

New radio results on the gamma-ray binary candidate HESS J1832–093

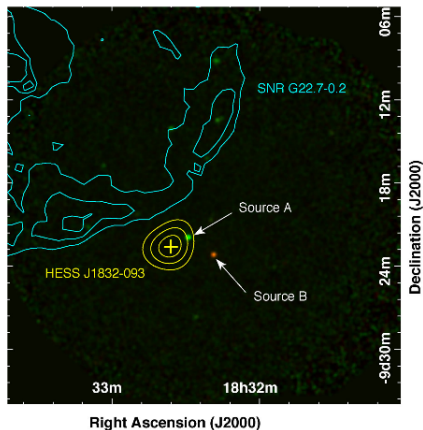
Javier Moldón

The University of Manchester

Variable Galactic Gamma-Ray Sources (IV)
Tokyo, 5 July 2017



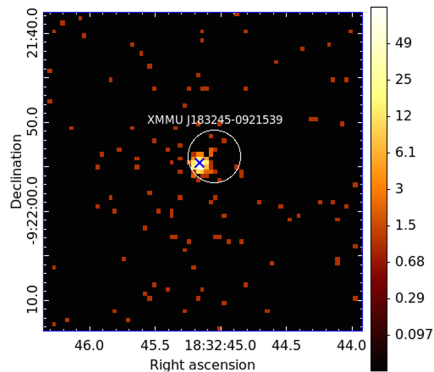
A new TeV binary system?



[HESS Collaboration 2015, A&A, 446, 1163]

- New TeV point source.
- Close to the Galactic plane.
- Not extended: probably not SNR or PWN.
- Very close to SNR G22.7–0.2.
- Main candidates: gamma-ray binary or background AGN.

X-ray and IR counterparts

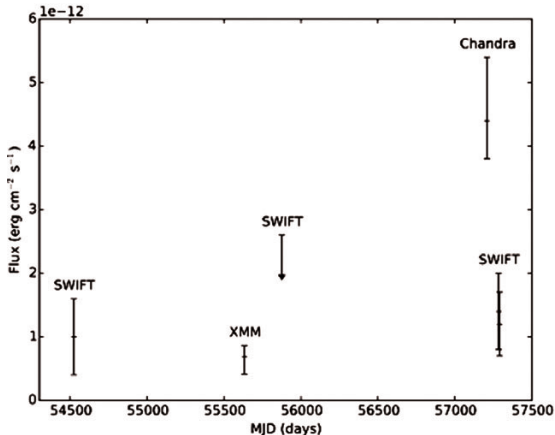


[Eger et al. 2016, MNRAS, 457, 1753.]

Still main candidates: binary or AGN.

- First *XMM-Newton* detection.
- A hard, highly absorbed point source.
- No pulsations or extended nebula.
- High column density $\times 10$ larger than the total Galactic value seen in HI.
- Positionally coincident with 2MASS source.
- No optical counterpart down to V 18, strong absorption?

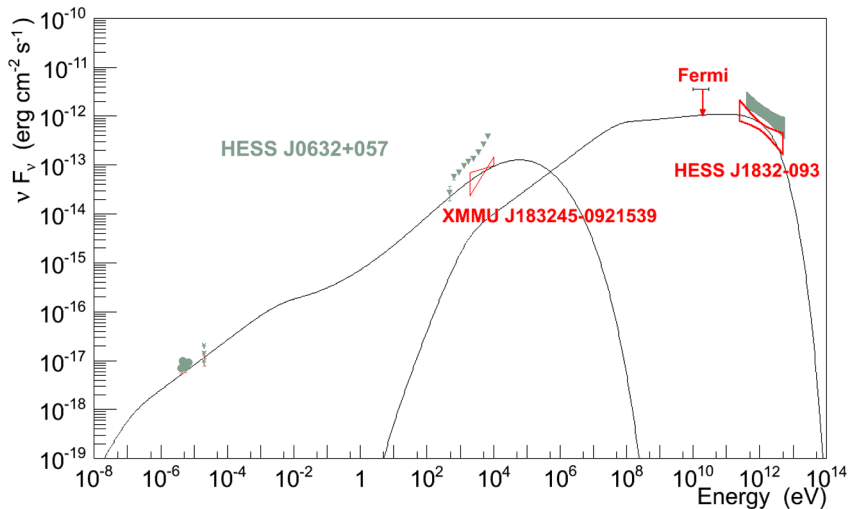
X-ray variability



[Eger et al. 2016, MNRAS, 457, 1753.]

