ʻŌnohiʻula PFS Status Report

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PFS A Project team

Subaru Users Meeting FY2026 PFS session

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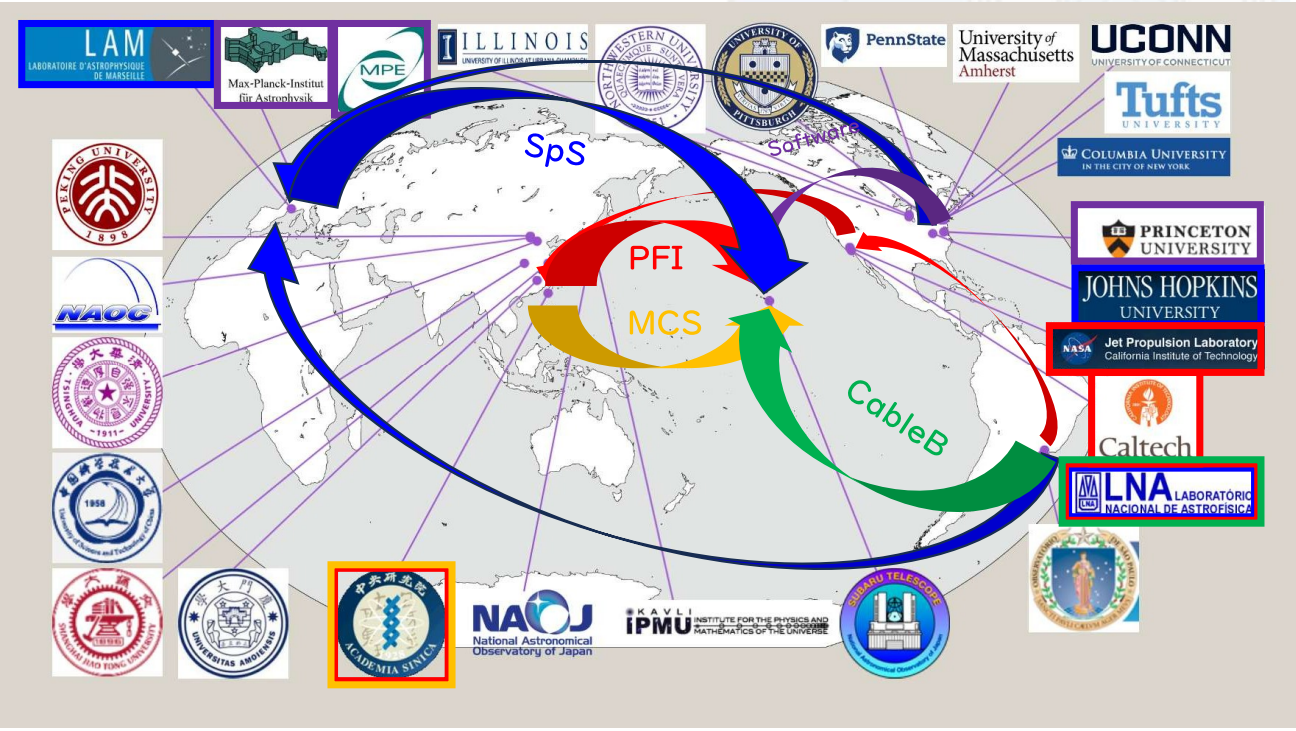
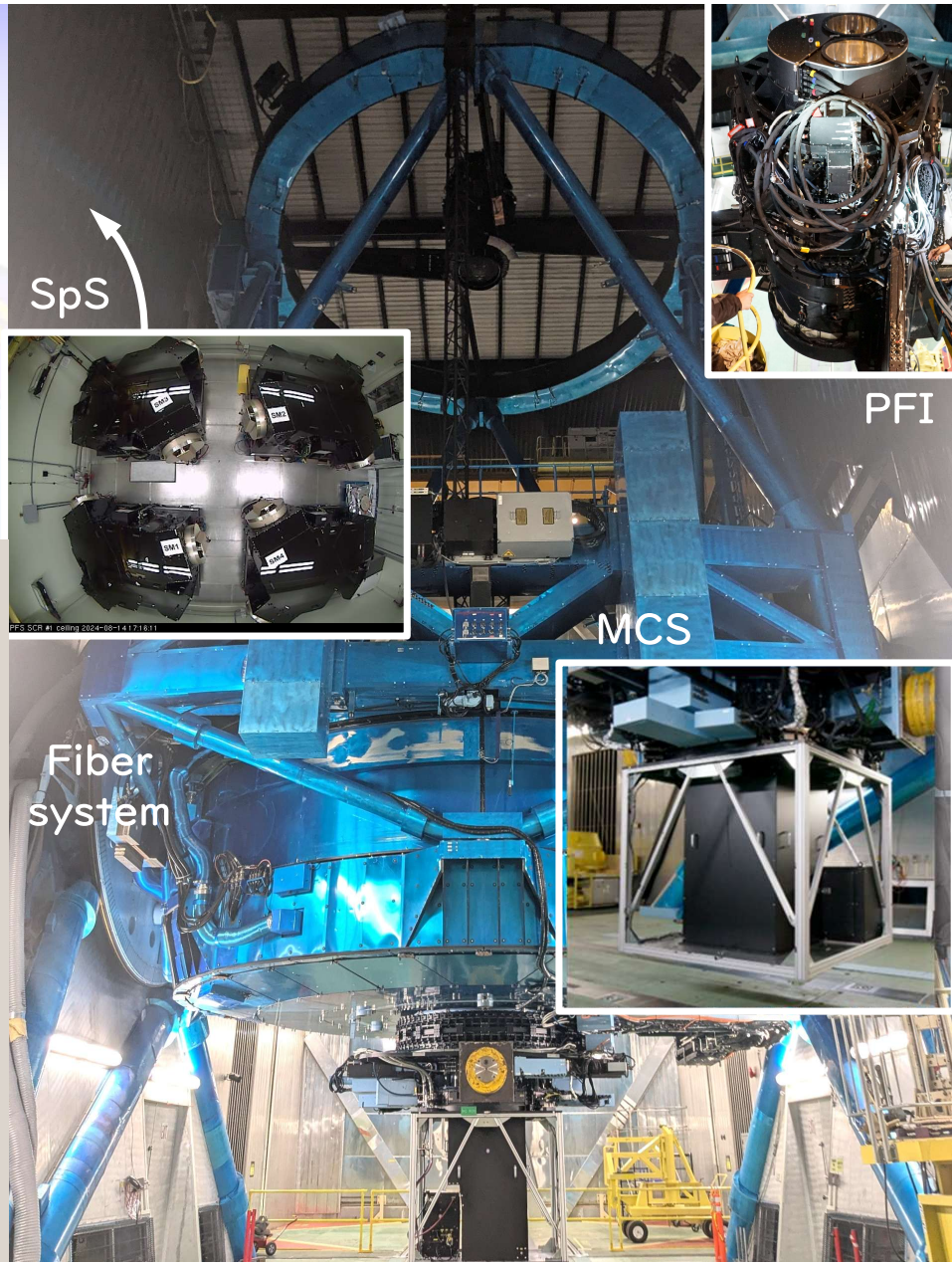
ʻŌnohiʻula PFS

