

PSR B1259-63: the gamma-ray binary pulsar

Thomas P.H. Tam

astro-news @ NTHU
29th November 2010

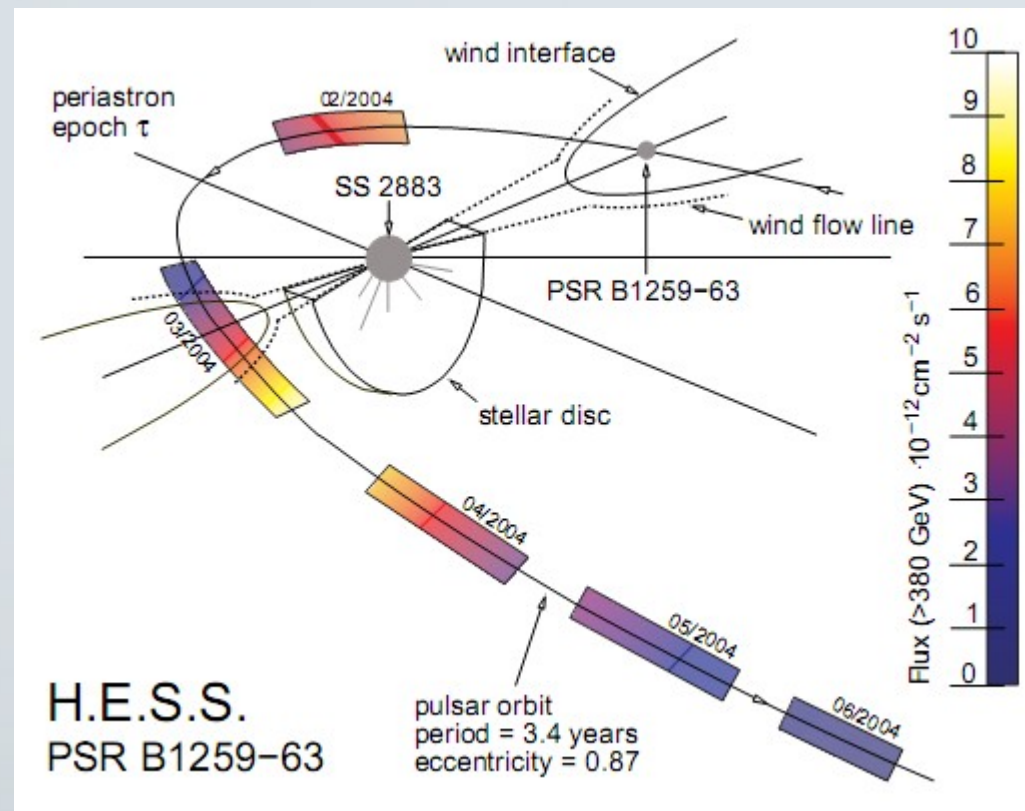
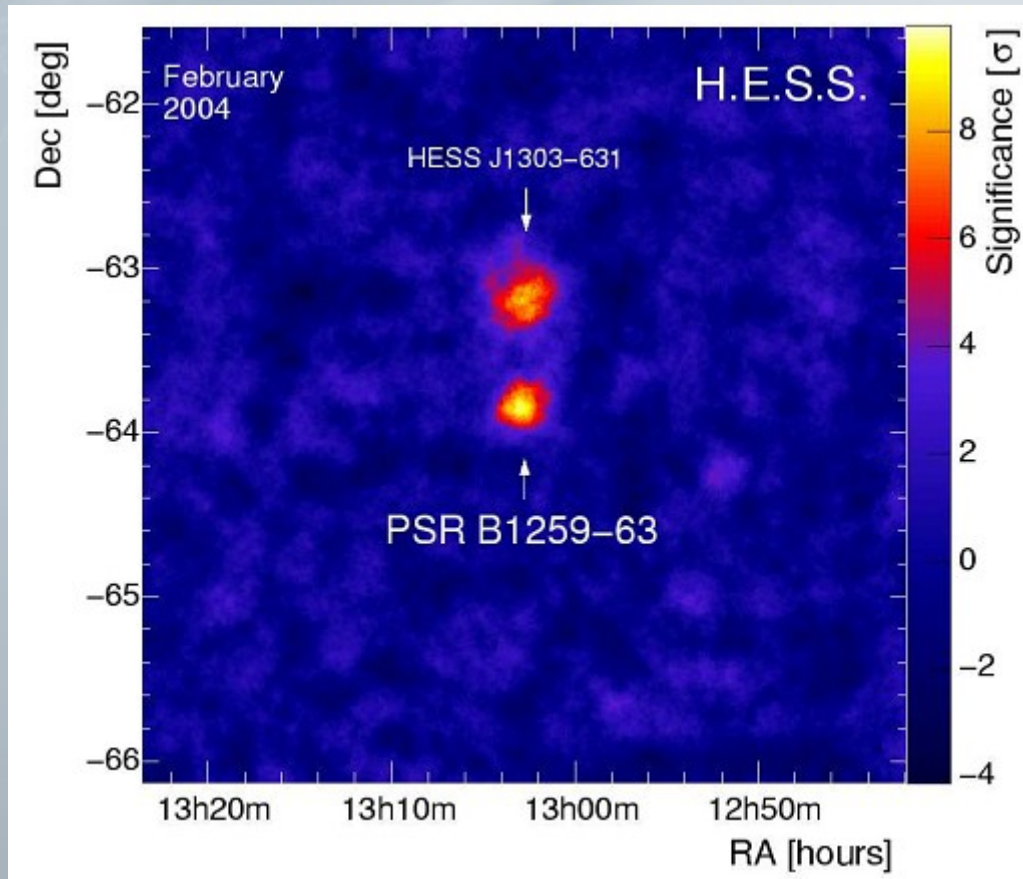
PSR B1259-63: a radio pulsar

