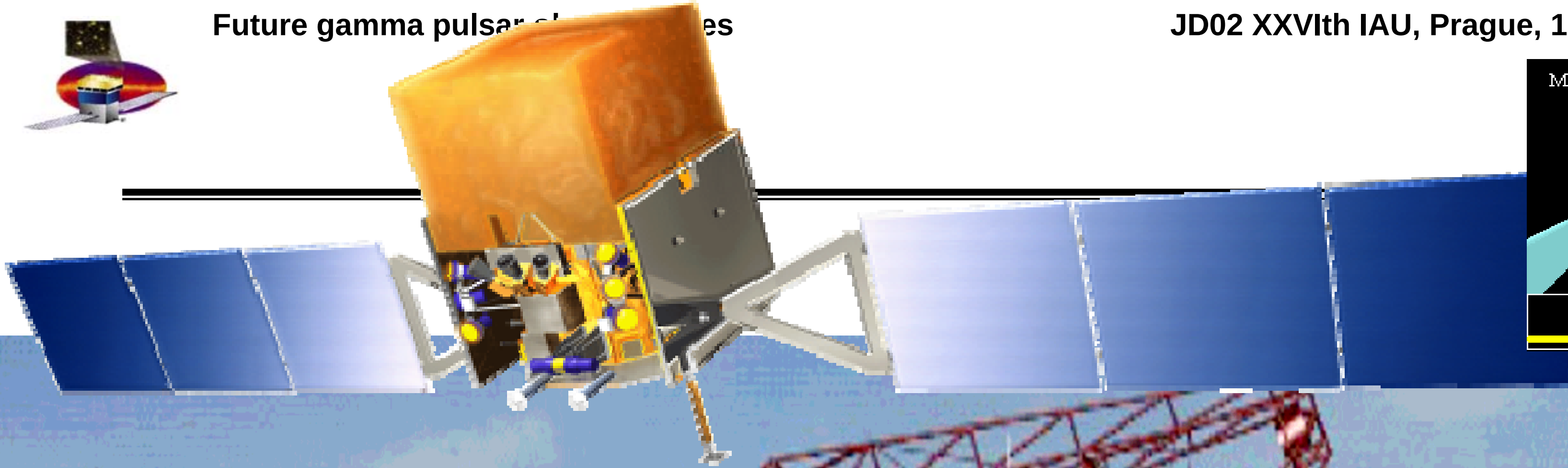

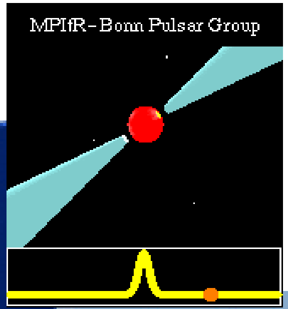

Future Gamma-ray and TeV Observatories for Pulsar Searches

David A. Smith
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Joint Discussion 2, IAU XXVIth Assembly
Prague, 17 August 2006

Detecting gamma ray pulsars

GOAL: detect more gamma ray pulsars, beyond the few seen by CGRO.

Secondary goals: phase-resolved spectroscopy, cut-offs. How high in energy do they go?

HOW TO DO IT: it boils down to

a) The (energy dependent) detection area, A(E), and background rejection (« sensitivity »)

b) The exposure time (duty cycle) for a given point in the sky.

That is: flux limit ~ √(exposure time) x [σ/√(time)], where σ = signal/ √(b'grd) and signal = $S = \int_0^\infty A(E) \frac{dN_\gamma}{dE} dE.$

with an analogous relation for the background.

This talk

- About A(E) for satellites and Cherenkov detectors.
- Specific cases of the GLAST LAT and AGILE ; and of HESS/VERITAS/MAGIC.

- Which pulsars are candidates? How many might we see?
- On the importance of up-to-date timing ephemeredes for many pulsars.

I will *not* discuss how seeing more gamma pulsars helps understand pulsars in general. See e.g. Dave Thompson ; Gottfried Kanbach; Alice Harding ; K.S. Cheng in http://www.mpe.mpg.de/363-Heraeus-Seminar/, as well as presentations in this workshop, especially Okie De Jager's.

Ground-based pulsar sensitivity

- Don't confuse the gamma ray collection area A(E) with the mirror area:
  - The mirror area determines the number of Cherenkov photons collected. Energy threshold decreases as inverse square.
  - A(E), together with background rejection & angular resolution, determines the minimum detectable gamma flux.

- (Particle detector arrays, e.g. HAWC and ARGO (Tibet) run at somewhat higher energies and with worse sensitivities and angular resolutions. In spite of high duty cycles, pulsar detection seems unlikely).

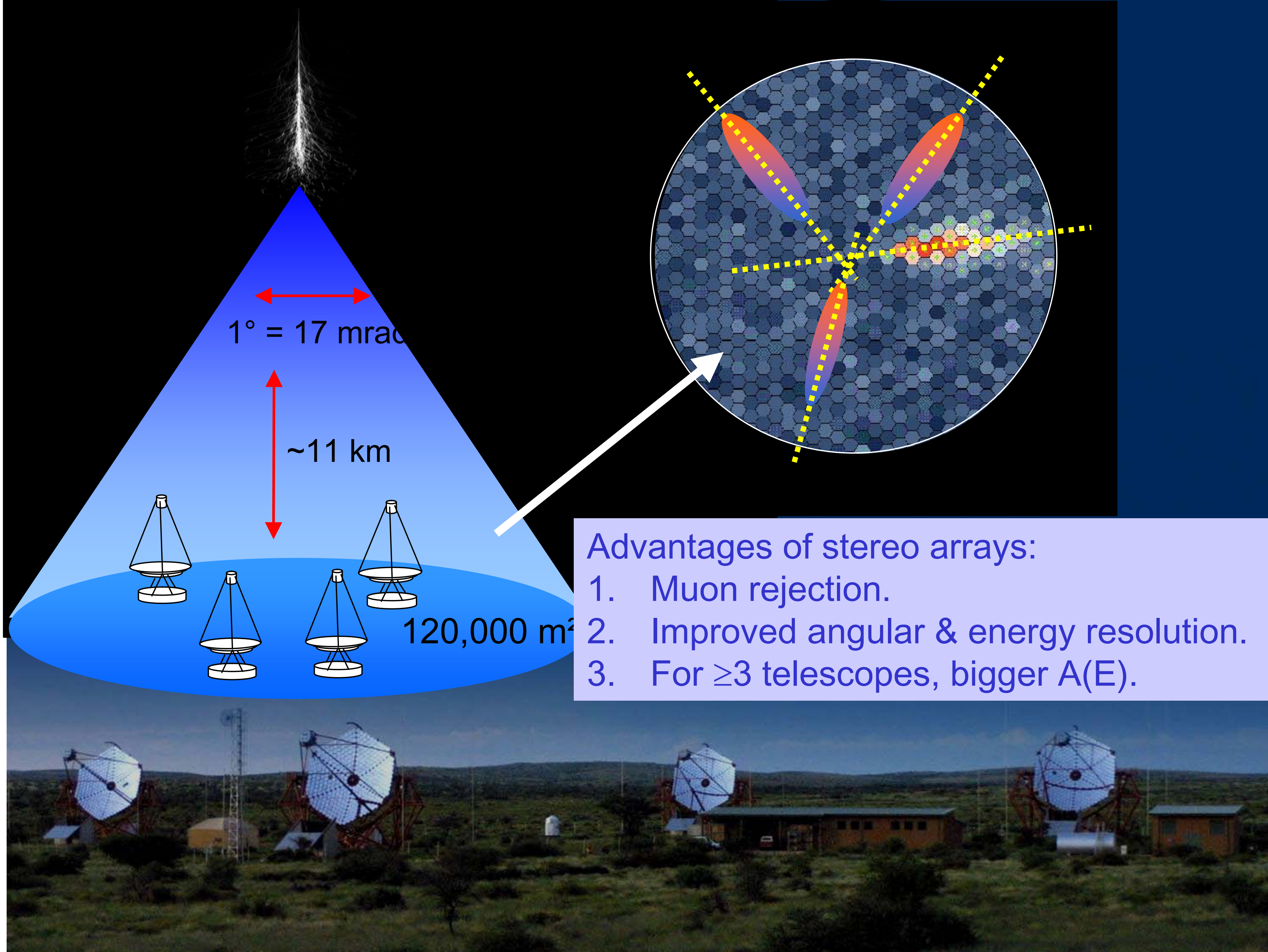
Atmospheric Cherenkov telescopes

A high energy particle strikes an air molecule.

- A gamma? Many electrons and positrons.
- A cosmic ray ion? Pions, muons, etc as well.

Most Cherenkov light emitted ~10 km above the ground. Multiple scattering ⊗Cherenkov angle ~20 mrad, thus a 200 meter disk is illuminated.

$A(E) \sim \pi\,(200)^2 = 120{,}000\ m^2$.



Advantages of stereo arrays:

1. Muon rejection.
2. Improved angular & energy resolution.
3. For ≥3 telescopes, bigger A(E).

Short digression

- Cherenkov « *imaging* » (Whipple, HESS, etc) has proven to be best.
- We once thought that re-converted solar plants, with 2500 m² mirror areas, could explore the energy range between EGRET and Whipple.
- Review at http://polywww.in2p3.fr/actualites/congres/cherenkov2005/ , go to « programme » and search for « Smith ».
- Best high energy limit on the Crab pulsar comes from « my » solar farm…

trigger: 20 m² @ 10 GeV,

10m² @ 20 GeV after analysis ➔

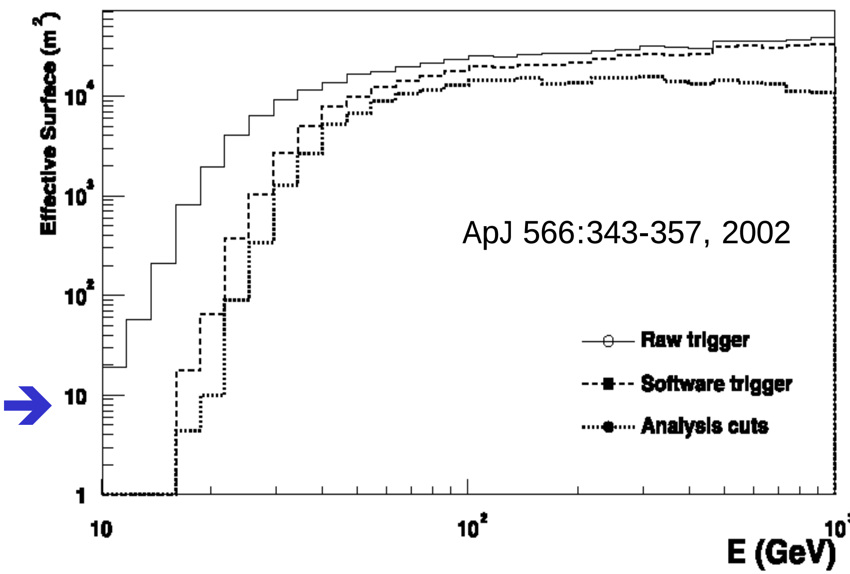


FIG. 10.—Effective surface area for gamma rays of CELESTE for a trigger threshold of 4.5 PEs heliostat^{-1}, in the direction of the Crab at transit. The analysis cuts are $N_{\rm peaks} \geq 10$ and $\sigma_{\rm grp} < 0.25$.

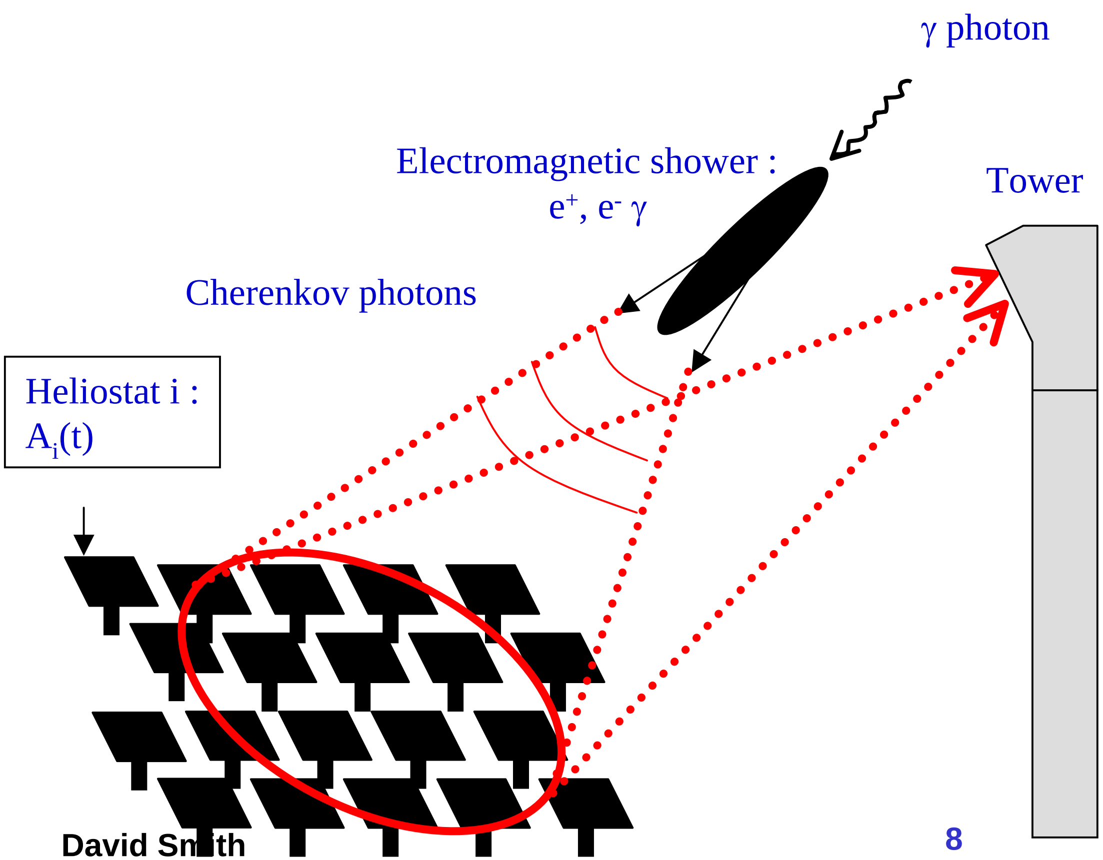
EGRET was 0.18 m² (two sheets of letter paper),

GLAST will be 1 m².

