technische universität
dortmund

Unfolding with the software TRUEE executed on MAGIC energy spectra

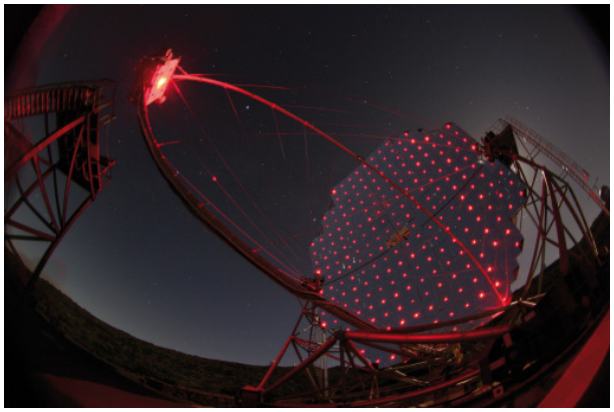
Sabrina Einecke

08.10.2011

Overview

- MAGIC
- Software TRUEE
- Analysis

MAGIC (10 GeV – 30 TeV)



Major

Atmospheric

Gamma-Ray

Imaging

Cherenkov

Telescopes

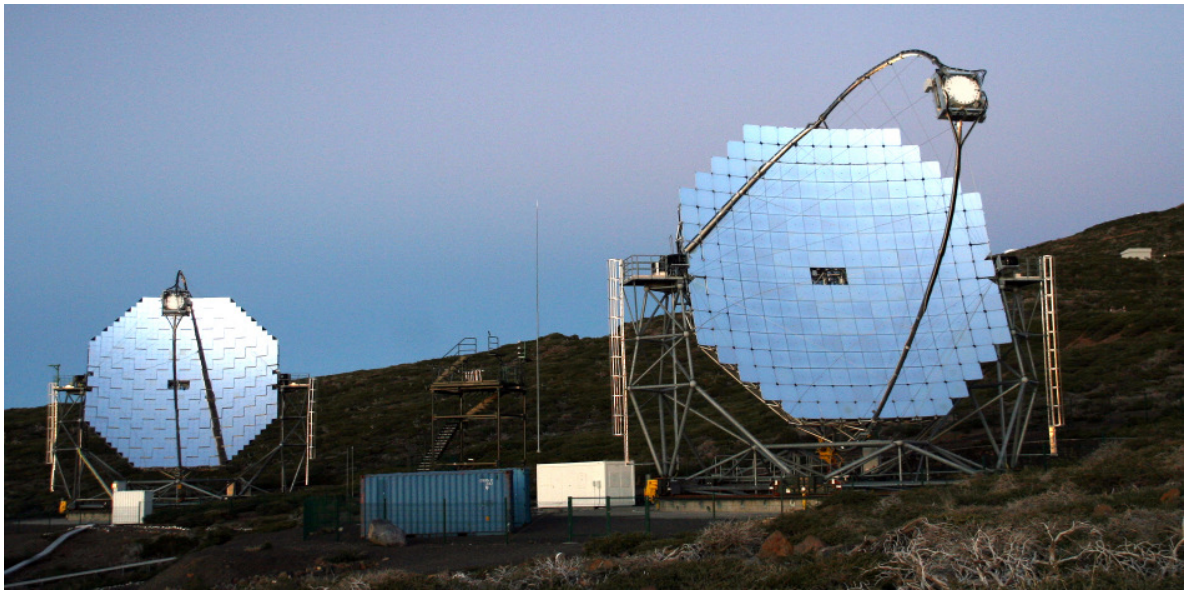
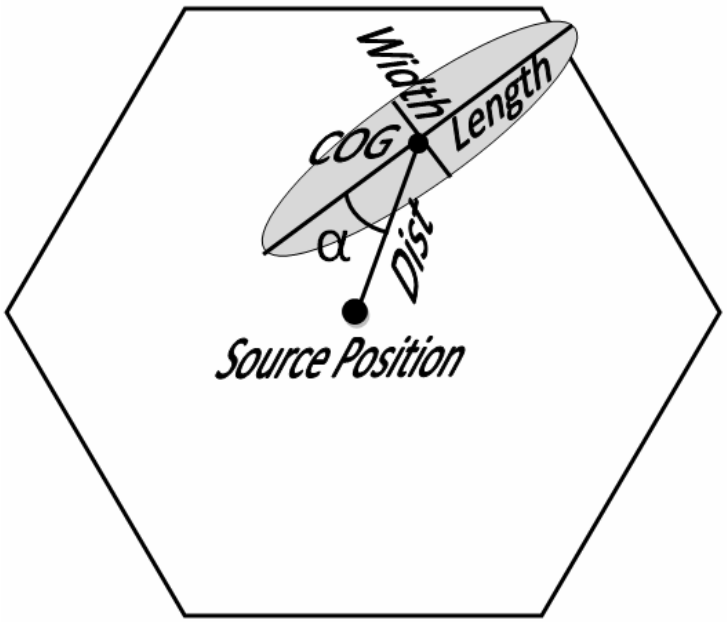
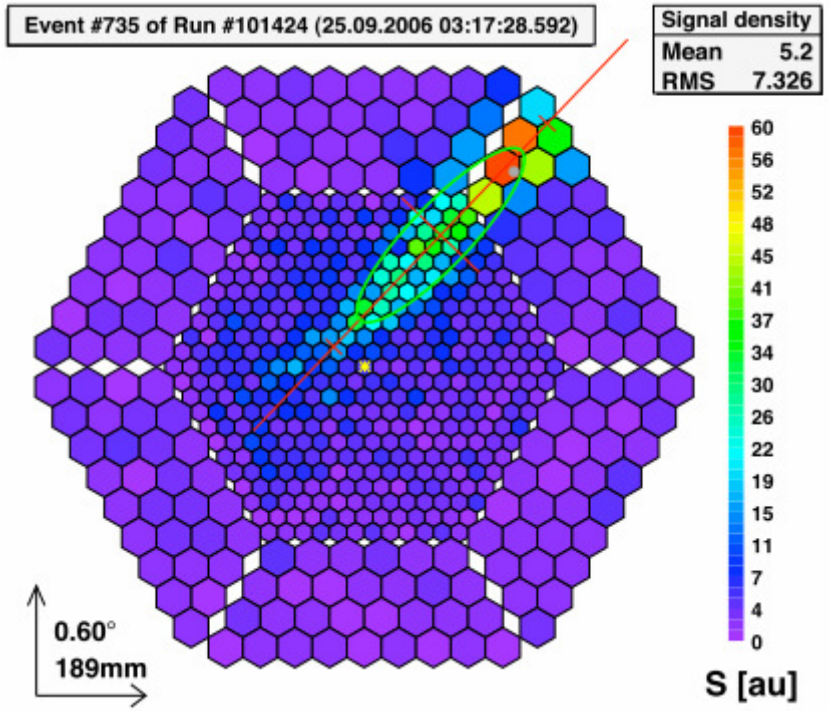


