The IceCube Reconstruction IceRec

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IceCube Berkeley meeting, March 2005

IceRec Group

- Close collaboration with DataClasses/IceTray group (Erik Blaufuss, Tyce DeYoung, Troy Straszheim...)
  - containers of and access methods to data, eventviewer etc
  - i/o of IceCube data (monolith-, fat-reader) and AMANDA data (F2K-, TWR-reader), Andreas Gross and Peter Steffen will help
- First IceRec activities started ~ Sep 2004
- Kick-off work-shop in Maryland Nov 2004
  - first results
  - plan of software releases
  - standards : technical/ coding, documentation and testing

- Active module authors and contributors in PY03: Christopher Wiebusch, Damian Pieloth, David Boersma, Dave Atlee, Dima Chirkin, Dusan Turcan, George Japaridze, Hagar Landsman, John Pretz, Kotoyo Hoshina, Mathieu Ribordy, Michael Greene, Rodin Porrata, Sean Grullon, Simon Robbins, Spencer Klein, Tom McCauley, Tyce DeYoung

Status of IceRec

- FeatureExtractor, Analog2Hits, (TWR2Hits - in FE?), CleanHits

- FG methods developed using AMASIM muDAQ hits:
  - LineFit, DipoleFit, AmaJAMs
  - Tensor-of-Inertia
  - CFirst
- Muon-LLH-reco

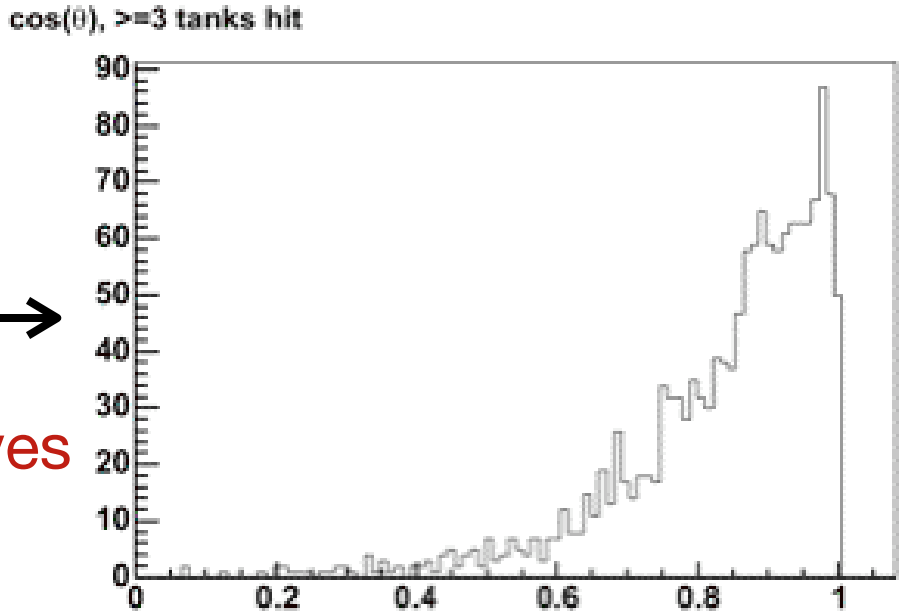
- reco-toolbox and test-bed (to measure properties and stability)

- Started: ReNew, CVertex, IceJAMS, generic LLHreco
- Largely done but not yet available: IceTop, Medusa, iPDF

- Further studies: for new muon and cascade algorithms
- Will start: Cascade-LLH, pattern recognition, tau, EHE, DirectWalk

Recent Issues

- Revisit algorithms for
  - IceCube pulses and hits
  - access to IceTop hits
- IceTop not yet in the official frame but working



- Technical problems with code archives
- No IceSim MC samples yet
- No WaveForms (ATDW, TWR) in production MC
- AMASIM MC samples (mu-DAQ) with IceCube geometry by Chihwa, Pat and Mike, many data samples e.g. I1 dcors, I4 and I4Ama dcors/ nusim, I16, I80...

