



# UW “Source Detection” Status

Disclaimer: We are not really in the source-detection game: this is not a good method for finding seeds

Toby Burnett, for Sean Robinson



# What we have

- New, simple PSF,  $A_{\text{eff}}$  parameterization
- Multiple point source generator
  - Input: specified  $\log N / \log S$  distribution
- Multichromatic continuous wavelet transform (MCWT)
  - Projection of a set of photon positions and energies
  - A peak is an estimator of:
    - Signal size
    - Source position
    - Significance (with separate estimate of total)
- One-year AGN study
  - Use model of Stecker & Salamon for AGN population
  - Quick MC to generate photons according to PSF.
  - Estimate number of sources, sensitivity



# New PSF parameterization

The functional form that has been found to fit the data well is:

$$f(u, \gamma) := \left(1 - \frac{1}{\gamma}\right) \cdot \left(1 + \frac{u}{\gamma}\right)^{-\gamma}$$

where  $u$  is a scaled squared deviation:  $u=0.5 (r/\sigma)^2$ ; where  $r$  is the angular deviation and  $\sigma$  a scale factor. Note that in the small angle approximation,  $du = \frac{d\Omega}{2\pi \cdot \sigma^2}$  The exponent shape

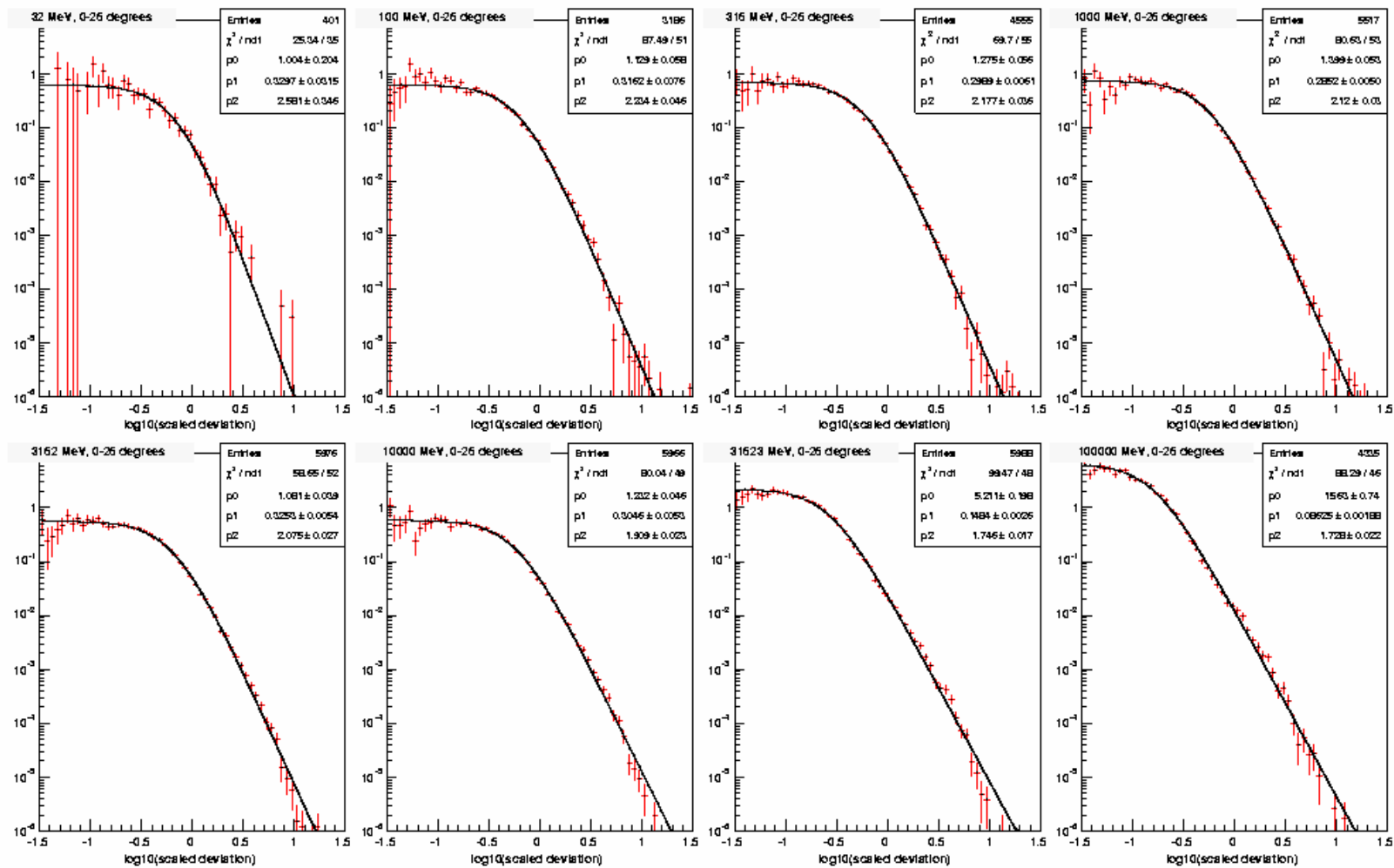
parameter  $\gamma$  is approximately 2 for most of the data. The ideal case of a gaussian is simply  $\exp(-u)$ : for small  $u$ , and  $s=2$ , this form has the same expansion to second order in  $u$ .