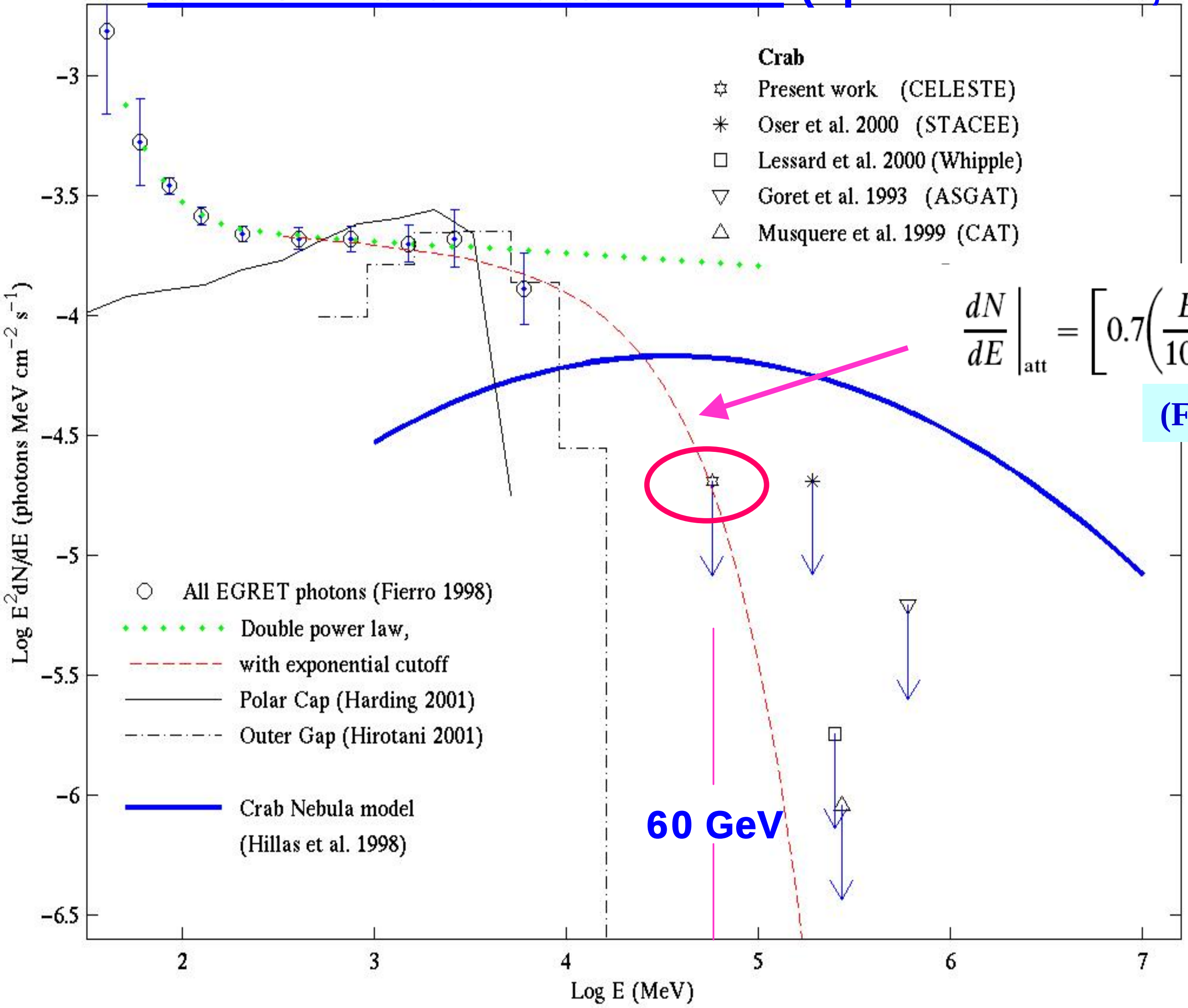
CELESTE

1998-2004: Only detector in the world between 10 and 100 GeV.

(French Pyrenees)



CELESTE Crab Pulsar Limit (ApJ 566:343-357, 2002)



$$\left.\frac{dN}{dE}\right|_{att} = \left[0.7\left(\frac{E}{100}\right)^{-4.89} + 2.3\left(\frac{E}{100}\right)^{-2.05}\right] e^{-E/E_0}$$

(Fierro et al)

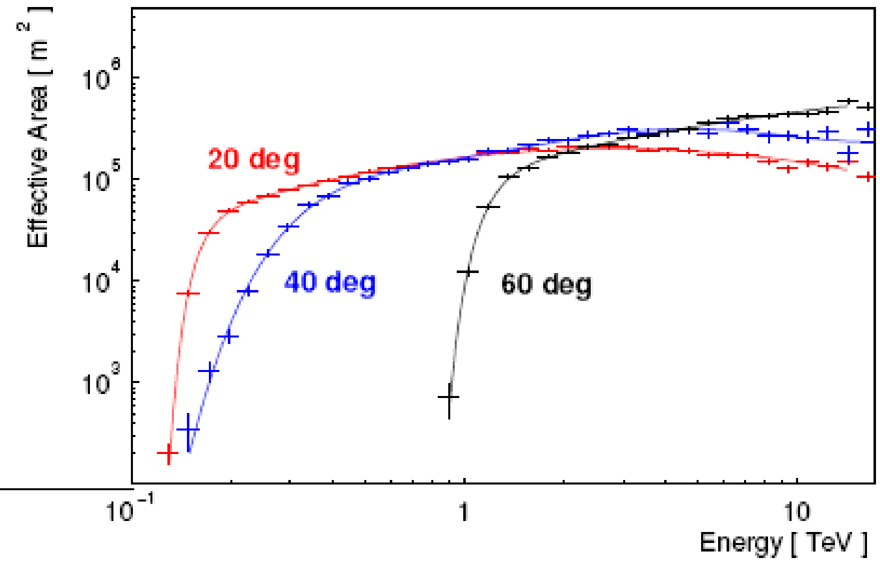
CELESTE: Eo<26 GeV

<0.5 γ /minute

(end of digression)

A(E) versus zenith angle for the HESS-I Cherenkov imager array

http://www-hess.physik.hu-berlin.de/theses.html Fabian Schmidt



HESS has lovely results *but* to see pulsars needs lower energy threshold.

astro-ph/0507388

10 GeV

Figure 2.10: Effective collection areas of the H.E.S.S. array versus gamma-ray energy, calculated for zenith angles of 20°, 40°, and 60°, with fit function. Note the higher threshold for large zenith angles, and the larger collection area at high energies, in comparison with small zenith angles.

Solution: HESS-II, a 5th telescope in the middle of the array.
27 meters => 20 GeV sensitivity, in 2008.

HESS non-detection of PSR J0437-4715

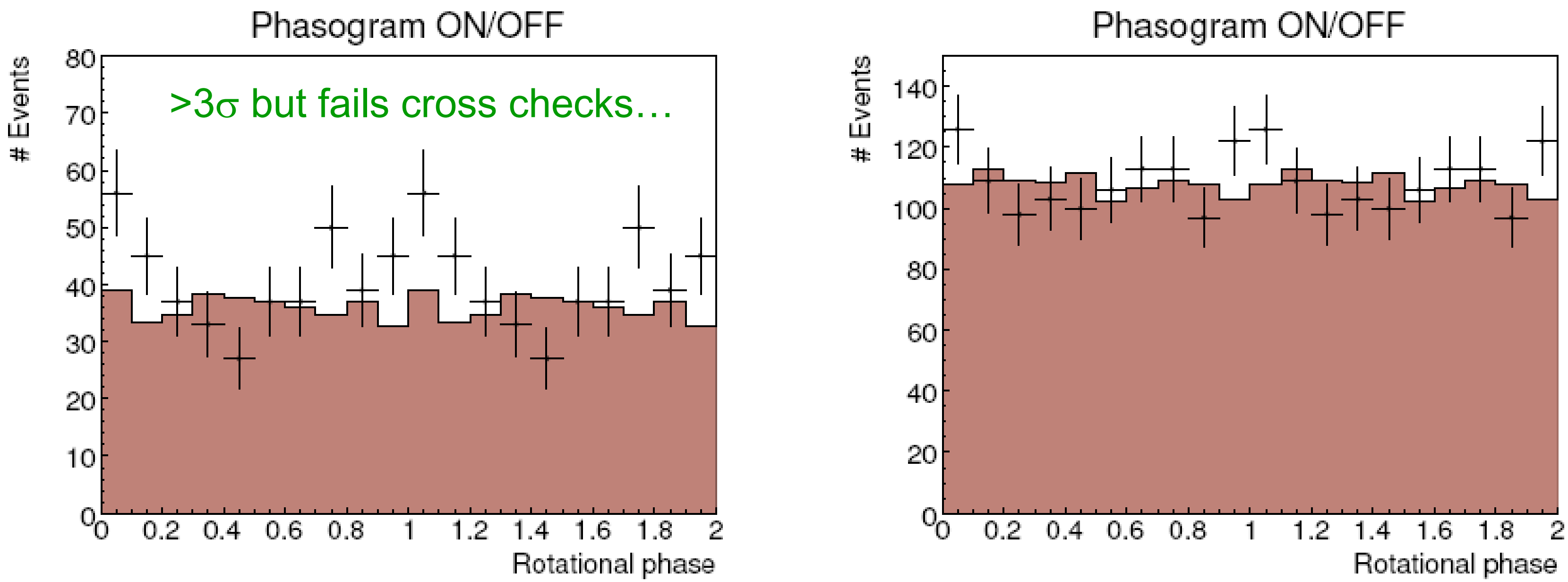
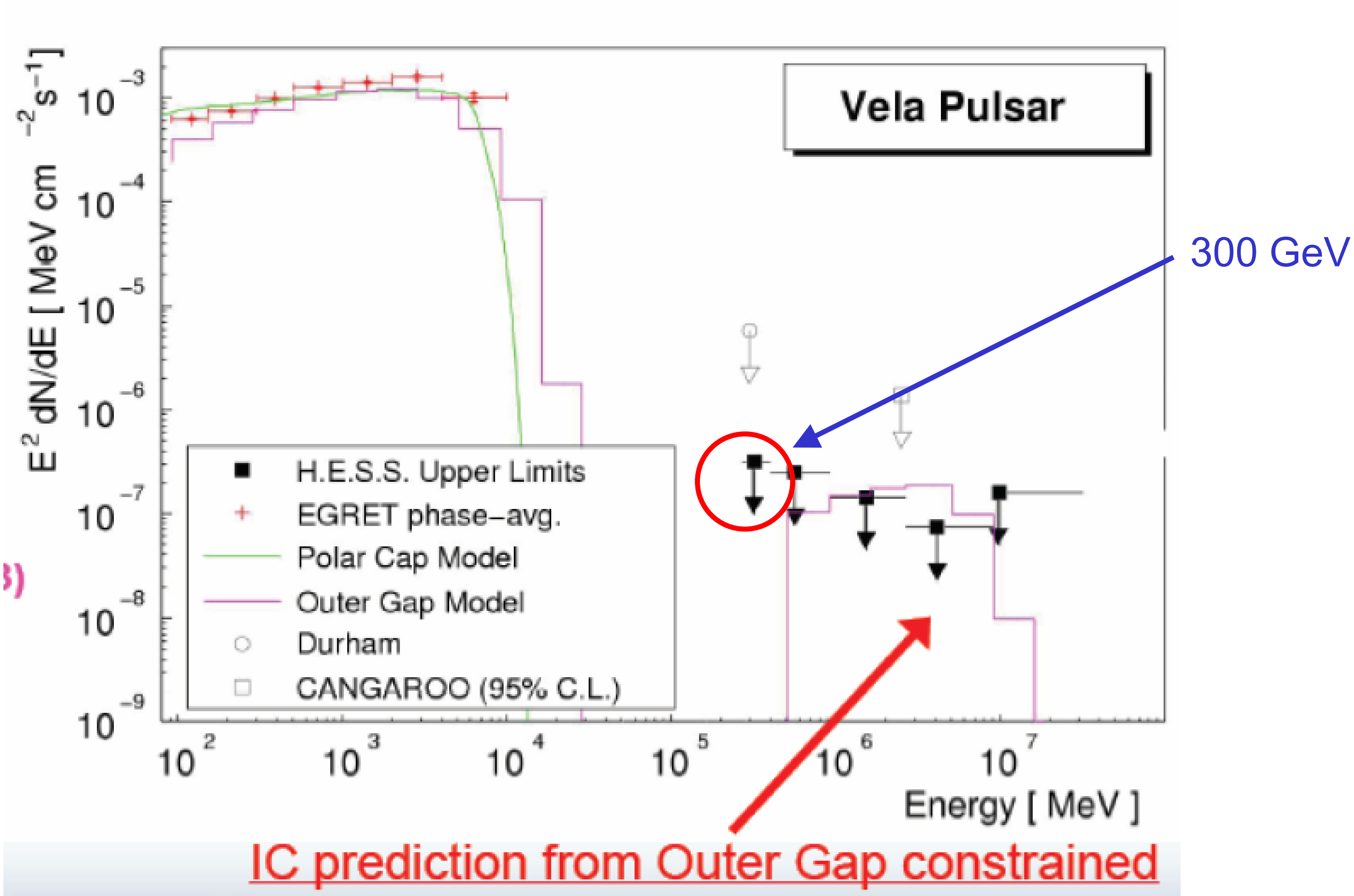


Figure 4.6: Phasograms showing two rotational phases cycles of the ON region (black points) and the OFF regions normalized (red solid) for events with energies **below 500 GeV** and **zenith angles < 25°**. **Left panel**: STD and **Right panel**: LOWE selection cut configurations.