Image parameters

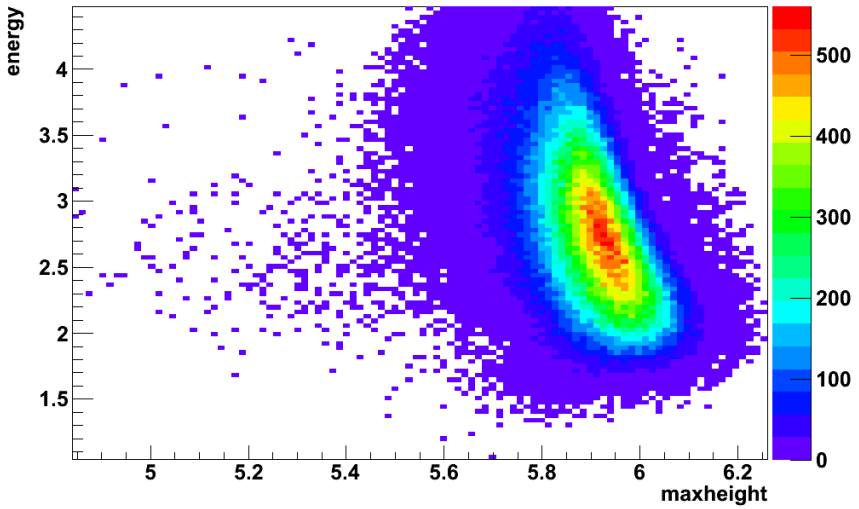


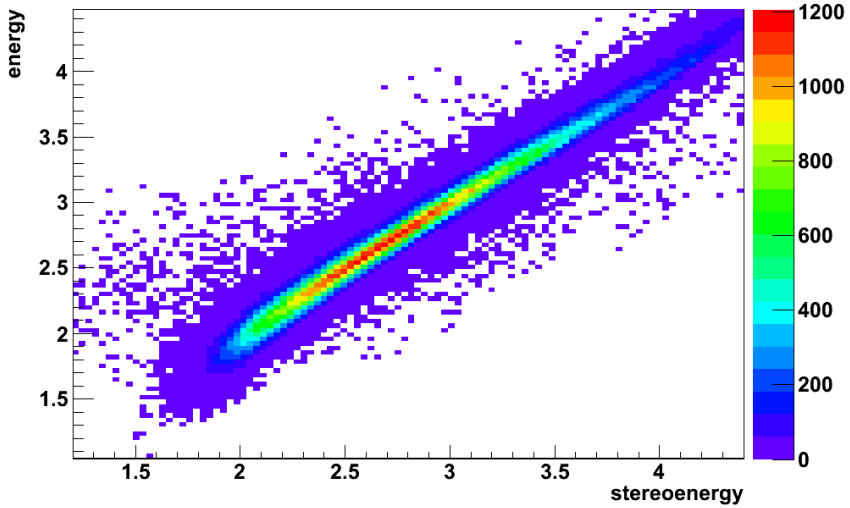
Schematic sketch of several image parameters.



Example of a camera image.

Correlation plots





Software?

Time-dependent

Regularized

Unfolding for

Economics and

Engineering

Written by N. Milke (TU Dortmund)