http://www-zeuthen.desy.de/~schlenst/icecube/docs/ICEREC/index.html

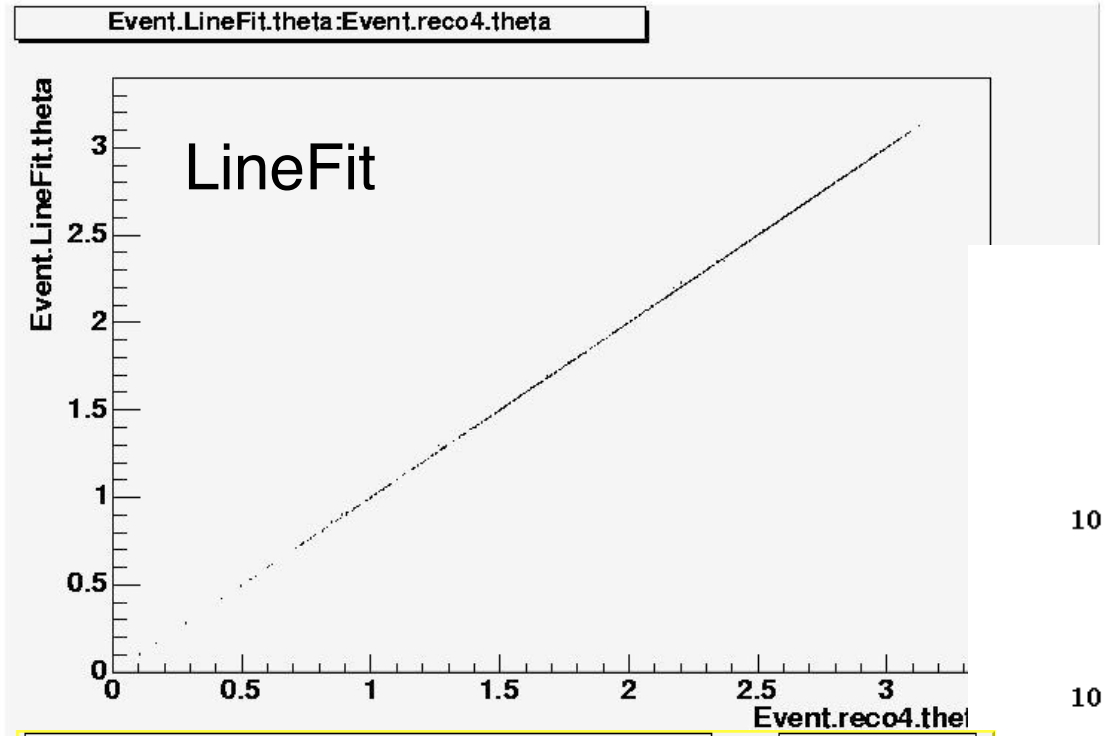
IceCube

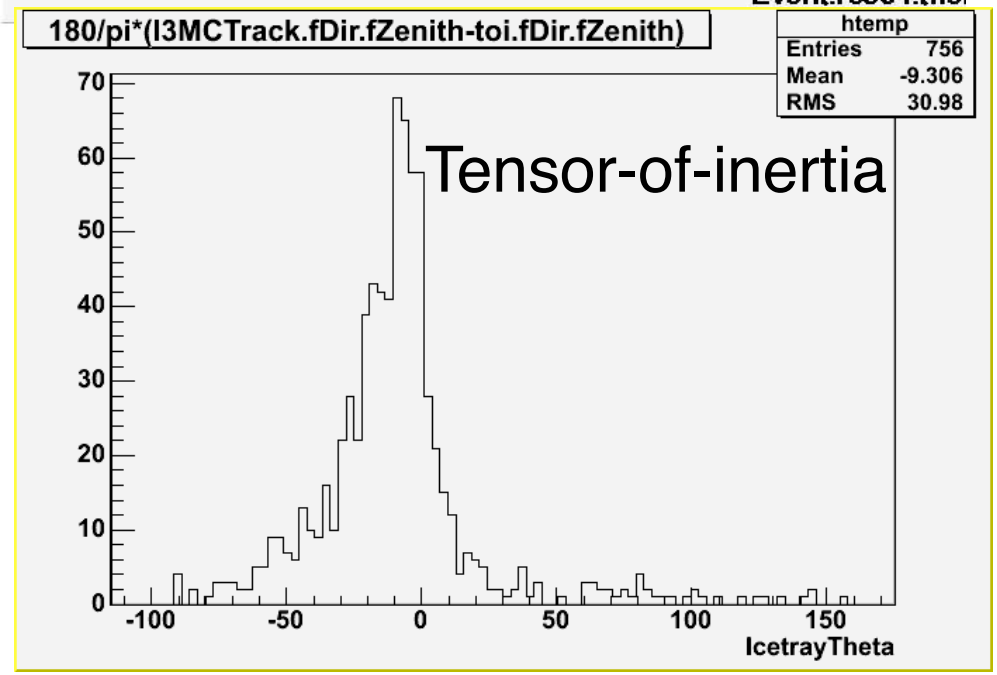
ICEREC contains the algorithms=projects (for the versions see ICEREC/.metatags) in the table below togethe following the coding standards and the results of the first physics tests.

Project	Code review	Results
amajams	D Pieloth, Jan 27, 2005	Evaluation and comparison with SL
cfirst	D Pieloth, Feb 18, 2005	Comparison with SL and MC and low E MC
cvertex		
dipolefit	M Greene, Mar 17, 2005	Comparison w SL for AMANDA and I4
directwalk		
icejams		
icetop		
linefit	M Greene, Feb 24, 2005	Comparison w SL for AMANDA and I4
renew		
tensor-of-inertia	T Hauschild, Feb 21, 2005	Comparison with MC and recoos
muon-llh-reco	D Boersma, Mar 16, 2005	Readme and some result plot vs MC
llhreco		
FeatureExtractor		
analog2hits	P Niessen, Mar 7, 2005	
medusa		
reco-toolbox		
test-bed		

