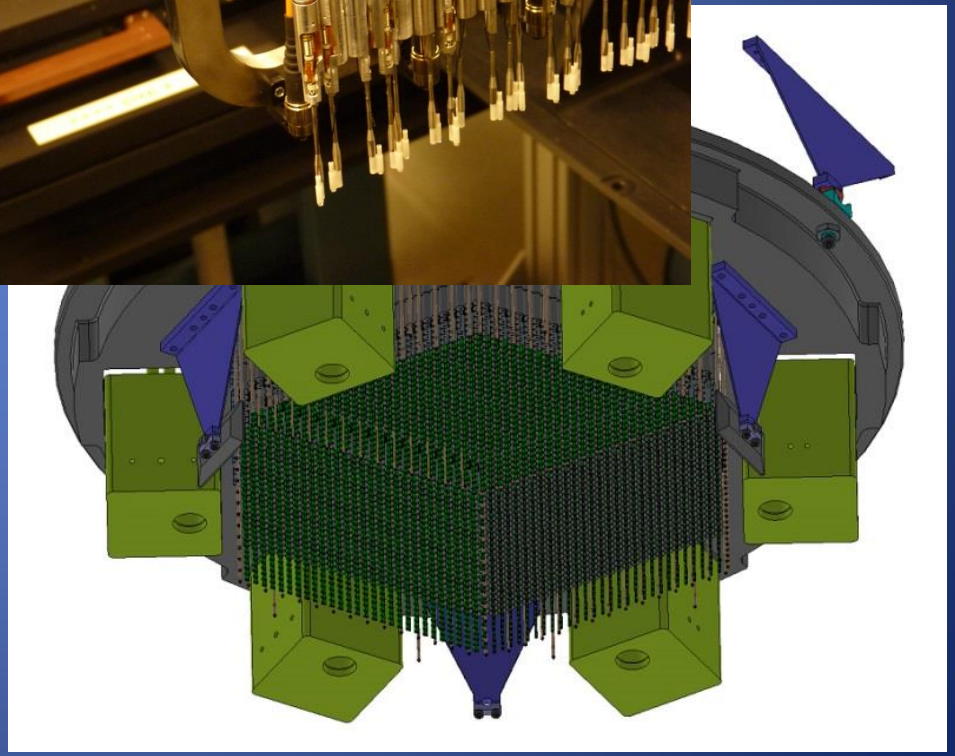




Focal plane and Cobra motors



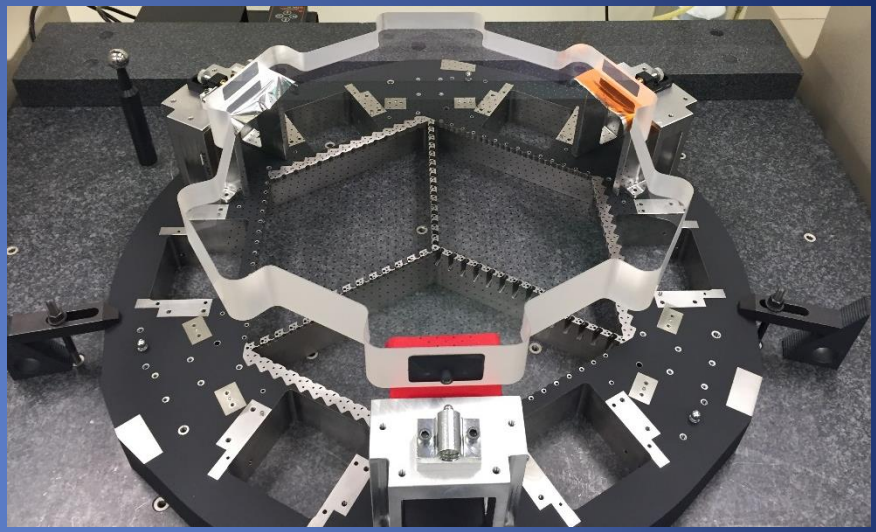




PFI components

Cable wrapper

optical bench and field element

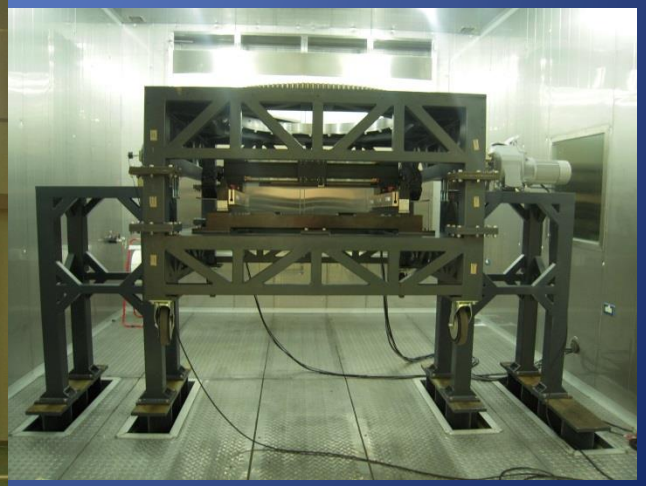


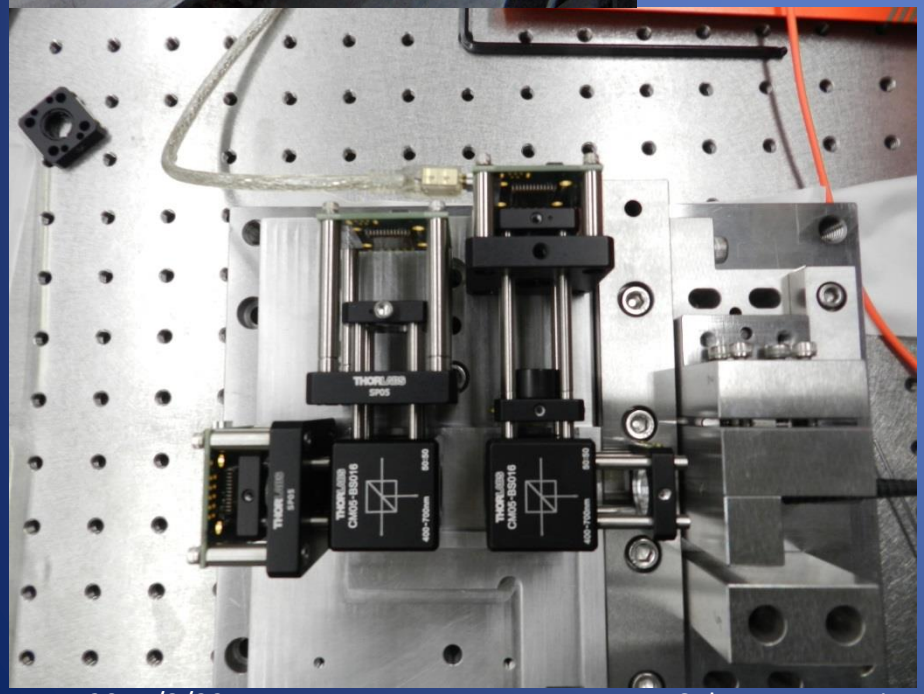
Telescope interface structure

Fitting tests

Integration & Test of PFI

- Integrate the 48 Cobra modules
  - 1.5 years for the whole process
- Measure all fiber home position in x, y, z and tilt at 5, 0 and -5 degree C
  - 10 μm position accuracy
  - 5’ accuracy in fiber tilt