- Prime Focus Spectrograph
  - Hyper multiplex spectrograph with 2386 science fibers in FoV of 1.3 degree in dimeter
  - Covers 380~1260nm with b, r, and n camera
- Developed under very wide international collaboration. All the subsystem has installed to Subaru since Aug. 2024.





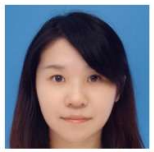
PFS A project updates

- Extended until the end of 2026 to complete some important development items.
  - N2 camera detector exchange
  - Maintenance and repair of CableC connector
  - Data Analysis Pipeline update
- Final acceptance review will be held by the end of 2026.
  - After the acceptance, PFS will operate as a Subaru facility instrument

Group members

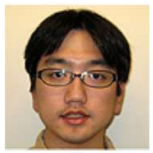
Shintaro Koshida
Management

Wilfred Gee
Software engineering



Kumiko Morihana
Instrument maintenance

Yuki Moritani
Commissioning in general



Hirofumi Okita
Telescope interface

Masato Onodera
Target management
Webtool development

Masayuki Tanaka
Data analysis management

Miho Ishigaki

Wanqiu He

Fumiaki Nakata

Open use framework

Satoshi Kawanomoto
Optics, AG system

Zhuoming Li

Sadman Ali
Data analysis Helpdesk

Kiyoto Yabe
DRP development

Takashi Hattori
Instrument maintenance

Eric Jeschke

Russell Kackley
Operation system software
QA database management

Tae-Soo Pyo

Akira Arai

Makoto Tanaka

"Ichi"

