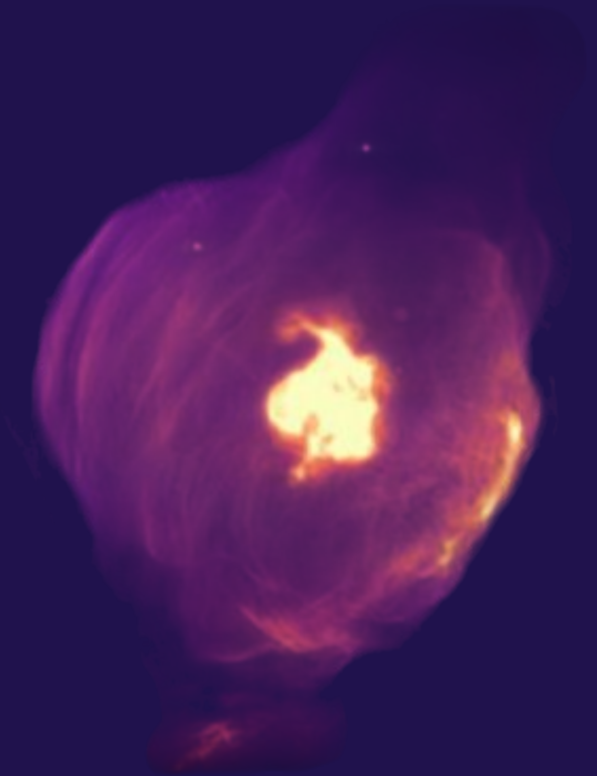
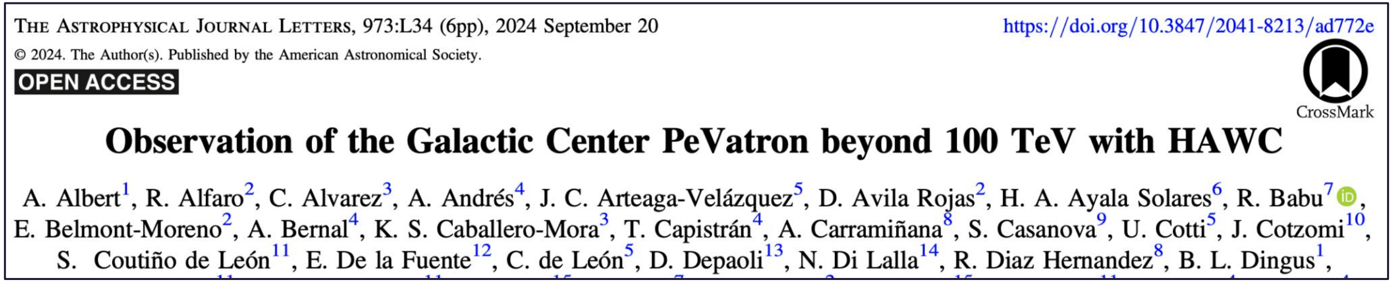


Multiwavelength modeling including the first hard X-ray observations of the PeVatron candidate PWN G0.9+0.1

Giulia Brunelli (University and INAF-OAS Bologna) on behalf of the PWN G0.9+0.1 team

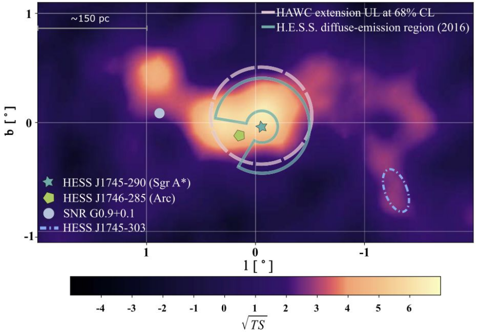
TeVPA 2025 - 4/11/2025

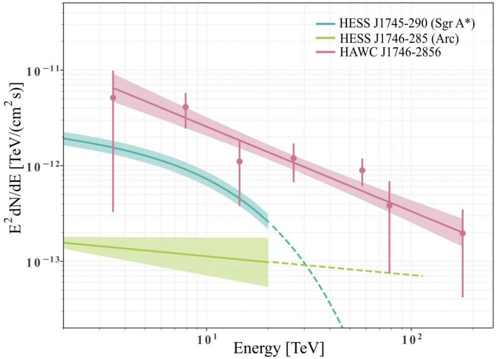
The Galactic Center is full of PeVatrons


THE ASTROPHYSICAL JOURNAL LETTERS, 973:L34 (6pp), 2024 September 20 https://doi.org/10.3847/2041-8213/ad772e

