
Status of HAP

HESS Analysis Package

Warsaw, November 20th 2007
APC, MPI-K, LLR



HAP software

- Objectives
 - Common software, stable, documented
 - Common data format between countries
 - Separation between the algorithm of shower reconstruction and the choice of cuts
 - Choose of algorithms for:
 - The shower reconstruction
 - The energy estimation
 - The background estimation
 - The spectrum fit method
- Current status
 - Machinery tested, stable and running
 - Still some features to test and some algorithms to add

From RawData to DST

- Raw data contain (asynchronous) data from different sub-systems
- DST contains a synchronous list of events directly usable for an analysis
- DST production
 - Needs the calibration of cameras, telescopes (pointing, optical efficiencies)
 - Made by experts with a tagged software version
 - Reproducibility
 - Homogeneity of DSTs

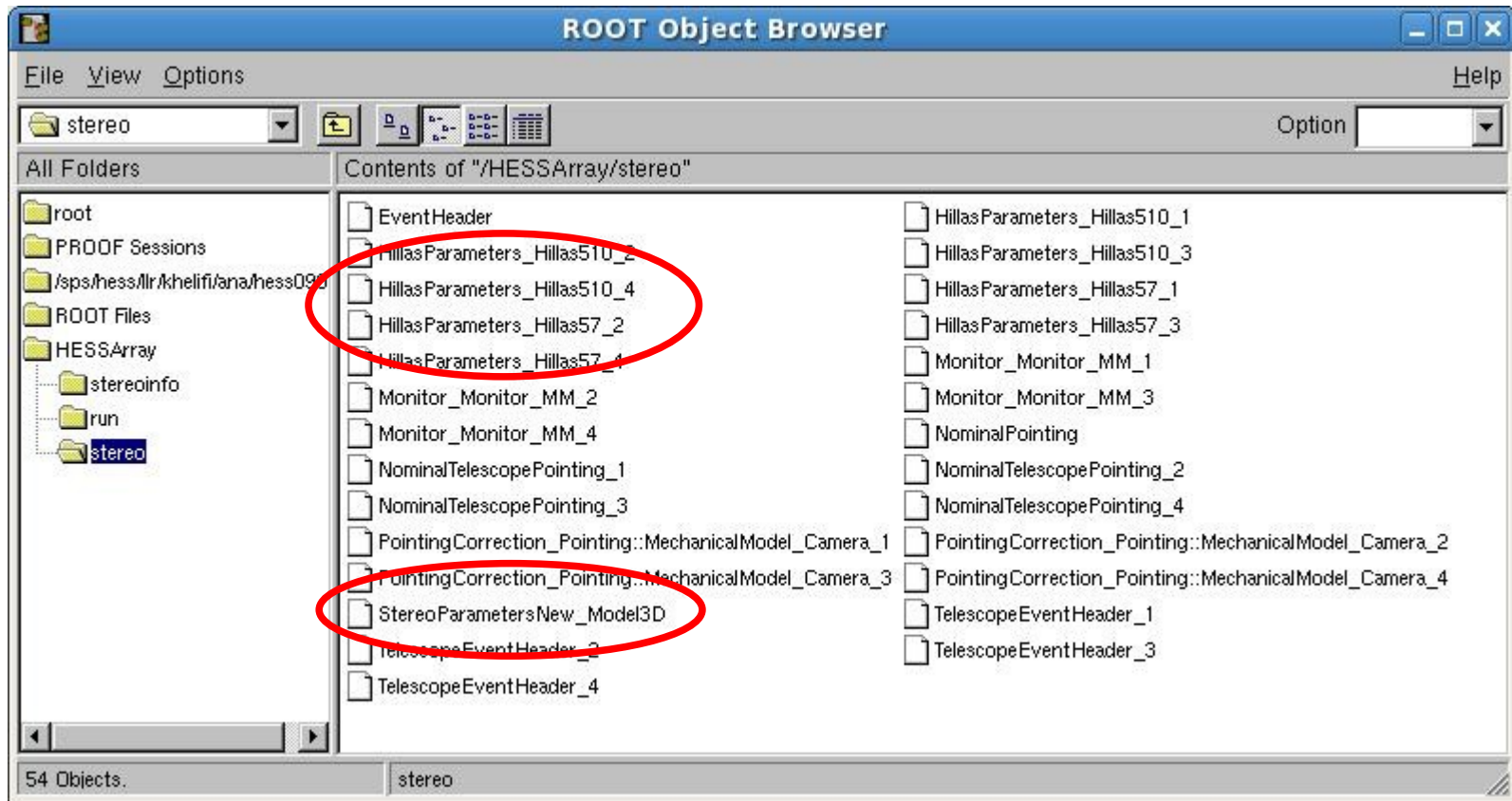
DST content

```
root /scratch/khelifi/dst_model3D_022234_01.root
root [2] .ls
TFile**          /scratch/khelifi/dst_model3D_022234_01.root
TFile*           /scratch/khelifi/dst_model3D_022234_01.root
KEY: TTree       run_tree;3          Sash DataSet
KEY: TTree       stereo_tree;874     Sash DataSet
KEY: TTree       TriggerStats_tree;1  Sash DataSet
KEY: Sash::DataSet TriggerStats;1     dst_model3D_022234_01.root
KEY: TTree       MuonStats_tree;1     Sash DataSet
KEY: Sash::DataSet MuonStats;1        dst_model3D_022234_01.root
KEY: Sash::DataSet run;1              dst_model3D_022234_01.root
KEY: Sash::DataSet stereo;1          dst_model3D_022234_01.root
KEY: TTree       stereoinfo_tree;1    Sash DataSet
KEY: Sash::DataSet stereoinfo;1       dst_model3D_022234_01.root
```

