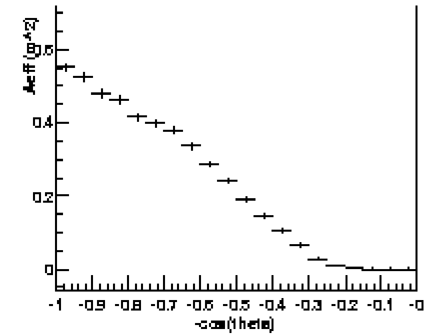
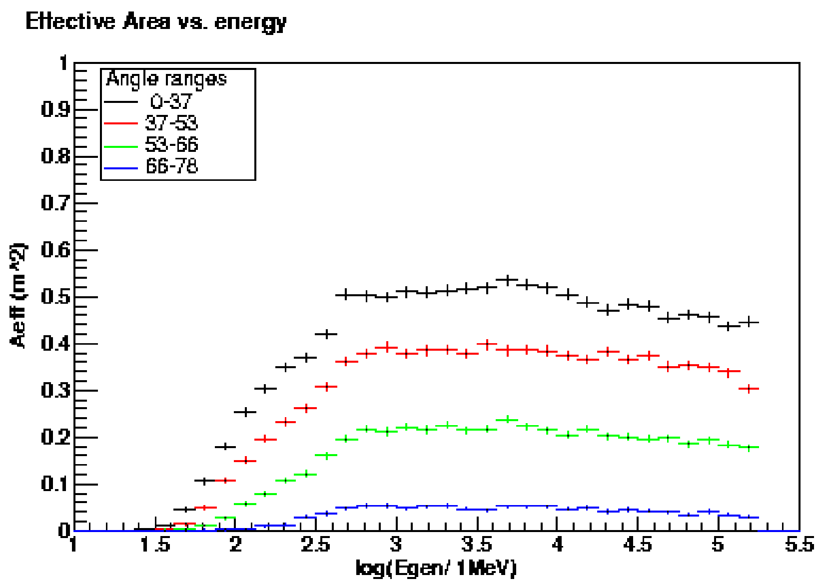
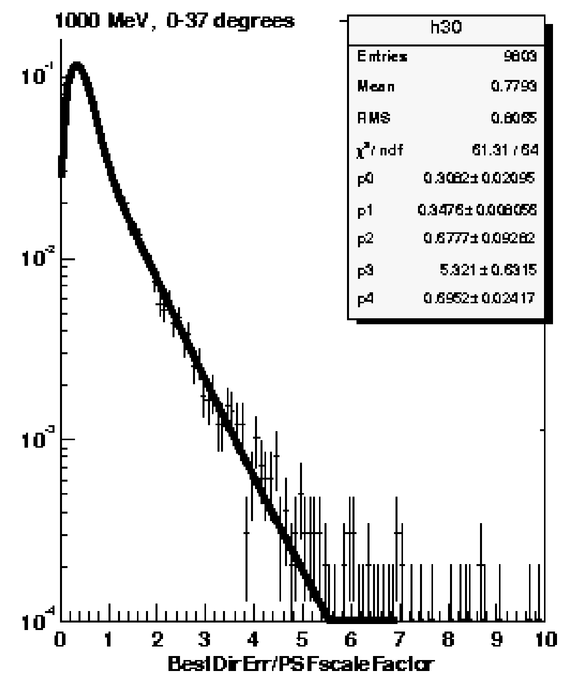
PSF revisited

- Current representation is based on the 4.7M generated using the all_gamma source
- Binned in ΔE/E=3.16, delta cos theta=0.2
- Generated during hectic weekend before DC1

