The search for Milky Way WIMP satellites using the GLAST LAT

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Outline

- **The internal structure of satellites**
- **Estimate the observable satellites in the Milky Way**
- **The progress of the satellite analysis**

Satellite Structure

- **Truncated NFW profile**
  (Hayashi et al., 2003, ApJ, 584, 541)

$$\rho(r) = \frac{f_t}{1+(r/r_t)^3}\,\rho_{NFW}(r)$$

$$\rho_{NFW}(r) = \frac{\rho_s}{r/r_s(1+r/r_s)^2}$$

r_t is the tidal radius to which the halo is stripped

f_t is the reduction in the central density

Observable Satellites (estimate)

- Semi-analytic models of halo substructure
  (Taylor & Babul, 2004, MNRAS)

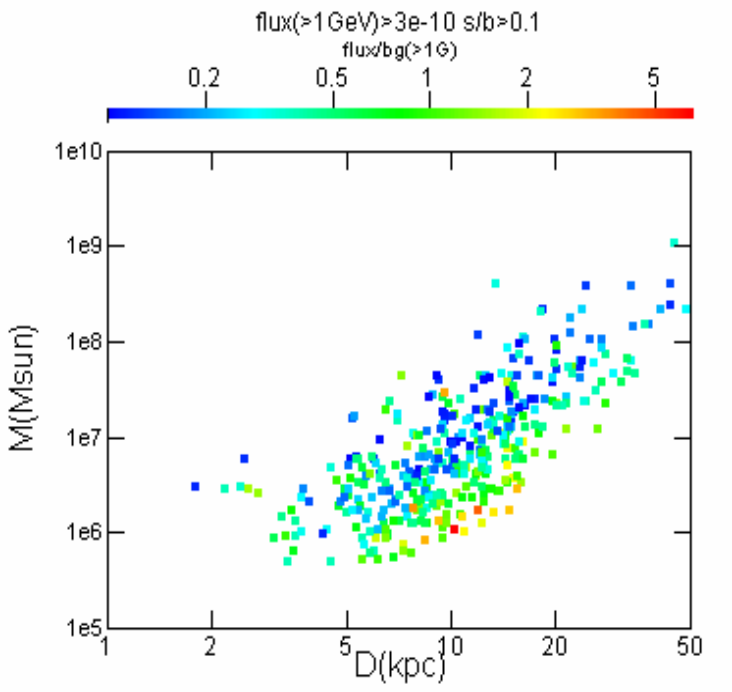
- Taylor's satellite list (59082 clumps for 24 realizations)

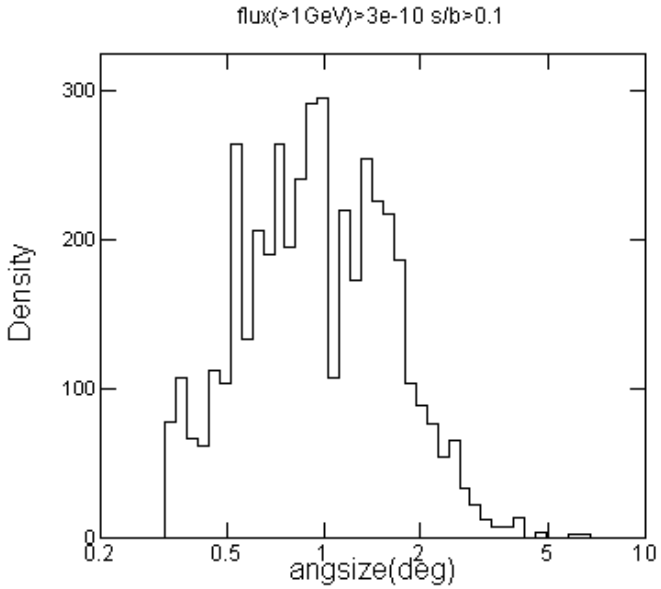
- Background estimate using EGRET extragalactic emission above 1GeV
  (Sreekumar et al., 1998, ApJ 494, 523)