Observation of the Galactic Center PeVatron beyond 100 TeV with HAWC

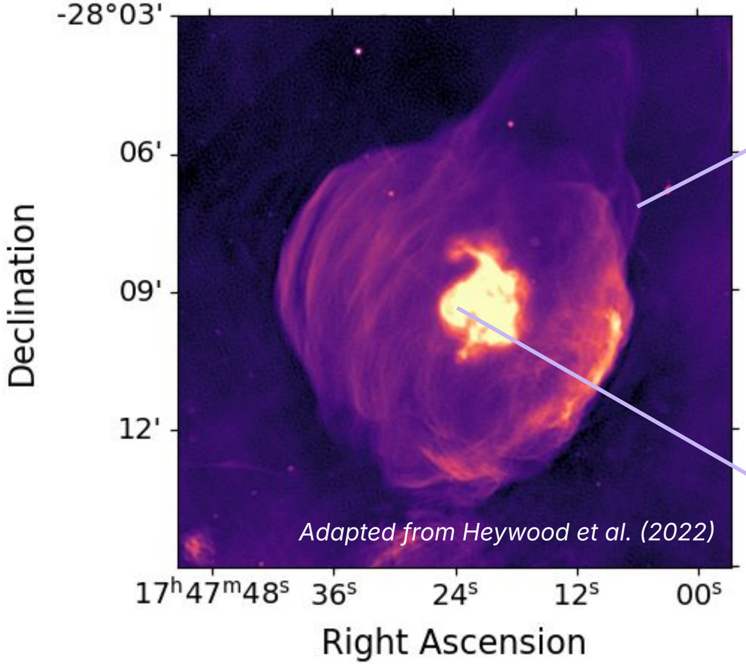
A. Albert[1], R. Alfaro[2], C. Alvarez[3], A. Andrés[4], J. C. Arteaga-Velázquez[5], D. Avila Rojas[2], H. A. Ayala Solares[6], R. Babu[7], E. Belmont-Moreno[2], A. Bernal[4], K. S. Caballero-Mora[3], T. Capistrán[4], A. Carramiñana[8], S. Casanova[9], U. Cotti[5], J. Cotzomi[10], S. Coutiño de León[11], E. De la Fuente[12], C. de León[5], D. Depaoli[13], N. Di Lalla[14], R. Diaz Hernandez[8], B. L. Dingus[1],





IACTs and X-ray telescopes can help us resolve them!

G0.9+0.1: a young energetic PWN in the GC region



Composite supernova remnant

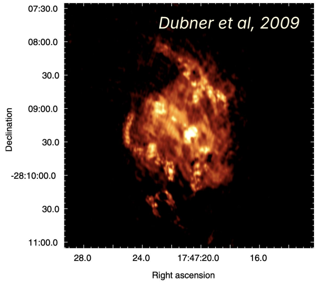
Second brightest TeV source in the GC

PSR J1747–2809

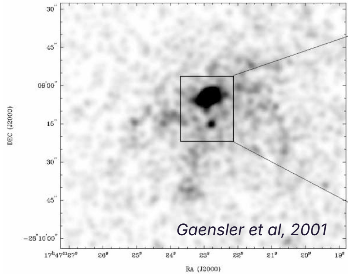
- $\tau_c \sim 5.3$ kyr
- $\dot{E} \sim 4.3 \times 10^{37}$ erg/s

PWN G0.9+0.1 has been observed from radio to TeV

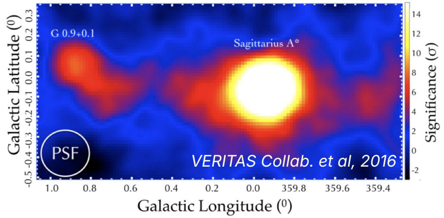
VLA 6 cm (5 GHz)



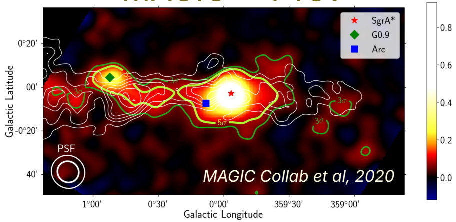
Chandra 3–8 keV

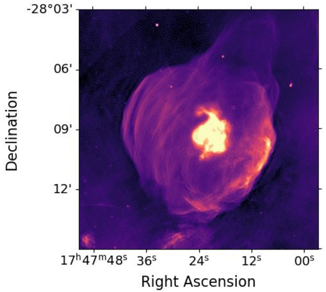


VERITAS > 2 TeV

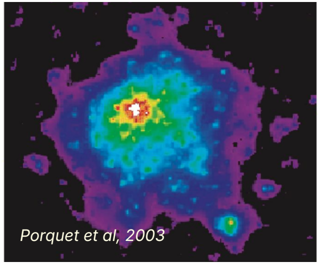


MAGIC > 1 TeV



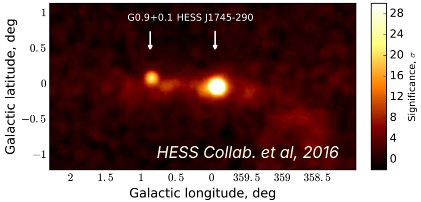


MeerKAT 1.28 GHz



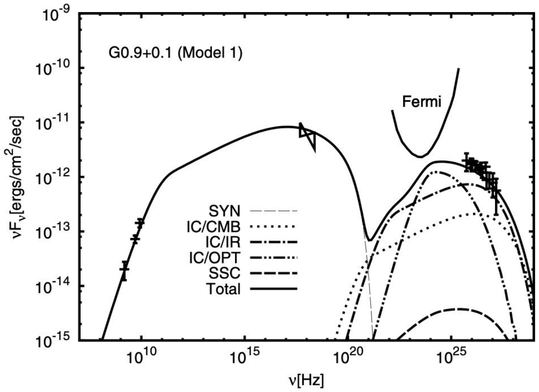
XMM-Newton 3–6 keV

HESS ~ TeV



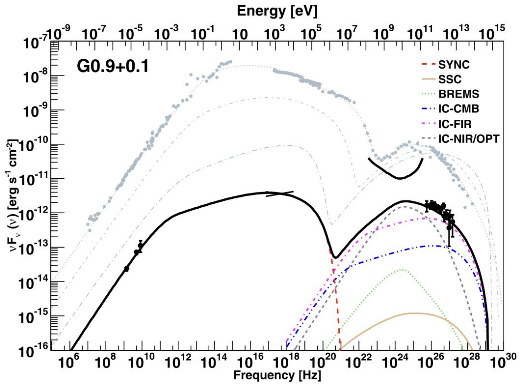
The SED of PWN G0.9+0.1 up to 2020

Tanaka & Takahara (2011)



