

# H.E.S.S. Observations of PSR B1259-63 during its 2014 periastron passage

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# Outline



- The PSR B1259-63 system
- H.E.S.S. in phase II
- H.E.S.S. results: light curves and spectrum from the 2014 campaign
- The MWL view

# The PSR B1259-63 system



- Pulsar (PSR B1259-63) + Be star (LS 2883)

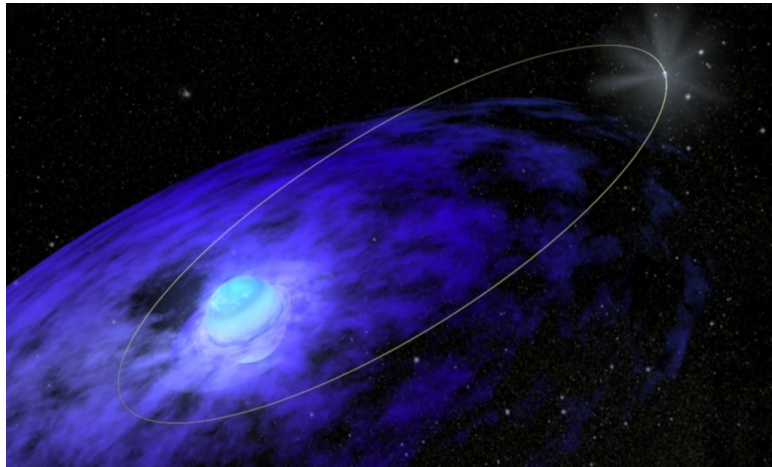


Image credits: Walt Feimer,  
NASA/Goddard Space Flight Center

48-ms pulsar + Be star driving stellar wind and equatorial outflow

- Period  $T = 3.4$  years
- Inclination  $i = 19^\circ - 31^\circ$
- Highly eccentric orbit  $e = 0.87$ 
  - $d_{\text{per}} = 0.94$  AU
  - $d_{\text{apa}} = 13.4$  AU

- Interaction between the disc and the pulsar wind shortly before and after the periastron