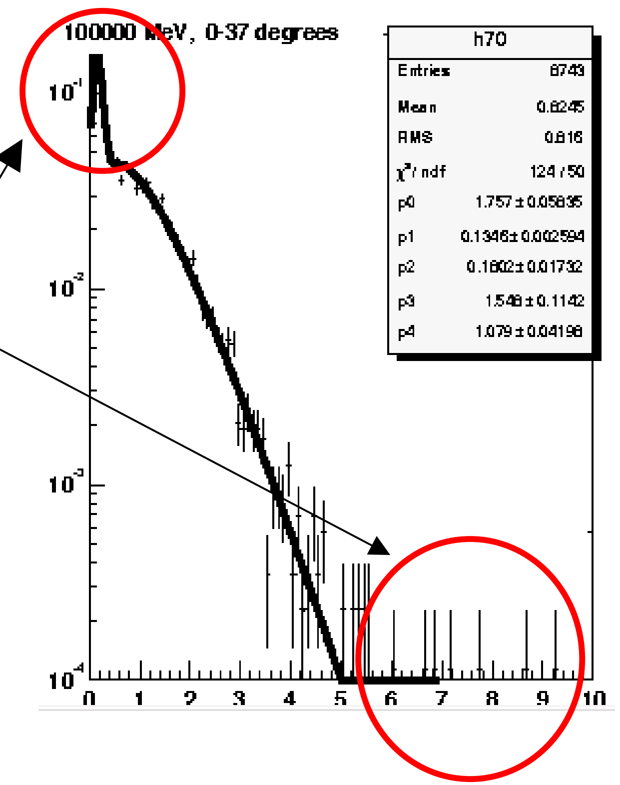






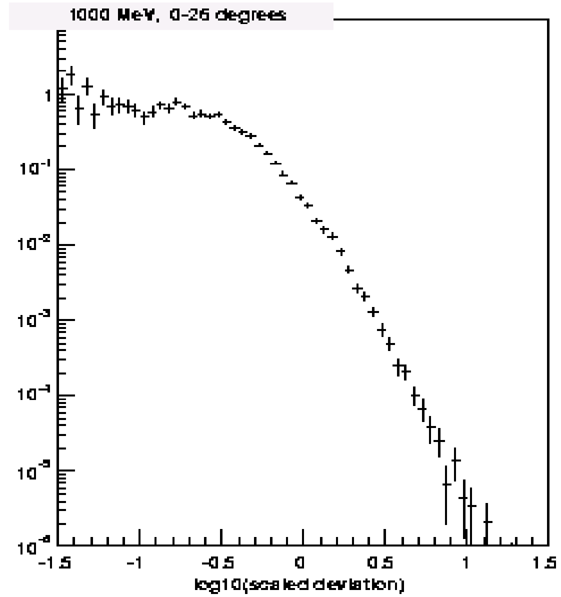
Why change?

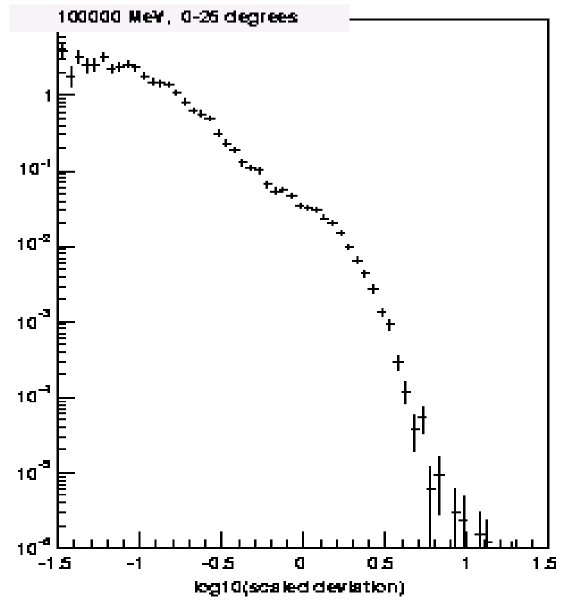
- The ad hoc 5-parameters PSF function (gaussian + power law) not very intuitive, poor fit to the tail. It is not very stable, requires pre-fit to determine parameter estimates.
- Strange behavior at 100 GeV to investigate, made hard by representation, histograms in the deviation itself



A different look

- Plot the log of the psf *density* vs. the log of the deviation
  - psf density: probability/unit solid angle
- Good statistics for both small and large deviation (factor of 100!)
  - small: constant
  - large: straight line indicates power law, not exponential
- 100 GeV plot shows clearly two components.