- Allow an analysis without a DB connexion

DST content (2)

```
root [3] stereo->GetEntry(0)  
root [4] TBrowser a;
```



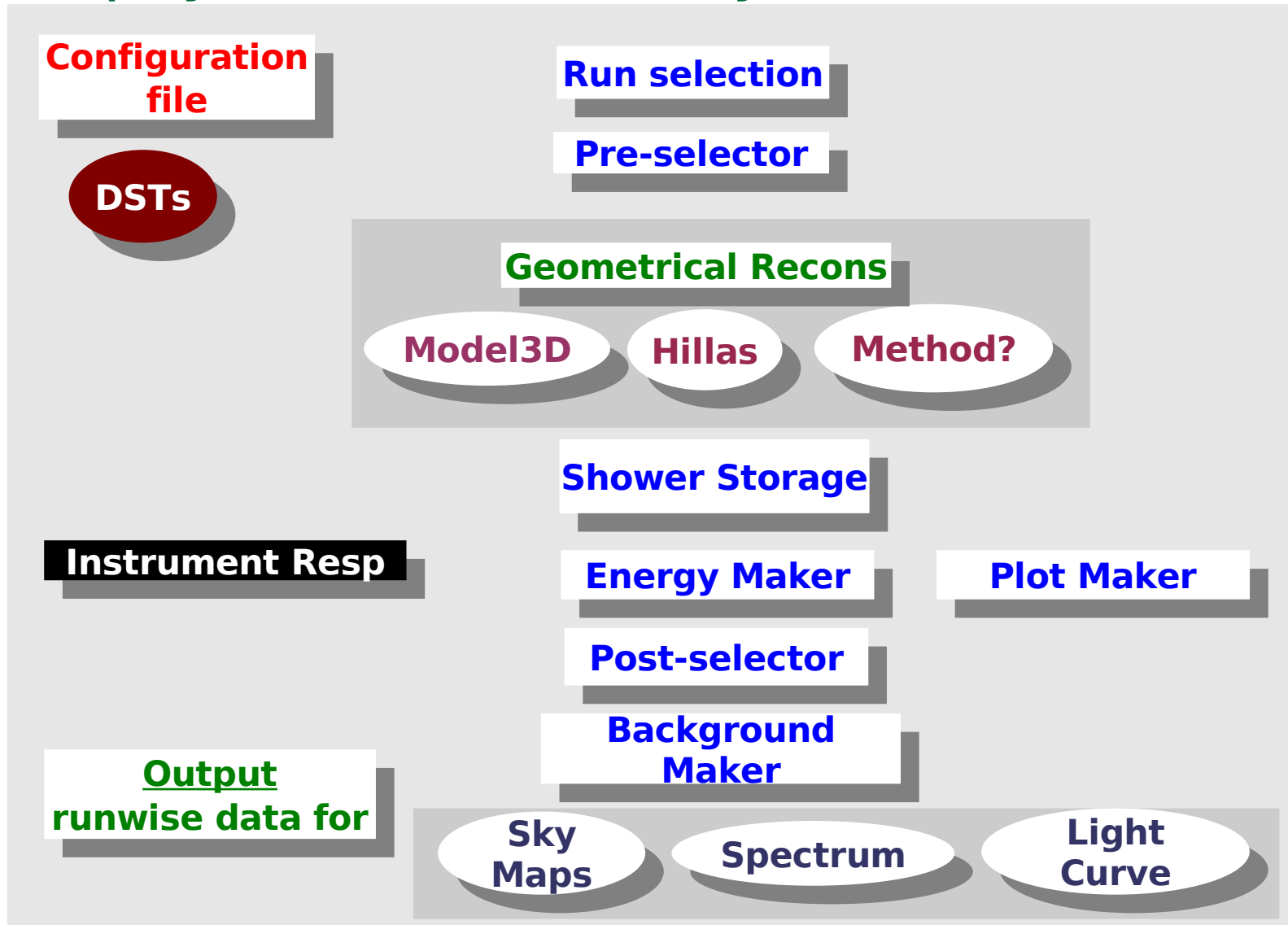
DST content (3)

- Basis for any analysis
- Produced systematically by expert as soon as calibration is done
- **Common format** between HD and France
 - Easiest comparison between French and German calibrations
 - Easiest comparison between French and German simulations
- Useful DB data are stored into DSTs

Philosophy of the HAP analysis

For each run

Output data
stored in
disk



Philosophy of the HAP analysis (2)