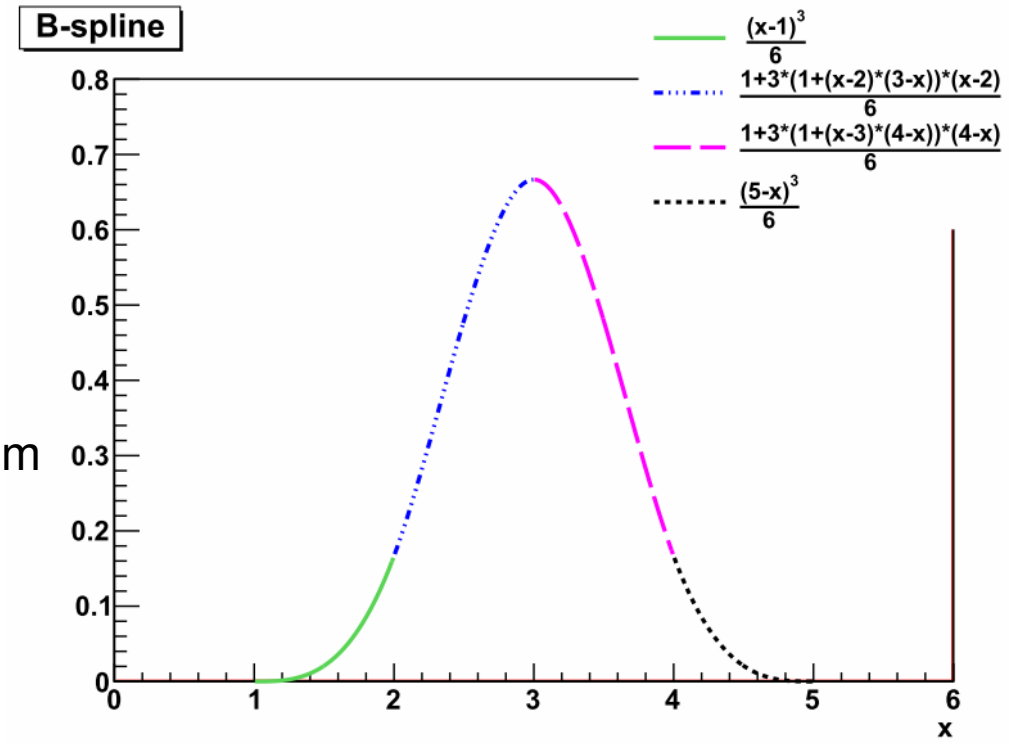
Fredholm integral equation

$$g(y) = \int_a^b A(y,x)\, f(x)\, dx + b(y)$$

$g(y)$	$A(y,x)$	$f(x)$	$b(y)$
Measured image parameters	Response-Matrix -> MC-Simulation	Sought-after energy	Background

Input parameter

- Image parameters for the Fit
- Number of Bins
  for the resulting histogram
- Number of degrees of freedom
  for the regularization
- Number of knots
  for the discretization



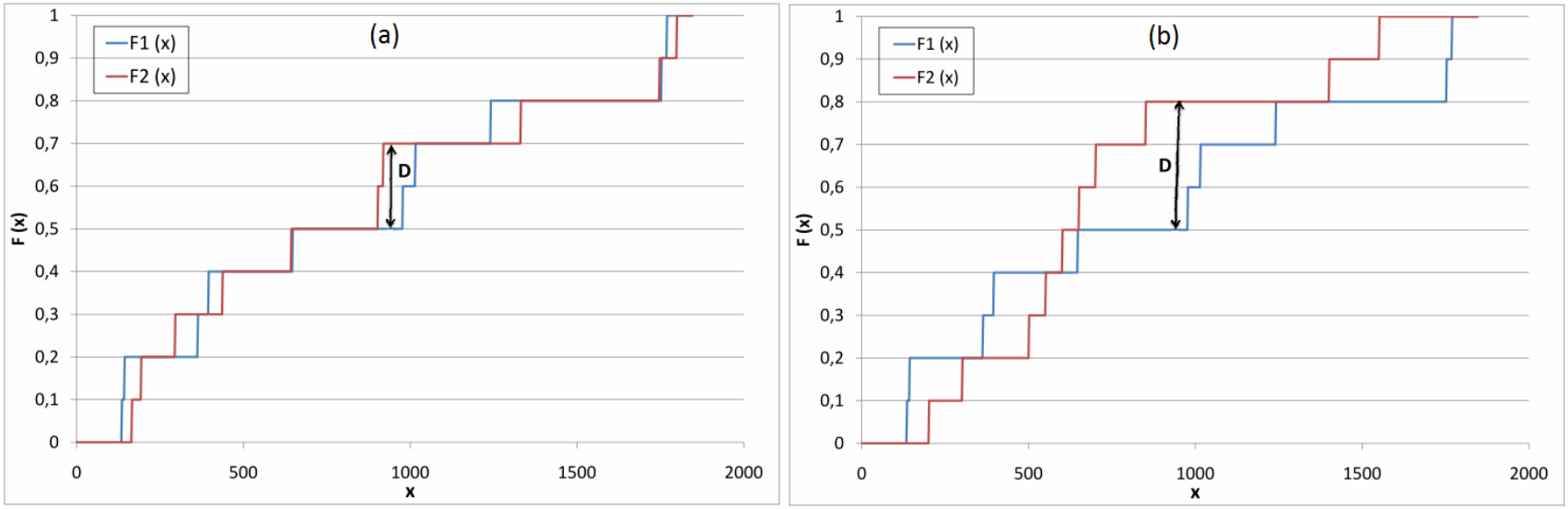
Example of a cubic B-Spline.