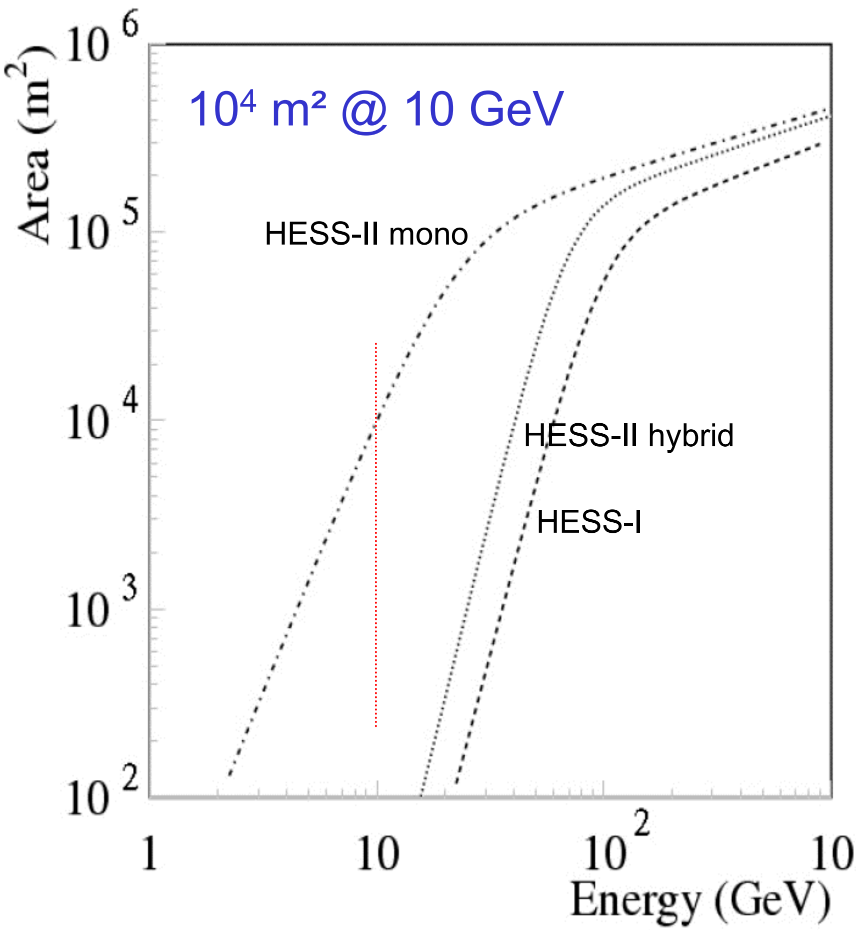
http://www-hess.physik.hu-berlin.de/theses.html Till Eifert

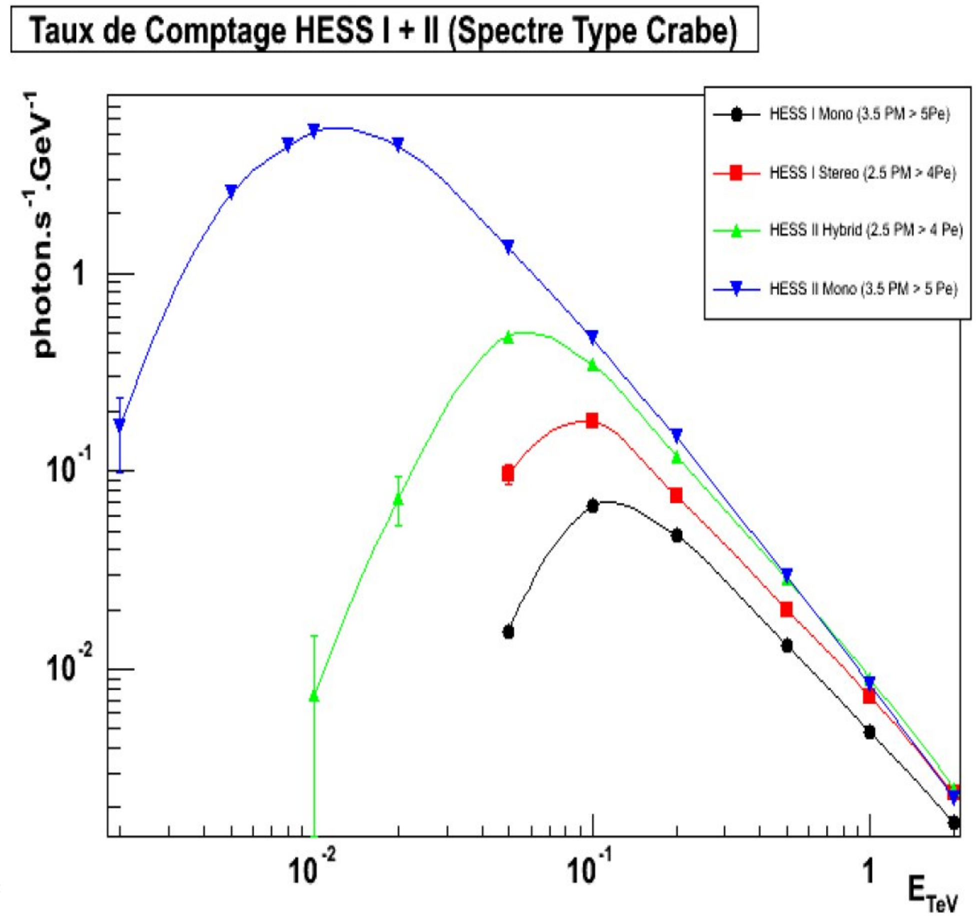
HESS-I on VELA



HESS-II should reach pulsar range

HESS-II, a 5th telescope, 27 meter diameter, for 2008.

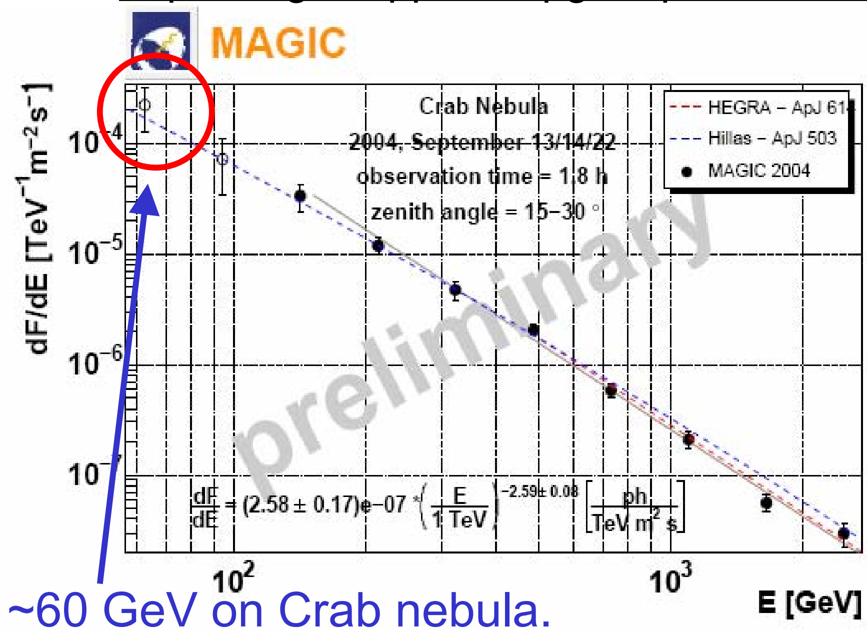




Courtesy W. Hofmann

MAGIC I

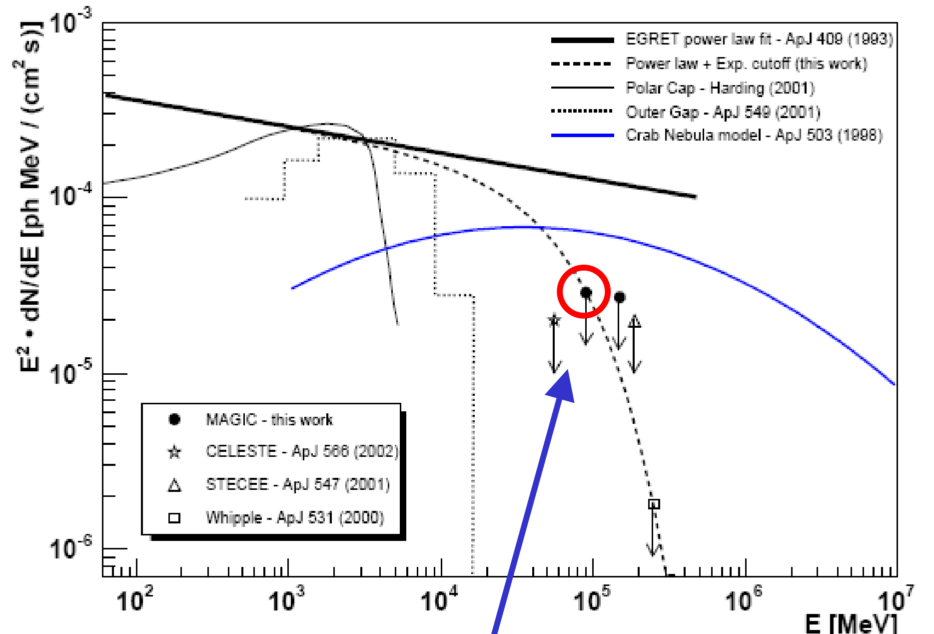
- MAGIC-I: Energy range a bit high for pulsars. Examples from http://magic.mppmu.mpg.de/publications/conferences/index.html



~60 GeV on Crab nebula.

Figure 1. Spectrum obtained for the Crab Nebula in two hours of observation (September 2004) at zenith angles between 15 and 30 degrees. The grey line is the fit to the experimental points above 150 GeV. Red and blue dashed lines are the fits obtained to data of other experiments.

(Ll. Font)



~100 GeV on Crab pulsar.

(M. Lopez, ICRC vol 4, 243-246)

29th International Cosmic Ray Conference Pune (2005) **00**, 101–106

MAGIC I, cont'd

See also

29th International Cosmic Ray Conference Pune (2005) **00**, 101–106 (vol 4, 247-250)

First pulsar observations with the MAGIC telescope

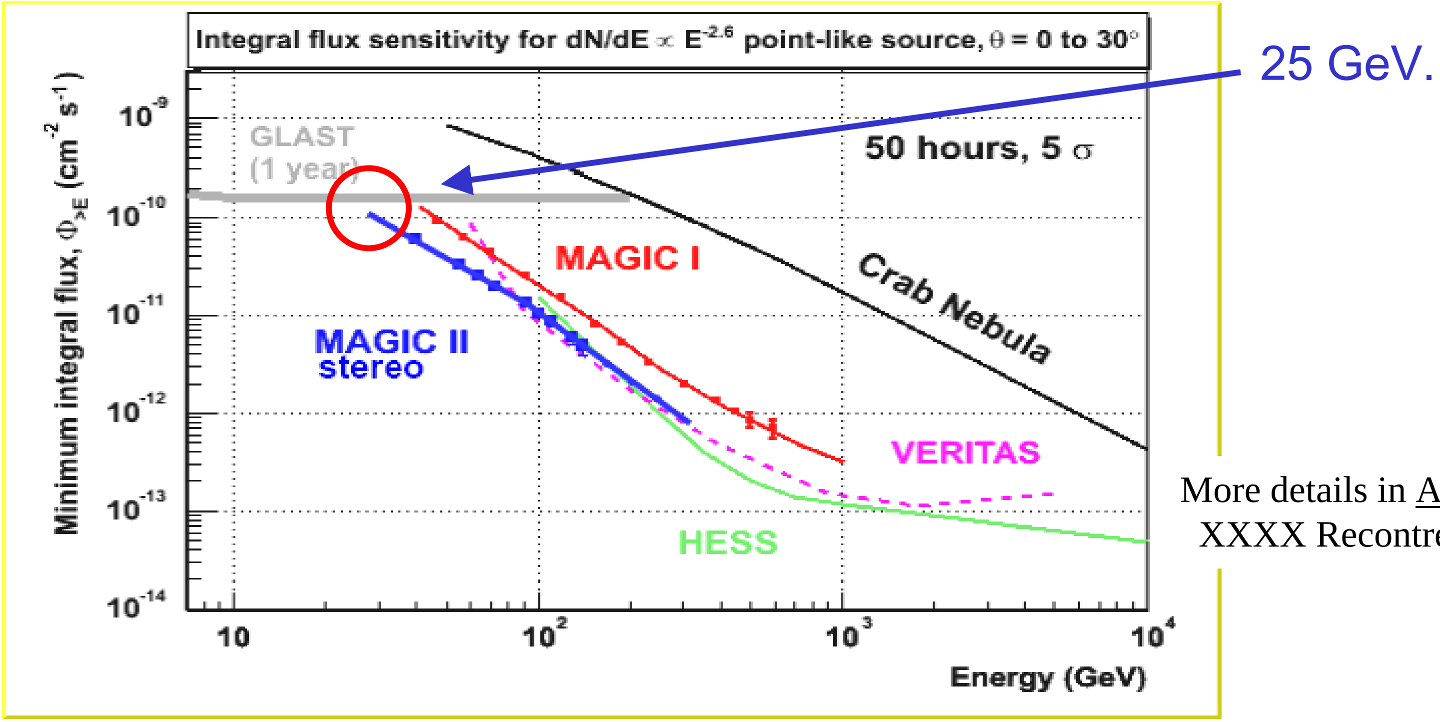
E. Oña-Wilhelmi[a], R. de los Reyes[b], J.L. Contreras[b], C. Baixeras[c], J.A. Barrio[b], M. Camara[b], J. Cortina[a], M.V. Fonseca[b], M. Lopez[b], I. Oya[c] and J.Rico[a] for the MAGIC collaboration.

A few regions of the sky containing pulsars have been observed by the MAGIC Telescope [2] during its commissioning phase, namely PSR B1957+20, and PSR J0218+4232. In this work we report on the analysis of these data, looking for γ-ray emissions both in continuous and pulsed mode. Constrains to different theoretical models about γ-ray emission from pulsars and plerions will be discussed.

Her thesis: « Optimization of MAGIC for Pulsars » (advisor: O.C. DeJager, with M.V. Fonseca), http://www.gae.ucm.es/~emma/tesis/

MAGIC II

- MAGIC-II: a 2nd 17 meter telescope 80 meters away, in 2007. « *Half the energy threshold, twice the sensitivity*. »
- See M. Teshima et al, ICRC 2005, vol. 5 227-230, w. discussion of MAGIC-II's complementarity with GLAST and HESS-II.



More details in A. Moralejo, XXXX Recontre de Moriond, 2005.

Figure 4: Sensitivities of the current MAGIC-I and MAGIC-II (two telescope system with advanced photon detector) are shown in the comparison with GLAST, HESS, and VERITAS. MAGIC-II improves the sensitivity by a factor of two compared to MAGIC-I. Around 30 GeV, the sensitivity of MAGIC-II in 50 hrs will cross the one of GLAST in 1 yr.

Future Cherenkov detectors

- VERITAS: Performance like HESS-I, in 2007, but for northern sky. Probably won't be a pulsar factory until a future upgrade…
- CANGAROO-III: 4 10-meter telescopes running since 2005, in Australia. Somewhat higher energy range.
- How far can you take these ideas? See astro-ph/0506465 « STEREO ARRAY of 30 m Imaging Atmospheric Cherenkov Telescopes: A Next-Generation Detector for Ground-Based High Energy Gamma-ray Astronomy »

A. Konopelko Astropart.Phys. 24 (2005) 191-207

$>10^3$ m² @ 4 GeV !!

