

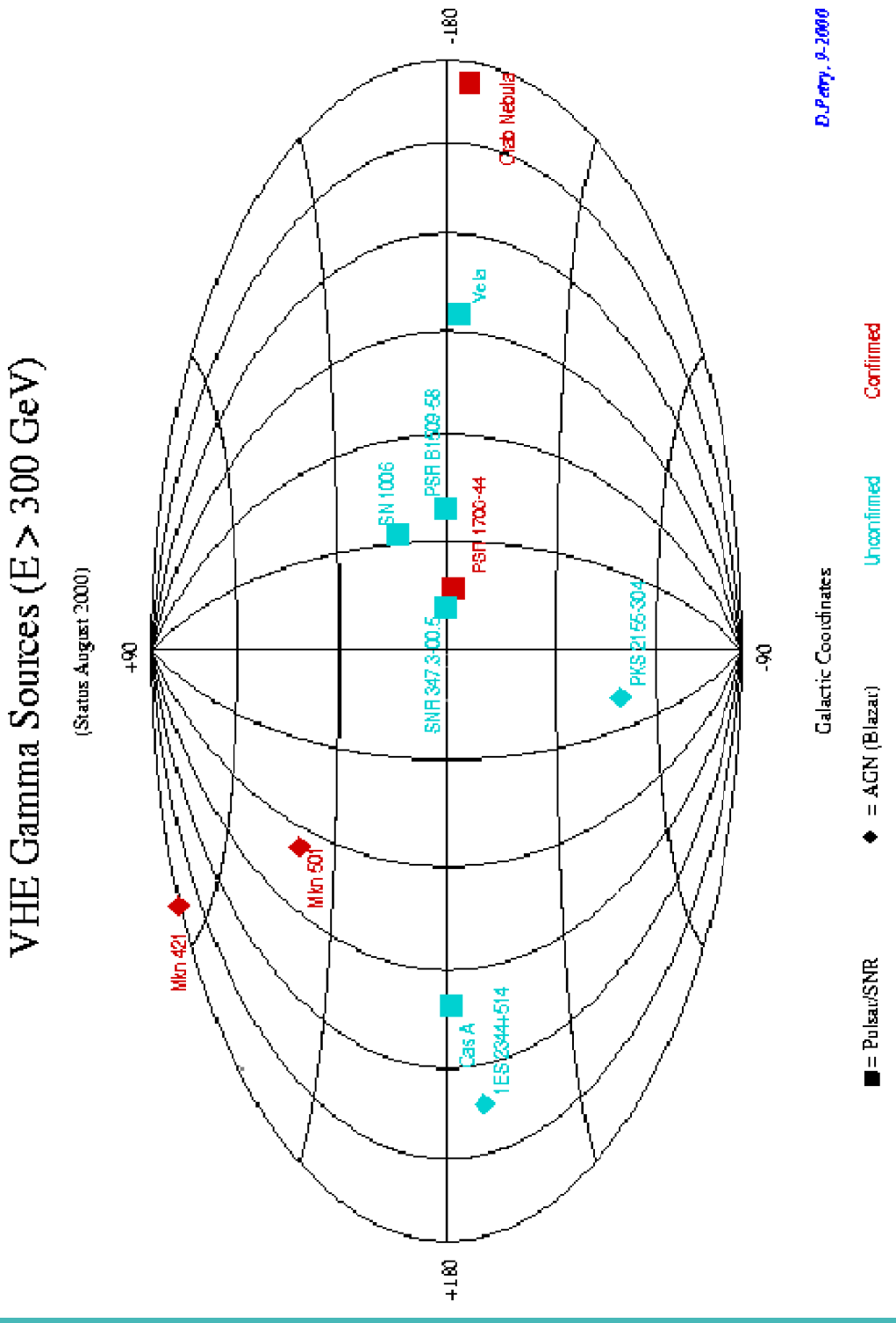
The VHE sky 2006–2010

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GLAST LAT Collab. Meeting – Aug 1–2, 2001

- VHE Catalog: AGN Observations above 50 GeV
- Future Experiments on the ground
- Importance for GLAST
 - Sensitivity
 - Overlap in sky, time
 - Unique capabilities on the ground

VHE Sources (2001)