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SP05
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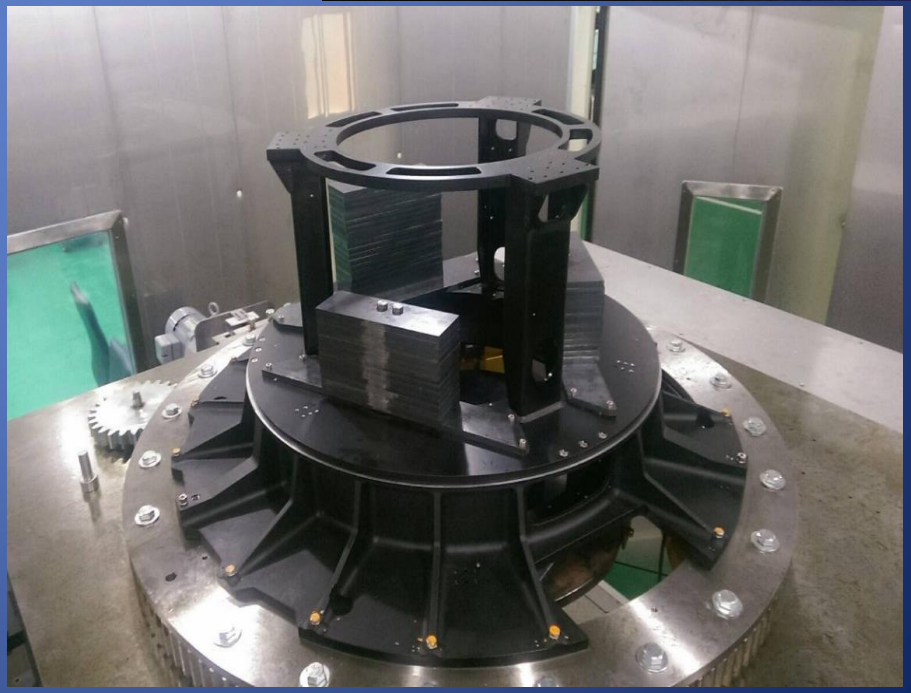
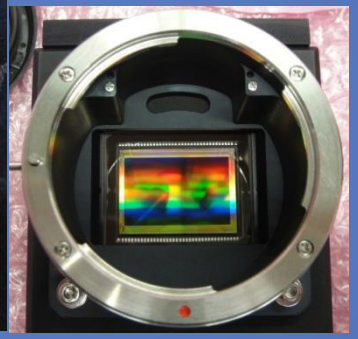
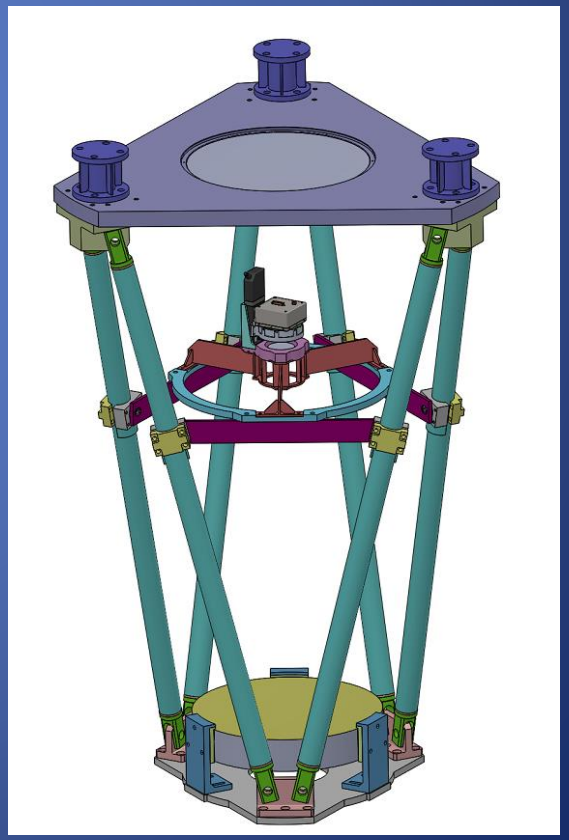
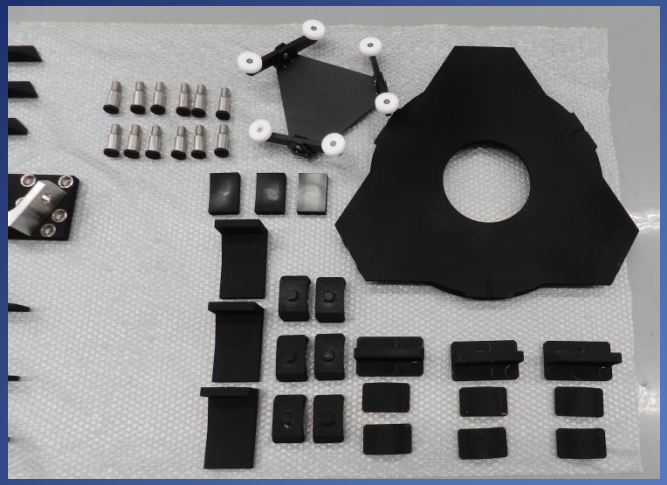