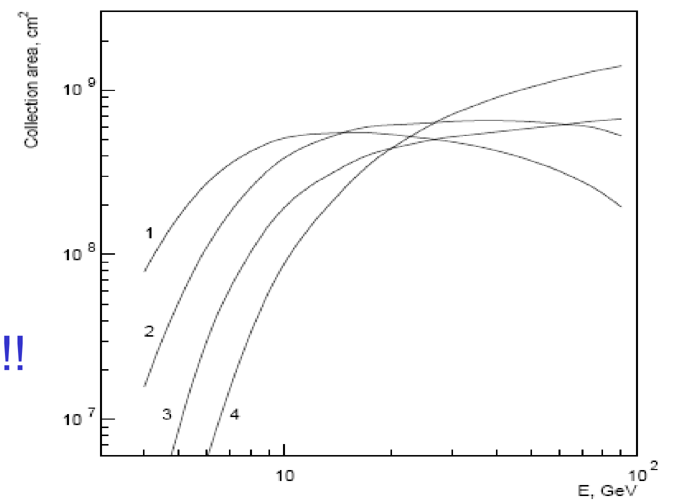


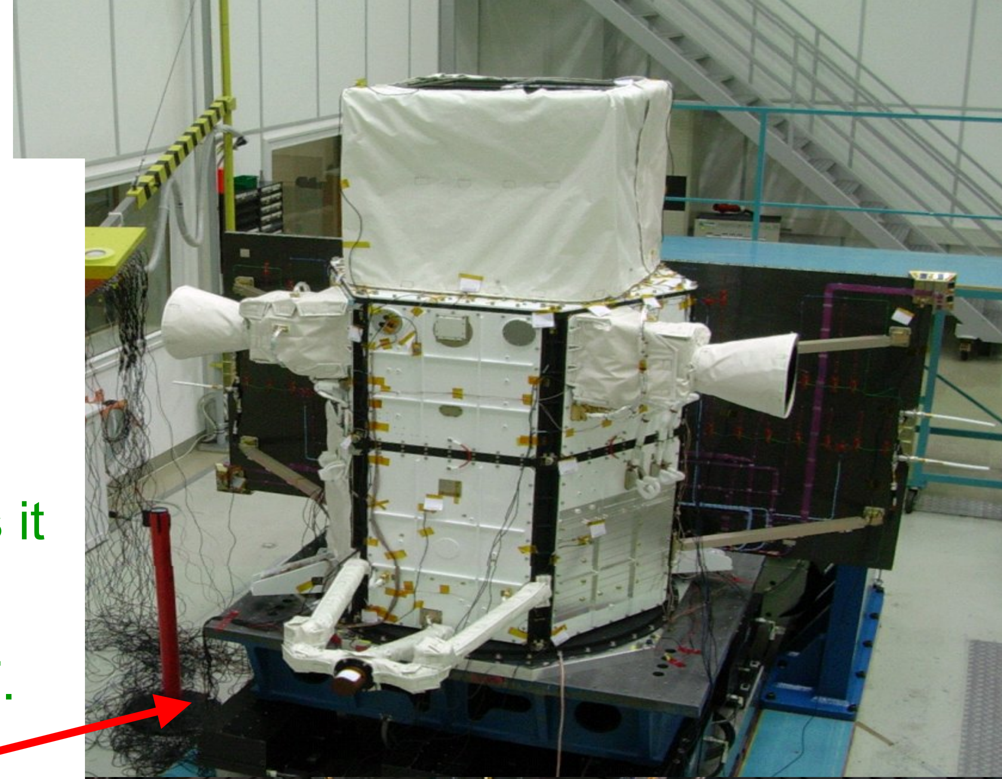
Fig. 5. The collection areas of γ-ray showers for a single stand-alone 30 m IACT (dashed curve), for a system of two 30 m IACTs with a 100 m separation (curve 1) and for a system of five 30 m IACTs for 2-fold telescopes coincidences (upper panel). The collection areas for a system of five 30 m IACTs for multiplicity of 2, 3, 4, 5 telescopes (curves 1,2,3,4, respectively, lower panel).

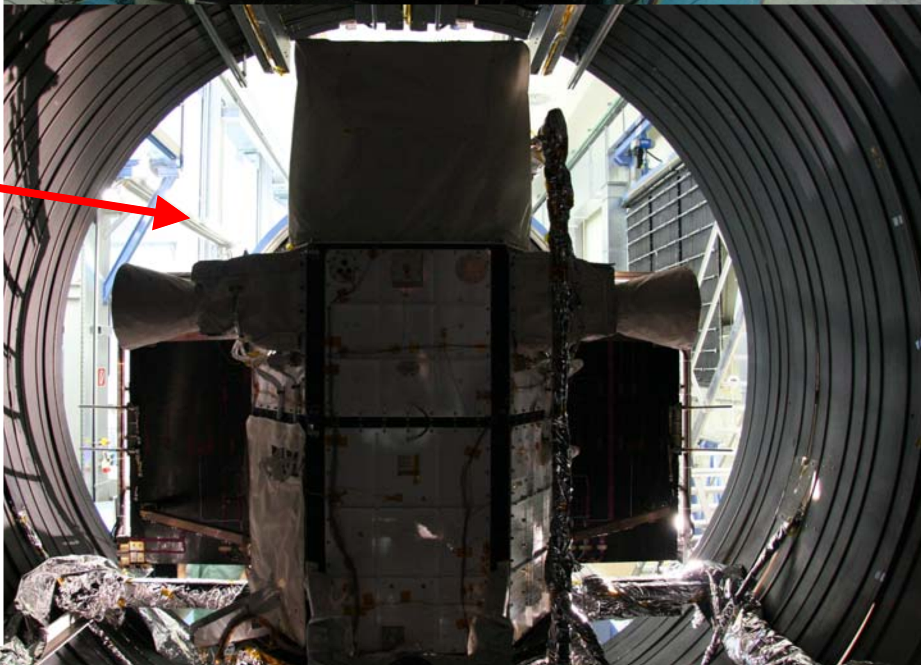
On to satellites!

AGILE

- To be first silicon tracker on an orbital gamma ray telescope.
- Thin calorimeter ($1\chi_o$) means low energies (~1 GeV).
- EGRET-like effective area makes it a pointing instrument.
- Field-of-view big like GLAST LAT.
- From web: « integration of the flight model completed December 2005. Flight qualification tests completed July 2006. To be launched by a PSLV rocket from the Satish Dhawan Space Centre in Sriharikota, India, in the next months. »*Unfortunately… US licensing hassles… change batteries… re-do environmental tests… Launch in January?*
- For pulsars: need ephemeredes only for the sources being pointed at, at time pointing occurs (more on this later).

See e.g. Pellizzoni 2004





Satellite pulsar sensitivity

- Sensitivity driven by collection area A.
- Want energy resolution? Need calorimeter thickness!
- But size is limited by *weight* $\propto$ volume = A x thickness
- EGRET spark chamber was heavier than the GLAST LAT silicon tracker, and EGRET shared CGRO with OSSE and Comptel.
- So the LAT can have a heavier calorimeter, i.e. larger area still keeping 8 radiation lengths ($8\chi_o$) of CsI(Tl).

- *The silicon tracker is compact: better angular resolution with a shorter lever arm ➔ bigger field-of-view.*

LAT (Large Area Telescope)
20 MeV-300 GeV

Budget: $ 160 M

fine pitch: 228 μm

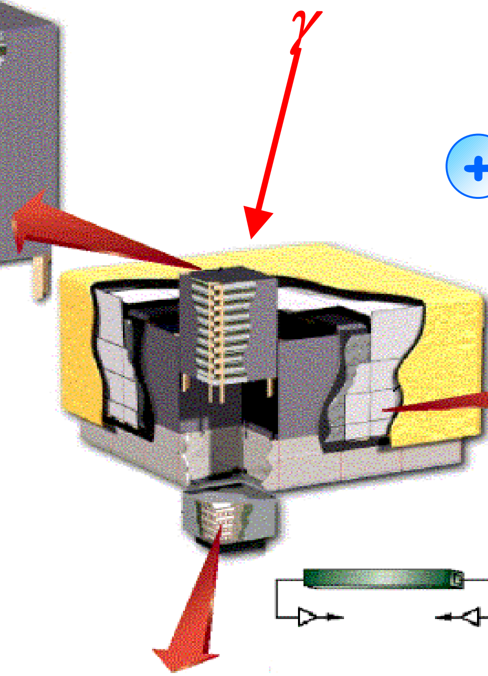
12 x 0.03 X_0 front-end

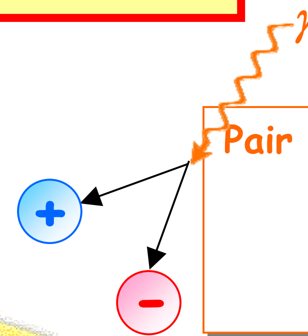
4 x 0.18 X_0 back-end

2 blank planes

884736 ch. of electronics

Si W Tracker



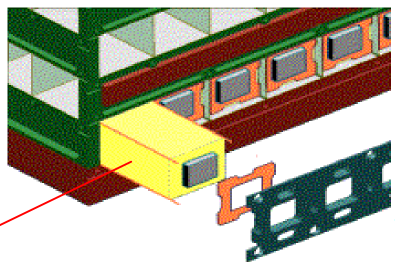


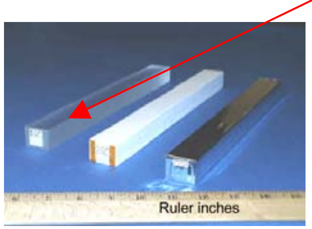
Pair conversion telescope
16 towers
- **Veto**
- **Tracker**
- **Calorimeter**

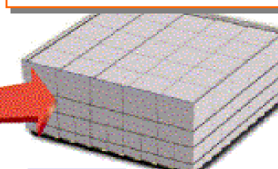
CsI Calorimeter

$8.6\ X_0$ 8 × 12 bars

2.0 × 2.8 × 35.1 cm







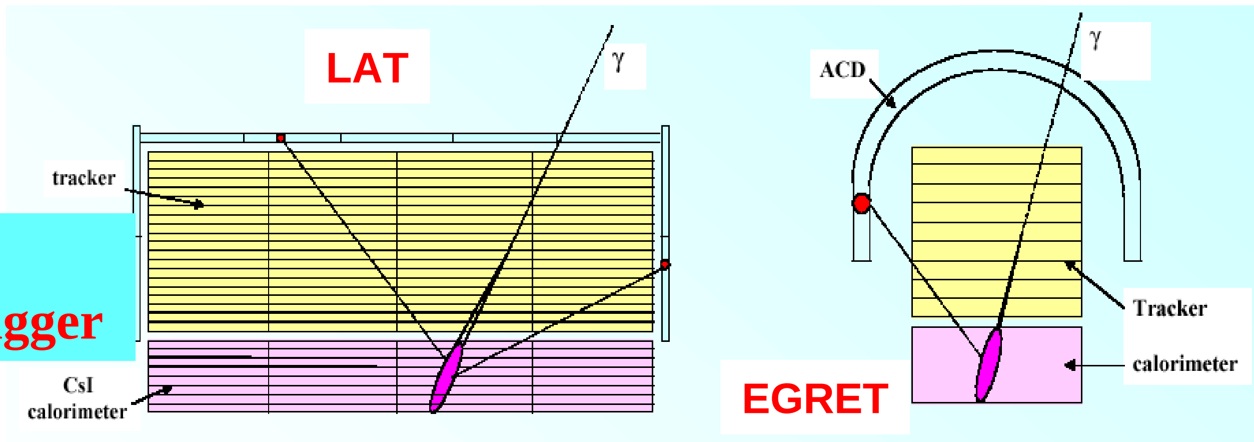
ACD

89 scintillator tiles

0.9997 efficiency

Plastic scintillator to reject charged cosmic rays

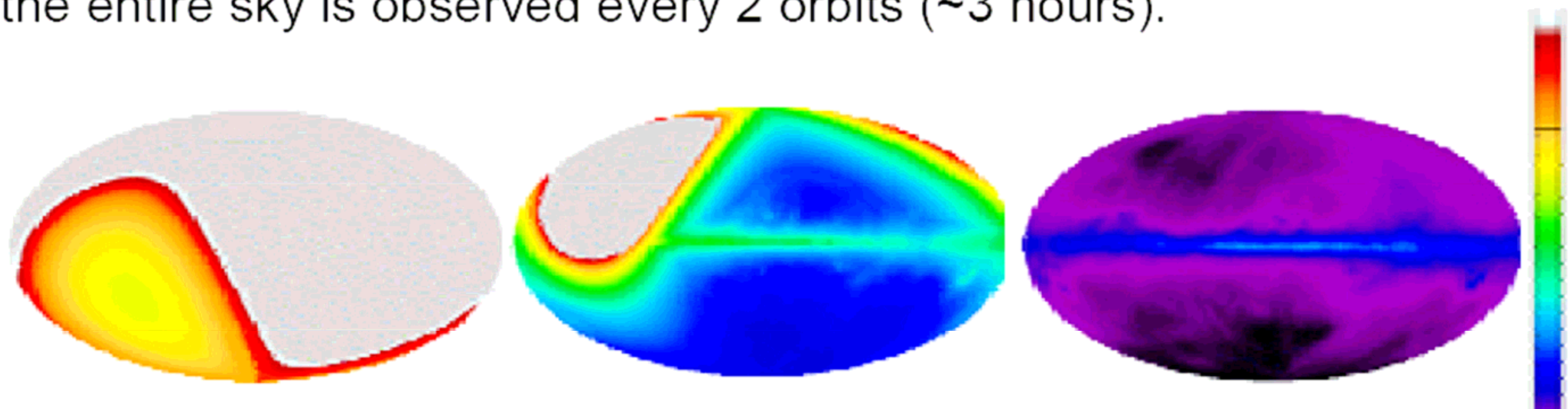
More compact
==> field-of-view is 4.8x bigger



GLAST maps the whole sky continuously

Field of View and Transient Monitoring

The field of view of the LAT is huge, ~20% of the sky at any instant, and can cover up to 75% of the sky every orbit. In scanning mode the the entire sky is observed every 2 orbits (~3 hours).