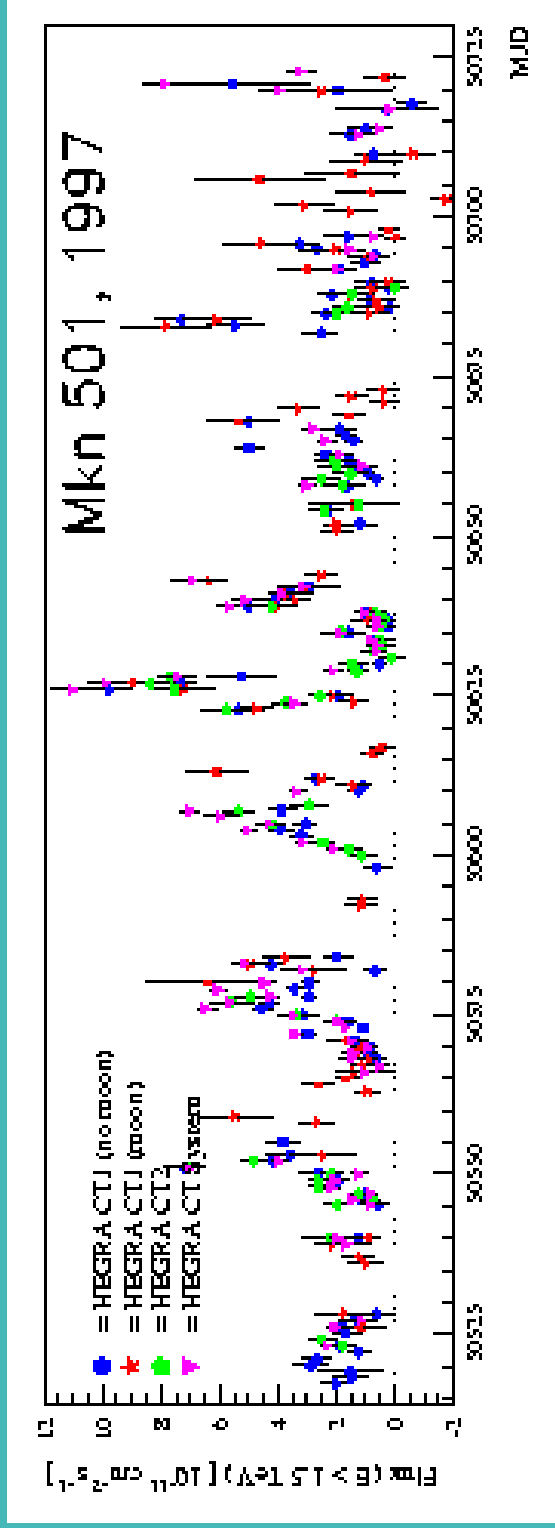
- All sources discovered with atmospheric Cherenkov technique

- **AGN Catalog (including weak detections)**

Name	Type	Z	EGRET ?
Mrk 421	XBL	0.031	Y
Mrk 501	XBL	0.034	Y
1ES2344+51	XBL	0.044	N
?? 1ES1959+650	XBL	0.048	N
PKS2155-304	XBL	0.116	Y
1H1426+428	XBL	0.129	N

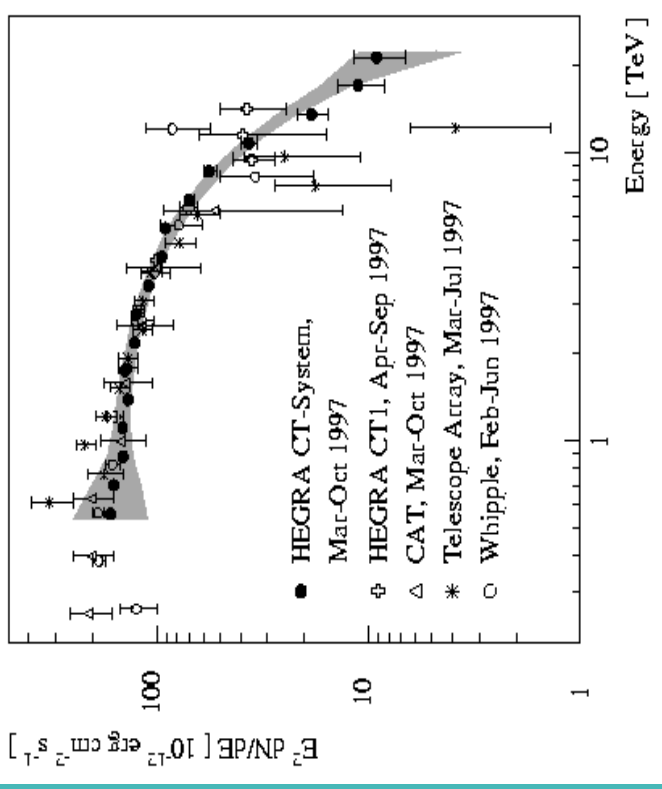
- All XBL's – different population from EGRET
- Nearby

