P06

Current status of PFS DRP development and processing of engineering run data

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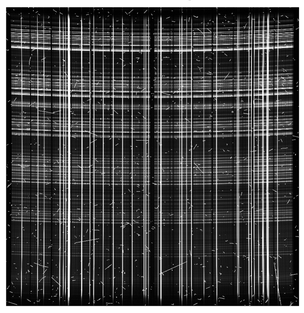
Abstract

PFS data reduction pipeline (DRP) processes raw 2D images on detectors of each spectrograph to extract calibrated 1D spectra and the physical quantities. Quality assessment (QA) for the processed data evaluates the accuracy of various calibrations, spectral extraction, and so on. The development has now shifted to a phase utilizing real data obtained in engineering observations. We are now putting more effort to establish a feedback mechanism for the development through the data processing and QA to improve DRP. We are also devising a way to release the processed products to the PFS collaboration, which is a good practice for the future data release of open-use observations including SSP. In this presentation, we report the current status of the development and the processing of engineering run data.

PFS DRP overview and development status

"2D-DRP"

2D raw images

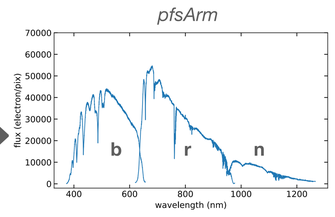


Reduction of 2D raw images to 1D calibrated spectra
- Basic instrumental signature removal (ISR)
- Wavelength calibration
- Spectral extraction
- Merge 3 arms
- Sky subtraction
- Flux calibration
- Coadd multiple visits

(work by Price, Le Fur, Lupton, et al.)

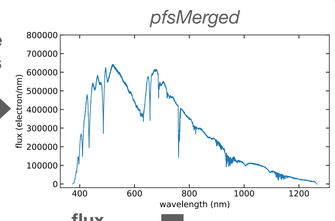
spectral extraction

pfsArm



merge 3 arms

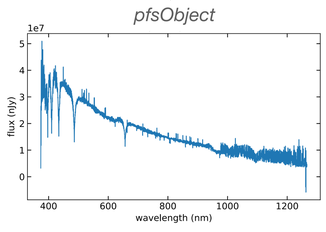
pfsMerged



flux calibration

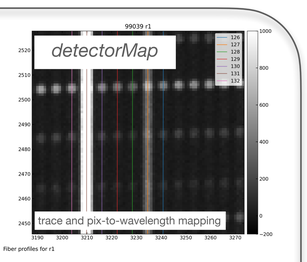
coadd

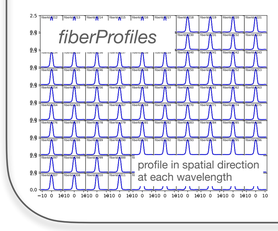
pfsObject



CALIB data

biases
darks

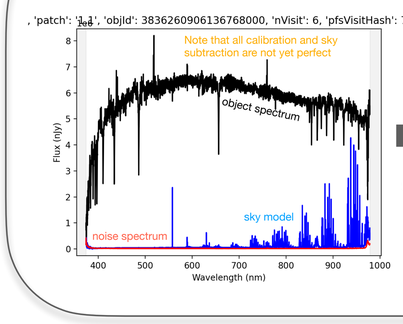




Basic ISR and spectral extraction are carried out to generate wavelength calibrated 1D spectra (*pfsArm*) in each camera using calibration data set (*CALIB*). *pfsArm*s of 3 cameras are merged into a single spectra (*pfsMerged*). Flux calibration is done and coadd multiple spectra into a single flux-calibrated spectrum (*pfsObject*).

"1D-DRP"

1D extracted spectrum (*pfsObject*)



spectral fitting

Measurement of physical quantities
- Object classification (stars/gals/QSO)
- Redshift of galaxies
- Emission line fluxes
- Radial velocity of stars
- etc.

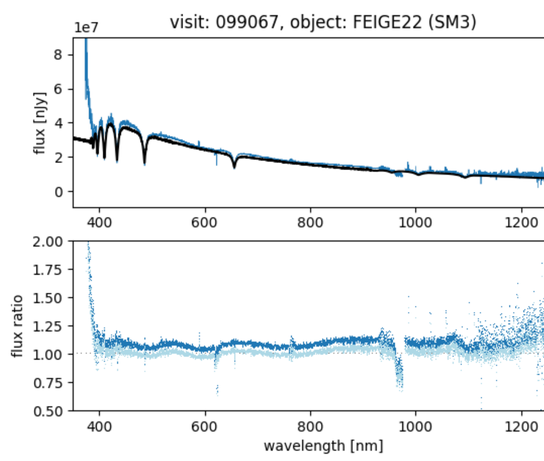
(work by Allaoui, Le Brun, et al.)

PFS DRP is consist of 2 different pipelines; one reducing raw 2D images to extract 1D spectra (2D-DRP) and one fitting 1D spectra to extract physical information (1D-DRP). Basic functionality of processing has been mostly developed, and now various tests with on-sky data are on-going. Currently improvement on generation of *fiberProfiles* and the extraction is one of the urgent tasks. Effort of sky-subtraction on 2D images by modeling the point-spread-function (PSF) on detectors is also on-going.

(work by Tanaka, Yamashita, Mineo, et al.)

