



**MAGIC**

Major Atmospheric  
Gamma Imaging  
Cerenkov Telescope

RICAP'07



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# MAGIC Observations of the HMXB LSI +61 303 in VHE gamma rays

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on behalf the MAGIC Collaboration





# The MAGIC Telescope



**La Palma, asl. 2200m**

**17 m diameter Mirror**

**3.5 ° FoV Camera**

**Trigger Threshold of  
 $E = 60 \text{ GeV}$**

**Sensitivity of 2.2 %  
Crab flux**

**Can operate under  
moonlight condtions**



**Very sensitive Instrument to study faint VHE gamma ray sources**





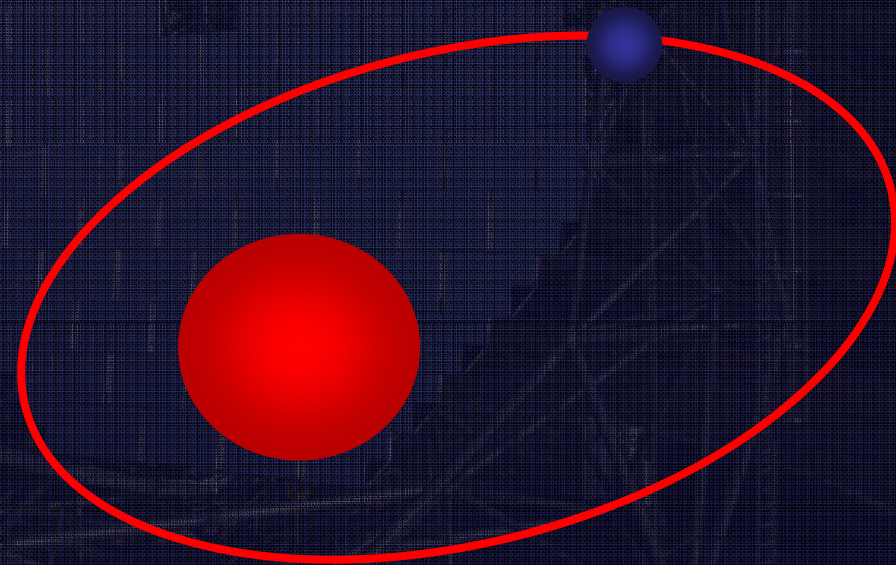
# HMXBs



**HMXB: Binary systems with massive star and lighter compact object orbiting the massive star**

## **LS I +61 303**

- **B0 V star with disc (Be)**
- **Compact object unknown**
- **Orbital period 26.496 days**
- **Distance ~ 2 kpc**
- **Periastron at  $\phi = 0.23$**
- **Eccentricity  $e = 0.73$**