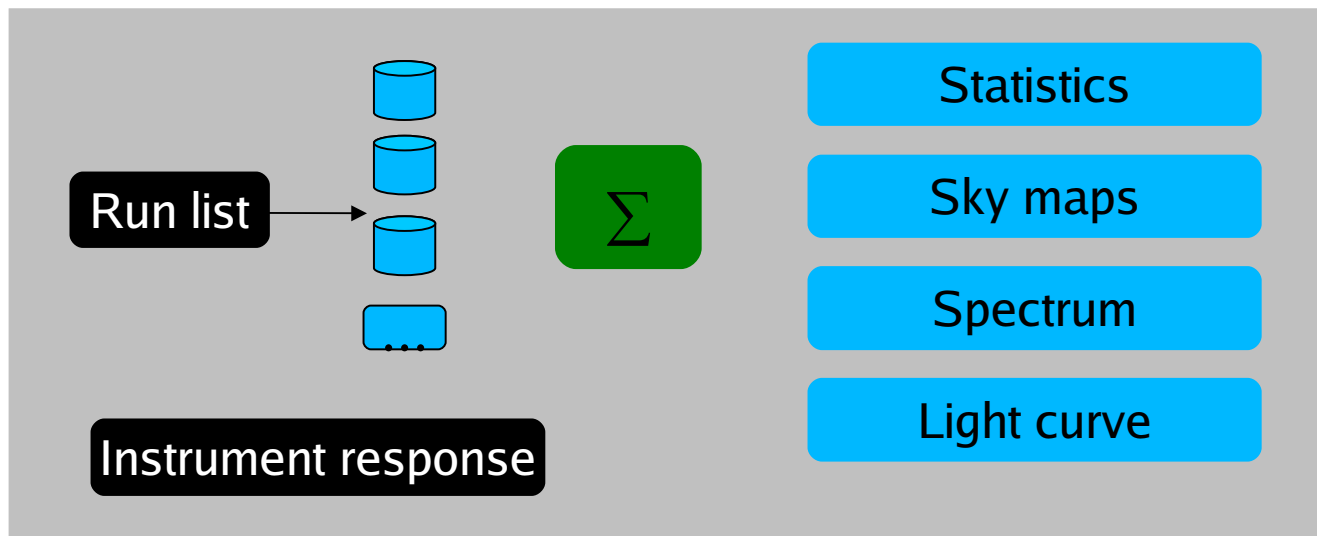
- Inputs
 - An example of 'configuration file'
 - The instrument functions:
 - Lookup tables for energy, collection area and energy resolution
 - Generally made by experts (long process even if it is automatised, lot of checks)
 - Two set of tables (N & S) for each shower reconstruction and each set of cuts
 - Today, there are in total ~20 sets of tables available!
 - DST stored in the Lyon data storage system (HPSS)
- Analysis (reconstruction & discrimination) made for each run in the batch system in Lyon
 - Made with the program `hap.C`
 - For each run, ~20000s CPU

Philosophy of the HAP analysis (3)

- Outputs
 - User plots (made by `Plotters::PlotMaker`)
 - Statistics and distributions of observation conditions
 - Stored in a specific class (`Background::BgStats`)
 - Spectra and light curves
 - Data storage for each event in a `TTree` (time, energy, ...)
 - Sky maps
 - Stored in a specific class (`Background::BgMaps`) with the same data format those in `HD::Plotters::SkyHist`
 - Helpful for the galactic scan analysis (add of runs without a whole data processing)
- Everything saved into 1 root file stored in a **public** directory

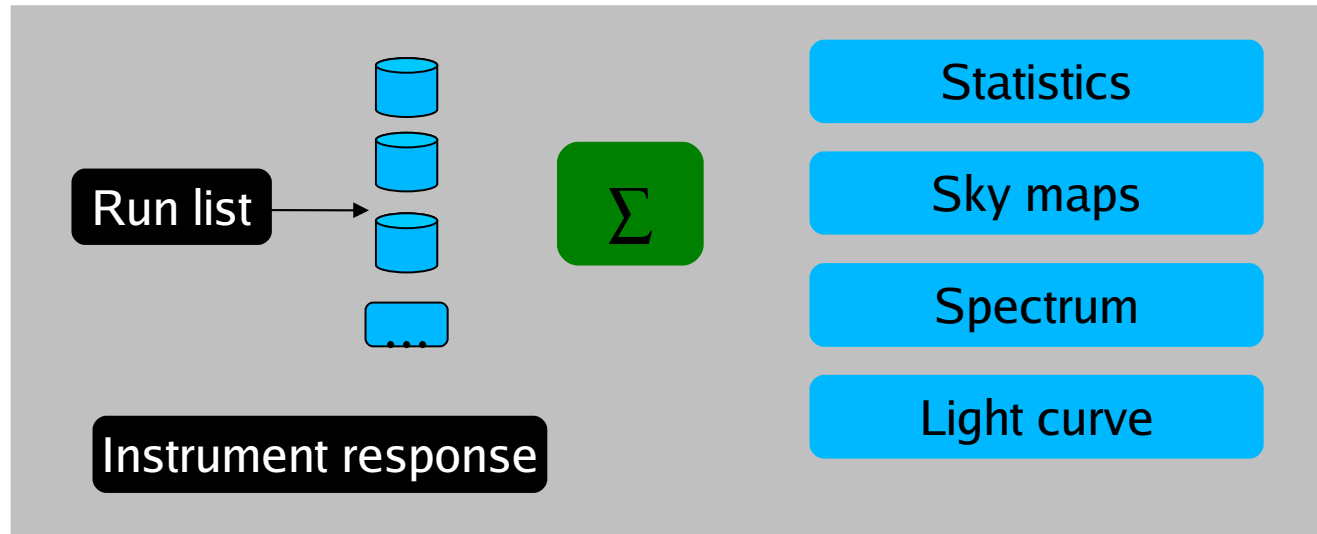
Final analysis

- After the run analysis, use of scripts to sum run results



- Statistics and distributions of observation conditions
 - Simple sum with a script (`AddBgStats.C`)

Final analysis (2)



- Spectra and light curves
 - Flexibility and speed of the summation scripts
 - Possibility to make light curves for energy slices
 - Possibility to make spectra for time slices
- Sky maps / Source morphology
 - Simple sum with a script (`AddBgMakerMaps.C`)
 - Possibility to change the smoothing without a whole reanalysis

Conclusions

- Stable version of HAP available
 - Strong efforts from MPIK, APC and LLR on easy installation, code simplification, code unification, reliability and documentation of programs
 - Work has started before the Cracow meeting
 - Now, a working version is ready (for publications)
- For HAP developers, use of a mailing list:
 - HESS-HAP-L@in2p3.fr (contact : Arache D.-A.)
- Organisation of initiation days is possible if you are interested (1-2 days)
- Available documentation:
 - Sash introduction:
http://www.mpi-hd.mpg.de/hfm/HESS/intern/hardware_meeting/ANALYSIS/CP
 - <http://polywww.in2p3.fr/activites/physique/hess/HAPdoc>

Documentation: main page

HAP documentation

Warning:

This documentation is still evolving, hence some pieces could be missing or wrong. Note that some examples may currently not be working.

