Prospects with VERITAS

Galactic sources and cosmic ray accelerators

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VERITAS collaboration
http://veritas.sao.arizona.edu

AGILE, Rome, February 2005

OUTLINE

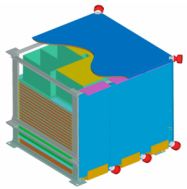
- Introduction: $C_4H_4M^2V^4$

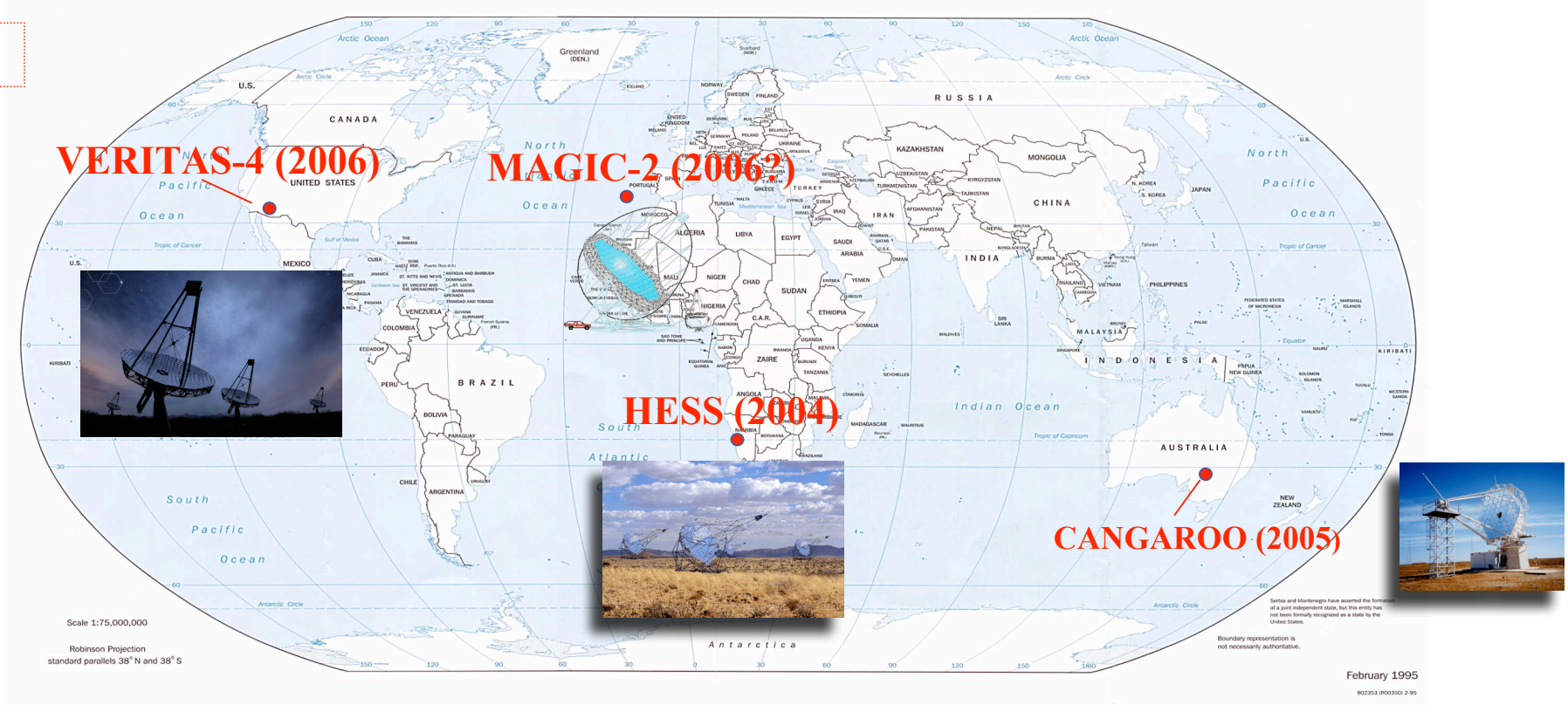
- Galactic Centre
- Binary pulsars
- Supernova Remnants
- TeV unidentified sources
- Galactic sky surveys