QA of engineering run data

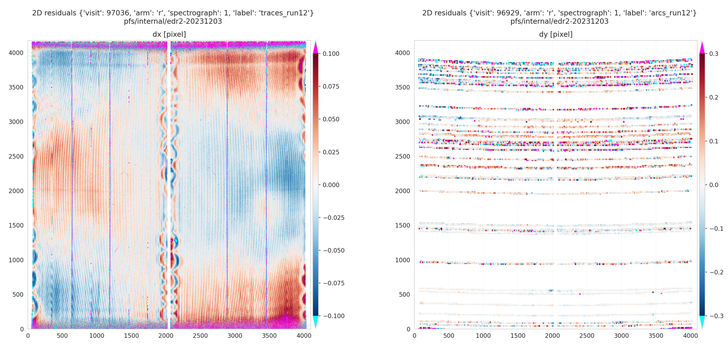
Quality checks of obtained and reduced data are on-going from various points of view (e.g., accuracy of wavelength solution, spectral extraction, flux calibration, and sky subtraction) along with development of various tools for these quality assurance (QA) in actual science operation. Here, some examples are shown.



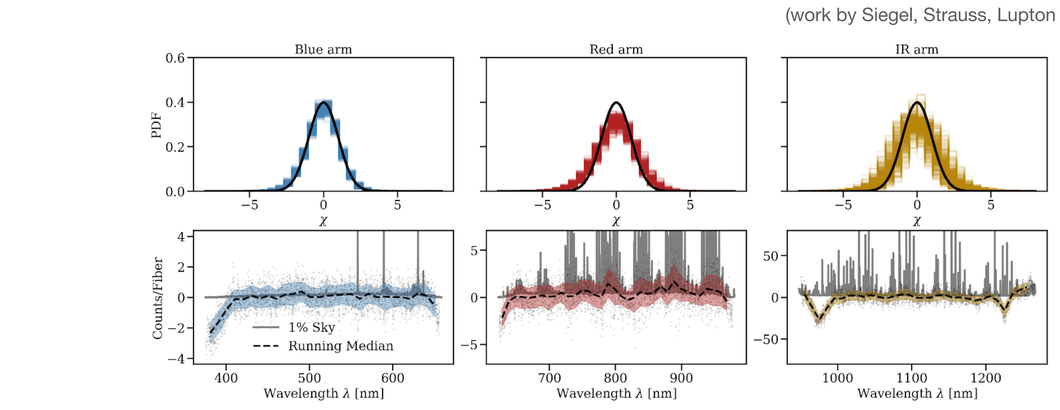
Example of flux calibration accuracy QA. This is a comparison of the observed (flux-calibrated) spectrum of a Calspec standard star to the actual spectrum. In some cases, a large discrepancy is seen but relative flux calibration is reasonably OK.

(work by Siegel, Strauss, Lupton et al.)

Example of residuals of detectorMap solution (measured position - modeled position in pix) on detector plane. In this case, the detectorMap solution is as good as ~0.1 pix in both spatial (left) and wavelength (right) direction but there is a spatial pattern left.

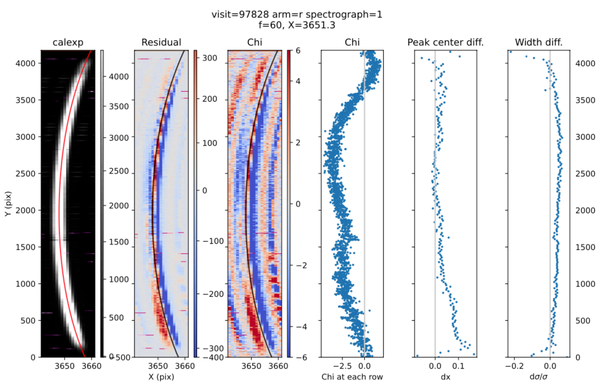


(work by Gee, Hamano, et al.)



Example of sky subtraction accuracy QA. Top panels show the chi distribution of the sky subtraction residual per pix for each fiber, which is *close* to a Gaussian distribution of N(0,1). Bottom panels show the averaged residual across the fibers with median (dashed) and 1σ interval (shaded region), which indicates slightly large deviation from 0 in sky lines busy wavelength region.

Example of residuals of spectral extraction (measured spectrum - extracted spectrum) in 2D). The QA tool also shows chi, spatial offset, and width of the profile as a function of wavelength.



(work by Hamano, et al.)

Data release to collaboration

Data taken during engineering runs are released to the PFS collaboration (Engineering Data Release=EDR). Currently, reduced products with basic and quick QAs are provided to registered users in the collaboration. Analysis interface (under Jupyter environment with 2D-DRP) to analyze the data, which is similar to environment the development team has been using, will be also provided.

- EDR1 (2023 Apr.)
- EDR2 (coming soon)
- EDR3 (TBD)
- ...

Be cautious about the fact that there remains many *known* issues, and feedback of many *unknown* issues to the development team is very helpful.

Future plan

Since the last 2 spectrographs (except of one NIR camera) were delivered and integrated on Nov. 2023, we have been taking calibration data to characterize all 4 spectrographs, which accelerates the DRP development with the *full* PFS system. Currently, raw images are automatically ingested into DRP data repository immediately once exposures are done, and basic ISR processing is also carried out. In future, we will automate all processing including the QA sending jobs to a cluster system which is currently under deployment in Hilo.

Let us know if you have any questions!