Two Magnetar Candidates
in HESS Supernova Remnants

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CTB 37B \quad d \approx 8 \text{ kpc} \quad \text{Age} = 1600 - 4900 \text{ yr}

Chandra ACIS-S CC-mode detects 3.82 s Pulsar
Halpern & Gotthelf 2009, in preparation

HESS J1731-347


ROSAT

1420 MHz

SNR G353.6−0.7

d ~ 3.2 kpc
Age ~ 27,000 yr
$$L_x = 1.1 \times 10^{34} \text{ erg s}^{-1}$$

$$kT_1 = 0.38 \text{ keV}, \quad kT_2 = 0.66 \text{ keV}$$

Marginally Significant 1.01 s Period
Magnetars are *not* Expected to be TeV Sources

1. None of the 14 known magnetars have PWNe.
2. Spin-down power of magnetars is $< 10^{36}$ erg s$^{-1}$.
3. Magnetars are powered on closed $B$-field lines.

**CONCLUSION**

HESS J1713$-$381 and HESS J1731$-$347 are SNR shells, not PWNe.

But wait . . .
Maybe Magnetars are Expected to be TeV Sources

Kes 75/PSR J1846–0258

“Transitional” Magnetar-Pulsar with PWN

\[ P = 0.32 \text{ s}, \quad \dot{E} = 8 \times 10^{36} \text{ ergs s}^{-1}, \quad B_s = 5 \times 10^{13} \text{ G} \]

Magnetar-like X-ray bursts:

Gavriil et al. 2008, Science, 319, 1802

X-ray variability:


TeV source: HESS J1846–029

Some magnetars are transient radio pulsars:

Magnetars could have left a “relic” PWN (following de Jager & Djannati-Atai 2008).

An electron that IC scatters a photon to $E_{\gamma}(\text{TeV})$ has synchrotron and inverse Compton lifetimes:

\[ t_s \approx \frac{4200 \text{ yr}}{\sqrt{E_{\gamma}(\text{TeV})}} \left( \frac{B}{10 \mu \text{G}} \right)^{-2} \]

\[ t_{IC} \approx \frac{8 \times 10^4 \text{ yr}}{\sqrt{E_{\gamma}(\text{TeV})}} \]

the latter for IC scattering on the microwave background.
H.E.S.S. Observation of Star Cluster Westerlund 1 . . .

\[ \tau_c = 70 \text{ kyr} \]

CONCLUSIONS

1. CTB 37B very likely contains a magnetar with $P = 3.82$ s and $B_s \geq 2 \times 10^{14}$ G.

2. G353.6–0.7 contains either a magnetar or a low $B$-field neutron star (CCO).

3. HESS J1713–381 and HESS J1731–347 may or may not be powered in part by magnetars.

4. Observations to measure $\dot{P}$ have been proposed.