- Summary

High energy gamma-ray telescopes

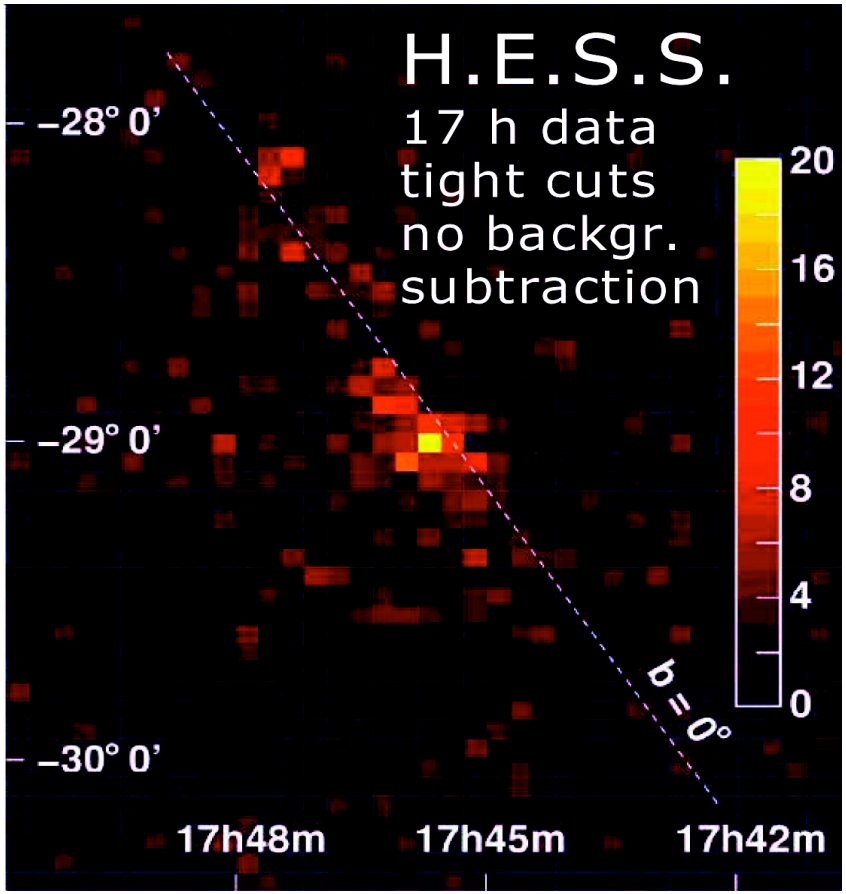
AGILE

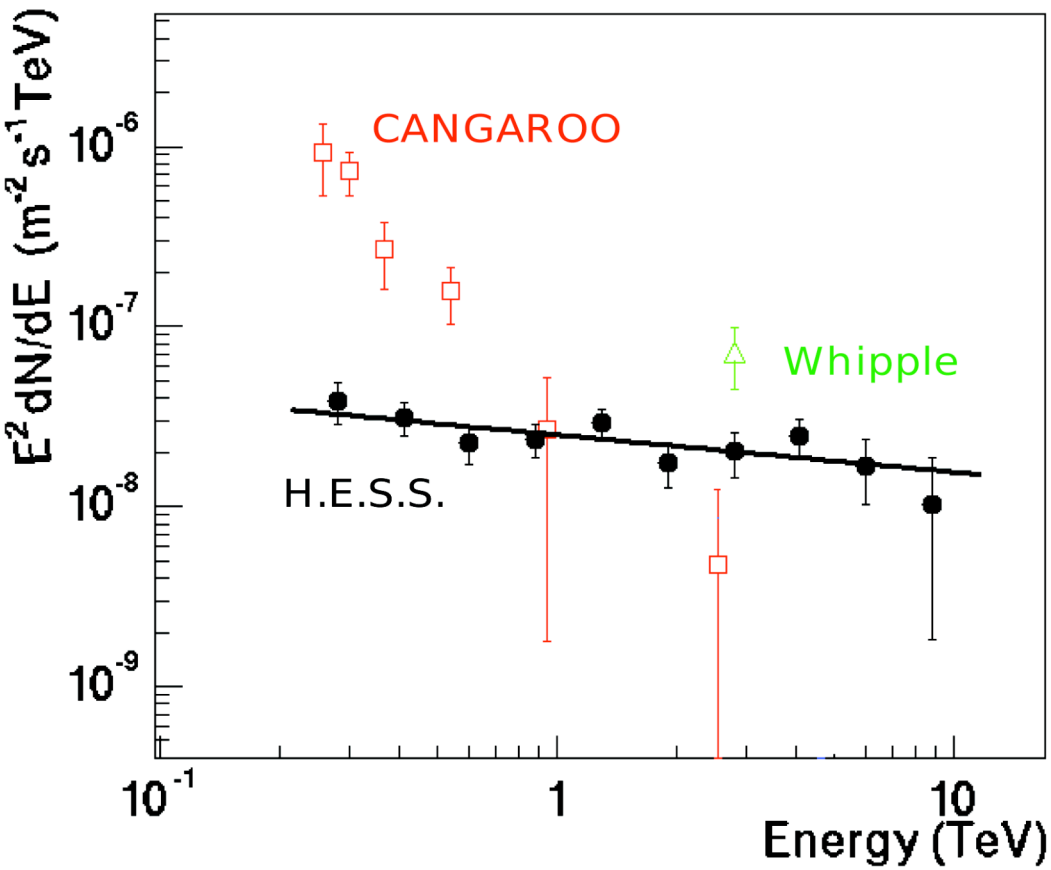




- Good global coverage - latitude & longitude.
- High flux sensitivity around 100 GeV