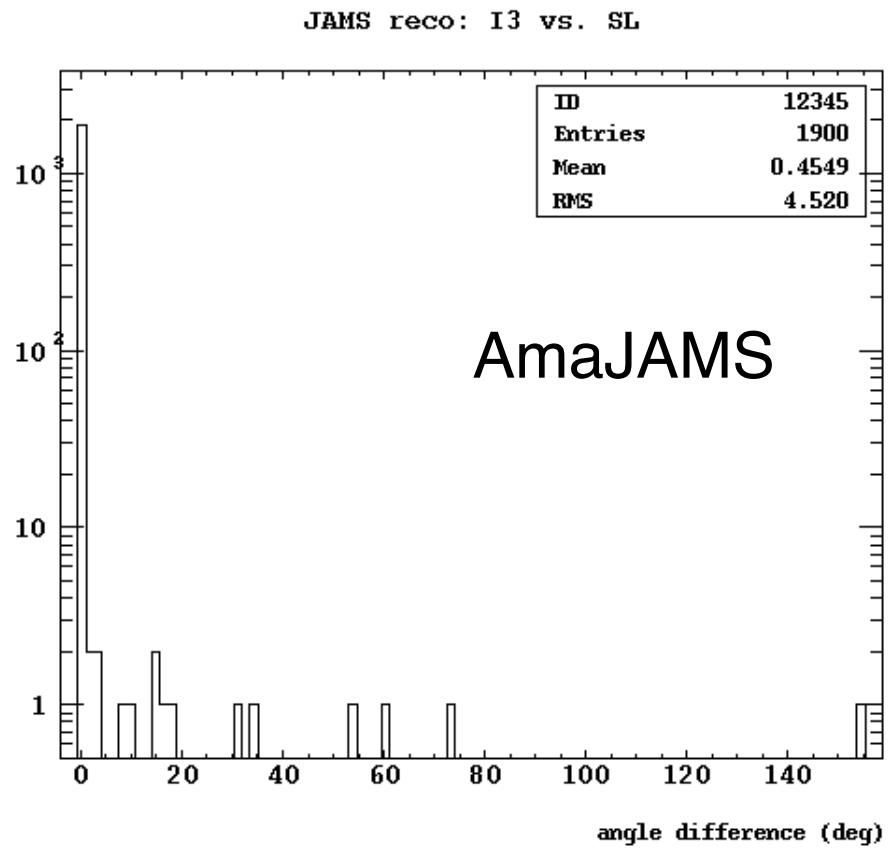
All build/ run on Linux and partially on BSDUnix – all with tests and documented, and code-reviewed

