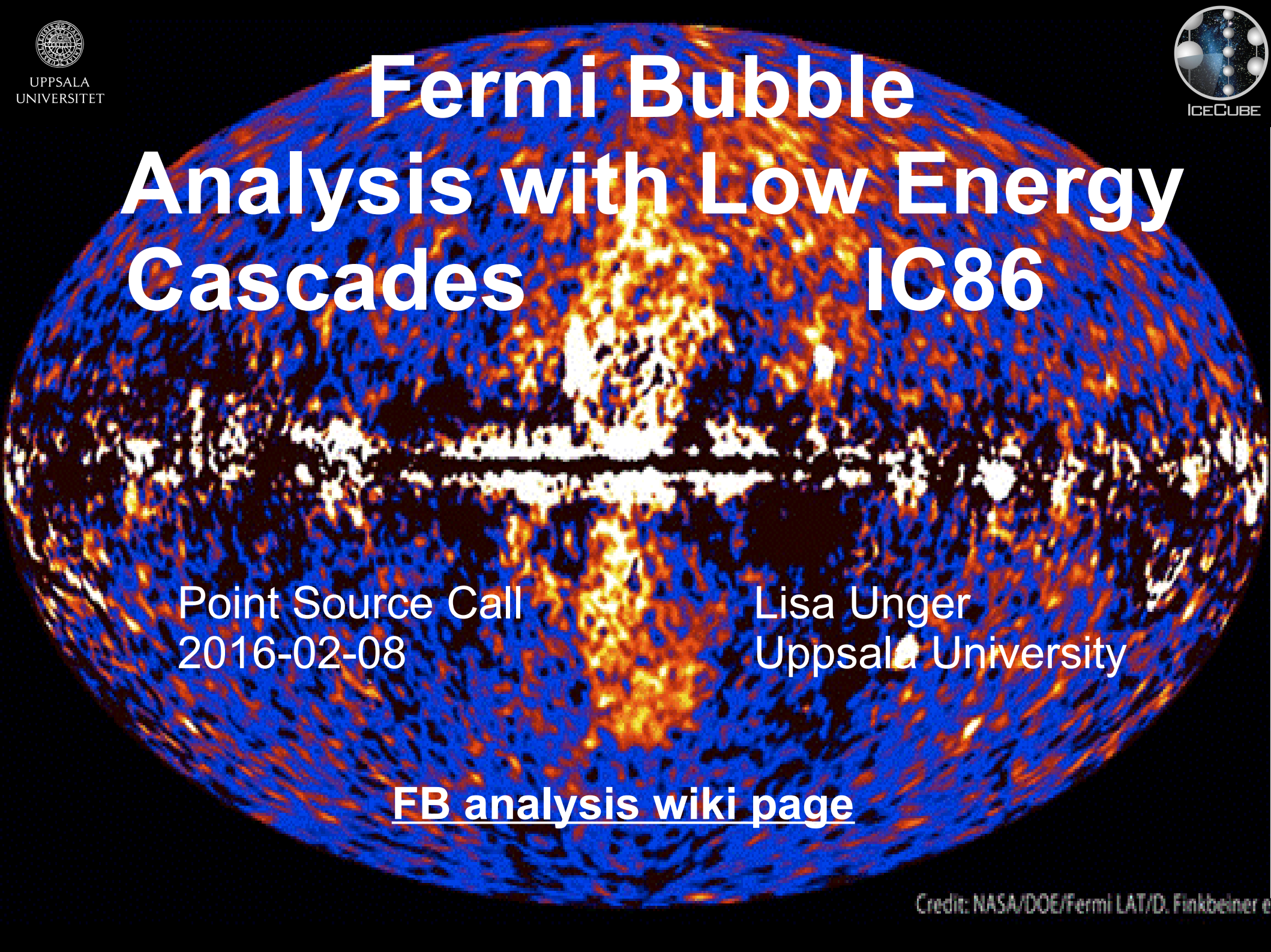
Fermi Bubble Analysis with Low Energy Cascades IC86



Point Source Call
2016-02-08

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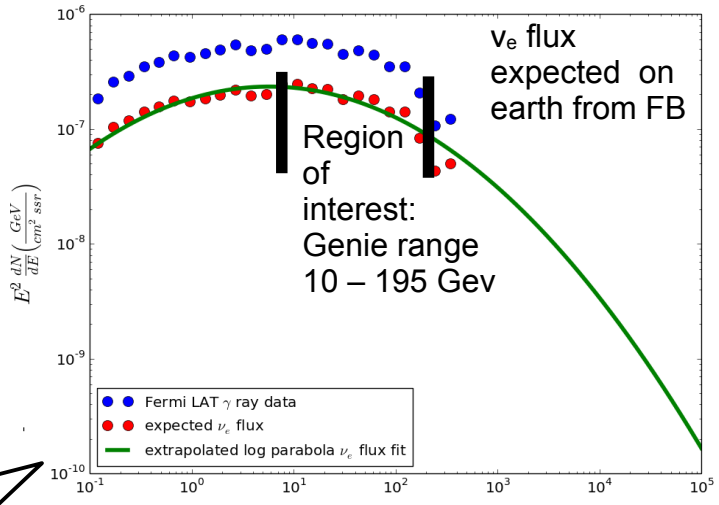
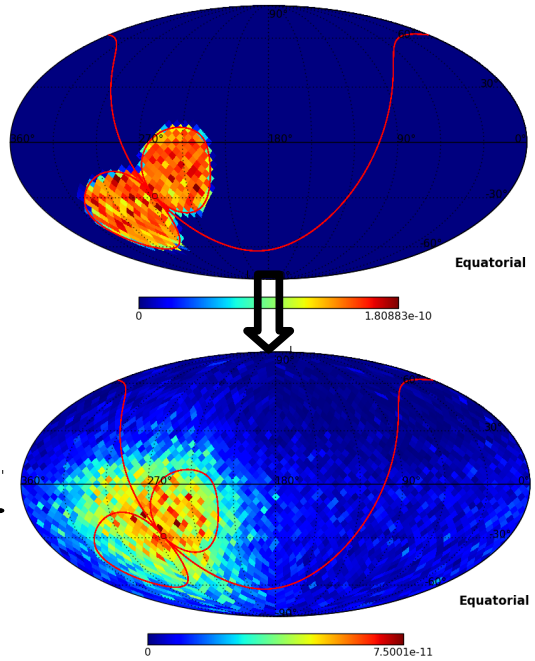
FB analysis wiki page

