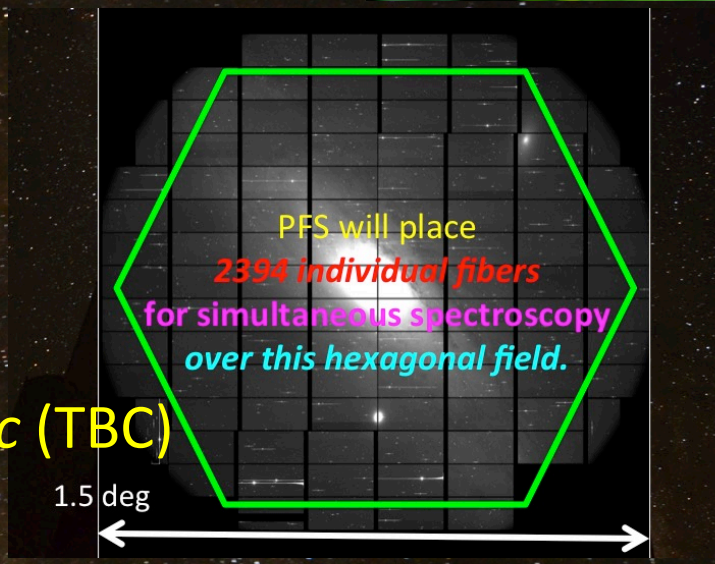
PFS - Fast facts

- Subaru *Prime Focus Spectrograph*:
  The spectroscopy part of the "SuMIRe" project.
  - Wide field: *~1.3 deg* diameter
  - High multiplicity: *2394 fibers*
    - Fiber diameter: ~1.05 arcsec
    - Fiber positioner pitch: ~85 arcsec
    - Minimum fiber separation: ~30 arcsec
  - Quick fiber reconfiguration: *~60-120 sec* (TBC)
    - *Dynamic* survey strategy is allowed.
  - VIS-NIR coverage: *380-1260nm simultaneously*
    - Low resolution mode: ~2.5 A resolution
    - Medium resolution mode (around 800nm): ~1.6 A resolution



- Aiming at start of science operation & survey program in *2021, as a facility instrument on Subaru Telescope.*

PFS subsystems distribution

Software system

Spectrograph system (SpS)

On the TUE floor
(IR side)

4 spectrographs

Fiber cable

Fiber connectors

Fiber cable

Prime Focus Instrument

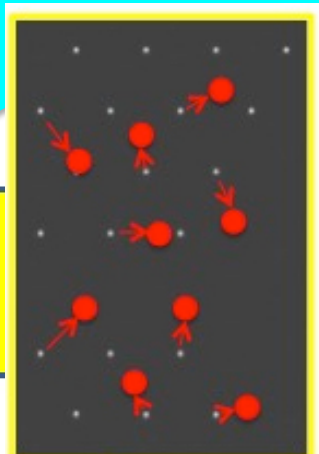
Wide-field corrector

… in Prime focus unit "POpt2" with Wide Field Corrector "WFC".

Calibration system

This takes an image of the prime focus with the fibers "backlit" and measure their current positions*: Key part of iterative fiber positioning process.*

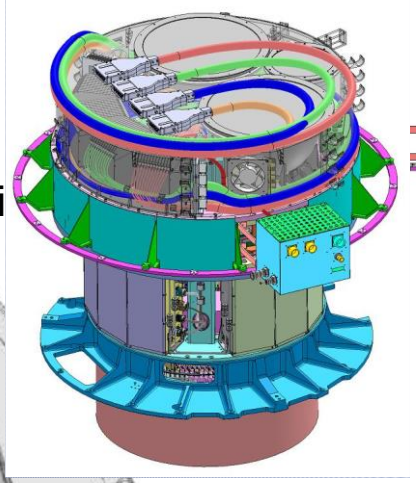
Metrology camera as a Cassegrain instrument