Table 1. Observed and derived parameters for PSR B1259 – 63.

Right Ascension, α (J2000)	13 ^h 02 ^m 47 ^s .68(2)
Declination, δ (J2000)	-63° 50' 08".6(1)
Period, P	47.762053919(4) ms
Period Derivative, \dot{P}	$2.2793(4) \times 10^{-15}$
Epoch of Period	MJD 48053.44
Dispersion Measure, DM	146.75(8) cm ⁻³ pc
Orbital Period, P_b	1236.79(1) days
Projected semi-major axis, $asini$	1295.98(1) light s
Longitude of periastron, w	138.6548(2)°
Eccentricity, e	0.869836(2)
Epoch of Periastron	MJD 48124.3581(2)
Magnetic Field, B	3.3×10^{11} G
Characteristic Age, τ_c	0.33 Myr
Mass Function, $f(M_p)$	1.53 M _⊙
Predicted Periastron Passage	MJD 49361.2 ≡ 1994 Jan 9.2

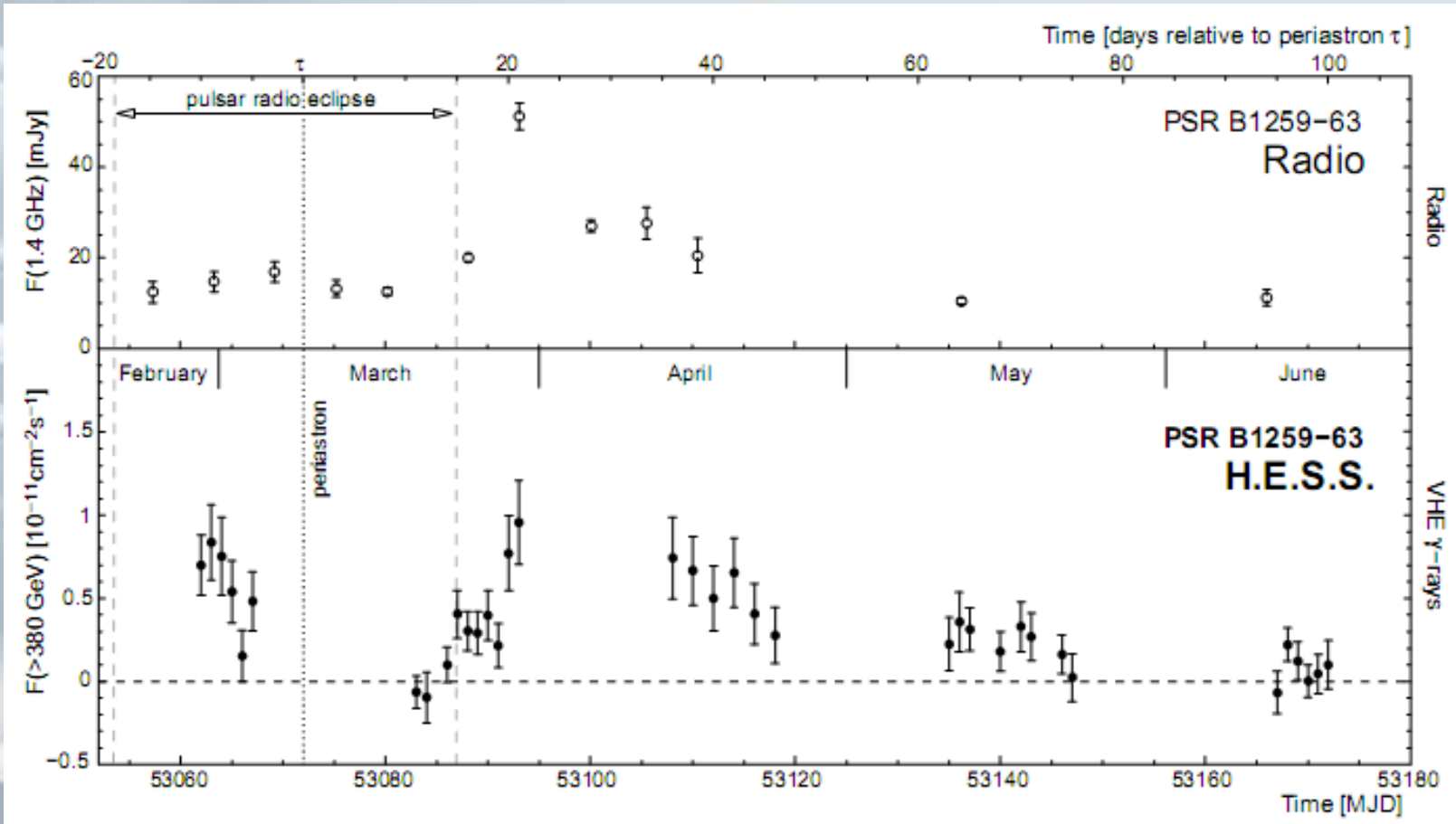
Johnston, et al. (1994)

Discovery as a gamma-ray binary pulsar



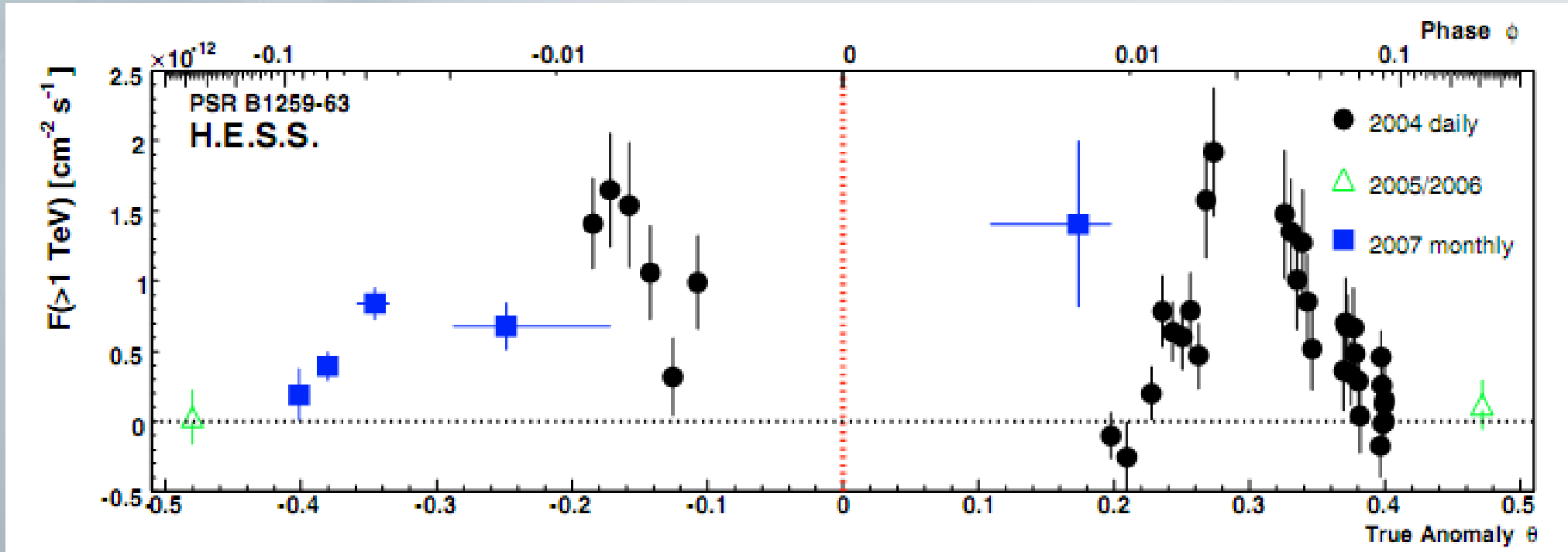
Aharonian, F. et al. 2005 (HESS collaboration)