A function inspired by electronics

This looks like the output from a low pass filter (A “Bode plot” of log response vs. log frequency). That function is just the inverse of a polynomial in ω.

Relate this to the Gaussian: if both projections are gaussian with variance σ^2 then the distribution in the angular deviation $\theta^2 = \theta_x^2 + \theta_y^2$ (small angle approx)

$$\frac{1}{N_{total}}\frac{dN}{d\Omega} = \frac{1}{2\pi\sigma^2}\exp\left(-\frac{\theta^2}{2\sigma^2}\right)$$

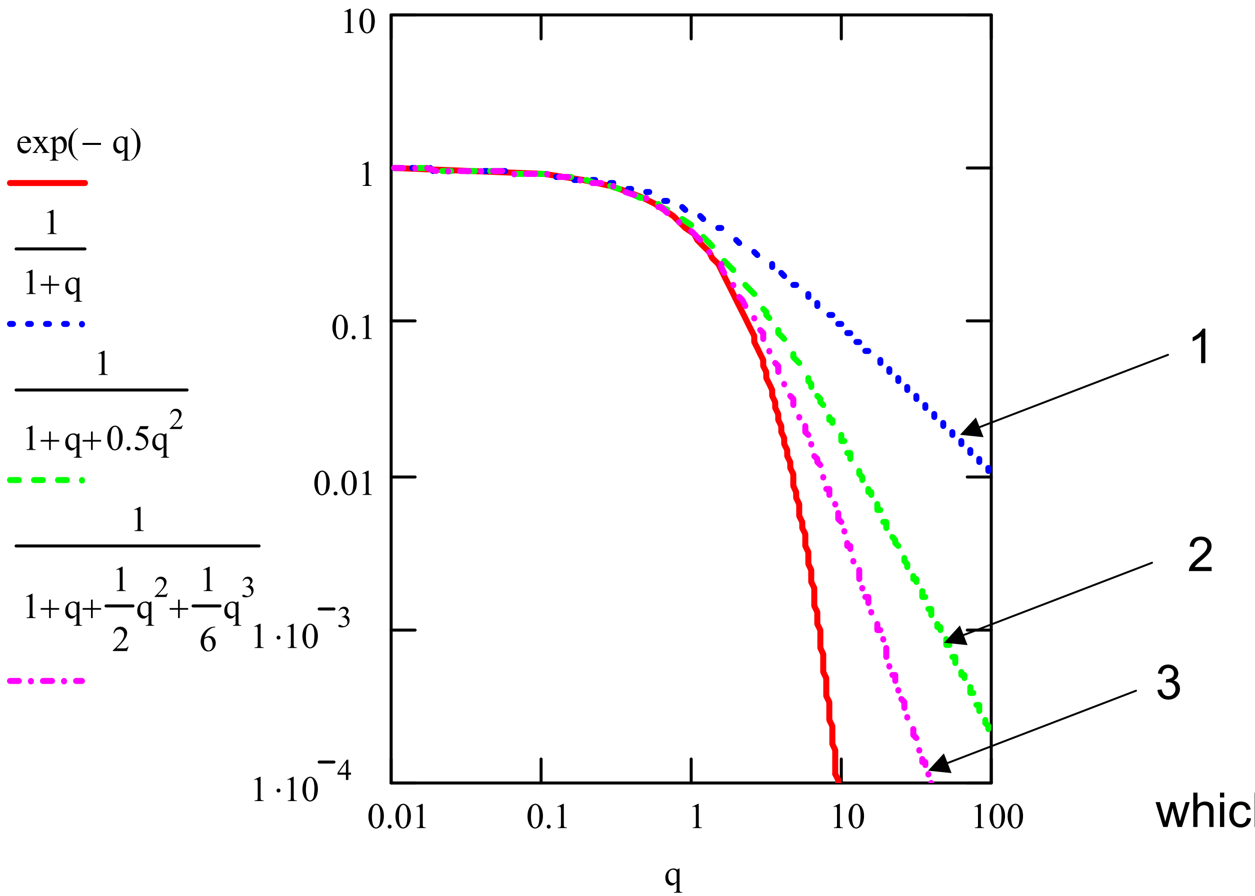
Define $q=\theta^2/2\sigma^2$: use this variable instead:

$$g(q) = \exp(-q)$$

is the properly normalized density

Exponential vs. polynomial

But this does not fall off like a exponential, as seen by the data. What if we use the power series for exp(q) and truncate it?



which do we see?