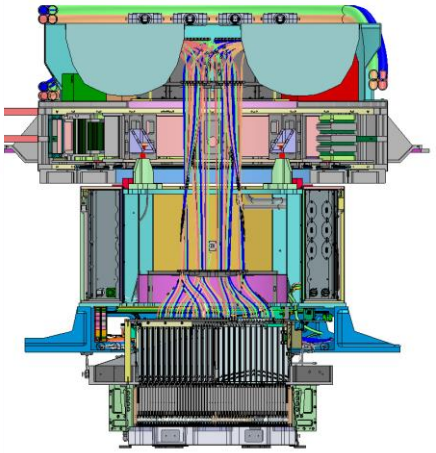


Subaru Telescope

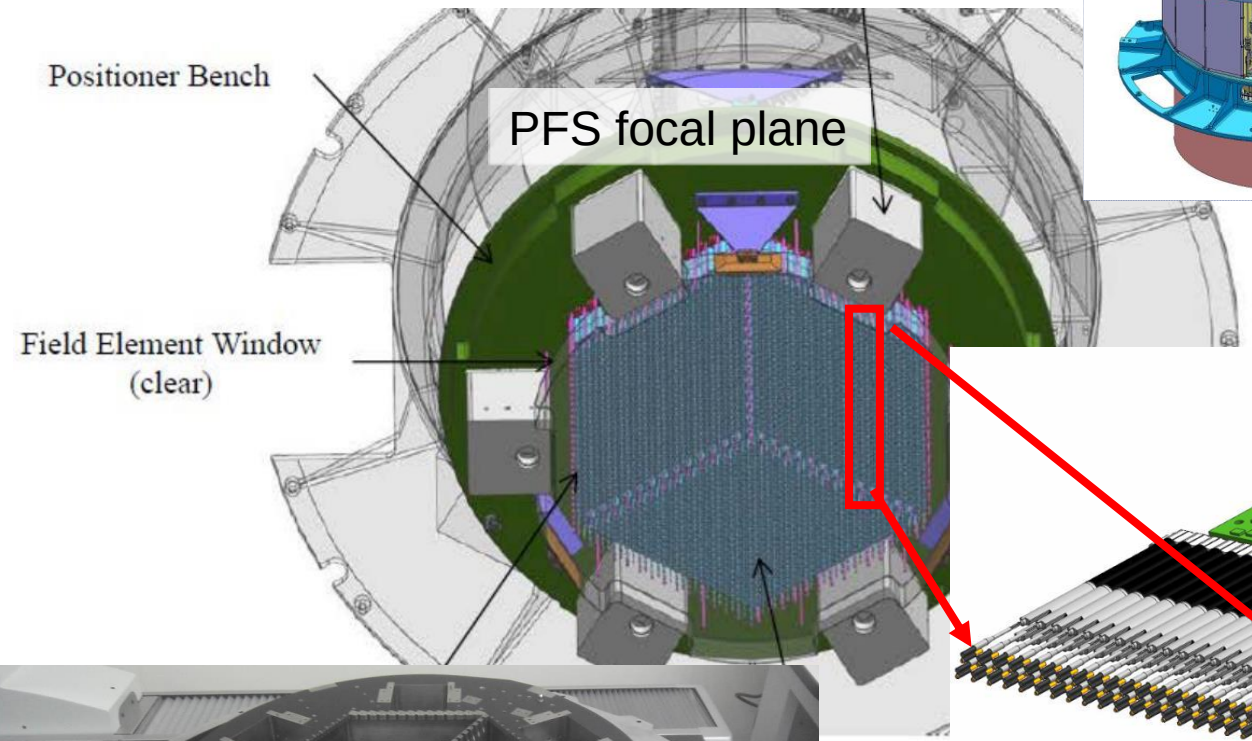
Prime Focus Instrument (PFI)

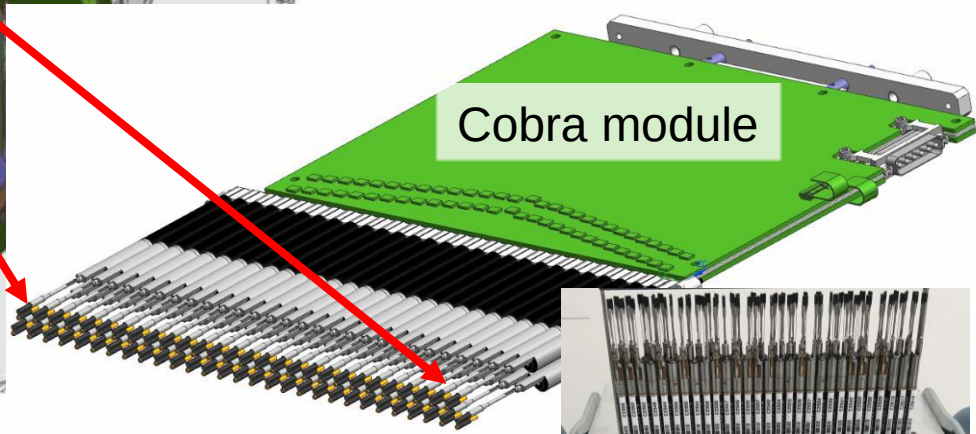
The focal plane will include 42 modules, each with 57 fi
Caltech is building and testing these modules