Last update: 27th of September, 2007

Stable version: /afs/in2p3.fr/throng/hess/hess0907

Development version: /sps/hess/apc/ana/hess1007

Introduction

The Hess Analysis Package (HAP) is the latest software developed to share data (DSTs, instrument response functions) and algorithms between all members of the collaboration. A simple text file is used to configure which data you want to process and with which analysis algorithms (e.g. French DSTs, Model3D shower reconstruction, Hillas cuts, French energy estimation - Reco::APCEnergyMaker and HD spectrum fit method - **Flux::SpecBinWeightMaker**). An effort has been made to make the analysis possible without a database connection, in a train or on your local computer farm).

This documentation is not yet fully achieved. Thus if you need complementary informations, please contact the persons in charge of the part of the software you are interested on:

- Basic **Sash** machinery, HAP machinery, ...: [Karl Kosack](#)
- Documentation, French DST production (Hillas and Model3D), production of instrument response functions: [Bruno Khélifi](#)
- DST reading and mix, cuts apply, background estimation: [Arache Djannati-Ataï](#)
- Usage of instrument response functions, energy estimation, spectrum and light-curves estimation: [Santiago Pita](#)

LLR

HD

APC

Documentation: DST content

How to access the HAP French DSTs ? [French HAP Modules]

- the **Sash::DataSet** *run* of the class **Sash::RunHeader**
 - the **Sash::DataSet** *TriggerStats* of the class **Trigger::Monitor** contains all needed information for the calculation of duration, levetime,
 - the **Sash::DataSet** *MuonStats* of the class **Calibration::TelescopeMuonEfficiency** stores all informations needed to deal with the decrease of the optical efficiency of the telescopes
 - the **Sash::DataSet** *stereo* contains:
 - an instantiation of the classes **Sash::EventHeader** and **Sash::TelescopeEventHeader** for each telescope
 - an instantiation of the class **Model3D::StereoParametersNew**, in which are stored all shower paramaters fitted by the Model3D and their errors
 - an instantiation of the class **Reco::HillasParameters** for each telescope
 - an instantiation of the class **Sash::PointingCorrection** for each telescope
 - an instantiation of the class **Intensity::intensityData** for each telescope
 - an instantiation of the class **Intensity::Stats** for each telescope
- There is one entry per event. You can access to the event number #n with the command:
- ```
stereoinfo->GetEntry(n)
```
- the **Sash::DataSet** *stereoinfo* of the class **Model3D::StereoInformation** which contain the statistics of the 3DModel analysis for this run (i.e. number of events in the DSTs, number of events for which the likelihood fit has converged)

# Documentation: HAP analysis

HAP Documentation - French pages: HAP documentationhttp://polywww.in2p3.fr/activites/physique/hess/HAPdoc/main.html

- version, DST status and checks)
- no one is allowed to remove or reproduce a DST without the permission of responsible persons

If you need further informations or if you need to produce missing DSTs or temporary DSTs, please contact [Bruno Khélifi](#) or [Arache Djannati-Ataï](#)

## HAP documentation

The general description of **Sash** can be found here: **Sash Basics**.  
In the following sections, you can find the basics and the use of main parts of the HAP analysis, from the software installation to the production of light-curves.

1. **How to get HAP**
2. **How to access the HAP French DSTs ?**
3. **How to make a run list ?**
4. **How to analyse a HAP DST ?**
5. **Final analysis**
6. **How to produce the instrument functions? (expert mode)**

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Generated on Fri Sep 28 01:03:15 2007 for HAP Documentation - French pages by  1.3.9.1

# Documentation: Final analysis

HAP Documentation - French pages: Final analysis

[http://polywww.in2p3.fr/activites/physique/hess/HAPdoc/group\\_\\_frhap...](http://polywww.in2p3.fr/activites/physique/hess/HAPdoc/group__frhap...)

## Final analysis

### [French HAP Modules]

Given a run list that can be *smaller* than the list used for the BQS hap scripts (see '[How to analyse a HAP DST ?](#)'), the final results are computed from all informations stored in the root files made for each run. This allows a fast computing of excess and statistics, plots and sky maps, spectra and lightcurves....

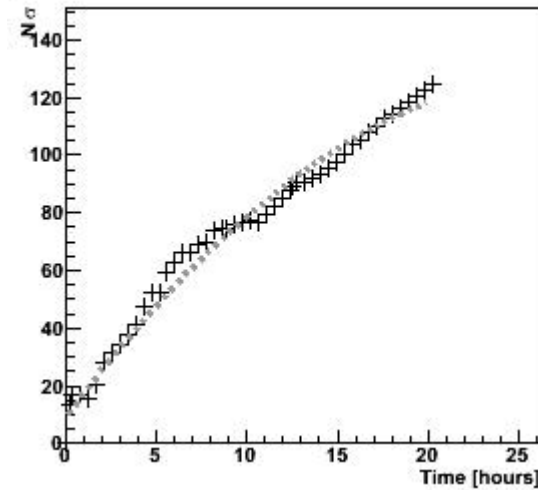
1. [Global statistics](#)
2. [Sky maps](#)
3. [Spectrum](#)
4. [Light curve](#)
5. [Morphology](#)