Vera Maria Passegger

Sweta Shah

Takuya Fujiyoshi

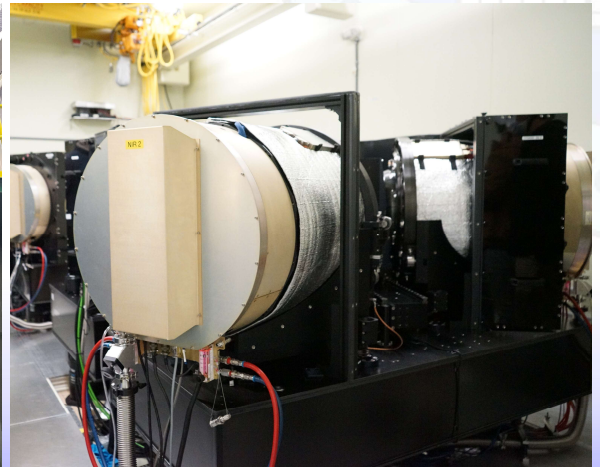
Tuyoshi Terai

Science operations
Night operations

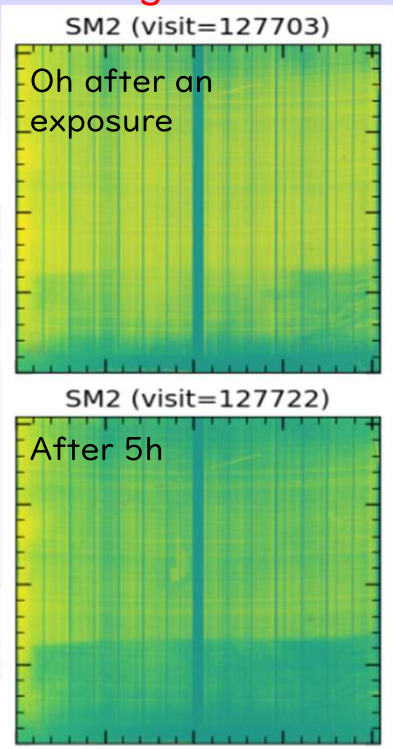
Updates on Instruments

Detector Exchange of SpS NIR camera for SM2

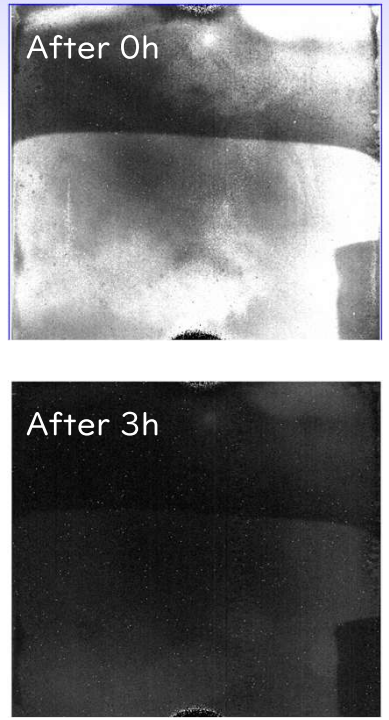
- N2 detector has been replaced.
  - The one having suffered from the worst persistence.
  - Shipped to JHU for replacement work in Feb. 2026 and completed replacement very smoothly in March.
  - Arrived at Subaru and re-installed in May.
- Working as expected so far.
  - Cooled down to operation temperature in May
  - The optical alignment is confirmed to be comparable to the one before the detector replacement.
- Will be tested on sky in July run.



Original



Replaced

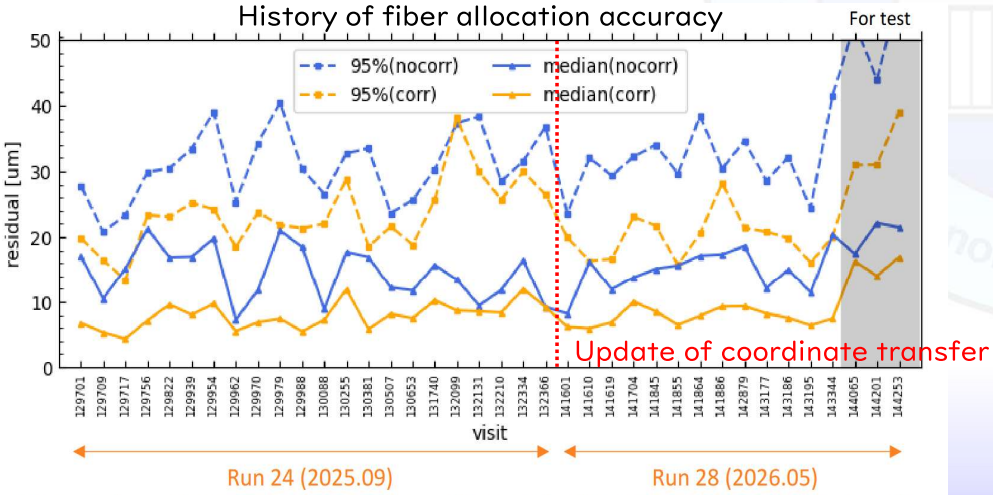


Persistence on the old and new detectors

Cumulative persistence signal on the old and new detectors

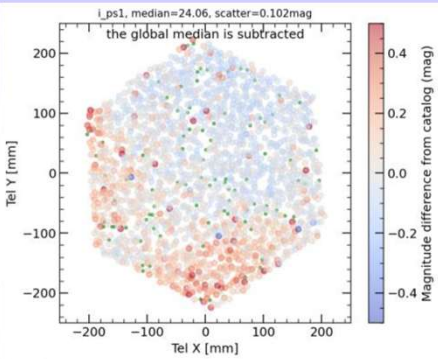
Flux non-uniformity

- The standard star flux in a field of view has non-uniformity about σ~0.15 mag.
  - Insufficient fiber positioning accuracy explains it.
  - Flux loss up to 0.5 mag can happen.
- Sag of Cobras was systematically measured, modelized, and implemented in the MCS-PFI coordinate transformation.
- Software bug with raster scan operation delayed the investigations.

