TripleSpec Focus Calculator

Release 1.0.3.dev0+g4501b8d.d20230425

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Apr 25, 2023

HOW TO INSTALL

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TEST COVERAGE

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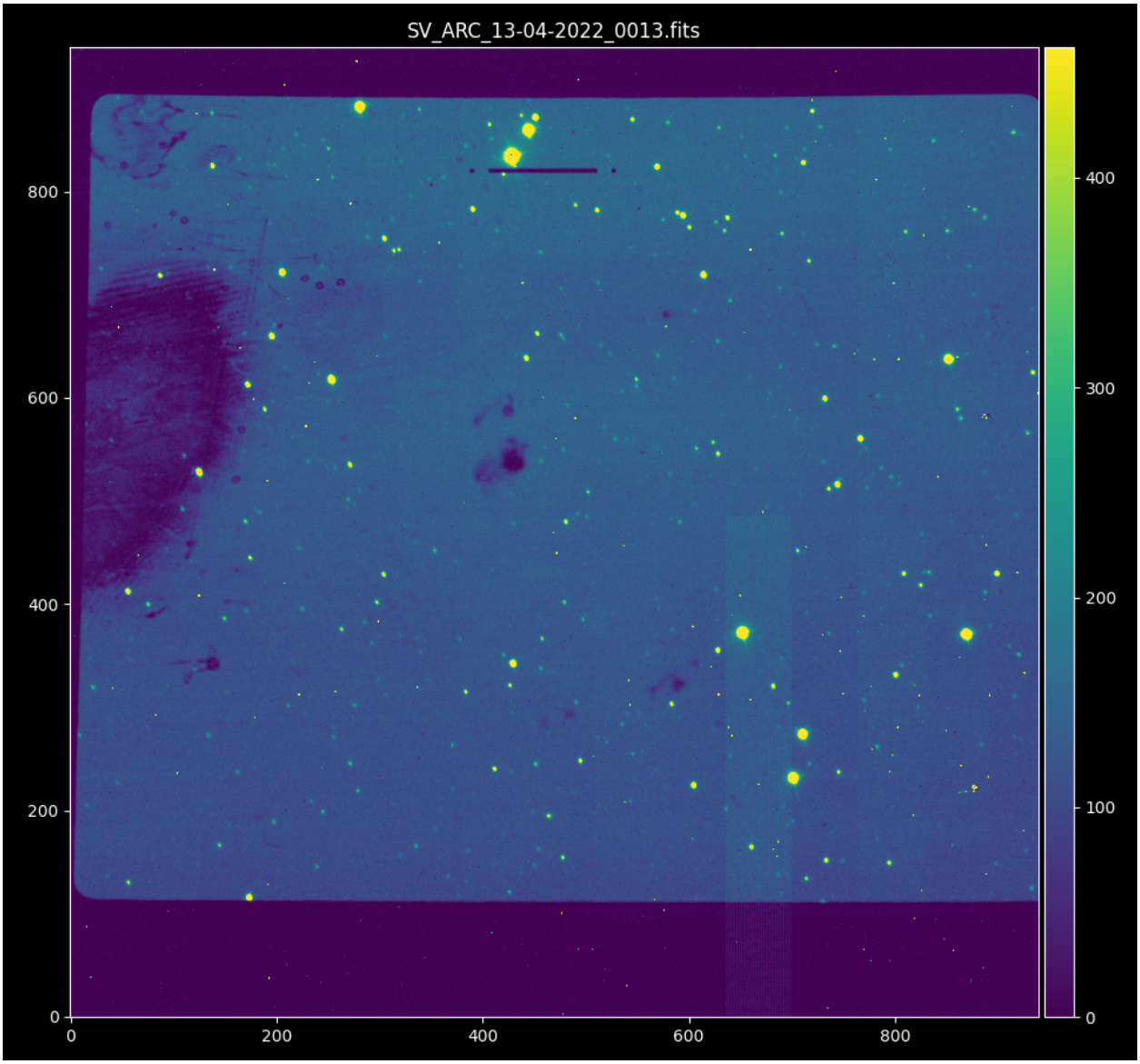
TWO

OVERVIEW

This is a tool to obtain the best focus value for the Slit Viewer camera of the TripleSpec NIR spectrograph. More information on TripleSpec can be found at NOIRLab Official Website

TripleSpec is a fixed configuration, this means that it has a fixed focus with respect to the telescope, but there is a slit viewing Camera that need focus adjustment.

