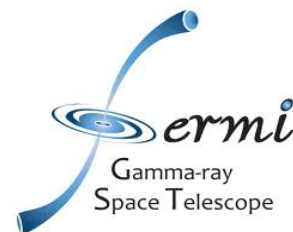


Gammalib and ctools.

Towards a common analysis framework for gamma-ray astronomy

Anneli Schulz, **Rolf Bühler**,
Jürgen Knödseder, Michael Mayer, ...
Fermi Collaboration Meeting
Montpellier, 01.09.2014



Introduction

- High-level analysis framework
- Framework allows to combine data from several instruments
- Likelihood approach for VHE instruments
- GammaLib available on <http://gammalib.sourceforge.net>
- Ctools available on <http://cta.irap.omp.eu/ctools/>
- Number of developers increasing
- Presented at ICRC 2013 (for the CTA consortium)

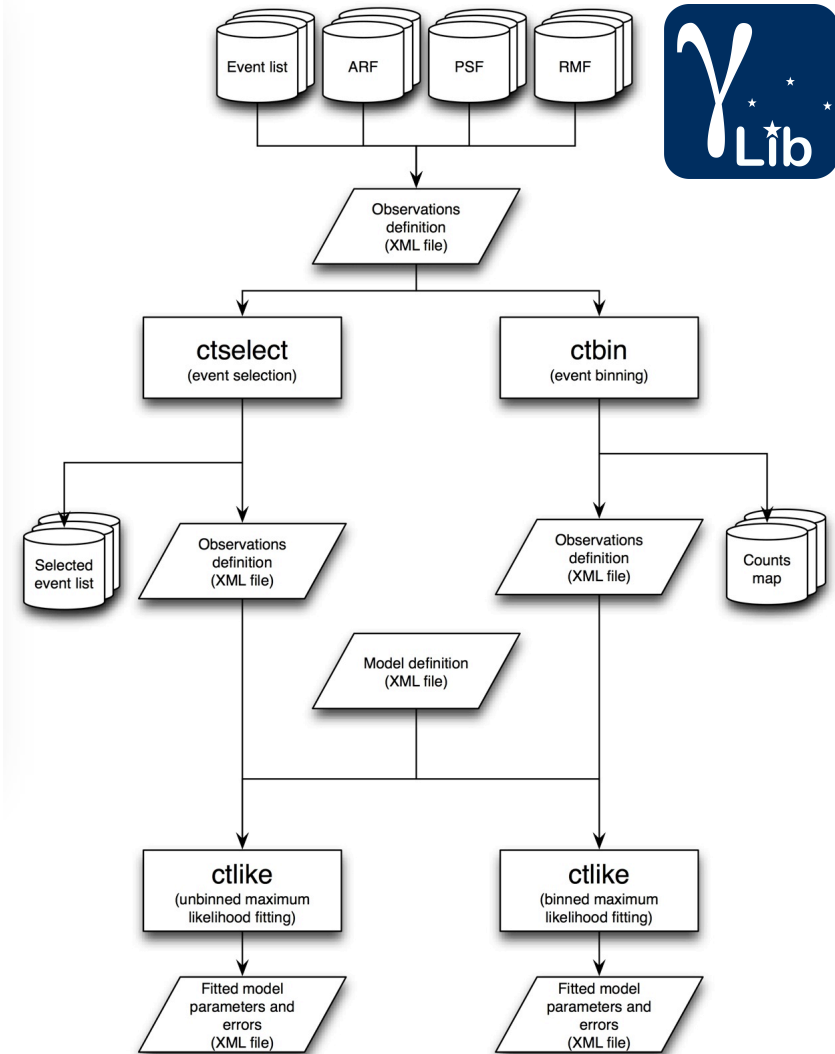


> GammaLib:

- self-contained, instrument independent, open source, multi-platform C++ library
- Likelihood analysis

> Ctools:

- Set of executables, performing individual analysis steps
- Fermi-like analysis chain