- Further point-like detections with *Chandra* and *Swift*.
- Data from March 2008 to Sep 2015.
- Persistent but clearly variable source.

Broadband SED



[Eger et al. 2016, MNRAS, 457, 1753.]

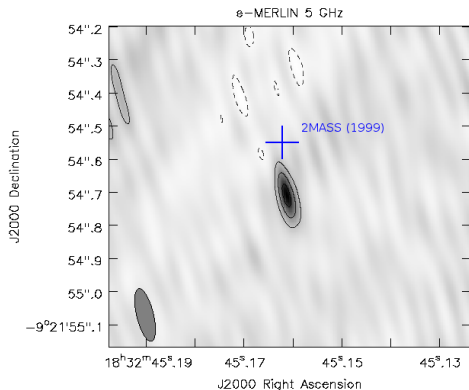
New radio results

e-MERLIN array



- 7 radio telescopes across England (max. 217 km).
- Operates at L, C and K bands.
- Resolution 150-40-10 mas.
- Optical-fibre connected: 512 MHz bandwidth.
- High sensitivity to about 10 microJy level.

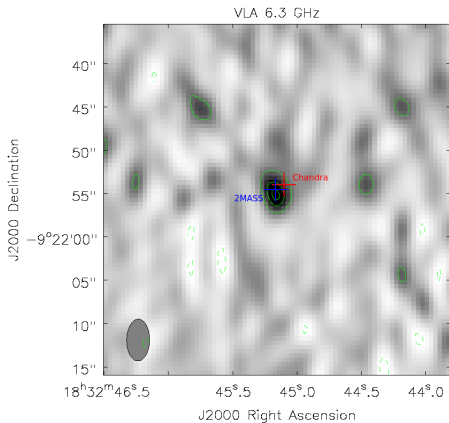
e-MERLIN: first targeted radio detection



[Moldon et al. (in preparation)]

- First detection of the radio counterpart of HESS J1832–093.
- 7 hours at C band (5 GHz) with a 512 MHz bandwidth.
- 9 March 2016.
- Beam size: 160×50 mas.
- Flux density: $420 \pm 50 \mu\text{Jy}$.

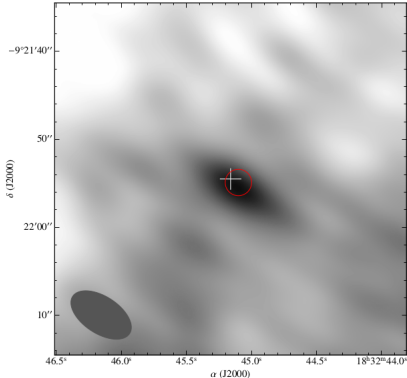
VLA: archival data



[Moldon et al. (in preparation)]

- Snapshot observation at 6.3 GHz.
- Off-center observations and small bandwidth (spectral line).
- March 2012.
- Flux density: $400 \pm 60 \mu\text{Jy}$.
- Coincident with the X-ray and IR counterparts.