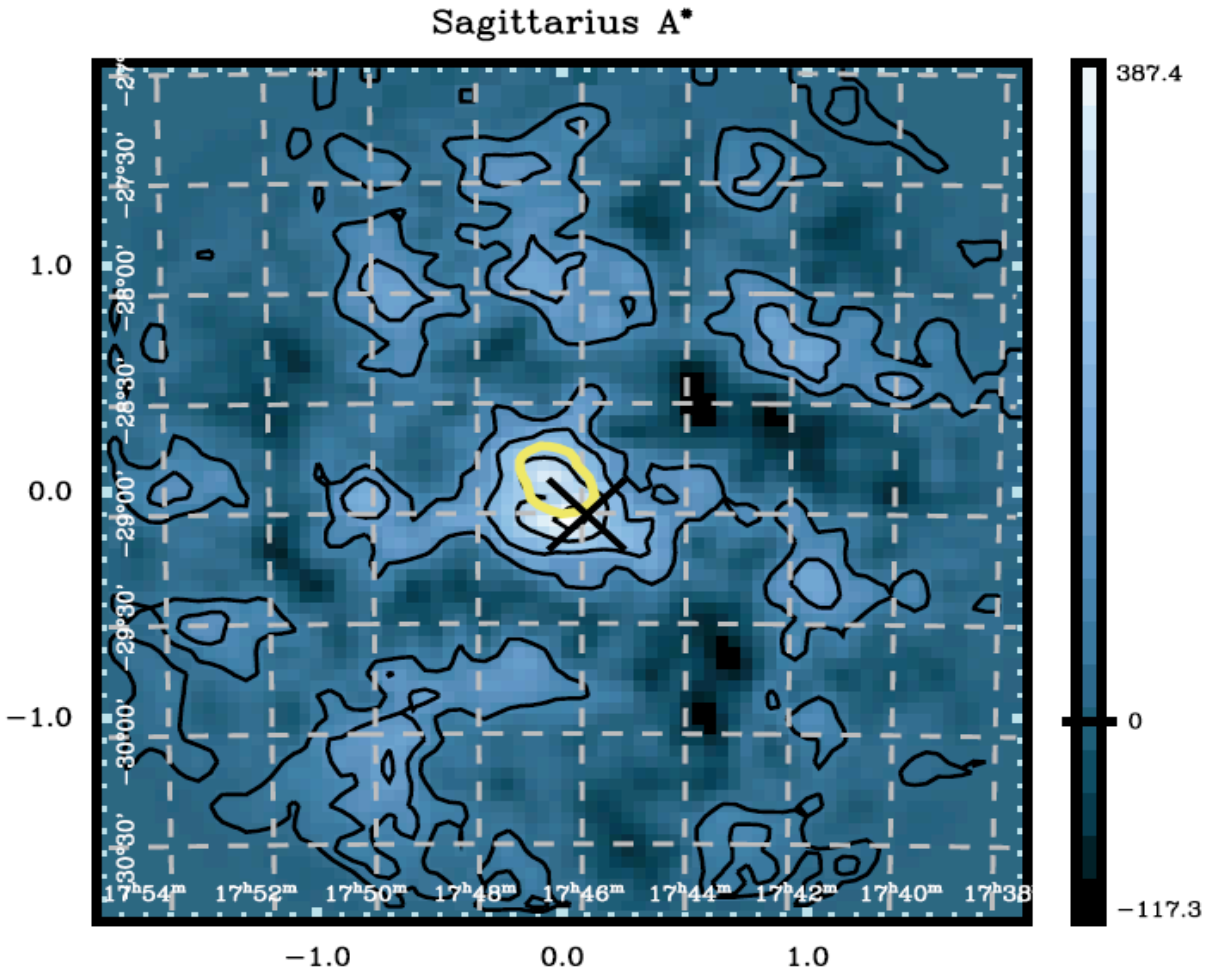
Galactic centre





C Masterson (HESS), DPF 2004

Galactic Centre



K. Kosack et al. (VERITAS), ApJ, 2004

Whipple 10 m telescope

26 hours, 1995 to 2003

Significance of 3.7 sigma

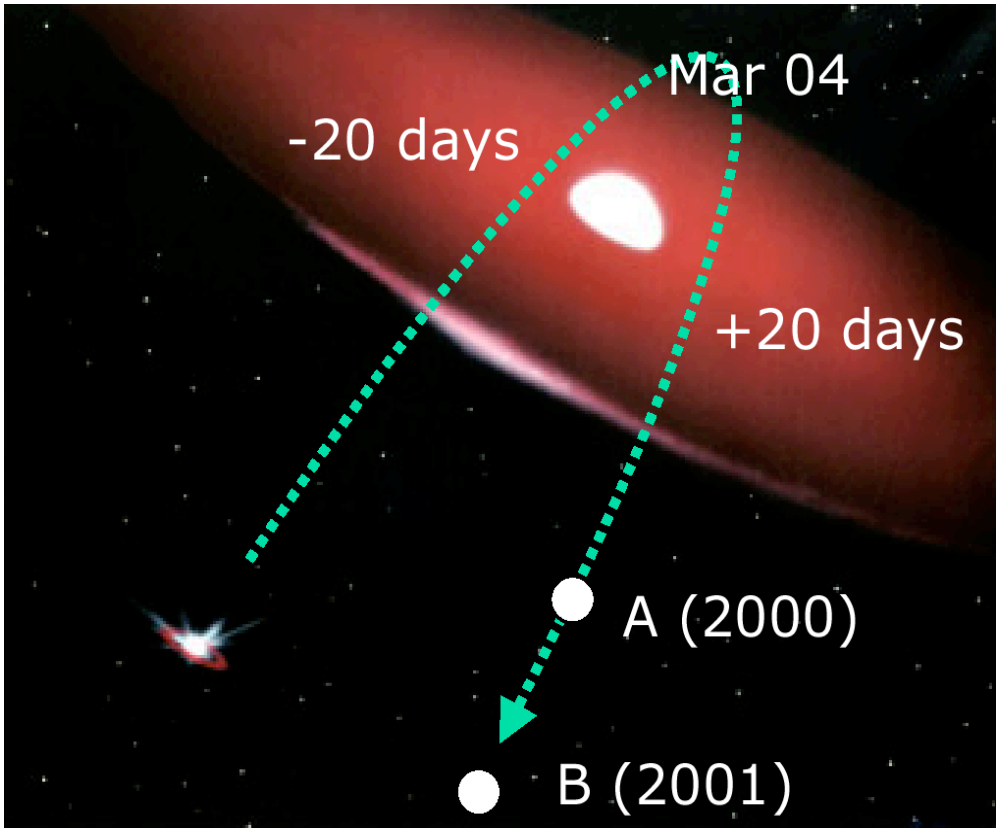
Energy above 2.8 TeV