Unpulsed Radio emission



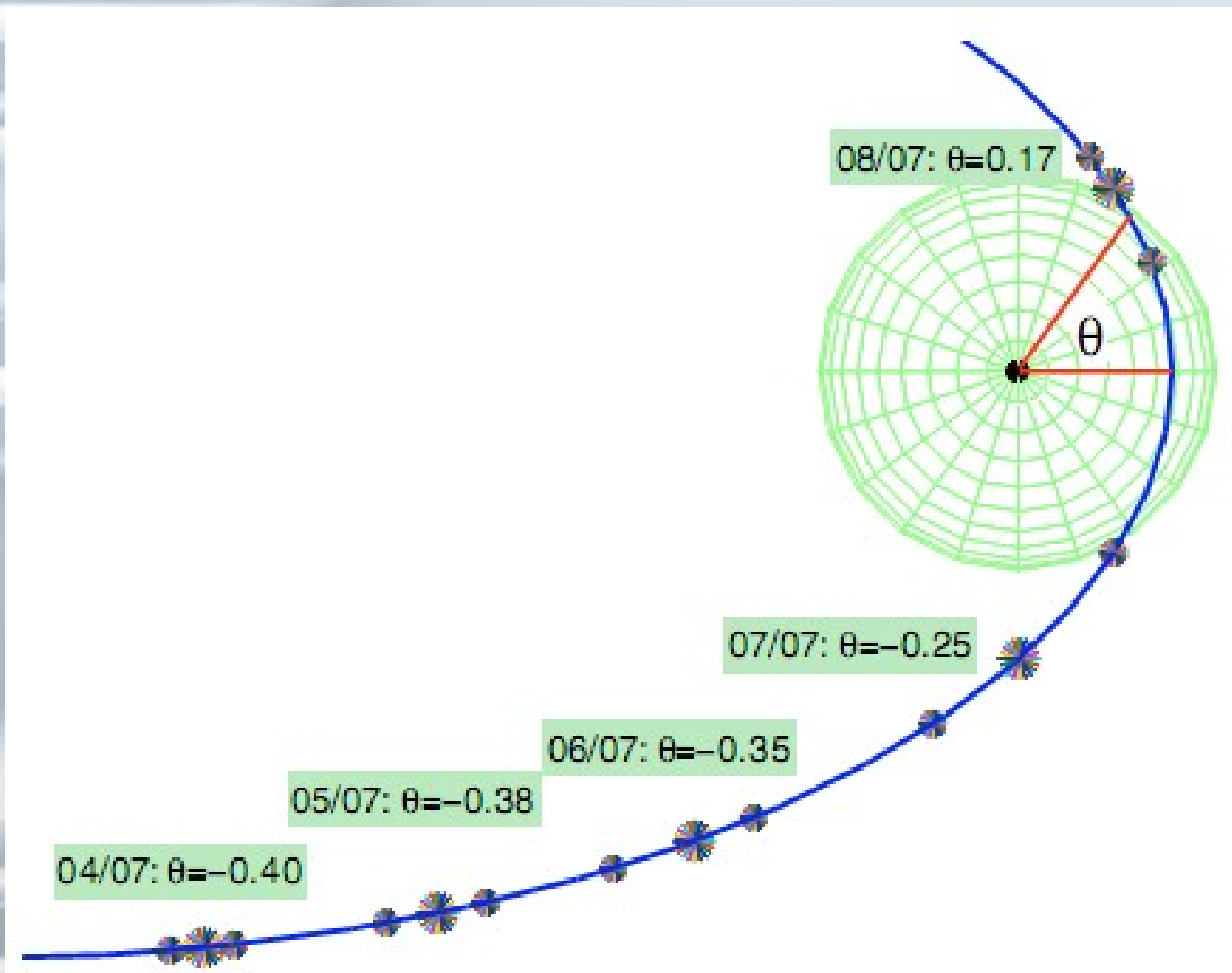
Aharonian, et al. (2005)

