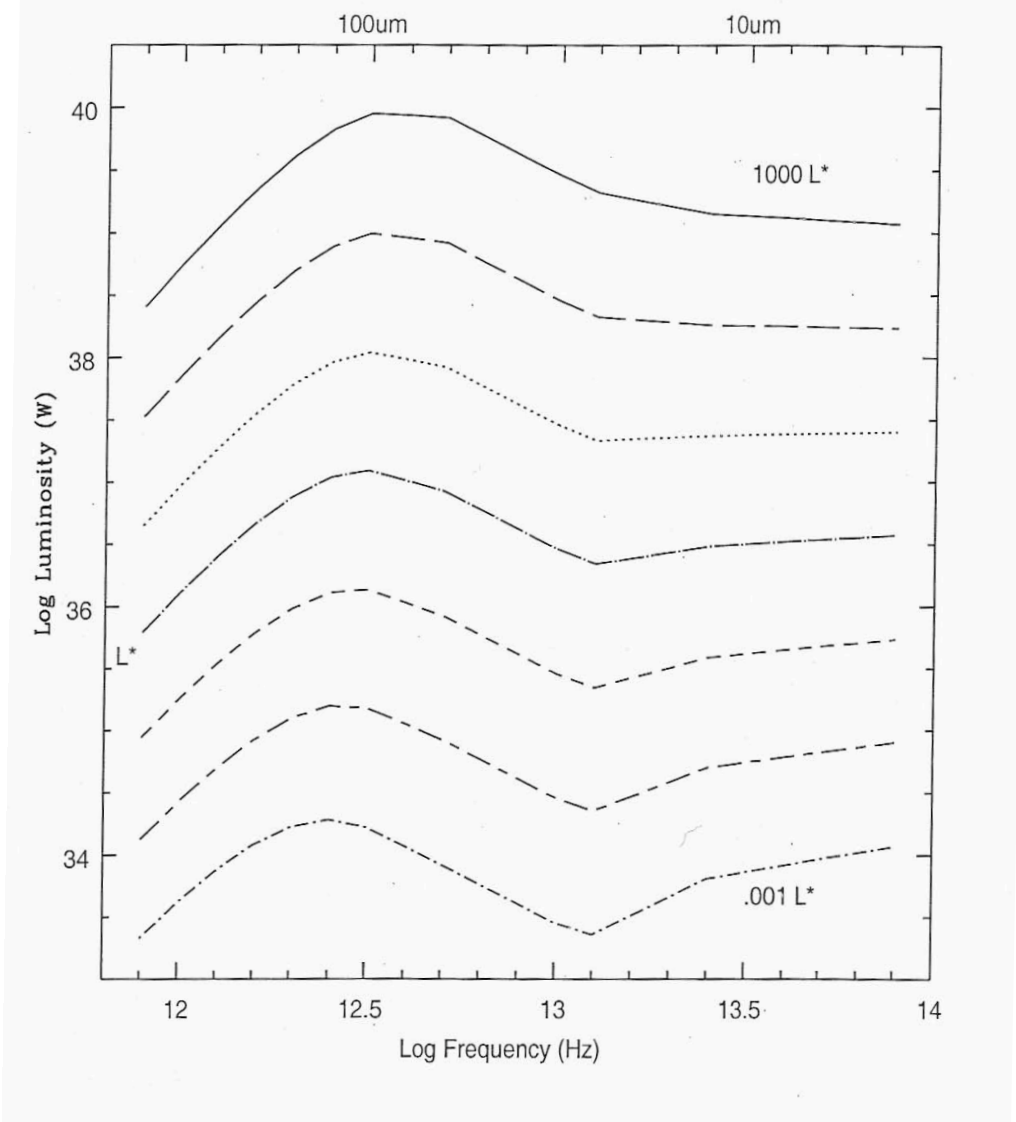
GLAST Studies of High Redshift Sources

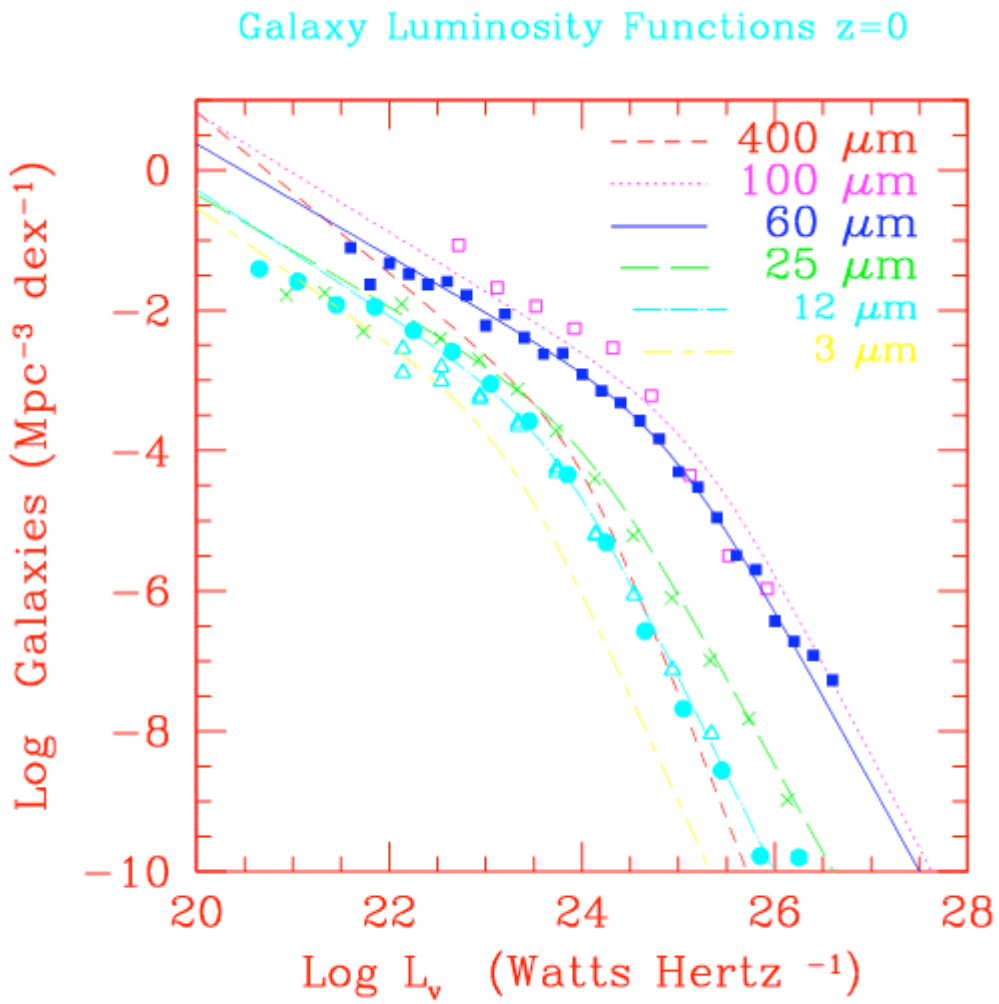
