AMEGO

ALL-SKY MEDIUM ENERGY GAMMA-RAY OBSERVATORY

Simulations of the Instrument Performance

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Energy range: 200 keV to >10 GeV
good energy and angular resolution
sensitivity 20-50x better than previous instruments

Measures both
Compton-scattering events and
pair-production events

This is an overview of the AMEGO simulation campaign:
initial results for effective area, angular resolution, polarization and sensitivity projections.

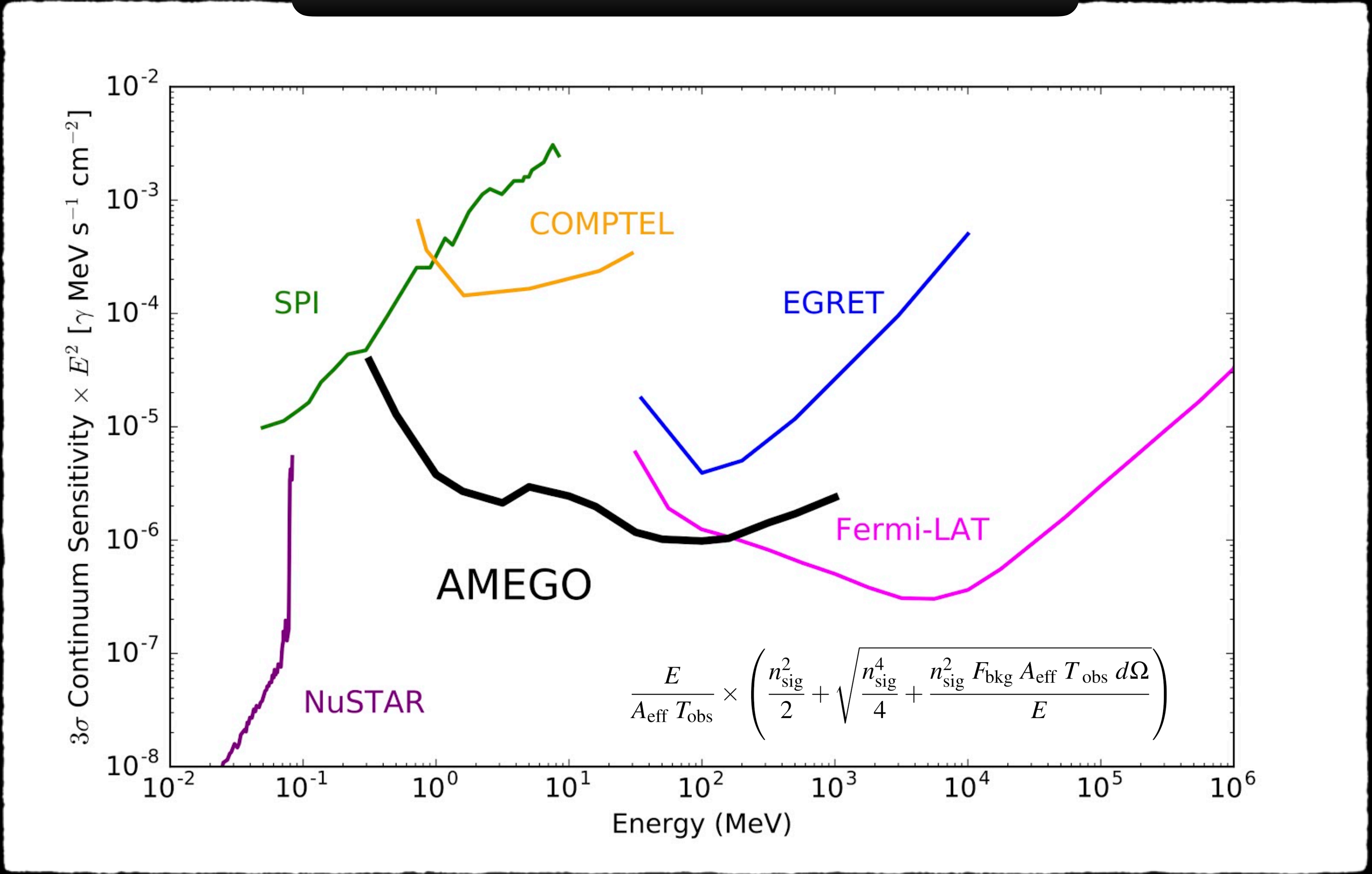
INTRODUCTION TO AMEGO

- ***Probe Concept: 2020 NASA Astrophysics Decadal Review***
- Observing strategy: survey
  - 80% sky/orbit, ~2.5 sr FoV
- Well ***understood***, ***tested*** technologies with ***space heritage***
- Science: pulsars/magnetars, gamma-ray bursts and multimessenger astrophysics, active galaxies, dark matter

SIMULATION OVERVIEW

- Performed using the MEGAlib toolkit [4]
  - ROOT (v6), Geant4 (v10)
- Event classes
  - Current: tracked Compton scattered, pair production
  - Future: untracked Compton scattered (low energies)