A leptonic model of broadband spectrum RX J1713.7-3946



Aharonian, F. et al. 2009 (HESS collaboration)

TeV emission before entering the disk



Aharonian, F. et al. 2009 (HESS collaboration)

Possible detection of PSR B1259-63 in GeV gamma-rays



Fermi/LAT and Swift/XRT detection of increased activity from the binary system PSR B1259-63/SS 2883

ATel #3046; *P.H.T. Tam, A.K.H. Kong, R.H.H. Huang (NTHU, Taiwan), C.Y. Hui (Chungnam, Korea)*

on 21 Nov 2010; 7:15 UT

Distributed as an Instant Email Notice (Request for Observations)

Password Certification: Albert Kong (akong@phys.nthu.edu.tw)

Subjects: X-ray, Gamma Ray, Request for Observations, Binaries, Pulsars

We report on the gamma-ray detection by the Large Area Telescope aboard the Fermi Gamma-ray Space Telescope from the sky position of the binary system PSR B1259-63/SS2883. A preliminary analysis of the region around the system has resulted in a detection significance of about 4 standard deviations using data taken between 2010-11-18 00:00:00 (UT) to 2010-11-21 00:04:42 (UT).

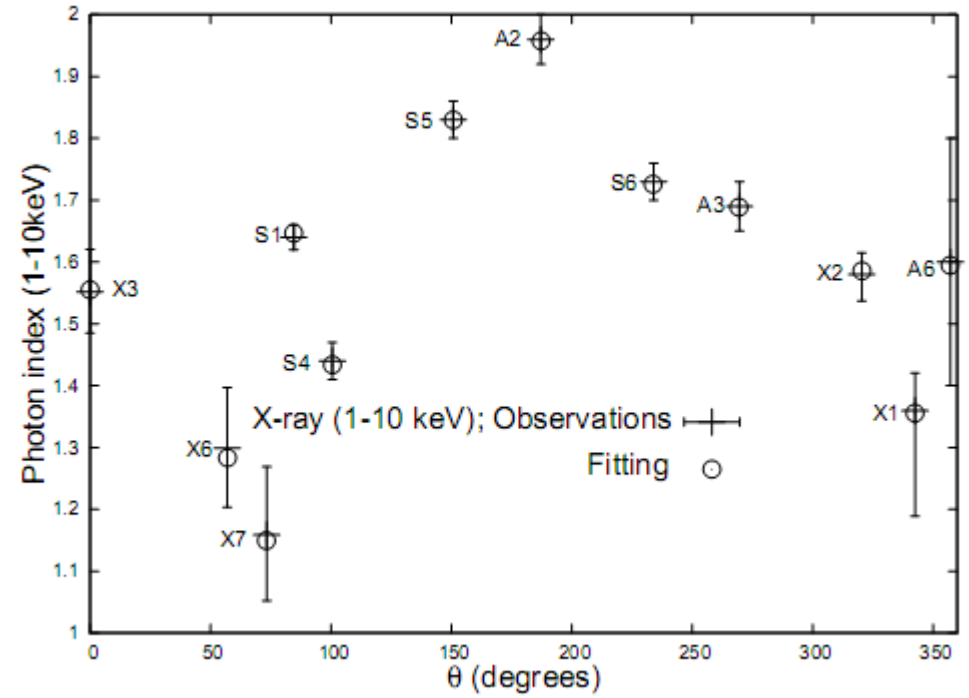
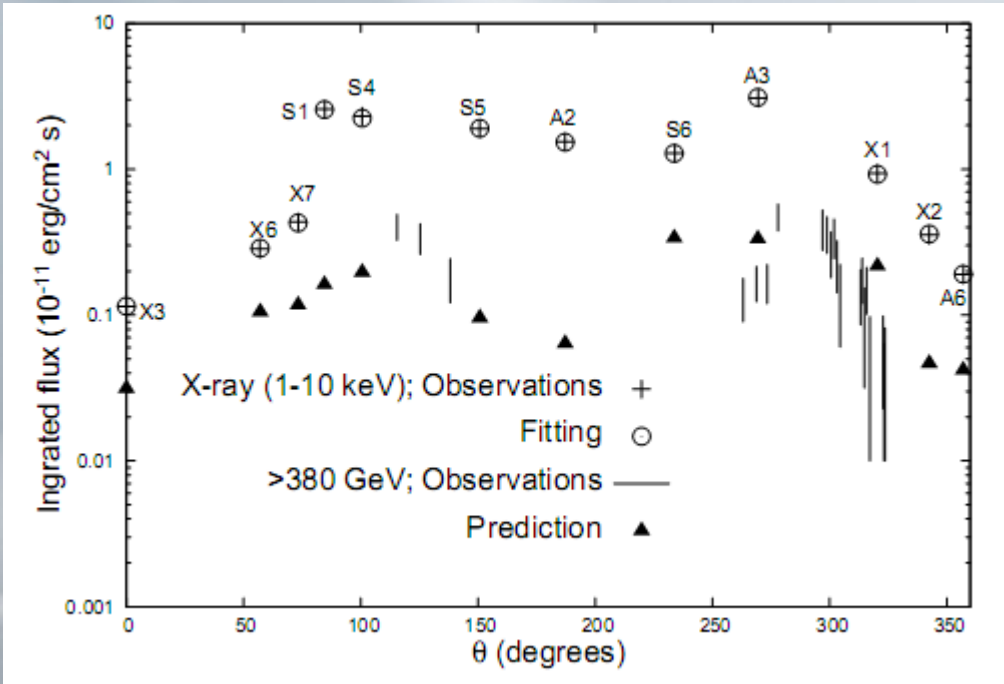