# Some outputs of the HAP analysis

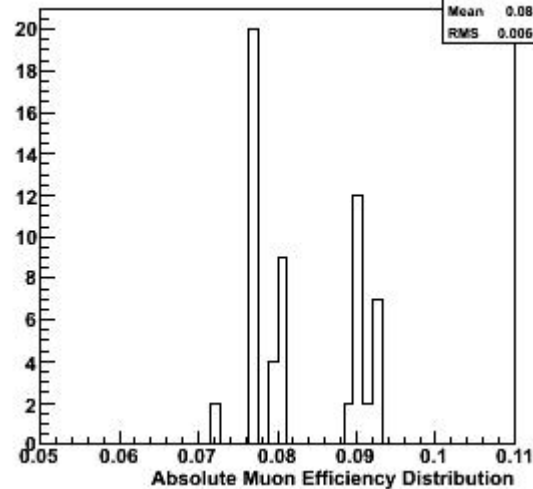
- HAP analysis has been run on many runs
- Standard outputs of:
  - Final statistics
  - Sky maps
  - Spectra and light curves
  - Studies of systematics

# Exemple : Crab

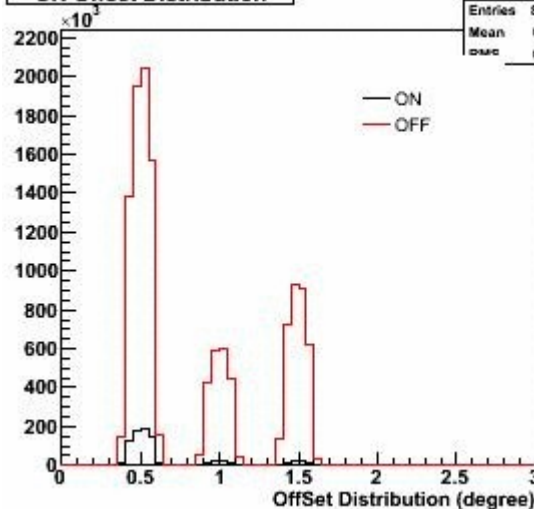