Analysis of Fermi-LAT data (P7REP) in ctools

- > All analysis steps until srcmaps are performed in Fermi Science Tools
- > Input for ctools: srcmaps, ltcube, expcube, IRFs, model
- > Nice agreement between the software frameworks

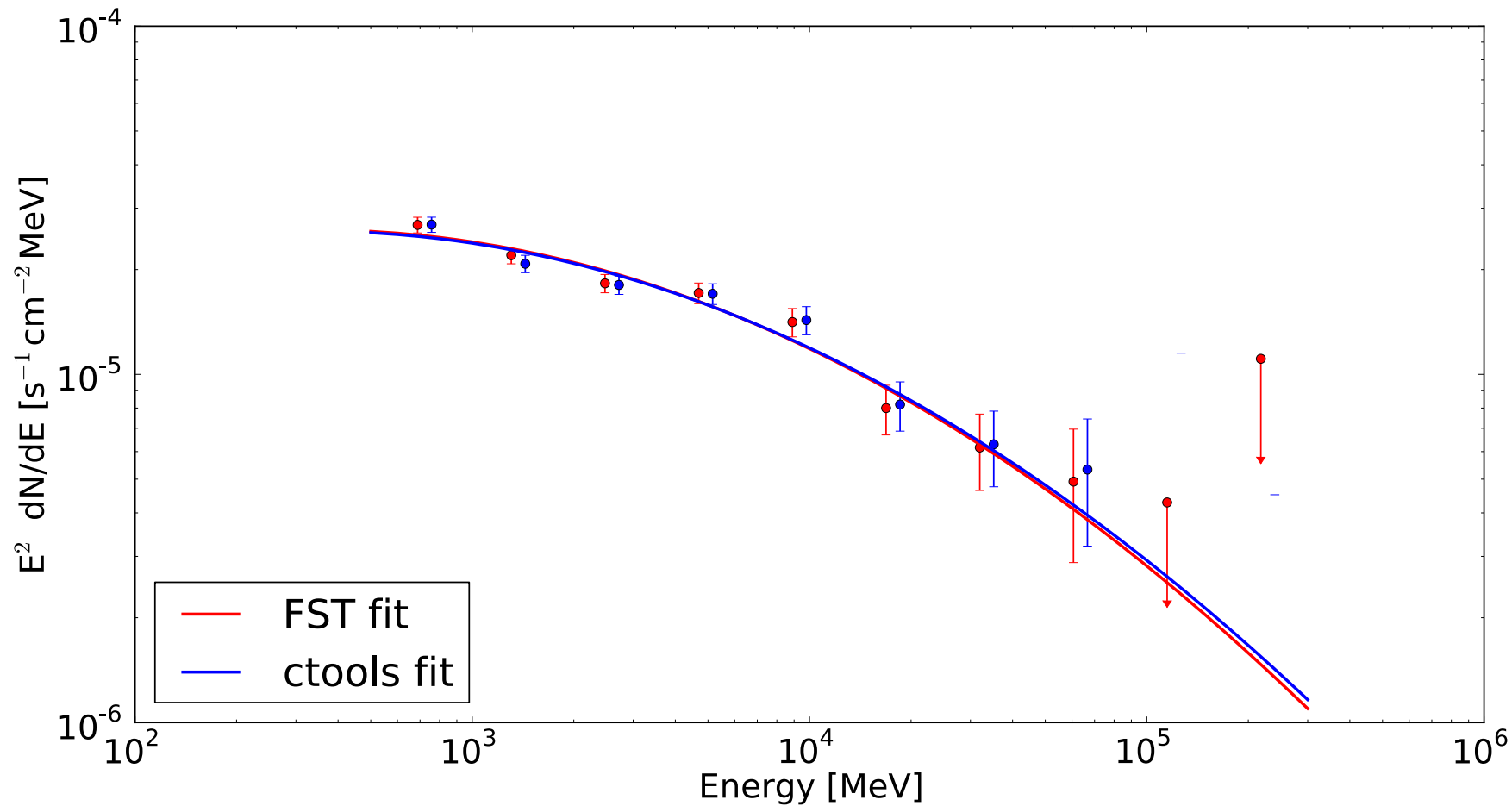
Source	Parameter	gtlike	ctlike
W49B	N_0 at 0.3 GeV [10^{-10}]	2.87 ± 0.02	2.85 ± 0.04
	α	1.98 ± 0.03	1.98 ± 0.13
	β	0.069 ± 0.008	0.067 ± 0.003
Galactic diffuse	N_0 at 1 MeV	1.102 ± 0.003	1.097 ± 0.005
	γ	$-(0.0172 \pm 0.0008)$	$-(0.022 \pm 0.001)$
Isotropic	N_0	0.37 ± 0.03	0.36 ± 0.04