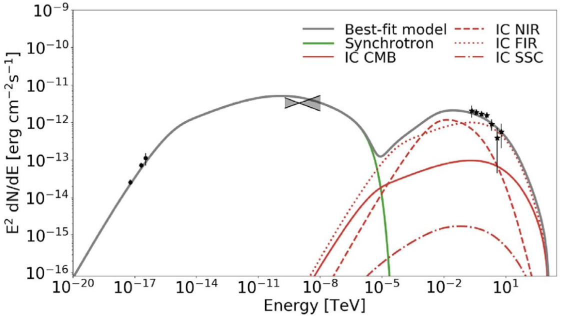
- t_{age} ~ 2 kyr
- BPL: p_2 ~ 2.6
- E_{max} ~ 400 TeV
- B_{PWN} ~ 15 μG

Torres et al. (2014)



- t_{age} ~ 2 kyr
- BPL: p_1 ~ 1.4, p_2 ~ 2.7
- E_{max} ~ 700 TeV
- B_{PWN} ~ 14 μG

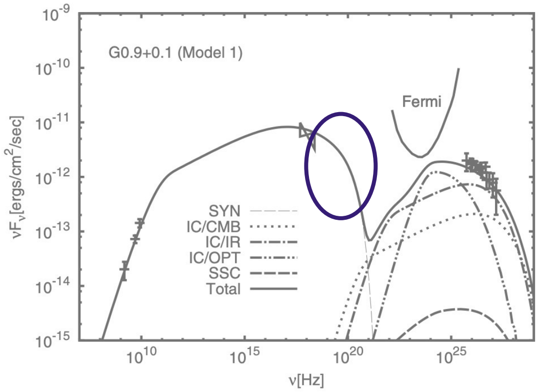
Fiori et al. (2020)



- t_{age} ~ 3 kyr
- BPL: p_1 ~1.1, p_2 ~ 2.52
- E_{max} > 600 TeV
- B_{PWN} ~ 22 μG

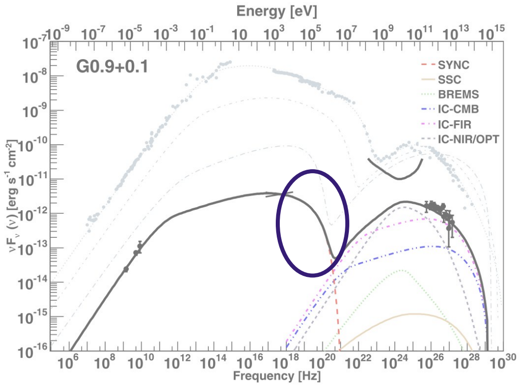
The SED of PWN G0.9+0.1 up to 2020

Tanaka & Takahara (2011)



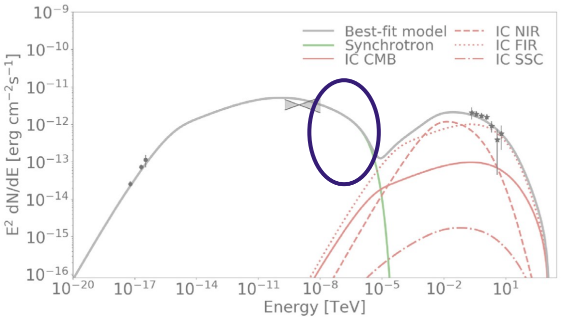
- t_{age} ~ 2 kyr
- BPL: p_2 ~ 2.6
- E_{max} ~ 400 TeV
- B_{PWN} ~ 15 μG

Torres et al. (2014)



- E_{max} ~ 700 TeV
- B_{PWN} ~ 14 μG

Fiori et al. (2020)



- t_{age} ~ 3 kyr
- BPL: p_1 ~1.1, p_2 ~ 2.52
- E_{max} > 600 TeV
- B_{PWN} ~ 22 μG

What about hard X-rays?

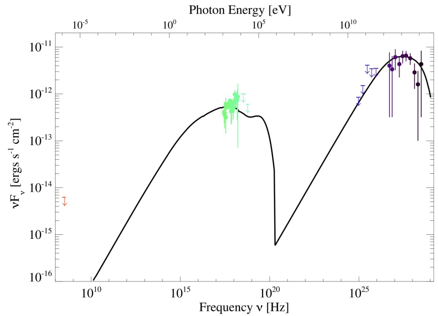
Hard X-ray data are fundamental to constrain E_{max}