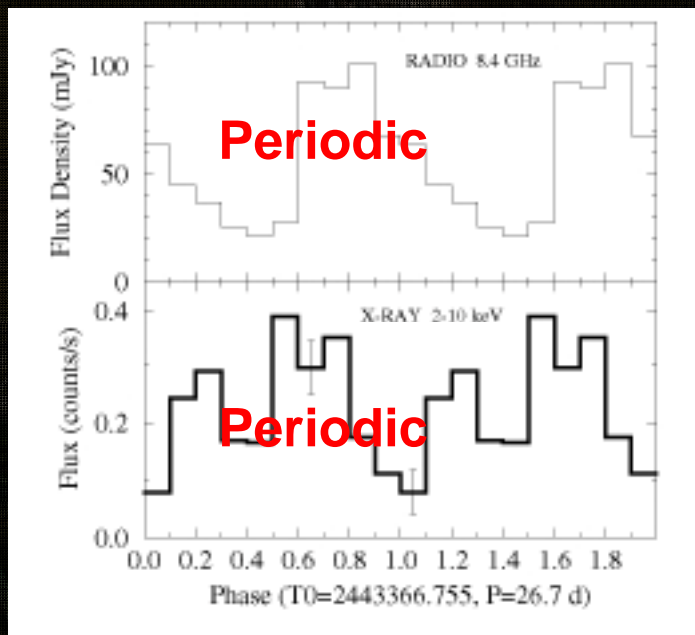


# LS I Observation



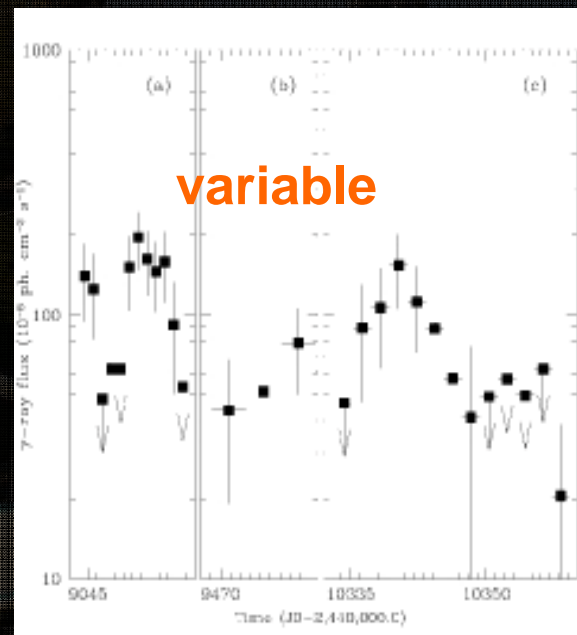
Detected in radio, optical, x-ray, HE ( $E < 10$  GeV) gamma rays

radio, x-ray



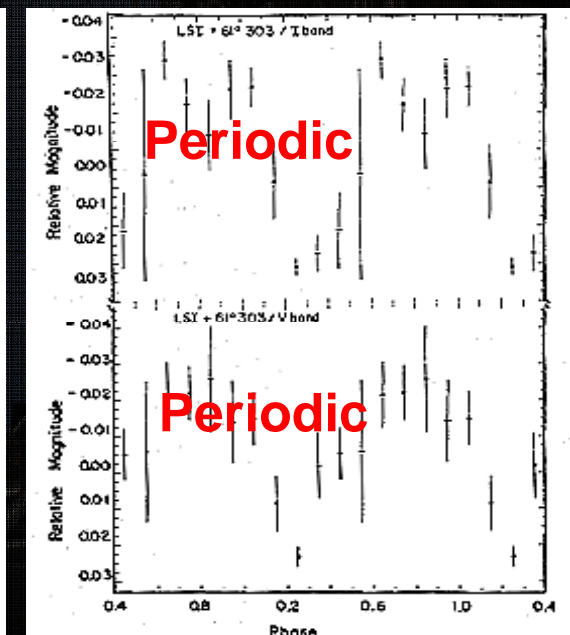
Paredes et al. 1997

HE ( $E < 10$  GeV)



