Gamma-Ray Astrophysics with STACEE

APS, DPF

Riverside, CA

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Aerial Photo of NSTTF from 20,000 courtesy of the USGS and the Microsoft Terraserver project

The STACEE Collaboration

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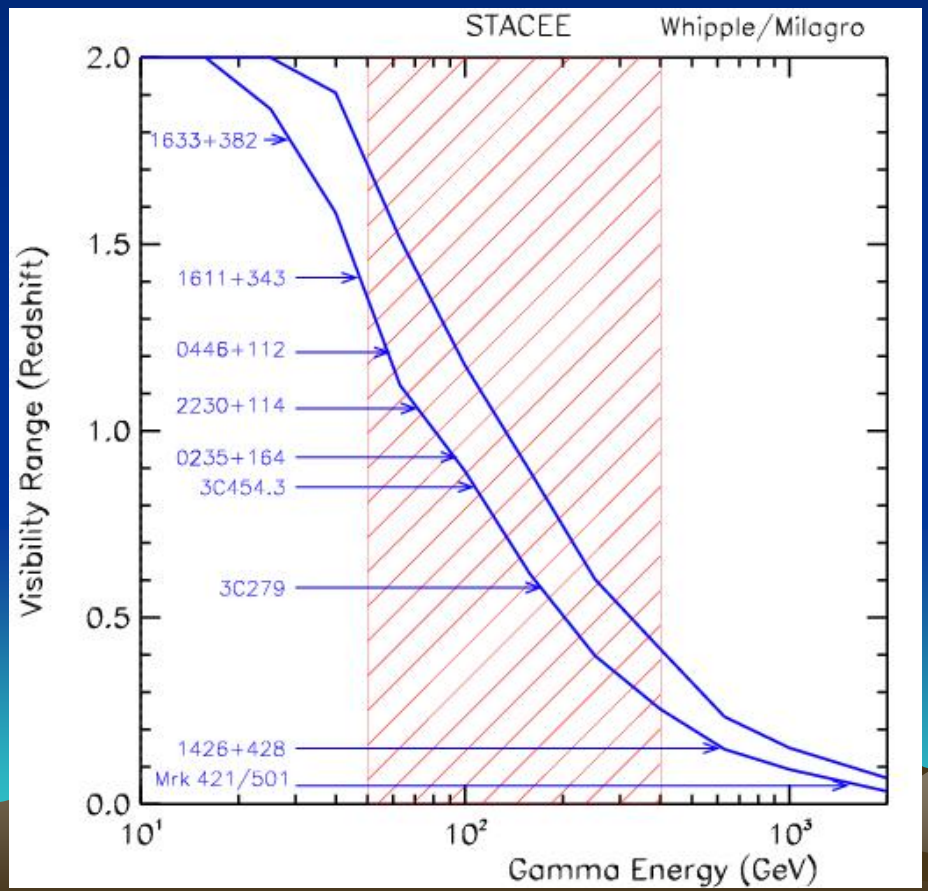
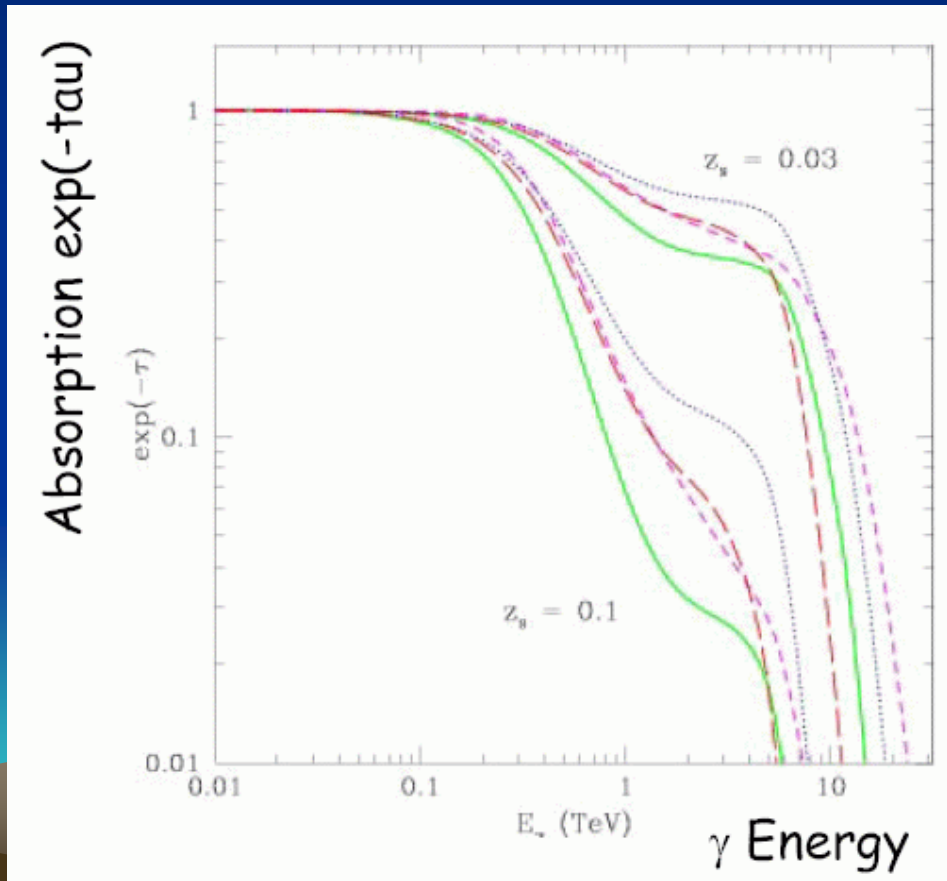
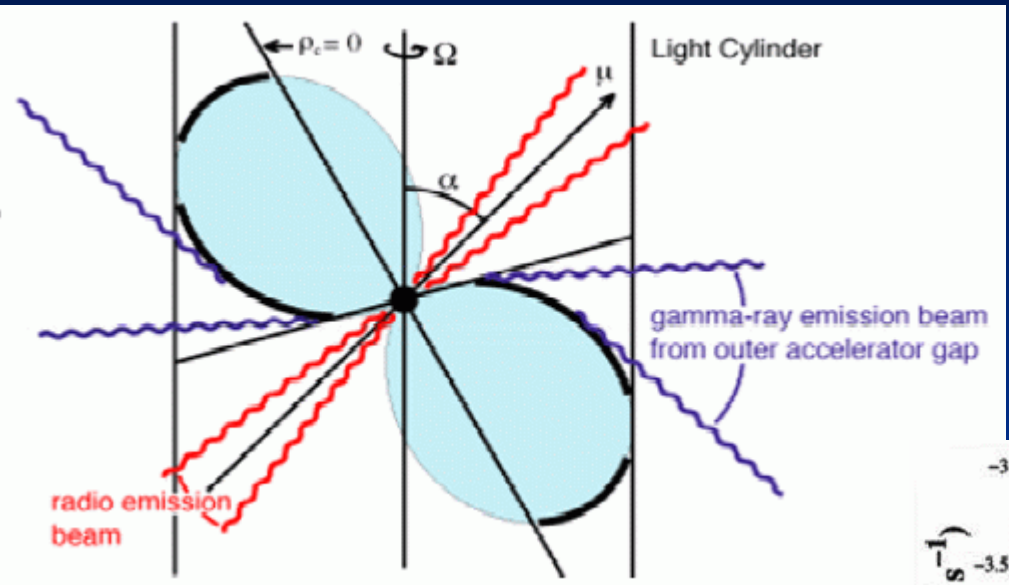
Scientific Motivation—AGNs