100 Seconds — 1 orbit (90 mins) — 1 day

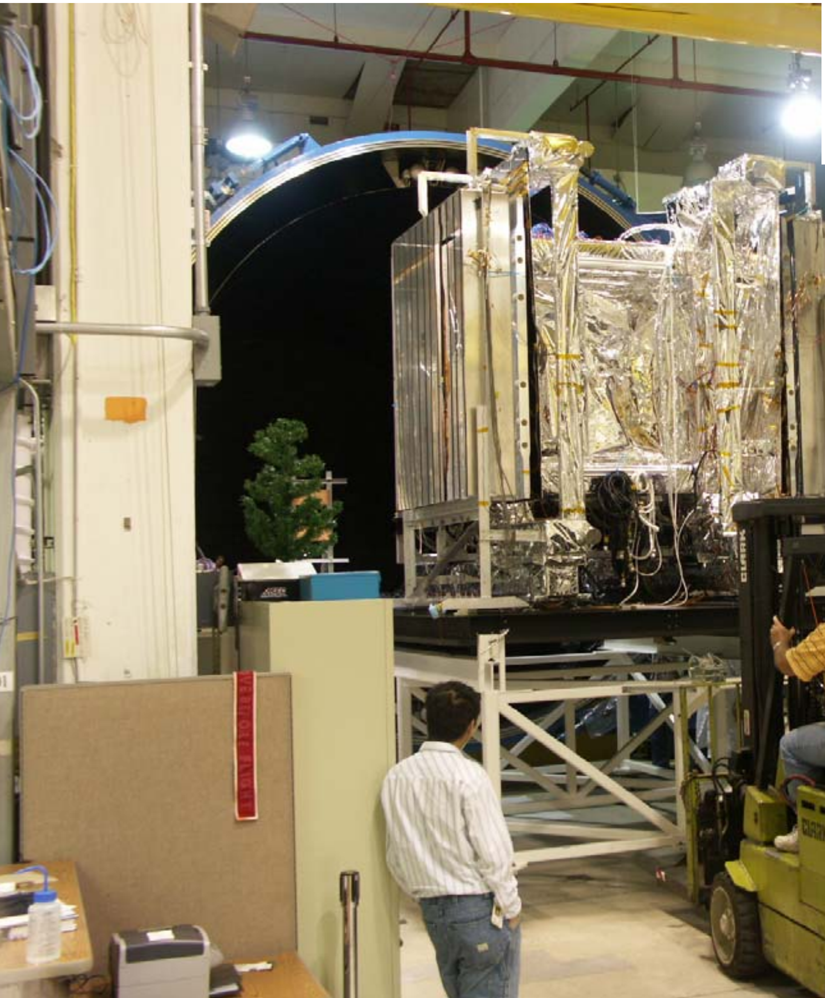
Pointing will be exceptional.
The consequences are huge – *will look at all pulsars all the time*.

BUT – for e.g. Crab, one photon per 500 rotations…. Vela detectable in a day.
Need Cherenkov detectors to quantify cut-offs beyond a couple of 10's of GeV.

Current events

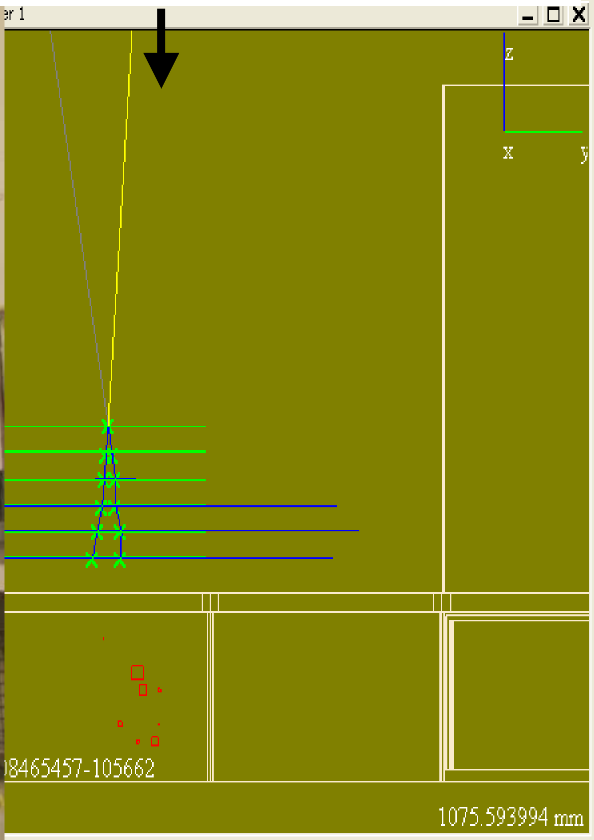
http://www-glast.slac.stanford.edu

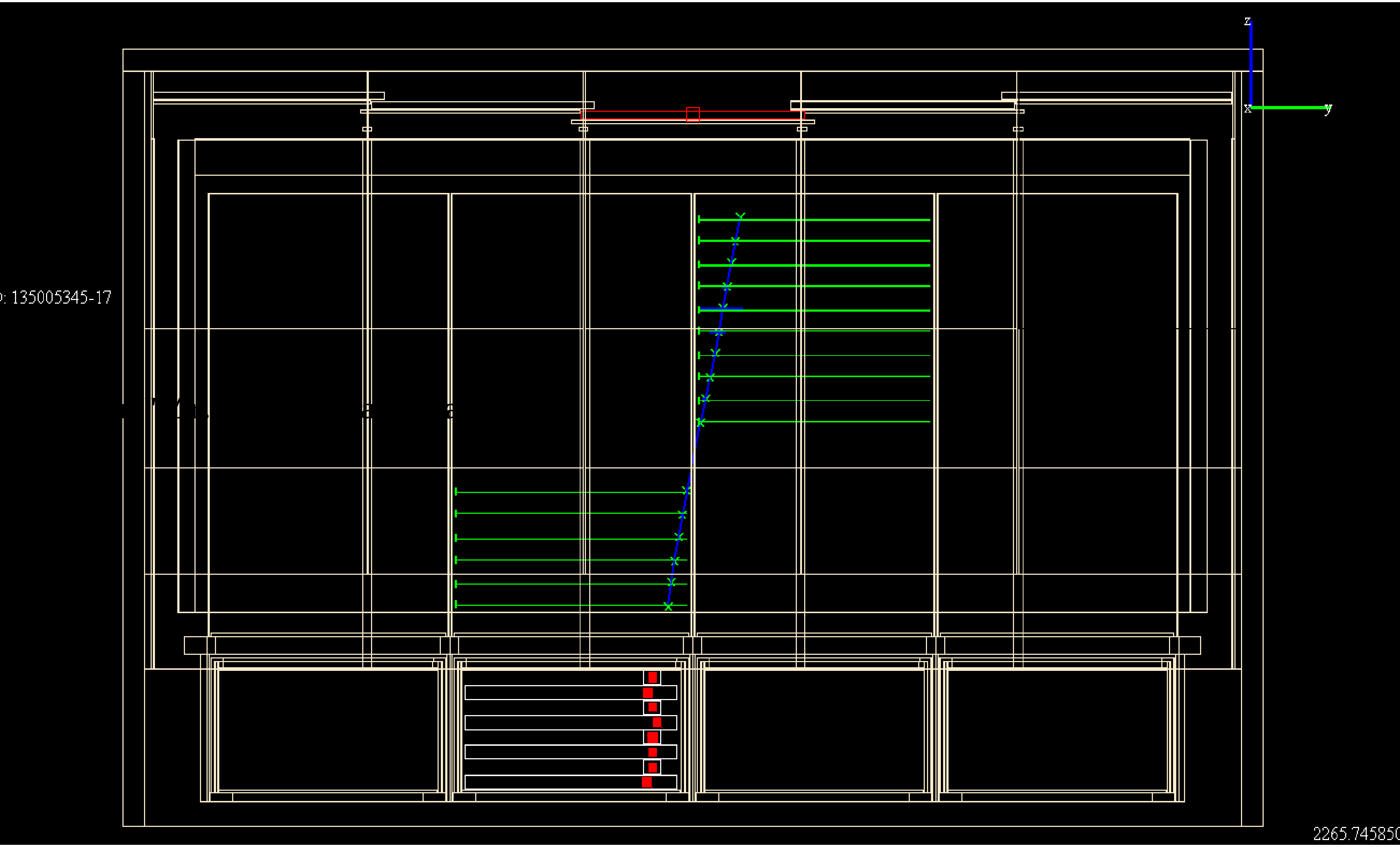
- **LAT completed at Stanford in December 2005.**
- **Presently, environmental tests at Naval Research Laboratory.**
- **A « calibration unit » now in CERN high energy beams.**
- **Fall -- spacecraft integration at General Dynamics near Tuscon, Az.**
- **Launch from Florida, Fall 2007** (Delta E heavy)**.**



Putting LAT into « Big Blue » for Thermal-Vac, 25/7/06.

A real atmospheric gamma

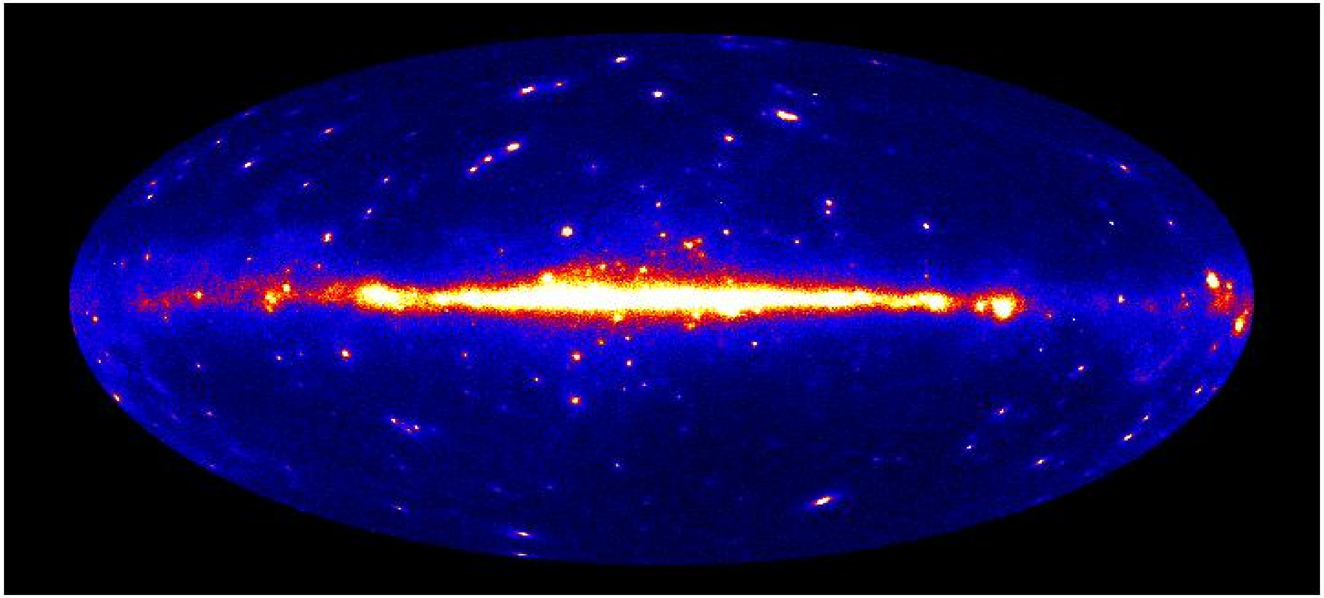




Event display by Riccardo Giannitrapani, INFN Udine
“Movie” by Anders Borgland, SLAC

