QuickStart guide

NOIRLab/IPAC/ESA/STScI/CfA

FITS Liberator

Version 4.0
Image Processing Software

FITS Liberator v4.0 - Quickstart guide

1. Introduction

New to FITS Liberator? If you are a new user of FITS Liberator and you want to know about the basics of image processing and understand the full workflow, we suggest you take a look at the materials developed

- [FITS Liberator Basics instruction video by Robert Hurt](#)
- [FITS Liberator Advanced instruction video by Robert Hurt](#)
- [Tour of the FITS Liberator Graphical User Interface](#)

Also, the v3 user guide is available at https://noirlab.edu/public/media/archives/techdocs/pdf/techdoc025.pdf.

2. Installation

Binaries for each operating system can be downloaded from:

https://noirlab.edu/public/products/applications/app001/

You will find the installers for Windows, MacOSX, and Linux. Command-line interface (CLI) is included with the installed version.

a. Windows

FITS Liberator 4 has been tested on Windows 10 64 bit, but it should work in other versions. The installation process is very straightforward and you will get the software running after the install process finished.

Download the installer for Windows, just double-click over the exe downloaded file
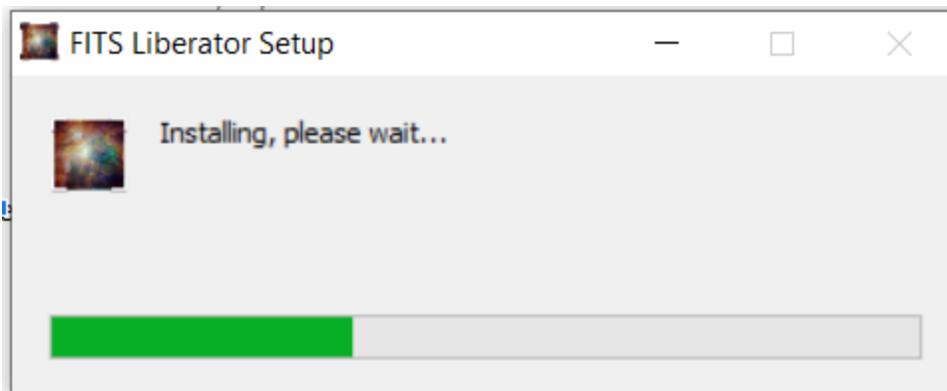
💡 Antivirus Warning: Some antivirus software can show warnings when opening the installer, even Windows SmartScreen. The official downloaded version is perfectly safe and thus warnings can be ignored.

You can set the path for access to the CLI using this location:

C:\Users\{USER}\AppData\Local\Programs\fitsliberator\fitscli\win

{USER} is the username that was used during the install process.

Windows version includes a TAB button that allows direct access to a console where the CLI is available.

b. MacOSX

FITS Liberator 4 has been tested on Mojave, Catalina, and Big Sur.
Download the DMG File, double click over the file to mount the image,
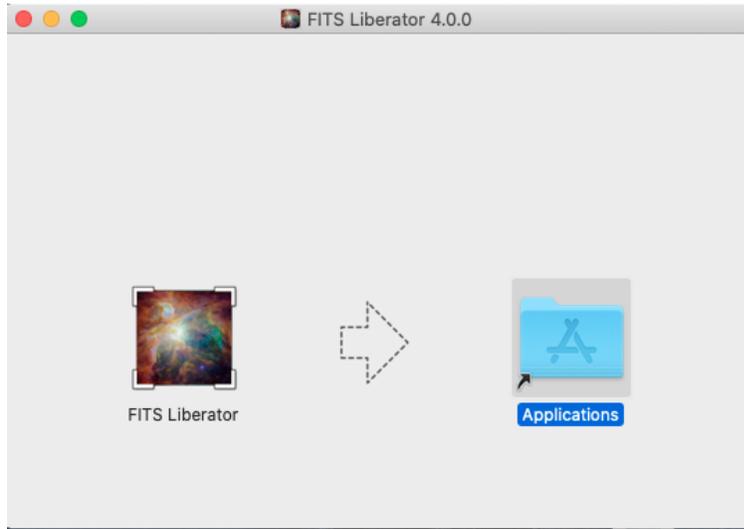
Just drag the FL4 Icon to the Applications folder and drop it.