F.W. Stecker
NASA/GSFC

Theoretical Calculations: Input

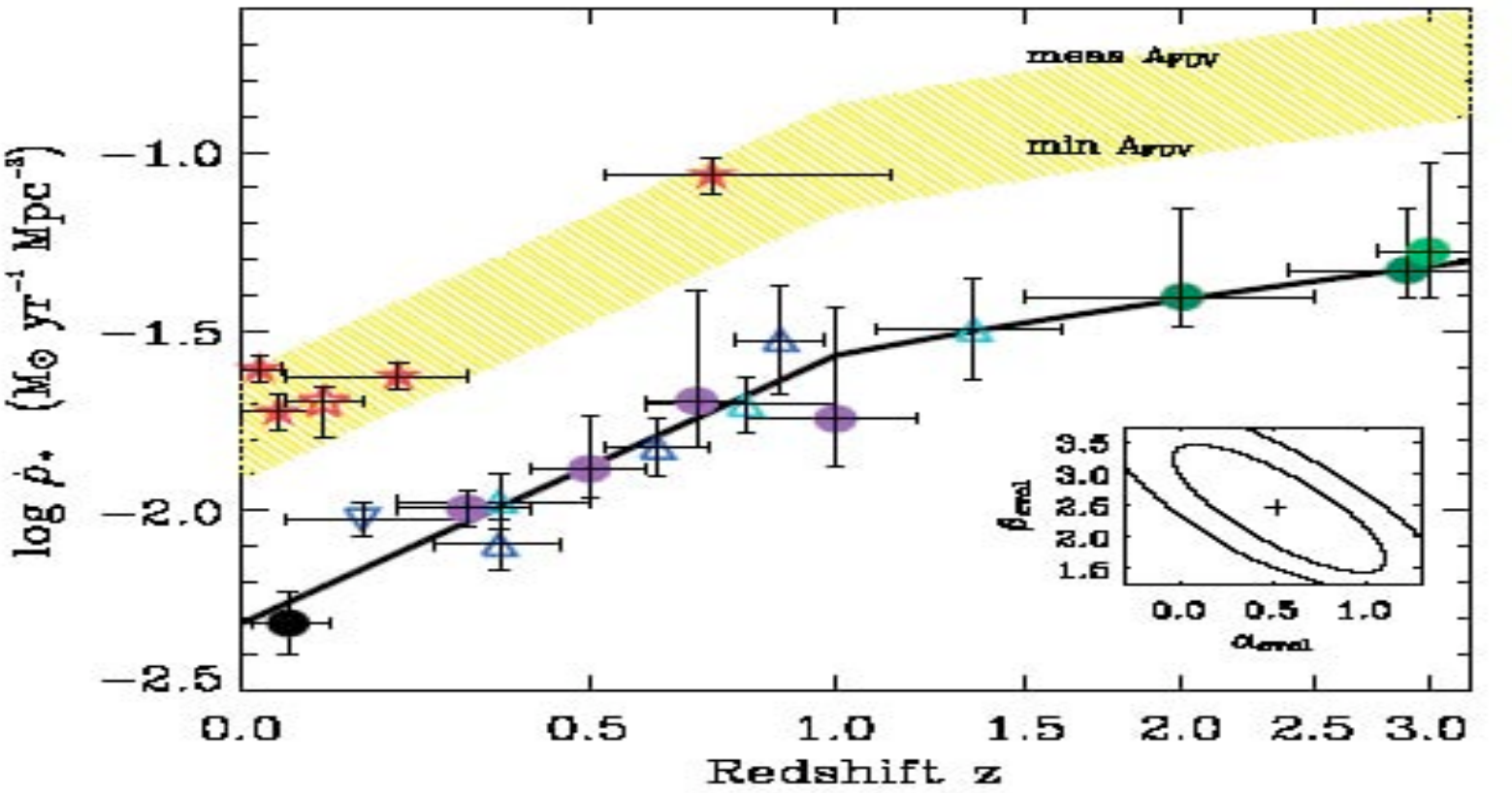
- Spectral Energy Distributions of Galaxies
- Galaxy Luminosity Functions (LF)
- Redshift Dependence of Galaxy LFs