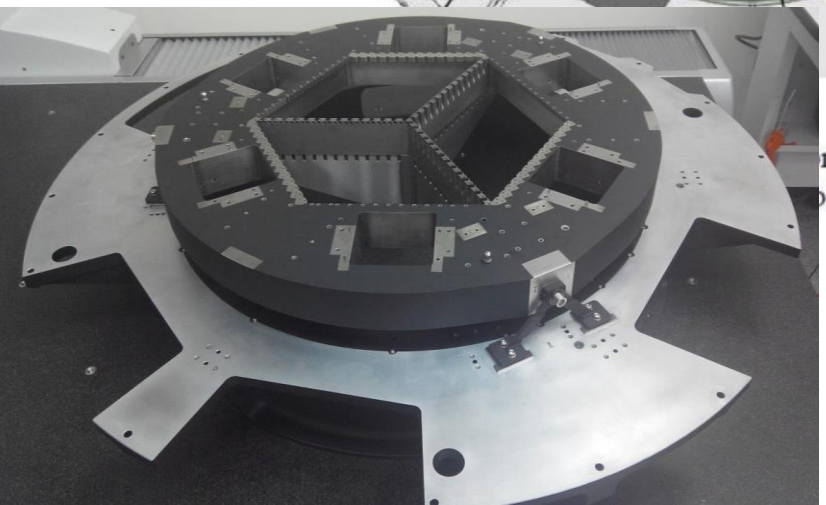




Each Cobra module includes
57 Cobra assemblies







ra Positioners
lue)

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Institute of Astronomy and Astrophysics

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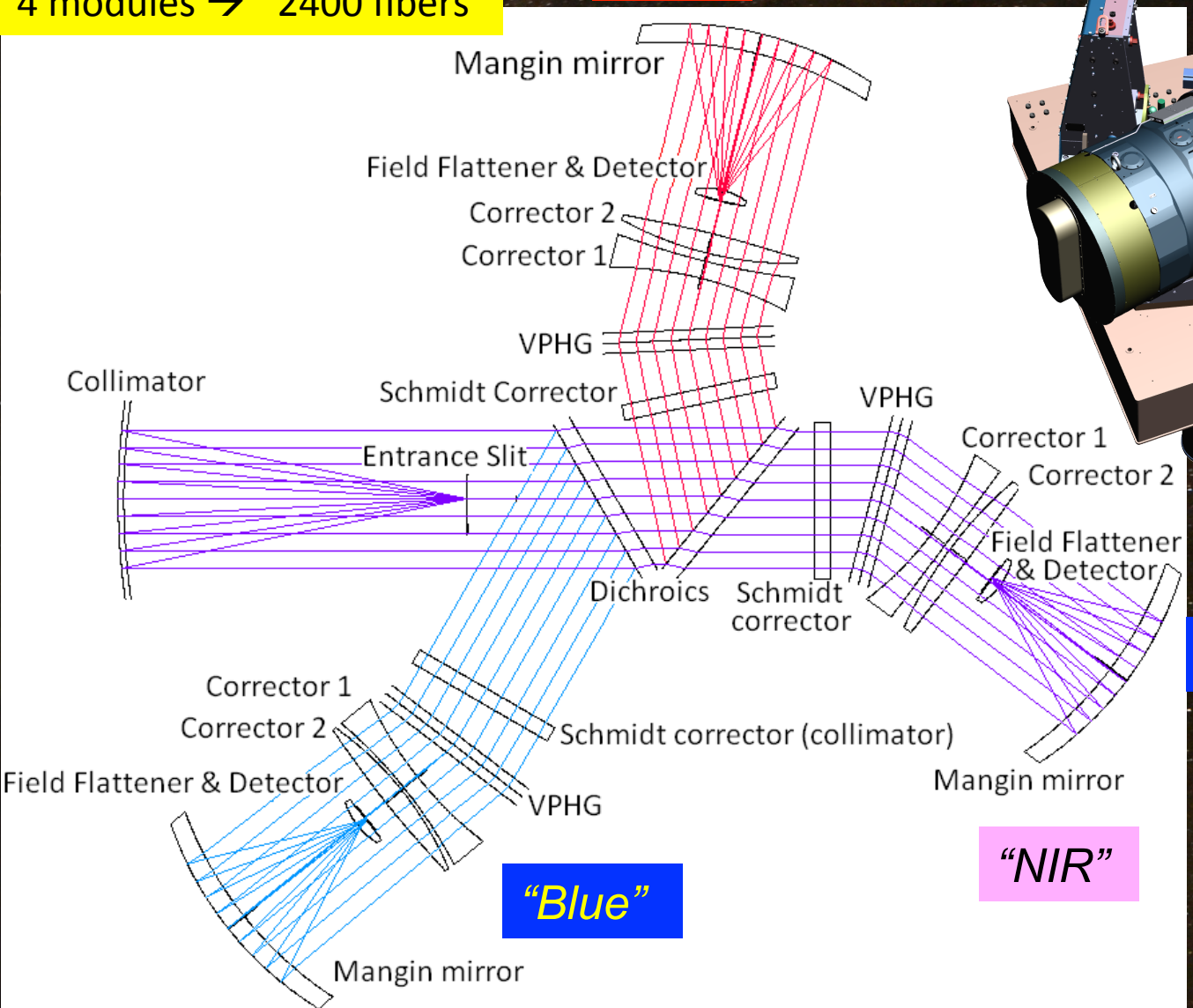
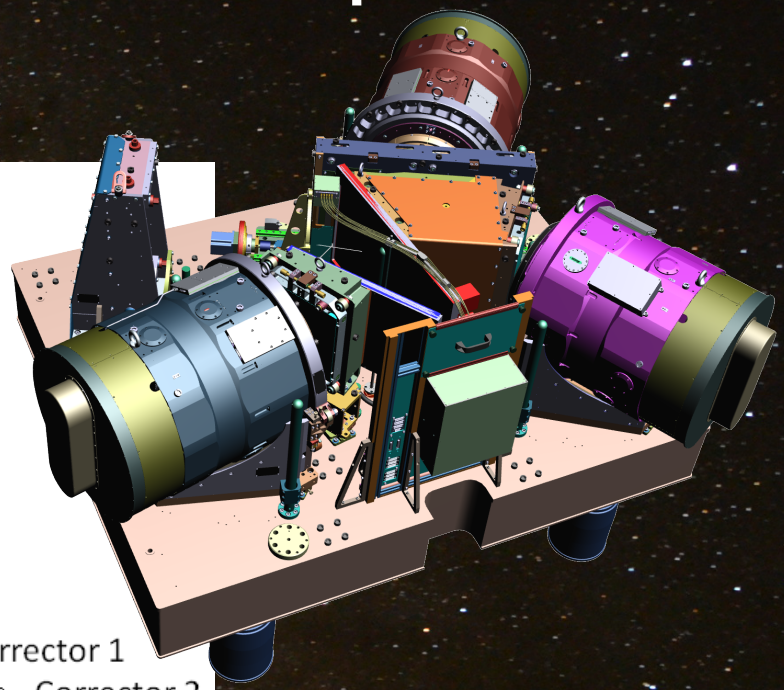
NASA JPL Caltech