You can set the path for access to the CLI using this location:

/Applications/FITS Liberator.app/Contents/fitscli/mac/bin

export PATH=$PATH:/Applications/FITS Liberator.app/Contents/fitscli/mac/bin

c. Linux

FITS Liberator 4 has been tested on Ubuntu 18.04, 20.04, but there are available binaries for RedHat-based distributions (rpm) and other distros (snap).
Download the deb package, you will need to install the required libraries, libvips, and cfitsio using the commands:

sudo apt install libvips

sudo dpkg -i fitsliberator_4.0.0_amd64.deb

```
ubuntu@ubuntu:~/Downloads$ ls
fitsliberator_4.0.0_amd64.deb
ubuntu@ubuntu:~/Downloads$ sudo dpkg -i fitsliberator_4.0.0_amd64.deb
Selecting previously unselected package fitsliberator.
(Reading database ... 190886 files and directories currently installed.)
Preparing to unpack fitsliberator_4.0.0_amd64.deb ...
Unpacking fitsliberator (4.0.0) ...
Setting up fitsliberator (4.0.0) ...
Processing triggers for gnome-menus (3.36.0-1ubuntu1) ...
Processing triggers for desktop-file-utils (0.24-1ubuntu3) ...
Processing triggers for mime-support (3.64ubuntu1) ...
Processing triggers for hicolor-icon-theme (0.17-2) ...
```

Libvips: Install Libvips is a must for using FITS Liberator, cfitsio is usually installed as a required package. Some versions require the use of the "universe" repository before installing libvips.

You can set the path for access to the CLI using this location:

/opt/FITS\ Liberator/fitscli/linux/

export PATH=$PATH:/opt/FITS\ Liberator/fitscli/linux/

3. FITS Liberator basics

FITS Liberator has been designed using two main components:

CLI: This is the Command Line Interface, which does most of the image processing, it runs in the background when the user is working on the visual interface. The CLI can be used to do batch processing of FITS files.

GUI: Is the Graphic User Interface, show the visual processing calling in the background the CLI for doing the processing, those giving to the user the preview of the processing.

a. User Interface (aka the GUI)

The new interface keeps almost the same layout as FL3, some of the functions have been simplified to get a cleaner workspace.

The TABS Area

The TABS allows selection between two work areas, the main area is called "Image Processing", here you can get a preview of the file to be processed. The TAB "FITS Header" shows the header of the file in a way that text can be copied for use in another astronomy software.

Image Processing

⌂	Restore the image to the initial size and position
⛶	Open the image in full-screen mode
🔍⊕	Zoom in to the image
🔍⊖	Zoom out to the image
🖊	Pick the black level from one pixel in the image
🖊	Pick the white level from one pixel in the image
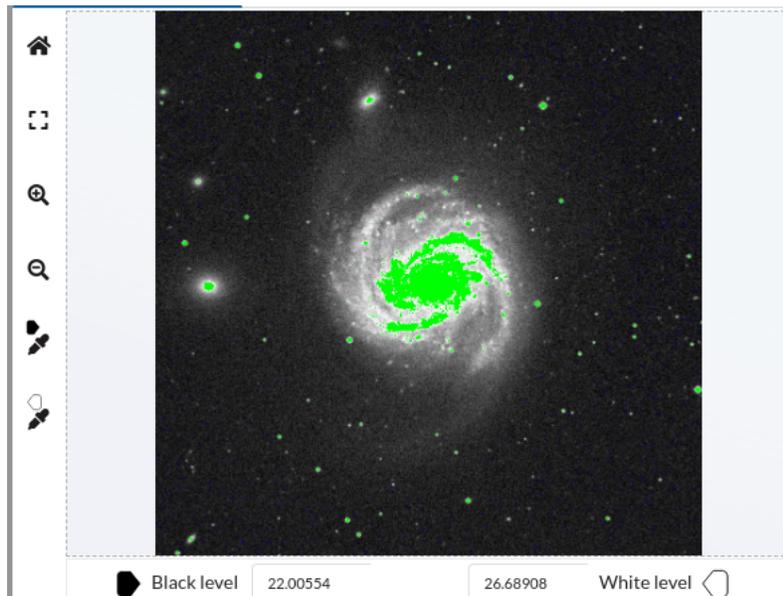
On the image preview, you will pan the image when clicking & moving, you can use the scroll function to zoom in and out.