Spectral Energy Distributions vs. Luminosity

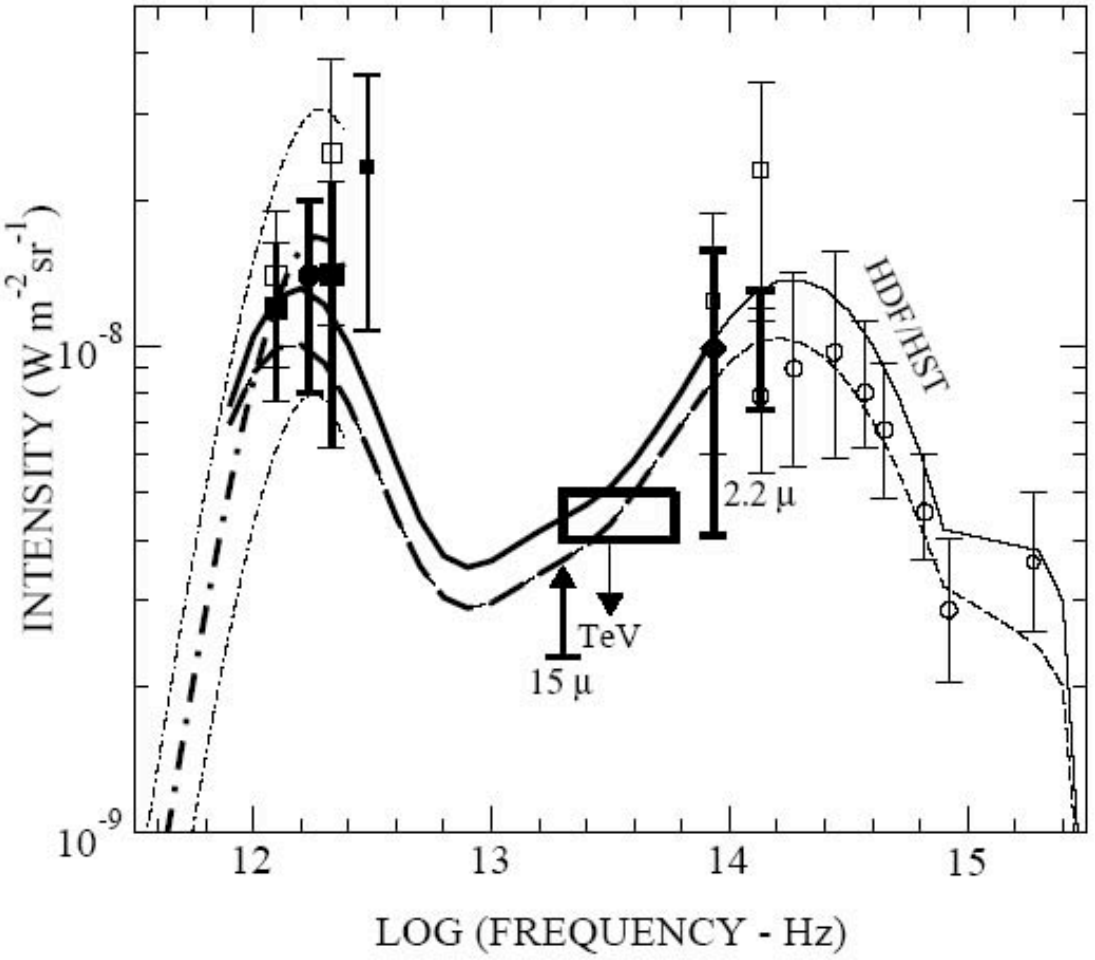



Galaxy Luminosity Functions z=0
400 μm
100 μm
60 μm
25 μm
12 μm
3 μm
Log Galaxies (Mpc⁻³ dex⁻¹)
0
−2
−4
−6
−8
−10
20
22
24
26
28
Log L_ν (Watts Hertz ⁻¹)