Spectrograph System (SpS)

1 module → ~600 fibers
4 modules → ~2400 fibers





Blue (380-650nm)

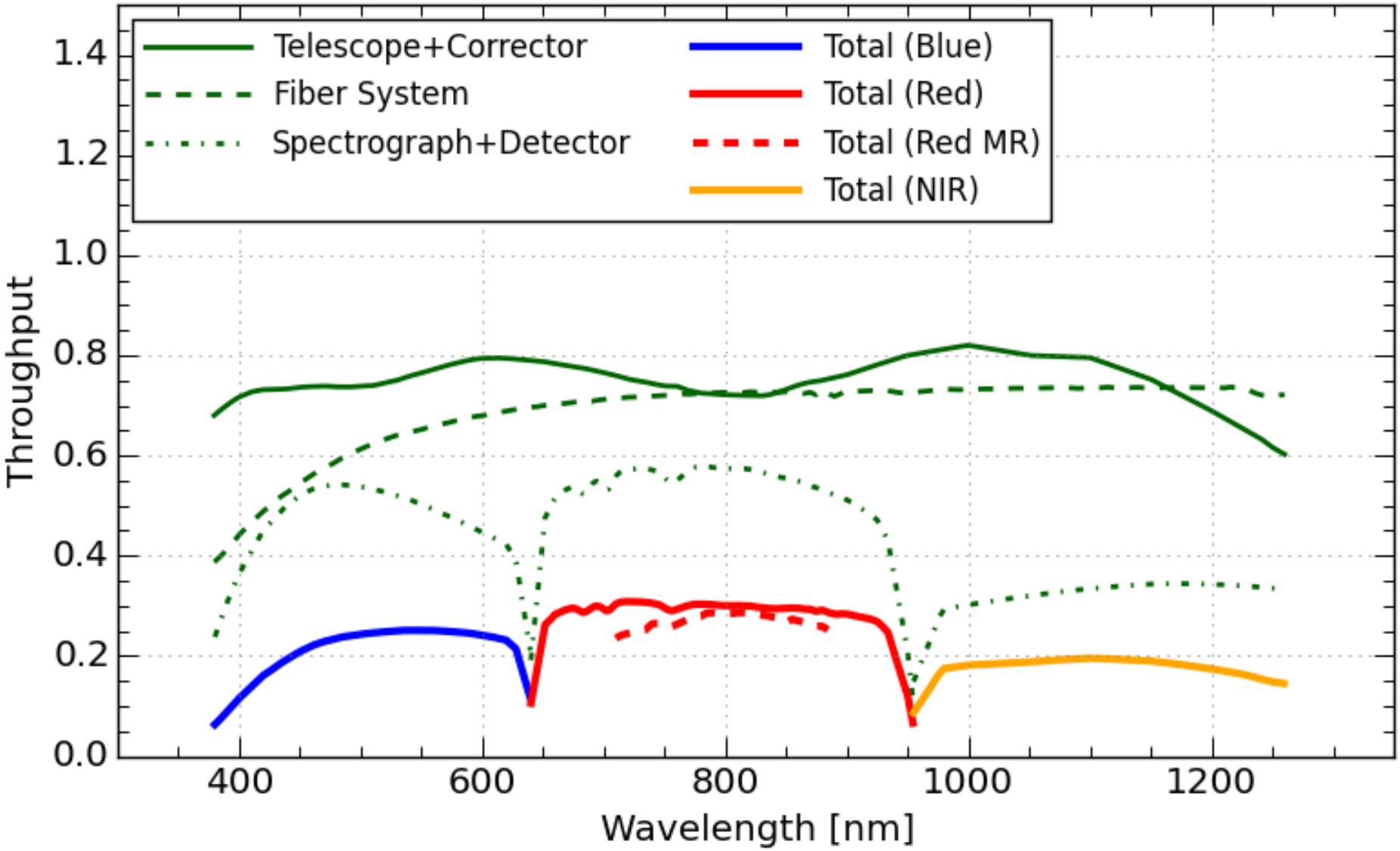
Red (630-970nm)