Based on the same data set and using a single power law model for the source, the averaged gamma-ray flux is around 4×10^{-8} photons/s/cm² over the energy range 300 MeV to 100 GeV and the photon index is about 1.7. We note that the gamma-ray flux from the binary system has increased over the last few days and we expect the flux to increase further in the coming days. Note that an earlier LAT observations this year did not reveal any emission from the source (ATel #2780).

Swift/XRT observed the region around PSR B1259-63 starting on 2010 Nov 20 05:02 (UT) for about 3.8 ks. The source spectrum of PSR B1259-63 is best described by an absorbed power-law with $N_H = 6.9(+5.5, -4.2) \times 10^{21}$ cm⁻² (90% confidence) and a photon index of 1.3 ± 0.4 (reduced $\chi^2/\text{dof} = 0.51/14$). The absorbed 1-10 keV flux is around 6.5×10^{-12} erg/s/cm². The Swift observation hence suggests an increasing X-ray flux compared to previous observation taken on 2010 Aug 8 (ATel #2782), and similar hardening behavior has been seen during the first, pre-periastron passage of the disk (Chernyakova et al. 2006, 2009).

PSR B1259-63 will pass through the periastron of its companion star SS 2883 in 2010 mid-Dec. The increase of X-ray and gamma-ray flux therefore occurs around the time when the pulsar enters the equatorial disk of the Be stars.

