

Installing Muphoten

For your convenience, we recommend that you download Anaconda in order to create custom Python environments.

Go to <https://www.anaconda.com/products/distribution> download the Anaconda distribution (Anaconda3-2022.05-Linux-x86_64.sh at the time of writing)

In Windows it works as

```
cd /tmp
```

```
curl -O https://repo.anaconda.com/archive/Anaconda3-2022.05-Linux-x86\_64.sh
```

Move it to your ~/Documents folder

Open a terminal and execute the following commands:

```
bash ~/Documents/Anaconda3-2022.05-Linux-x86_64.sh
```

```
source .bashrc
```

```
conda create -n grandma python=3.8
```

```
conda activate grandma
```

```
conda install -c conda-forge astromatic-source-extractor astromatic-scamp astromatic-psfex  
astromatic-swarp
```

This creates a new conda environment in which relevant Python libraries will be installed. (If you wish to leave this conda environment, use the command “conda deactivate”)

If you recently installed your OS or don't use it frequently, we advise you to look into the Known Installation Issues section to check if essential packages are installed.

It is then time to install CFitsio, go to <https://heasarc.gsfc.nasa.gov/fitsio/> and download the latest version (cfitsio-4.1.0.tar.gz at the time of writing). Extract the compressed folder in

```
tar -xzf cfitsio-4.1.0.tar.gz
```

```
~/Documents
```

Go back into your terminal and execute the following:

```
cd ~/Documents/
```

```
mv cfitsio-4.1.0/ cfitsio
```

```
cd cfitsio/
```

```
./configure
```

```
make
```

```
make install
```

If problem with WINDOWS go to “Known issues” to install additional libraries

And perform

```
./configure --prefix=/usr/local
```

```
make
```

```
make install
```

Now comes the time to install the HOTPANTS software. Execute in your terminal:

```
conda install git
cd ~/Documents/
git clone https://github.com/acbecker/hotpants.git
cd hotpants/
make all
```

```
sudo cp hotpants /bin/
```

Finally, you can install MUPHOTEN by executing the following:

```
cd ~/Documents/
git clone https://gitlab.in2p3.fr/icare/MUPHOTEN.git
cd MUPHOTEN/
pip install .
```

Alongside MUPHOTEN, we advise you to install SaoDS9, in order to read and display FITS files:

```
sudo apt install saods9
```

Known Installation issues

If you just installed your OS, we advise you to execute the following commands in a terminal in order to install essential packages. Otherwise, these are only suggestions in case of errors arising during installation: when errors suggest a missing package use the corresponding command.

```
sudo apt install build-essential      (gcc compiler)
sudo apt-get install pkg-config
sudo apt-get install zlib1g-dev
sudo apt-get install gfortran
```

```
sudo apt install libgl-dev libglu-dev libglib2.0-dev libsm-dev libxrender-dev libfontconfig1-dev
libxext-dev
```

```
sudo apt-get install libcfitsio-bin   (fpack funpack)
```

You can check the version of the installed gcc compiler with the command `gcc --version`

With recent versions of Ubuntu, you may encounter an error when trying to compile HOTPANTS with “make all”, with a message “error: ld returned 1 exit status”

This can be fixed by adding a flag in the Makefile. To that end, execute the command lines:

```
cd ~/Documents/hotpants/
vi Makefile
```

Then find the line COPTS = -funroll-loops -O3 -ansi -std=c99 -pedantic-errors -Wall -I\$(CFITSIOINCDIR) -D_GNU_SOURCE, change it into:
COPTS = -funroll-loops -fcommon -O3 -ansi -std=c99 -pedantic-errors -Wall -I\$(CFITSIOINCDIR) -D_GNU_SOURCE, and save the modification.

Now go back to your terminal and execute:

```
make clean  
make all
```

Using Muphoten

Muphoten relies on configuration files for each telescope, The two most important ones are "muphoten.hjson" and "hotpants.hjson". The former contains the parameters for muphoten and the latter controls the parameters of HOTPANTS, the software responsible for template subtraction.