E_{max} electrons

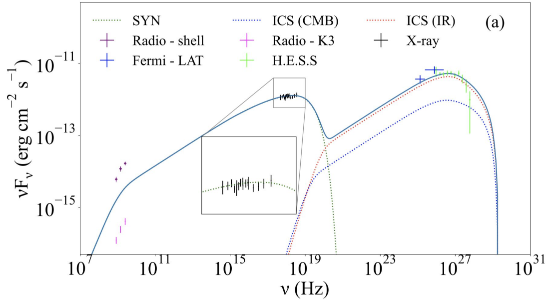
B_{PWN}

Hard X-ray photons

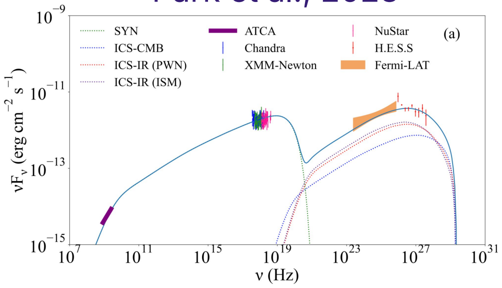
"Eel" PWN
Burgess et al., 2021



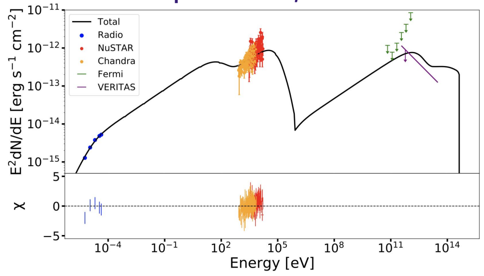
"Kookaburra" PWN
Park et al., 2023



"Rabbit" PWN
Park et al., 2023

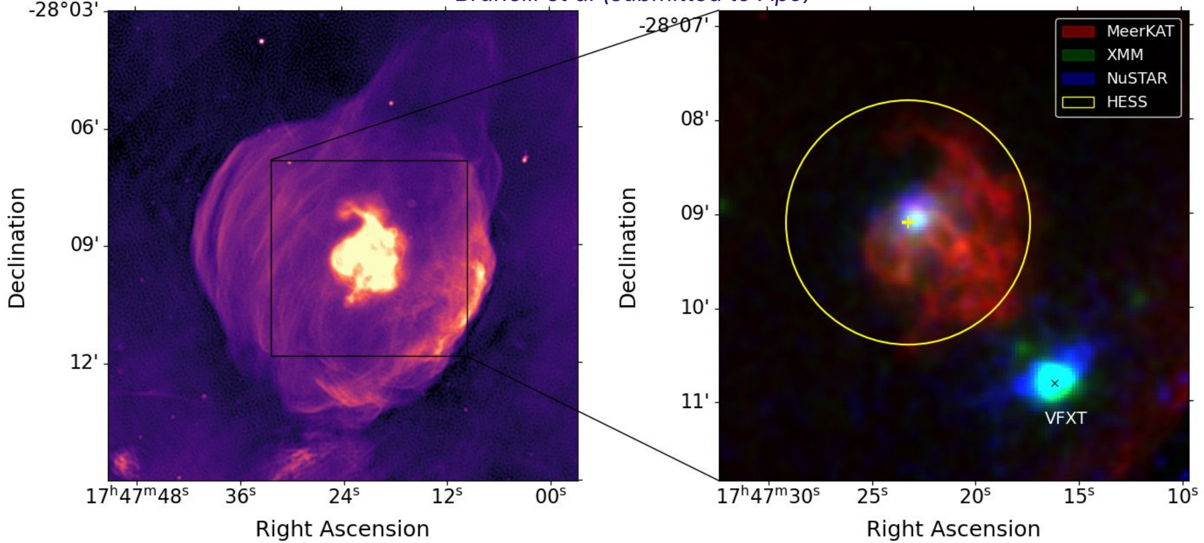


"Boomerang" PWN
Pope et al., 2024



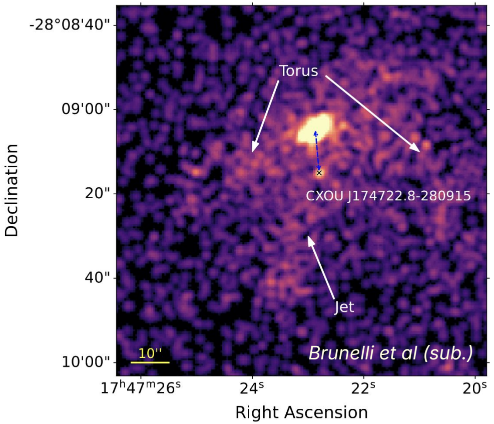
The first SED of PWN G0.9+0.1 including NuSTAR

Brunelli et al (submitted to ApJ)

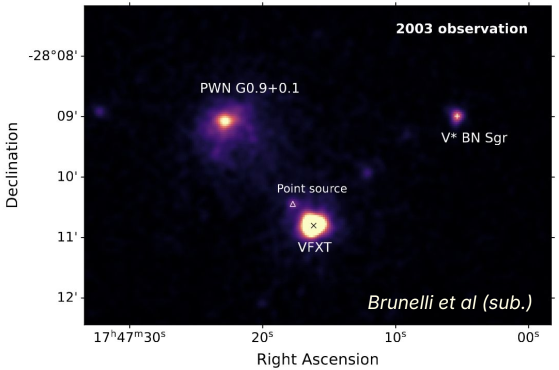


First broadband X-ray spectrum → Updated model of the radio–TeV SED → Compare SED models