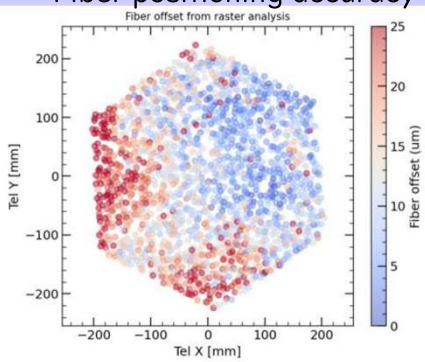


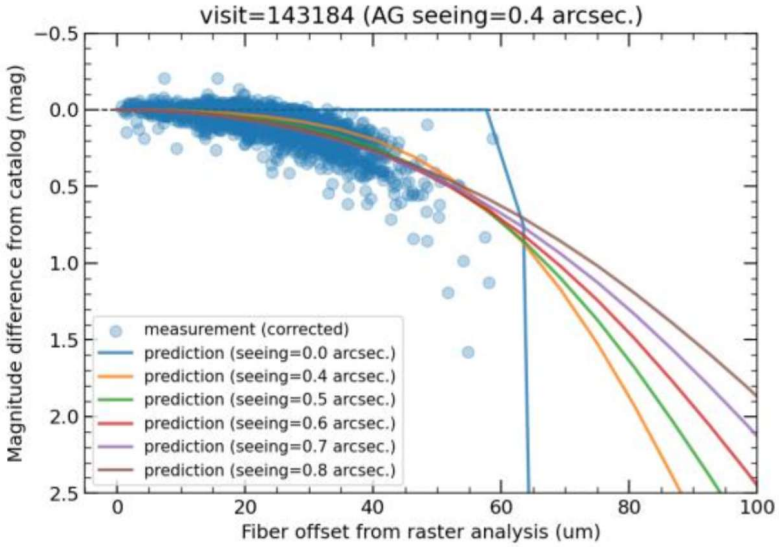
Measured fiber configuration accuracy as median and 95 percentile. "Nocorr" means raw measurement, and "corr" means result after subtracting measured shift, rotation and scale.

Difference of fluxSTD from PS1



Fiber positioning accuracy



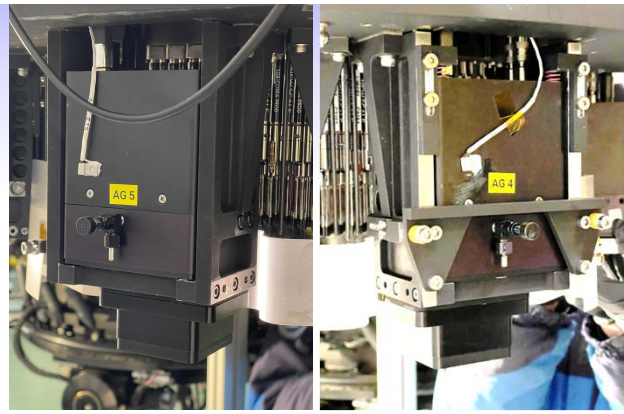


Comparison of flux loss with model

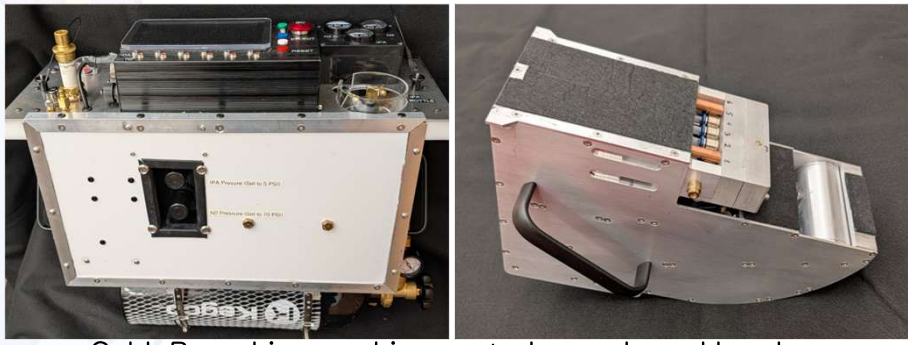
- The most recent run result showed that the fiber positioning accuracy remains in a similar level.
  - 20-40um
- Further analyses on the fiber positioning errors are ongoing.

Other updates on Instruments

- AG camera support upgrade
  - Robust support structure to suppress the wobble of the Autoguiding cameras.
  - Upgrade for 3 cameras (of 6 in total) has completed.
  - Slight improvement along the focus axis: ~20um -> ~10um
- CableB fiber cleaning machine
  - Clean-up the index matching gel at the fiber connector
  - Reduce the burden of regular operation: >1 full day work into a half day work?
  - Under shipment to Subaru.
- CableC long-term maintenance
  - Replacement of cracked connector housing
  - Replacement of two broken MTP ferrules
  - Fiber surface clean-ups
  - Upgrade of the connector structure to resolve the mismatching of ferrules.