Two-sample Kolmogorov-Smirnov test

$$F_1(x) = \frac{\text{number of } x_i \leq x}{n} \quad \text{and} \quad F_2(x) = \frac{\text{number of } y_i \leq x}{n}$$

$$D = \sup_x |F_1(x) - F_2(x)|$$

Two-sample Kolmogorov-Smirnov test



Examples of the cumulative functions $F_1(x)$ and $F_2(x)$ and the Kolmogorov-Smirnov statistic D drawn from (a) the same distribution (b) two different distributions.

Two-sample Kolmogorov-Smirnov test

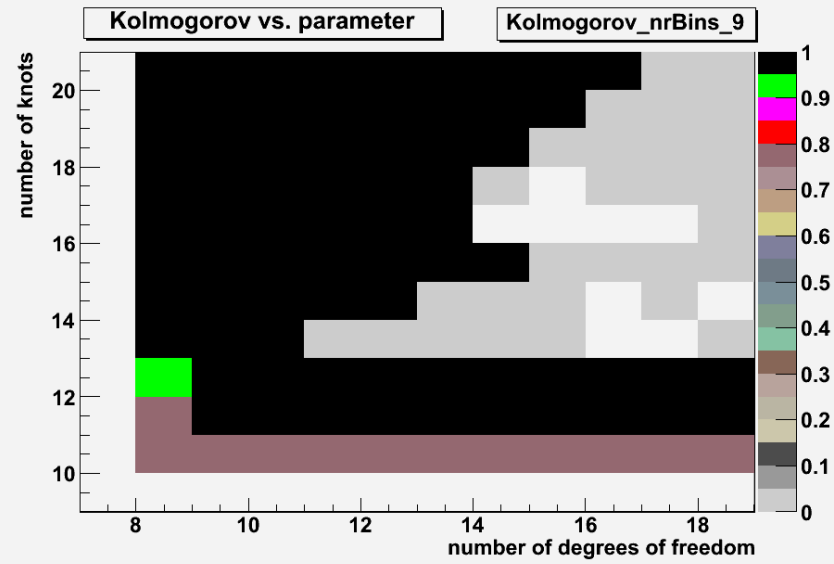
$$D^* = \sqrt{\frac{n}{2}} D \leq z$$

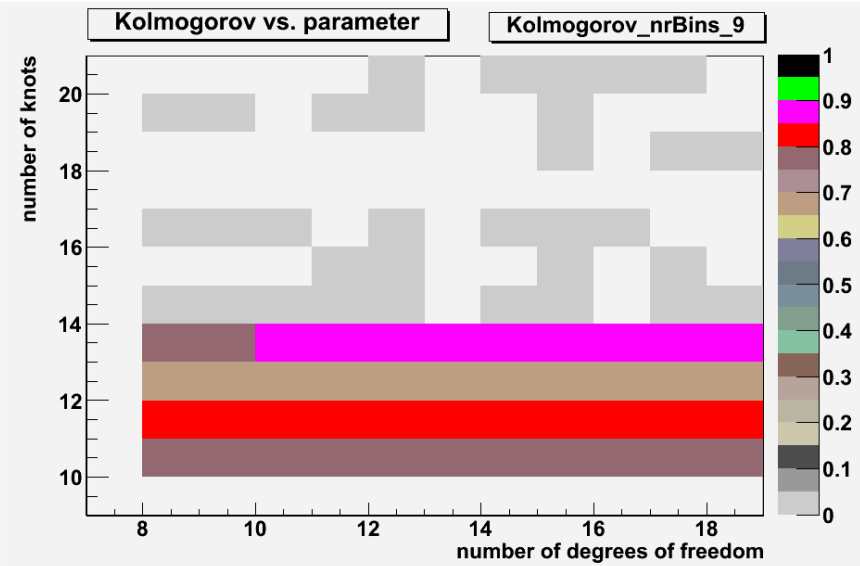
$$\lim_{n\to\infty} P(D^* \leq z) = 1 - 2\sum_{i=1}^{\infty} (-1)^{i-1} \exp^{-2i^2 z^2}$$