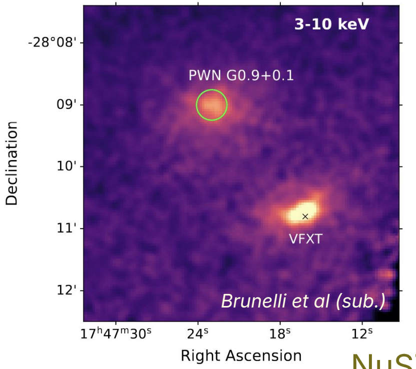
PWN G0.9+0.1 under different X-ray eyes



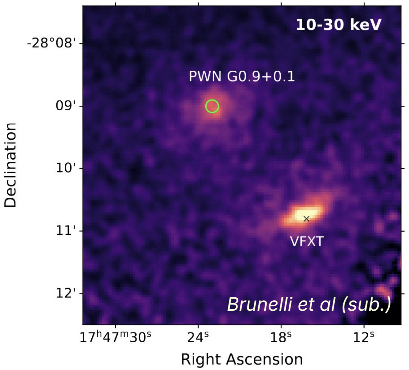
Chandra 2–7 keV



XMM–Newton 2–10 keV



NuSTAR



The first 2–30 keV spectrum of PWN G0.9+0.1

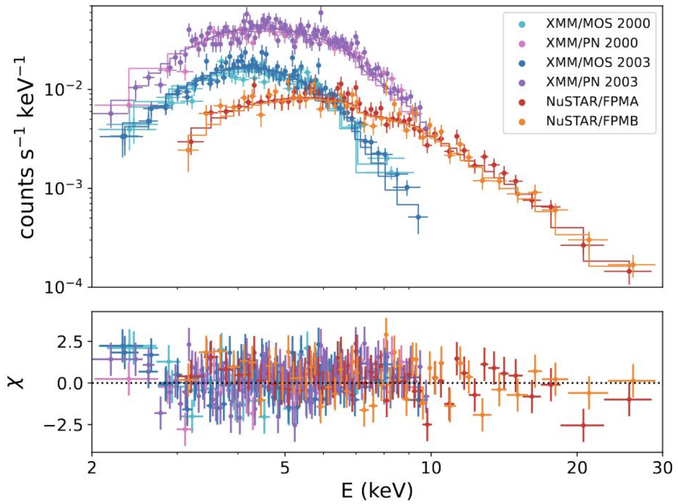
Well fitted by a **single power law**

Data set	Energy (keV)	N_H (10^{23} cm^{-2})	Γ	F_{3-10} (10^{-12} erg s^{-1} cm^{-2})	χ^2/dof	Constant
XMM	2–10	$1.96^{+0.13}_{-0.11}$	1.83 ± 0.11	$3.4^{+0.1}_{-0.2}$	472.3/545	0.96 ± 0.04 (M03) 0.92 ± 0.04 (P00) 0.88 ± 0.04 (M00)
NuSTAR	3–30	1.9 ± 0.4	$2.20^{+0.13}_{-0.12}$	$3.2^{+0.4}_{-0.3}$	256.5/303	1.06 ± 0.06 (B)
XMM + NuSTAR	2–30	2.19 ± 0.09	2.12 ± 0.07	$3.6^{+0.1}_{-0.2}$	762.0/851	0.96 ± 0.04 (M03) 0.92 ± 0.05 (P00) 0.88 ± 0.04 (M00) 0.92 ± 0.04 (N)

Brunelli et al (sub.)

High column density

Brunelli et al (sub.)



Compatible with Porqet et al., 2003

We tested complementary SED models

One-zone model (Gelfand et al., 2009)

Multi-zone model (Kim & An, 2020)

We tested complementary SED models

One-zone model (Gelfand et al., 2009)

Spherical
PWN

Multi-zone model (Kim & An, 2020)

Spherical
PWN

We tested complementary SED models

One-zone model (Gelfand et al., 2009)

Spherical PWN +

- PSR injection
- Synchrotron + ICS
- Adiabatic losses

Multi-zone model (Kim & An, 2020)

Spherical PWN +

- PSR injection
- Synchrotron + ICS
- Adiabatic losses
- Diffusion

We tested complementary SED models

One-zone model (Gelfand et al., 2009)

Spherical PWN + PSR injection, Synchrotron + ICS, Adiabatic losses + Uniform B_{PWN} and ρ_{PWN}, Time evolution inside SNR

Multi-zone model (Kim & An, 2020)

Spherical PWN + PSR injection, Synchrotron + ICS, Adiabatic losses, Diffusion + Radius-dependent B_{PWN} and V_{flow}

We tested complementary SED models

One-zone model (Gelfand et al., 2009)

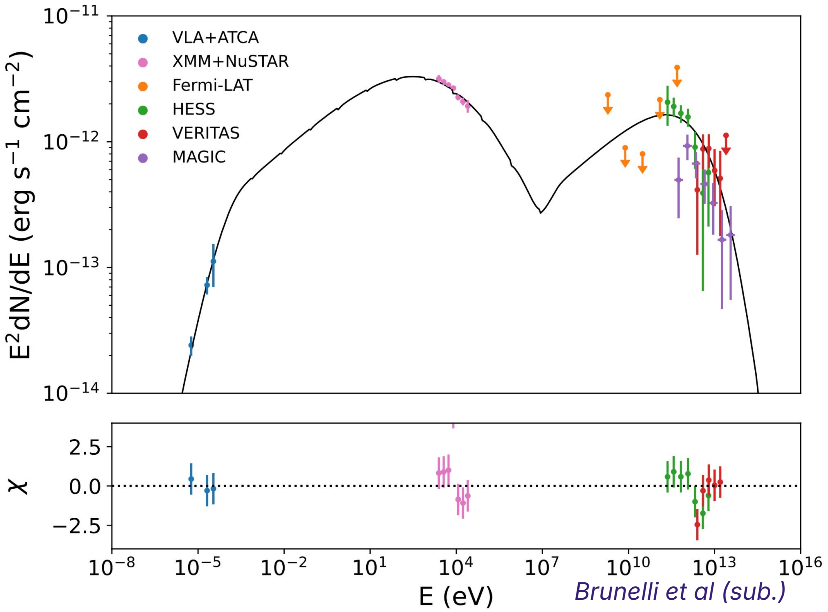
Spherical PWN + PSR injection, Synchrotron + ICS, Adiabatic losses + Uniform B_{PWN} and ρ_{PWN}, Time evolution inside SNR = **Time-dependent SED**, **R_{PWN} and R_{SNR}**

Multi-zone model (Kim & An, 2020)

Spherical PWN + PSR injection, Synchrotron + ICS, Adiabatic losses, Diffusion + Radius-dependent B_{PWN} and V_{flow} = **Present day SED**, **X-ray radial profiles**