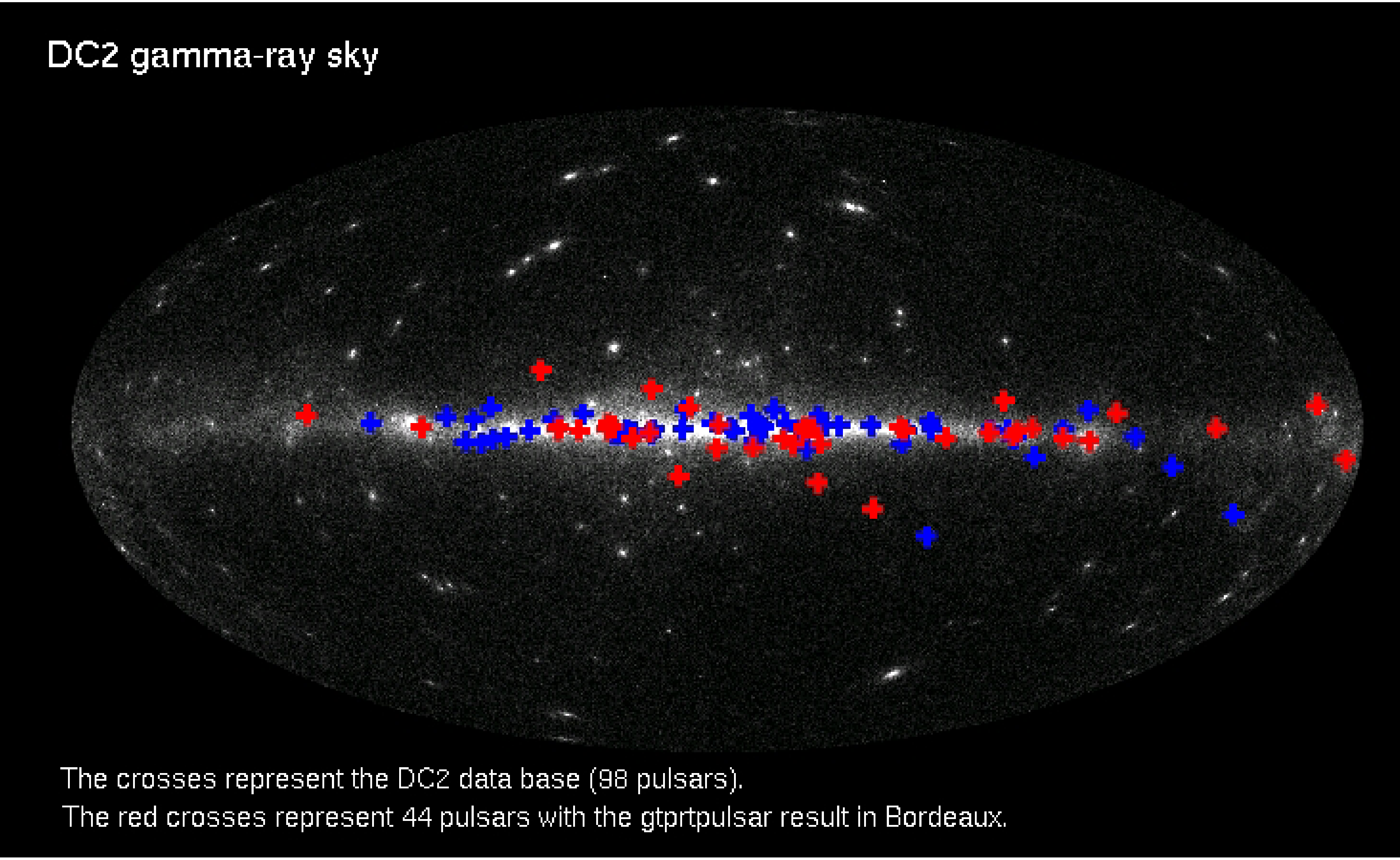
Expected LAT pulsar performance

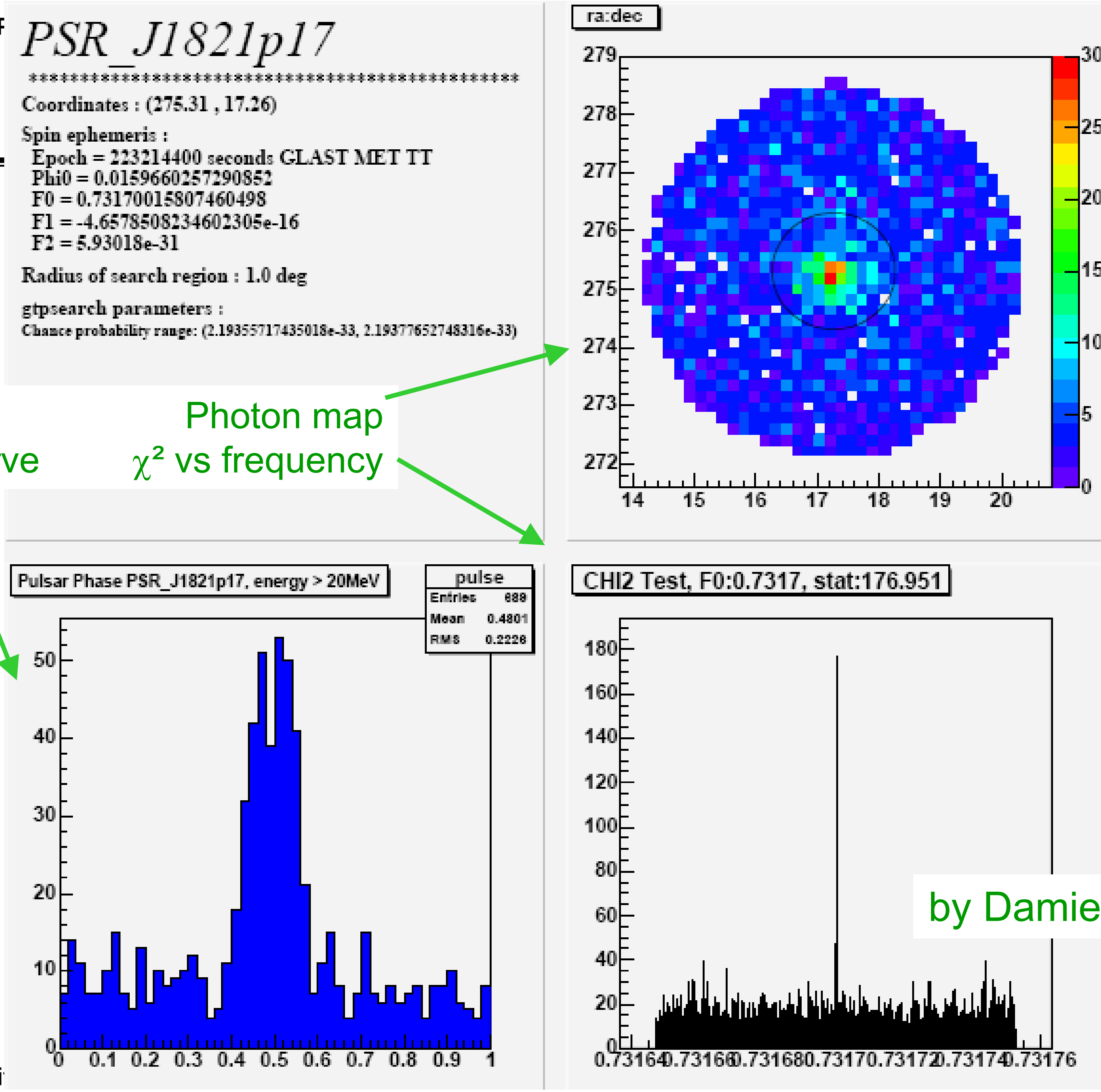
- Overall, the GLAST LAT should be 25x more sensitive than EGRET. (Naively: $25^{3/2}$ = 125 larger volume of space…) A(E) complex for a non-pointing instrument…
- GLAST conducted « Data Challenge II », March-June 2006: collaborators performed blind analyses of 55 days of highly realistic simulated on-orbit data, using « Science Tools ».
- Included 414 real and fake gamma pulsars, of which 98 radio-loud.



Simulated GLAST sky (S. Digel)

Sky map: of 98 pulsars with known ephemeredes, 44 easily detected





Photon map

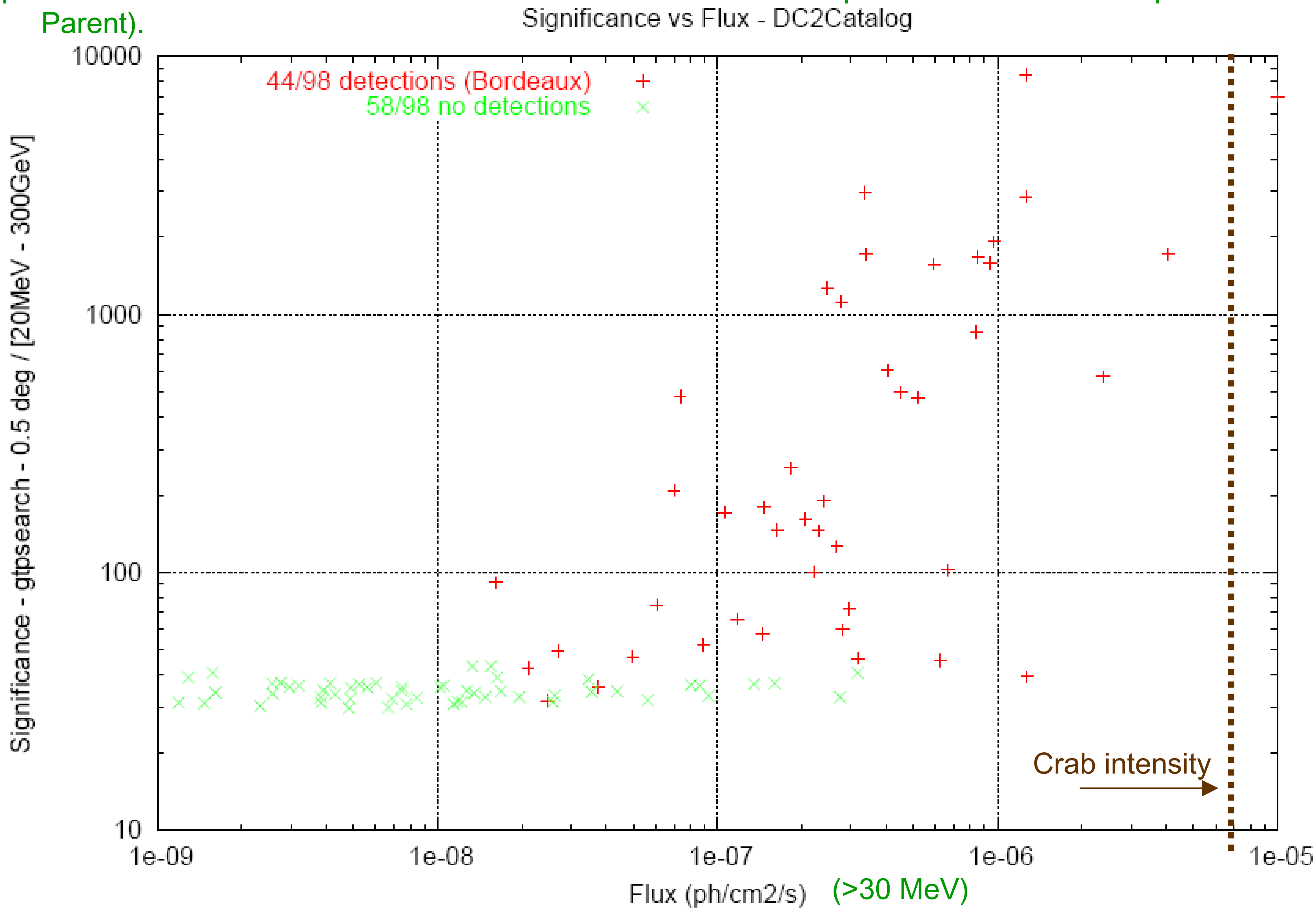
Light curve

χ^2 vs frequency

by Damien Parent

LAT gamma pulsar sensitivity (preliminary)

Gtpsearch test statistic versus true flux of the 98 simulated pulsars with known ephemeredes. (D. Parent).



LAT pulsar sensitivity, with ephemeredes

- DC2 conclusions still being refined. Sensitivity depends on diffuse gamma background (e.g. galactic latitude) and pulse profile. Also, true backgrounds will only be known once we're on orbit.
- However, it seems to be a few % of Crab for 2 months of data.
- Twice that along the galactic ridge (e.g. PSR B1951+32).
- In ApJ 604:775-790 (2004) "Role of Beam Geometry in Population Statistics and Pulse Profiles of Radio and Gamma-Ray Pulsars", Gonthier, Van Guilder, & Harding, the number used was the 5E-8 /cm²/s for a year (>100 MeV), consistent with DC2 results.

- *« Worst » predictions: several tens of new gamma ray pulsars.*

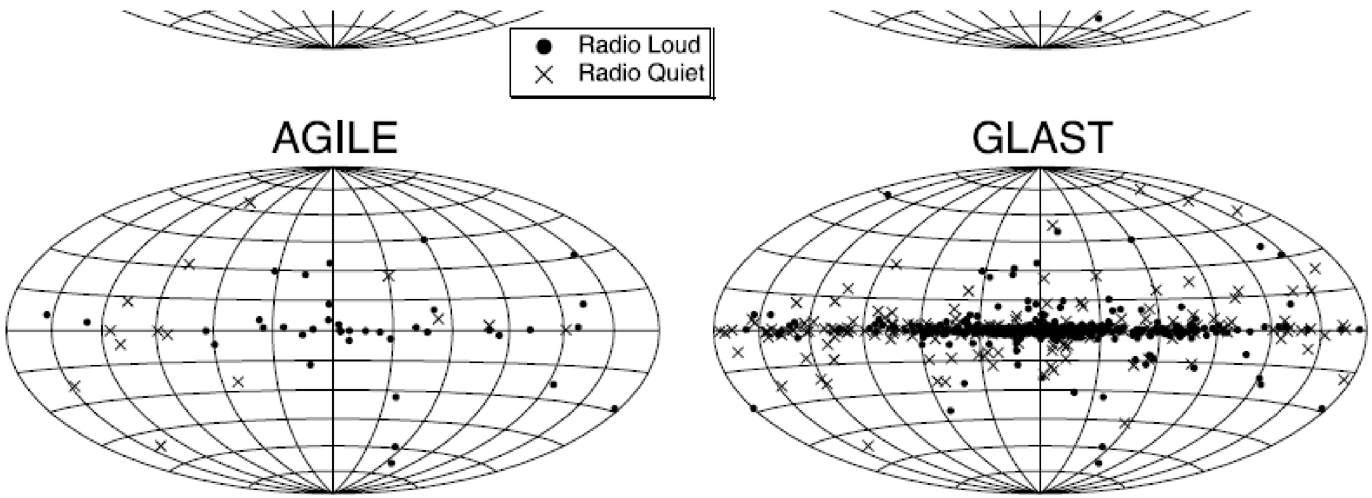


FIG. 12.—Aitoff plots of radio-quiet (*crosses*) and radio-loud (*dots*) γ-ray pulsars detected by EGRET (*top left*) and simulated for EGRET (*top right*), *AGILE* (*bottom left*), and *GLAST* (*bottom right*), assuming a field decay constant of 2.8 Myr.

Towards new geminga-like objects

Gamma-loud, radio quiet

• DC2 *blind* pulsar searches (that is, without using an *a priori* pulsar period) obtained sensitivity only ~8x worse than if period known.

➔ *three were found*.

• In Gonthier, Van Guilder, & Harding,

- DC detections were counted (i.e. not necessarily a pulsed signature)
- for pulsed detections, range of diffuse backgrounds neglected
- sensitivity difference with and without ephemeredes also neglected
- predicted numbers of radio quiet (« geminga-like ») pulsars possibly overestimated.

• Nevertheless, some models predict that GLAST will detect scores or hundreds of radio-quiet gamma-ray pulsars.

• Want to understand pulsar beam geometry? And from there, populations? Or perhaps acceleration regions? Important to have radio phase to compare with the HE light curve (unless the pulsar is truly quiet at other wavelengths) .

• GLAST LAT asking for Xray ephemeredes when radio unavailable.

Gamma ray pulsar candidates

- The known gamma pulsars have large spin-down energies and are nearby.
- We made a list of 254 candidates, applying some somewhat arbitrary cuts to ATNF. All known « favorites » are (hopefully!) included.