- Going to lower energy extends the viewing horizon and provides better information on the extragalactic background radiation



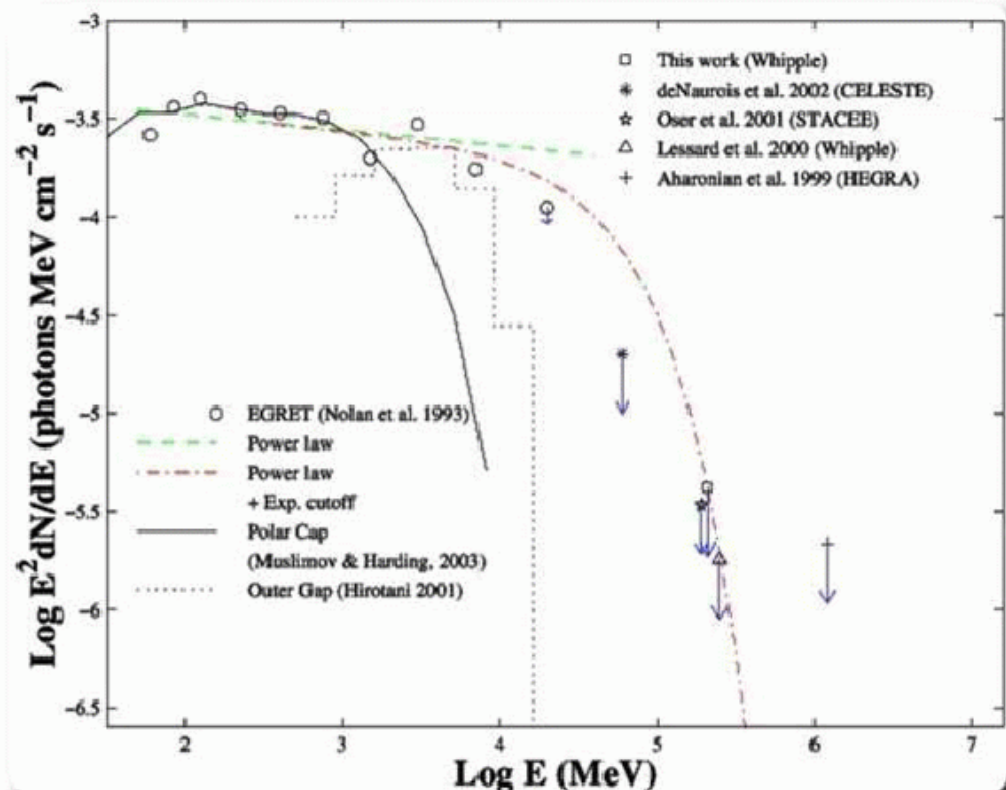


Scientific Motivation--Pulsars



- Emission mechanism of pulsed flux is unknown

- Highest energy of pulsed component would distinguish between the outer gap and polar cap models



The STACEE Detector

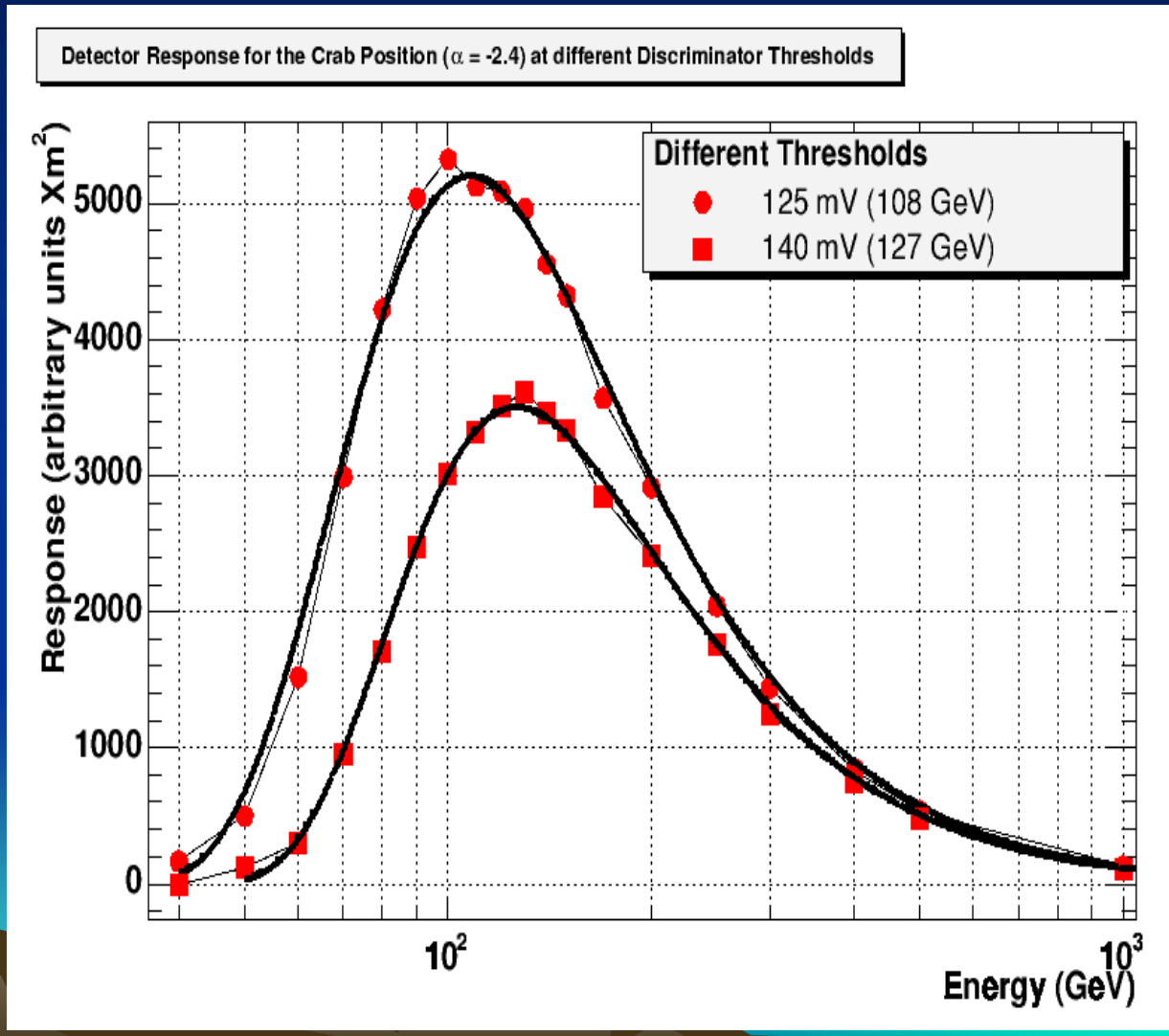
- Located at the National Solar Thermal Test Facility, Sandia National Labs, Albuquerque, NM
- Uses 64 heliostats with ~40m^2 collection area
- Heliostat field is comparable in size to footprint of Cherenkov shower on the ground