- Signal, background flux inside the tidal radius

- M=100GeV
  $\langle \sigma_{ann} v \rangle = 2.3 \times 10^{-26} cm^3 s^{-1}$

- Flux(>1GeV) > 3e-10 /cm^2/s
- Signal/Background > 0.1
- 383 clumps (for 24 realizations)



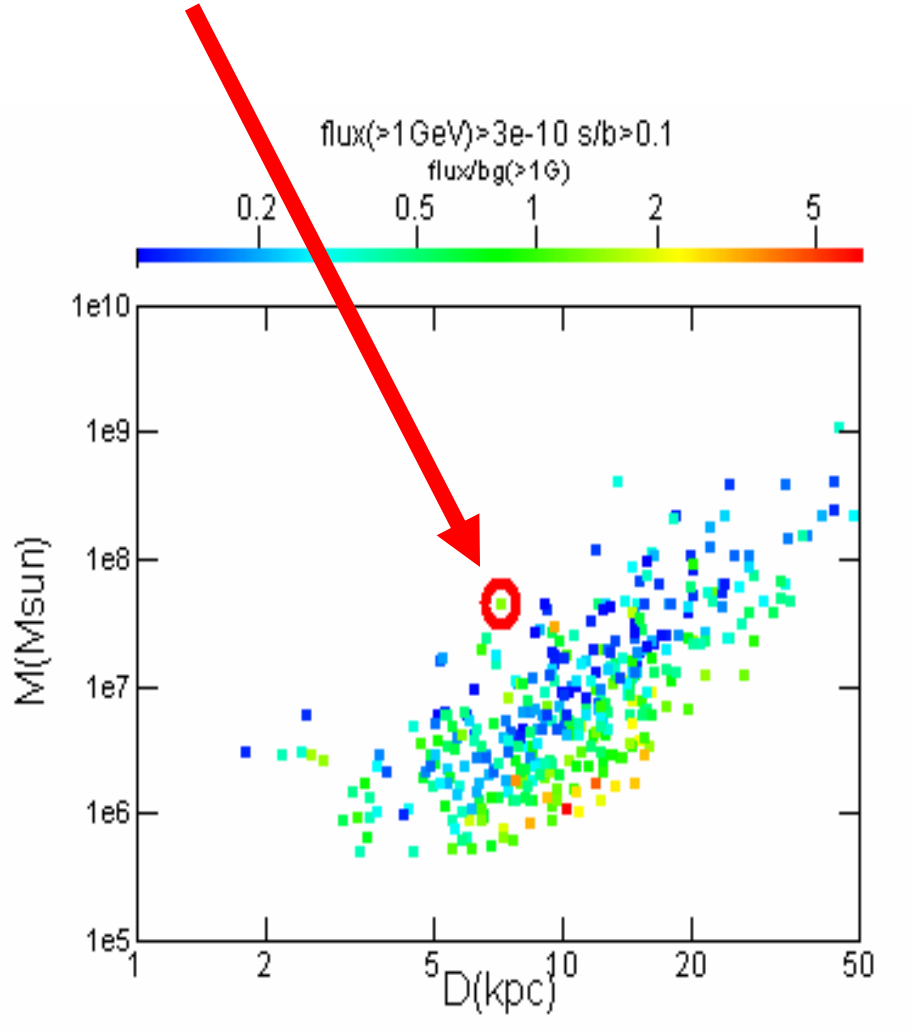


Satellite Analysis

- Use GALPROP for galactic diffuse background
- Assume powerlaw index -2.1 for extragalactic diffuse background
- Use 100 GeV mass WIMP, π^0 gammas only
- 55 day exposure
- Binned likelihood analysis