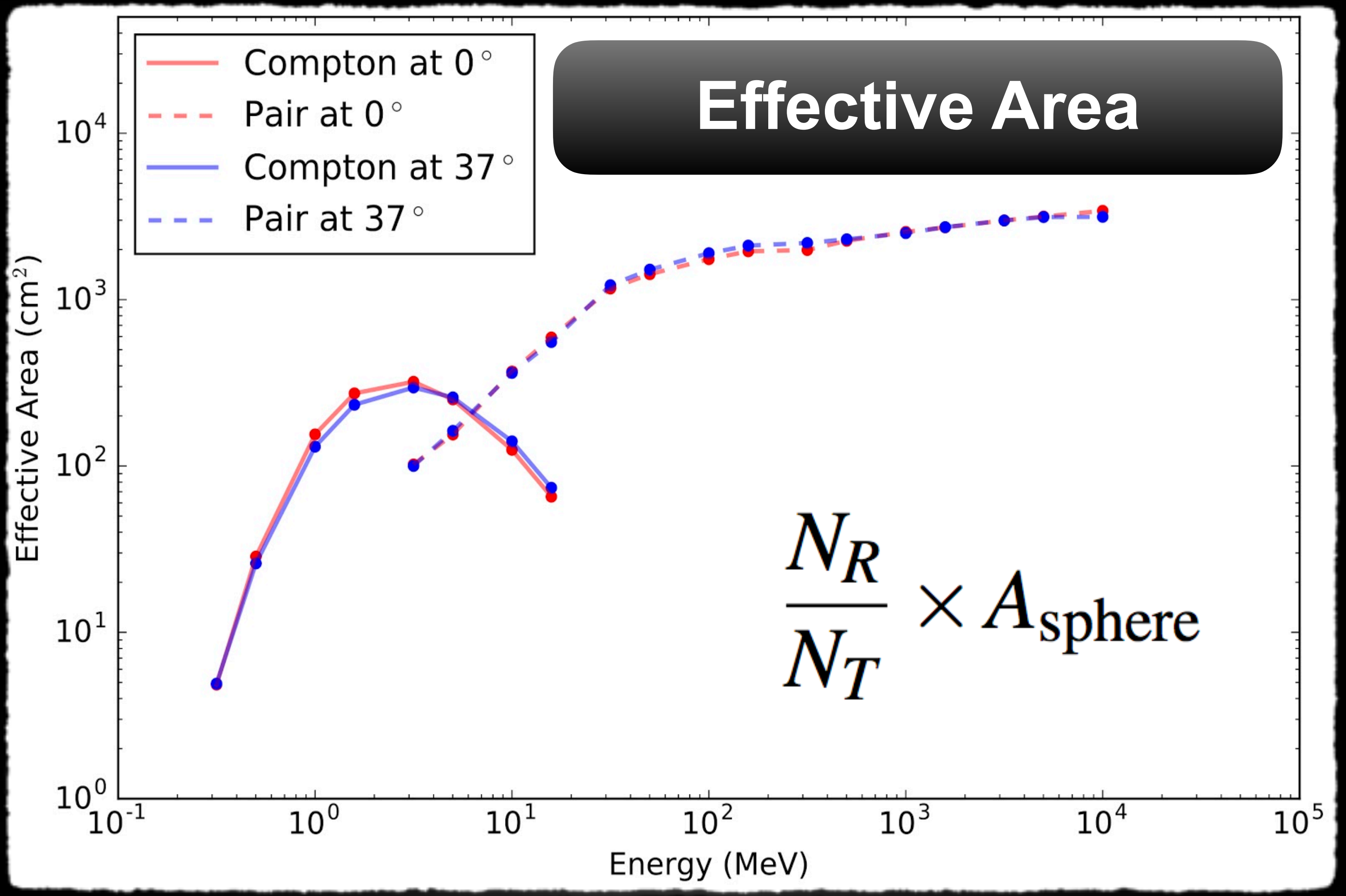
3σ CONTINUUM SENSITIVITY



3-year mission (20% efficiency for FOV/SAA) assuming the background shown (bottom left). In the compton regime, the backgrounds are scaled up by x10, which we found to be conservative. Fermi-LAT (5-year mission), COMPTEL and EGRET (2 week pointing), and NuSTAR and SPI (10^6 s live time) are also shown for comparison. These choices