Number of Sigma vs Time



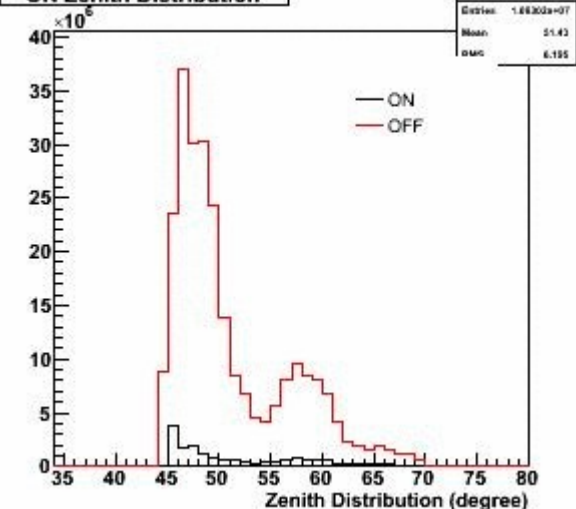
MuonEffDistribution



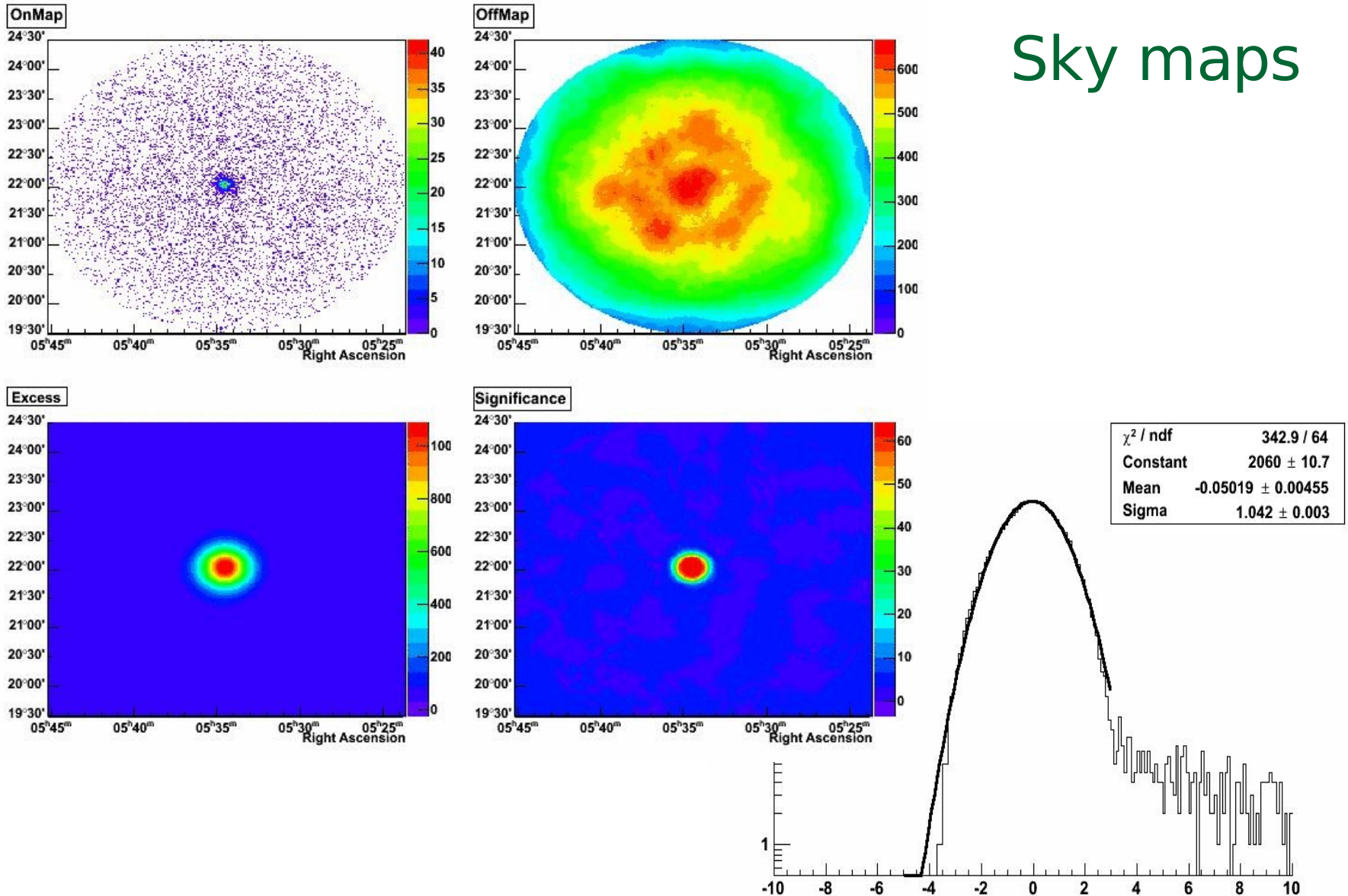
ON Offset Distribution



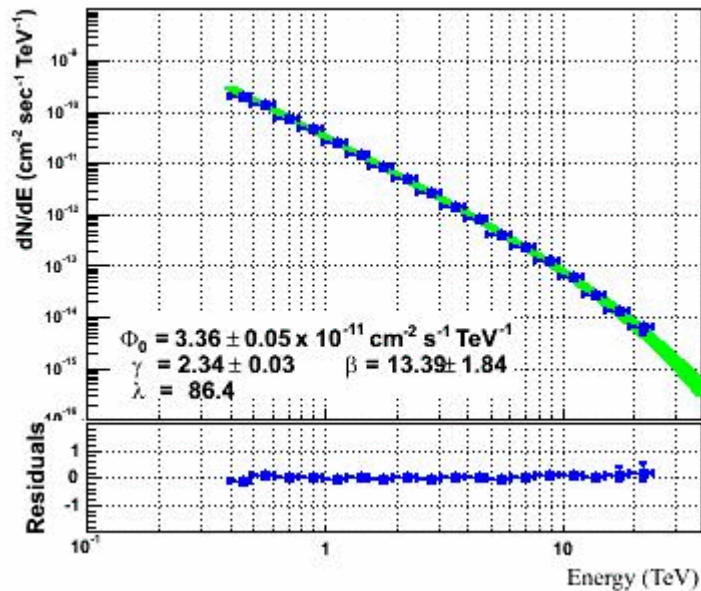
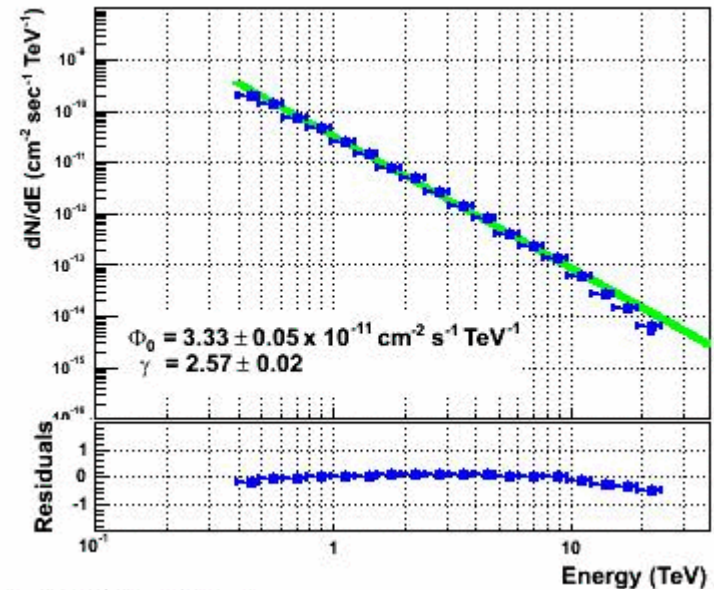
ON Zenith Distribution