P	0.01	0.05	0.50	0.68	0.95	0.99	0.999
D*	0.44	0.50	0.83	0.96	1.36	1.62	1.95

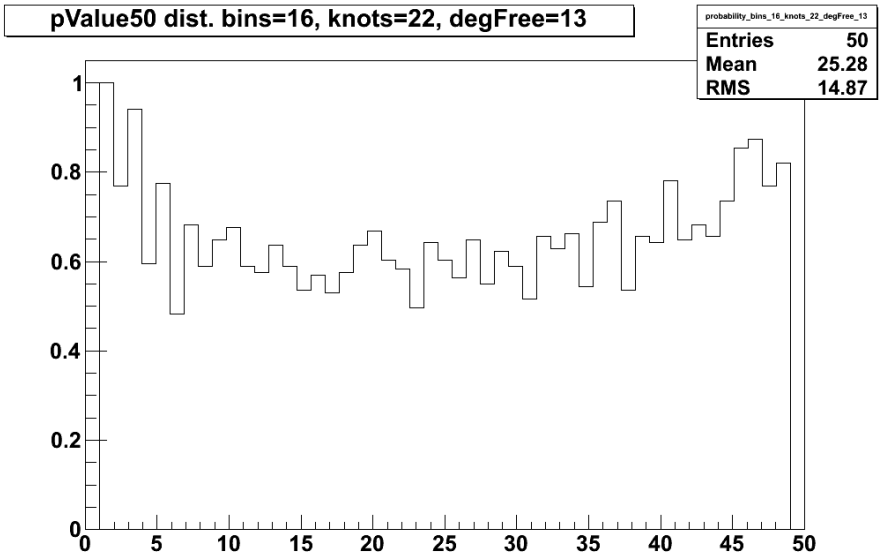
Critical values of D* with their respective probability.