Reminder

Reviewer:
internal: Mike Richman
external: Spencer Klein

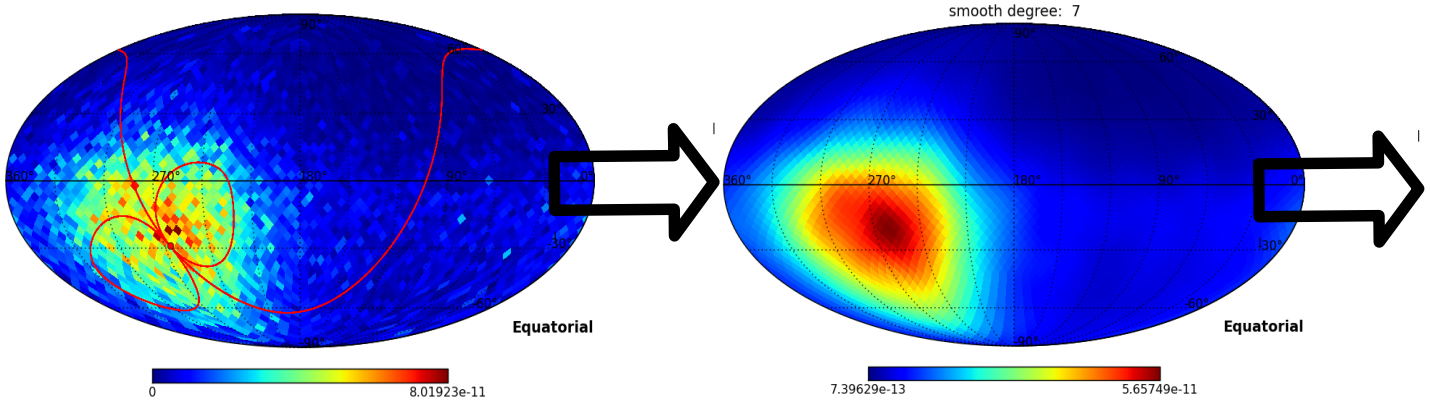
- Used data: IC86 2011
- Samples from Galactic Center WIMP Analysis with Cascades by Henric Taavola (wiki page)
- Low- and High Energy Data Stream (LE / HE)
- All ν - flavors genie simulation
- Events weighted with expected ν - flux from FB per flavor
- Events moved within Zenith bands into the FB area
- Reconstructed with Monopod