Large zenith angle leads to high energy threshold:

Future opportunity to measure the spectrum far beyond 10 TeV?

Spectrum endpoint at neutralino mass?

Binary pulsars

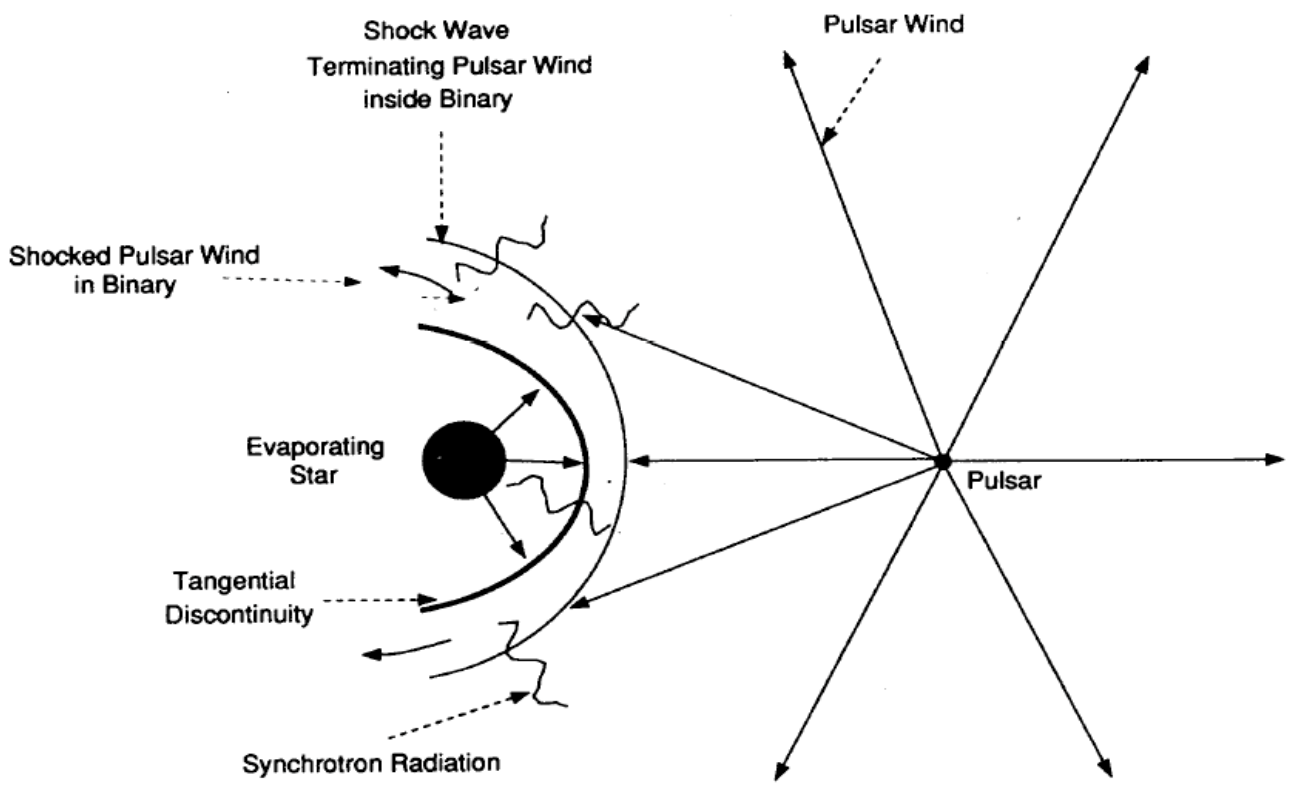


Southern hemisphere detection of PSR1259-63 at TeV energies (HESS, 2004)

A new class of high energy gamma ray source.