A slit viewing image looks like this:



The slit is visible near the top center.

2.1 Install with pip

Note: We recommend using a virtual environment management system such as astroconda

To install you need to have at least python 3.8, it is tested with python 3.9 and 3.10 as well.

Just run the following command in a terminal.

```
pip install triplespec-focus
```

2.2 Data and Process Overview

You have seen already a sample of the data. You will get typically 10 to 15 images taken at different focus values.

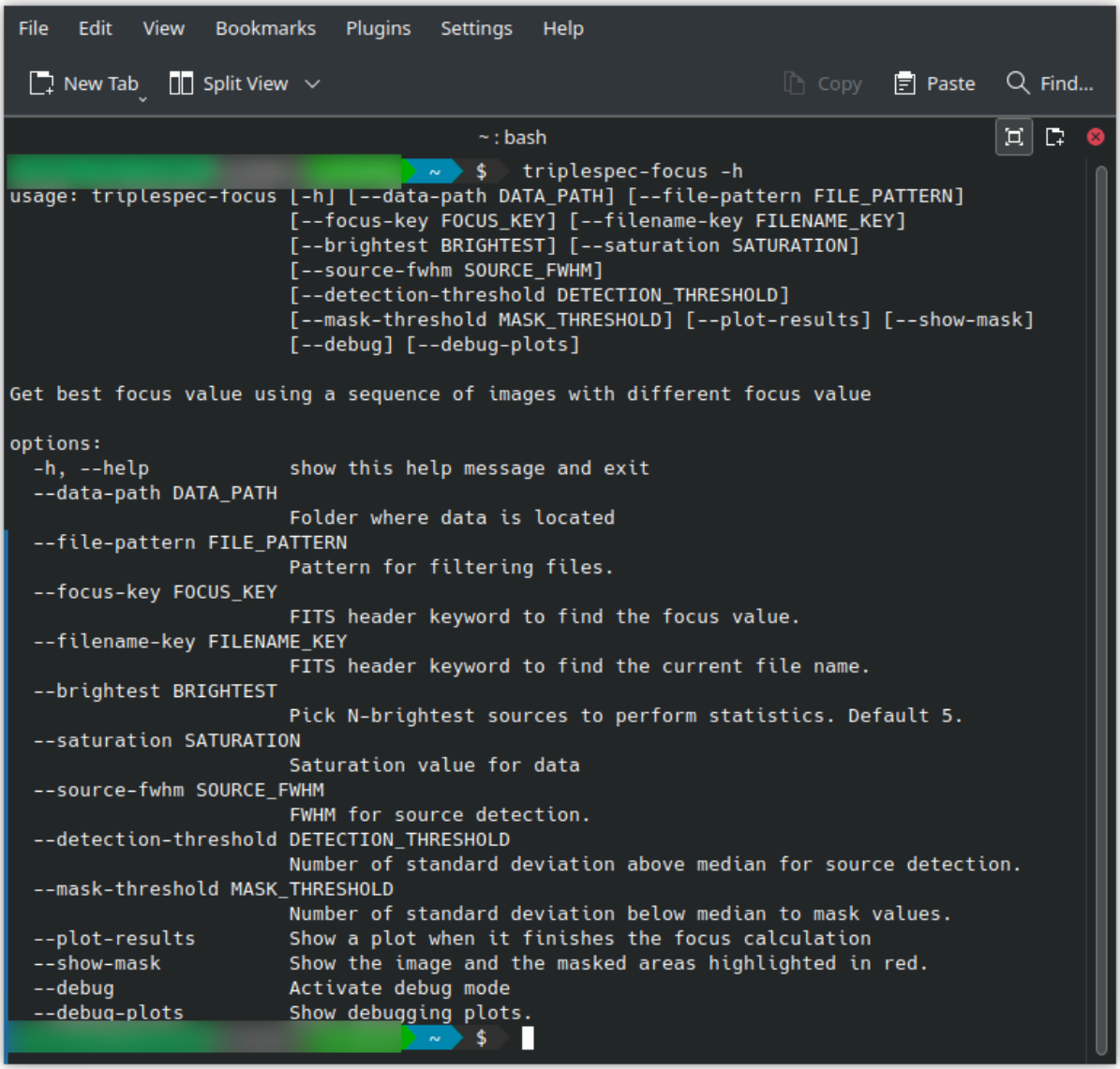
A quick examination routine will select the sharpest image by selecting the most intense image whose peak is also below the saturation level which for TripleSpec Slit Viewer camera is set to $40.000 ADU$