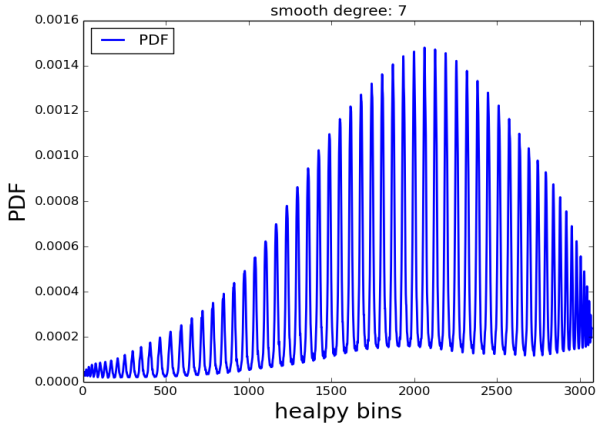




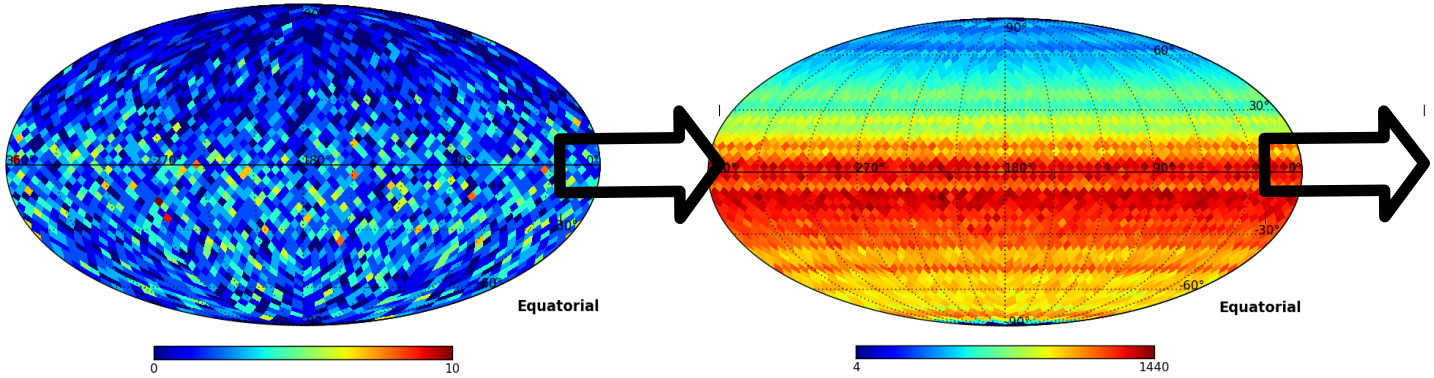
Reminder: PDFs

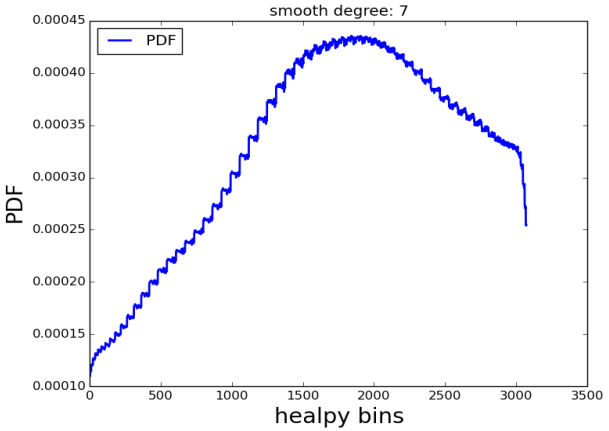
Signal PDF LE





Backgound PDF LE





Real data IC86 2011 scrambled in right ascension

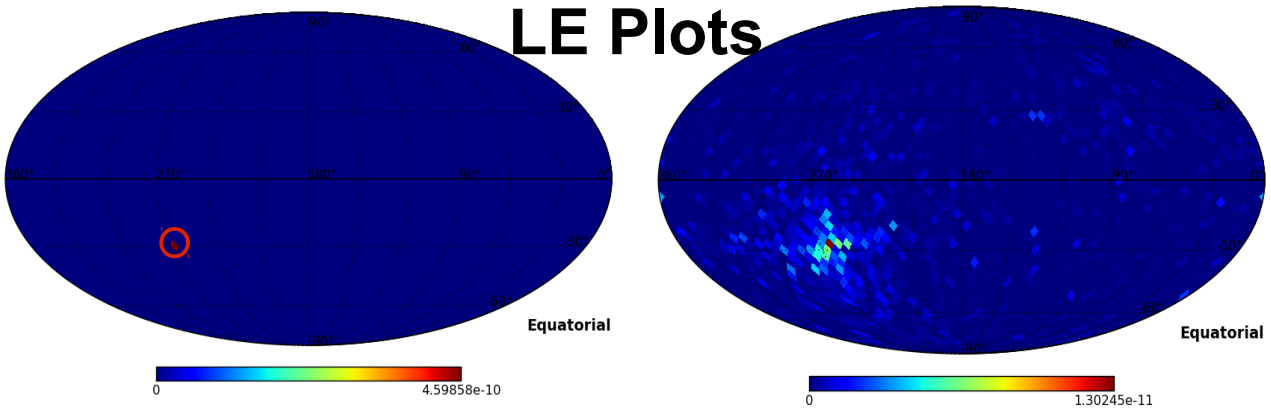
5 degree cut on poles oversampled 500 times