Old mechanical support (left) and new (right) of AG cameras



CableB waching machine control console and head

Inspection of CableC fibers (left) and newly fabricated connector housing (right)

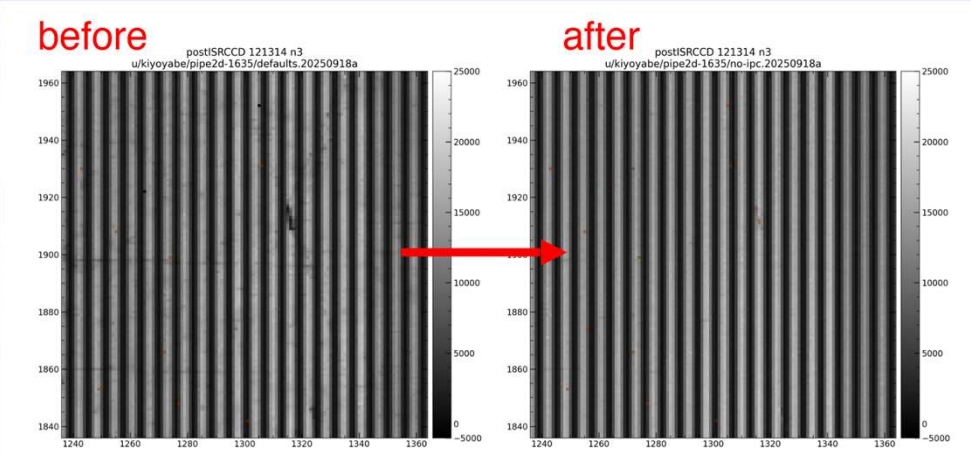
Updates on DRP

Please also visit P17 by Yabe-san

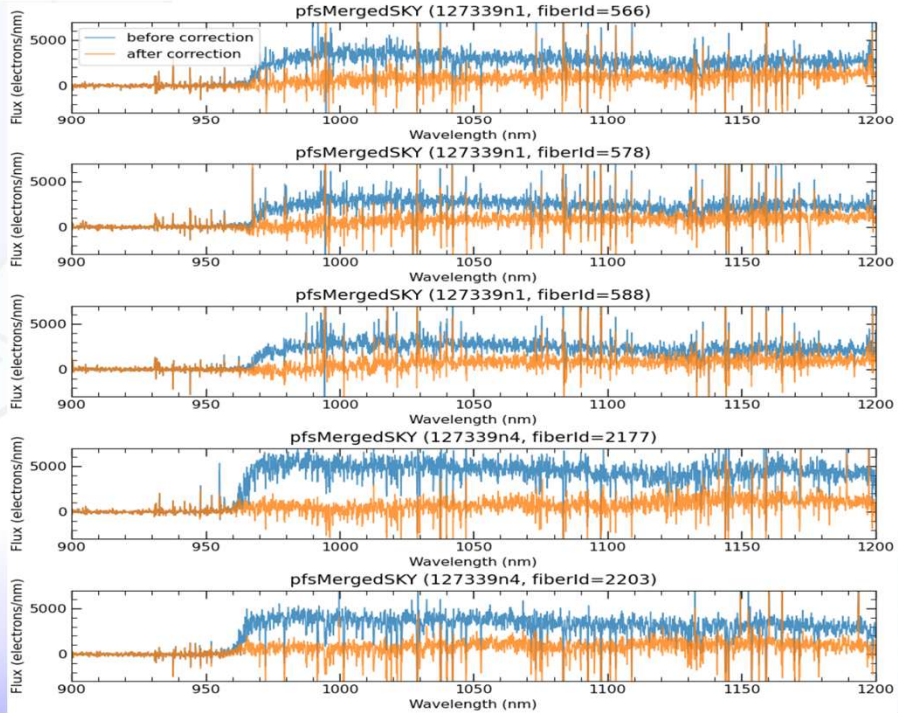
NIR data

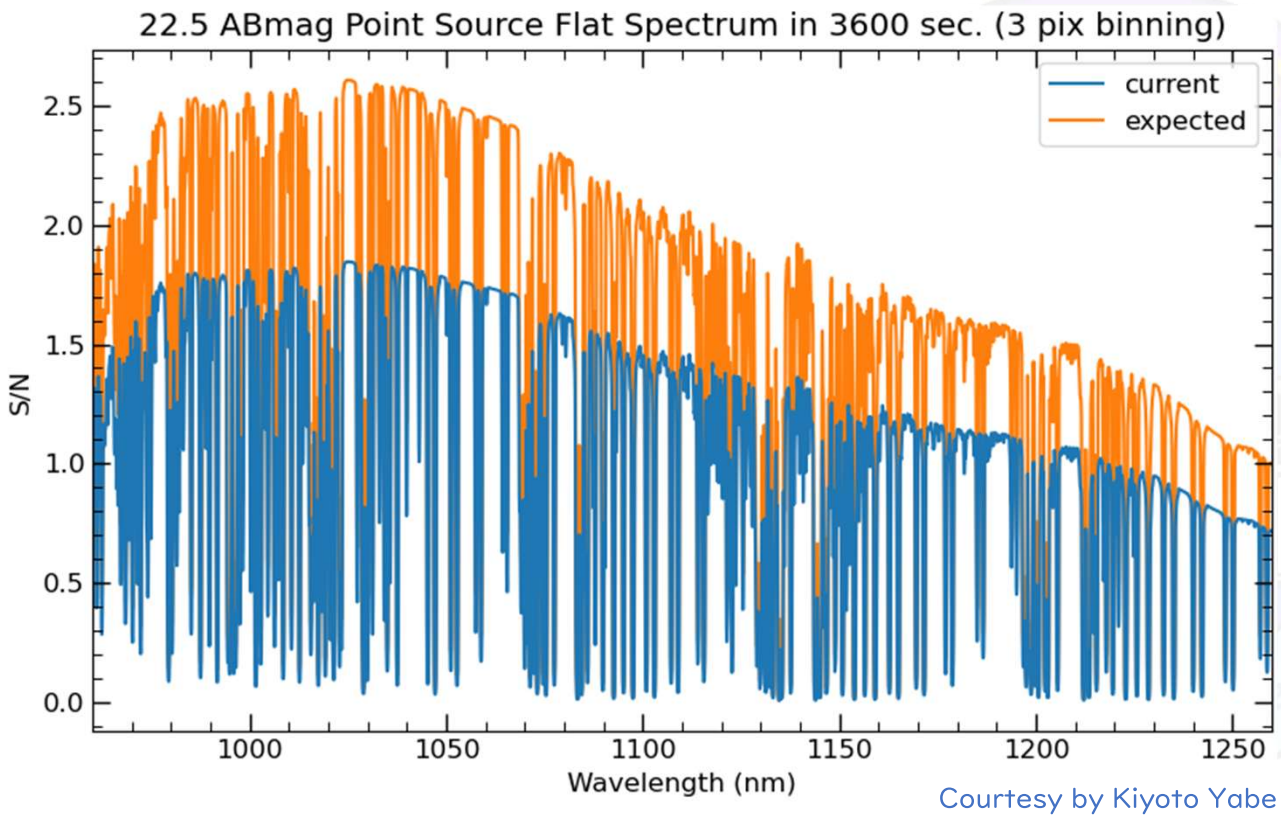
- NIR data analysis upgrade
  - nirDark (full up-the-ramp information) is being updated every run to chase the over-time variation.
  - Non-linearity correction in each pixel: applied before Up-the-ramp weighted summation
- Quick persistence correction
  - Modeling a single event of persistence after exposure and read-out based on the experimental data set, but the same decay parameter in a camera
  - Sum up the remaining persistence signals from each previous exposures in a certain time window and subtract it.
  - Still in a conceptual design phase, aiming implementation in a several-month time scale.