Histogram Area
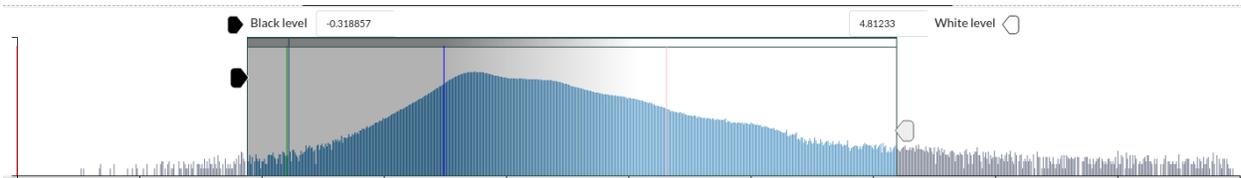
The histogram area shows the statistics of the image, between the minimum and maximum value of the image points. You can drag the black and white level over the histogram and get a preview of the image processing result.

You will get color line markers for the Zero, Mean, Background level, and Scaling Peak Level for the image according, using the colors described below:

Dark Mode

This version includes a Dark mode to reduce the light emitted and get an easy way of getting the focus on the image preview during iterations of changes to the image. Use the light/dark mode switch for setting your preferred style.
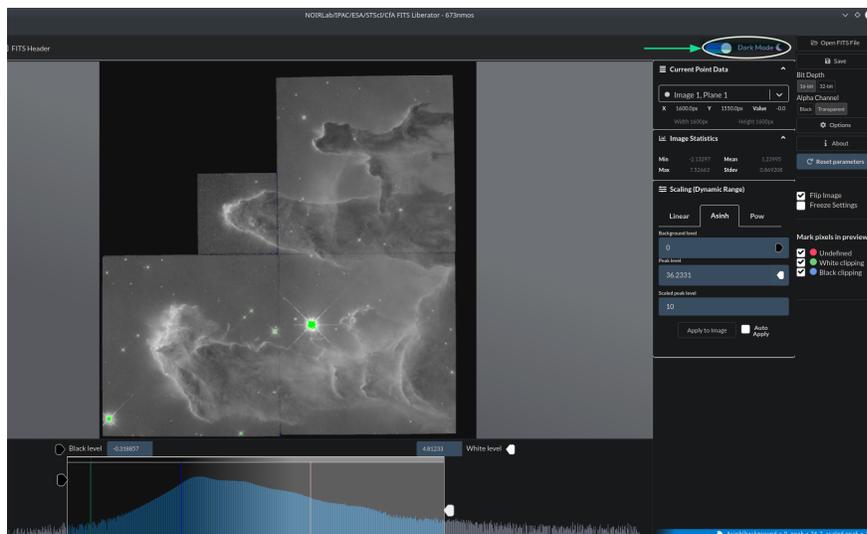
Point Info and Plane / Image Selection
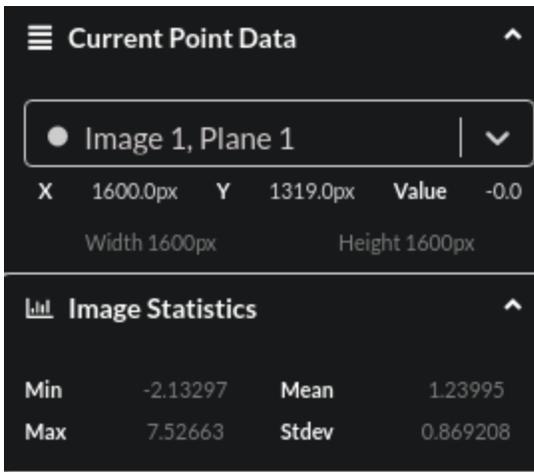
Use the Combo box for selecting the plane and image available on the FITS file for doing the processing.

X, Y, and Value show the coordinates and value of the point on the image where the cursor is located. Width and Height show the specific dimensions of the current image.

Image Statistics shows the minimum, maximum value, the mean, and the standard deviation as a reference to make it easiest to select the parameters on each iteration.

Scaling
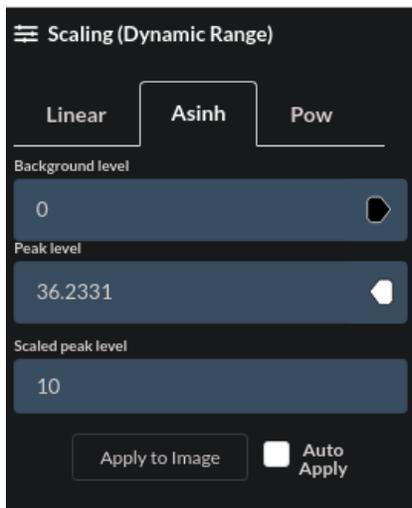
Use the scaling controls to set the function and parameters for the image processing. You can check the "Auto Apply" option if you want to Apply the scaling function and parameters each time you change a value.

Auto-Apply: Keep in mind that each time you apply changes to an image the CLI is called in the background, on very big images it could be faster to keep the Auto-Apply function disabled and use the "Apply To Image" button.