On this selected image the `DAOStarFinder` routing will be used to detect all the sources, the the most intense sources are selected to obtain the $FWHM$ using `ApertureStats` which is then fitted with a `Chebyshev1D` of order 6.

2.3 Use from terminal

The installation will create a terminal entrypoint `triplespec-focus`

Getting help is as easy as running with the `-h` argument:



If you run `triplespec-focus` from the same data folder as the location of the data, you don't need to specify any argument.

The arguments, default values and options are listed in the following table:

Table 1: Default values for arguments

Argument	Default Value	Options
`--data-path <input>`	Current Working Directory	Any valid path
`--file-pattern <input>`	`*.fits`	Any pattern
`--focus-key <input>`	`TELFOCUS`	Any valid FITS keyword
`--filename-key <input>`	`FILENAME`	Any valid FITS keyword
`--brightest <input>`	5	Any positive integer
`--saturation <input>`	40000	Any positive float
`--source-fwhm <input>`	7	Any positive float
`--detection-threshold <input>`	5	Any positive float
`--plot-results`	False	True
`--show-mask`	False	True
`--debug`	False	True
`--debug-plots`	False	True

After running the script with all desired parameters the result will be printed in the terminal.

2.4 Using as a Library

This library can be integrated into other software, just import `TripleSpecFocus` create an instance and call it.

```
from triplespec_focus import TripleSpecFocus

focus = TripleSpecFocus(debug=False,
                        date_key='DATE',
                        date_time_key='DATE-OBS',
                        focus_key='TELFOCUS',
                        filename_key='FILENAME',
                        file_pattern='*.fits',
                        n_brightest=5,
                        saturation=40000,
                        plot_results=False,
                        debug_plots=False)
```

Since in this case all the parameters are the default ones it is equivalent to do:

```
from triplespec_focus import TripleSpecFocus

focus = TripleSpecFocus()
```

Once the instance is created you can just call it or you can modify certain parameters.

```
results = focus()
```

or

```
from pathlib import Path

data_path = Path('./')

results = focus(data_path=data_path,
                source_fwhm=7.0,
                det_threshold=5.0,
                mask_threshold=1,
                n_brightest=5,
                saturation_level=40000,
                show_mask=False,
                plot_results=False,
                debug_plots=False,
                print_all_data=False)
```

Usually you would want to have more control so you can modify any parameters, but the most interesting part is that you can pass a list of files.

Using the same `data_path` variable created in the previous example

```
file_list = sorted(data_path.glob(pattern='*.fits'))
```