Table A.2.: Cross-check between *Fermi Science Tools* and *ctools*, using 5 years of *Fermi*-LAT data of W49B. The units of N_0 are: $\text{cm}^{-2} \text{s}^{-1} \text{MeV}^{-1}$.

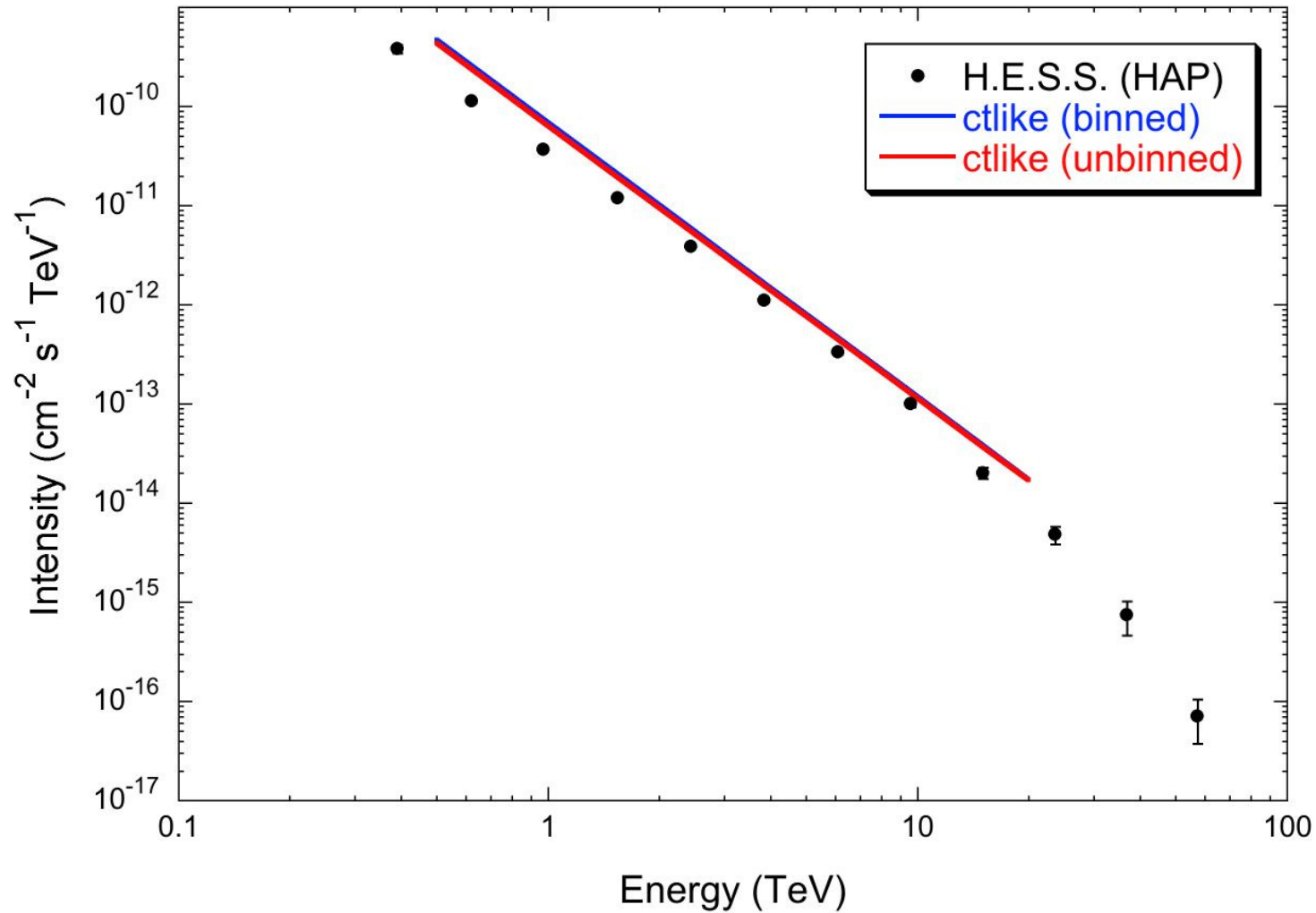


Cross-check Fermi Science Tools – ctools example: W49B

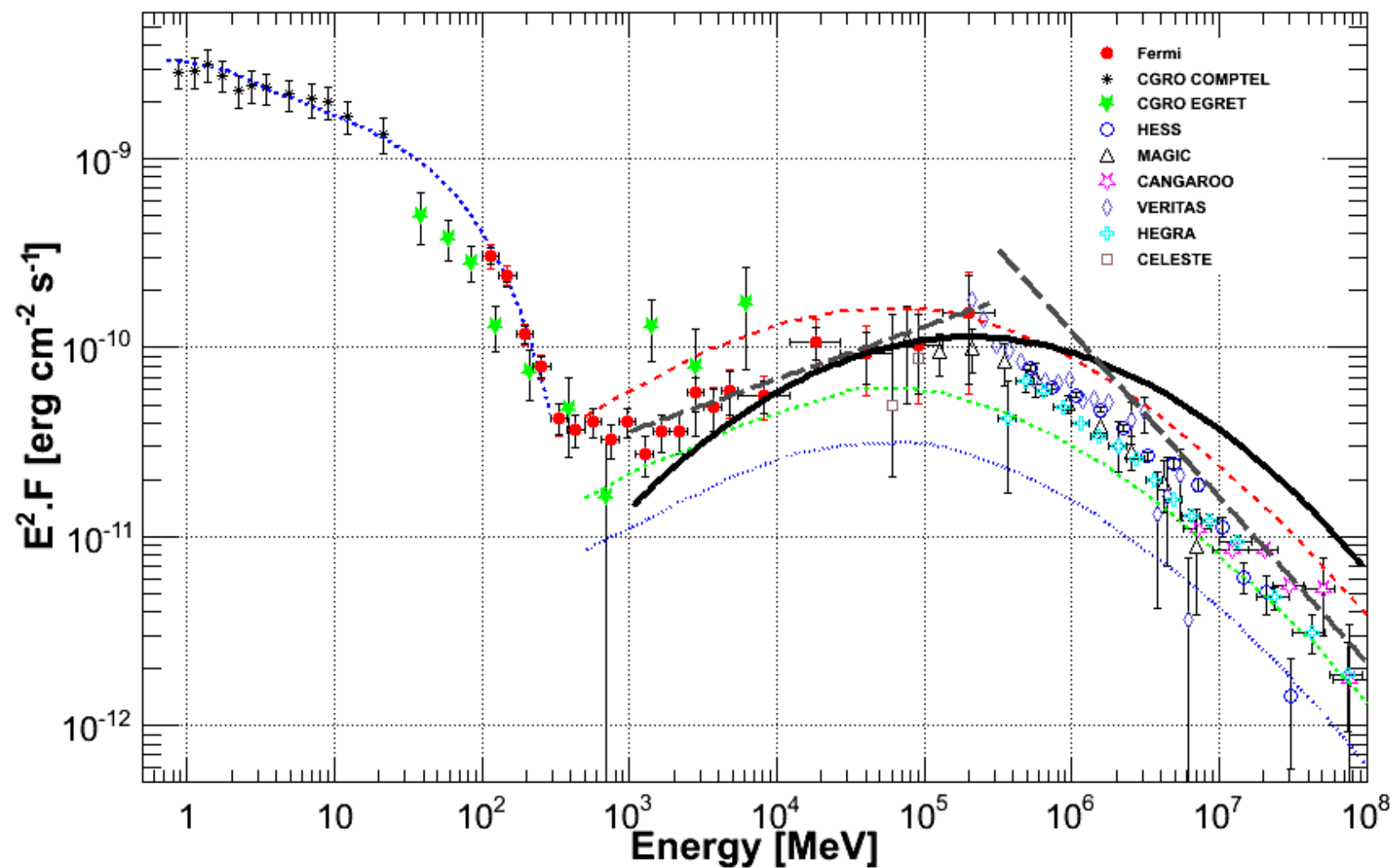
➤ 5 years of P7REP data, ctools points shifted by 10% to enhance visibility