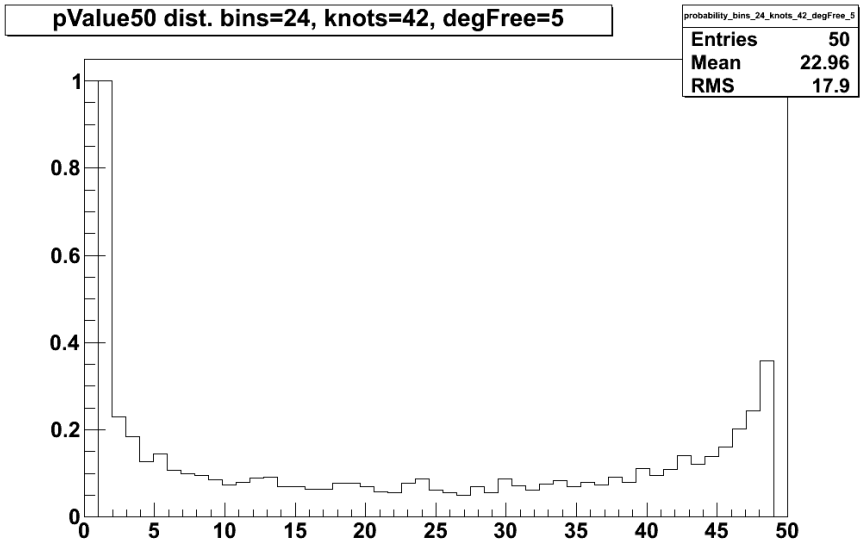
Two-sample Kolmogorov-Smirnov test





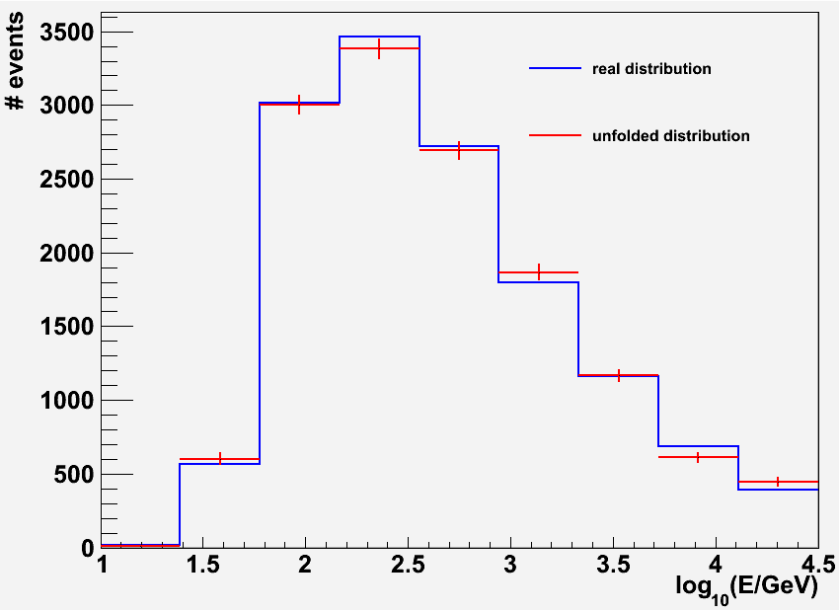
Distribution of the p-value





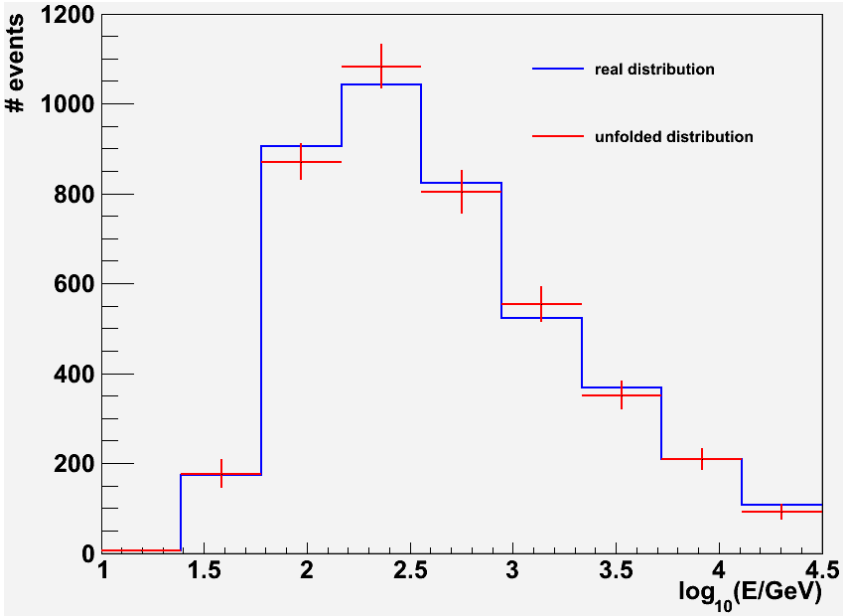
Comparison of the distribution of the p-value between a good result (a) and a worse result (b).

Resulting histograms



Fit variables:

Size and MaxHeight



Fit variables:

Size and Zenith

Interested in TRUEE?

- Download:
  https://svn.e5.physik.tu-dortmund.de/repos-file/TRUEE/

  login: desytruee
  pwd: unfoldingtruee

  Please check the current release.

- Several utilizations: MAGIC, IceCube, LHC, …