NIR (950-1280nm)

Instrument Parameters

Prime Focus Instrument				
Field of view	~1.38 deg (hexagonal - diameter of circumscribed circle)			
Field of view area	~1.25 deg^2			
Input F number to fiber	2.8			
Fiber core diameter (1)	127 μm (1.12 arcsec at the FoV center, 1.02 arcsec at the edge)			
Positioner pitch	8 mm (90.4 arcsec at the FoV center, 82.4 arcsec at the edge)			
Positioner patrol field	9.5 mm diameter (107.4 arcsec at the FoV center, 97.9 arcsec at the edge)			
Fiber minimum separation (2)	~30 arcsec			
Fiber configuration time	~60-120 sec. [TBC]			
Number of fibers	Science fibers	Fixed fiducial fibers		
	2394	96		
Fiber density	~2000 deg^{-2} / ~0.6 $arcmin^{-2}$			
Number of A&G camera (3)	6			
Field of view of A&G camera	~5.1 $arcmin^2$ per one camera			
Sensitivity of A&G camera	r'~20.0 AB mag for S/N~30 (100) in 1 (10) sec. exposure			
Spectrograph				
Spectral arms	Blue	Red		NIR
		Low Res.	Mid. Res.	
Spectral coverage	380 - 650 nm	630 - 970 nm	710 - 885 nm	940 - 1260 nm
Dispersion	~0.7 Å/pix	~0.9 Å/pix	~0.4 Å/pix	~0.8 Å/pix
Spectral resolution	~2.1 Å	~2.7 Å	~1.6 Å	~2.4 Å
Resolving power	~2300	~3000	~5000	~4300
Spectrograph throughput (4)	~53% (@500nm)	~57% (@800nm)	~54% (@800nm)	~33% (@1100nm)

Throughput of the system



PFS Expected Performance

Arm		Wavelength range [nm]	Throughput(1)	Resolving Power	Continuum sensitivity(2) [AB mag]		Emission line sensitivity(3) [10^{-17} erg/s/cm^2]	
					mean(4)	representative(5)	mean(4)	representative(5)
Blue		380 - 450	14%	~2300	22.0	22.1 (@415nm)	2.9	2.8 (@415nm)
		450 - 550	24%		22.4	22.5 (@505nm)	1.5	1.4 (@505nm)
		550 - 650	23%		22.1	22.2 (@605nm)	1.5	1.3 (@605nm)
Red	Low Res.	630 - 750	29%	~3000	22.2	22.5 (@680nm)	1.2	1.0 (@680nm)
		750 - 850	30%		22.0	22.4 (@796nm)	1.1	0.9 (@796nm)
		850 - 970	27%		21.6	22.1 (@912nm)	1.2	0.9 (@912nm)
	Mid. Res.	710 - 775	26%	~5000	21.6	21.8 (@741nm)	1.3	1.1 (@741nm)
		775 - 825	28%		21.6	21.8 (@796nm)	1.1	1.0 (@796nm)
		825 - 885	27%		21.5	21.7 (@856nm)	1.2	1.0 (@856nm)
NIR		940 - 1050	17%	~4300	20.9	21.5 (@993nm)	2.0	1.3 (@993nm)
		1050 - 1150	19%		21.0	21.4 (@1100nm)	1.6	1.2 (@1100nm)
		1150 - 1260	17%		20.9	21.3 (@1208nm)	1.5	1.2 (@1208nm)

(1) The total throughput including primary mirror reflectivity, WFC transmission, and PFS instrument. See here. The fiber aperture effect is not included because it depends on seeing condition and object type. The vignetting effect, ~94% at the field center and ~71% at the field edge, is not included either because it depends on the field position. The continuum and emission-line sensitivity information, however, are calculated taking these factors into consideration.