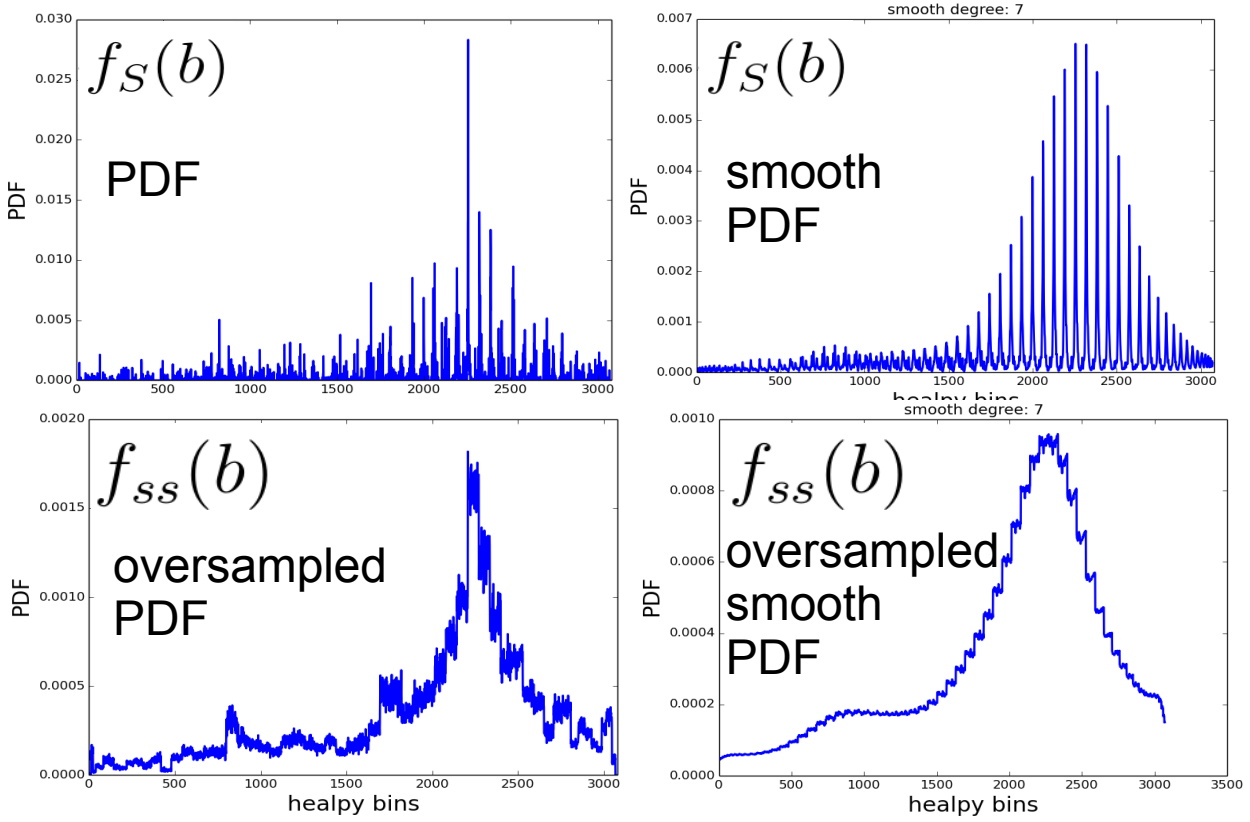
Smooth PDF

Looking for a Galactic Center Signal?

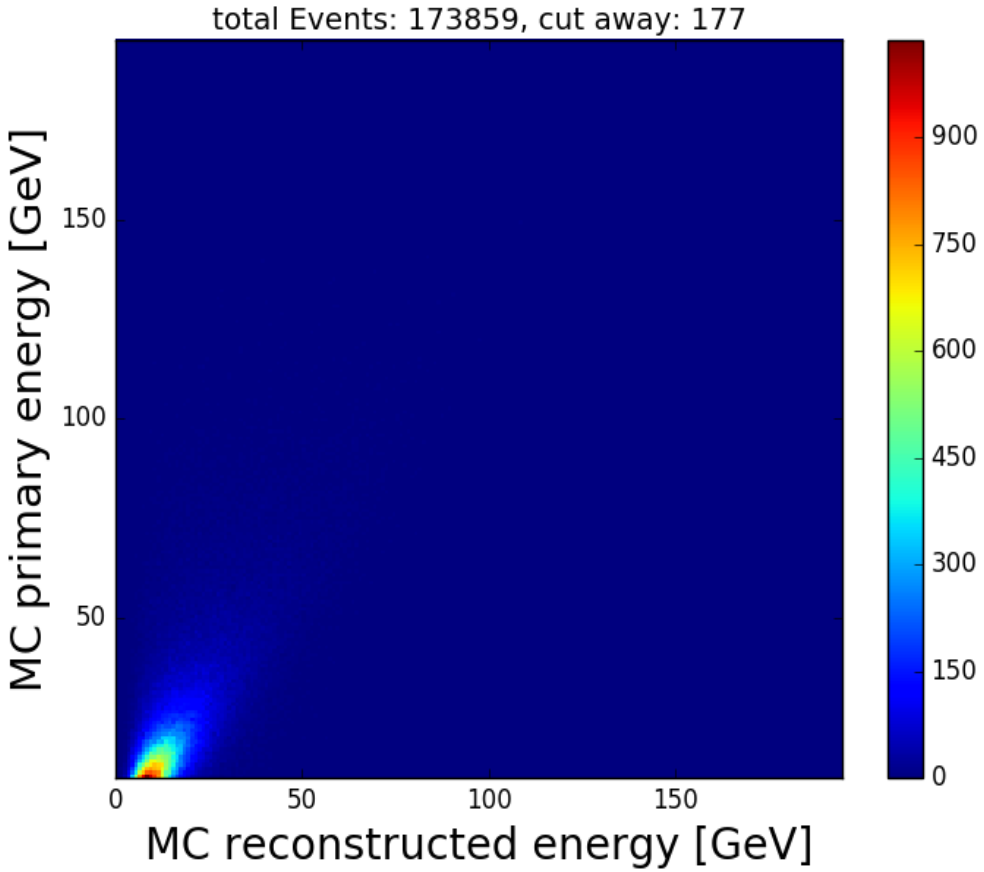
- Events distributed within 0.5 degrees radius around the Galactic Center
- Same procedure as for FB
- HE plots are on the wiki page
- GC PDFs differ significantly from the FB PDFs