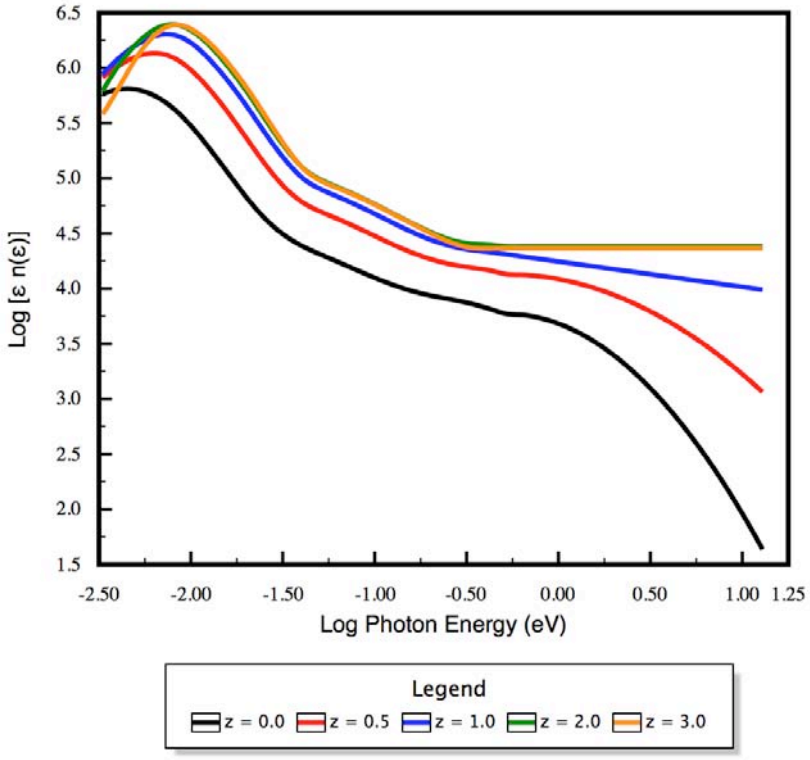
Star Formation Rate *v.* Redshift from Spitzer Data (Schiminovich *et al.* 2005)



EBL: Data and Predicted Fluxes



Photon Density Spectra



$$\tau(E_\gamma, z) = \int_0^{z_{Source}} dz \frac{dl}{dz} \int_0^2 dx \frac{x}{2} \int_{\frac{2m_e^2c^4}{E_\gamma x(1+z)}}^{\infty} d\varepsilon \; n(\varepsilon, z)\sigma(s)$$