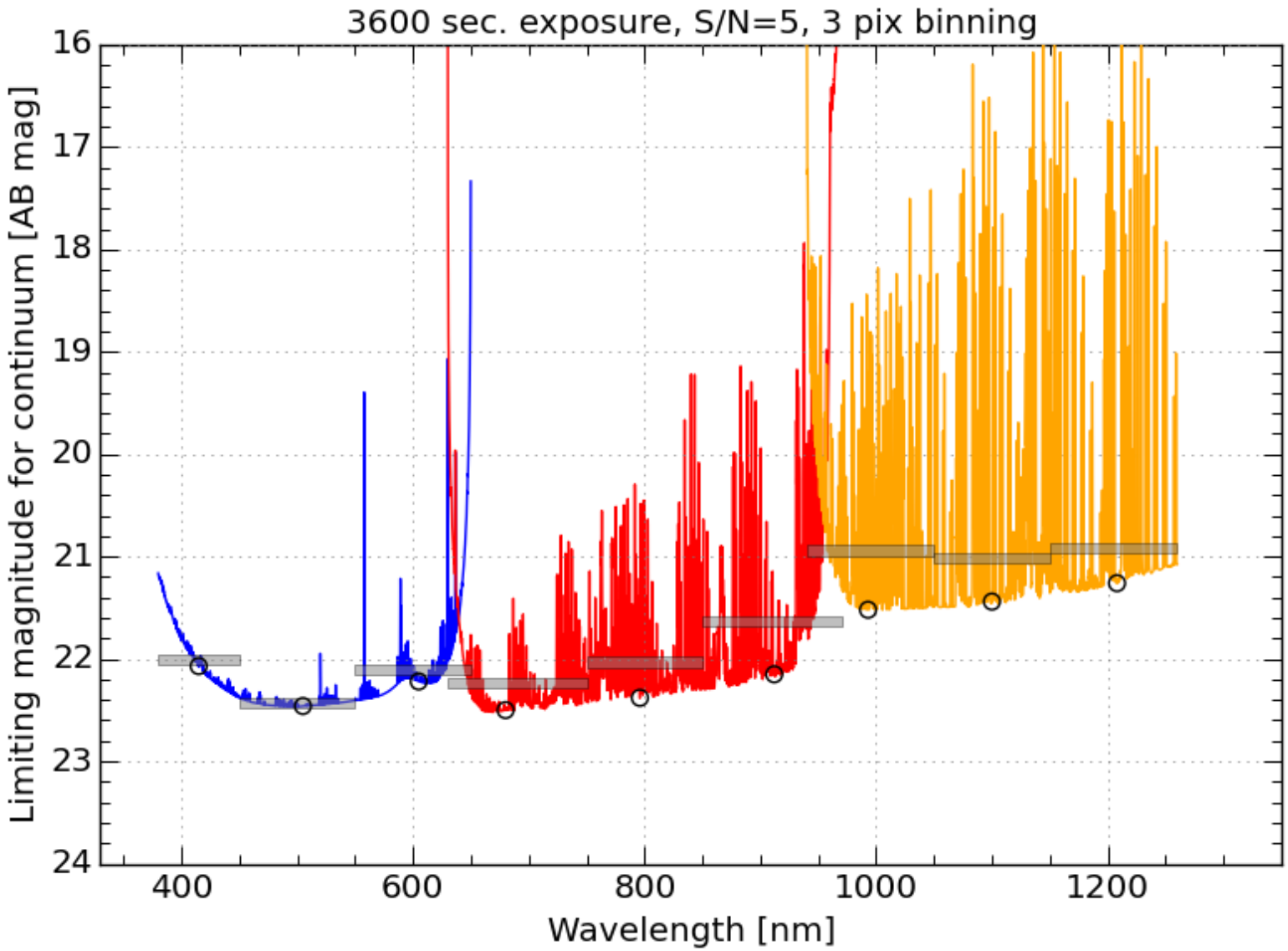
(2) Continuum sensitivity in case of point source, to achieve S/N=5 for 1-hour on-source exposure (8×450 sec.), after 3 pixel binning.

(3) Emission-line sensitivity in case of point source, to achieve S/N=5 for 1-hour on-source exposure (8×450 sec.). Here, the line width is assumed to be σ=70 km/s.

(4) The average limiting magnitude and line flux in the wavelength range. This value may be affected by the sky emission line.