CUT N' PASTE OF THE ATNF WWW EXPERT MENU:

User-defined variables

C1 (sqrt(Edot)/Dist1/Dist1)/5.362E18 *(normalize to ~Crab)*

C2 Edot/Dist1/Dist1/1.2E38 *(ditto)*

C3 B_LC/9.8E5 *(ditto)*

C4 (((W50/P0)**3)/S1400/s1400)/2.12E7 (*guesstimate of radio telescope time)*

Sort on field C1 Order Descending

Condition

(Edot>1E34 || (sqrt(Edot)/Dist1/Dist1)/5.362E18 > 0.01) *(~1% of Crab)*

- The table is available at http://www.cenbg.in2p3.fr/ftp/astropart/Smith/Pulsars/Prague/

Beginning of the LAT list…

Microsoft Excel - Pulsar_List_BordeauxFormula

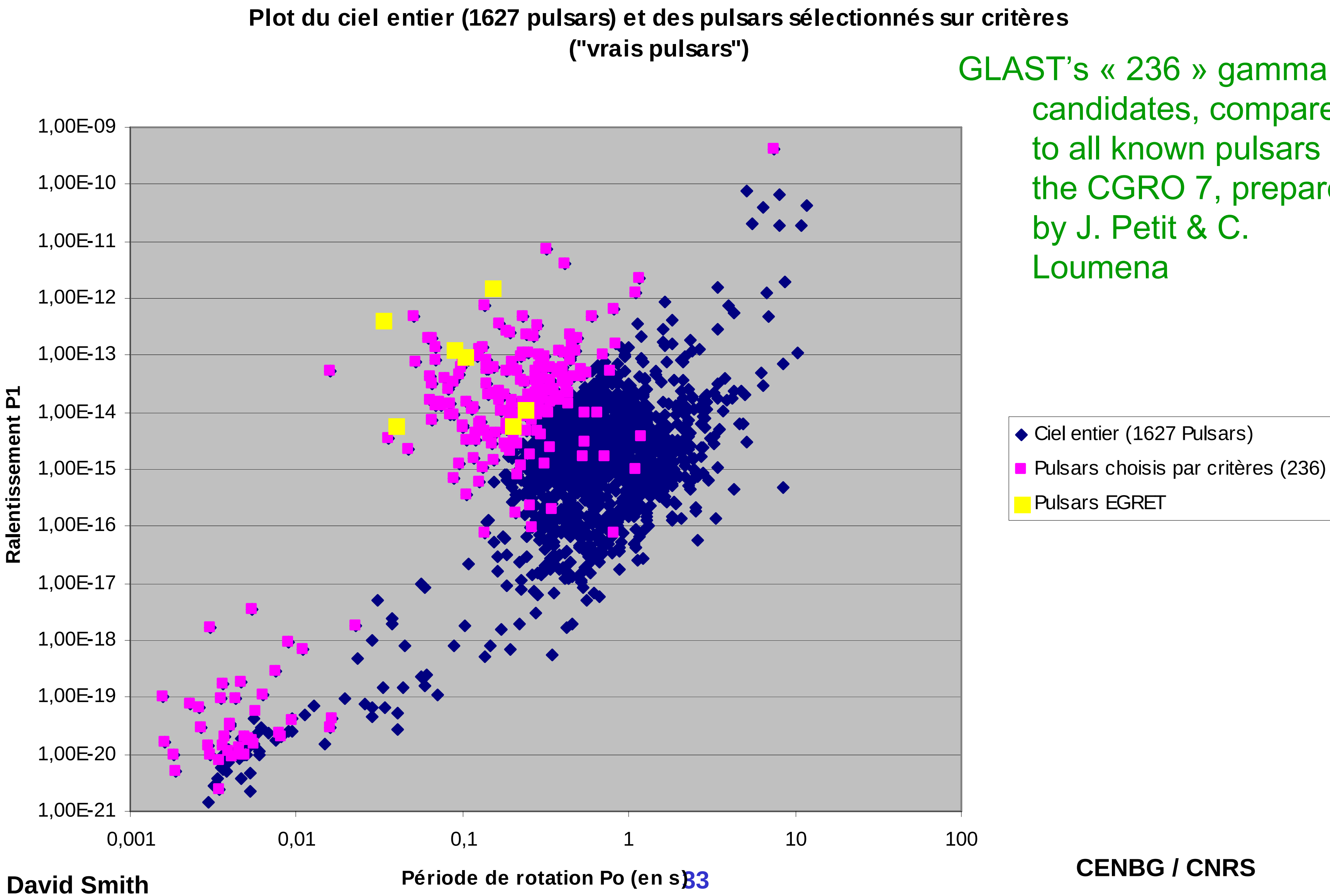
H20 = *

#	NAME	P0 (s)	P1	W50 (ms)	W10 (ms)	DIST1 (kpc)	ASSOC	C1	C2	C3	C4
1	B0833-45	0,089328385	1,25E-13	2,1	4,5	0,29	SNR:Vela	5,83E+00	6,84E-01	4,54E-02	5,06E-10
2	J0633+1746	0,237099442	1,10E-14	*	*	0,16	GRS:Geminga	1,30E+00	1,04E-02	1,17E-03	*
3	J0437-4715	0,005757452	5,73E-20	0,969	2,325	0,14	*	1,04E+00	5,10E-03	2,91E-02	1,20E-05
4	B0531+21	0,033084716	4,23E-13	3	4,7	2	SNR:Crab[ccl+69]	1,00E+00	9,58E-01	1,00E+00	1,79E-04
5	B0656+14	0,384891195	5,50E-14	18,4	30	0,29	SNR:Monogem_Ring[tbb+03	4,32E-01	3,77E-03	7,82E-04	3,76E-04
6	B0743-53	0,214836351	2,73E-15	13	30	0,25	*	3,13E-01	1,47E-03	7,48E-04	*
7	J2124-3358	0,004931115	2,05E-20	0,51	3,82	0,27	*	2,11E-01	7,77E-04	2,57E-02	7,72E-03
8	J0034-0534	0,001877182	4,96E-21	0,8	1,1	0,54	*	1,11E-01	8,57E-04	1,41E-01	9,81E+00
9	J0030+0451	0,004865453	1,00E-20	*	*	0,32	*	1,06E-01	2,77E-04	1,86E-02	*
10	J1744-1134	0,004074546	8,94E-21	*	*	0,36	*	1,04E-01	3,34E-04	2,73E-02	6,78E+01
11	B0840-48	0,644354056	9,50E-15	8,3	75	0,27	*	9,57E-02	1,60E-04	8,95E-05	2,62E-04
12	J0205+6449	0,065686382	1,94E-13	2,3	*	3,2	SNR:3C58	9,46E-02	2,20E-02	1,21E-01	1,00E+00
13	B1929+10	0,226517635	1,16E-15	7,4	14	0,36	*	8,99E-02	2,51E-04	4,27E-04	1,27E-06
14	J1024-0719	0,005162205	1,85E-20	1,2	1,8	0,39	*	8,93E-02	2,90E-04	2,17E-02	7,32E-01
15	J1012+5307	0,005255749	1,71E-20	*	*	0,41	*	7,61E-02	2,33E-04	2,00E-02	4,14E+01
16	J0843-5022	0,208955693	1,72E-16	6,1	29	0,26	*	7,56E-02	9,25E-05	2,01E-04	1,22E-02
17	J1747-2958	0,098812758	6,14E-14	7	*	2,01	*	7,30E-02	5,16E-03	2,47E-02	2,68E-01
18	B0808-47	0,547199236	3,08E-15	15	35	0,27	*	6,96E-02	8,46E-05	7,67E-05	1,08E-04
19	B0950+08	0,253065165	2,30E-16	9,5	20,6	0,26	*	6,53E-02	6,90E-05	1,44E-04	3,54E-07
20	B1706-44	0,102459246	9,30E-14	6	13	2,3	SNR:G343.1-2.3(?)[mop93]	6,50E-02	5,36E-03	2,78E-02	1,78E-04
21	B1055-52	0,197107608	5,83E-15	14	17	0,72	*	6,23E-02	4,82E-04	1,36E-03	1,40E+00
22	J1833-1034	0,061865672	2,02E-13	2,5	*	4,3	SNR:G21.5-0.9	5,88E-02	1,53E-02	1,45E-01	6,17E-01
23	J1740+1000	0,154087174	2,15E-14	*	*	1,24	*	5,82E-02	1,25E-03	4,82E-03	*
24	B1951+32	0,039531193	5,84E-15	4,7	9,6	2,5	SNR:CTB80	5,74E-02	4,93E-03	7,53E-02	7,93E-02
25	J1357-6429	0,166108328	3,60E-13	15	31	2,47	*	5,38E-02	4,23E-03	1,63E-02	1,79E-01
26	J0737-3039A	0,022699379	1,74E-18	*	*	0,52	*	5,30E-02	1,82E-04	5,20E-03	4,57E+00
27	B1257+12	0,006218532	1,14E-19	0,58	1,4	0,77	*	4,34E-02	2,67E-04	3,39E-02	3,83E-02

Sheet1 Sheet2 Sheet3

Prêt Somme=4586715,58

démarrer Prague Future Gamma-ray a… Microsoft Excel - Puls… Microsoft PowerPoint … FR 17:18



GLAST's « 236 » gamma candidates, compared to all known pulsars and the CGRO 7, prepared by J. Petit & C. Loumena

Ephemeredes database for the LAT

- The gamma ray pulsar candidates are young and turbulent. Timing noise and glitches cause timing solutions to spoil quickly (see ref below).
- GLAST doesn't point – photons collected over *years*.
- Realize later that PSR Jxxxx+yy might have been a good one?

TOO LATE, you can't go back, see e.g. 2229+6114 in astro-ph/0112518.

- GLAST LAT needs the biggest list possible of accurate ephemeredes, and now is the time to be compiling it.
- *Quality of GLAST pulsar science depends alot on radio contributions*, (we're counting on your help!)

ASTROPHYSICAL JOURNAL, 422:671–680, 1994 February 20

TIMING BEHAVIOR OF 96 RADIO PULSARS

Z. ARZOUMANIAN,[1] D. J. NICE,[2] AND J. H. TAYLOR[3]
Joseph Henry Laboratories and Department of Physics, Princeton University, Princeton, NJ 08544

AND

S. E. THORSETT[4]
Owens Valley Radio Observatory, California Institute of Technology, MS 105-24, Pasadena, CA 91125

Splinter meeting after this talk (1:15-2:30 pm Thursday, in Meeting Room 1.2):

Radio Timing for GLAST

THE ASTROPHYSICAL JOURNAL, 422:671–680, 1994 February 20

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Received 1993 June 1; accepted 1993 August 25

1. INTRODUCTION

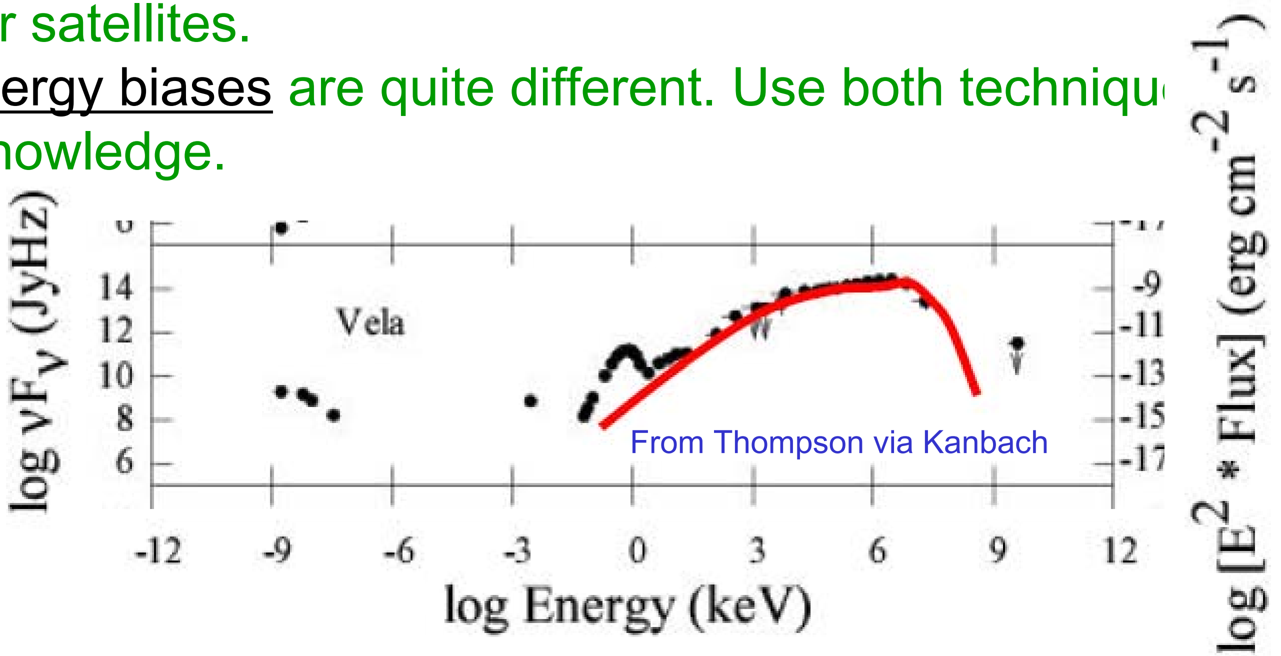
In anticipation of the launch of the *Compton Gamma Ray Observatory*, and mindful of the requirement for accurate, contemporaneous timing parameters in order to observe pulsars at gamma-ray energies, we began an extensive series of pulsar timing observations with the NRAO 43 m telescope in 1989 August. About 120 pulsars north of $-45°$ declination were selected, with preference given to objects considered most likely to be detectable in gamma rays. Our observing list also

Example of what can be done.

Lead time required – don't wait for the last minute.

Summary: complementarity of satellites & Cherenkov

- Higher sensitivity to high energy on ground – measure cut-offs better, with shorter integration times.
- Satellite energy range well-matched to spectral energy peak.
- GLAST capable of phase-resolved spectroscopy over more than 3 energy decades.
- Both have good imaging – resolve pulsar from PWN?
- Ground sees only ~latitude-40° < dec < latitude+40°.
- Serendipity? HESS surveys show that unpredicted sources *can* be seen from the ground, as for satellites.
- Backgrounds and energy biases are quite different. Use both techniqu to enhance spectral knowledge.



CONCLUSIONS

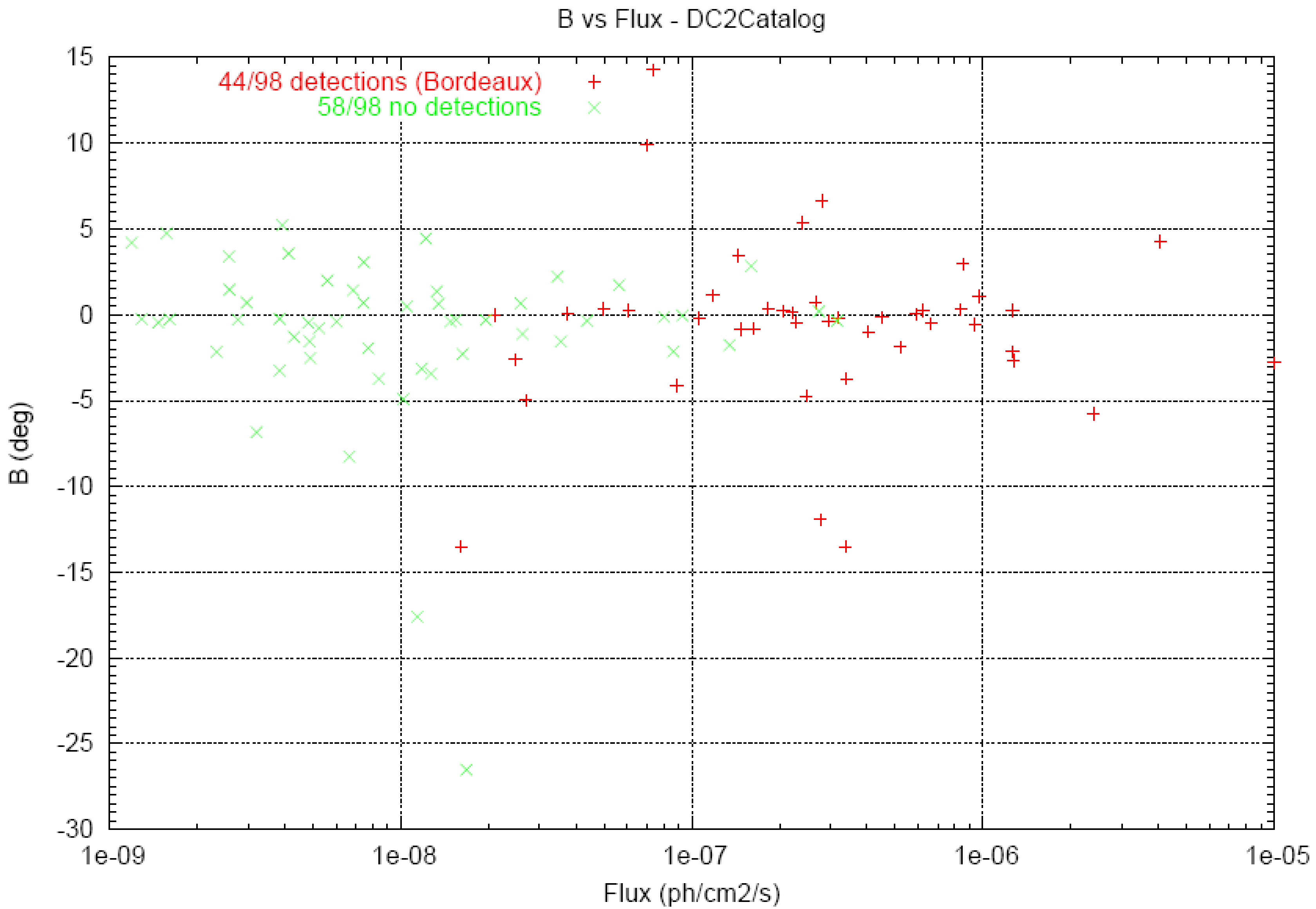
• Ground based Cherenkov detectors have reached the sub-100 GeV energy range but have yet to detect pulsed gammas.
• HESS-II in the south and MAGIC-II in the north might see a few, with sensitivity below 30 GeV.
• AGILE should confirm the EGRET detections, the almost-detections, and perhaps some new ones.
• But the GLAST LAT is best placed to grow the GeV pulsar sample by a fat factor of ten.
• *That will require long-term radio timing of many pulsars.*

• Gamma pulsar studies should make a quantum leap in 2008.

sadgage

Extra slides….