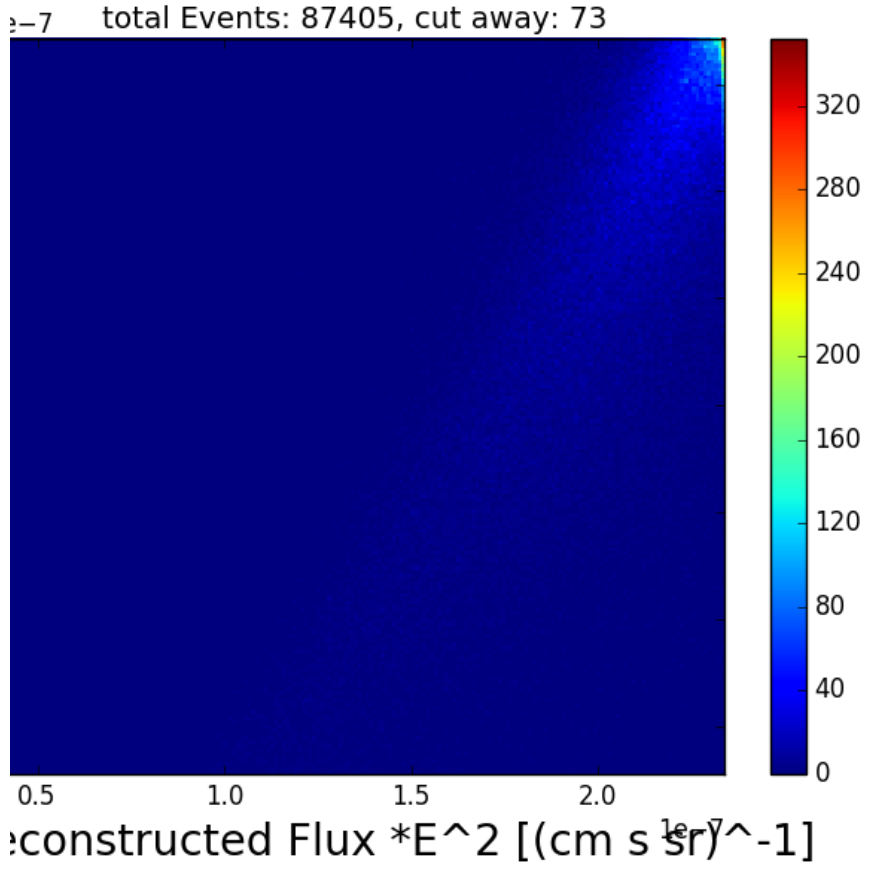
LE Plots



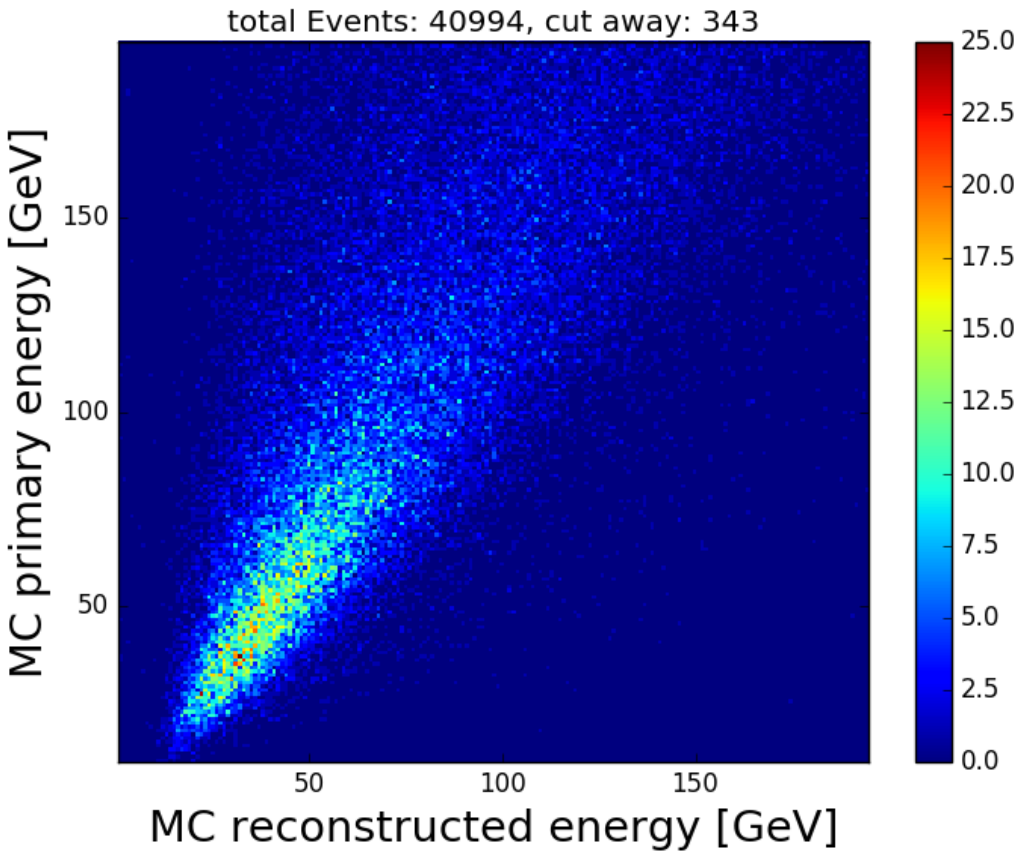


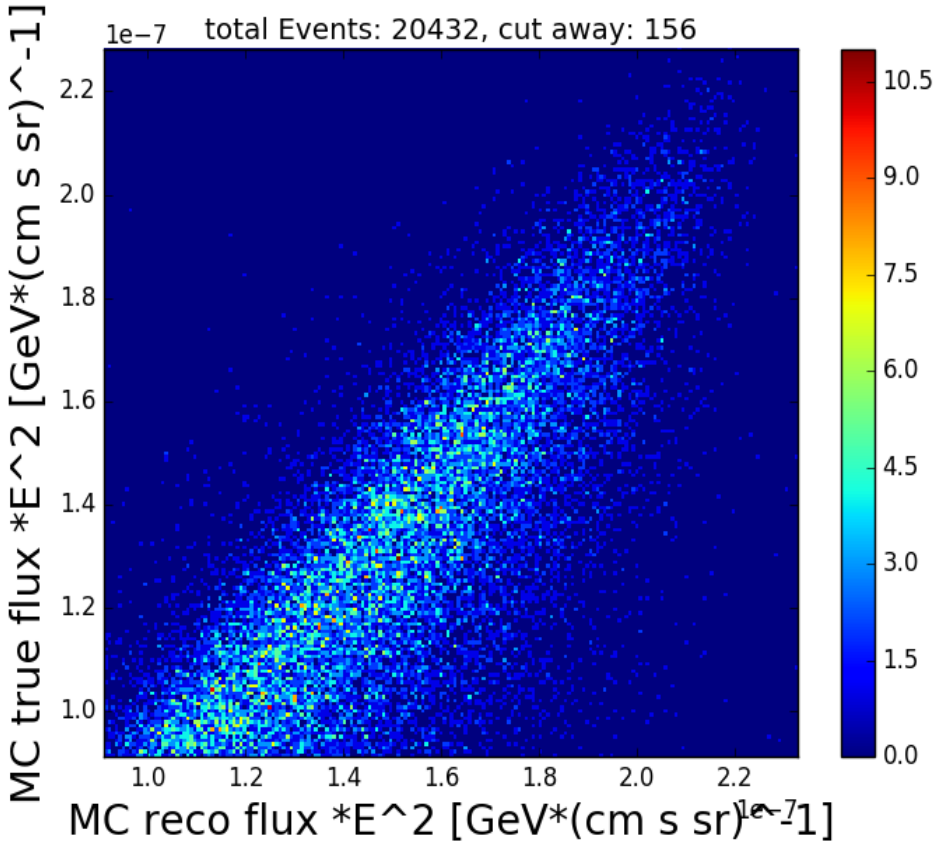
Energy cut LE





Energy cut HE





Sensitivity

MLSandbox result:

- median upper limit (μ_{90}) for LE PDFs:

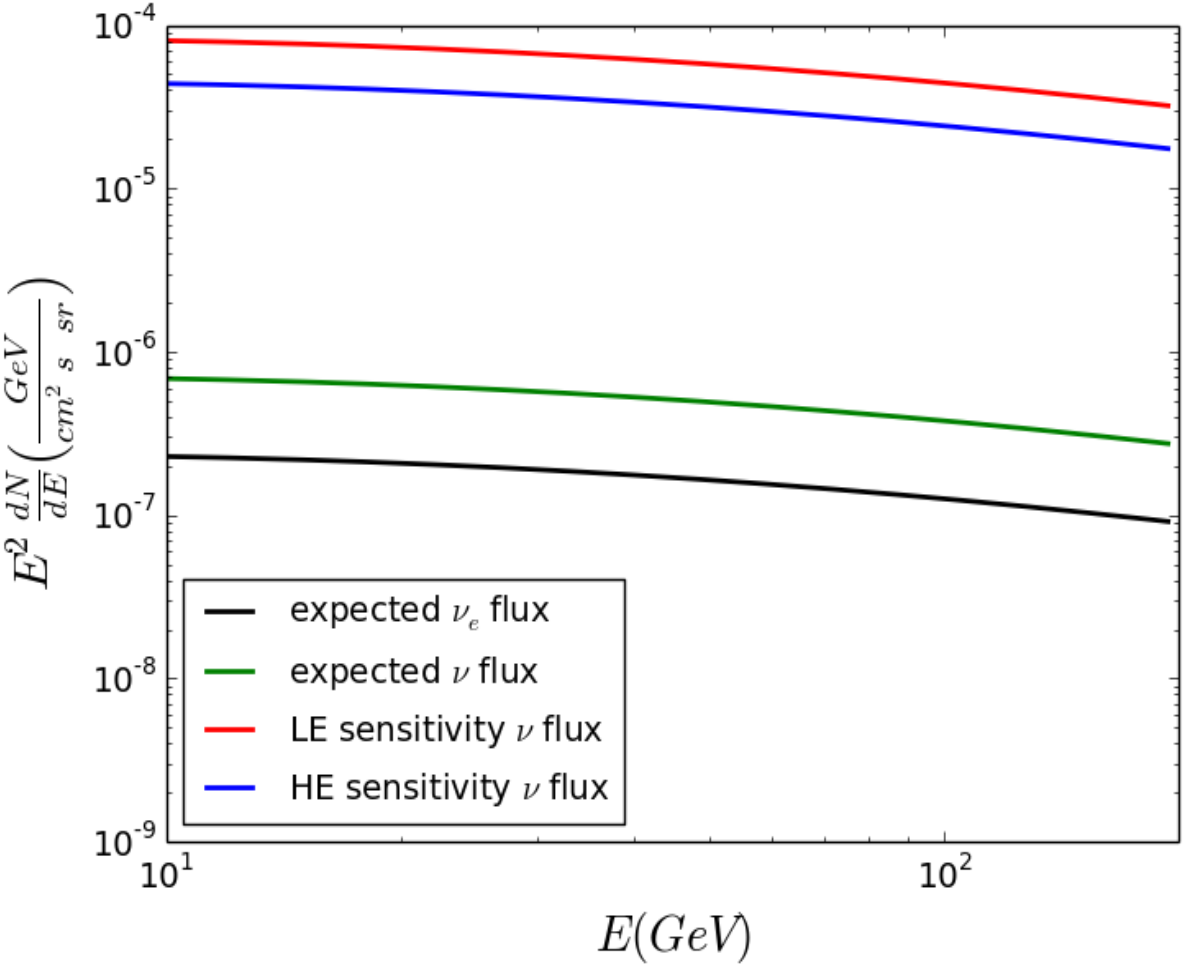
  146 events / 329.1 days
  70 events for GC
  143 events with energy cut

- median upper limit (μ_{90}) for HE PDFs:

  55 events / 329.1 days
  41 events for GC
  42 events with energy cut

- median upper limit (μ_{90}) for combined PDFs:

  135 events / 329.1 days



Summary

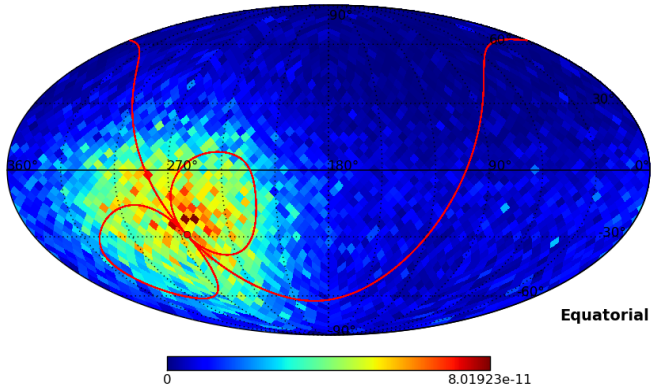
- Shaped maximum likelihood analysis
- Signal simulation with genie, weighted with expected FB flux
- Real scrambled data as background
- **Comparison of results with**