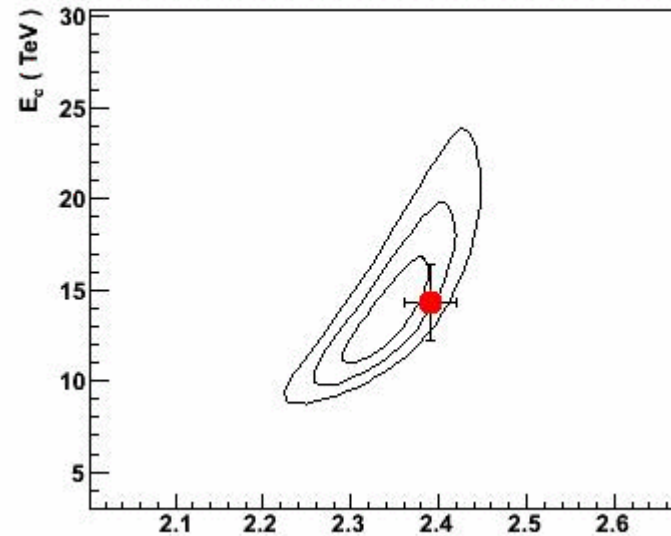
# Sky maps



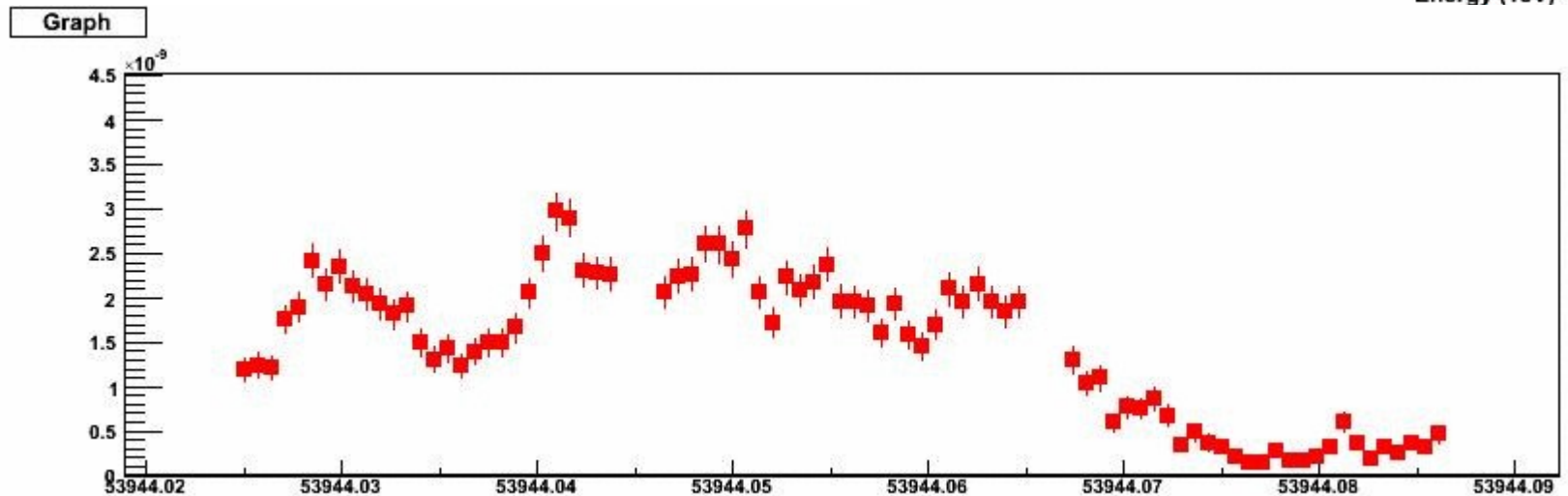
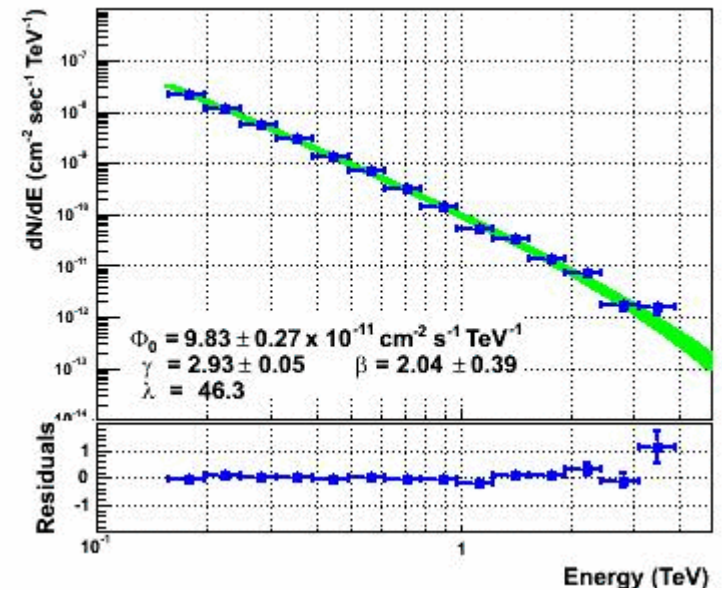
# The Crab spectrum...