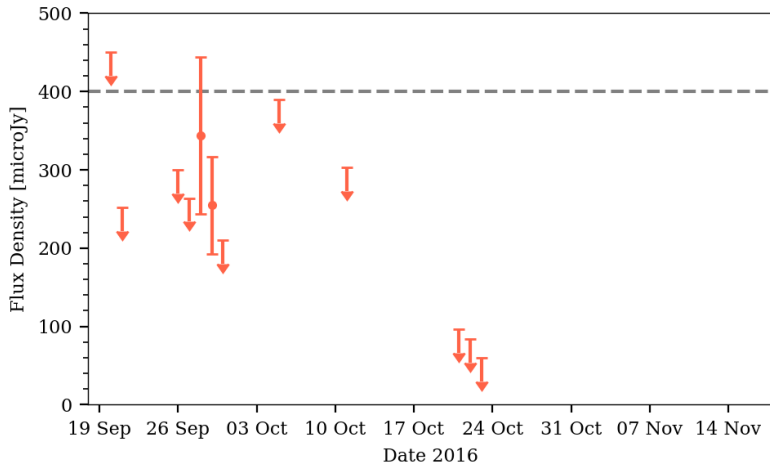
GMRT: archival data



- Archival data from August 2013.
- Observations at low frequency: 600 MHz
- August 2013.
- Flux density of 1.0 ± 0.3 mJy.
- Coincident with IR and X-ray counterparts.
- Thanks to B. Marcote.

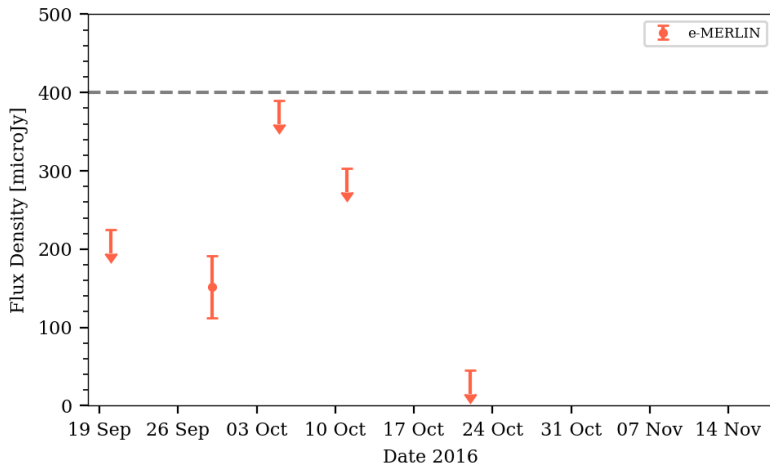
Monitoring and light curve

Radio monitoring: e-MERLIN 5 GHz



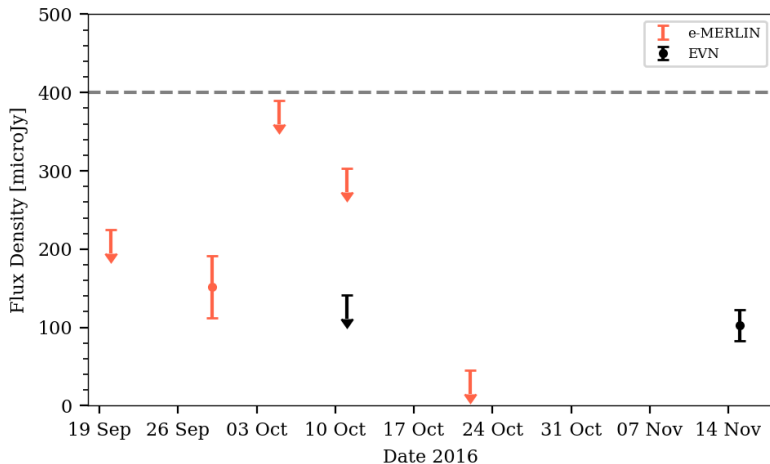
- One month monitoring thanks to filler time.
- Radio emission strongly suppressed.