Try a minimal scheme: 3 parameters

x: (scaled) deviation

p[0] : normalization

p[1]: sigma (determined by linear term)

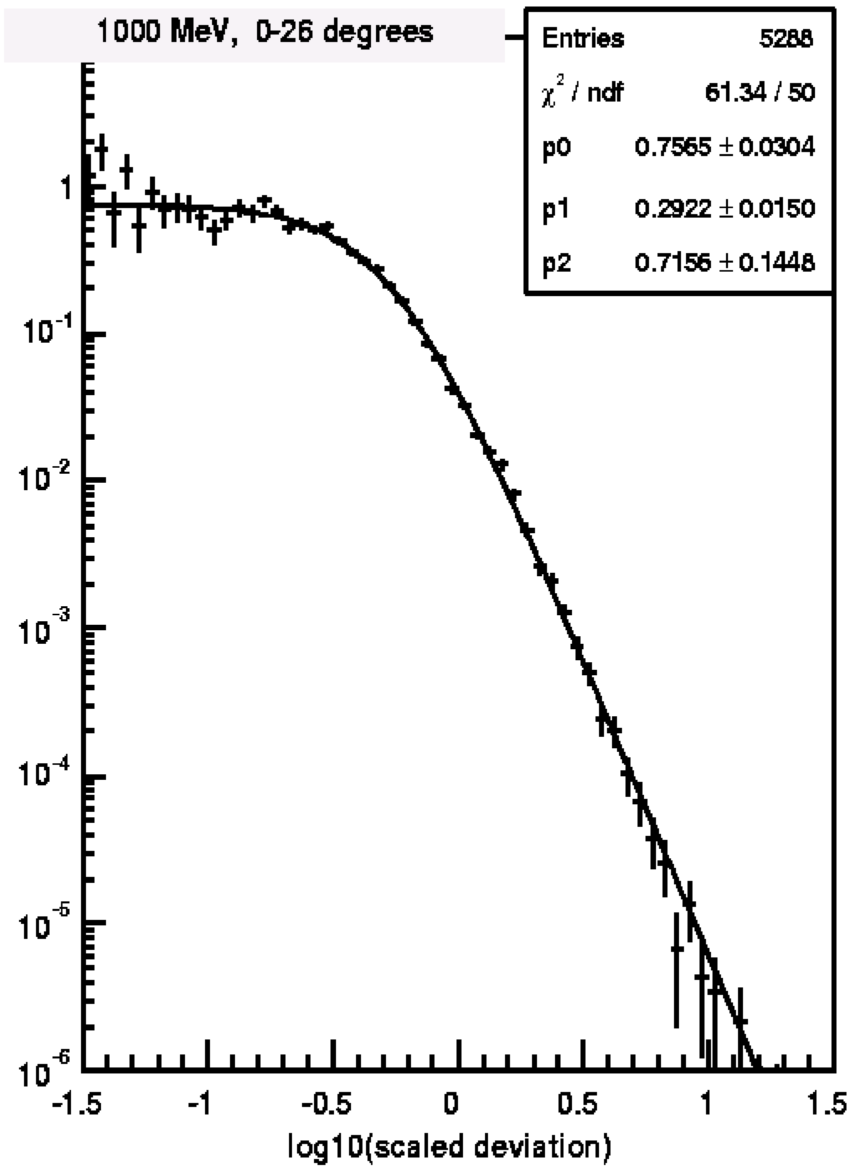
p[2]: shape (ratio of quadratic term to gaussian)

$$q(x) = \frac{1}{2}\cdot\left(\frac{x}{p_1}\right)^2 \qquad f(x,p) = \frac{p_0}{1 + q(x) + 0.5\cdot p_2\cdot q(x)^2}$$