File Options
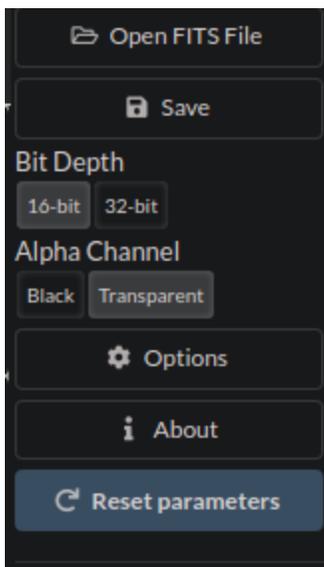
Use the file options for opening and export the processed files.

Use the Open FITS File for choosing the file to be opened, using local files you will get better performance. Supported extensions are: .FIT, .FITS, .FZ.

Compressed FZ Files: Unlike version 3, you won't need to rename the FZ file to Fits file, in fact, if you keep the fz extension the CLI will use CFITSIO funpack to get more accurate values for the uncompressed file.

Use the Save button for exporting the final TIFF when you are happy with the preview result. The exported file can be 16 or 32 bits. The undefined values can be saved as black points or as transparent, this can be selected using the Alpha Channel selector.

The options show information about the marking lines and allow a cache-clearing, releasing disk space used by previous processing tasks.

The About button shows information about the version and the development team.

The Reset Parameters reset the Black Level, White Level, and scaling function/parameters to the first state after opening the image.

Other Options
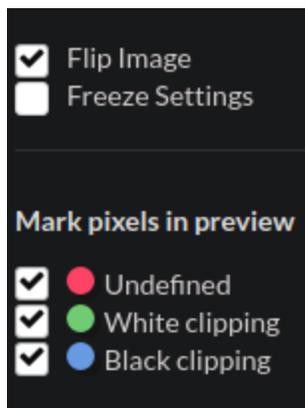
The checkboxes are described below:

- Flip: Flips vertically the image, set to true by default.
- Freeze Setting: Keeps the parameters and scaling function set as the current values even if you open other files.
- Mark Pixels Undefined: Mark in red the pixels that will be exported as Black or Transparent (according to the Alpha Channel selector).
- White clipping: Mark in green the pixels that will be clipped due to the White level value set.
- Black clipping: Mark in blue the pixels that will be clipped due to the Black level value set.

Status Bar
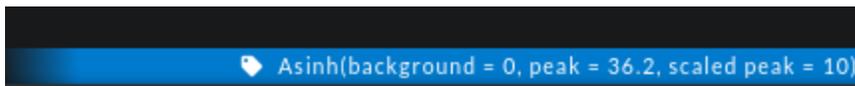
The status bar (to the right bottom) shows the last scaling function applied with the selected parameters.

Scaling Functions

This version only has three main scaling functions that can be applied to the image, each function has its own parameters described below:

- **Linear:** Apply a linear scaling using the Peak level as the main parameters.
- **Asinh:** Apply an inverse hyperbolic sine using Background level, Peak Level, and Scaled Peak Level as parameters
- **Pow:** Apply a Power function using Background level, Peak Level, and exponent, the exponent can be by example 0.5 for doing a square root.

4. The Command Line interface (CLI)

This new version of the FITS Liberator includes a Command Line Interface (CLI), thus providing the ability to process FITS files without using the graphic interface, this can be useful when the parameters for processing are known or you want to speed up the image processing iteration.

```
-i, --infile arg            FITS Input File
-o, --outfile arg           TIFF Output File
-s, --stretch arg           Stretch math function (asinh,linear,pow,log)
                            (default: linear)
-e, --exponent arg          Power Function exponent (default: 0.5)
-k, --backgroundlevel arg   Background Level (default: 0)
-p, --peaklevel arg         Peak Level (default: 1)
-S, --scaledpeaklevel arg   Scaled Peak Level (default: 100)
-b, --blacklevel arg        Black Level (default: 0)
-w, --whitelevel arg        White Level (default: 1)
-d, --depth arg             Bit depth (8, 16 or 32) (default: 16)
-I, --image arg             Image index for multi-image files (default: 1)
-z, --plane arg             Plane index for multi-plane images (default: 1)
-f, --flip arg              Flip the image vertically (default: 1)
-F, --outformat arg         Output format 1=tiff, 2=png (default: 1)
-q, --quiet arg             Quiet execution without echo (default: 0)
-a, --autolevels arg        Autoselect white & black levels using statistics
                            (default: 0)
-u, --undefined arg         Alpha channel for undefined values
                            (0=black,1=transparent) (default: 0)
-x, --ispreloader arg       Run CLI in preloading mode (used by GUI Only)
                            (default: 0)
-B, --bins arg              Number of bins for histogram data (used for
                            preloading) (default: 1000)
-Z, --deepzoom arg          Generate deepzoom (used for big images on the
                            GUI) (default: 0)
-P, --progress arg          Print image operation progress  (default: 0)
-X, --fastmode arg          Faster processing (reducing quality)  (default:
                            0)
-m, --memory arg            Max memory usage (default: 2048)
```

