

{{lastupdated\_at}} by {{lastupdated\_by}}

# ctools

ctools is a software package developed for the scientific analysis of Cherenkov Telescope Array (CTA) data. Analysis of data from existing Imaging Air Cherenkov Telescopes (such as H.E.S.S., MAGIC or VERITAS) is also supported, provided that the data and response functions are available in the format defined for CTA.

ctools comprises a set of ftools-like binary executables with a command-line interface allowing for interactive step-wise data analysis. ctools includes also a Python module allowing to control all executables. Creation of shell or Python scripts and pipelines is supported. ctools provides cscripts, which are Python scripts complementing the binary executables. Extensions of the ctools package by user defined binary executables or Python scripts is supported.

ctools are based on GammaLib, a versatile toolbox for the high-level analysis of astronomical gamma-ray data. Besides CTA, GammaLib supports also the analysis of Fermi/LAT and COMPTEL data, and extensions to support further gamma-ray instruments are planned. An interface to virtual observatory resources is also in preparation. By making use of the GammaLib multi-instrument capabilities, ctools supports the joint analysis of CTA (or any IACT providing data in the CTA format), Fermi/LAT and COMPTEL data.

ctools are developed by a team of enthusiastic gamma-ray astronomers with support from engineers. We regularly organise coding sprints where key developers but also newcomers meet to discuss the developments and next steps, and advance with the coding of the software.

ctools is free software distributed under the GNU GPL license version 3

## Features

- CTA observation simulation
- Binned and unbinned maximum likelihood fitting
- Imaging
- Spectral analysis
- Light curves

## Getting ctools

The actual version of the ctools code can be retrieved from our git repository using

```
$ git clone https://cta-gitlab.irap.omp.eu/ctools/ctools.git
```

In case that you get error: SSL certificate problem, verify that the CA cert is OK. you may add

```
$ export GIT_SSL_NO_VERIFY=true
```

before retrieving the code. Before you can build the ctools code obtained using git you have to generate the configuration script using

```
$ ./autogen.sh
```

Then you may proceed with the usual

```
$ ./configure  
$ make  
$ make check  
$ [sudo] make install
```

## Documentation

The ctools documentation is available on the dedicated web site <http://cta.irap.omp.eu/ctools/>. This documentation refers to the last ctools release. The documentation corresponding to the current development branch can be found at <http://cta.irap.omp.eu/ctools-devel/>.

## Support & getting help

If you need support, please send an e-mail to [jurgen.knodlseder@irap.omp.eu](mailto:jurgen.knodlseder@irap.omp.eu).

You may also submit a bug report, a patch or a feature request by using [this](#) form. Before submitting a bug report, a patch or a feature request here, please read the [\[\[Submission guidelines\]\]](#).

## Contributing

If you would like to contribute to the development of ctools, please send an e-mail to [jurgen.knodlseder@irap.omp.eu](mailto:jurgen.knodlseder@irap.omp.eu) by specifying in which area you would like to contribute.

Once you have a user ID and a password, please read [\[\[Contributing to ctools\]\]](#) before starting your software development.

To help news developers in joining the project we regularly organise [\[\[Coding sprints\]\]](#).

## Science Validation

As ctools are intended for scientific analysis, science validation of the software is an important issue. The [\[\[Science Validation\]\]](#) page summarizes the studies that have so far been done.