The STACEE Detector

- Light from each heliostat is collected in a single PMT
- Each PMT signal is sent to custom trigger electronics and also digitized with a 1GHz FADC

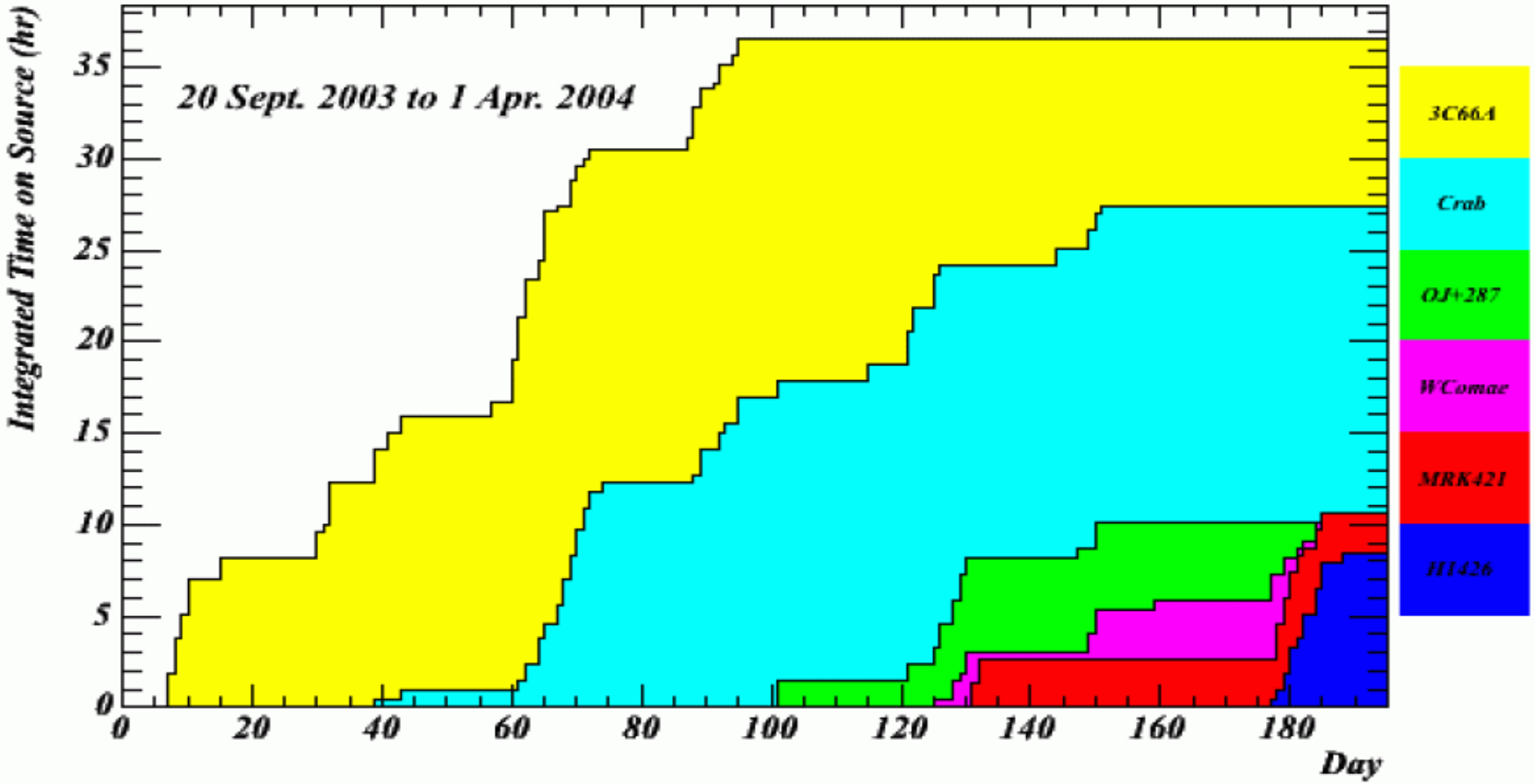
The STACEE Detector

- Due to the large mirror area, STACEE achieves a lower energy threshold than imagers and is sensitive below 100 GeV
- This will continue to be an important niche in the early days of the new satellite and imaging detectors