Pick a bright satellite…

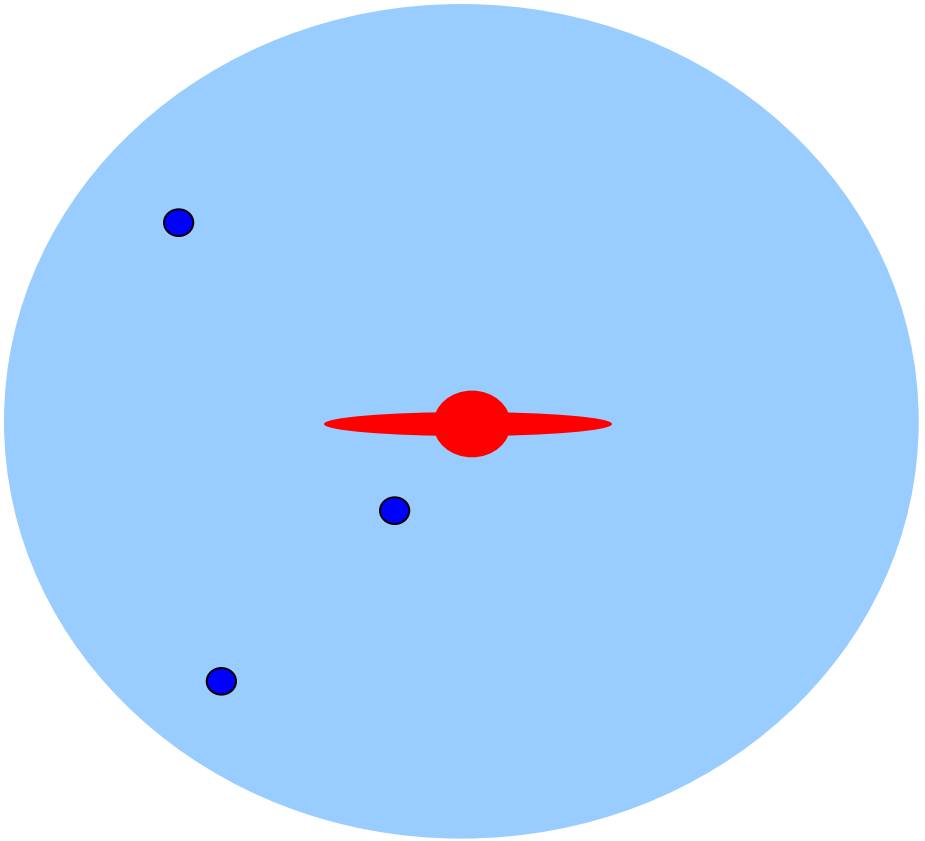
- Coordinate of test case:
  l, b = 9.8deg, -31.0deg
- Total flux: 2.85e-8 /cm^2/s
- Most of gamma flux is within 1.5 deg of clump center
- 70 counts signal, 43 counts background (55 days on orbit, within 1.5 deg of clump center, E>1GeV)