Radio monitoring: e-MERLIN 5 GHz



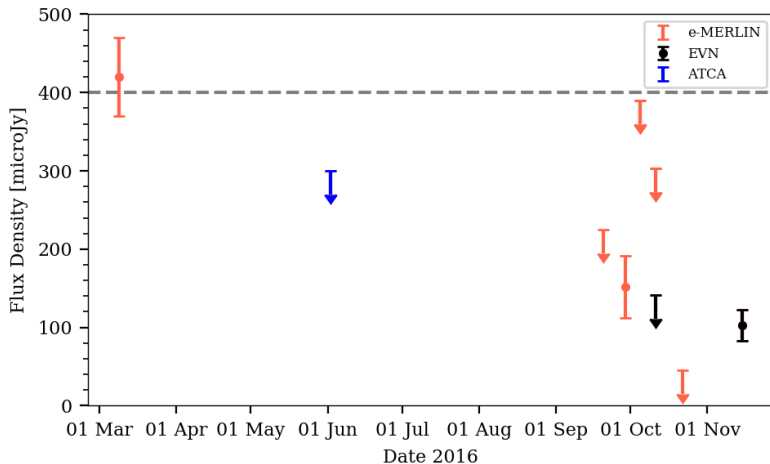
- One month monitoring thanks to filler time.
- Radio emission strongly suppressed.

Radio monitoring: adding EVN



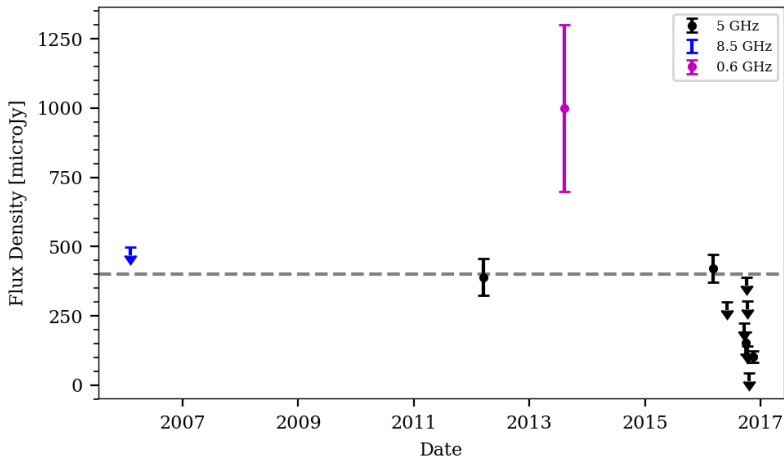
- Reappearance of the source after two months.
- Flux density much lower than previously seen (B. Marcote).

Radio monitoring: whole 2016 campaign



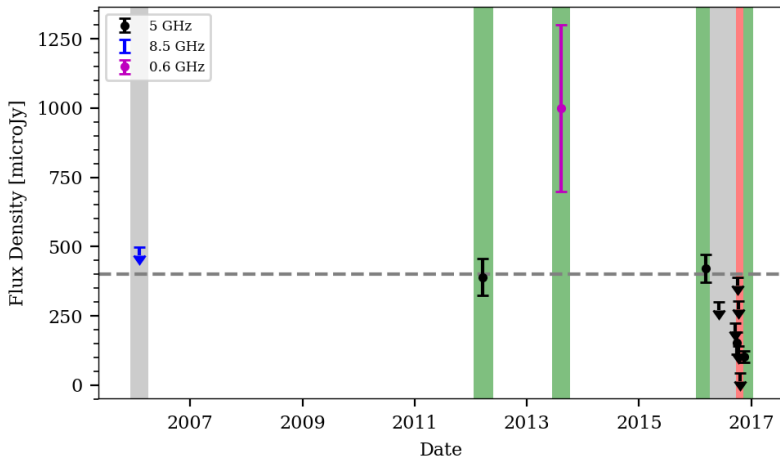
- ATCA observation in June.
- The source is inactive between 1 month (maybe up to 8 months).