# The PSR B1259-63 system

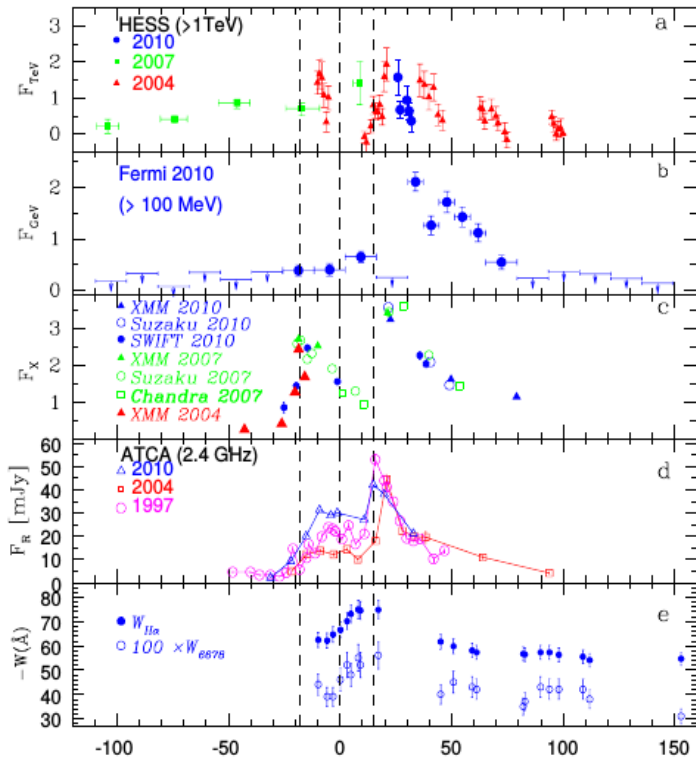


2004

2007

2010/2011

2014

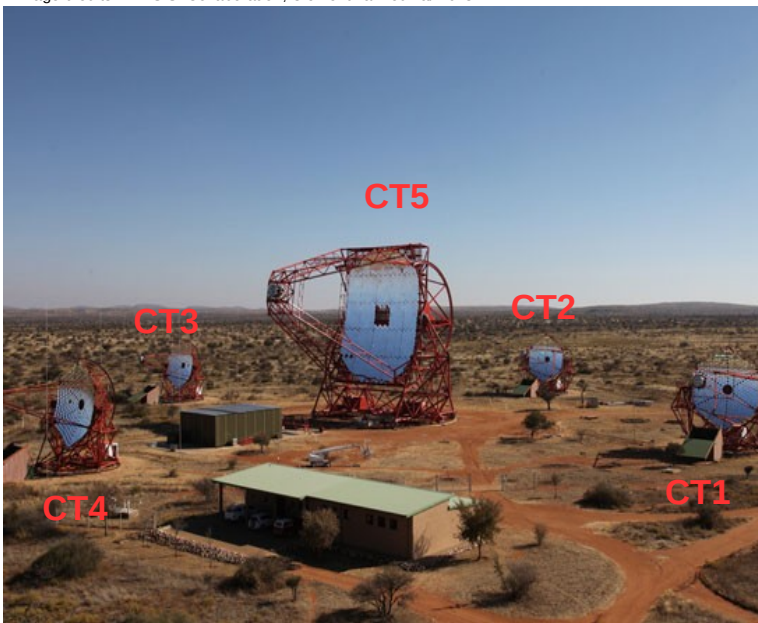


From Chernyakova et al., 2014

01-08-2015

- Enhancement of the non thermal emission over the full electromagnetic spectrum when approaching the periastron
- Double peak in the X-ray light curve in correspondence of the two disc crossings
- HE flare detected by the *Fermi*-LAT during the campaign in 2010/2011

Image credits: H.E.S.S. Collaboration, Clementina Medina/Irfu-CEA



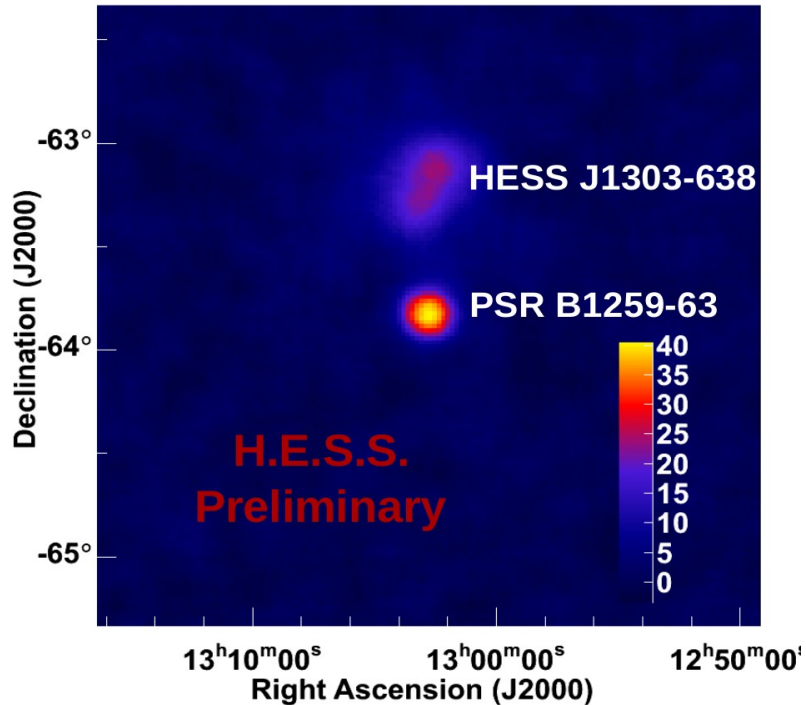
Addition of a new telescope with 28m diameter (CT5)

Different possible analysis configurations:

- **MONO** analysis: data from CT5 only (for lower energy)
- **STEREO** analysis: from any trigger of 2 telescopes (to gain sensitivity)
- **COMBINED** analysis:
  - MONO analysis for CT5-only events + STEREO for higher multiplicities