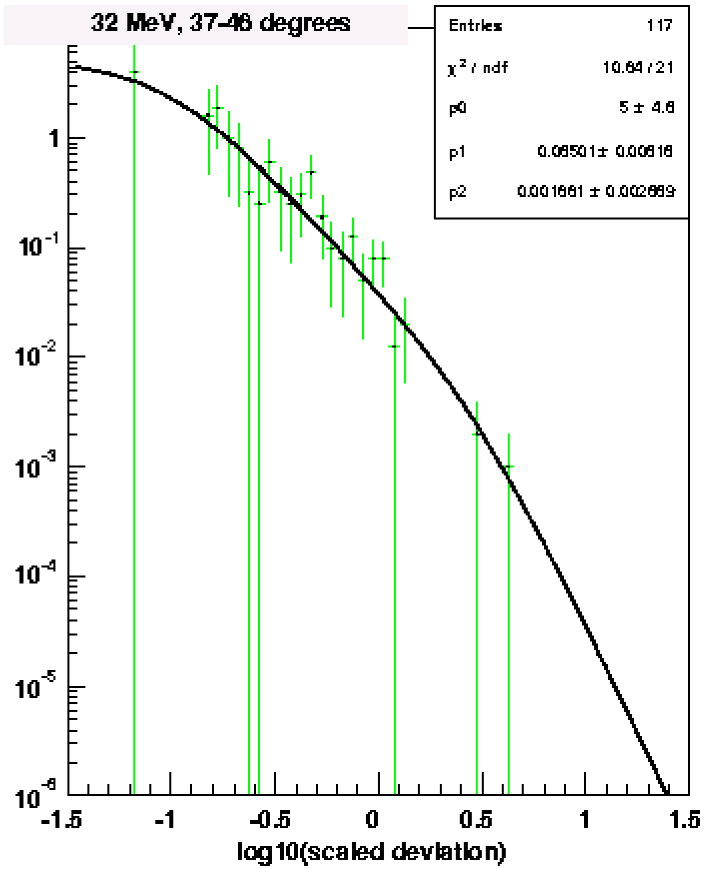
One advantage: analytic, so integral exists in closed form. Easy to derive shape parameters, like 68%

The results: first look at 1 GeV

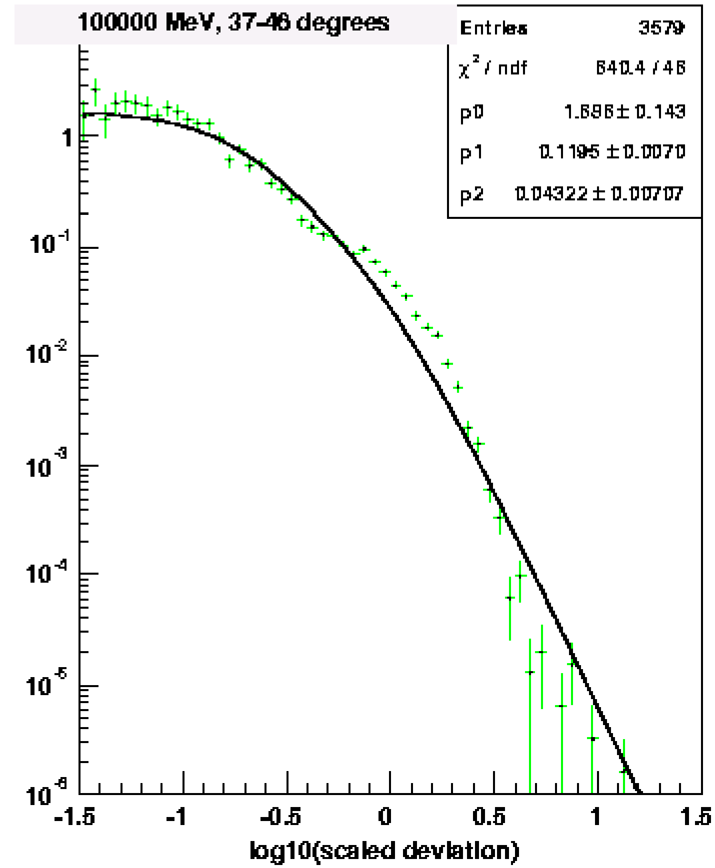
- good fit: slight overestimate at high end, (which could be corrected with a cubic term), but density is very small here.
- In general, quite stable. Only seems to require ~500 events for good representation.