Reconstruction Results



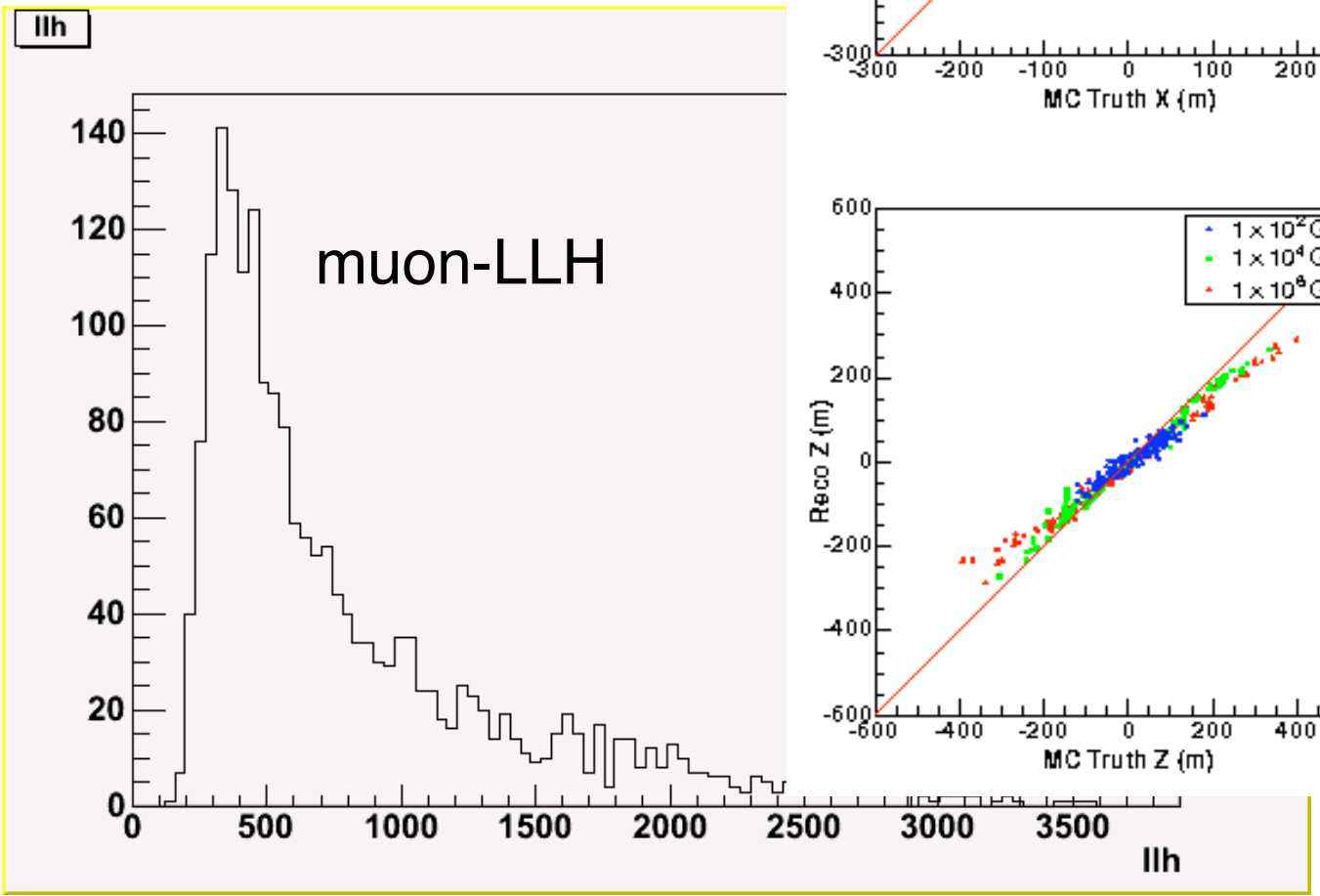


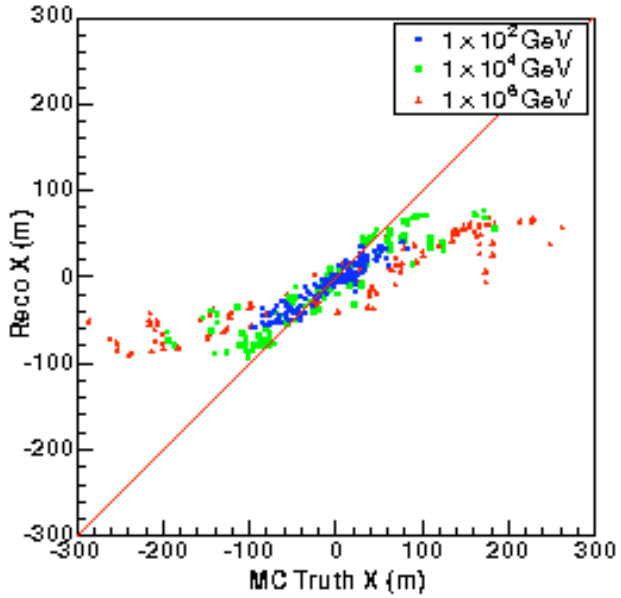
Comparisons with MC, Sieglinde and Siegmund