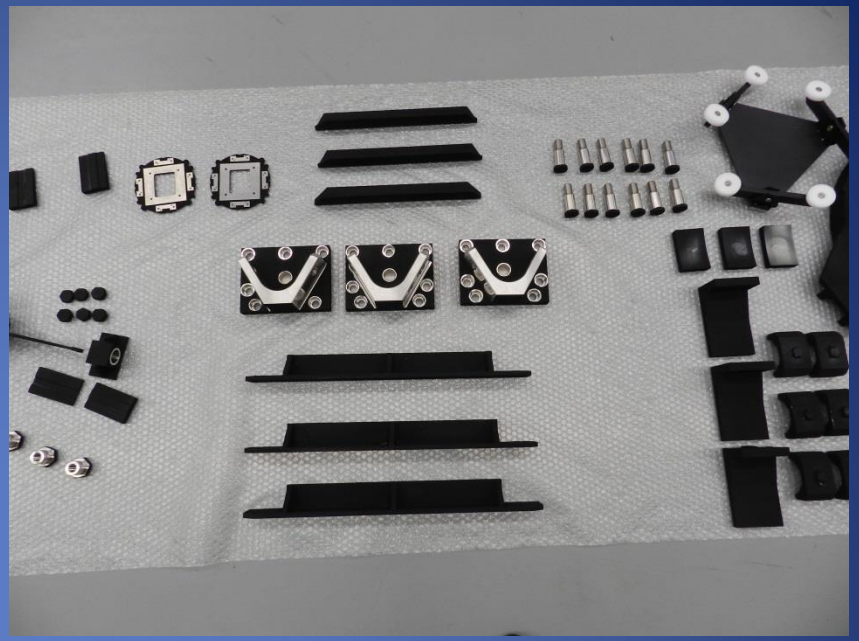
PFS Metrology Camera

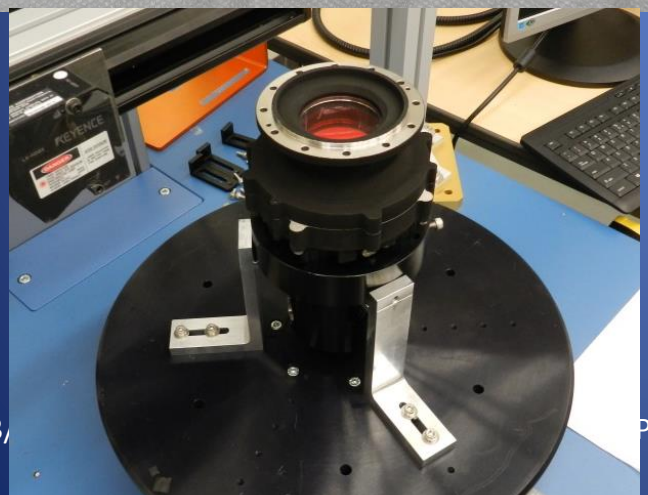
- 380mm aperture Schmidt telescope
- 50M pixel CMOS sensor
- Measure all fiber positions with 3 microns error in 2 sec