Any Northern hemisphere candidates?

Northern hemisphere binary pulsar targets



PSR1957+20, Arons and Tavani, 1993

Whipple telescope observations

Hall et al (VERITAS), ApJ, 2003

PSR1959 observations

Whipple 10 m telescope

11.4 hrs up to 2004

More time approved for 2005

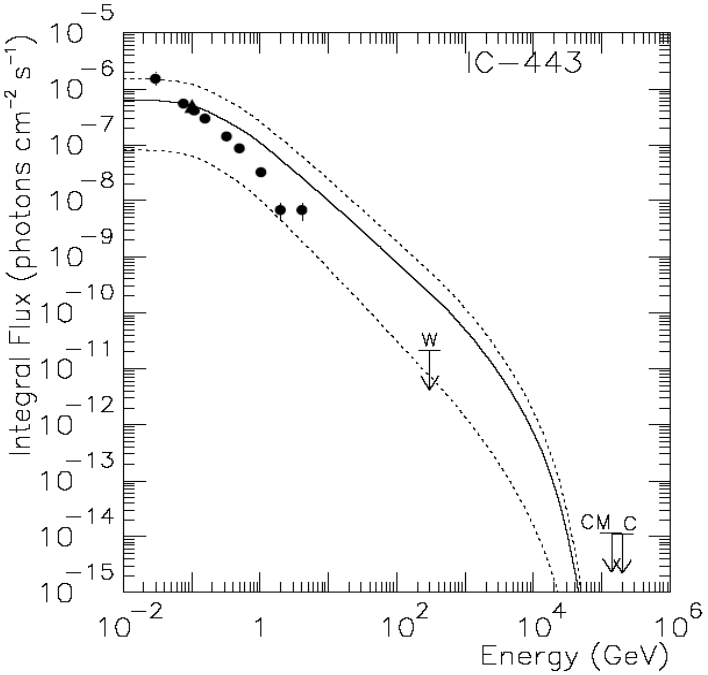
LSI+61303 observations

Whipple 10 m telescope

Awarded 50 hours

Observations in progress

Supernova remnants



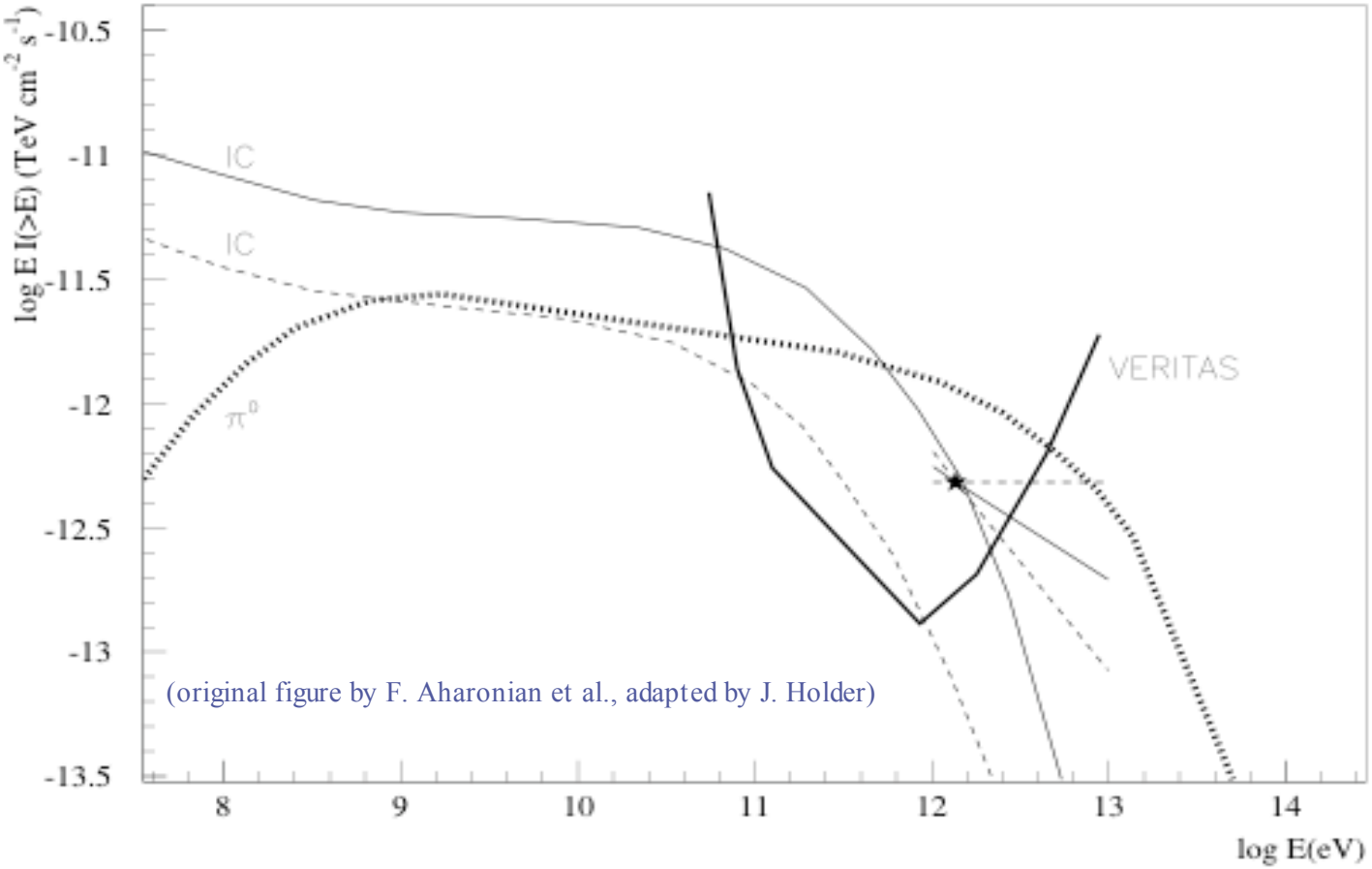
Whipple telescope upper limits in Buckley et al,
Astron. Astrophys. 1998

