H.E.S.S. and XMM-Newton observations of the field of view around SNR G284.3-1.8


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The crowded region around SNR G284.3-1.8

- **SNR G284.3-1.8**
  - Shell-like SNR (~10 kyr) interacting with Molecular Clouds [Ruiz & May 1986]
  - D=2.9 kpc (±20% error)
  - Bright, narrow filament in Hα
  - “Finger” tail on the direction of PSR J1016-5857

![Fig. 1: Most-Molonglo 843 MHz](image)
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![SuperCosmos H-alpha](image)
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- **PSR J1016-5857 & its PWN**
  - Vela-like pulsar [Camilo et al 2001, 2004]
  - 35’ away from the SNR centre
  - P=107 ms, 21 kyrs
  - $E = 2.6 \times 10^{36}$ erg s$^{-1}$
  - d=9$^{+3}_{-2}$ kpc
  - Non-thermal PWN aligned with the radio-finger
  - Fermi-LAT and AGILE detection of pulsed emission [Pellizonni et al 2011, Abdo et al, 2010]
The crowded region around SNR G284.3-1.8

- **1FGL J1018.6-5856**
  - Periodic emission from the centre of the SNR (~16.6 days) [Corbet et al, 2011]
  - 06V((f)) star proposed as counterpart
  - Swift-XRT periodic counterpart in X-ray detected
H.E.S.S. Observations

• The region benefits from deep exposure from Westerlund 2 observations. Exposure-corrected time: 40h

• New VHE source HESS J1018-589 discovered >8σ level (>80pe MVA analysis [Becherini et al, 2011])

• The best-fit position for HESS J1018-589:

\[ \alpha(J2000) = 10^h18^m45.8^s \pm 2.4^s_{\text{stat}} \]
\[ \delta(J2000) = 58^\circ56'28'' \pm 36''_{\text{stat}} \]
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H.E.S.S. Gaussian-smoothed (0.07°) excess map. Significance contours, calculated using an oversampling radius of 0.1° (green) and 0.22° (white) are shown.
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- 1D Fit \( \chi^2_{\text{red}} = 1.6 \)
- 2D Fit \( \chi^2_{\text{red}} = 0.96 \)
H.E.S.S. Observations

- **Timing-analysis** for a point-like source centred on the best-fit position (compatible with the Fermi new high energy binary)

- **No variability** found in the 0.6 to 10 TeV energy range

- $\chi^2/\text{ndf}=52.8/66$ -> variable integral flux on a run-by-run basis at the level of 0.2σ

- **BUT**, the observation exposure prevents yet a firm conclusion on variability at the Fermi-LAT reported period.
XMM-\textit{Newton} Observations

- 20 ksec observation time centred on the SNR
XMM-Newton Observations

green: 1.0 - 2 keV
red: 0.3 - 1 keV

2 - 10 keV

thermal emission coincident with the brightest part of the shell

non-thermal point-like emission coincident with Swift-XRT source
XMM-Newton Observations

> The spectrum of the point-like source is well-fit by an absorbed power-law function:

- \( N_H = (6.6 \pm 0.8) \times 10^{21} \text{ cm}^{-2} \)
- \( F = (1.5 \pm 0.3) \times 10^{-4} \text{ keV}^{-1} \text{ cm}^{-2} \text{ s}^{-1} \)
- \( \Gamma = 1.65 \pm 0.08 \)

> The thermal emission spectrum is well-fit by an absorbed non-equilibrium ionization model (PSHOCK):

- \( kT = (0.53 \pm 0.03) \text{ keV} \)
- \( N_H = (7.9 \pm 0.4) \times 10^{21} \text{ cm}^{-2} \)
- \( n \sim 0.5 \text{ cm}^{-3} (2.9 \text{ kpc/d})^2 \)
Origin of the VHE emission

- If SNR G284.3-1.8
  - **Pros**: SNR/MC ($\sim 3 \times 10^3 \, M_\odot$) interaction is energetically plausible
  - **Cons**: Contrary to other VHE SNR/MC candidates, a morphological correlation with the MC is not observed.
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  **Pros**: Similar characteristics to other VHE PWNe. Energetically feasible (high spin-down pulsar) and X-ray PWN (e.g. HESS J1825-137)
  
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- **If 1FGL J1018.6-5856**
  
  **Pros**: VHE center of gravity is compatible ($<1\sigma$) with its position and the morphology of the H.E.S.S. source suggests a point-like source plus diffuse emission.
  
  **Cons**: No time variability found in the data set, but sampling is unadecuated for a 2 weeks periodic signal.
Conclusions

• **H.E.S.S. Observations**
  > A new VHE has been discovered with the H.E.S.S. telescope $>8\sigma$
  > The statistics and complexity of the region do not allow yet a firm identification of the origin of the emission
  > The morphology of the VHE source suggests two possible components. Further studies on the time variability should help to clarify the association with the different objects in the field of view (SNR/PWN/Binary)

• **XMM-Newton Observations**
  > Thermal emission from the SNR shell was detected $<2$ keV, associated with the hot plasma left behind by the SNR shock.
  > A non-thermal point-like source (XMM J101855.4-58564) is found with spectral index 1.65, detected as a periodic source with Swift-XRT and associated with the high-energy binary system.