Open sources tools survey

Work package 6.4 : Open-source data analysis tools

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Task Area 6 : Synergies and services

WP 1 : Marketplace

WP 2 : Authorisation and authentification structure

WP 3 : Cross-community efforts towards FAIR data

WP 4 : Open-source data analysis tools

WP 5 : Services in big data management

TA 6 – WP 4 : Open-source data analysis tools

This work package addresses the PUNCH objectives

- 2 : Strengthen the implementation of the FAIR principles in its community
- 4 : Provide better documentation of analysis workflows
- 6 : Enable “live analysis” and “live peer review” : in the future, a research product would be associated with the paper under review, and the reviewer can now cross-check the complete implementation of the workflow, wherever needed

TA 6 – WP 4 : Open-source data analysis tools

D-TA6-WP4-1 : Survey based overview including documentation of analysis tools currently developed and used within PUNCH4NFDI.

D-TA6-WP4-2 : Example repository with continuous integration and deployment setup along with general guidelines for open software development.

D-TA6-WP4-5 : Software platform for PUNCH4NFDI and the NFDI with relevant software tools and frameworks.

D-TA6-WP4-4 : Detailed and non-trivial examples of data analysis based on open-source tools and example data sets representative for PUNCH4NFDI.

D-TA6-WP4-1 : Survey of open-sources tools

Name	Description	Link	Download	Tutorials	Code	Use / Contribute	#citations

Google Sheets

System

General

Analysis / Simulation

Workflow management

D-TA6-WP4-1 : Survey of open-sources tools

System	General	Analysis & Simulations	Workflow managment
Manjaro	astropy	gammapy	Luigi
NextCloud	numpy	gamera	Snakemake
Emacs	keras	Root:RDataFrame	Reana
Latex	scikit	ctapipe	Taiga
OpenSSH	paraview	corsika	Camunda
OpenConnect	jupyter	fermipy	Processmaker
Mattermost	dealii	Awkward	...
Mu	gnuplot	agnpy	
Xournalpp	Octave	Fermitools	
...	...	...	

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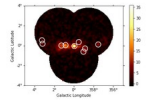
D-TA6-WP4-1 : Survey of open-sources tools

Gammapy :

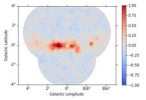
- Gamma ray dedicated open source analysis python package
- Prize winning software
- Adapted to GADF format
- Already used for HESS, HAWC, FERMI, selected for CTA

gammapy.org

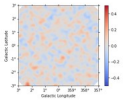
A **Python** package for **gamma-ray** astronomy



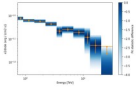
Basic image exploration and fitting



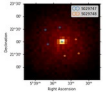
3D detailed analysis



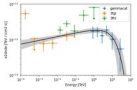
3D map simulation



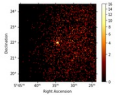
Spectral analysis



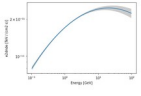
Spectral analysis with energy-dependent directional cuts



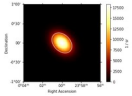
Flux point fitting



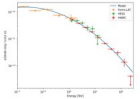
Makers - Data reduction



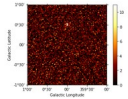
Source catalogs



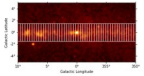
Models



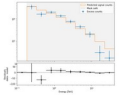
Multi instrument joint 3D and 1D analysis



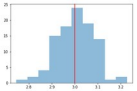
Event sampling



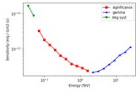
Flux Profile Estimation



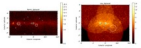
Spectral analysis of extended sources



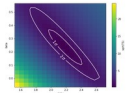
1D spectrum simulation



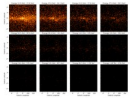
Point source sensitivity



Modelling



Fitting



Maps

D-TA6-WP4-1 : Survey of open-sources tools

Gamera :