Complete timeline



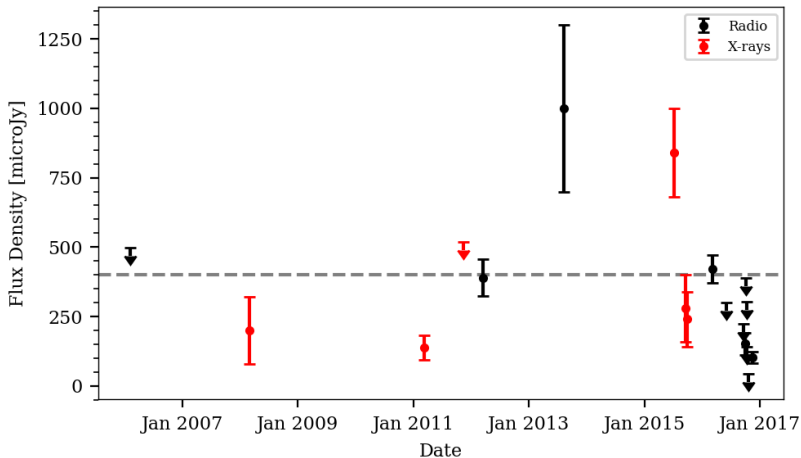
- Observations at different frequencies, but not simultaneous.
- Spectrum is probably steep.

Complete timeline



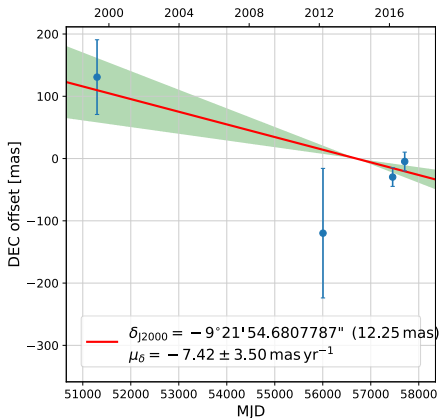
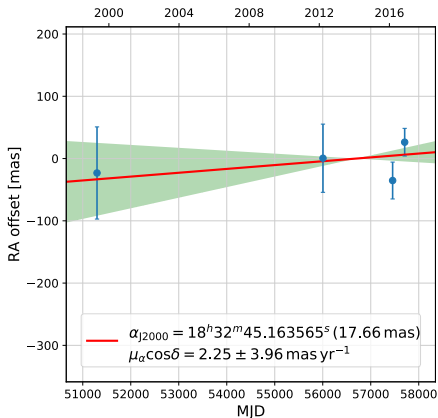
- Between 1 and 8 months none/reduced activity.
- Assuming 50% duty cycle: orbital period $\sim 2\text{--}16$ months.

X-rays/radio light curves



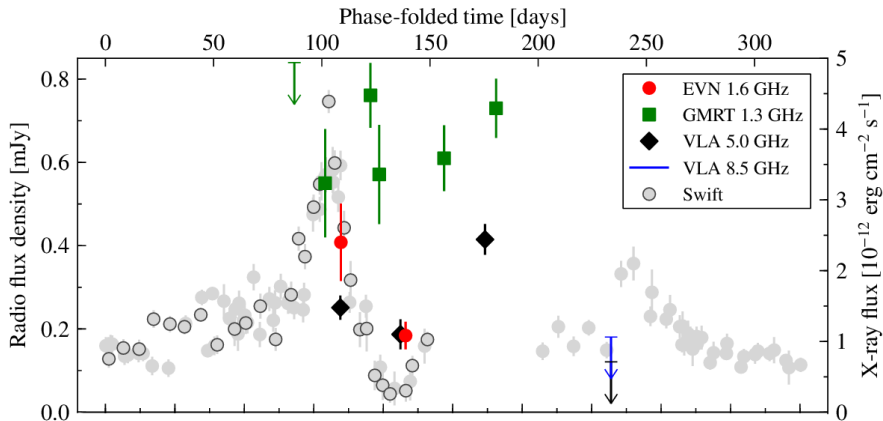
- No constraints at the moment.
- Closest points are 4 months away.

Proper motion



- There appears to be an offset or proper motion in the N-S direction.
- Not very significant yet. We need more accurate radio detections!