Tavani et al. 1998

optical + infrared



Mendelson et al. 1989

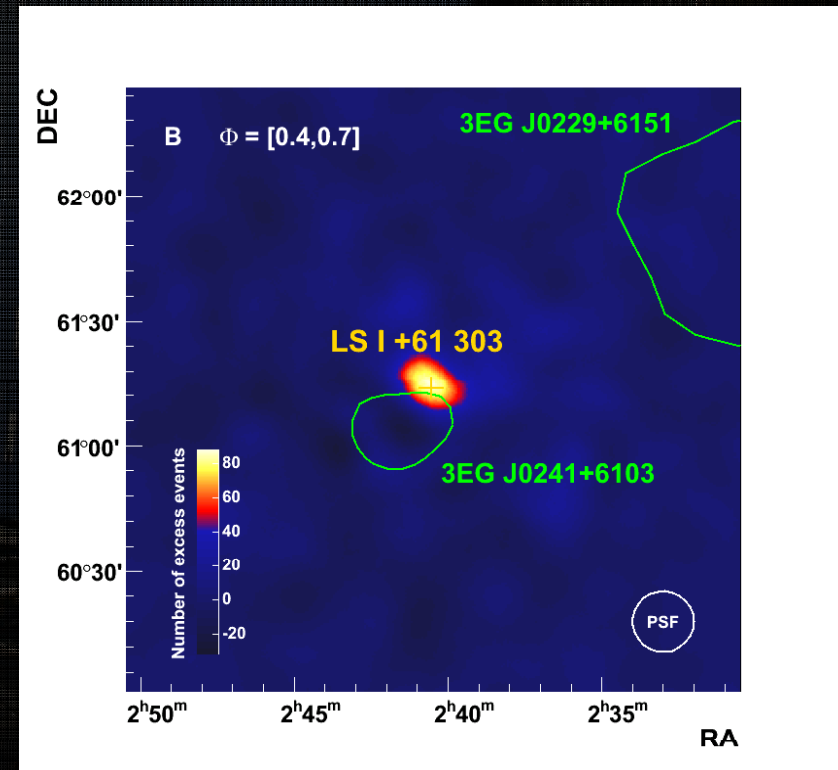




# MAGIC Observation



- LS I was observed for 6 orbits between Oct 05 and March 06
- In total 54 hours of data, **22% of data taken during moon**
- Clear detection with **8.7 sigma**
- Excess position:  
RA=2h 40m 34s DEC= + 61°15' 25"  
In agreement with LS I position
- Possible association with variable EGRET source







# Orbital Light Curves



Phases 0.8 – 0.1 not observed  
due to bright moon

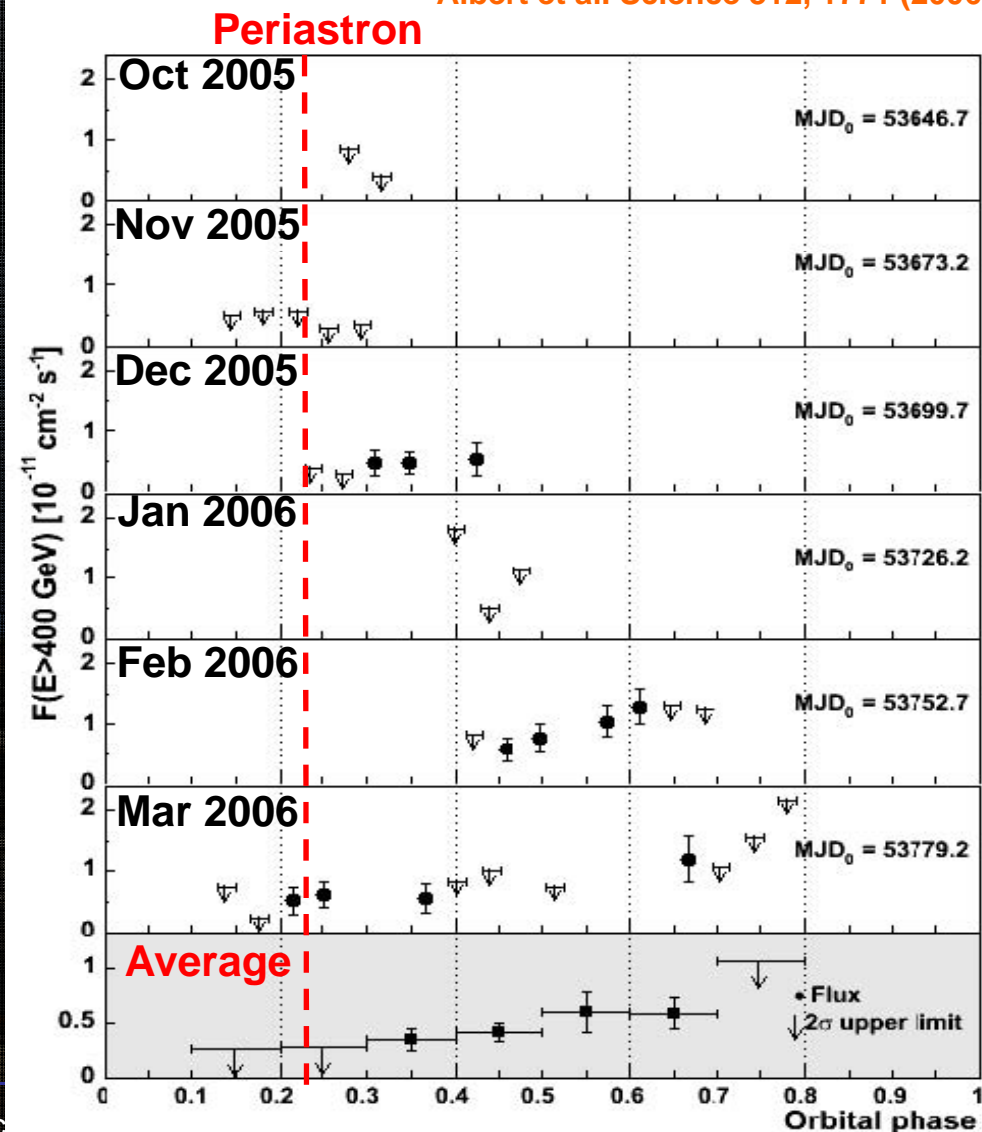
Strong variability between  
phases

Probability of a constant flux  
 $< 3 \times 10^{-5}$

Source is quiet at  
periastron and loud before  
apastron !