MRK 501 – 1997

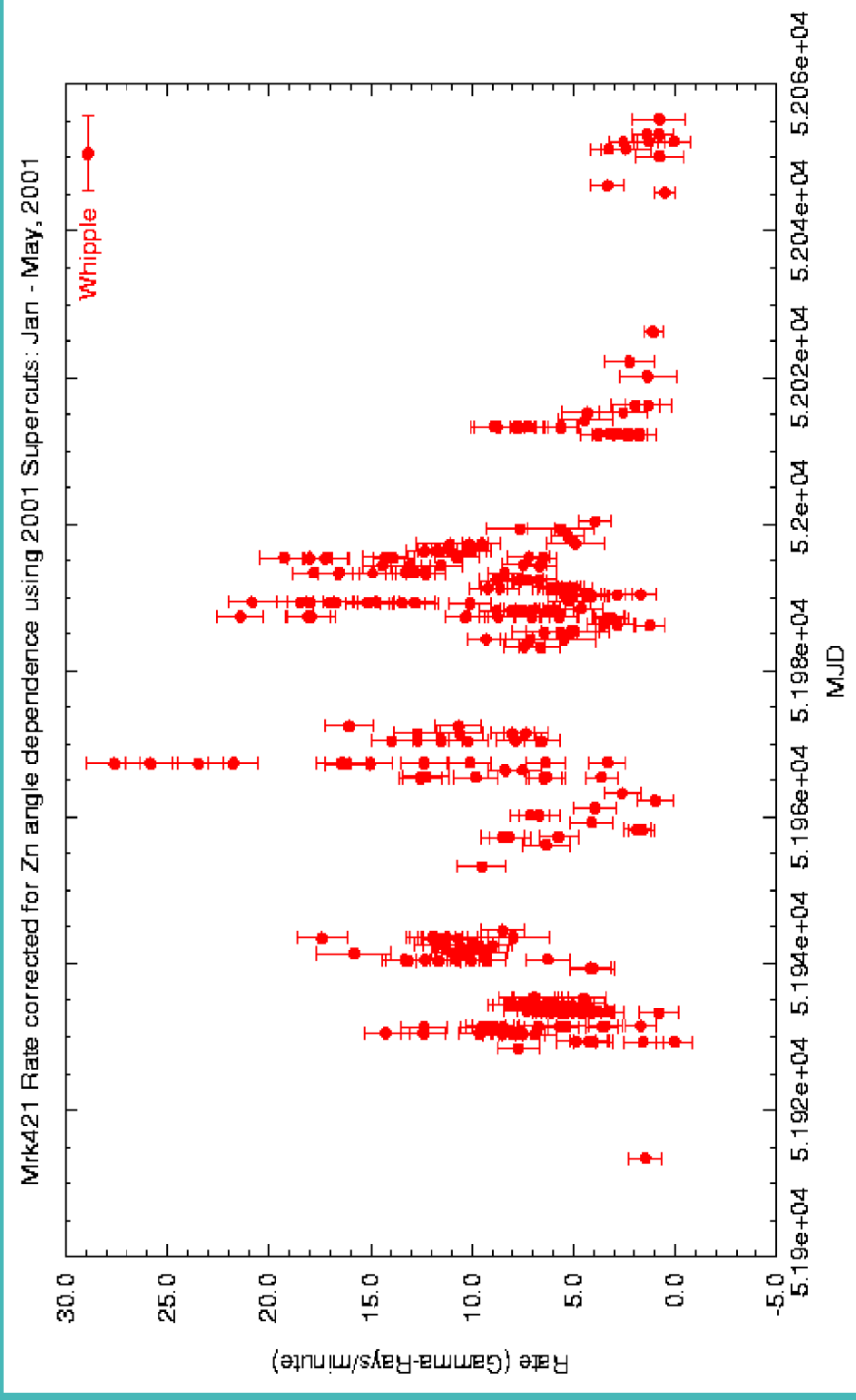


● Light curve

● Spectrum



MRK 421 – 2001

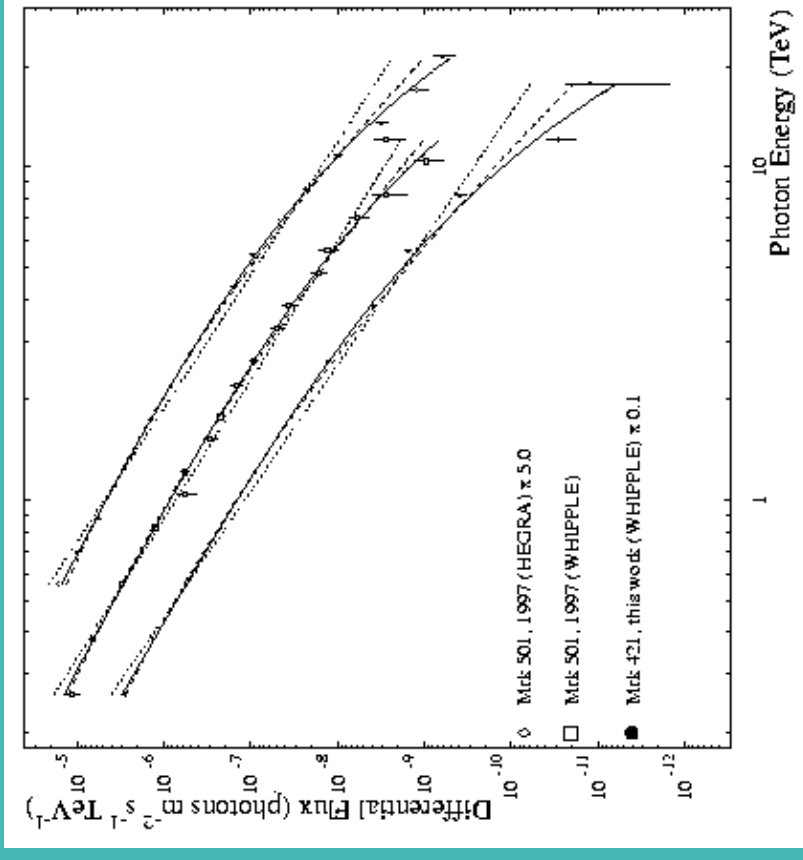
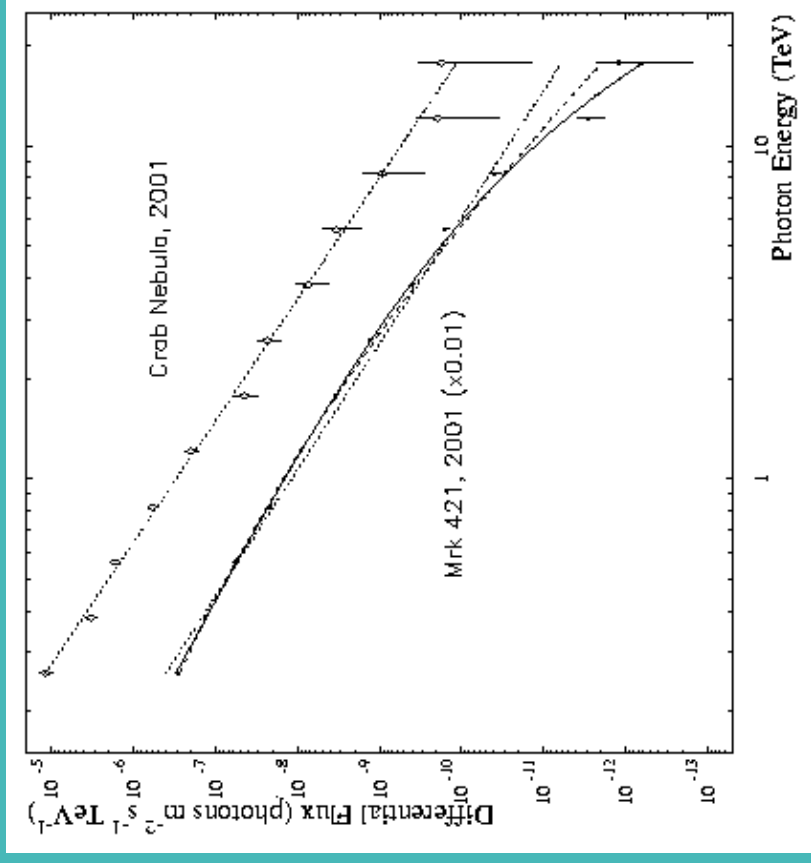


- Detection $> 200 \sigma$
- Correlation with X-rays (Holder et al, ICRC Hamburg)
- Short term variability minimum $\tau \sim 30$ min rise \sim fall

MRK 421 – 2001

astro-ph/0107113

Whipple/MERITAS



- Difficult to measure "cutoff"

- Universal feature ?