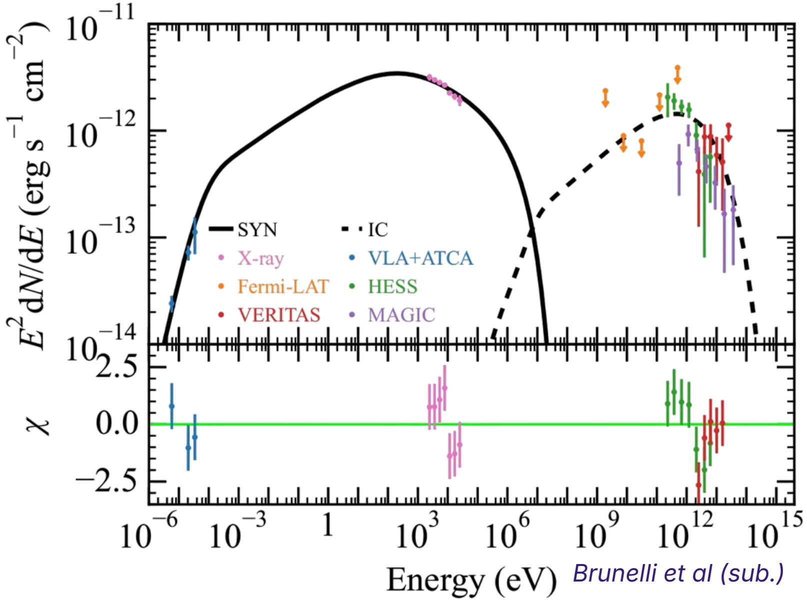
Both models can reproduce the radio–TeV SED

One-zone model



Brunelli et al (sub.)

Multi-zone model



Brunelli et al (sub.)

The models predict comparable parameters

Brunelli et al (sub.)

Parameter	One-zone Model	Multi-zone Model
SNR parameters		
Supernova energy $E_{\rm SN}$ (10^{51} erg)	2.9	...
Ejecta mass $M_{\rm ej}$ ($M_\odot$)	14.0	...
ISM density $n_{\rm ISM}$ (cm^{-3})	0.23	...
Radius $r_{\rm SNR}$(pc)	10.8	...
Pulsar parameters		
Age (kyr)	2.2	2.2[a]
Spindown timescale $\tau_{\rm sd}$ (kyr)	3.1	3.1[a]
Initial spin down power $\dot{E}_0$ (10^{38} erg s^{-1})	1.3	1.3[a]
PWN parameters		
Spectral index p	2.60	2.61
Minimum energy $E_{\rm min}$ (GeV)	12.8	13.3
Maximum energy $E_{\rm max}$ (PeV)	2.2	2.0
Magnetic fraction η_B	0.023	0.009
Radius $r_{\rm PWN}$ (pc)	3.2	2.1[a]
Velocity $V_{\rm PWN}$	0.005c	...
Bulk flow velocity at TS V_0	...	0.04c
Bulk flow velocity index α_V	...	-0.86
Average magnetic field (μG)	16.6	20.5
Magnetic field at TS B_0 (μG)	...	32
Magnetic field index α_B	...	-0.14
ICS field temperature $T_{\rm IR}$ (K)	54	54
ICS field energy density $u_{\rm IR}$ (eV cm^{-3})	5.6	2.2

The models predict comparable parameters

Brunelli et al (sub.)

Parameter	One-zone Model	Multi-zone Model
SNR parameters		
Supernova energy $E_{\rm SN}$ (10^{51} erg)	2.9	...
Ejecta mass $M_{\rm ej}$ ($M_\odot$)	14.0	...
ISM density $n_{\rm ISM}$ (cm^{-3})	0.23	...
Radius $r_{\rm SNR}$(pc)	10.8	...
Pulsar parameters		
Age (kyr)	2.2	2.2[a]
Spindown timescale $\tau_{\rm sd}$ (kyr)	3.1	3.1[a]
Initial spin down power $\dot{E}_0$ (10^{38} erg s^{-1})	1.3	1.3[a]
PWN parameters		
Spectral index p	2.60	2.61
Minimum energy $E_{\rm min}$ (GeV)	12.8	13.3
Maximum energy $E_{\rm max}$ (PeV)	2.2	2.0
Magnetic fraction η_B	0.023	0.009
Radius $r_{\rm PWN}$ (pc)	3.2	2.1[a]
Velocity $V_{\rm PWN}$	0.005c	...
Bulk flow velocity at TS V_0	...	0.04c
Bulk flow velocity index α_V	...	-0.86
Average magnetic field (μG)	16.6	20.5
Magnetic field at TS B_0 (μG)	...	32
Magnetic field index α_B	...	-0.14
ICS field temperature $T_{\rm IR}$ (K)	54	54
ICS field energy density $u_{\rm IR}$ (eV cm^{-3})	5.6	2.2

Energetic (~2.9×10^{51} erg) and massive (~14 $M_\odot$) progenitor

The models predict comparable parameters

Brunelli et al (sub.)

Parameter	One-zone Model	Multi-zone Model
SNR parameters		
Supernova energy E_{SN} (10^{51} erg)	2.9	...
Ejecta mass M_{ej} ($M_\odot$)	14.0	...
ISM density n_{ISM} (cm^{-3})	0.23	...
Radius r_{SNR}(pc)	10.8	...
Pulsar parameters		
Age (kyr)	2.2	2.2[a]
Spindown timescale τ_{sd} (kyr)	3.1	3.1[a]
Initial spin down power $\dot{E}_0$ (10^{38} erg s^{-1})	1.3	1.3[a]
PWN parameters		
Spectral index p	2.60	2.61
Minimum energy E_{min} (GeV)	12.8	13.3
Maximum energy E_{max} (PeV)	2.2	2.0
Magnetic fraction η_B	0.023	0.009
Radius r_{PWN} (pc)	3.2	2.1[a]
Velocity V_{PWN}	0.005c	...
Bulk flow velocity at TS V_0	...	0.04c
Bulk flow velocity index α_V	...	-0.86
Average magnetic field (μG)	16.6	20.5
Magnetic field at TS B_0 (μG)	...	32
Magnetic field index α_B	...	-0.14
ICS field temperature T_{IR} (K)	54	54
ICS field energy density u_{IR} (eV cm^{-3})	5.6	2.2

Energetic (~2.9×10^{51} erg) and massive (~14 $M_\odot$) progenitor

Very young (~2.2 kyr) pulsar!