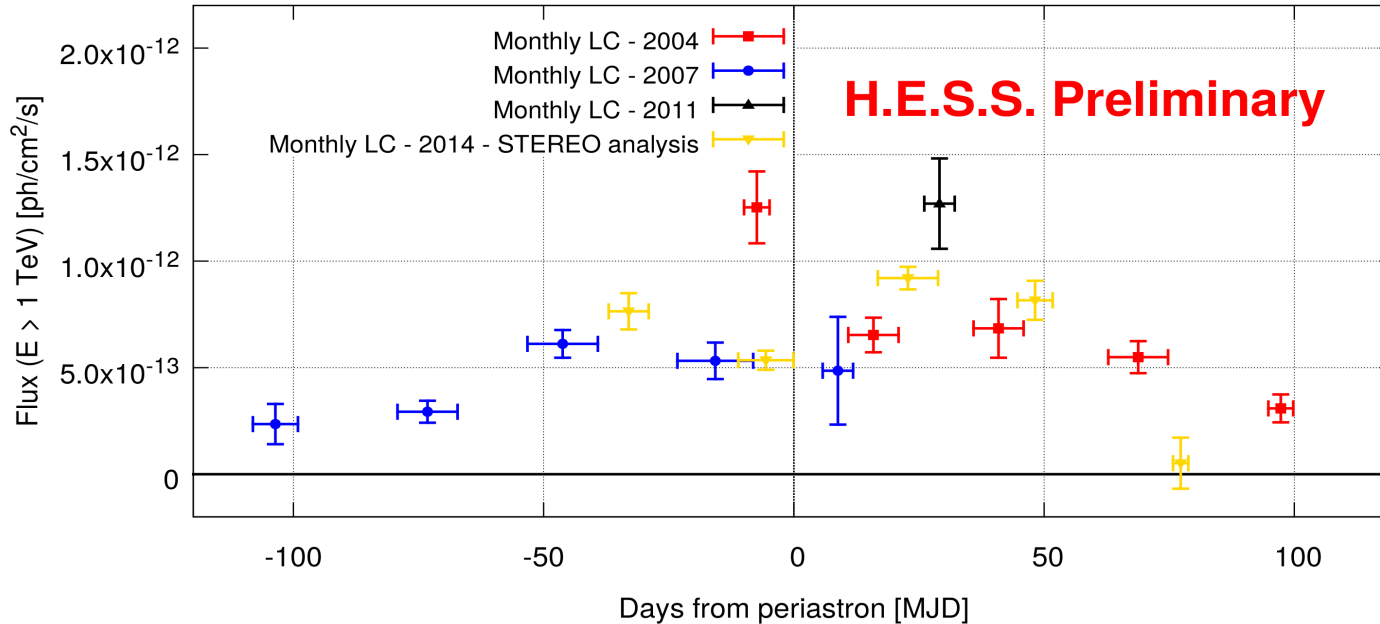
Holler, M. et al. "Photon Reconstruction for H.E.S.S. Using a Semi-Analytical Shower Model" (2015) this proc.  
Murach, T. et al. "A Neural Network-Based Monoscopic Reconstruction Algorithm for H.E.S.S. II" (2015) this proc.  
Parsons, D. et al. "H.E.S.S. II Data Analysis with ImPACT" (2015) this proc.