Two parameters:

$\sigma$ : scale factor, corresponds to rms for gaussian

$\gamma$ : exponent

# Example fits





# Multiple point source generator

- Behaves like a standard *flux* source
- Input:  $\log N / \log S$  function

# Multichromatic Continuous Wavelet Transform (MCWT)

$$W(\hat{r}) = \sum_i w\left(\frac{\hat{r}-\hat{r}_i}{\alpha(E_i)}\right)$$

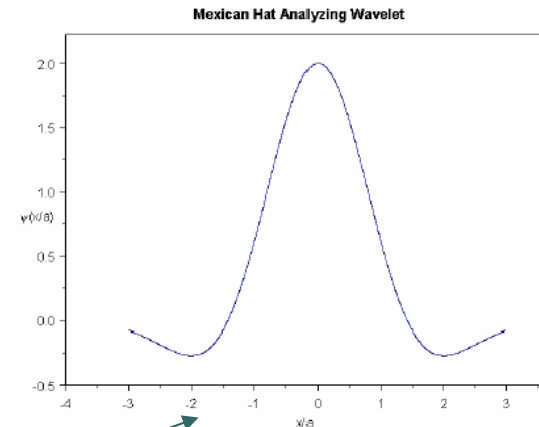
$\hat{r}_i, E_i$  : photon direction, energy

$w(r)$  : wavelet function

$\alpha(E)$  : scale function

Continuous

Multichromatic



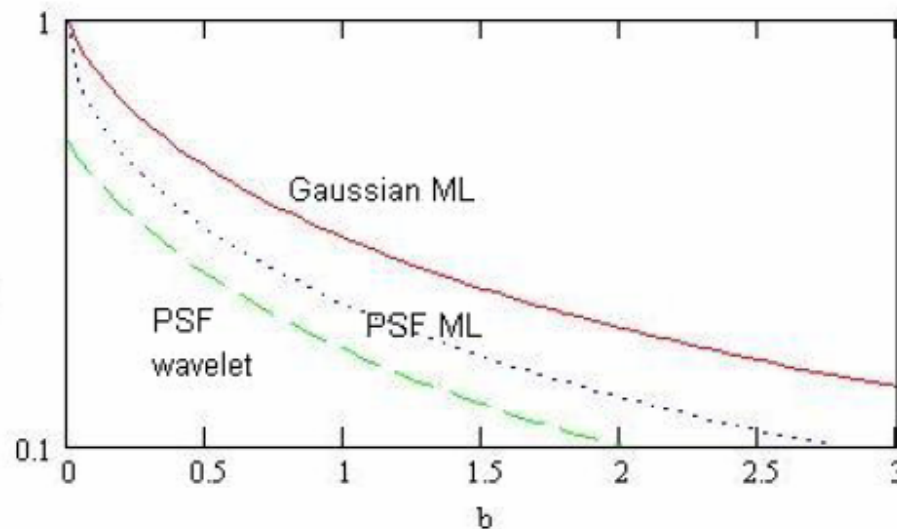


# Estimators from peak of MCWT

- Value: the rate
- Position
- Significance (from auxiliary measurement of background)