$$s = 2xE_\gamma \varepsilon(1+z) \qquad E_\gamma = E_\gamma(z=0)$$

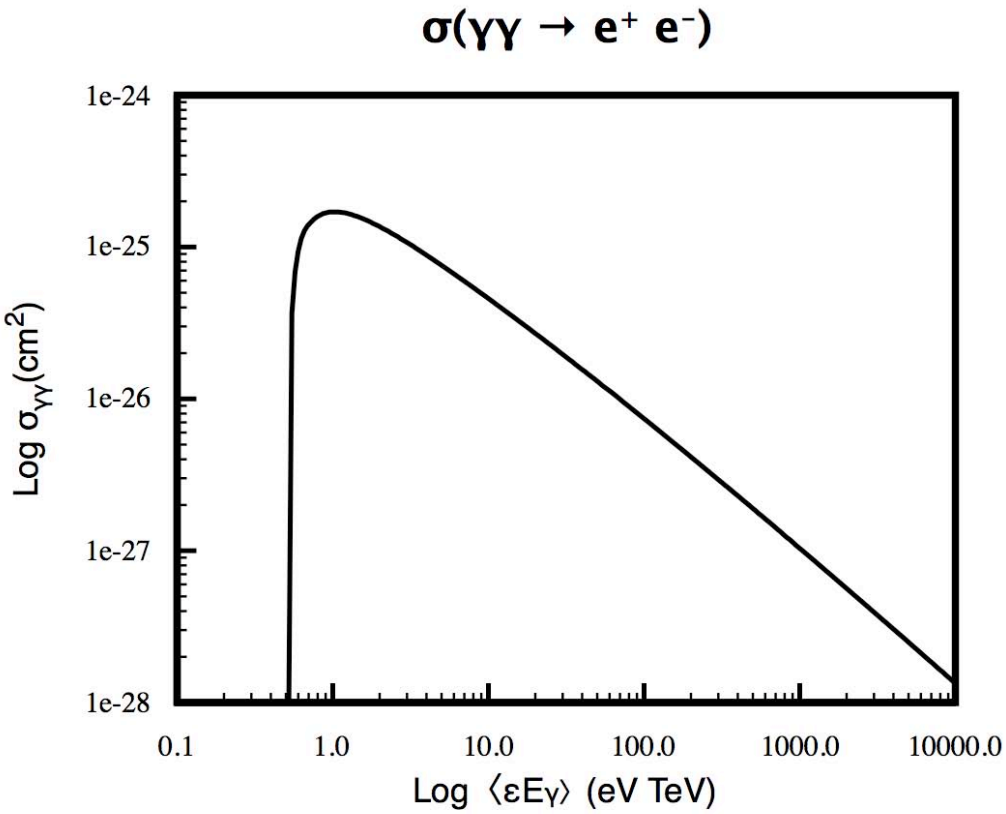
$$\varepsilon = \varepsilon(z)$$

$$x = 1 - \cos\theta$$