Milky Way Satellite Progress

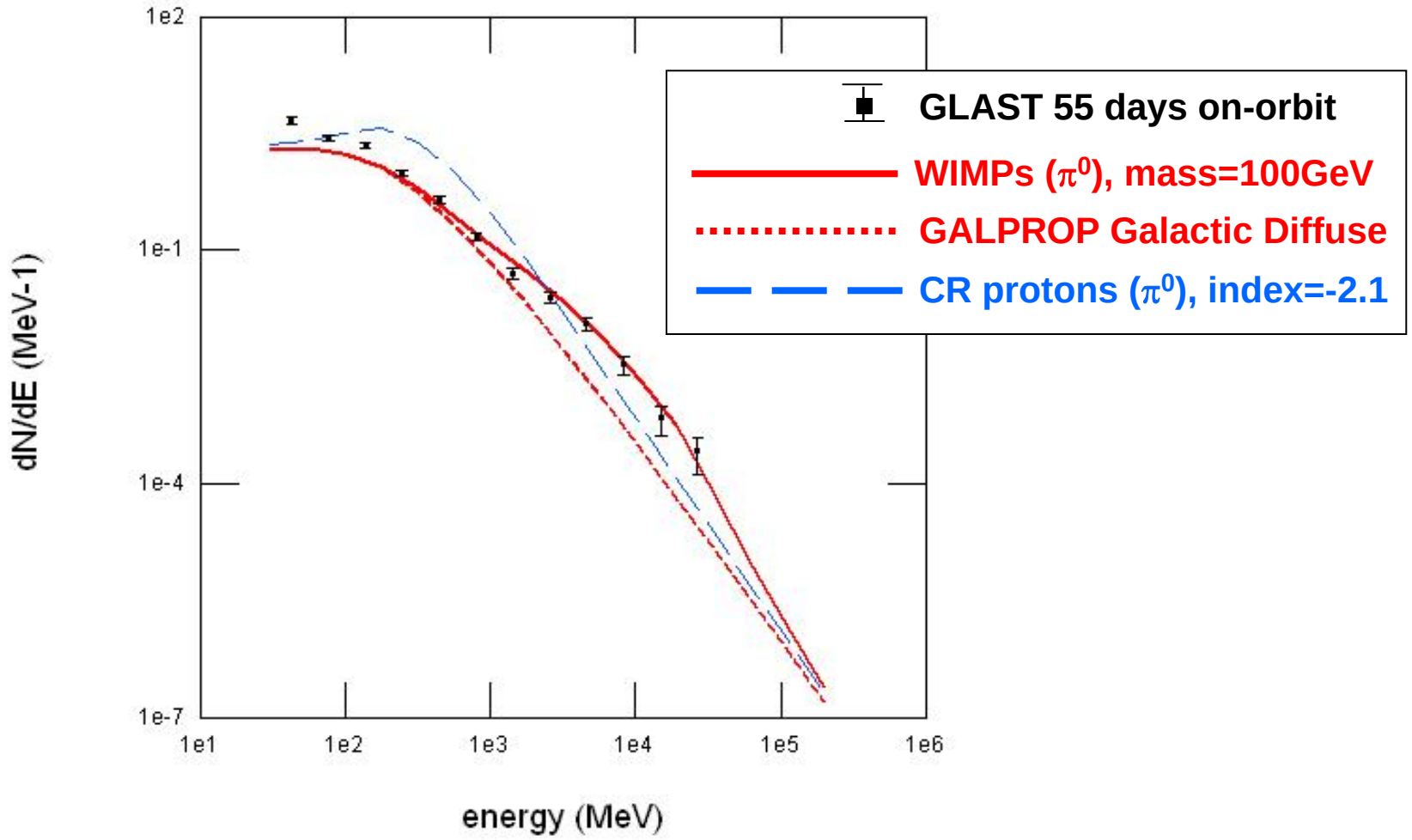
- **Exclusion of toy molecular cloud (PP spectrum, truncated NFW profile)**