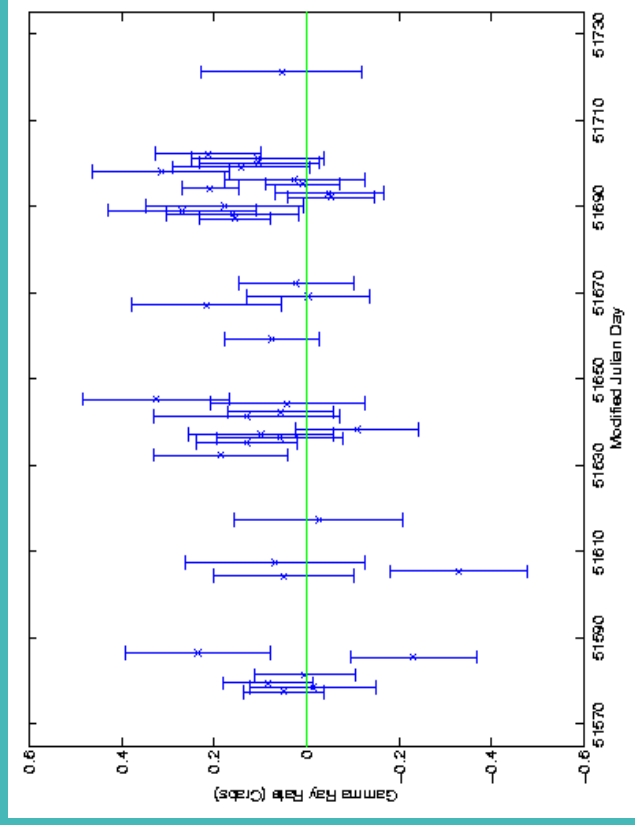
- Absorption at Source ?

- Note: HEGRA sees somewhat different spectral shapes – Mrk 421 appears different than Mrk 501 (ICRC Hamburg)

1H1426+428

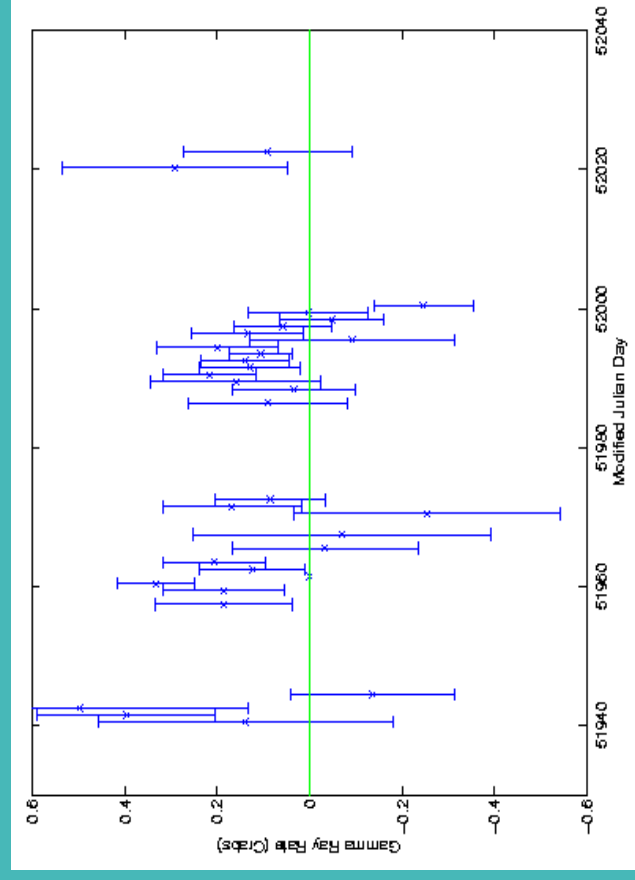
(Horan et al., ICRC Hamburg)

Whipple/VERITAS (also seen by HEGRA at similar significance)