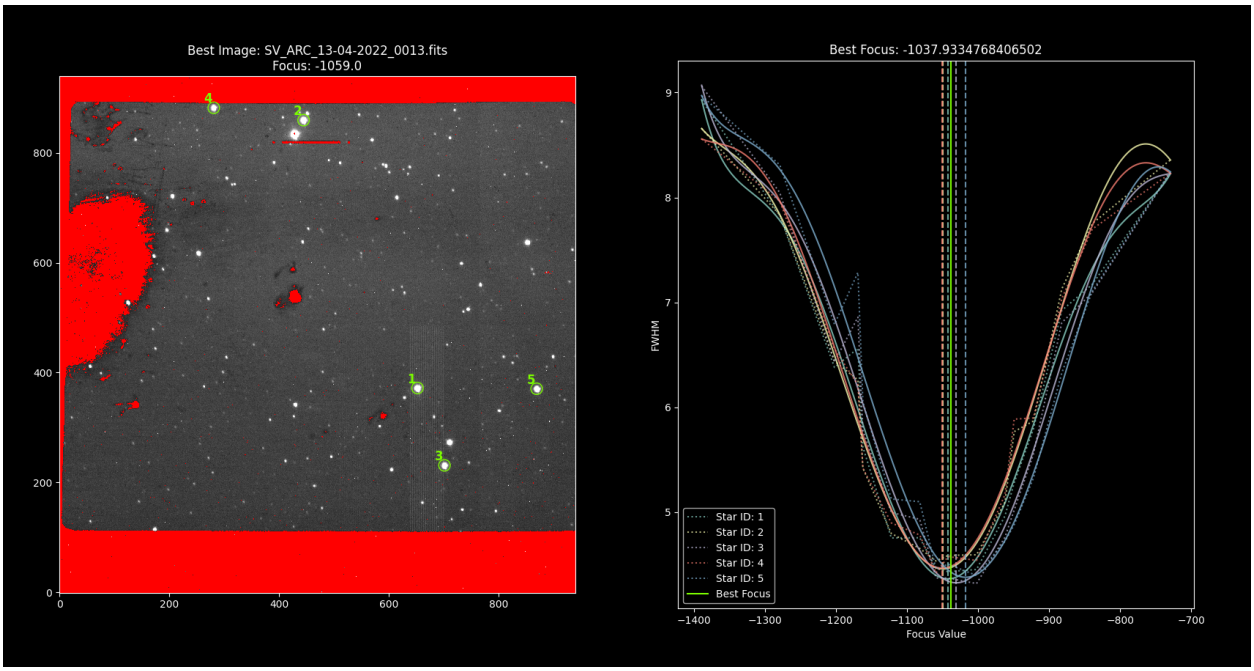
or create the list manually or programatically

```
file_list = [
'/path/to/file_001.fits',
'/path/to/file_003.fits',
'/path/to/file_007.fits',
'/path/to/file_008.fits',
'/path/to/file_010.fits',
'/path/to/file_012.fits',
]

results = focus(file_list=file_list,
                source_fwhm=7.0,
                det_threshold=5.0,
                mask_threshold=1,
                n_brightest=5,
                saturation_level=40000,
                show_mask=False,
                plot_results=False,
                debug_plots=False,
                print_all_data=False)
```

2.5 Interpreting the Results

Using the option `--plot-results` or set `plot_results=True` you will get the following information at the end.



The sources used are plotted to the left and to the right you get the data and fitted models plot. The dashed vertical lines represent the best focus for each individual star. The solid vertical line represent the best focus value.

The result is a dictionary.


```
{
    "date": "2022-04-14",
    "time": "2022-04-14T02:00:16.472",
    "mean_focus": -1037.9334768407,
    "median_focus": -1042.3437309744,
    "focus_std": 12.4463329703,
    "fwhm": 4.400507903,
    "best_image_name": "SV_ARC_13-04-2022_0013.fits",
    "best_image_focus": -1059.0,
    "best_image_fwhm": 4.451495851,
    "focus_data": [
        -1389.0,
        -1279.0,
        -1202.0,
        -1169.0,
        -1162.0,
        -1122.0,
        -1081.99,
        -1059.0,
        -1042.0,
        -1002.0,
        -962.0,
        -949.0,
```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```
        -922.0,
        -882.0,
        -839.0,
        -729.0
    ],
    "fwhm_data": [
        8.8346668203,
        7.9968682153,
        6.520501982,
        6.6366621644,
        5.6593294617,
        4.9156293967,
        4.8462257042,
        4.451495851,
        4.4960399387,
        4.4620697186,
        4.9432397845,
        5.3684107482,
        5.6873559877,
        6.8445617244,
        7.3650931863,
        8.2617132835
    ]
}
```


2.6 Change History

2.6.1 1.0.0 07-09-2022

- First functional version
- Uses ApertureStats to obtain sources' statistics
- Fully documented
- Fully tested

2.6.2 0.0.1.dev0 06-05-2022

- Initial release of a non-functional tool but will all the packaging setup.

2.7 License

CHAPTER

THREE

INDICES AND TABLES

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- modindex
- search