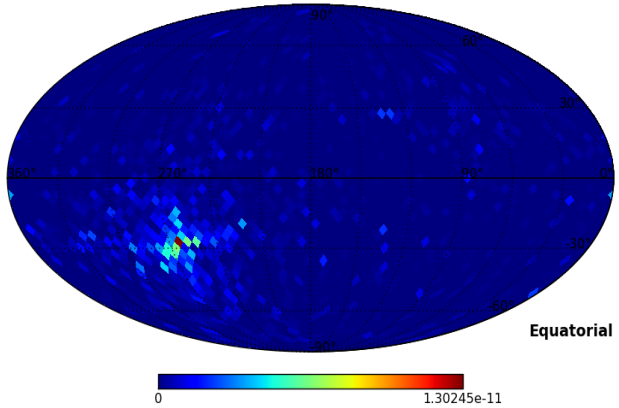
  not smoothed PDFs

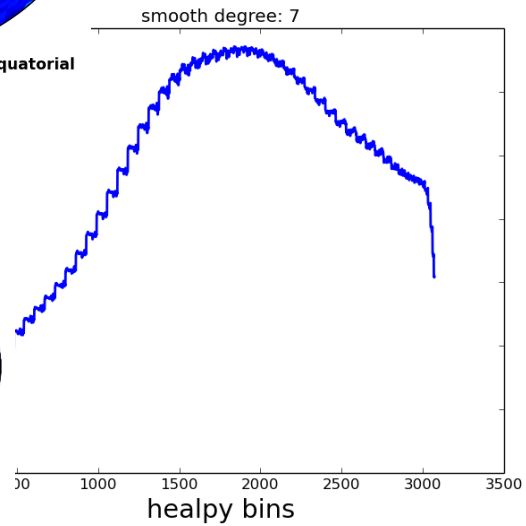
  GC signal

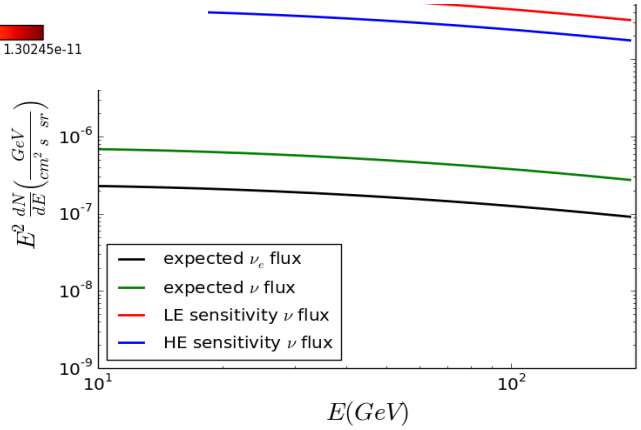
  energy cut of 195 GeV

  combination of LE & HE









Unblinding request

We wish to unblind this analysis for the Fermi Bubbles and the Galactic center and to view the un-scrambled reconstructed directions for the IC86-2011 dataset for the low- and high-energy cascade event selection.

After unblinding, the best fit and median upper limits for the number of signal events at 90% Confidence level will be calculated using the maximum likelihood method.

Back up

More information can be found on my
FB analysis wiki page

Analysis Method

- Shaped Maximum Likelihood Analysis
- Similar to the IC79 Low Energy Galactic Center Analysis (Samuel Flis, Martin Wolf)
- Likelihood will be calculated using ML Sandbox (Samuel Flis)

$$\mathcal{L}(b) = \prod_{i=1}^{n_{obs}} f(b_i|\mu)$$

healpy bins — signal events

$$f(b|\mu) = \frac{\mu}{n_{obs}} f_S(b) + \left(1 - \frac{\mu}{n_{obs}}\right) f_B(b|\mu)$$