reflect the observing strategy and preliminary approximated mission duration. In the energy band ~1 to ~100 MeV AMEGO is at least an order of magnitude more sensitive, due mainly to the increased effective area and angular resolution. Comparing a 2 week AMEGO exposure, AMEGO is ~10x more sensitive than COMPTEL.

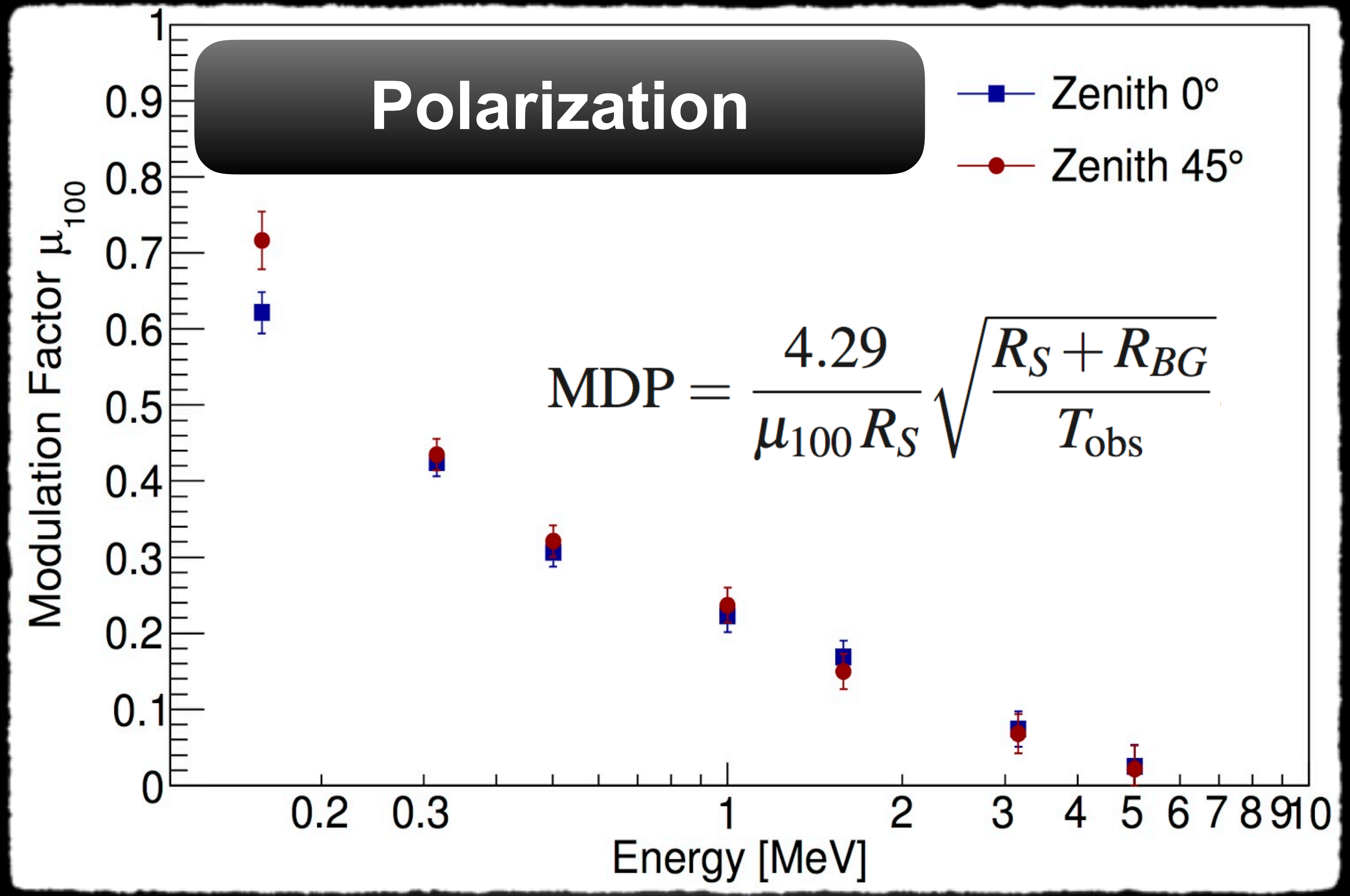
PERFORMANCE PLOTS FOR THE AMEGO INSTRUMENT