X-ray observations

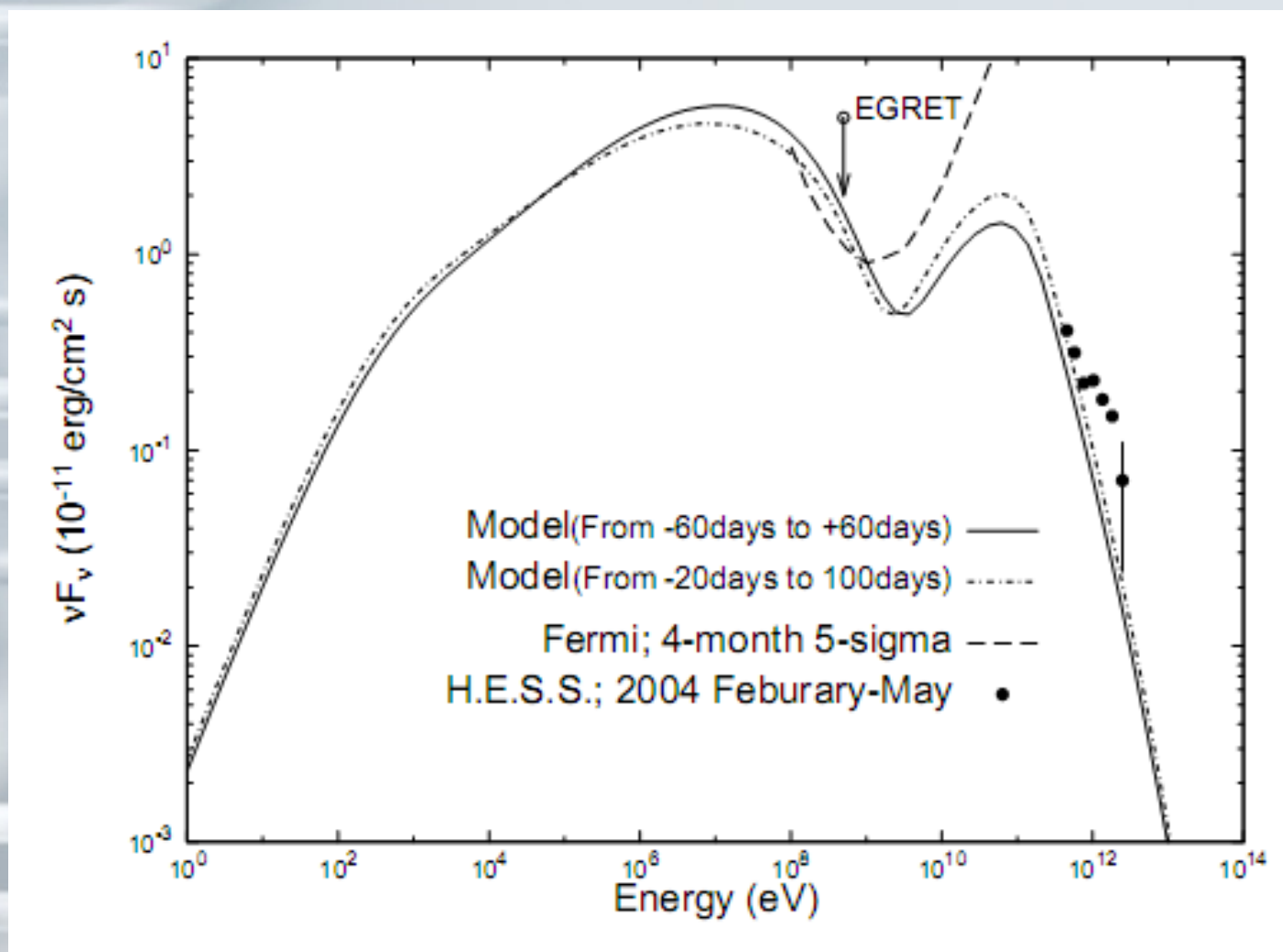
Flux



Photon Index

Takata & Taam (2009)

Origin of the gamma-rays?



Takata & Taam (2009)