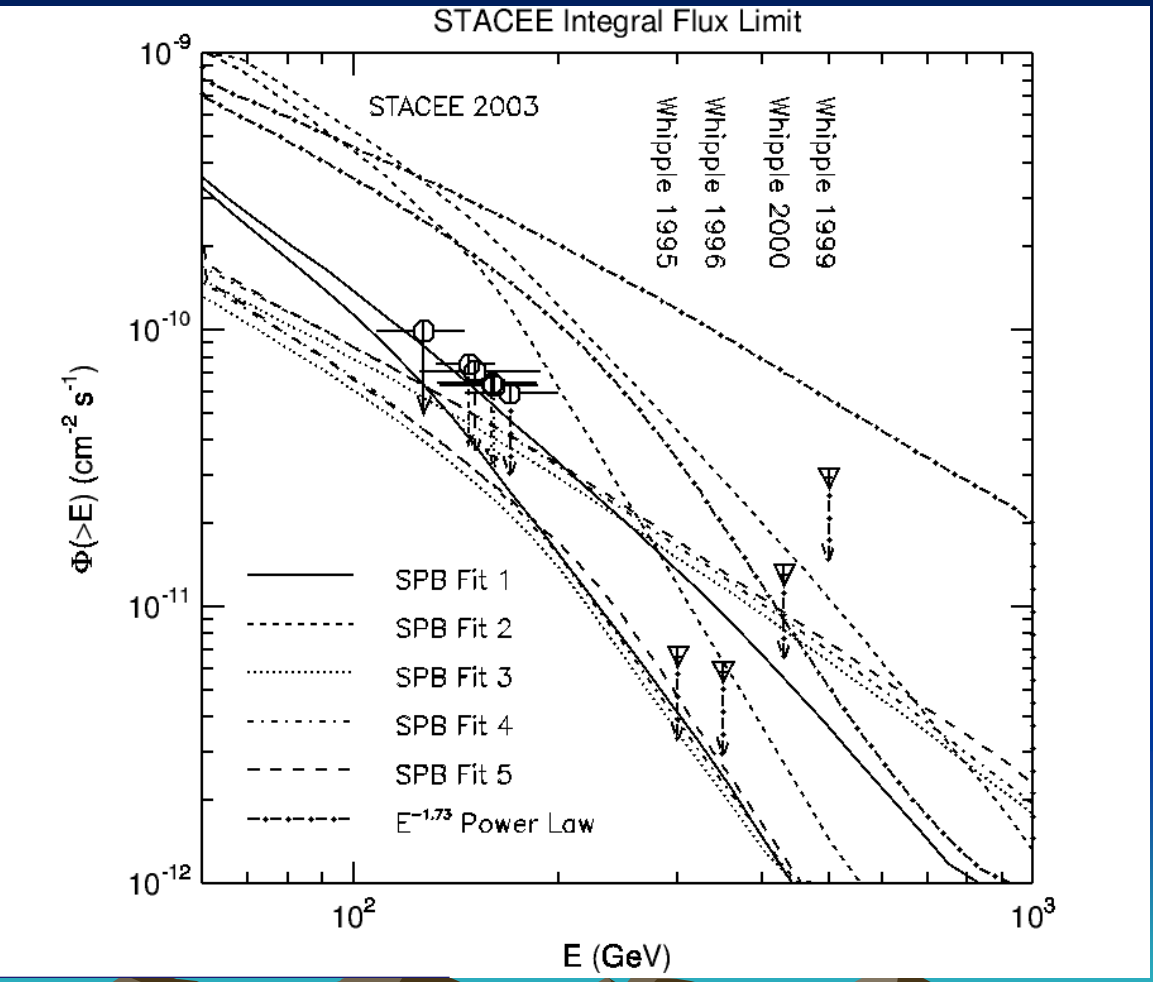


Observations and Results

- Active participation in multi-wavelength campaigns, ToOs and GCN alerts

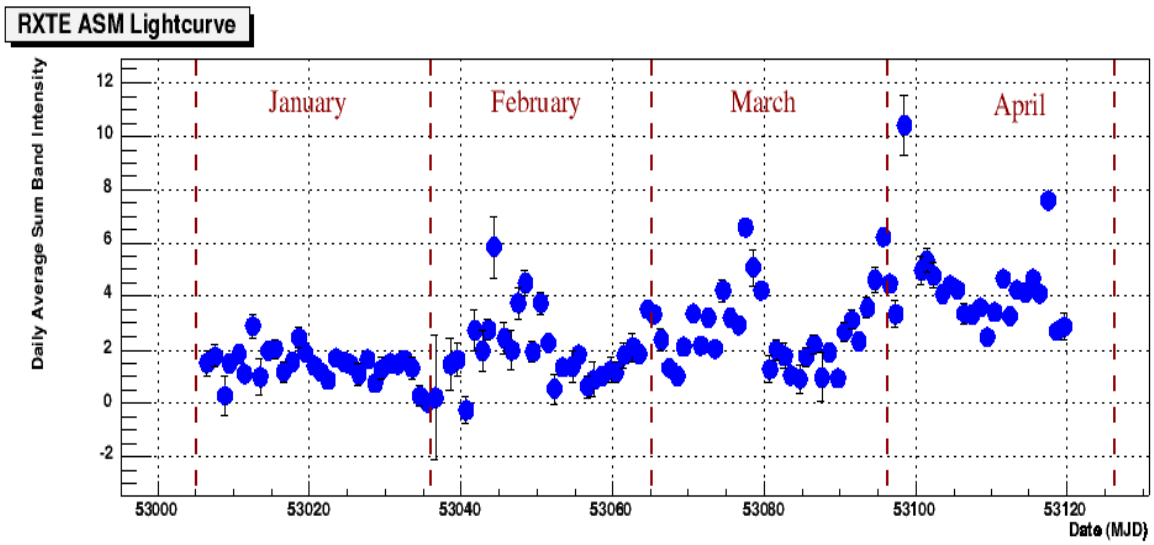


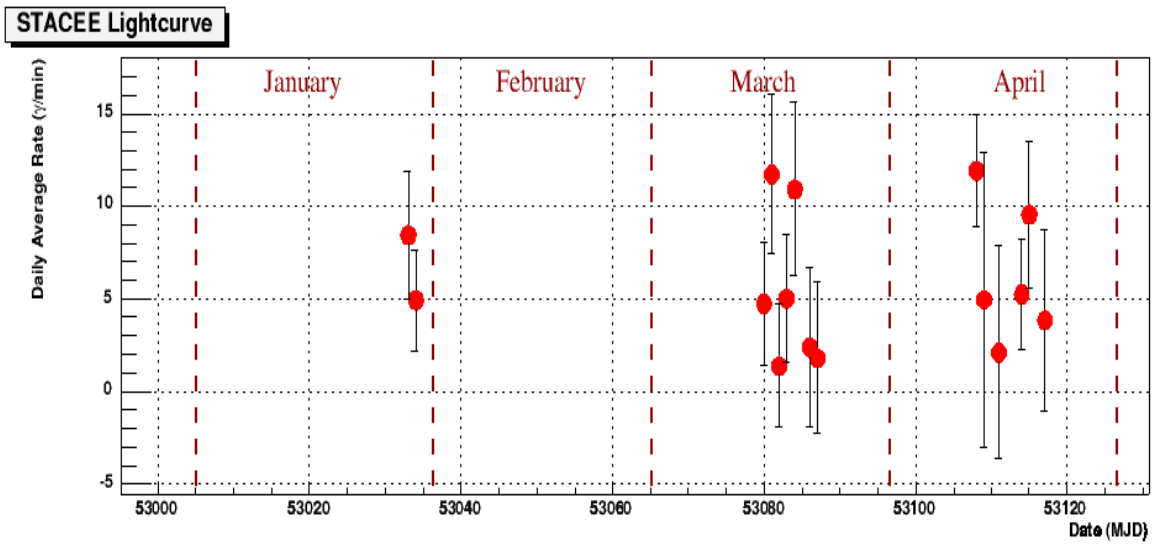
STACEE Results--WComae



- Z=0.102
- EGRET blazar, hard spectrum, no cutoff
- STACEE data analyzed and published (Scalzo, ApJ, 2004)
- STACEE upper limit begins to constrain emission models

STACEE Results—Mrk421





- Z=0.031
- First TeV AGN detected (1992)
- Correlated emission between Whipple and STACEE data seen (Boone, ApJ, 2002)
- Observed during flaring states in 2004
- Analysis ongoing

GRB Observations

GRB data acquired:

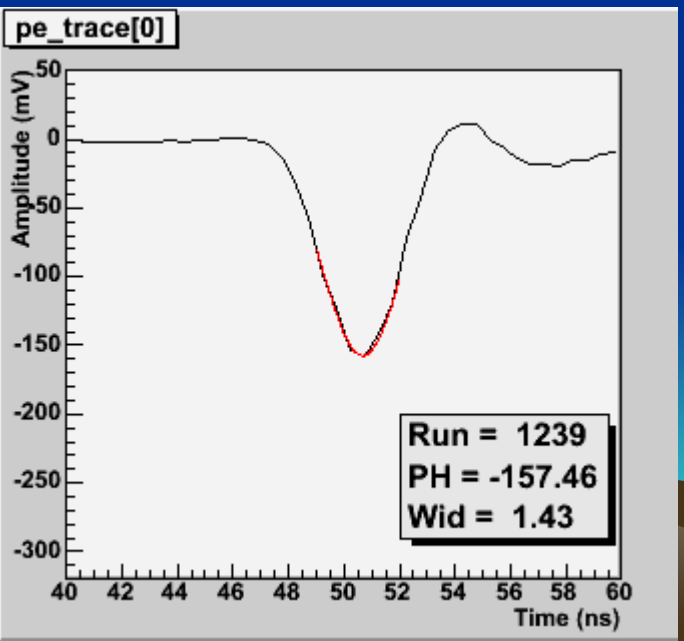
GRB	UTC Time	Spacecraft	Notice Delay (minutes)	Time until Observable by STACEE (hours)	STACEE Observations
021004	12:06:14	HETE	0.8	14.1	None
021112	03:28:16	HETE	81	3.2	Starting 219 minutes after burst ;112 minutes on burst position
021211	11:18:34	HETE	0.4	0.0	None; bad weather
030115	03:22:34	HETE	71	8.4	None; full moon
030227	08:42:16	INTEGRAL	48	17.7	None
030324	03:12:43	HETE	0.4	2.0	Starting 123 minutes after burst; 56 minutes on burst position
030328	11:20:58	HETE	53	16.7	None
030329	11:37:15	HETE	73	15.2	None
030417	06:24:20	INTEGRAL	0.2	>24	None
030418	09:59:19	HETE	3.6	17.2	None
030501A	03:10:19	INTEGRAL	0.3	4.6	Starting 369 minutes after burst; 28 minutes on burst position
030519	14:04:54	HETE	0.6	Infinite	None
030528	13:03:03	HETE	0.6	17.6	None
030722	11:02:46	INTEGRAL	0.2	>24	None
030723	06:28:18	HETE	0.8	Infinite	None
030824	16:47:35	HETE	60	11.7	None
030913	17:06:58	HETE	0.6	9.9	None; full moon
031015	19:23:46	INTEGRAL	0.2	>24	None