VHE: Comparison of ctlike spectra to published ones



Combined fit of Fermi and H.E.S.S. data



Project management and bug tracking – Redmine

Search: GammaLib

- Overview
- Activity
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Action #998

[Update](#) [Log time](#) [Unwatch](#) [Duplicate](#)

Introduce classes and readers for a cube-style IRF format

Added by Mayer Michael 2 days ago. Updated about 5 hours ago.

Status:	New	Start date:	11/20/2013
Priority:	Normal	Due date:	
Assigned To:	-	% Done:	<input type="text"/> 0%
Category:	-	Spent time:	-
Target version:	00-08-00		
Duration:			
Remaining (hours)			

Description [Quote](#)

In order to analyse sources with different morphologies (from point-like to extended), we decided on a preliminary format for the instrument response which can be read by gammalib. The idea is to pass run-wise files to gammalib, which contain the effective area and the PSF (see example files attached).
The file format for the effective area is similar to the format of a `GModelSpatialDiffuseCube`. It can be stored in instrument coordinates (for unbinned analyses) or in sky coordinates (for binned analyses). The third axis of the cube is the energy.
The file for the PSF should be a binary table storing every required parameter of the PSF parametrisation as a function of instrument coordinates (for unbinned analyses) or sky coordinates (for binned analyses) and energy.
The goal is to read in these files, store their content in classes and access the values within `GCTAResponse`.

[expcube_23544.fits](#) - exposure cube, can be changed to store effective area instead of exposure (135 kB) [Mayer Michael, 11/20/2013 02:48 pm](#)

[psf_23544.fits](#) (135 kB) [Mayer Michael, 11/20/2013 02:48 pm](#)

Subtasks [Add](#)

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History

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Sprints

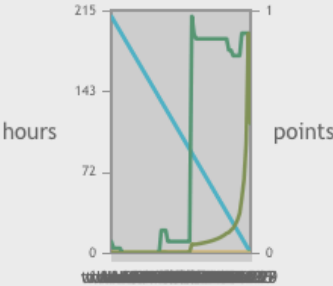
00-08-00
SPI sprint #1

GammaLib

[Product backlog](#)
[Webcal Feed](#)

Sprint "00-08-00"

[Task board](#)
[Burndown](#)
[Wiki](#)
[Impediments](#)



Watchers (6) [Add](#)

- Buehler Rolf
- Gerard Lucie

<https://cta-redmine.irap.omp.eu/projects/ctools/>



Summary and Outlook

- > High-level analysis framework in the context of CTA, open-source
- > Fermi-like analysis for VHE
 - Different background modeling approaches in progress
 - Cross-checks with current IACT data in progress
- > Combined fits of multi-instrument data

Plans

- > GammaLib and ctools release 1.0 together with
- > Paper about software and basic functionality (~end of the year)
- > Fermi Data as show case → Cat 2 paper



Combined fit of Fermi and H.E.S.S. data