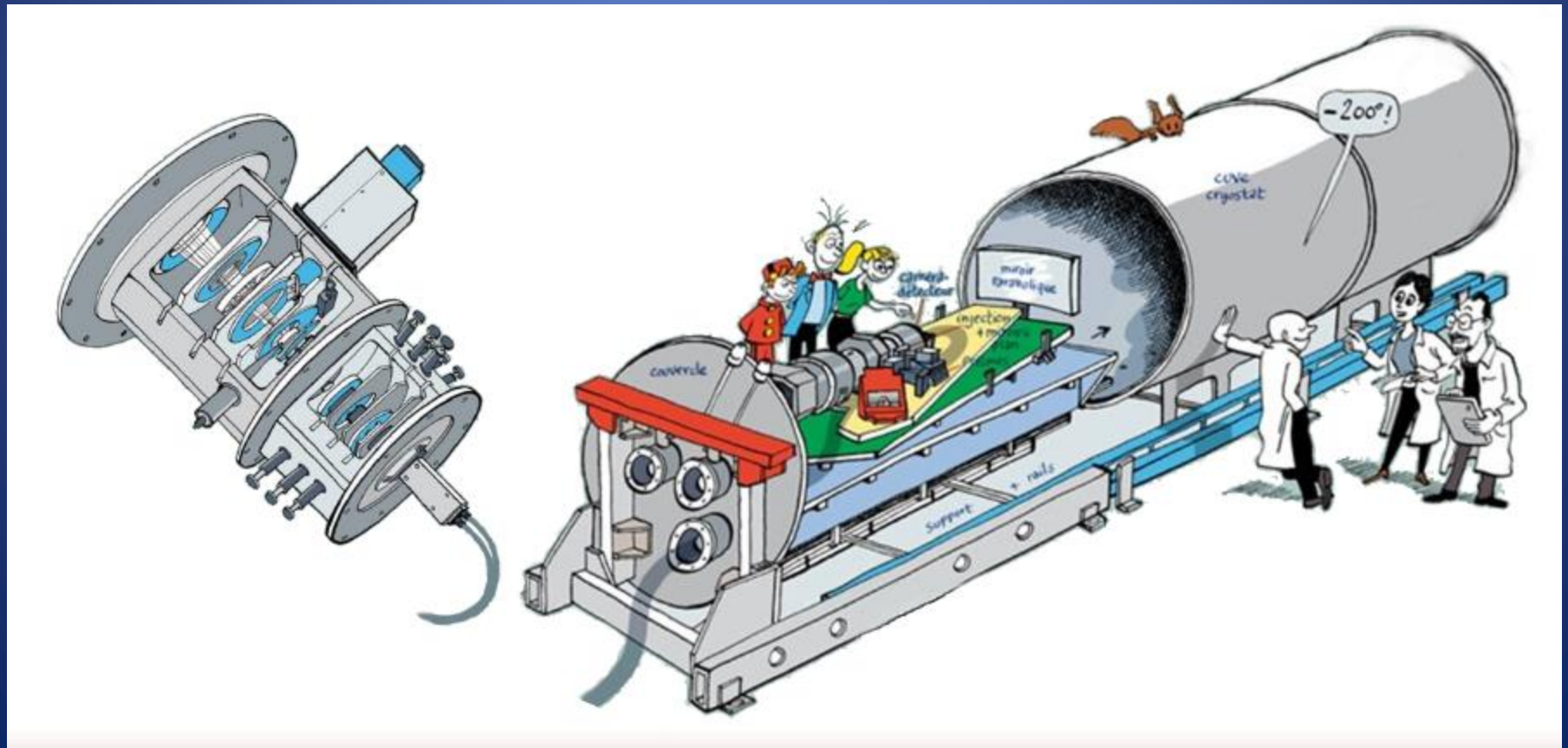



KEYENCE


GRANITE PRECISION LEVEL
DANG SHEN MEASURING TOOLS

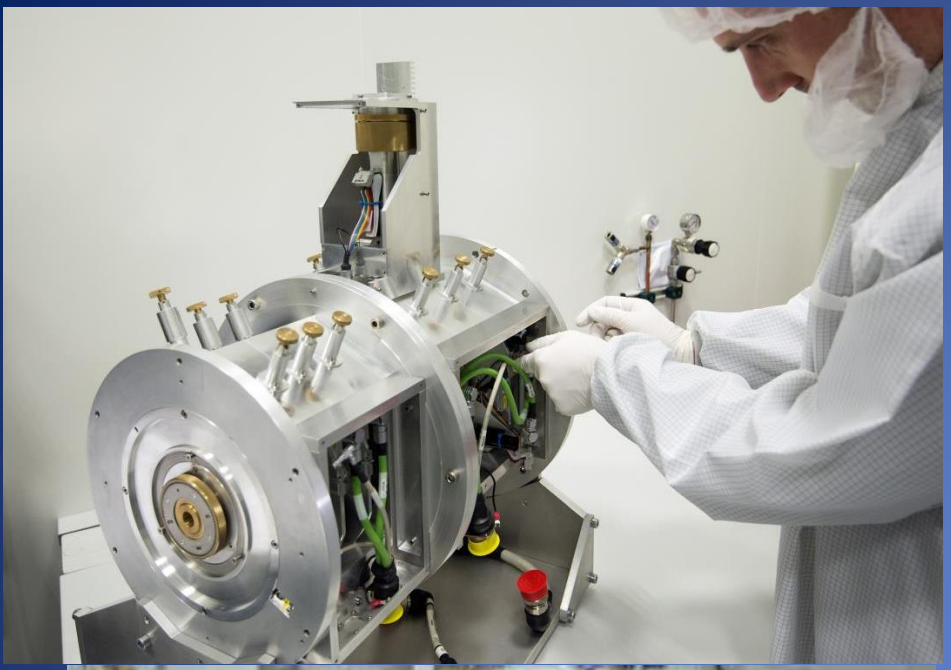
CFHT/SPIRou

- Led by IRAP in Toulouse (Jean-Francois Donati) from 2009
  - UoM, HIA, are major partners
  - Brazil, Geneva, Portugal, ASIAA are minor partners