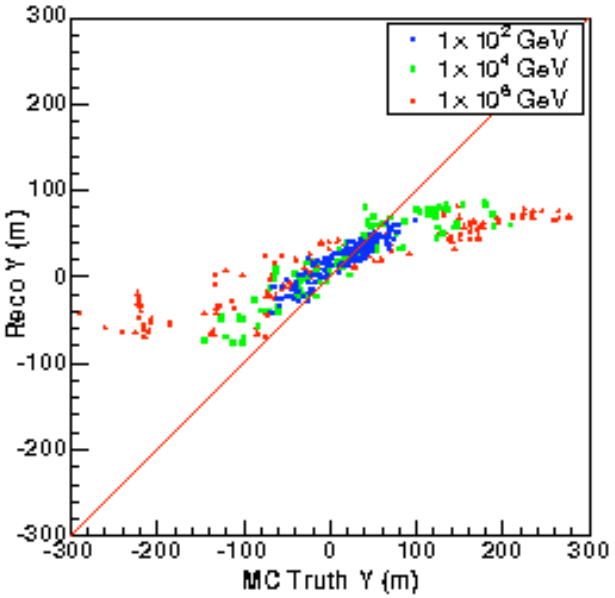


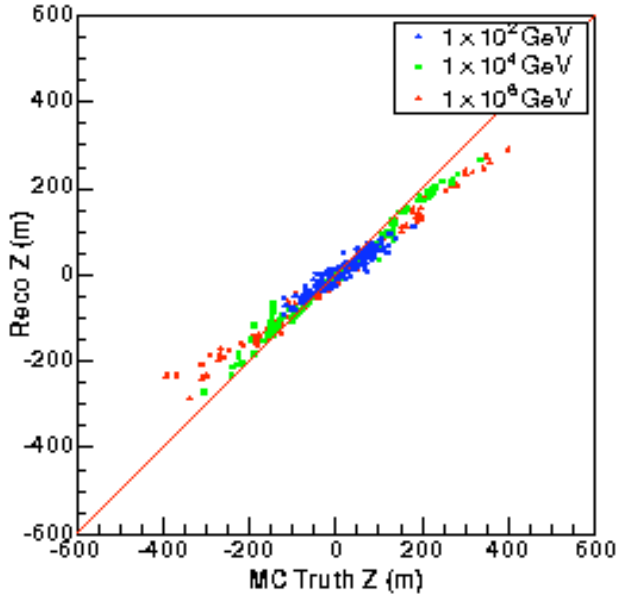
Reconstruction Results

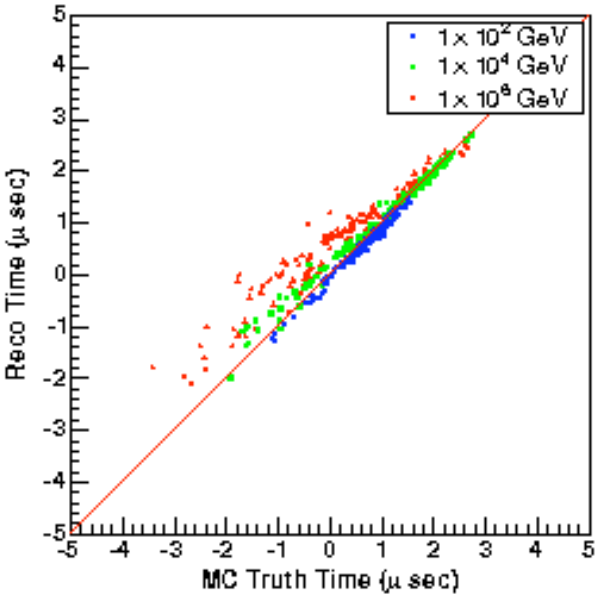
CFirst:
Comparison with MC







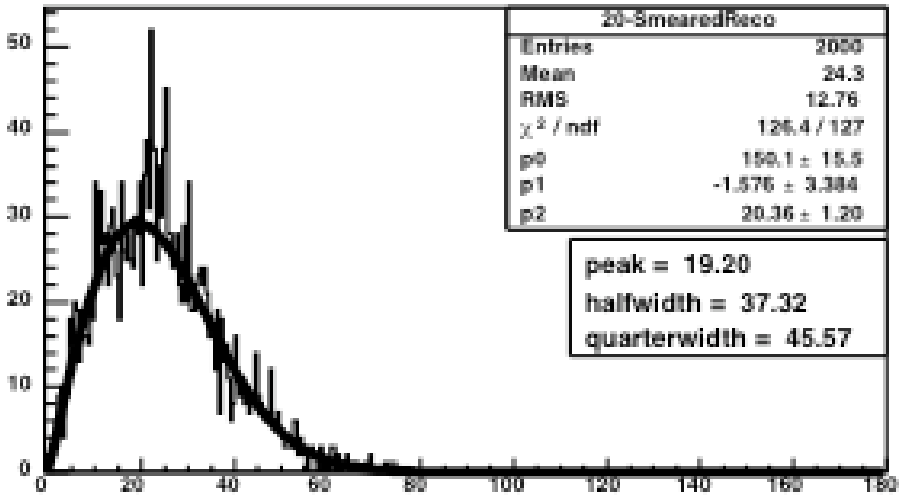


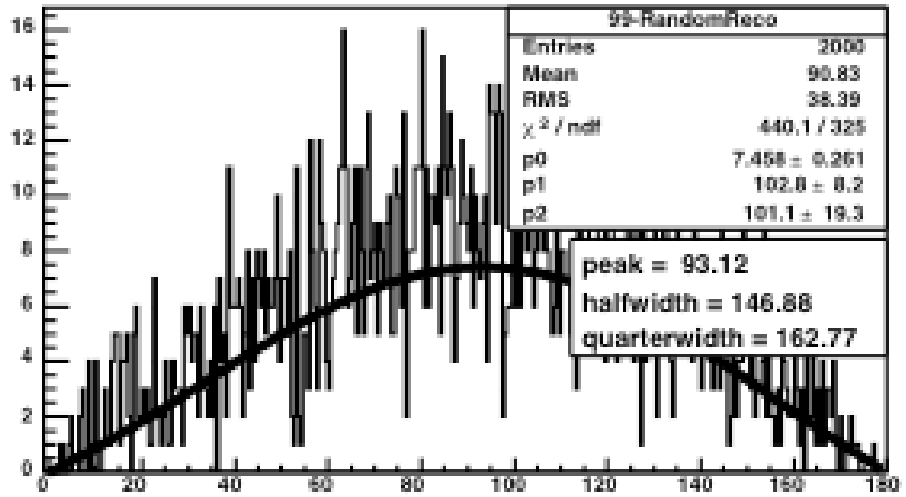


Reconstruction Test-bed

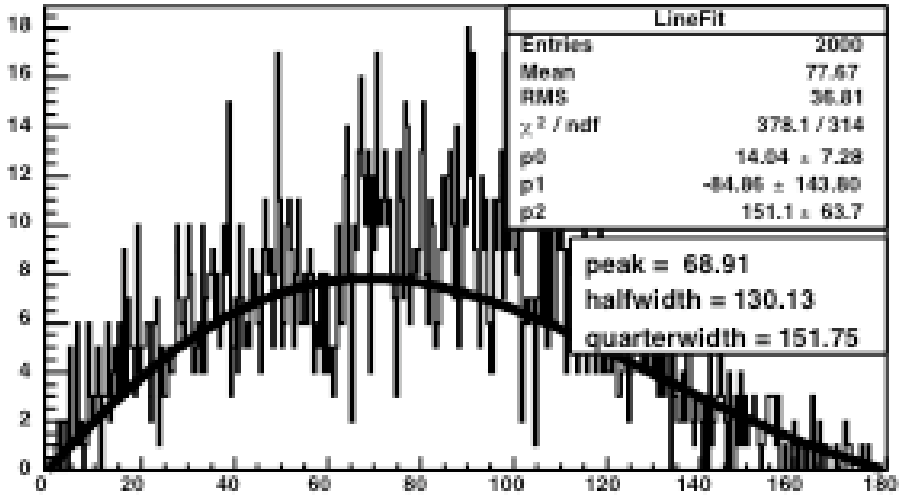
Nightly test of software and physics output