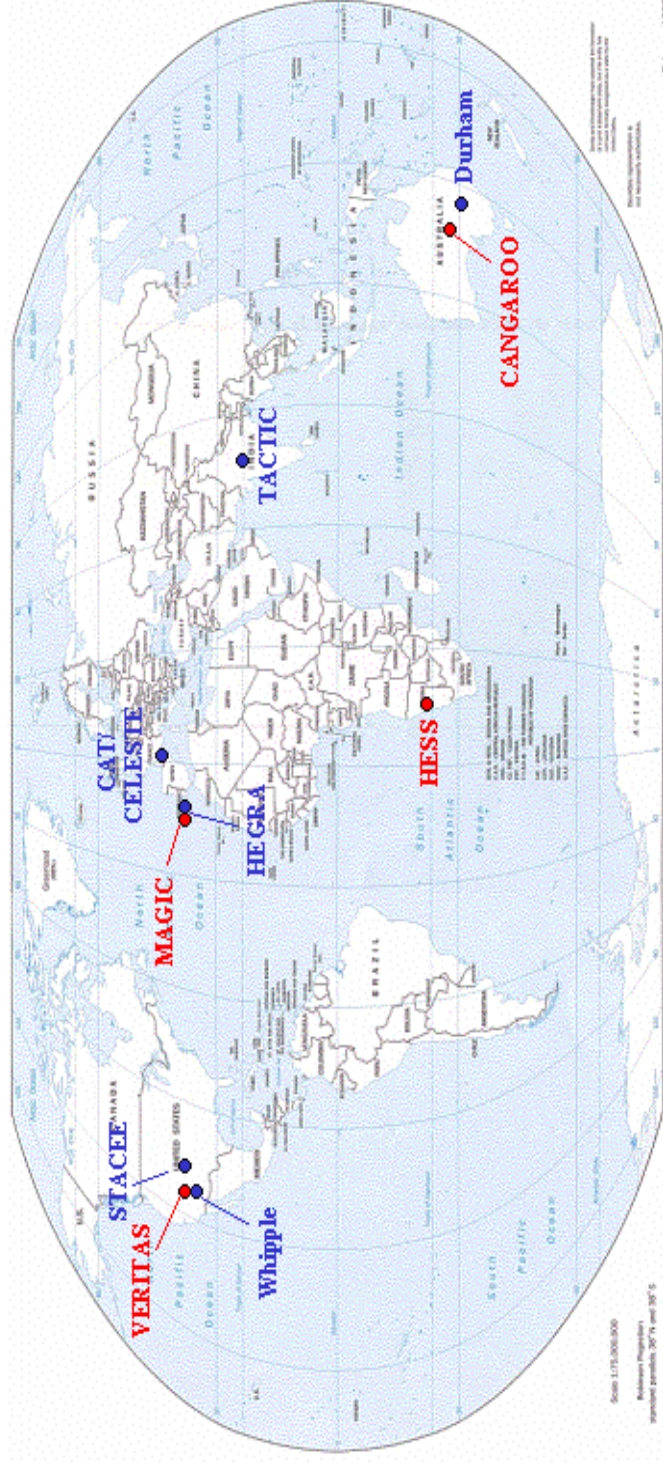
● 2000 4.19 σ

● Weak signal $\sim < 100$ mCrab



● 2001 4.94 σ

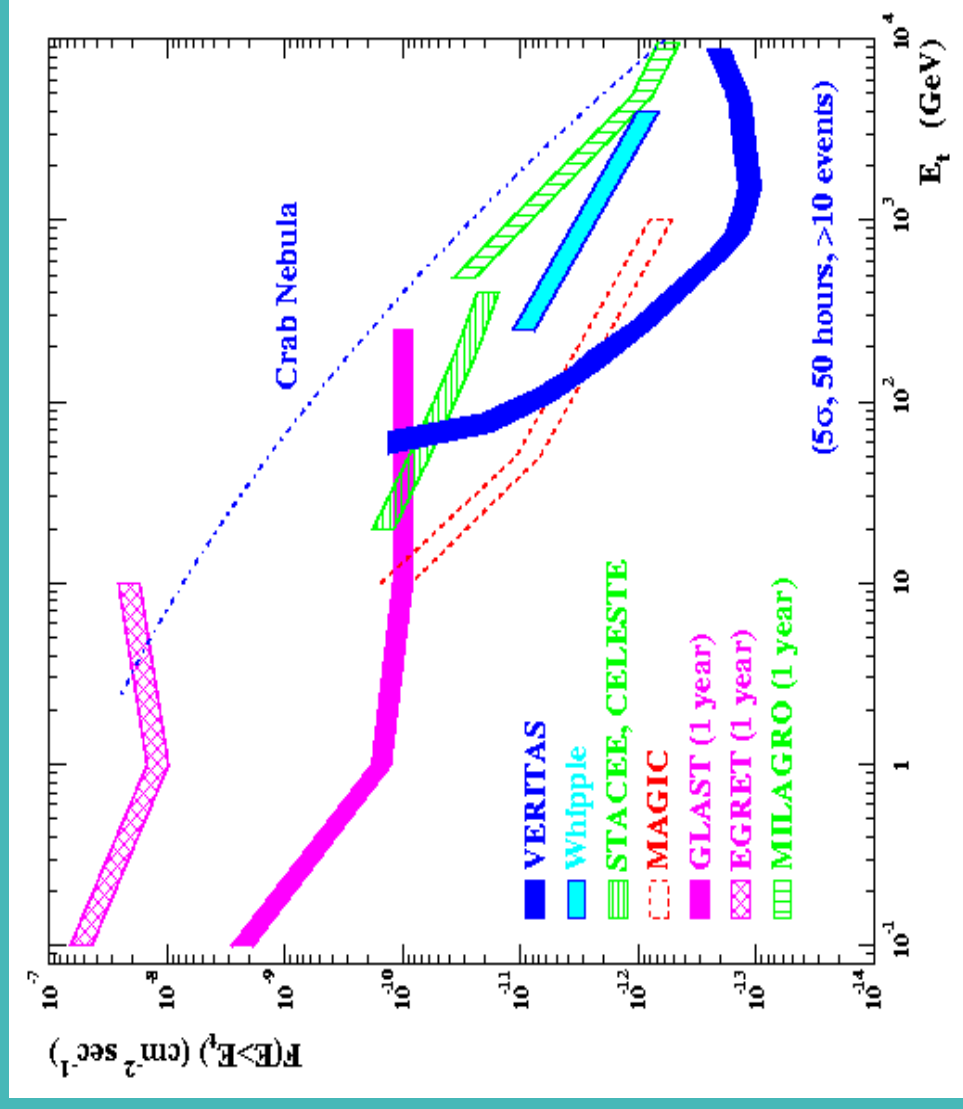
Cherenkov Telescopes around the World



2001: **Operational**
Under Construction

- 2005 All four new telescopes should be operational 2 N, 2 S
- Do not consider air shower arrays
- For review, see Weekes, astro-ph/0010431