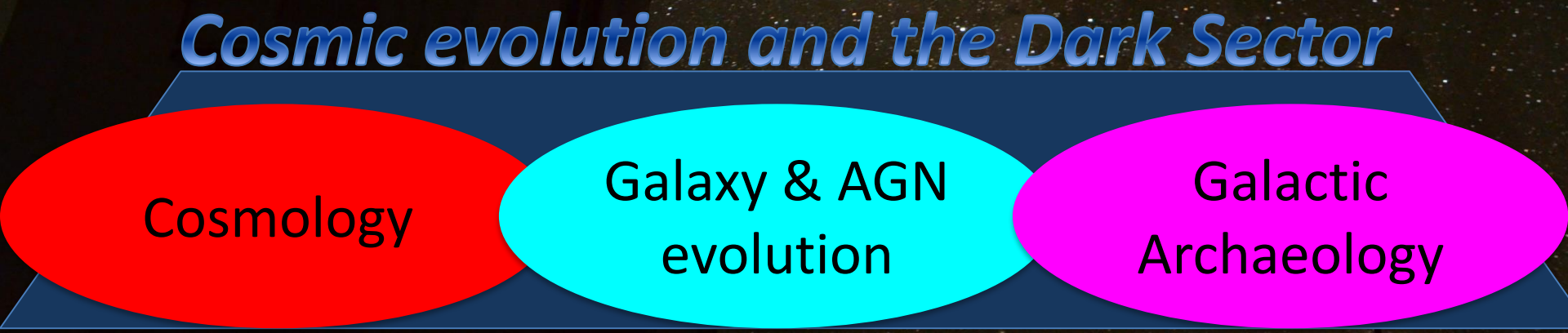
(5) The representative value at the wavelength where the spectrum is not affected by the sky emission line.