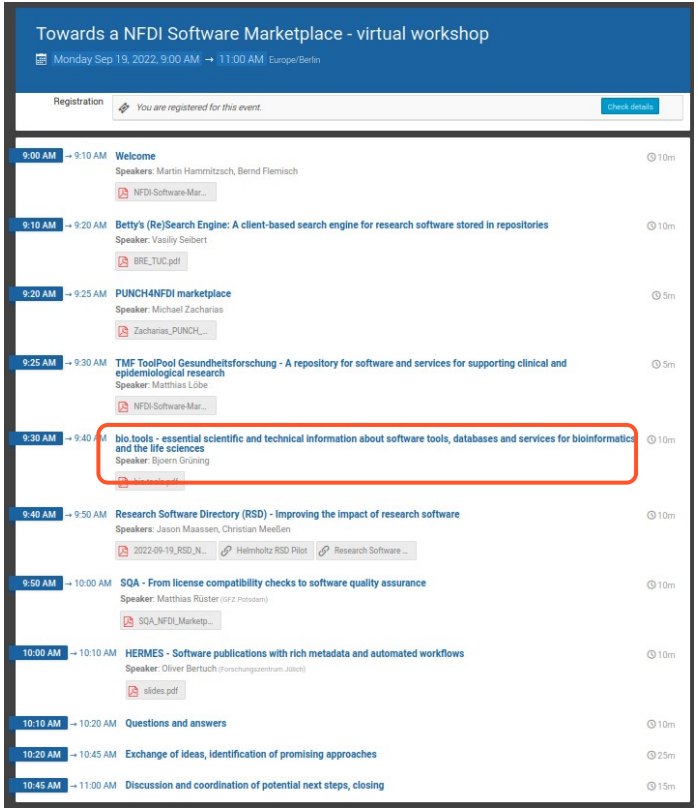
- C++ library for modeling in high energy astrophysics.
- It is also available as a swig-wrapped python module (which is internally called gappa)
- It is launched by the Max Planck Institute for Nuclear Physics (MPIK)

Tutorials

How to ...

- calculate the broad-band radiation spectrum from a parent population of hadrons or electrons
- evolve a particle population in a time-constant environment
- evolve a particle population in a changing environment
- set up more complicated Inverse-Compton radiation fields (SSC, anisotropy, arbitrary shape)
- pick your hadronic interaction model
- take particle escape into account
- display the particle energy loss scales
- Take into account gammagamma absorption

D-TA6-WP4-2/5 : Example repository → Software platform

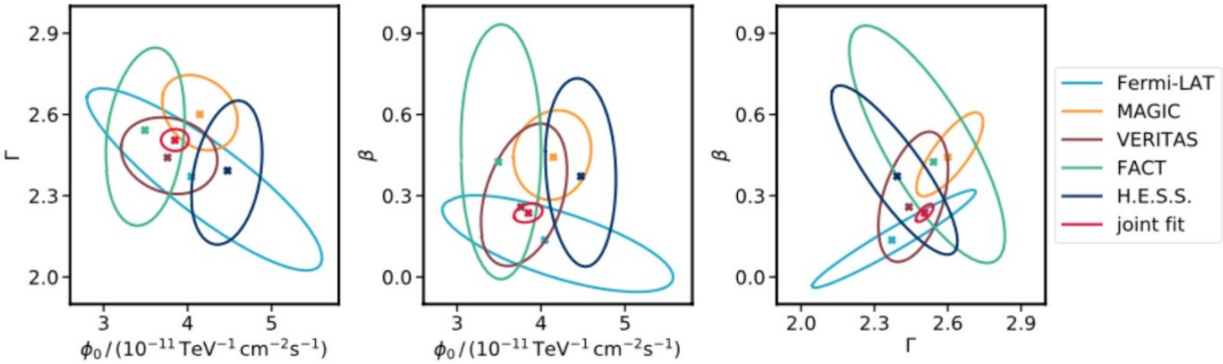


D-TA6-WP4-4 : non-trivial examples using open source tools

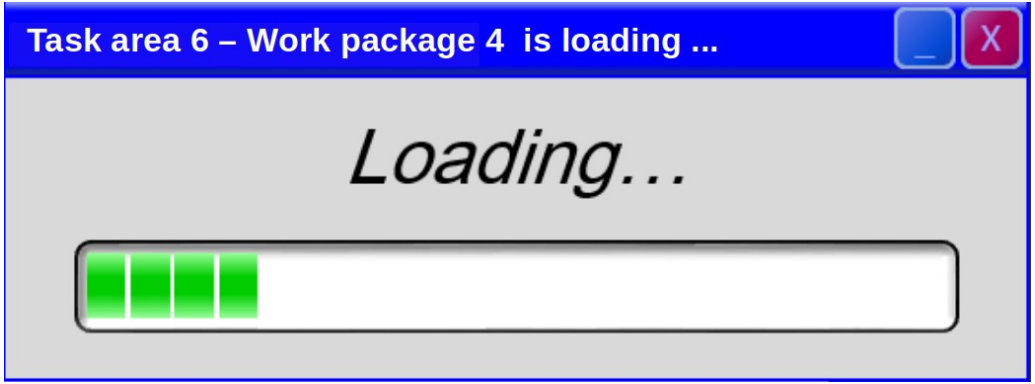
Example of analysis : Crab

Multi-Instrument (Fermi-LAT, MAGIC, VERTIAS, FACT, HESS) analysis in gamma rays astronomy of **formatted data** (GADF) using an **open source software** (GammaPy) .

Analysis is fully **reproducible** (Shared notebooks).



Conclusion



TA3-WP1 : Statistical methods

TA4-WP2 : Mapping and collating metadata

TA4-WP4 : Build and operate the data portal

TA6-WP1: Marketplace

TA6-WP3 : Cross-community efforts towards FAIR data