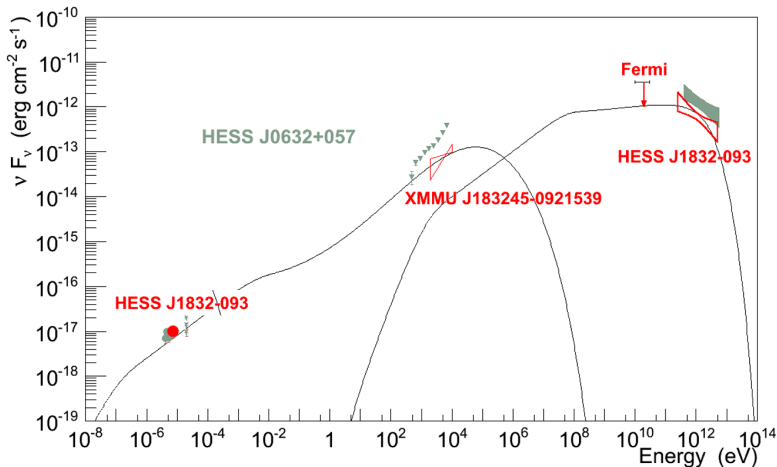
Comparison to HESS J0632+057



[Moldon et al. 2011, A&A 533, L7]

- HESS J0632+057 was also detected at 0.2–0.4 mJy at 5 GHz.

Comparison to HESS J0632+057



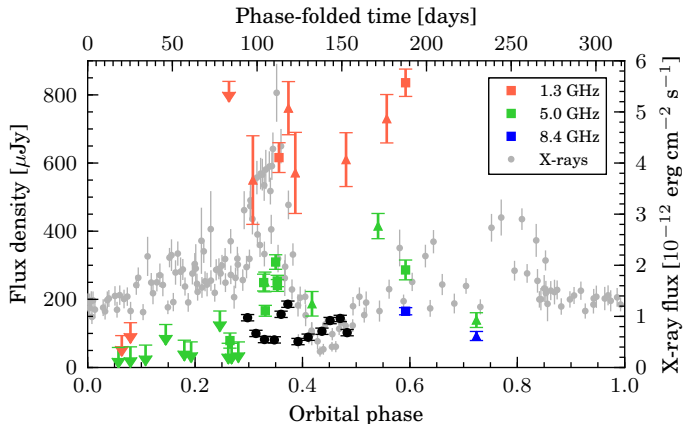
- HESS J1832–0.93 slightly brighter in radio in relation to X-rays.

Conclusions

- Radio counterpart detected.
- It is variable.
- Non-simultaneous negative spectral index.
- 1–8 months being radio quiet(er).
- It may have proper motion, supporting galactic origin.
- Estimated orbital period between 2 and 16 months.
- It seems to be close family of HESS J0632+057.

Bonus tracks

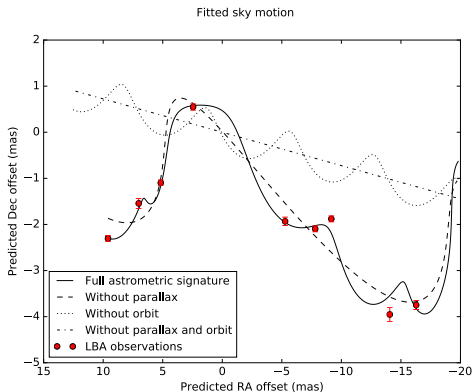
Updated HESS J0632+057 light curve



[Moldon et al. (in preparation)]

- Campaigns of 2008, 2009, and 2011.
- Better coverage. Detections close to secondary maximum.

Orbital parameters of PSR B1259–63



[Miller-Jones et al. (in preparation)]

- Astrometry for the last 5 years.
- Last observation next August.
- Results ready in early 2018.
- Fit accuracy:
 - Proper motion to 5–8%.
 - Parallax (distance): 12–20%
 - Inclination to 6–9 deg.