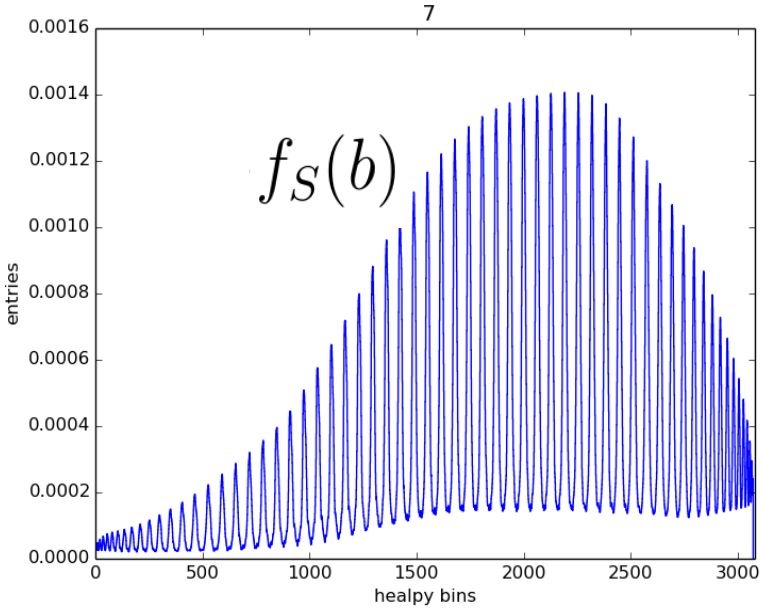
signal PDF — background PDF

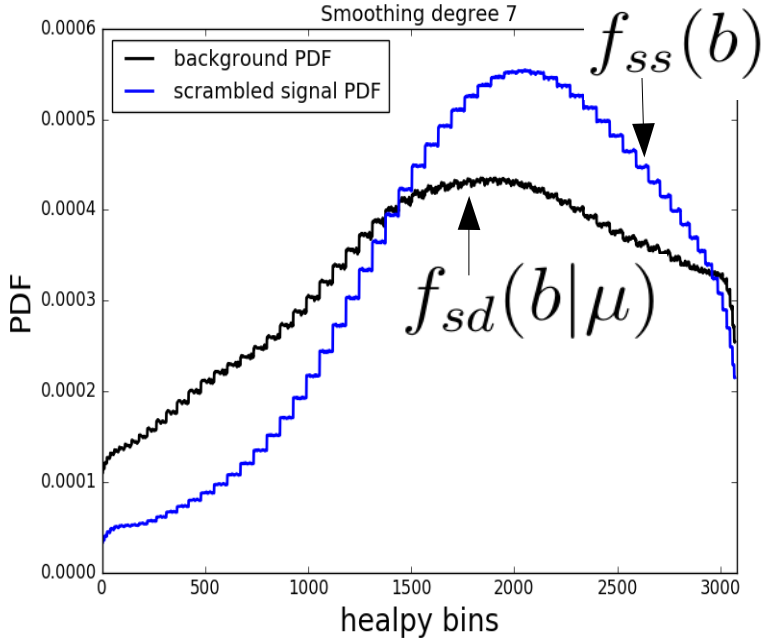
$$f_B(b|\mu) = \frac{\mu}{n_{obs}} f_{ss}(b) + \left(1 - \frac{\mu}{n_{obs}}\right) f_{sd}(b|\mu)$$

scrambled signal PDF — scrambled data PDF

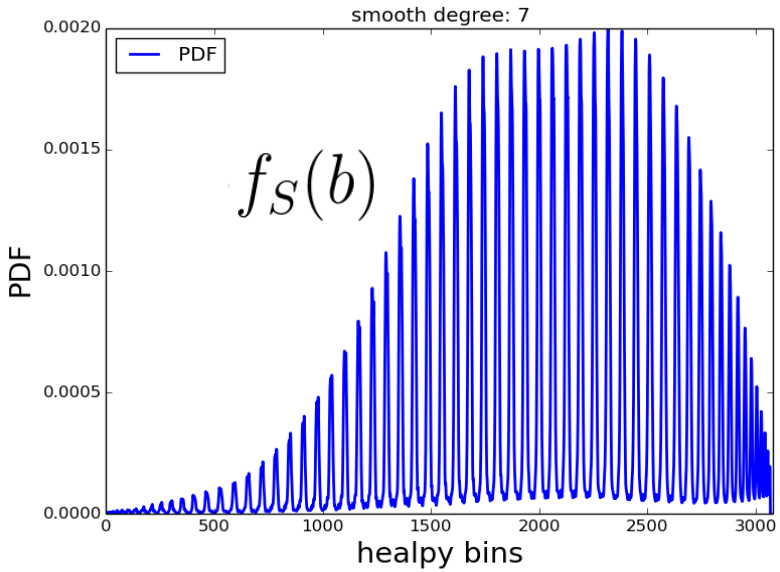
Probability Density Functions

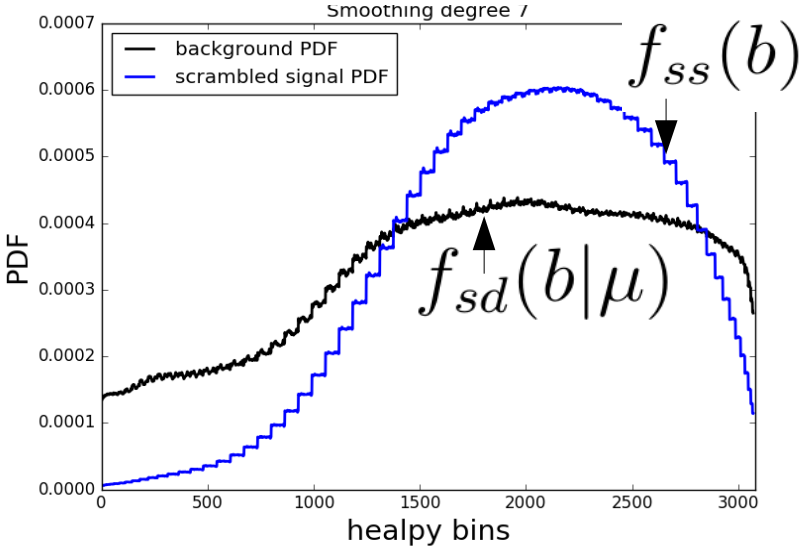
LE sample:





HE sample:





Expected events - genie

$$N_{Events} = T_{live} \cdot \sum \frac{OneWeight}{nFiles \cdot nEvents} \cdot \frac{\Phi_\nu(E,\Omega)}{dE\ d\Omega}$$

livetime: 329.1 days

	LE stream	HE stream
Nue :	~ 0.6 events / livetime	~ 0.5 events / livetime
Numu:	~ 0.3 events / livetime	~ 0.1 events / livetime
Nutau:	~ 0.3 events / livetime	~ 0.2 events / livetime
Nu:	~ 1.2 events / livetime	~ 0.8 events / livetime

Units

$$[\Phi_\nu] = \frac{1}{GeV\ cm^2\ s\ sr}$$

$$[OneWeight] = GeV\ cm^2\ sr$$