Search for the source of cosmic rays:

Many upper limits, but no smoking gun!

Object Name	Pointing Direction α(1950)	δ(1950)	Aperture Radius (deg)	ON-Source Counts	OFF-Source Counts	Total Time (min)	Effective Area (10^8cm^2)	Upper Limit (10^{-11}cm^{-2}s^{-1})
Tycho	00^h22^m30	+63°52′23	0.29	315	302	867.2	2.1	0.8
IC443	06 14 00	+22 30 00	0.64	715	654	413.0	1.7	4.2
	06 12 43	+22 19 12	0.64	850	868	663.7	1.6	1.9
	total:		0.64	1565	1522	1076.7		2.1
W44	18 53 29	+01 14 57	0.55	450	426	360.1	1.8	3.0
W51	19 20 00	+14 00 00	0.68	361	294	168.0	1.5	9.6
	19 21 30	+14 00 00	0.68	258	265	300.0	1.7	2.3
	total:		0.68	619	559	468.0		3.6
γ-Cygni	20 18 59	+40 15 17	0.76	382	395	252.0	1.6	3.4
	20 20 08	+39 40 36	0.76	319	347	168.0	1.3	5.0
	20 20 00	+40 02 00	0.76	339	362	140.0	1.5	5.6
	total:		0.76	1040	1104	560.0		2.2
W63	20 15 15	+45 24 36	1.05	452	501	140.0	1.3	6.4

Cas A: High energy gamma-ray observations



HEGRA detection (tbc) and models for Cas A.

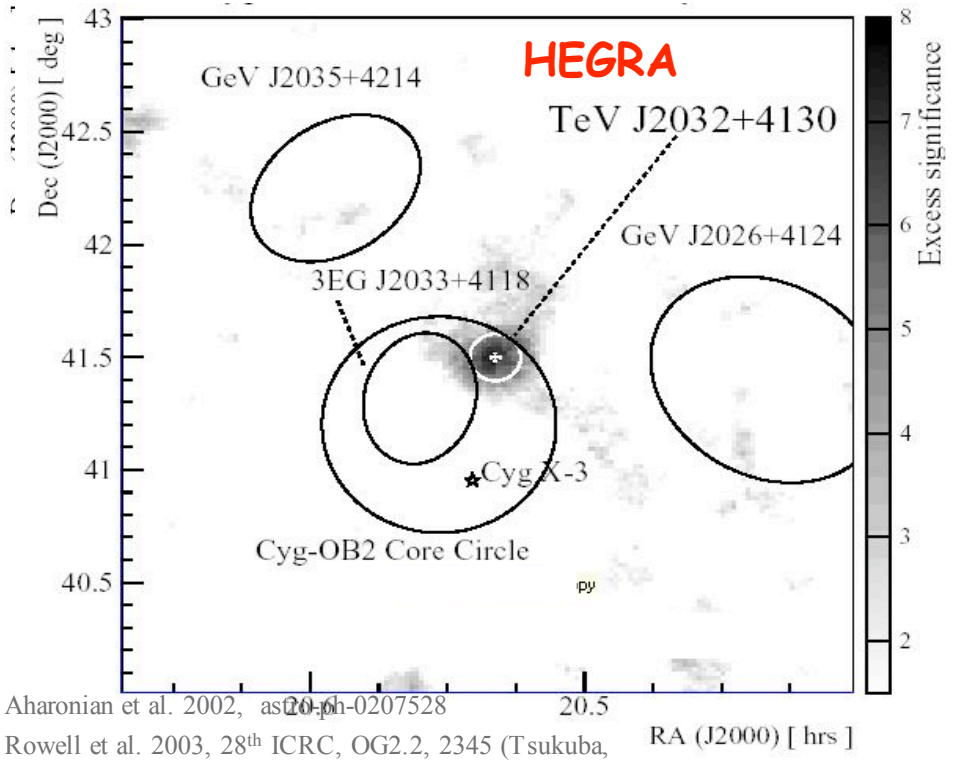
Dotted line:
predicted **hadronic** emission.