- **Exclusion of toy pulsar (WIMP annihilation spectrum, point source)**

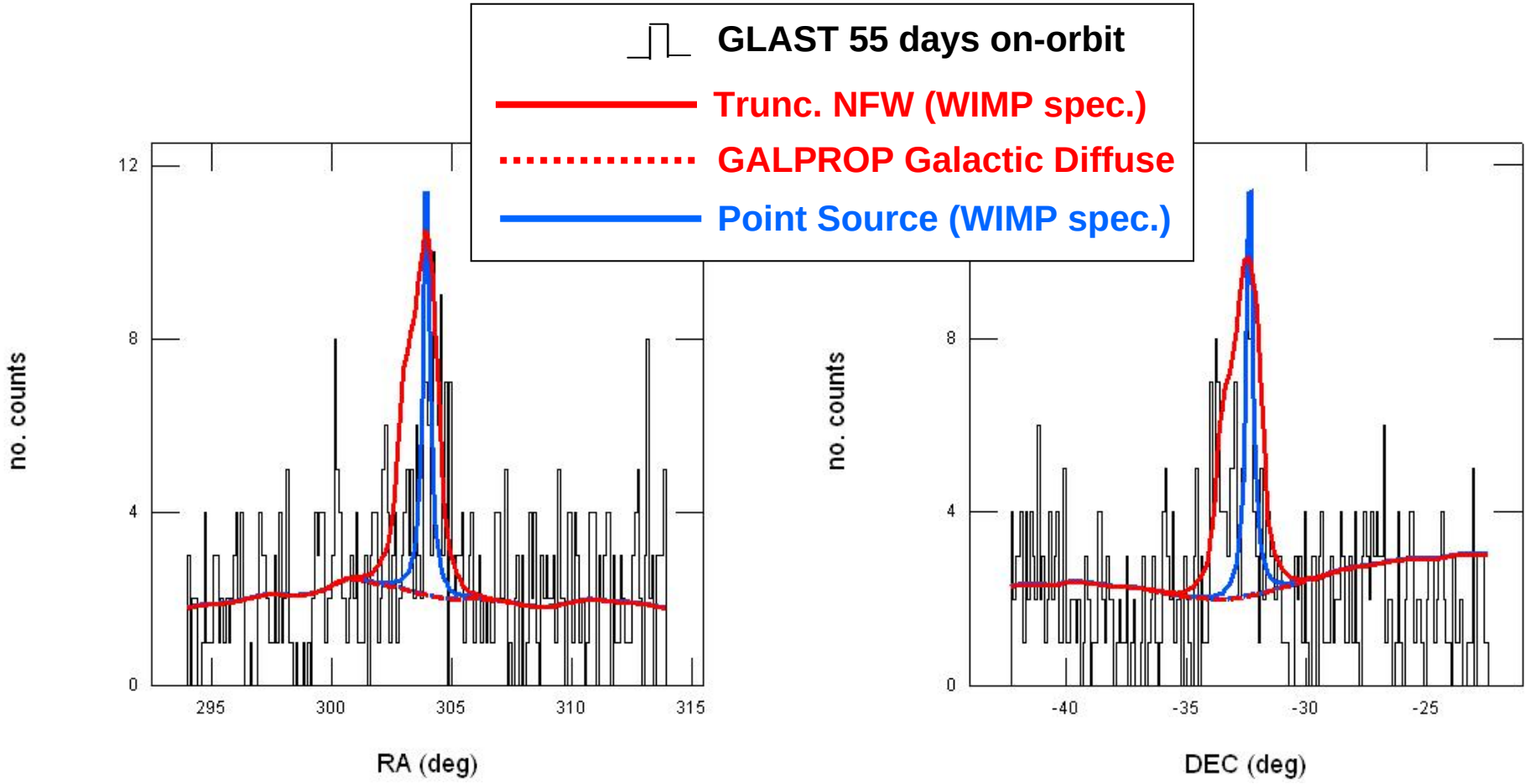


Energy Spectrum

(within +/- 1.5 deg of clump center)