# The H.E.S.S. results



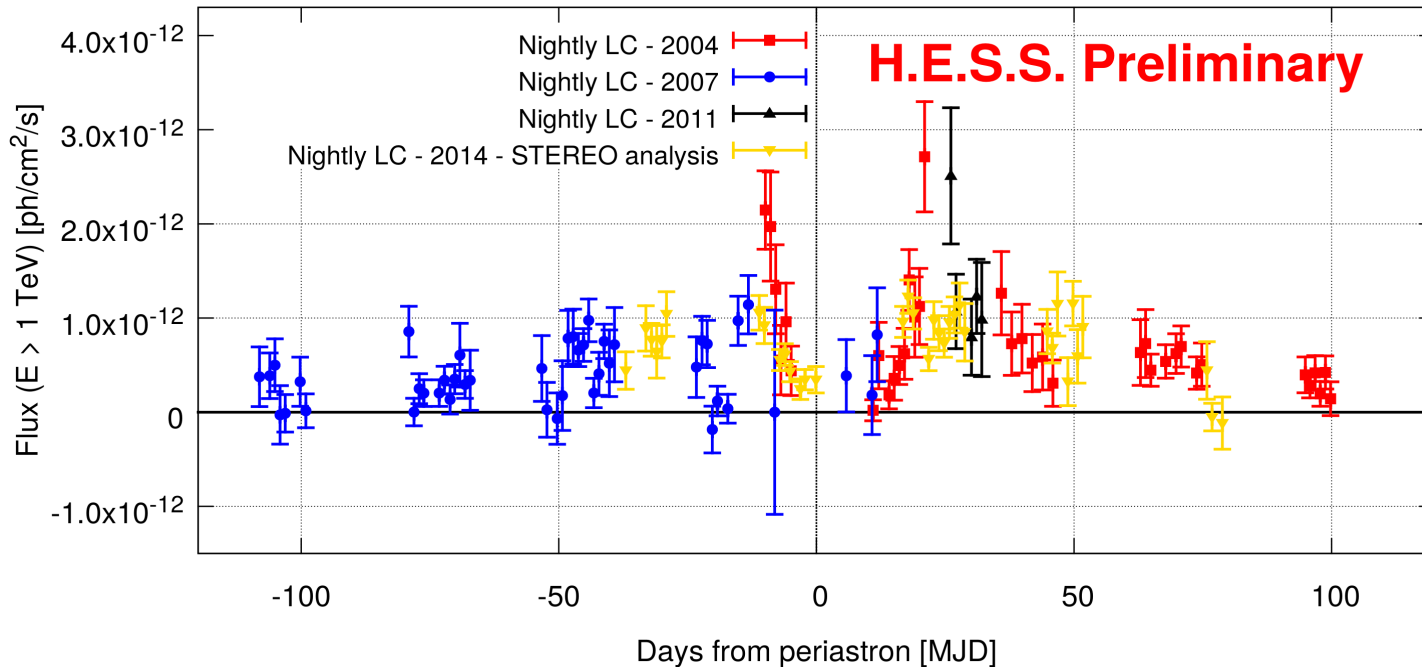
- More than 57 hours of livetime analysed with STEREO and MONO analysis chains
- Average zenith angle of 42 degrees
- Source detected at  $40\sigma$  significance level
- HESS J1303-638 visible above the source (PWN with energy-dependent morphology)

## Monthly light curve



- Re-analysis of previous data with new tools
- STEREO analysis of 2014 data
- Hints of incompatibility between the 2004 and newer data

## Nightly light curve



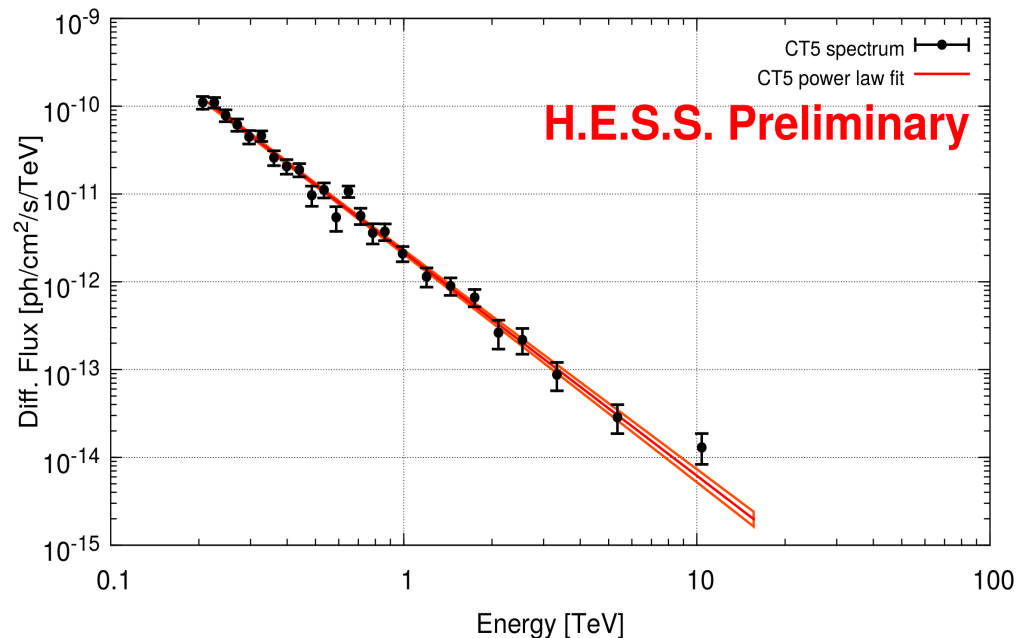
- Clearer trend of the double peaked behaviour
- Local minimum at the periastron passage
- Source active 40-50 days after periastron
- Differences between light curves visible also in this case (the source is not a perfect clock)