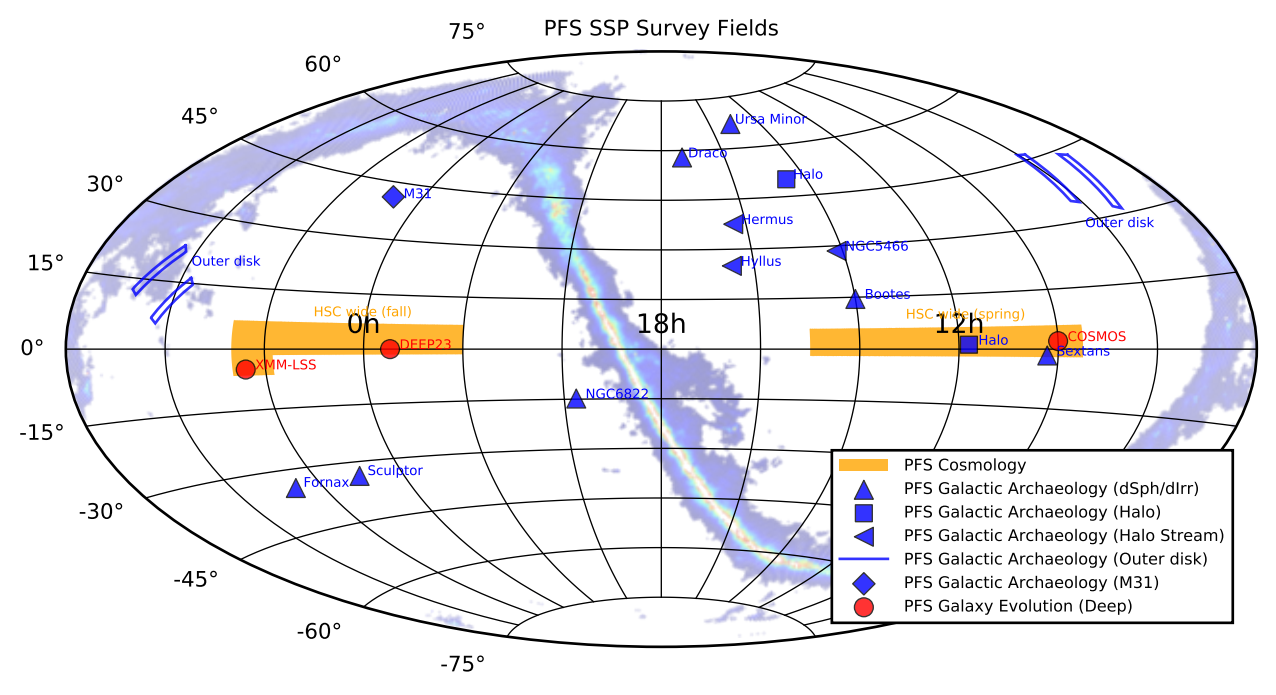
Limiting magnitude for continuum



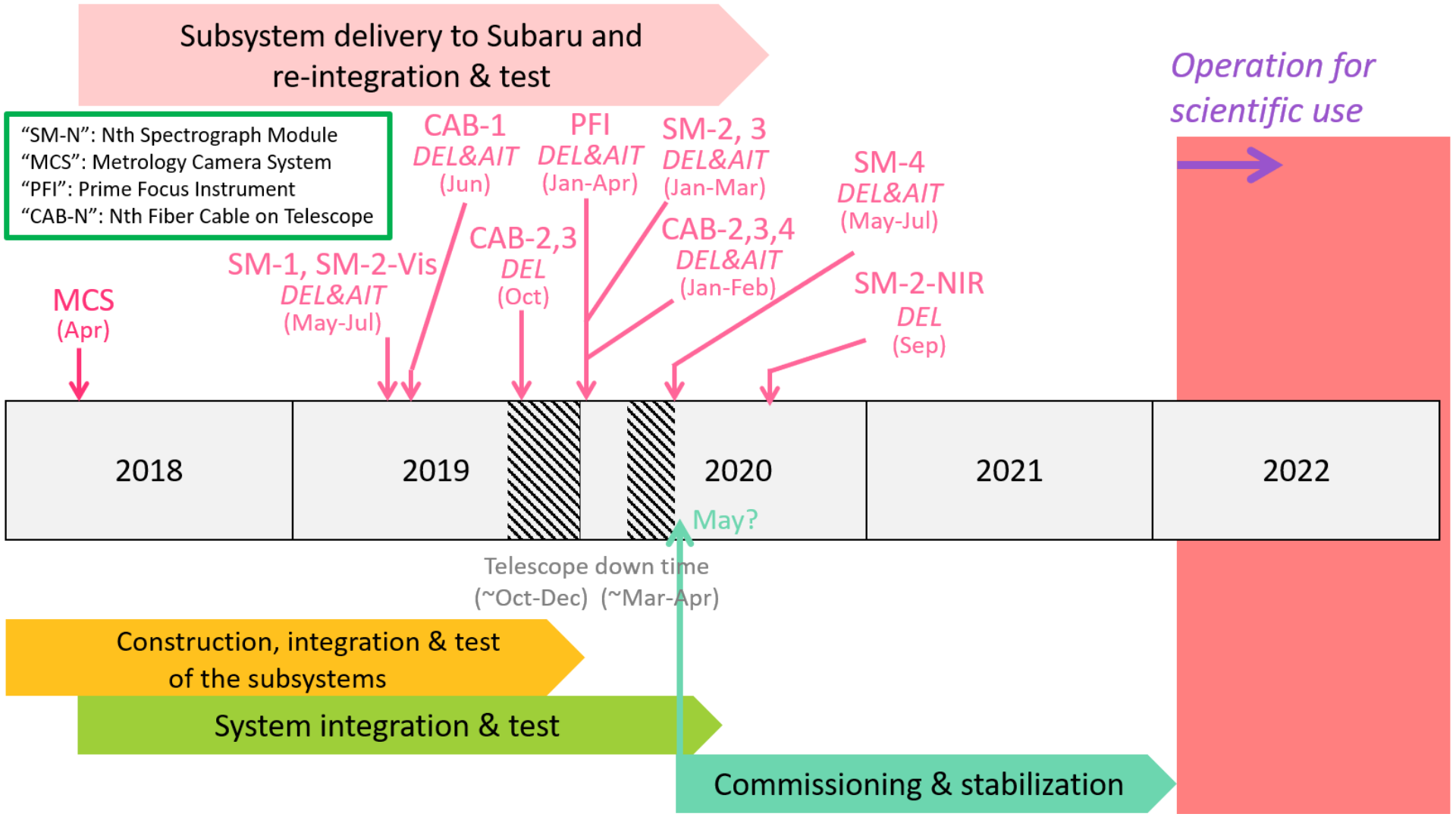
Planning of PFS survey program

- Subaru Strategic Program (SSP): ~300 nights over ~5 years
  - HSC SSP has been progressing since 2014.
    - Continuing out to ~2020(?).
  - PFS SSP: A proposal is in preparation.
    - Timely start after the HSC SSP
    - A survey program with the three “pillars”:




PFS SSP Survey Fields
75°
60°
45°
30°
15°
0°
-15°
-30°
-45°
-60°
-75°
0h
18h
12h
Ursa Minor
Draco
Halo
M31
Hermus
NGC5466
Hyllus
Bootes
Outer disk
Outer disk
HSC wide (fall)
HSC wide (spring)
DEEP23
XMM-LSS
NGC6822
Halo
COSMOS
Sextans
Fornax
Sculptor
PFS Cosmology
PFS Galactic Archaeology (dSph/dIrr)
PFS Galactic Archaeology (Halo)
PFS Galactic Archaeology (Halo Stream)
PFS Galactic Archaeology (Outer disk)
PFS Galactic Archaeology (M31)
PFS Galaxy Evolution (Deep)

Timeline


Subsystem delivery to Subaru and re-integration & test
Operation for scientific use
"SM-N": Nth Spectrograph Module
"MCS": Metrology Camera System
"PFI": Prime Focus Instrument
"CAB-N": Nth Fiber Cable on Telescope
CAB-1 DEL&AIT (Jun)
PFI DEL&AIT (Jan-Apr)
SM-2, 3 DEL&AIT (Jan-Mar)
SM-4 DEL&AIT (May-Jul)
CAB-2,3 DEL (Oct)
CAB-2,3,4 DEL&AIT (Jan-Feb)
SM-2-NIR DEL (Sep)
MCS (Apr)
SM-1, SM-2-Vis DEL&AIT (May-Jul)
2018
2019
2020
2021
2022
May?
Telescope down time
(~Oct-Dec) (~Mar-Apr)
Construction, integration & test of the subsystems
System integration & test
Commissioning & stabilization