Some “bad” ones

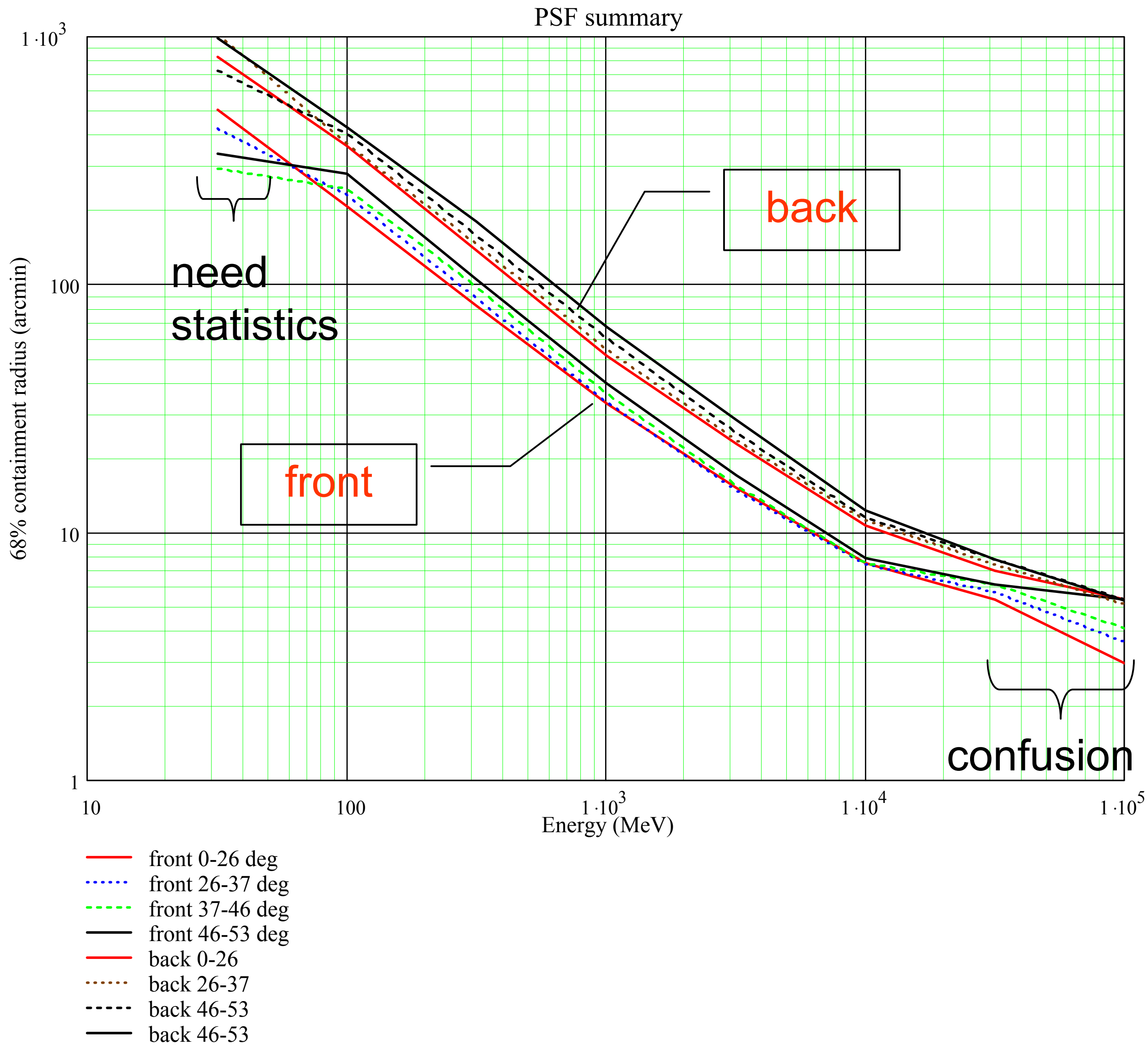


Not enough data—need a larger run for <1 GeV



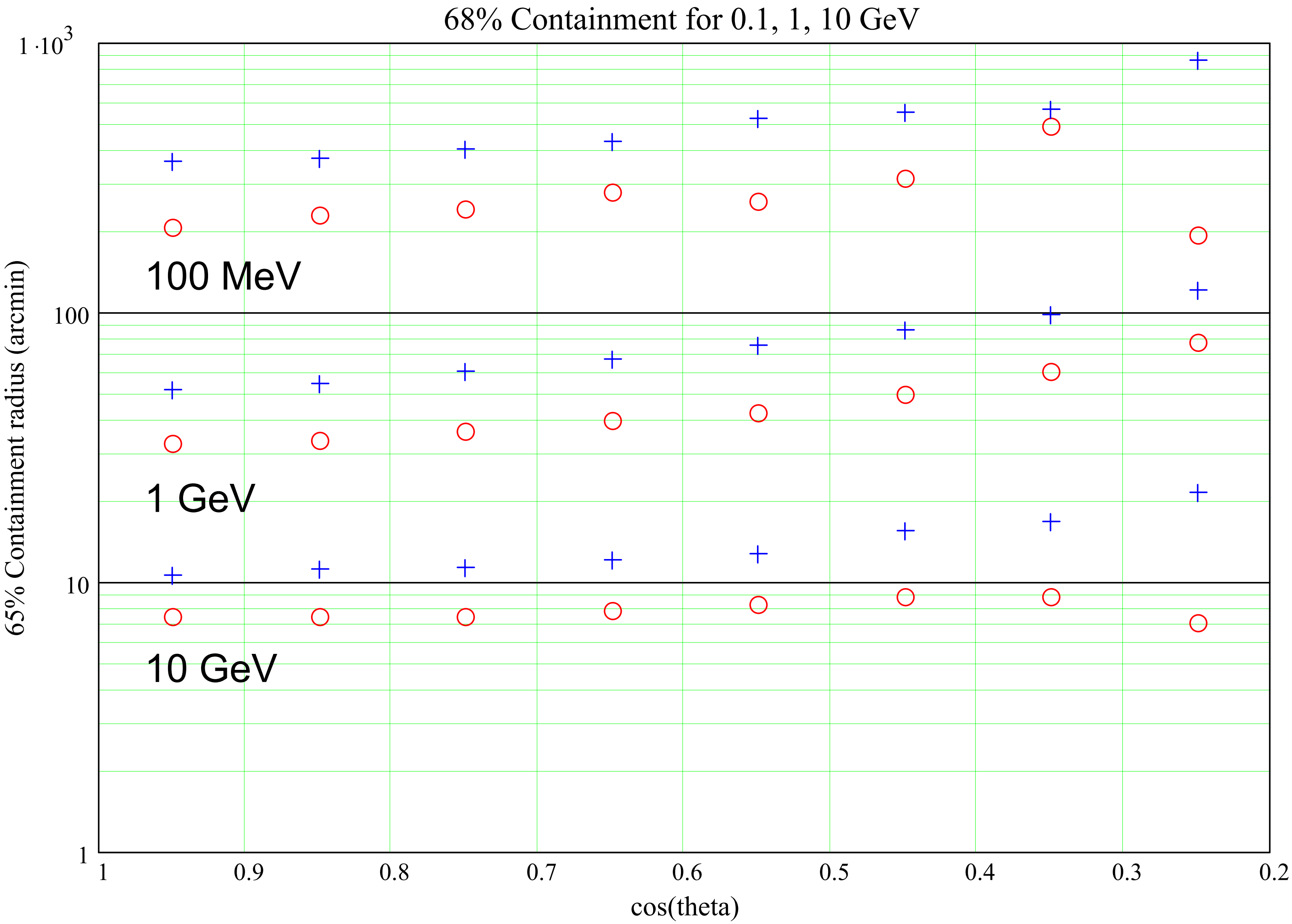
Track fit problem, two components

68% summary

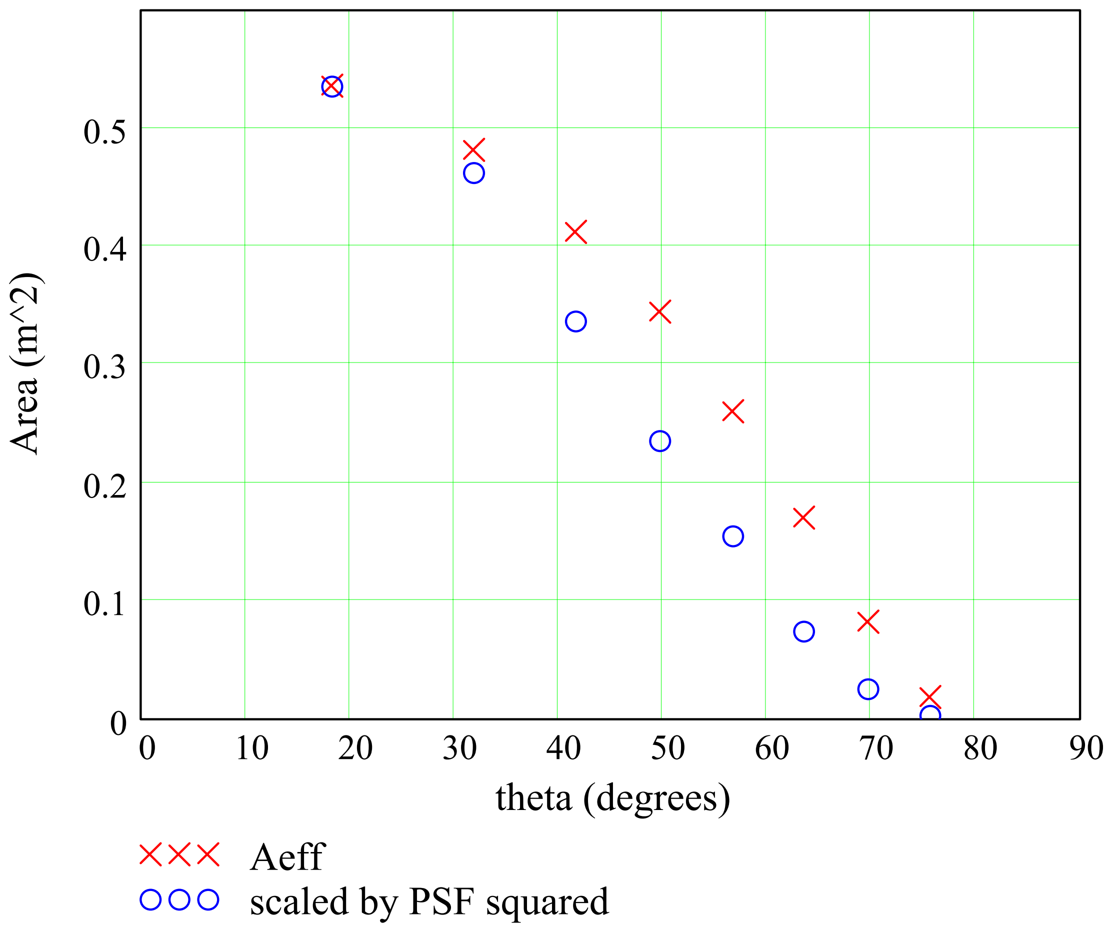


PSF summary
68% containment radius (arcmin)
Energy (MeV)
1 ·10^3
100
10
1
10
100
1 ·10^3
1 ·10^4
1 ·10^5
need statistics
back
front
confusion
front 0-26 deg
front 26-37 deg
front 37-46 deg
front 46-53 deg
back 0-26
back 26-37
back 46-53
back 46-53

Angular dependence in more detail



Redo the FOV calculation (for 1 GeV)



Summary

- Where to find this stuff
  - Code: Package is in cvs at users/burnett/THBanalysis, programs psf and psf2 tag v6.
  - These results (except for summary plots) http://glast.phys.washington.edu/DC1/THBanalysis/v6/data
- What's to do
  - A new run with better statistics for E<100 MeV
  - Understand track-fit problem with E>10 GeV