Galactic latitude versus True flux of the 98 simulated pulsars with known ephemeredes (D. Parent).



Gamma ray pulsars

From G. Kanbach, 363rd Heraeus seminar, May 2006 – other authors order these differently…

High-Energy Pulsars: Multiwavelength Detections

PSR	P (ms)	$\dot{E}/d^2$ rank	radio	opt	X_{low}	X_{hi}	γ_{low}	γ_{hi}
high confidence γ-ray detections								
B0531+21 (Crab)	33.4	1	P	P	P	P	P	P
B0833-45 (Vela)	89.3	2	P	P	P	P	P	P
J0633+1746 (Geminga)	237.1	3	P?	P	P	P	?	P
B1706-44	102.5	4	P	?	D			P
B1509-58	150.7	5	P	D	P	P	P	
B1951+32	39.5	6	P		P		P	P
B1055-52	197.1	33	P	D	P		P	P
candidate γ-ray detections								
B0656+14	384.9	18	P	P	P		?	?
B0355+54	156.4	36	P		D			?
B0631+10	287.7	53	P		D			?
B0144+59	196.3	120	P					?
ms PSR γ-ray detection & candidates								
J0218+4232	2.32	43	P		P			P
B1821-24	3.05	14	P		P			?
Likely PSR - γ-ray source positional coincidence								
B1046-58	123.7	8	P		D			D?
J1105-6107	63.2	21	P		D			D?
B1853+01	267.4	27	P					D?

P = pulsed detection, P? = low significance pulsation, D = unpulsed detection

Qui fait GLAST?

Mission NASA-DOE pour les 3/4.

Principaux labos USA:

Stanford Linear Accelerator Center = “SLAC” (près de San Francisco)

NASA Goddard Space Flight Center (près de Washington, D.C.)

Naval Research Laboratory (Washington, D.C.)

Réalisation de trajectograph en silicium:

INFN-Pise (avec participation financière de l’ASI)

La Suède a acheté les cristaux CsI ukrainiens. Présence japonaise importante.

En France:

IN2P3/CNRS -- Réalisation de la structure mécanique du calorimètre, caractérisation du calo sous faisceau, reconstruction de gammas.

LLR Ecole Polytechnique ; CEN de Bordeaux ; LPTA Montpellier

Sap du CEA-Saclay -- Préparation du catalogue, aidé par le CESR-Toulouse.

Crab: quite large zenith angle for HESS

http://www-hess.physik.hu-berlin.de/theses.html Fabian Schmidt

@ 10 GeV:
~1E-4 /m²/s

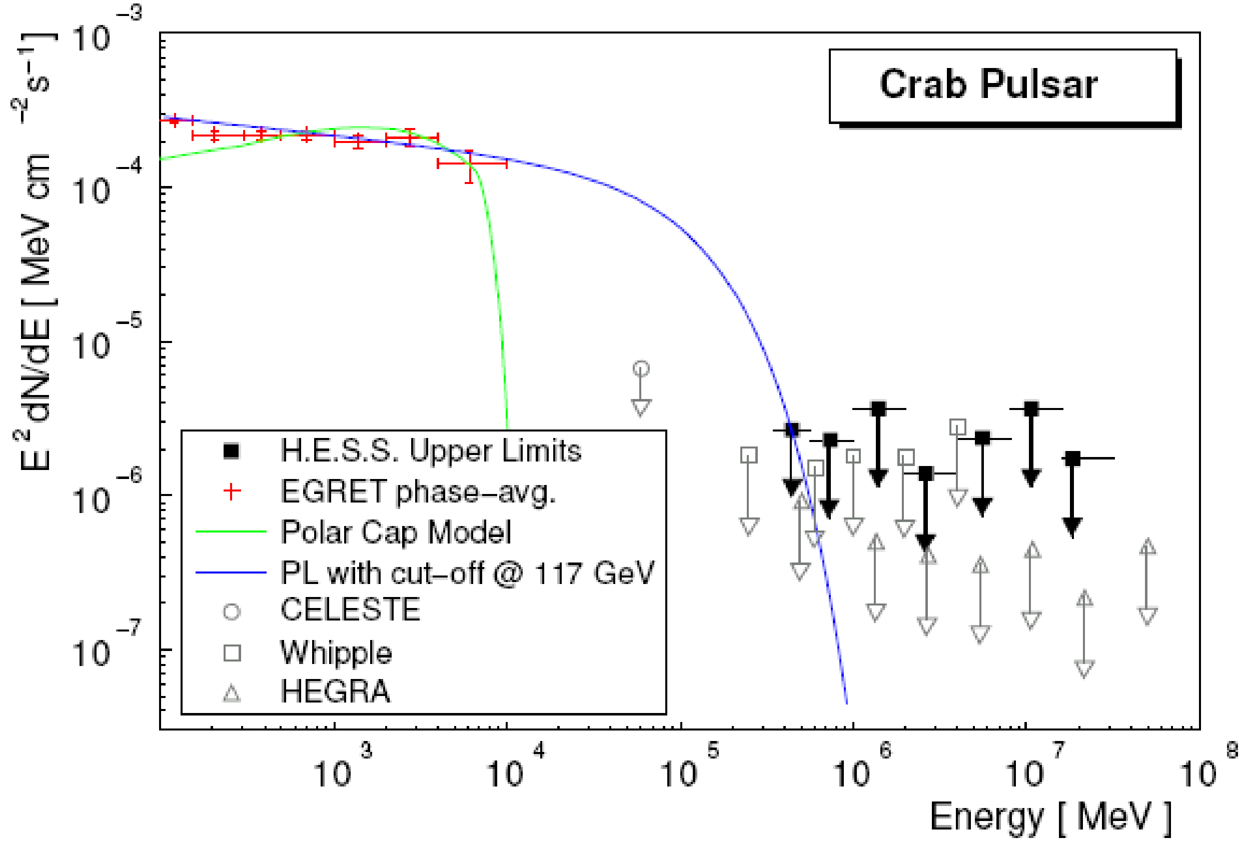
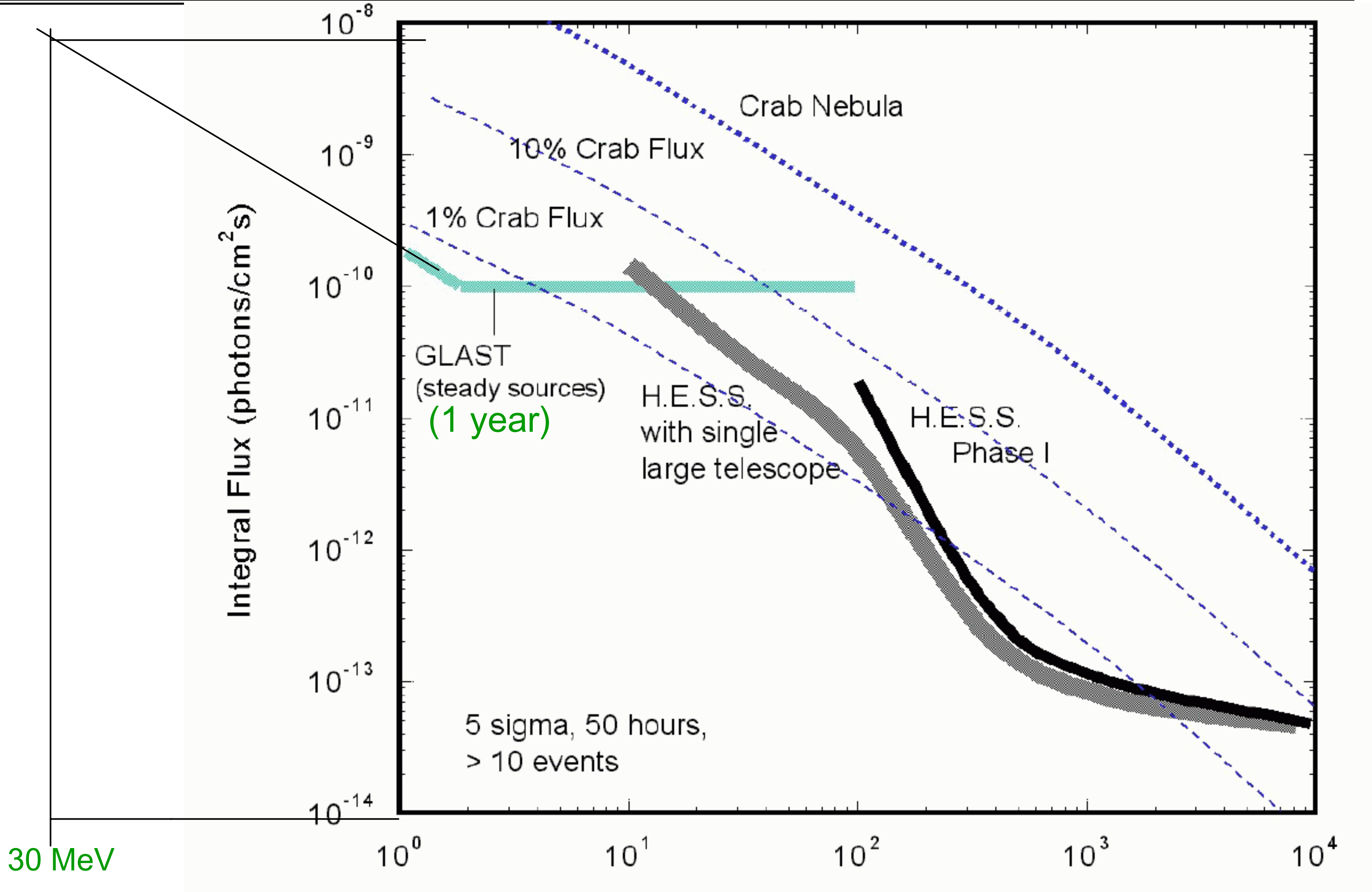


Figure 3.5: Pulsed spectrum of the Crab pulsar as measured by EGRET (red points) with H.E.S.S. upper limits (black) and predictions from the Polar Cap model (green). Also shown are the previously published upper limits from the Whipple [47], CELESTE [16], and HEGRA [18] experiments, as well as a power-law (PL) with the maximum exponential cut-off consistent with the H.E.S.S. upper limits (Sec. 3.1.3).

Summary of future sensitivities



Courtesy W. Hofmann

Detecting, cont'd

http://www-hess.physik.hu-berlin.de/theses.html

Fabian Schmidt

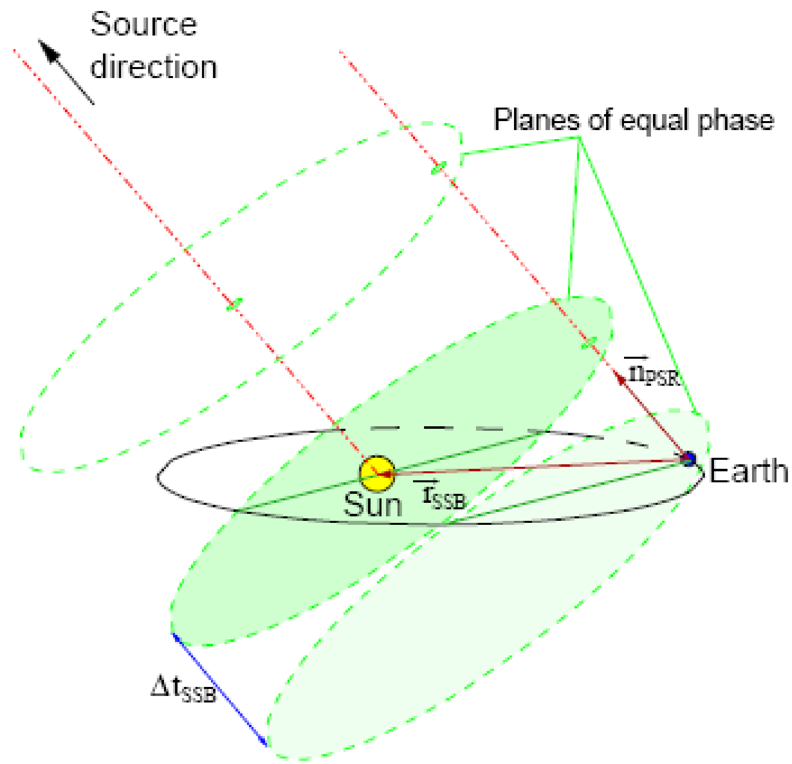


Figure 2.12: Sketch illustrating the calculation of the barycentric correction. As the Earth's orbit is inclined with respect to the planes of equal pulsar phase, the arrival time of a pulse depends on the Earth's position in its orbit and, in a similar way, on the observer's position on Earth.