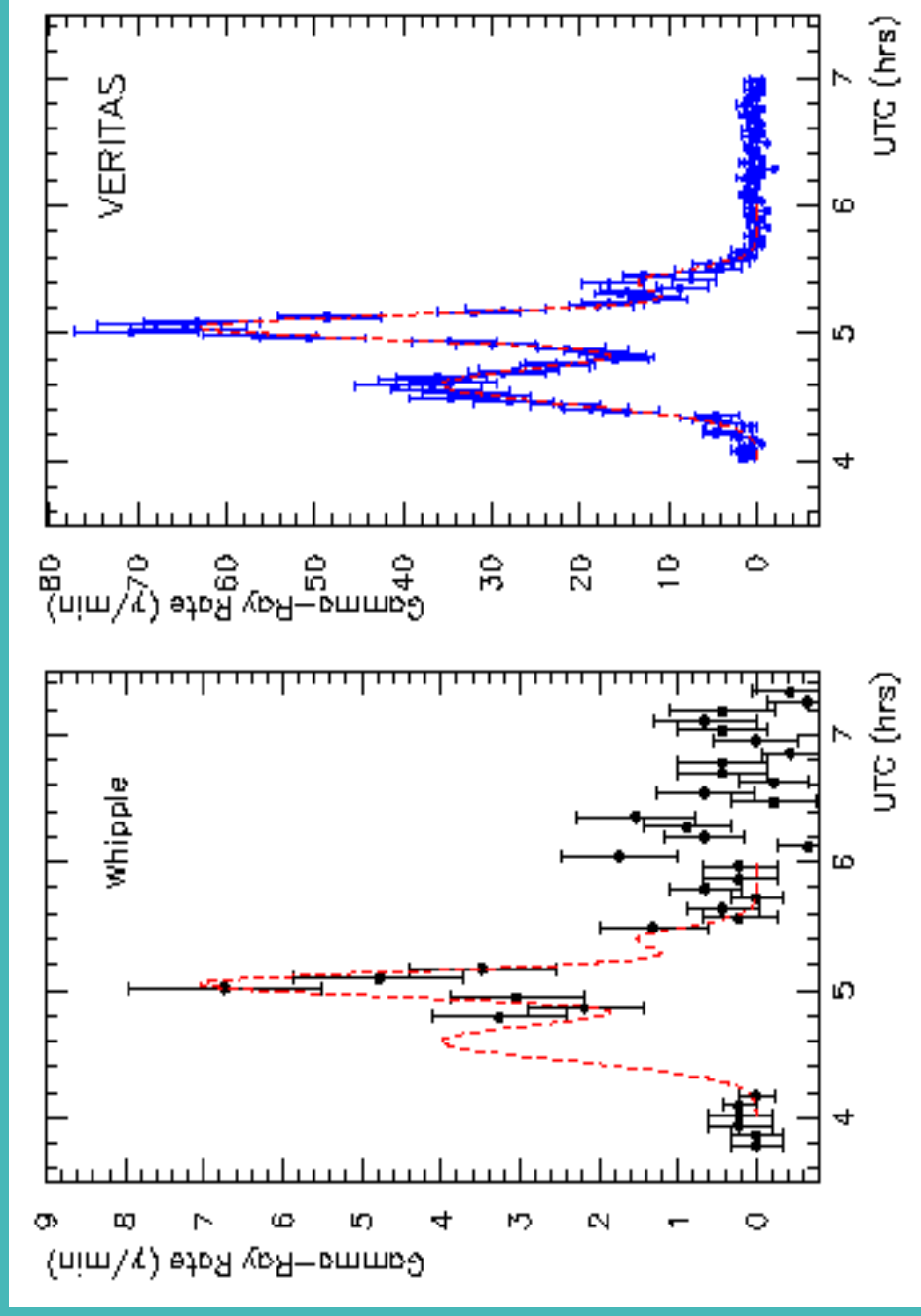
Sensitivities



- Both in space and on ground, sensitivities $\sim 10 \text{ mCrab}$
- Limitation space– HE photon counting ground– LE threshold
- Comparing "apples" and "oranges"

Most important strength for Ground-Based

– short term sensitivity



Comparison with GLAST

Parameter	GLAST	NGACT (e.g. VERITAS)
Angular resolution (single photon)	0.10° (1 GeV) 0.04° (50 GeV)	0.14° (50 GeV) 0.05° (300 GeV)
Energy resolution	7–10 % (1–50 GeV)	15–10 % (50–500 GeV)
FOV	2.5 sr	2×10^{-3} sr
Duty Cycle	100 %	16%
Area (m ²)	1.3	$10^4 - 10^5$
Instant. Crab Rate	< 0.5 / min	~ 50 /min

Overlap with GLAST

Assumptions (optimistic):

- Two HESS/VERITAS ACTs in each hemisphere
- Duty cycle of 10% for each telescope
- Yearly operation of 10 months/telescope
- Telescopes formulate independent observing plans
- Have not folded in GLAST observing constraints
- Fraction of Time Covered by 1 or more ACTs
(for sources that transit near zenith)
 - Average (year) ~ 13%
 - Average (month) ~ 20% winter
~ 8% summer
 - Peak (day) ~ 80% winter
 - Peak (day) ~ 45% summer

Overlap with GLAST (cont.)

- Fraction of Sky covered (observations down to zenith= 45°)
 - Northern Hemisphere ~ 82%
 - Southern Hemisphere ~ 65%
 - Good overlap for $\delta = -10^\circ$ to 10°
- # Sources / ACT in a year
 - Include additional 80% source efficiency
 - **14** sources @ 25 hr/source
- Total sources (both hemispheres) seen on ground in a year
 - Minimum ~ 28 (expts in each hemis. have identical obs plans!)
 - Typical ~ 40
 - ~ 40–50% will be extragalactic

Comments

- Have not considered "survey" modes for ACTs
 - VERITAS increase numbers of sources by 4–5
 - decrease sens. by 4 @100 GeV, by 8 @ 1 Tev
- For particular sources, monitoring can continue for months
- Coordination among ground-based community will help
- GLAST will strongly affect ground-based observing plans

Summary

- NGACTs will be an important complement to GLAST
- Key strength – follow ~25 AGN with great sensitivity at VHE
- Without coordination, capabilities will greatly surpass those today
- Coordination would substantially improve the science