Test the test-bed

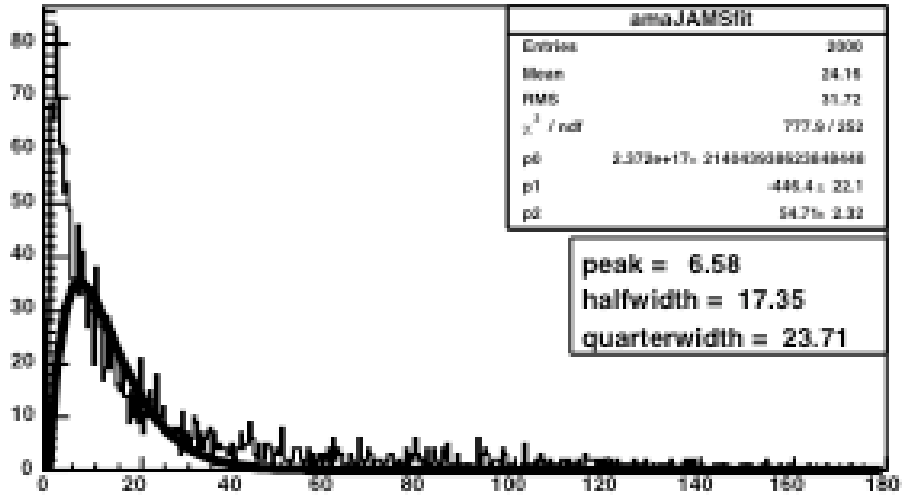




LineFit

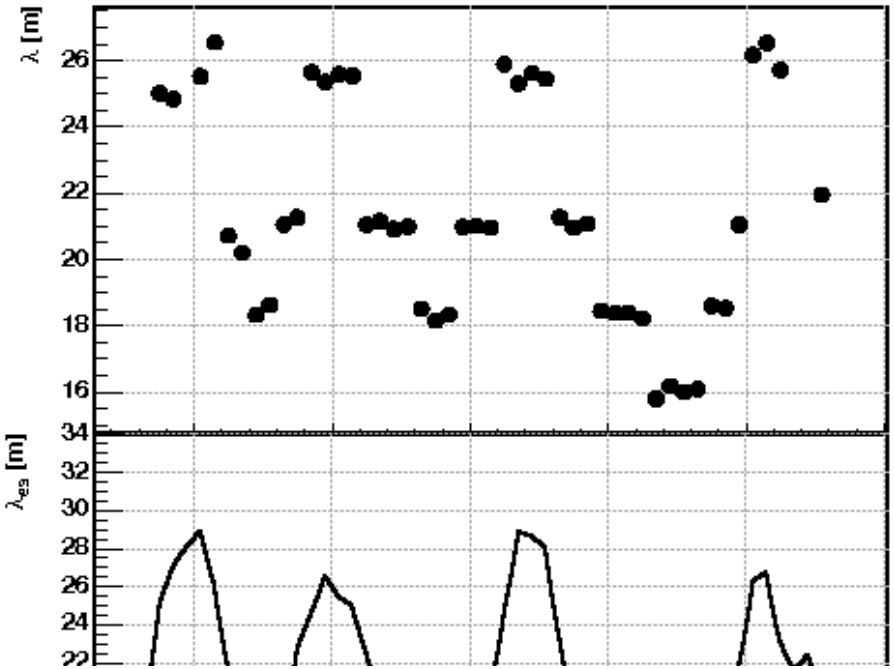


AmaJAMS



delta(space angle)