2D images before and after the non-linearity corrections



Examples of quick persistence correction



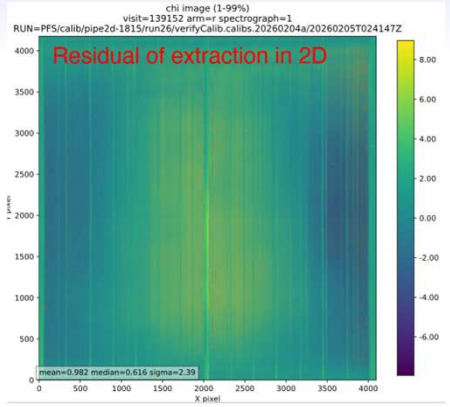


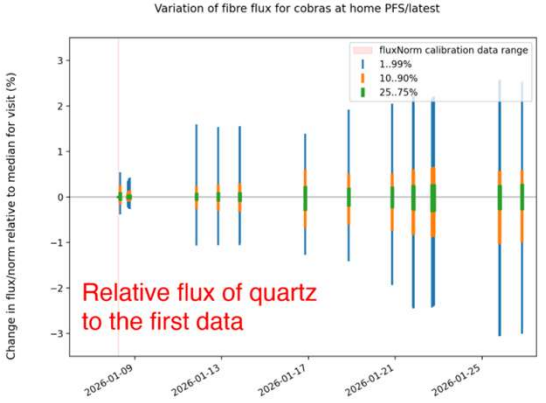
Courtesy by Kiyoto Yabe

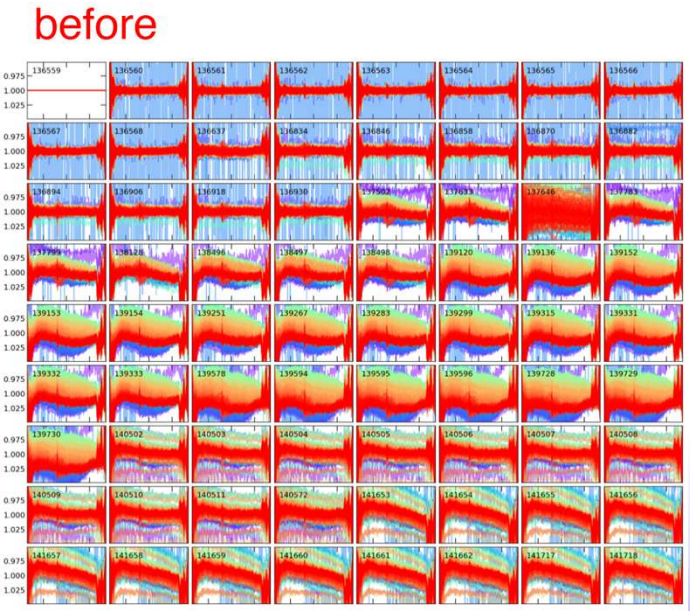
- Comparison of ETC results
  - "Expected": model based predicted spectrum
  - "Current": adjusted spectrum to match the current actual observations
- S/N of current data is 1.4 times lower than expected.
  - It requires 2 times of effective exposure time
  - Note that this includes various effects such as persistence, sky subtraction errors, etc.