Bursts from 9/01/02 through 10/31/03 with alert within 90' of burst

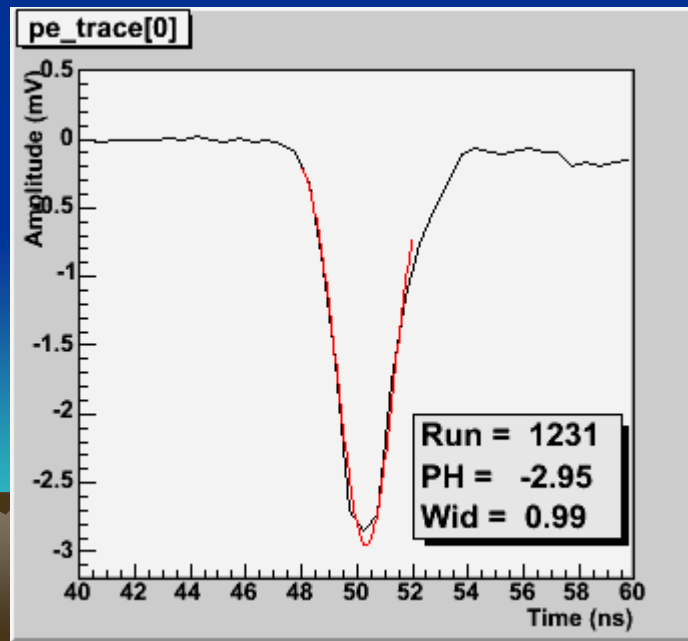
STACEE Upgrade

- GHz bandwidth amps installed
- Low bandwidth electronics removed
- Will allow STACEE to run with a lower energy threshold than in the past