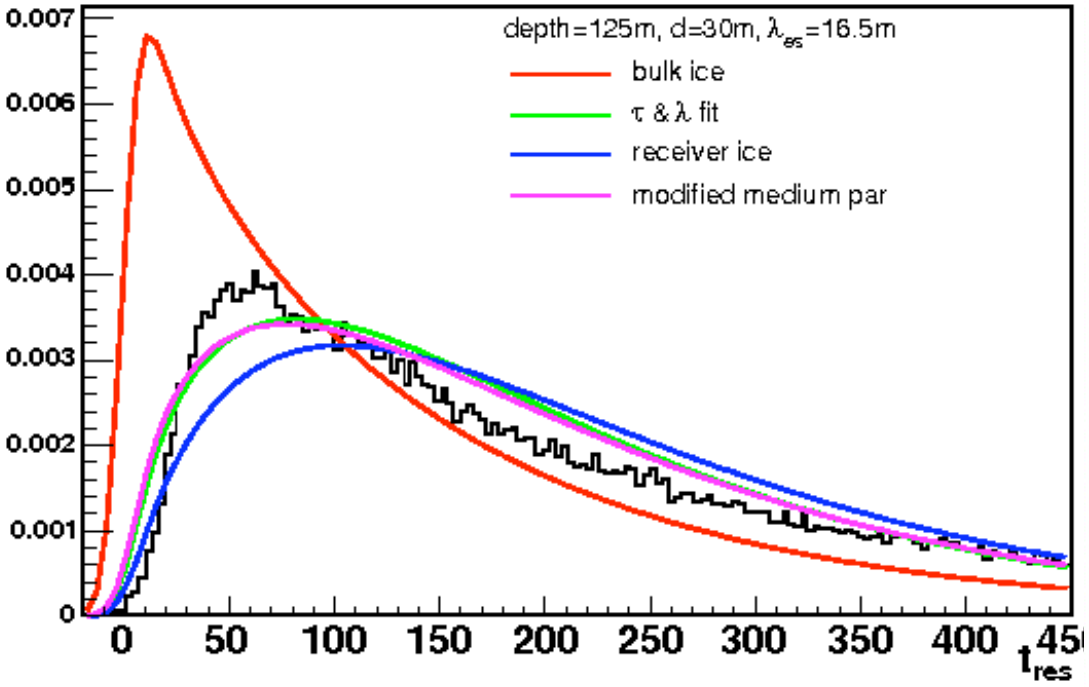
Photon Time Delay

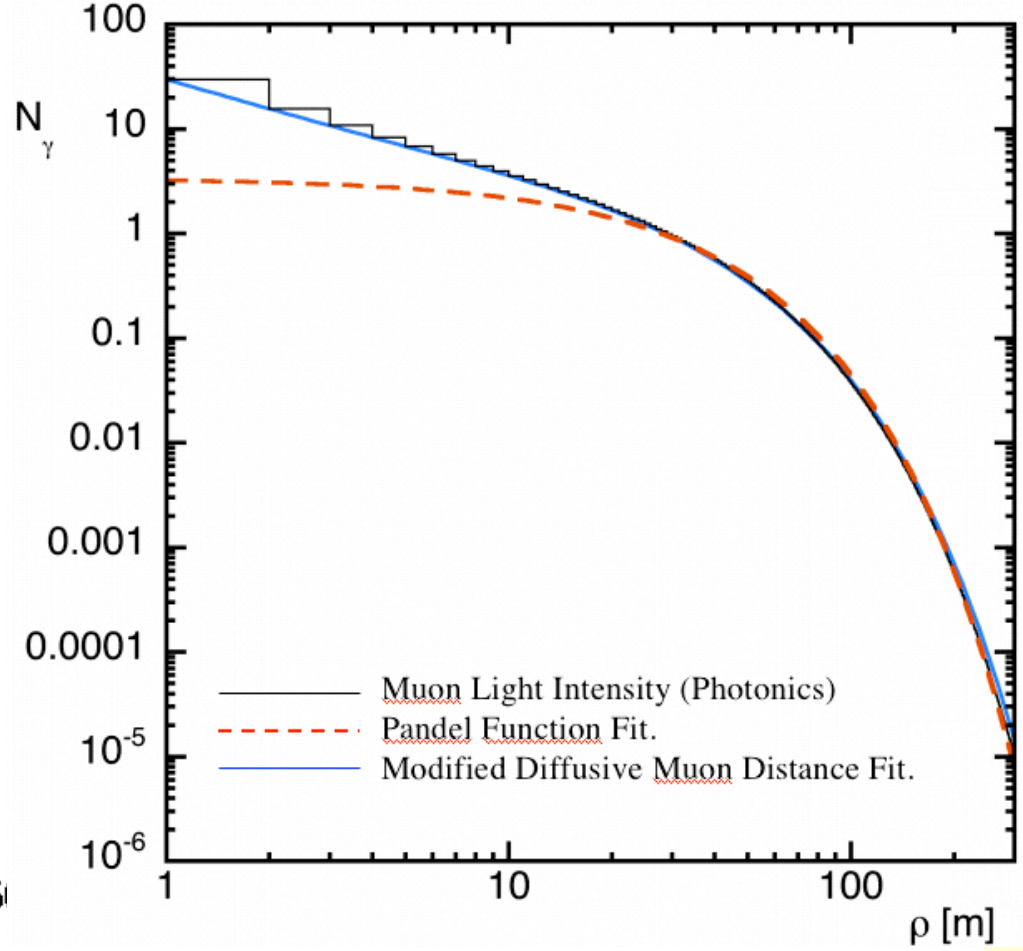


The event reconstruction in AMANDA is based on the PDF p, introduced in [3], which describes the probability that a photon reaches the distance R from an isotropic point-like emitter with a time delay $t \equiv t_{arrival} - t_{geom}$

$$p(R, t;\ \lambda, \tau) = \frac{1}{t}\left(\frac{t}{\tau}\right)^{R/\lambda} \frac{e^{-t/\tau}}{\Gamma(R/\lambda)} \qquad (1)$$

λ and τ are respectively interpreted as an effective scattering length and a time