Maximum flux 16% of Crab  
Nebula at 0.5 - 0.7

Albert et al. Science 312, 1771 (2006)



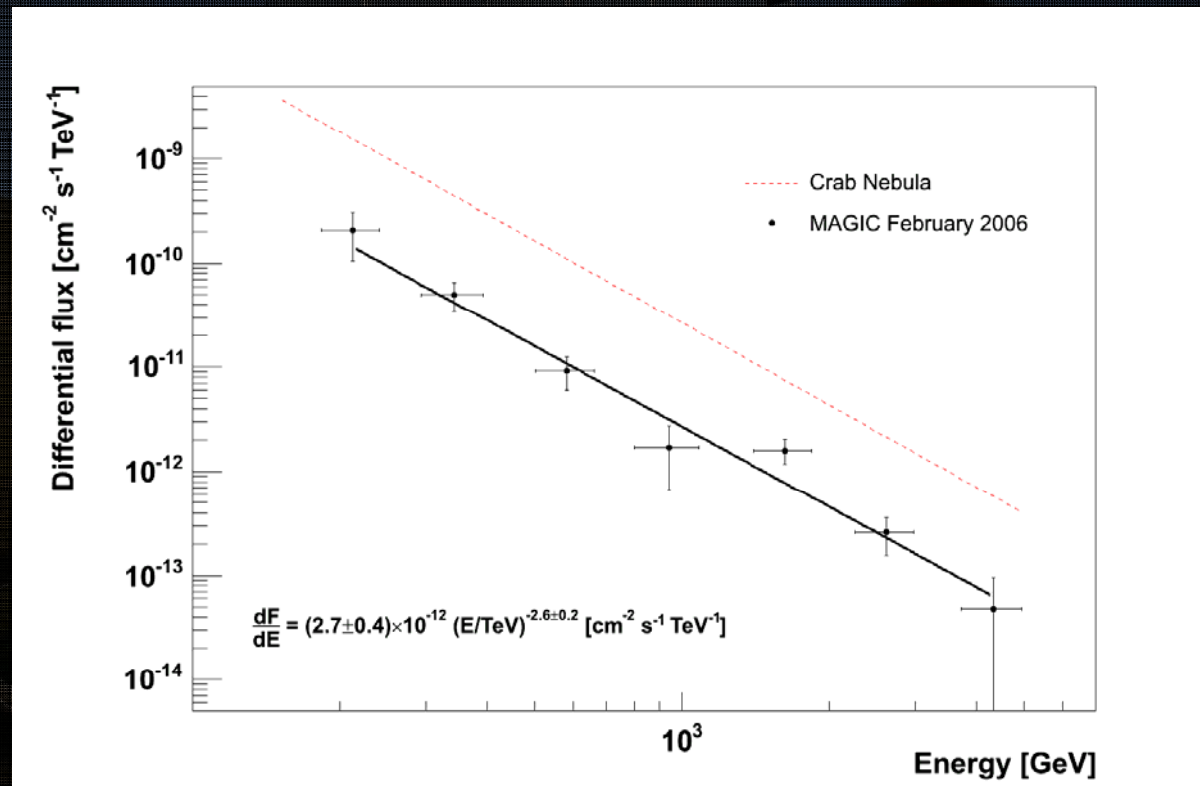




# VHE Gamma Ray Spectrum



Spectrum from  
phase 0.4 - 0.7



- Spectral shape compatible with power law

**Spectral index  $2.6 \pm 0.2$  stat.  $\pm 0.2$  syst.**

- VHE ( $E > 200$  GeV) **luminosity  $\sim 7 \times 10^{33} \text{ erg s}^{-1}$**  for distance = **2 kpc**