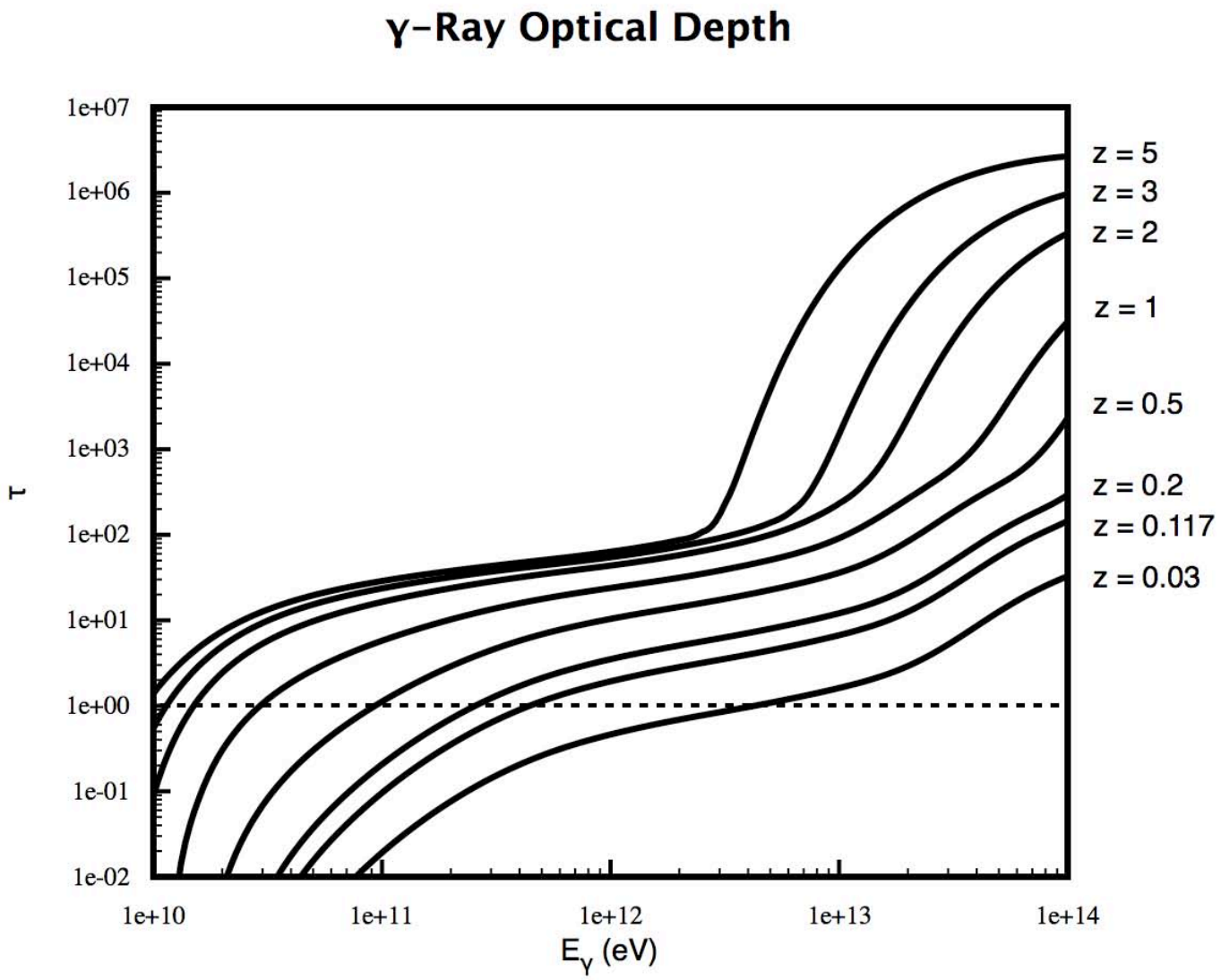
$$\sigma(s) = \sigma_0(1-\beta^2)\left[2\beta(\beta^2-2) + (3-\beta^4)\ln\left(\frac{1+\beta}{1-\beta}\right)\right]$$