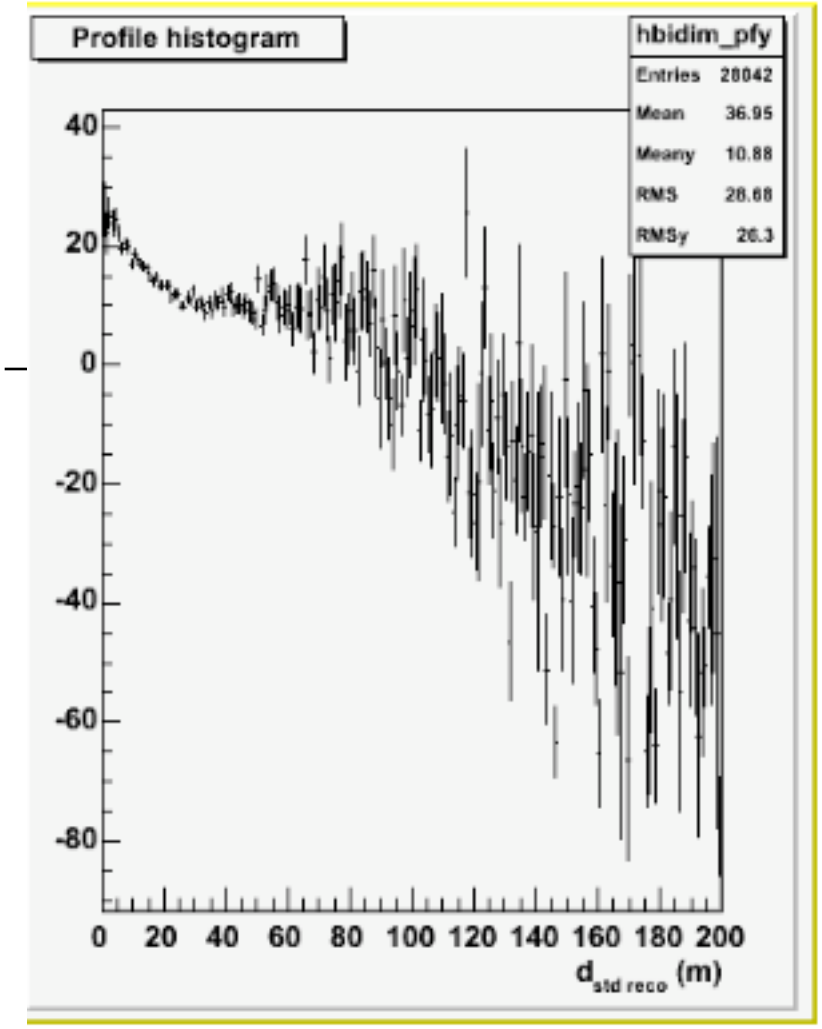


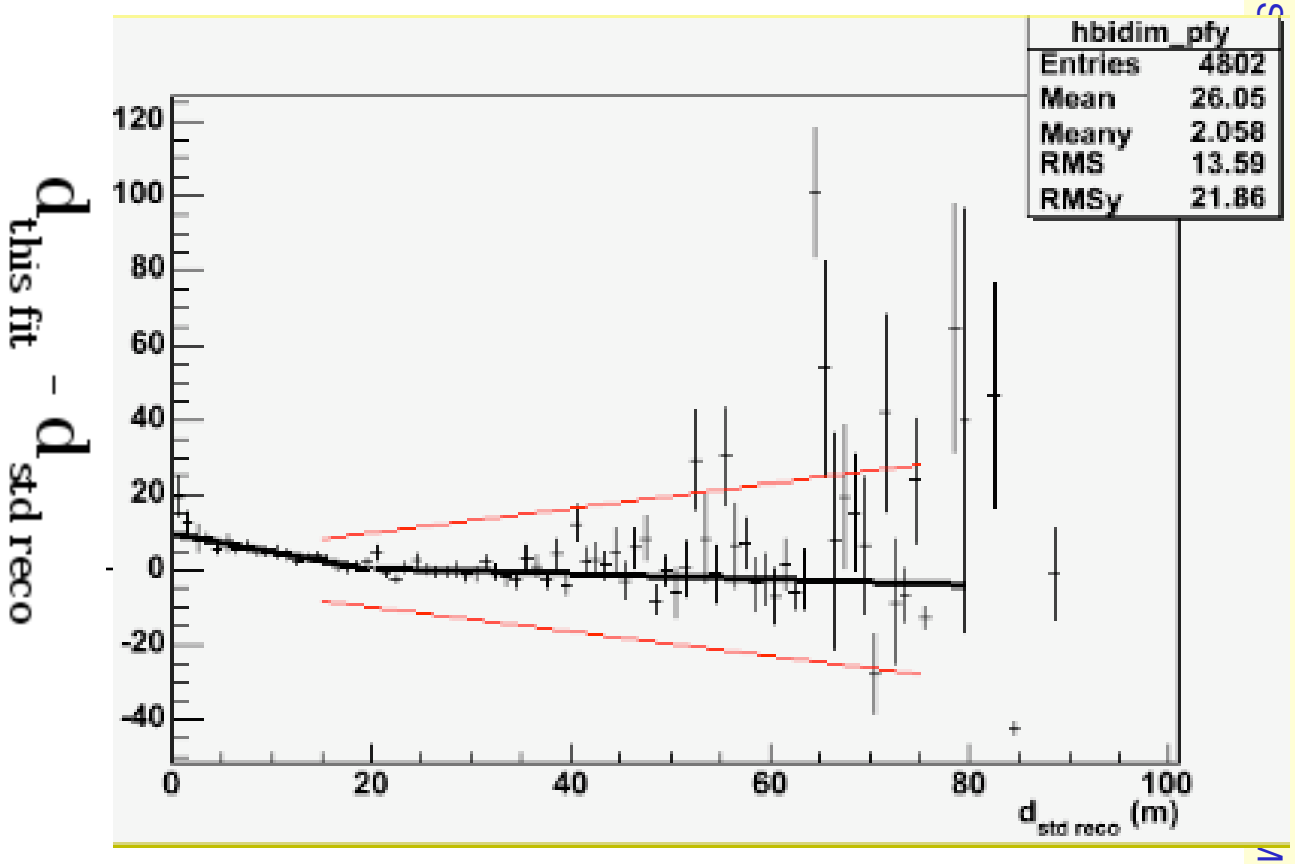


Usage of a better PDF

Reconstruction of UHE muons using TWR (OMs with 5 hits)

Standard 16-iterative LLH





Including inhomogeneous ice

Determination of distances with TWR makes better angular resolution

Summary and Outlook

- What do we have: IceCube and AMANDA hits, hit cleaning, FirstGuess methods for muons and cascades, a muon LLH method
  - use (typically) AMANDA analog readout, is tested on small AMANDA samples, is code reviewed and documented
- Started with the next steps: PDF improvements, generic LLH framework, IceTop, new algorithms
- And a list of things that we need with more strings (pattern recognition, tau-search, EHE)

- IceRec will be ready for on-Pole reconstruction of IceCube?!

- When will IceRec have a “complete” set of reconstruction methods for filtering and analyses (LLH, physics observables)?
  - (When) will IceRec replace SiegLinde?