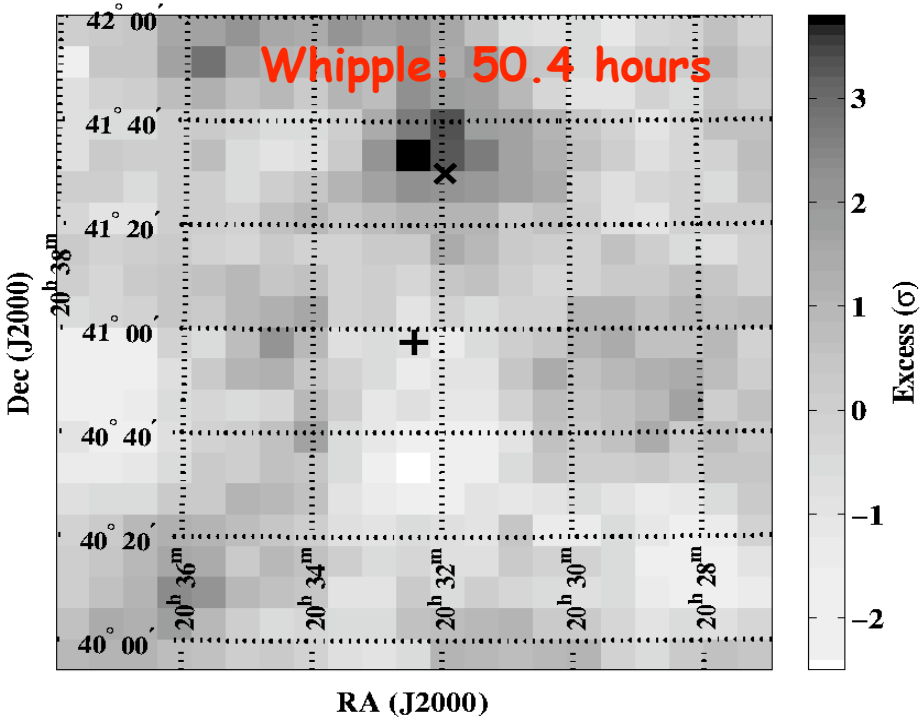
Solid and dashed lines:
range of **leptonic** models.

Thick curve:
VERITAS **sensitivity** for a 50 hour observation.

Need both VERITAS **angular resolution** and good **energy reconstruction** to resolve details.