There are six scripts for Muphoten :

mu_bkg_subtraction :

- images IMAGES Path where the images are stored.
- telescope Alias for the available telescopes.
- keep-old Keep previous results
- skip-processed, --skip
Skip already processed files
- save-png Save the background images as fits and png. Default: False
- save-fits Save the background images as fits and png. Default: False

Script estimating the background and subtracting it. Can save the background as a .png file or as a .fits file. The results will be saved in a repertory called ./results/NAME_IMAGE/background

mu_psf :

- images PATH_IMAGE Base path to repertory containing the images to analyse.
- keep-old, --keep Keep previous results
- skip-processed, --skip
Skip already processed files
- telescope Alias for the available telescopes.
- conv-filter CONVFILTER
Corresponds to FILTER_NAME keyword for sextractor(without .conv).
- use-weight If set, use weight map. Must be same name as image with .weight.fits extension. (Default: False)
- verbose {QUIET,NORMAL,FULL,LOG}
Level of verbose, according to astromatic software. (Default: NORMAL)

Script for estimating the PSF in an image with PSFex. The results will be saved in a repertory called ./results/NAME_IMAGE/psf

mu_sanitise :

--images IMAGES Path to images.
--telescope TELESCOPE
Telescope that acquired the images.
--filter FILTER Filter used to acquire the images.

Script removing keyword not used by muphoten in the HEADER of a fits file. It also adds the keywords FILTER and TELESCOP in the header for other scripts.

mu_mag_lim :

--images IMAGES Path to images.
--outname OUTNAME Name of the output file.
--telescope TELESCOPE Telescope that acquired the images.
--precision PRECISION
Bin size for the estimation
--lower-mag LOWER_MAG
Lower bound for the limit magnitude.
--upper-mag UPPER_MAG
Upper bound for the limit magnitude.
--threshold THRESHOLD
The threshold, where the limit magnitude is considered reached

Script for computing the limiting magnitude in images. This is done by computing the ratio in magnitude bins of the number of stars detected in the images divided by the number of stars detected in Pan-STARRS in the same FoV. After the ratio goes below THRESHOLD, the limiting magnitude is reached. Some developments are ongoing for these estimations, more techniques will be implemented at some points.

mu_photometry :

--coord COORD Coordinates file's path.
--images IMAGES Path to images.
--outname OUTNAME Name of the output file.
--telescope TELESCOPE Telescope that acquired the images.
--catalog {Pan-STARRS,USNO-B1,Gaia,SDSS,skm}
Catalog to use for the calibration.
--photo {kron,iso,fixed}
Type of photometry. Use muphoten configuration file to modify the radius of the isophote or the factor used for the fixed apertures. Default is iso.
--sub-method {sub,nosub}
Whether HOTPANTS has been used to perform template subtraction (sub) or not (nosub).
--keep-old, --keep Keep previous results
--skip-processed, --skip Skip already processed files
--band BAND Band used to acquire the image. To use if the filter keyword is not in the fits header. Use Capital names for Johnson-Cousins filters, use lowercase names for the Sloan filters, and use the cmag name for unfiltered images and luminance filters.

--mask-size MASK Using a square mask centred on the transient. Beyond this mask, the sources are not used for the calibration.

--save-bkg Save the background images as fits and png. Default: False

Main photometry script. Prior to running it, it is necessary to :

- Have done template subtraction (if relevant for the followed up object)
- Have created the coord file with WCS coordinate (Ra, Dec) of the transient in **deg** (see screenshot XX) and the coordinate of a star in the FoV that will be used as a quality check for photometry

The parameters are tuned from the "muphoten.hjson" configuration file.

If the catalog argument is not used, muphoten will try to find the most appropriate, usually Pan-STARRS.

If the transient does not need any template subtraction use the 'nosub' option

The mask optional argument will make muphoten calibrate using only source in a square centred on the transient coordinates.

