# Spectroscopic Data Reduction on your web browser

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## Abstract

The *goodman-pipeline* package provides all the functionality needed to reduce raw data obtained with the Goodman High Throughput Spectrograph on the Southern Astrophysical Research (SOAR) 4.1m telescope, and produce 1-D wavelength calibrated spectra. However, many science use cases, especially those targeting transients and variable objects, depend critically on having fully reduced spectra available shortly after the raw data are written to disk; the goodman-pipeline was not designed to fulfill this requirement. To address this issue we have developed a system that combines the data reduction elements of the goodman-pipeline with a Web API implementation within a web-based structure, to provide the user with immediate spectroscopic processing through a web browser.
This approach provides users with fully reduced spectra just seconds after the shutter closes, which could be critical when making real time decisions such as whether to obtain more data of the same object, switch to a different configuration or instrument, submit an observation request to another facility, or simply discard the object as one of no interest for the specific science case, and move to a new target.

## Architecture

The applications run in Docker containers and are built using Django and Django Rest Framework. The main components are:

**Private Web API**: Implements the data reduction routines developed in the goodman-pipeline package, as a web API. Does not require authentication, since it can only be accessed from another container within the same docker network. Also referred as data reduction API or reduction API, it is independent to allow expansion to other instruments.

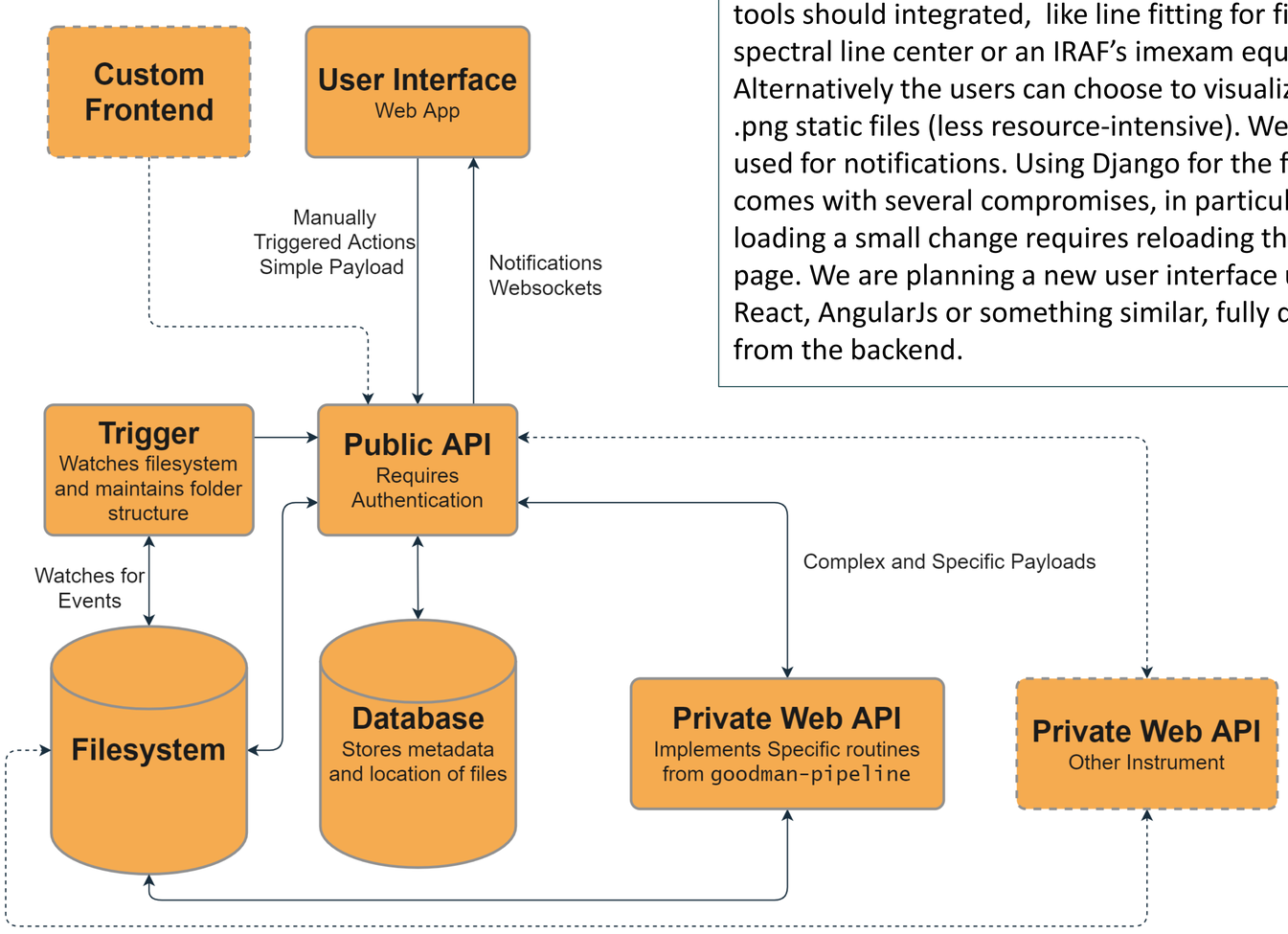
**Public Web API**: Provides several endpoints for very specific actions; it requires authentication. It doubles as a proxy for the private web API.