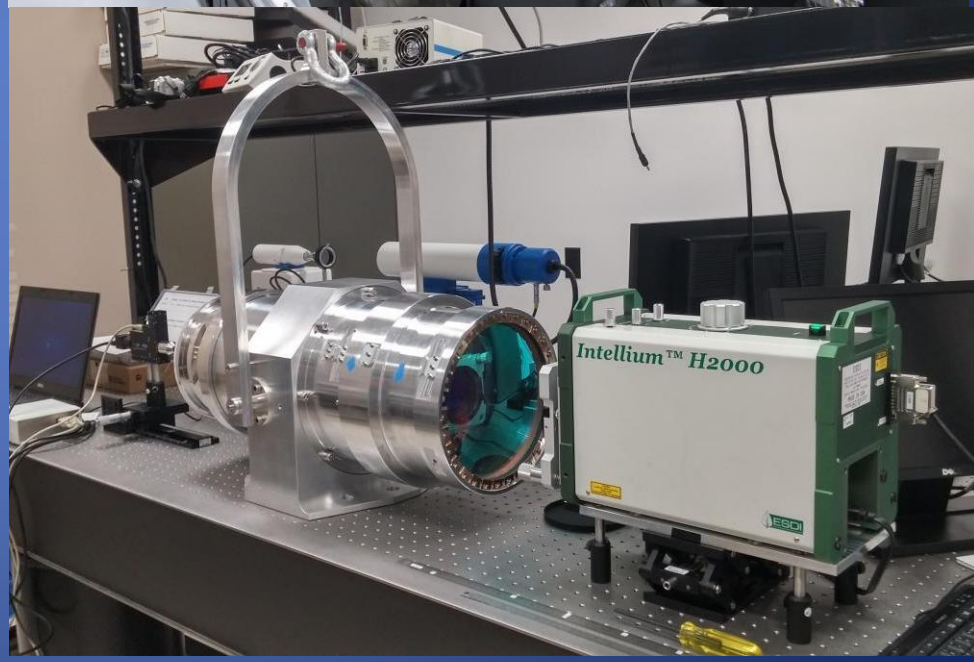


SPIRou Parameters

- Single-shot 0.95-2.40 µm coverage
- Resolving power : ~70 000
- Short and long-term stability
  - RV accuracy <1m/s
- Dual channel polarimeter, <1% crosstalk between states
- Peak throughput ≈15%, S/N=110 per 2 km/s in 1h for *J*=12, *K*=11
- Thermal background smaller than telescope+sky background

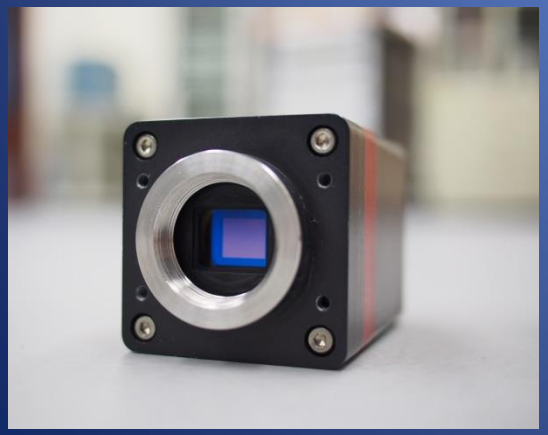


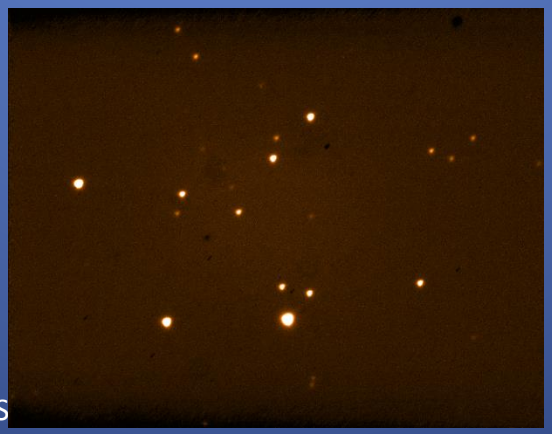

SPIROU
SPIROU

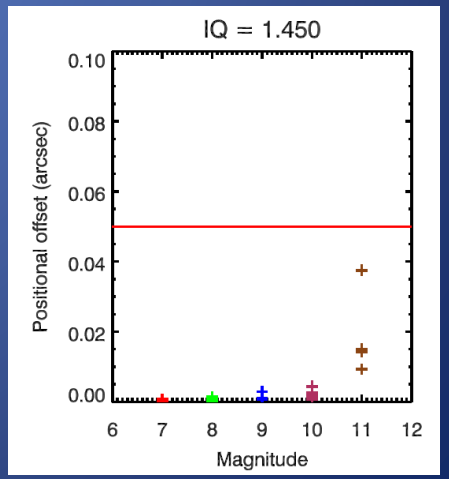

Intellium™ H2000

Our Contribution in SPIRou

- Tip tilt and viewing camera
  - Provide the correction signal to image stabilizer unit at 50Hz
  - Targeted target star position error respected to the pickup mirror <0.05” during the exposures
  - Based on a commercial camera with fast centroiding algorithm