See our Github Repository [5]



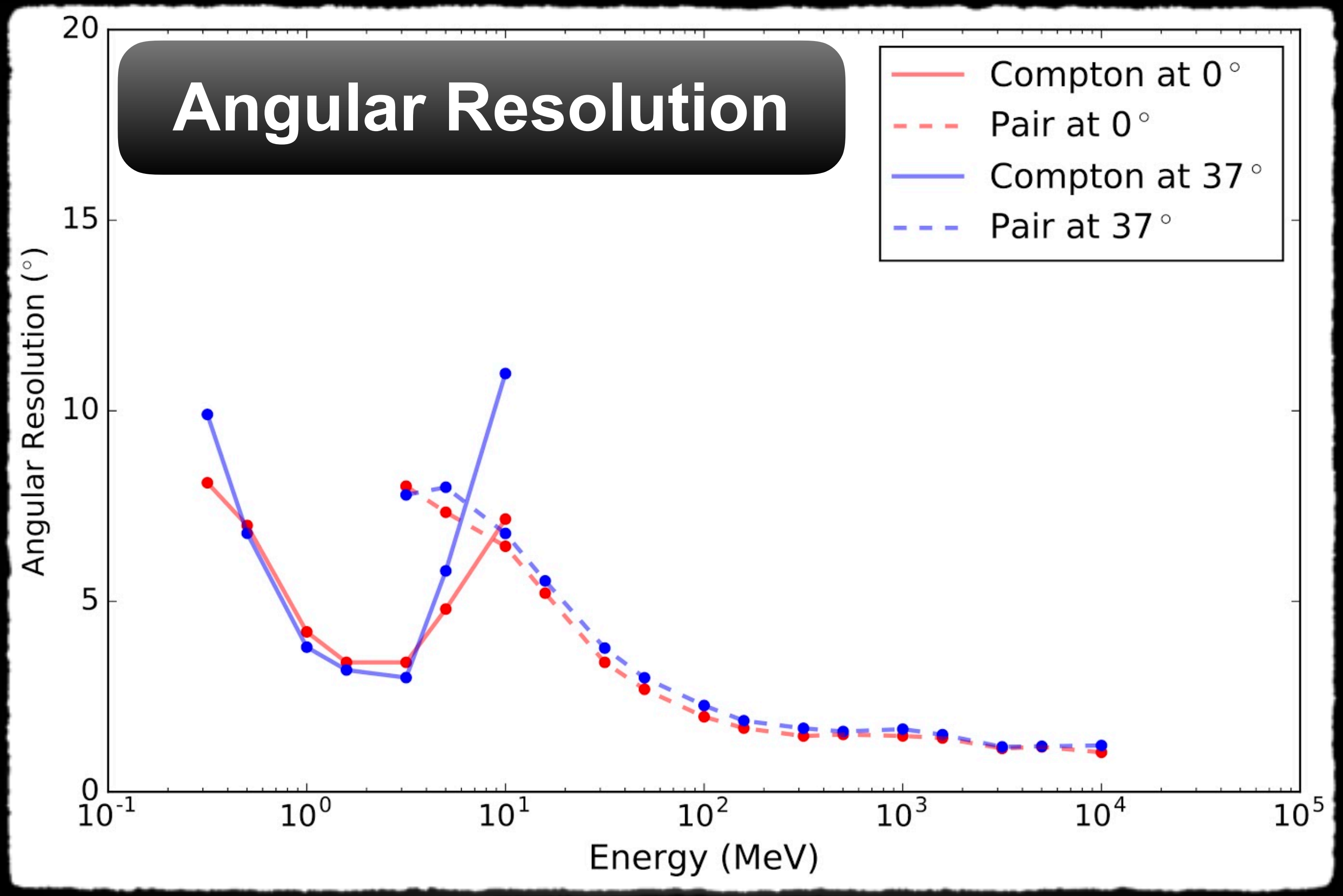
Effective area: ratio of the reconstructed (N_R) and generated (N_T) events times the total area (A_{sphere}) vs. energy. Relatively constant vs. incidence angle.