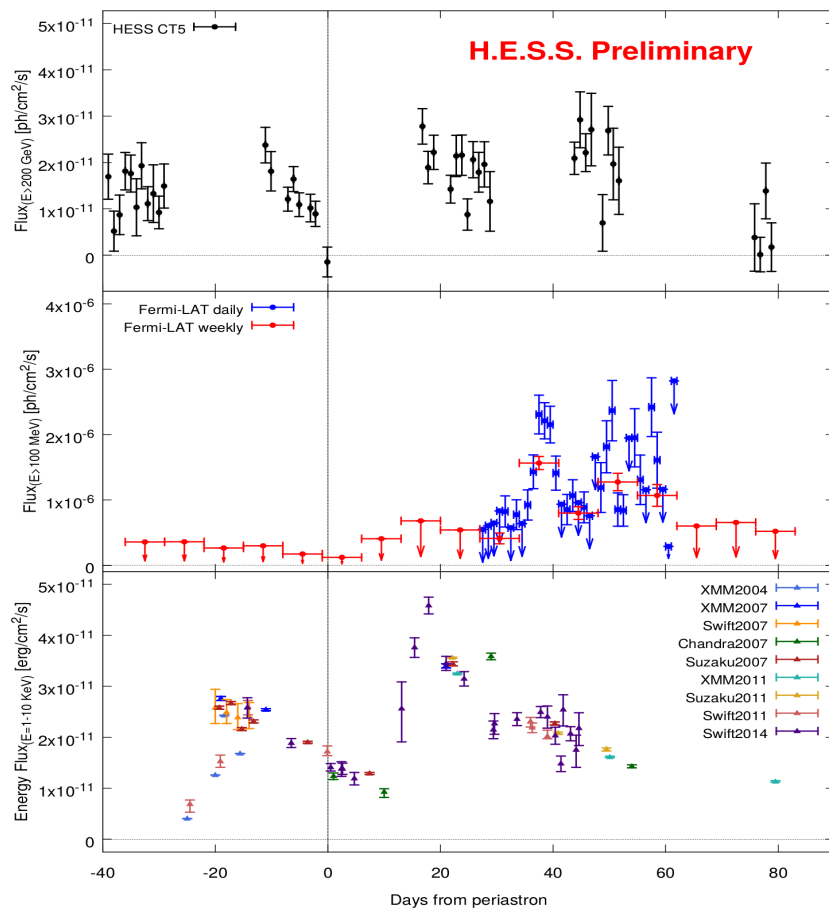


# The H.E.S.S. results



- Spectrum using MONO data
- *Conservative* energy threshold of 200 GeV (already factor 2 lower than HESS I results)
- Photon index  $2.55 \pm 0.06$ 
  - Harder but compatible with previous results
    - 2004:  $2.8 \pm 0.1$
    - 2007:  $2.8 \pm 0.2$
    - 2010/2011:  $2.9 \pm 0.3$
  - Possible contamination from HESS J1303-638, under investigation





Comparison of results from H.E.S.S., *Fermi*-LAT and *Swift*-XRT

- Clear double peak structure in the X-rays
- Again detection of a HE flare
- High state of the source in HE and VHE with hints of variability also in the X-ray domain

# Summary



- Observation campaign in 2014 very successful covering almost all the periastron period
- Local minimum of the flux in correspondence of the exact periastron
- Differences in the flux levels between the more recent data and the previous observations
- Repetition of the sub-GeV flare with hints of variability in the X-ray range and high state of the source at VHE



**THANK YOU!**

# Additional material

# Spectral fits



- Fermi fit integrated over 5 weeks:
  - Flux above 100 MeV  
 $(1.0 \pm 0.5) 10^{-6} \text{ ph cm}^2 \text{ s}$
  - $\alpha = 3.02 \pm 0.08$
- H.E.S.S. fit above 200 GeV
  - Normalization  
 $(1.36 \pm 0.06) 10^{-11} \text{ ph/cm}^2/\text{s/TeV}$
  - $\alpha = 2.55 \pm 0.06$
  - $E_{\text{ref}} = 0.49 \text{ TeV}$