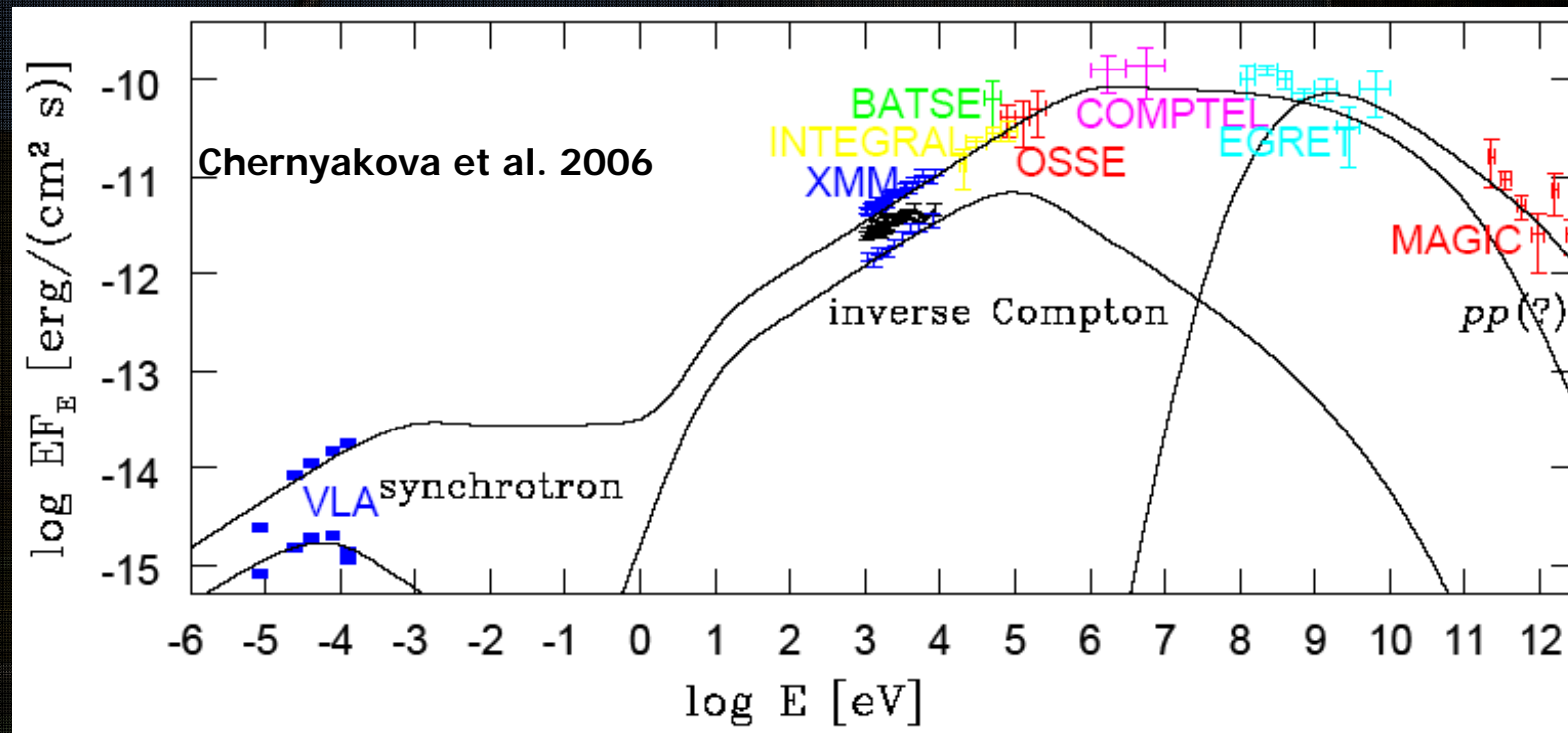








# Broad Band Spectrum



**IC Model for the Binary Pulsar scenario (data not simultaneous)**

→ **additional VHE  $\gamma$  - ray production due to hadronic mechanism?**

**VHE measurements are very important to understand LS I**





# Conclusion



- 2nd detection of a variable galactic source in VHE  $\gamma$  - rays
- LS I is more luminous in GeV-TeV energies than in x-ray
- Spectral break between 10 and 200 GeV
- Acceleration mechanism still unknown
- Nice laboratory for studying either Pulsar Wind / Stellar Wind interactions or for jet physics

**Future VHE gamma ray measurements will give a more detailed view of the system and more precise input to theories**