MDP	*Energy (MeV)*
5%	0.5-1
12%	1-2

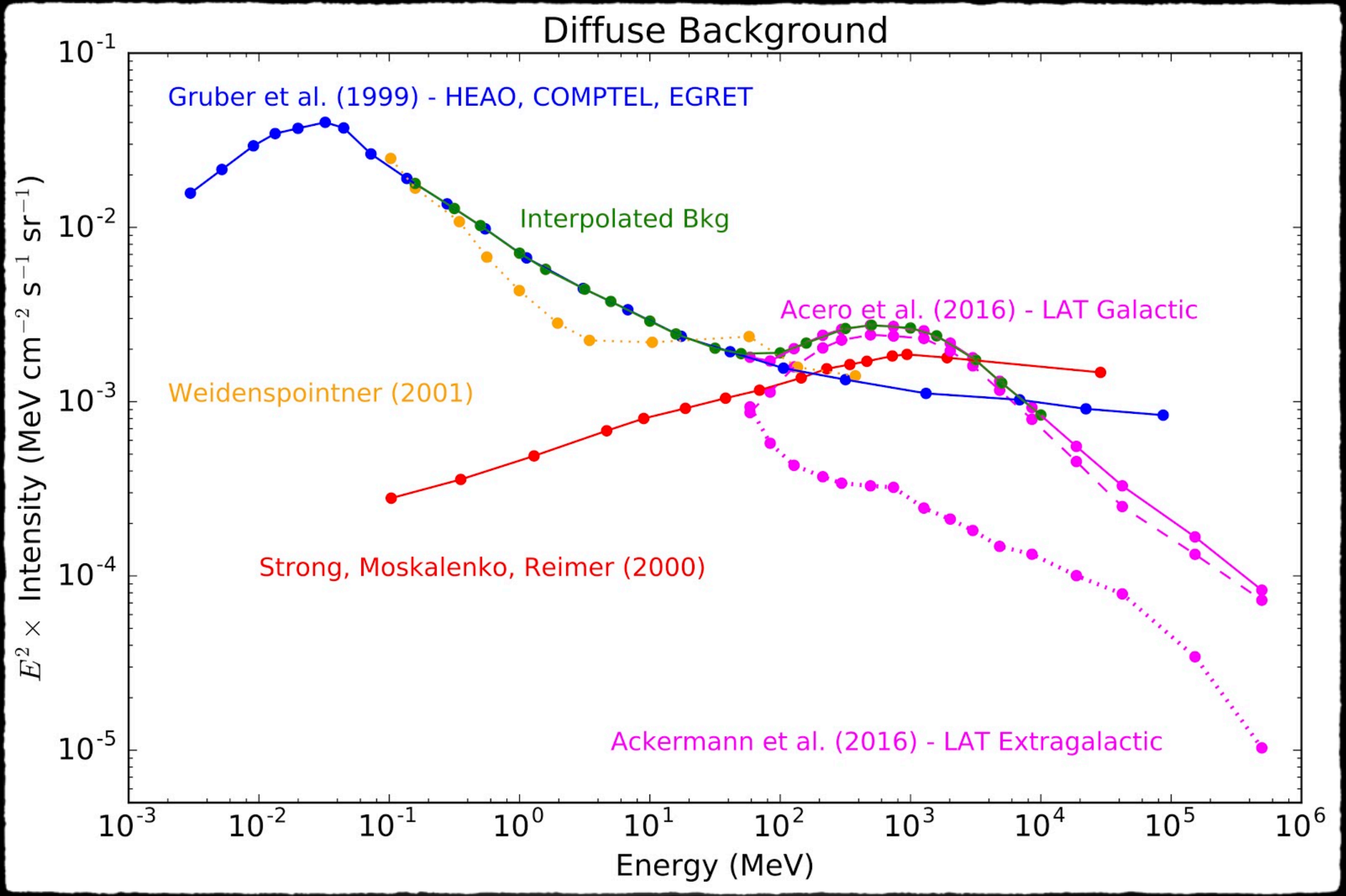


Polarization: simulated polarized source is fit to a sin function. Determine amplitude of azimuthal modulation (μ_{100}) (top left) vs. energy. Calculate minimal detectable polarization (MDP) for the signal (R_S), background (R_{BG}) and observation time (T_{obs}) (see equation inset and table on the left)

Angular resolution: angular distance from true direction to outer edge of Compton cone (Compton events), bisect angle of the electron/positron vectors weighted by energy (pair events) vs. energy. Also relatively constant vs. incidence angle.



AMEGO BACKGROUND ESTIMATION



Sources of Backgrounds: cosmic photon sources (Galactic and Isotropic), charged particles from cosmic sources and the Earth's Albedo, atmospheric secondary gamma rays, internal instrument backgrounds and from SAA. Backgrounds in analysis: Gruber et al. (1999) in blue x10, and Acero et al. (2016) in pink

REFERENCES

[1] J. L. Racusin et al. *AMEGO: Transients and Multi-Messenger Sources*, in ICRC (July 2017)

[2] J. S. Perkins et al. *AMEGO: Active Galactic Nuclei,* in ICRC (July 2017)

[3] R. Caputo et al. *AMEGO: Dark Matter Prospects* in ICRC (July 2017)

[4] A. Zoglauer et al., *MEGAlib The Medium Energy Gamma-ray Astronomy Library,* New A Rev. **50** (2006) 629

[5]https://github.com/ComPair

[6] A. Moiseev et al., *All-Sky Medium Energy Gamma-ray Observatory (AMEGO),* in ICRC 2017 (July 2017)

[7] J. S. Perkins et al. *AMEGO: Instrument and Technology Development,* in ICRC (July 2017)