Correlation Plot

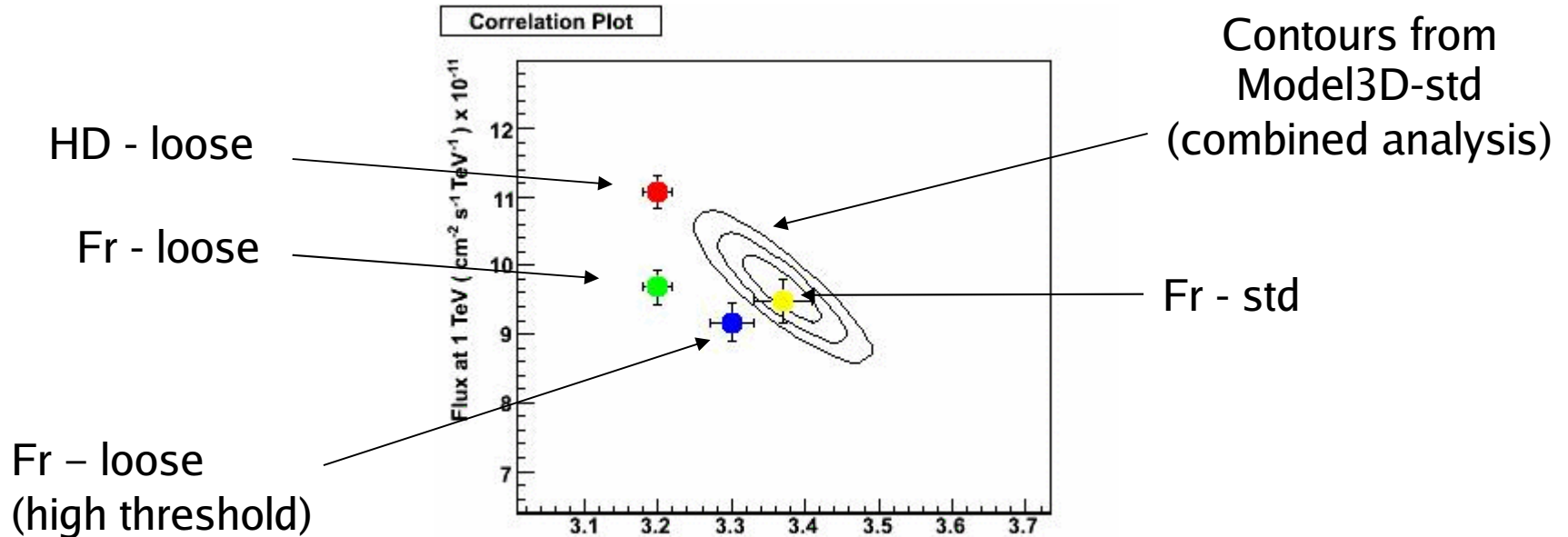


# The “Big Flare” of ...

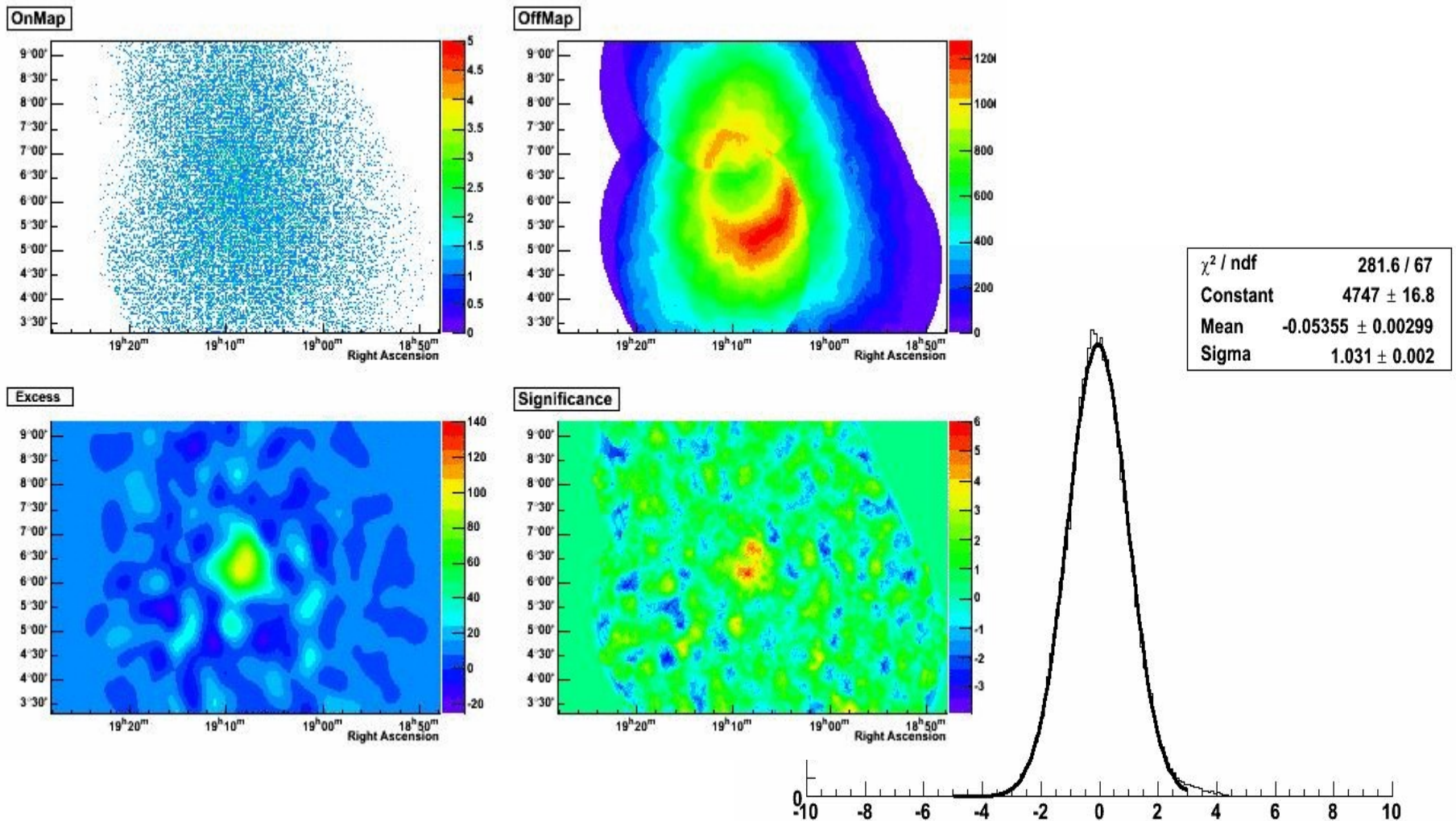


# PKS2155 : study of systematics

Comparison between analyses for a power-law fit:  
Hillas std, Hillas loose, Combined Model3D-Hillas



# Extended sources, exemple : J1908+063



# Perspectives

- The machinery is working, thus.....
- Exchange the instrument functions between Germany and France for studies of systematics
- Add **your** analysis algorithms:
  - Energy reconstruction with Model3D
  - Use of the Model2D results
  - Xeff analysis (developped in LAPP)
  - ...
- Cut optimisation for a combined analysis
- For HESS II, event selection machinery but spectrum fit has to be tested