The models predict comparable parameters

Brunelli et al (sub.)

Parameter	One-zone Model	Multi-zone Model
SNR parameters		
Supernova energy $E_{\rm SN}$ (10^{51} erg)	2.9	...
Ejecta mass $M_{\rm ej}$ ($M_\odot$)	14.0	...
ISM density $n_{\rm ISM}$ (cm^{-3})	0.23	...
Radius $r_{\rm SNR}$(pc)	10.8	...
Pulsar parameters		
Age (kyr)	2.2	2.2[a]
Spindown timescale $\tau_{\rm sd}$ (kyr)	3.1	3.1[a]
Initial spin down power $\dot{E}_0$ (10^{38} erg s^{-1})	1.3	1.3[a]
PWN parameters		
Spectral index p	2.60	2.61
Minimum energy $E_{\rm min}$ (GeV)	12.8	13.3
Maximum energy $E_{\rm max}$ (PeV)	2.2	2.0
Magnetic fraction η_B	0.023	0.009
Radius $r_{\rm PWN}$ (pc)	3.2	2.1[a]
Velocity $V_{\rm PWN}$	0.005c	...
Bulk flow velocity at TS V_0	...	0.04c
Bulk flow velocity index α_V	...	-0.86
Average magnetic field (μG)	16.6	20.5
Magnetic field at TS B_0 (μG)	...	32
Magnetic field index α_B	...	-0.14
ICS field temperature $T_{\rm IR}$ (K)	54	54
ICS field energy density $u_{\rm IR}$ (eV cm^{-3})	5.6	2.2

Energetic (~2.9×10^{51} erg) and massive (~14 $M_\odot$) progenitor

Very young (~2.2 kyr) pulsar!

Single power law injection spectrum

The models predict comparable parameters

Brunelli et al (sub.)

Parameter	One-zone Model	Multi-zone Model
SNR parameters		
Supernova energy E_{SN} (10^{51} erg)	2.9	...
Ejecta mass M_{ej} ($M_\odot$)	14.0	...
ISM density n_{ISM} (cm^{-3})	0.23	...
Radius r_{SNR}(pc)	10.8	...
Pulsar parameters		
Age (kyr)	2.2	2.2[a]
Spindown timescale τ_{sd} (kyr)	3.1	3.1[a]
Initial spin down power $\dot{E}_0$ (10^{38} erg s^{-1})	1.3	1.3[a]
PWN parameters		
Spectral index p	2.60	2.61
Minimum energy E_{min} (GeV)	12.8	13.3
Maximum energy E_{max} (PeV)	2.2	2.0
Magnetic fraction η_B	0.023	0.009
Radius r_{PWN} (pc)	3.2	2.1[a]
Velocity V_{PWN}	0.005c	...
Bulk flow velocity at TS V_0	...	0.04c
Bulk flow velocity index α_V	...	-0.86
Average magnetic field (μG)	16.6	20.5
Magnetic field at TS B_0 (μG)	...	32
Magnetic field index α_B	...	-0.14
ICS field temperature T_{IR} (K)	54	54
ICS field energy density u_{IR} (eV cm^{-3})	5.6	2.2

Energetic (~2.9×10^{51} erg) and massive (~14 $M_\odot$) progenitor

Very young (~2.2 kyr) pulsar!

Single power law injection spectrum

Large magnetic field (~ 20 µG)

The models predict comparable parameters

Brunelli et al (sub.)

Parameter	One-zone Model	Multi-zone Model
SNR parameters		
Supernova energy E_{SN} (10^{51} erg)	2.9	...
Ejecta mass M_{ej} ($M_\odot$)	14.0	...
ISM density n_{ISM} (cm^{-3})	0.23	...
Radius r_{SNR}(pc)	10.8	...
Pulsar parameters		
Age (kyr)	2.2	2.2[a]
Spindown timescale τ_{sd} (kyr)	3.1	3.1[a]
Initial spin down power $\dot{E}_0$ (10^{38} erg s^{-1})	1.3	1.3[a]
PWN parameters		
Spectral index p	2.60	2.61
Minimum energy E_{min} (GeV)	12.8	13.3
Maximum energy E_{max} (PeV)	2.2	2.0
Magnetic fraction η_B	0.023	0.009
Radius r_{PWN} (pc)	3.2	2.1[a]
Velocity V_{PWN}	0.005c	...
Bulk flow velocity at TS V_0	...	0.04c
Bulk flow velocity index α_V	...	-0.86
Average magnetic field (μG)	16.6	20.5
Magnetic field at TS B_0 (μG)	...	32
Magnetic field index α_B	...	-0.14
ICS field temperature T_{IR} (K)	54	54
ICS field energy density u_{IR} (eV cm^{-3})	5.6	2.2

Energetic (~2.9×10^{51} erg) and massive (~14 $M_\odot$) progenitor

Very young (~2.2 kyr) pulsar!

Single power law injection spectrum

Likely a new Galactic PeVatron!