Each parameter can be used with the full name (example: --exponent) or the single letter (example: -e), the main parameters are described in the next table:

Parameter	Description
-i, --infile	The name of the FITS input file
-o, --outfile	The name of the TIFF output file (can be PNG too)
-s, --stretch	Set the scaling function between asinh, linear and power (pow)
-k, --backgroundlevel	Set the background level for asinh and power functions.
-p, --peaklevel	Set the peak level for linear, power, and asinh functions.
-S, --scaledpeaklevel	Set the Scaled peak level for the asinh function.
-b, --blacklevel	The black level selected, thus clipping pixels on the image below this value.
-w, --whitelevel	The white level selected, thus clipping pixels on the image over this value.
-I, --image	The number of the image, 1-n indexed value, 1 is the first image.
-z, --plane	The plane to do the processing, 1-n indexed value, 1 is the first plane.
-P, --progress	Show progress status on each stage of processing, 1=show, 2=hide
-F, --outformat	You can choose the output file format: 1=tiff, 2=png, tiff is the default.
-m, --memory	Limit the usage of the memory during processing
-f, --flip	1 or 0 value indicating if the image must be flipped vertically, 1=flip, 0=keep

Memory usages: The "--memory" parameter allows increase the performance, if you have enough memory setting to higher values make the processing faster, low values make the CLI use the disk for processing the big image slowing the speed of processing.

Examples

Linear Stretch

./fits --infile 673nmos.fits --outfile test2.tiff -s linear -e 1 -k 3.71 -p 21.76 -S 10 -b 2.45 -w 37.55

```
# Power Stretch (1/2)

./fits --infile 673nmos.fits --outfile test3.tiff -s pow -e 0.5 -k 3.71 -p 21.76 -S 10 -b 1.57 -w 6.13


# Asinh(asinh) Stretch, output to PNG, no flip

./fits --infile 673nmos.fits --outfile test4.png -s asinh -e 1 -k 3.71 -p 21.76 -S 10 -b 1.15 -w 2.68 -F 2 -f 0

# BATCH PROCESSING: Processing multiple FITS files with the same scaling function and parameters

# Windows>

for %%f in (*.fits) do (

  FOR /f "tokens=1,2 delims=." %%a IN ("%%f") do (

    fits.exe  --infile  %%f -o %%a.tiff -s asinh -e 1 -k 3.7 -p 26.5 -b 1.2 -w 3.23  -S 10 -u 1 -F 1

  )

)

# Mac & Linux:

for file in *fits;

        do fits --infile $file -o $file.tiff -s asinh -e 1 -k 3.7 -p 26.5 -b 1.2 -w 3.23  -S 10 -u 1 -F 1;

done
```

5. Acknowledgments

FITS is an abbreviation for Flexible Image Transport System and has been a standard since 1982 and is recognized by the International Astronomical Union.

Version 4.0 is being developed in a partnership between NSF's NOIRLab, the Infrared Processing and Analysis Center (IPAC Caltech), the European Space Agency (ESA), the Space Telescope Science Institute (STScI) and the Harvard-Smithsonian Center for Astrophysics (CfA).

The NOIRLab/IPAC/ESA/STScI/CfA FITS Liberator uses NASA's CFITSIO library, Libvips, OpenSeaDragon, ReactJS, ElectronJS, and D3.js.

The team that produced the NOIRLab/IPAC/ESA/STScI/CfA FITS Liberator consists of:

Development, CLI and GUI: Juan Fajardo & David Zambrano Lizarazo

Scientific, technical support and testing: Robert Hurt

Technical Project Manager: Javier Enciso

Project Executive: Lars Lindberg Christensen

6. Contact and Support

For support, bug reporting, and ask for new features please send an email to:

fitsliberator@noirlab.edu

Full source code is available at:
- CLI https://gitlab.com/noirlab/fits-liberator-cli
- GUI https://gitlab.com/noirlab/fits-liberator-gui