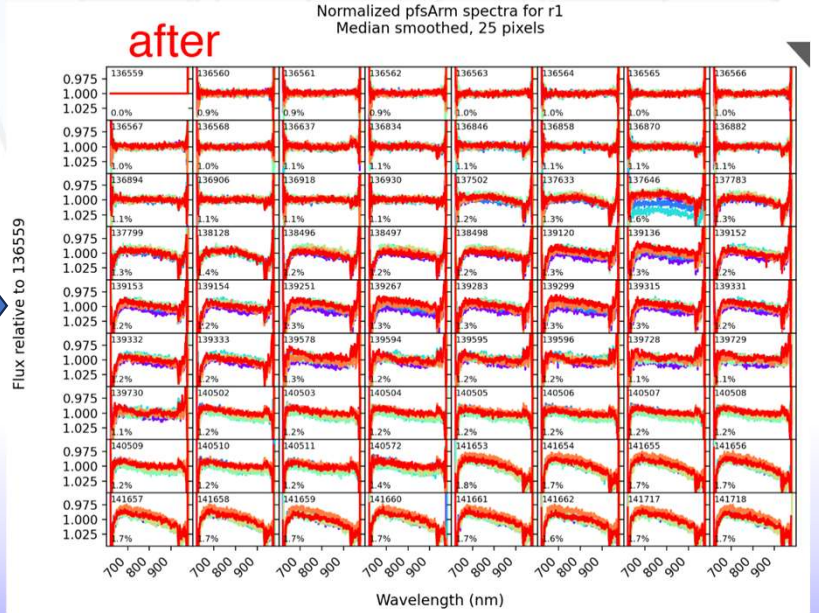
Fiber profile variation

- It was found that fiberNorm varies in Run 26 (Jan. 2026)
  - In the timescale of a couple of weeks.
  - A few % variation with about 20% fibers.
  - The position and widths of fiberProfile on the detectors has changed, and it caused the worse spectrum extraction.
  - A method is under development to collect the variation with kernel fitting.
  - The physical cause of fiberProfile variation is not clear yet.



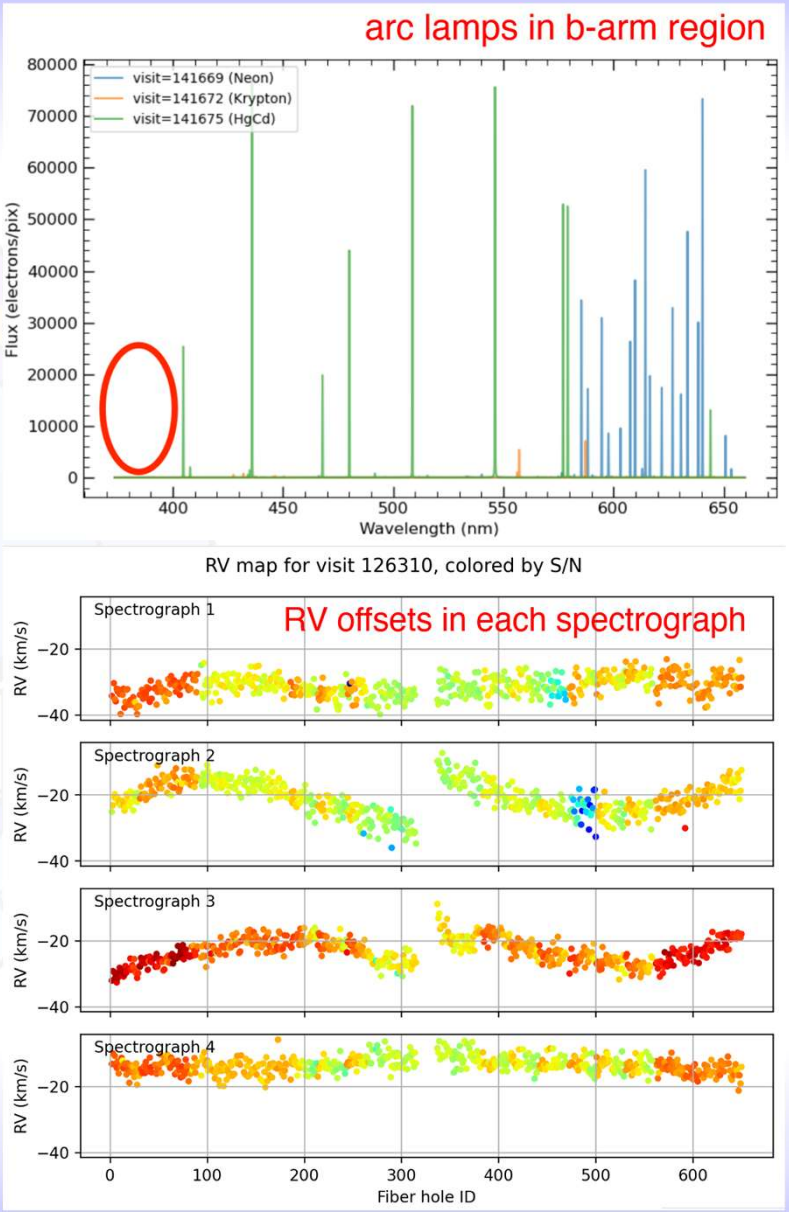






Wavelength Calibration

- The wavelength calibration accuracy has been a problem especially in b-arm.
  - There aren't enough number of emission lines for calibration especially below 400nm.
- The offsets of the radial velocity was measured by the comparison of twilight data and the solar spectrum. (by SSP GA WG).
  - Each spectrograph shows different pattern
  - In a spectrograph, the offset varies depending on positions on the fiber slits (SM2, 3)
- The upgraded Internal Illumination Source (IIS) equips He lamp (~389nm) and it can be also available.
- The improvement of the wavelength calibration in other bands is also planned.