There are three different photometry types are available :

- Kron : The apertures are computed based on the shape of the source in an automated way.
- Fixed: all the apertures have the same size. It is PSF X Fixed_Factor, where Fixed_Factor value is given by the configuration file, and user-selected.
- Isophotal (default): Similar to kron magnitude, but the aperture ellipses semi-major axe and semi-minor axe are estimates based on the source shape, then multiplied by a factor passed by the configuration file.

The results will appear in the repertory ./results/NAME_IMAGE/calibration for the images. It should contain three png files, one for the image, one for the detected source and a third one with the calibration curve and the zero-point estimate. It also contains a "calibration.dat" file containing the information used for the calibration.

After all the images are analysed, the OUTNAME results file will be in ./results.

mu_subtraction :

--images IMAGES Base path for the images to analyse.

--skip-processed, --skip
Skip already processed files

--keep-processed, --keep
Skip already processed files

--telescope Alias for the available telescopes.

--astrometry {no,scamp}
Whether to perform astrometric calibration, with scamp.

--sub DOSUB Whether to perform astrometric calibration, with ps1 images or user-provided reference image. Type "ps1" for PS1 reference image or provide the path to your reference image.

--ps1-method {mosaic,individual}
When subtracting images using Pan-STARRS reference images, there 2 options, either create a mosaic of all PS1 images and subtract or do the subtraction individually for each PS1 image. In the latter case, your image is cut to match the PS1 image. (Default: mosaic)

--mosaic Whether to combine the individual frames into a common mosaic when `ps1_method` is set to `individual`. (Default: not set)

--output-data-level {0,1,2}
Number of output files that are kept after the process. 0: minimum, 2: maximum(Default: 0)

--conv-filter CONVFILTER
Corresponds to FILTER_NAME keyword for sextractor (without .conv).
Different filter available listed here:

/home/duverne/Documents/muphoten/muphoten/config/conv_kernels/ (Default: default)

--verbose {QUIET,NORMAL,FULL,LOG}
Level of verbose, according to astromatic software.

Script using the HOTPANTS software to perform template subtraction for removing host galaxy flux.

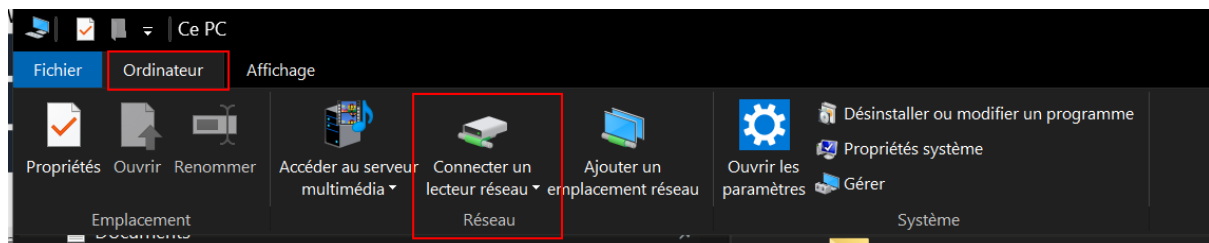
The HOTPANTS parameters are set up by the hotpants.json configuration file.

There are two options for template : either subtract a reference image provided by the user or download images from Pan-STARRS.


For a Pan-STARRS template, there are two options, either create a mosaic of the FoV or subtract the PS frames and create a subtracted image for each one.

For Windows:

To browse the Ubuntu file, we can mount the network drive to access to your Ubuntu files via the browser



And copy this line → `cd \\wsI$Ubuntu`

←  Connecter un lecteur réseau

×

À quel dossier réseau voulez-vous vous connecter ?

Spécifiez la lettre désignant le lecteur et le dossier auxquels vous souhaitez vous connecter :

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Dossier :

Exemple : \\serveur\partage

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Then in network folder, you will see the ubuntu