**Events Trigger**: Watches filesystem events, in particular, detects when a new file is written to a specific folder and triggers the appropriate actions, such as moving it into the corresponding new location.

## Operation

The Goodman Spectrograph is a highly configurable instrument. There are 20 pre-set modes that allow for full spectral range coverage at resolutions R~800-14000 depending on the grating. Though the Goodman-pipeline package is capable of handling data obtained with any of the pre-sets, we initially constrained the options to just 5 of the most used ones.

## General Workflow and Relations




## User Interface

Built using Django because of its integrated security. It's a responsive design using Bootstrap 4. For interactive visualization uses Bokeh, ideally some simple analysis tools should integrated, like line fitting for finding a spectral line center or an IRAF's imexam equivalent. Alternatively the users can choose to visualize data as .png static files (less resource-intensive). Websockets is used for notifications. Using Django for the frontend comes with several compromises, in particular speed; loading a small change requires reloading the whole page. We are planning a new user interface using React, AngularJs or something similar, fully decoupled from the backend.

POST /api/files/reduce/

```
{
    "file_id": "808"
}
```

Response from Private API

Request from public API to Private API


```
{
    "api_version": "0.1.0.dev1",
    "username": "storres",
    "file_id": "808",
    "error": "",
    "api_response": {
        "api_version": "0.1.0.dev1",
        "pipeline_version": "1.3.2",
        "error": "",
        "request_data": {
            "file_full_path": "/pipeline/data/20200131/RAW/0234_2019wcj-01-02-2020.fits",
            "reduced_data_path": "/pipeline/data/20200131/REDUCED",
            "master_bias_file": "/pipeline/data/20200131/CALIBRATIONS/master_bias_RED_SP_2x2_R03.89_G01.48.fits",
            "master_flat_file": "/pipeline/data/20200131/CALIBRATIONS/norm_master_flat_400_M2_GG455.fits",
            "technique": "Spectroscopy",
            "setttings": {
                "id": 10,
                "ignore_bias": false,
                "min_bias_files": 10,
                "ignore_flats": false,
                "min_flat_files": 10,
                "cosmic_ray_rejection": "dcr",
                "flat_normalization": "simple",
                "flat_normalization_order": 15,
                "saturation_threshold": 1,
                "extraction_type": "fractional",
                "background_threshold": 1,
                "correlation_tolerance": 15,
                "target_fit_model": "gaussian",
                "max_targets": 3,
                "technique": "Spectroscopy",
                "proposal": 10
            }
        },
        "overscan_region": "[3:24,1:948]",
        "trim_section": "[26:2055,2:948]",
        "slit_trim_section": "[1:2005,89:907]",
        "master_bias": "/pipeline/data/20200131/CALIBRATIONS/master_bias_RED_SP_2x2_R03.89_G01.48.fits",
        "master_flat": "/pipeline/data/20200131/CALIBRATIONS/norm_master_flat_400_M2_GG455.fits",
        "full_path": "/pipeline/data/20200131/REDUCED/cfzst_0234_2019wcj-01-02-2020.fits",
        "file_name": "cfzst_0234_2019wcj-01-02-2020.fits"
    },
    "reduced_file_id": 829
}
```



**Figure 1**. Screenshot of the current user interface. The **Observed Files** section lists all the raw files that the user has authorization to see, calibration files are available for everyone. The large card to the right contains a preview of the raw image and all the files that were produced from it, i.e. the reduced, all the extracted and wavelength calibrated.

## Contact

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