# Wavelet estimator performance

$$\frac{N_{sig} \sigma_0^2}{(\sigma_S / S)^2}$$

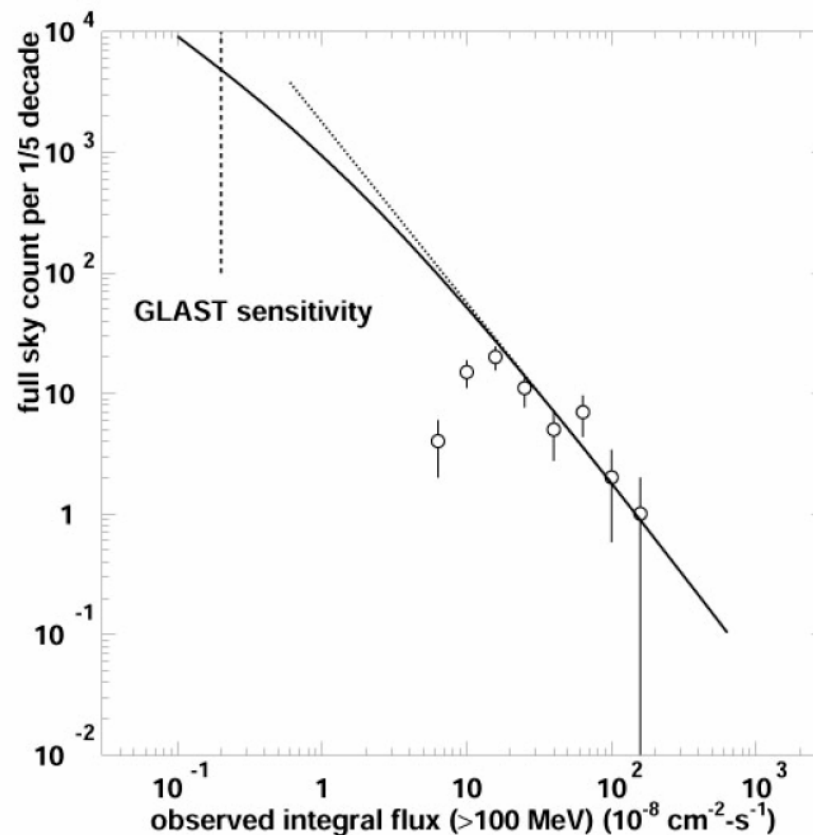


Background to signal ratio

The wavelet sigma is ~10% worse than full ML.

# AGN population model

- The inspiration: this plot from Stecker and Salamon.
  - Data points: EGRET identified and presumed AGN population
  - Solid line: their model
  - Dashed line:  $-3/2$  power
  - GLAST sensitivity: from AO document
- Question: is observed high-latitude diffuse consistent with undetected AGN's?



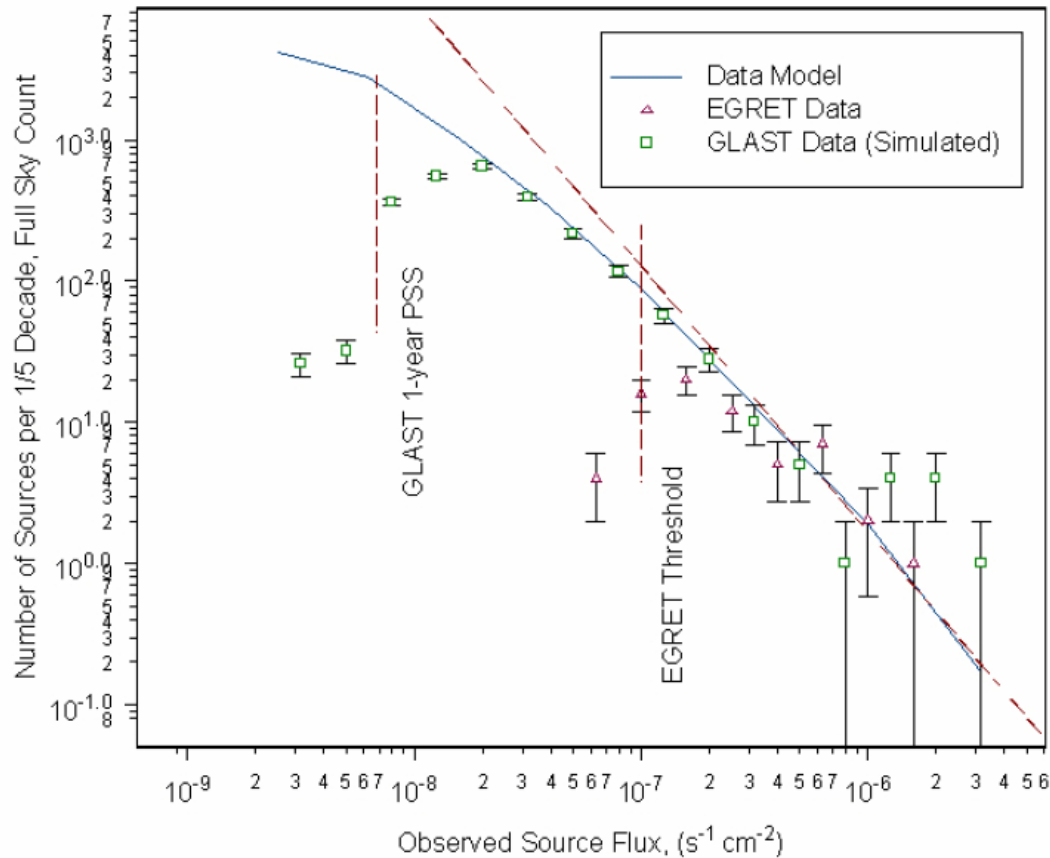


# Ingredients in the calculation

- The  $\log N/\log S$  function from S&S, input to the special source generator.
- Constant fluxes, with fixed spectral index 2.15.
- The instrument model (PSF,  $A_{\text{eff}}$ )
- Only front section used
- One year observation

# Sean's result: detect 2673

logN/logS for EGRET Observations,  
1-year Simulated GLAST Observations





# Conclusions, outlook

- This wavelet technique provides robust and accurate estimation of point sources
- Multiple AGN generation according to model works fine
- Have a preliminary estimate of number of AGNs a 1-year survey would see, and corresponding limit on remaining diffuse
- Both tools need refinement, documentation