TeV Unidentified Source





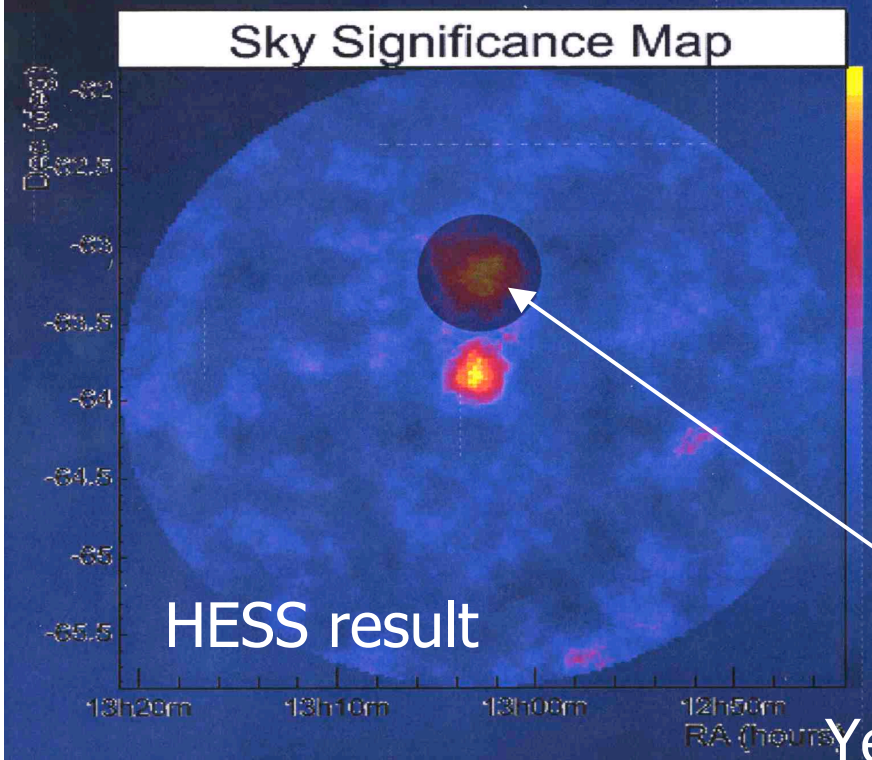
Aharonian et al. 2002, astro-ph-0207528

Rowell et al. 2003, 28th ICRC, OG2.2, 2345 (Tsukuba, Japan)

- Region nearby Cygnus X3 and GeV J2032+4214 shows a 4.6 σ excess
- Confirmed by 2002 observations → 7 σ detection
- 3% of Crab flux
- coincident with OB association OB Cyg OB2
- search for emission in Whipple 1989/90 archive data → 3.5 σ

Serendipitous sources

PSR B1259-63



- Observed at Periastron
  - Feb - March 2004
  - Peak in emission expected
- Strong detection
  - ~5% Crab Flux
  - Soft energy spectrum
  - Point source
  - Detected again in April/May

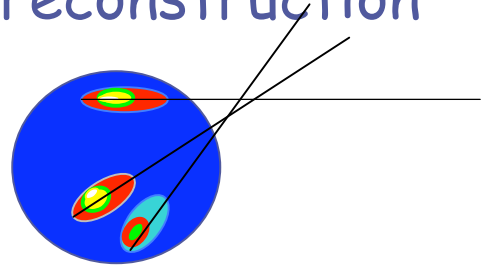
Yet another TeV unidentified!

Sky Survey

Veritas4 capabilities

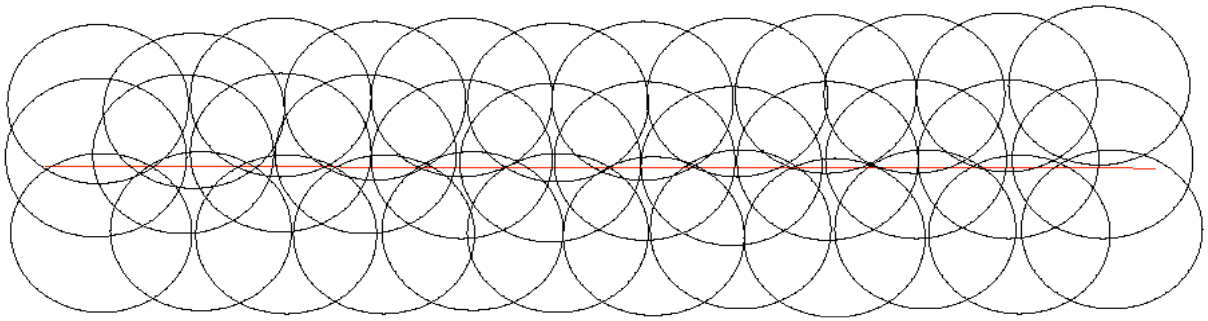
- sensitivity:
  2% Crab, 5 h, 3σ

- FOV: 3.5 – 5deg.
  sensitive
  to outside camera
  due to stereo
  reconstruction



galactic plane

- Anticenter, Crab region: l=165-195
- Cygnus region: l=100-150
- parallel plane: l=50-80



Summary:

- VERITAS first light in 2006
- TeV gamma rays are becoming relevant to a variety of different types of objects
- Northern hemisphere sources to be discovered
- Astrophysics needs multi-wavelength approach

THE END

VERITAS multi-wavelength observations

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VERITAS collaboration
http://veritas.sao.arizona.edu

Multi-wavelength web-pages

See VERITAS pages at

http://jelley.wustl.edu/multiwave

Information about:

(a) VERITAS contact persons,
(b) past and future multi-wavelength campaigns,
(c) the VERITAS experiment and its sensitivity,
(d) policies for guest investigators.

Observing time interval calculator tool.

Sign up to receive VERITAS multi-wavelength alert emails.

Transients and alerts

VERITAS strategy:

- Monitor **established sources** and candidates

- Pre-approved time to react to
  - VERITAS alerts
  - community alerts, e.g. RXTE ASM, optical, SWIFT

- Near real-time gamma-ray rapid data analysis

- If VERITAS detects a gamma-ray flare:
  - invoke campaign
  - send e-mail alerts.

Multi-wavelength collaboration

Alternative:

Individual VERITAS members* can apply to other projects as co-investigators.

VERITAS is open to such collaborations.

Publications:

Unpublished VERITAS data: include entire VERITAS collaboration as co-authors.

Negotiate specifics on a case to case basis.

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