$$\frac{dl}{dz} = \frac{c}{H_0}(1+z)^{-1}\left[\Omega_\Lambda + \Omega_m(1+z)^3\right]^{-1/2}$$

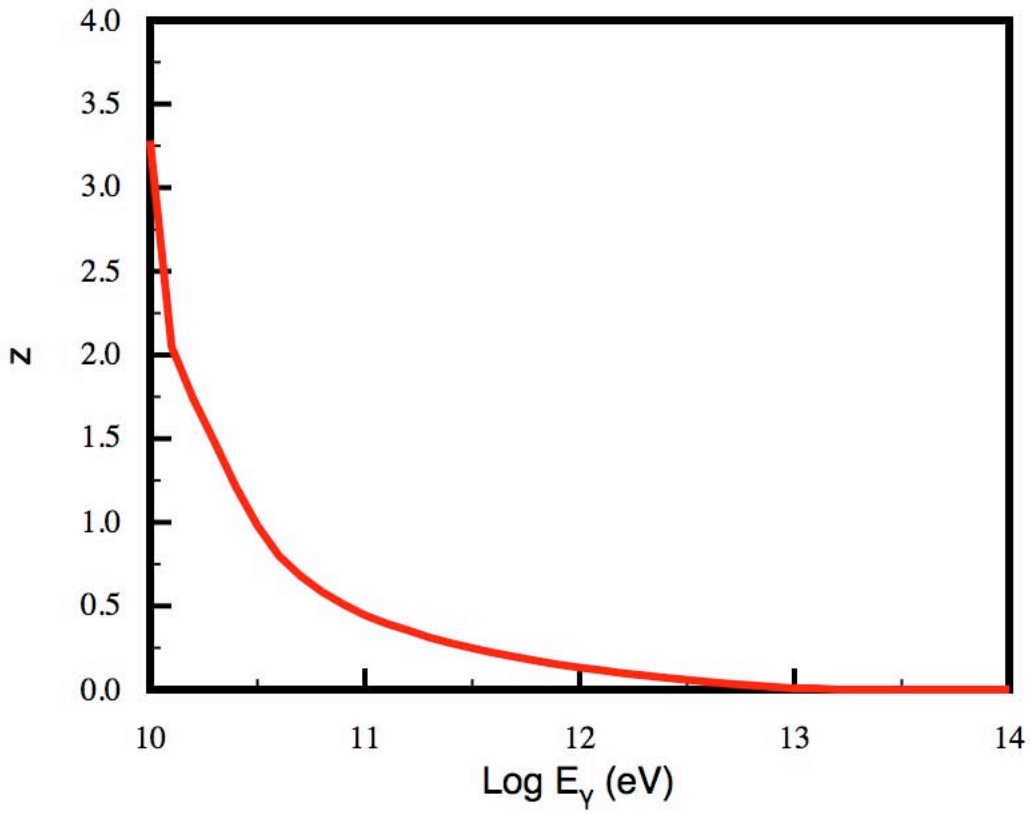
Pair Production Cross Section



γ-Ray Optical Depth

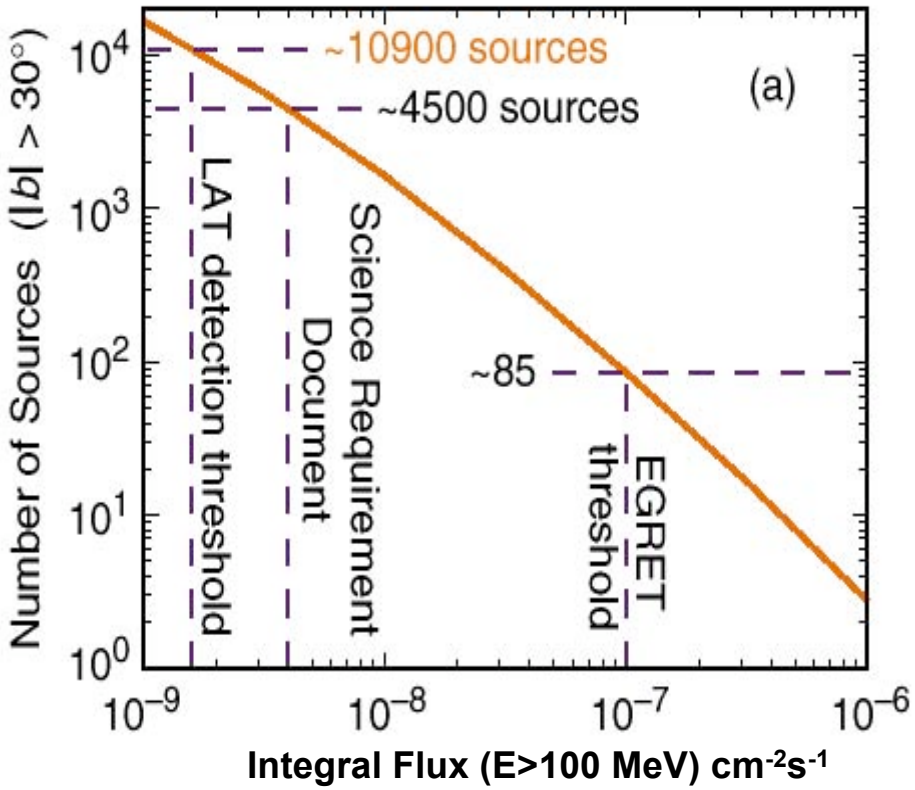


$\tau(E_{\gamma,crit},z) = 1$



AGN: What ***GLAST*** will do

EGRET has detected ~ 90 AGN --
GLAST should expect to see dramatically more–
in fact, THOUSANDS (Stecker & Salamon 1996, ApJ 464, 600):



Goals for GLAST

- Look for sharp cutoffs in the Energy Range above ~10 GeV in High-Redshift Blazar Spectra to Probe Fossil Intergalactic Background Radiation from Early Galaxies and Star Formation Rate

- Use Cutoffs in Unidentified Source Spectra to Determine Redshifts of High-Redshift Sources

γ-ray Absorption References

Stecker, Malkan & Scully 2006, *ApJ* **648**, 774; corrected Table 1, *astro-ph/0612048*

Stecker & Scully, *ApJ Lett.* **652**, L9