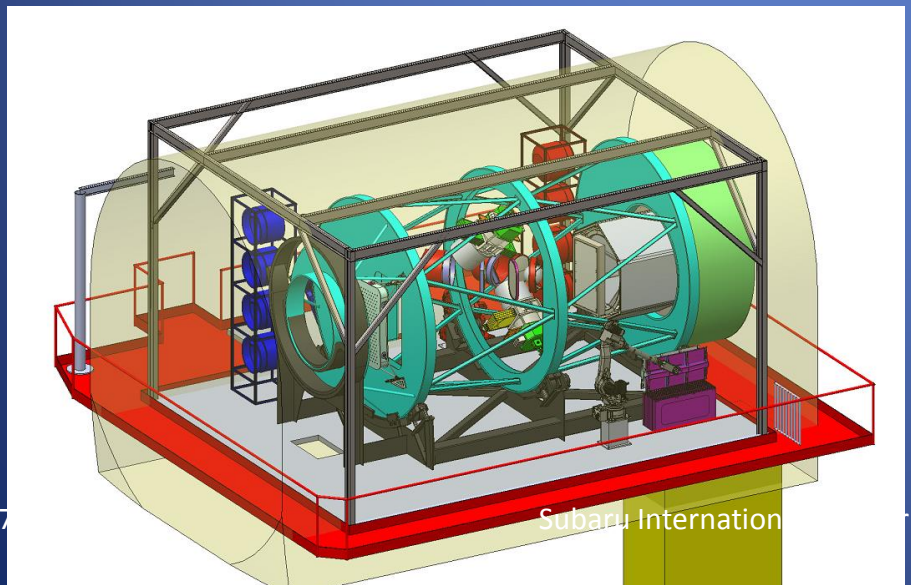


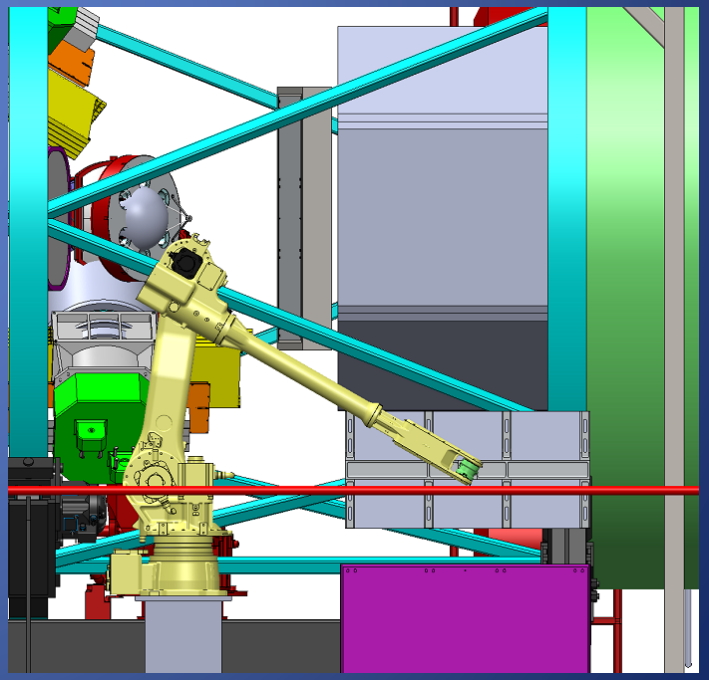




TMT WFOS

- ASIAA was involved in the ministudy of the mask exchange system with NAOJ and NAOC
- Tradeoffs between the mask exchange time and the number of masks in MOBIE
  - On board or fixed robot
  - Curved or flat masks





Summary

- The collaboration between ASIAA and Subaru has been quite successful in the past 10 years
  - Instrumentation development and SSP without guarantee time
- It is indeed a win-win collaboration
- We look forward to working with new partners in the future