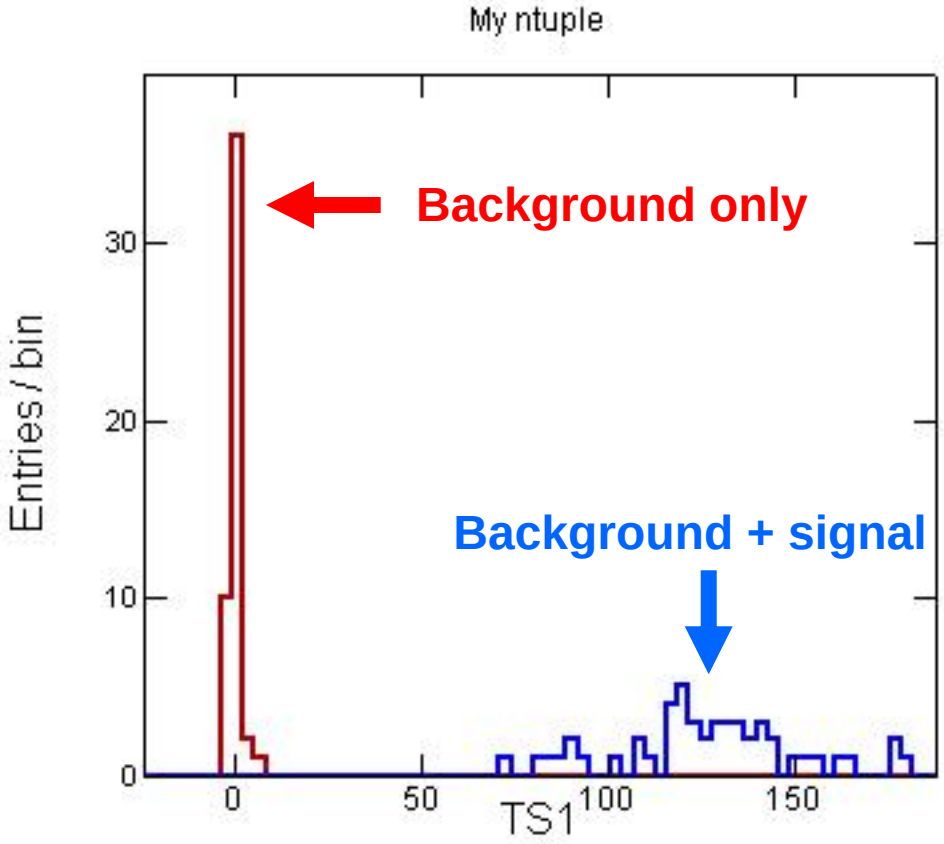


Angular Distribution (E>1GeV)



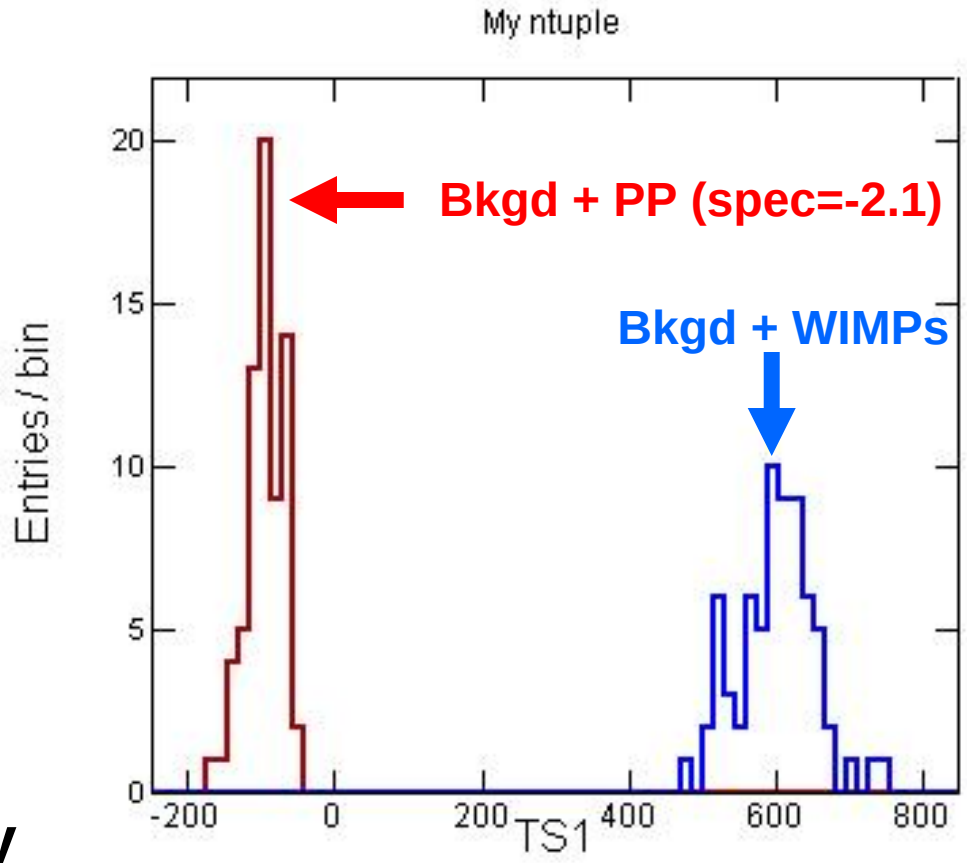
Significance of signal above background

- **Test statistic definition: 2(loglike(bkgd+signal) - loglike(bkgd))**
- ➢ **Calculate test statistic for background only Monte Carlo (50 x 55day runs)**
- ➢ **Calculate test statistic for background+signal Monte Carlo (50 x 55day runs)**



Exclusion of toy molecular cloud

- **Test statistic definition: 2(loglike(bkgd+ WIMP signal) - loglike(bkgd+ PP signal))**
  - **Calculate test statistic for background + PP (inj.spec=-2.1) Monte Carlo (50 x 55day runs)**
  - **Calculate test statistic for background+WIMP Monte Carlo (50 x 55day runs)**



Summary

- **About 16 observable satellites in the Milky Way**
- **Some are separable from point sources, molecular clouds**