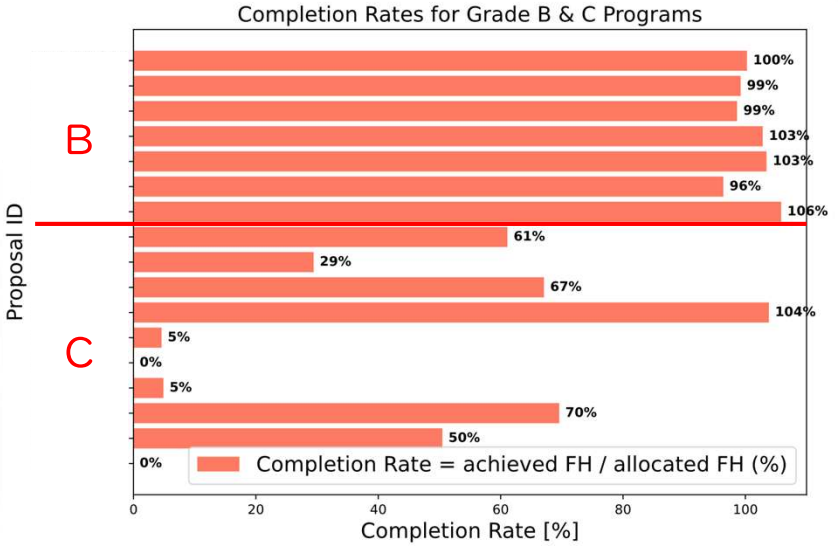


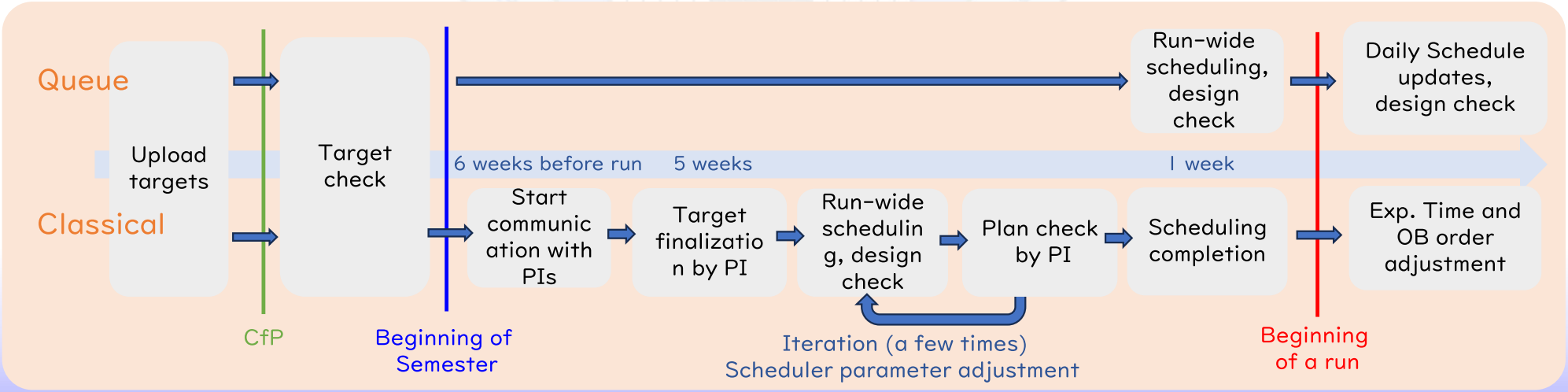
Open-use status and updates

Please also visit P34 by Arai-san

- S25B completion rate
  - Achieved about 100% with grade B programs
- S26A 3 runs, about 40 open-use nights
  - Classical: 10.5 Nights (5 Programs), queue: 15.1 nights, SSP: 14 nights
- Planning of classical nights requires many efforts.
  - Careful consideration on the possibility of queue is appreciated.
- Calibration data acquisition takes time.

  →The morning twilight time even on classical nights will be used for calibration data acquisitions.





Summary

- Instrument updates
  - N2 camera detector exchange is almost completed successfully.
  - Flux non-uniformity caused by insufficient fiber positioning accuracy still remains. Another component in the correction model will be tested in the next run.
  - AG mechanical support upgrade, CableC maintenance
  - CableB cleaner will be delivered to Subaru soon.
- DRP updates
  - NIR data analysis is getting improved. Non-linearity, quick persistence correction.
  - The correction method of fiberProfile variation is being developed.
- Open-use operation
  - Working smoothly so far, but work load is very heavy.
  - Morning twilight time will be used for calibration data acquisition on any type of observation.