Single PE shape with old electronics



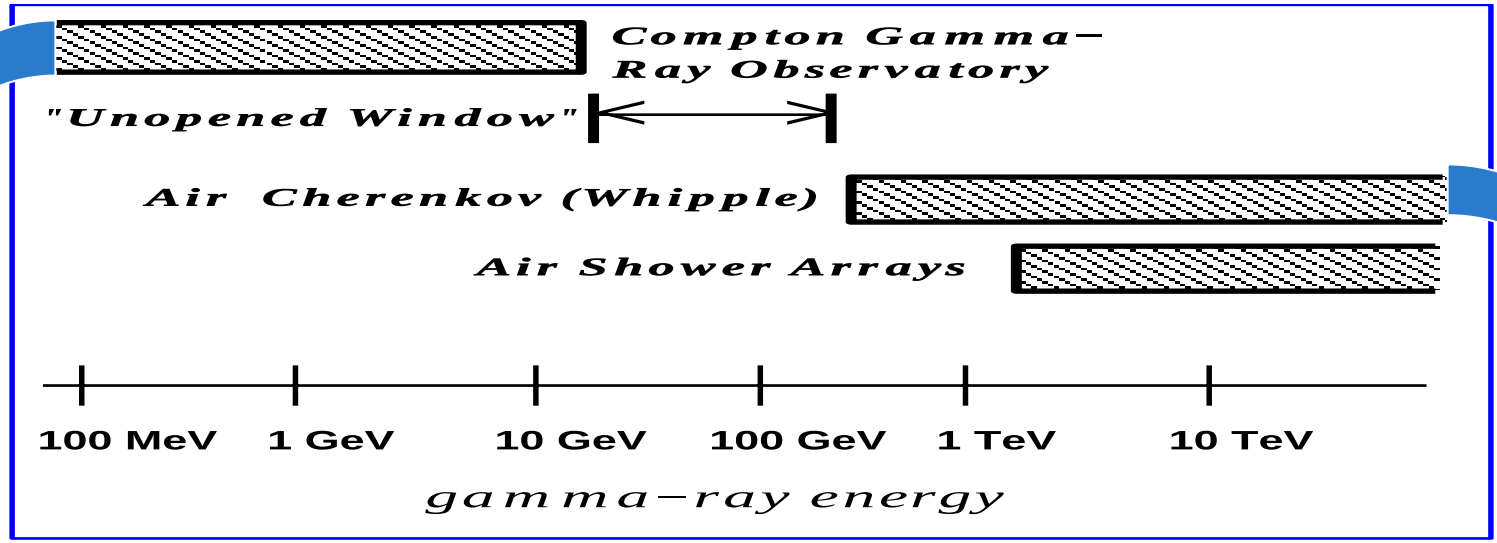
Single PE shape with new electronics

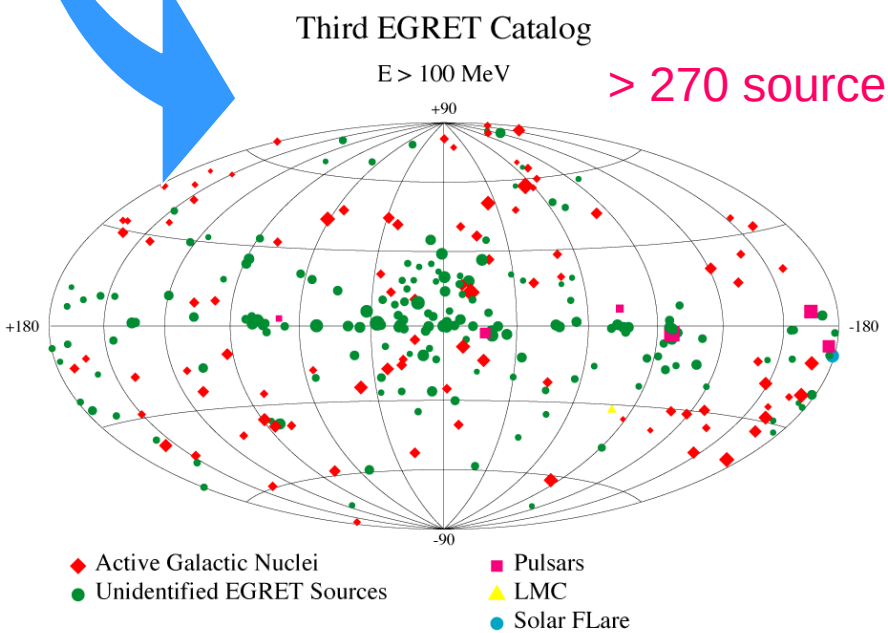


Outlook/Conclusions

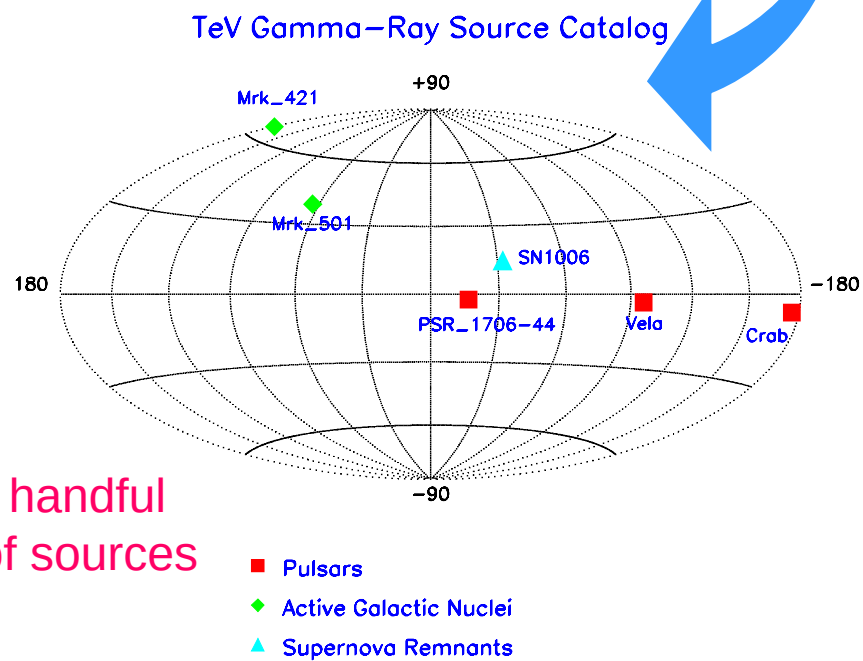
- STACEE is the lowest energy gamma-ray Cherenkov telescope operating in the world today
- STACEE has carried out regular observing on a variety of sources since Fall 2002. We have results from these observations which will be improved in future as we improve our analysis
- 2004: we made a significant modification to detector that will lower the threshold. We are also working to fully understand power of the FADC system
- STACEE will operate at least until 2006/7 time frame, when VERITAS/GLAST will be operational.

The mid 1990's Gamma-ray sky





> 270 sources



handful of sources