Large magnetic field (~ 20 μG)

A unique PeVatron PWNe in the NuSTAR sample

Brunelli et al (sub.)

PWN	G0.9+0.1	G18.5-0.4[a] "Eel"	G75.23+0.12[b] "Dragonfly"	G106.65+2.96[c] "Boomerang"	G313.54+0.23[d] "Kookaburra"	G313.3+0.1[e] "Rabbit"	G338.3–0.0[f] HESS J1640–465
PSR	J1747–2809	J1825–1256	J2021+3651	J2220+6114	J1420–6048	J1418–6058	J1640–4631
τ_c (kyr)	5.3	14.4	17	10	13	10.4	3.4
$\dot{E}$ (erg s^{-1})	4.3×10^{37}	3.6×10^{36}	3.4×10^{36}	2.2×10^{37}	1×10^{37}	5×10^{36}	4.4×10^{36}
d^{g} (kpc)	8–16 (8)	3.5	0.4–12 (3.5)	0.8–7.5 (7.5)	5.6–7.7 (5.6)	3.5	12
$E_{\rm max}$ (PeV)	2.0–2.2	2	1.4	1.2	0.9	1	1.2
$B_{\rm PWN}$ (μG)	20	1	2.7	2.5	5.1	12.3	4.1
$t_{\rm age}$ (kyr)	2.2	5.7	16	2.1	9	7	3.1
Interaction with RS?	No	Possible	Yes	Yes	Possible	Possible	Yes
SED model	One-zone Multi-zone	One-zone	One-zone	One-zone	Multi-zone	Multi-zone	One-zone

NOTE—[a]D. A. Burgess et al. (2022);[b]J. Woo et al. (2023); [c]I. Pope et al. (2024); [d]J. Park et al. (2023a); [e]J. Park et al. (2023b); [f]M. Abdelmaguid et al. (2023); [g] Range of estimated distances, and assumed distance in the SED modeling in parentheses.

A unique PeVatron PWNe in the NuSTAR sample

Brunelli et al (sub.)

PWN	G0.9+0.1	G18.5-0.4[a] "Eel"	G75.23+0.12[b] "Dragonfly"	G106.65+2.96[c] "Boomerang"	G313.54+0.23[d] "Kookaburra"	G313.3+0.1[e] "Rabbit"	G338.3–0.0[f] HESS J1640–465
PSR	J1747–2809	J1825–1256	J2021+3651	J2220+6114	J1420–6048	J1418–6058	J1640–4631
τ_c (kyr)	5.3	14.4	17	10	13	10.4	3.4
$\boxed{\dot{E}}$ (erg s^{-1})	4.3×10^{37}	3.6×10^{36}	3.4×10^{36}	2.2×10^{37}	1×10^{37}	5×10^{36}	4.4×10^{36}
d^{g} (kpc)	8–16 (8)	3.5	0.4–12 (3.5)	0.8–7.5 (7.5)	5.6–7.7 (5.6)	3.5	12
$E_{\rm max}$ (PeV)	2.0–2.2	2	1.4	1.2	0.9	1	1.2
$B_{\rm PWN}$ (μG)	20	1	2.7	2.5	5.1	12.3	4.1
$t_{\rm age}$ (kyr)	2.2	5.7	16	2.1	9	7	3.1
Interaction with RS?	No	Possible	Yes	Yes	Possible	Possible	Yes
SED model	One-zone Multi-zone	One-zone	One-zone	One-zone	Multi-zone	Multi-zone	One-zone

NOTE—[a]D. A. Burgess et al. (2022);[b]J. Woo et al. (2023); [c]I. Pope et al. (2024); [d]J. Park et al. (2023a); [e]J. Park et al. (2023b); [f]M. Abdelmaguid et al. (2023); [g] Range of estimated distances, and assumed distance in the SED modeling in parentheses.

Energetic pulsars

E_{max} ~ 1-2 PeV

A unique PeVatron PWNe in the NuSTAR sample

Brunelli et al (sub.)

PWN	G0.9+0.1	G18.5-0.4[a] "Eel"	G75.23+0.12[b] "Dragonfly"	G106.65+2.96[c] "Boomerang"	G313.54+0.23[d] "Kookaburra"	G313.3+0.1[e] "Rabbit"	G338.3–0.0[f] HESS J1640–465
PSR	J1747–2809	J1825–1256	J2021+3651	J2220+6114	J1420–6048	J1418–6058	J1640–4631
τ_c (kyr)	5.3	14.4	17	10	13	10.4	3.4
$\dot{E}$ (erg s^{-1})	4.3×10^{37}	3.6×10^{36}	3.4×10^{36}	2.2×10^{37}	1×10^{37}	5×10^{36}	4.4×10^{36}
d^{g} (kpc)	8–16 (8)	3.5	0.4–12 (3.5)	0.8–7.5 (7.5)	5.6–7.7 (5.6)	3.5	12
E_{max} (PeV)	2.0–2.2	2	1.4	1.2	0.9	1	1.2
B_{PWN} (μG)	20	1	2.7	2.5	5.1	12.3	4.1
t_{age} (kyr)	2.2	5.7	16	2.1	9	7	3.1
Interaction with RS?	No	Possible	Yes	Yes	Possible	Possible	Yes
SED model	One-zone Multi-zone	One-zone	One-zone	One-zone	Multi-zone	Multi-zone	One-zone

NOTE—[a]D. A. Burgess et al. (2022);[b]J. Woo et al. (2023); [c]I. Pope et al. (2024); [d]J. Park et al. (2023a); [e]J. Park et al. (2023b); [f]M. Abdelmaguid et al. (2023); [g] Range of estimated distances, and assumed distance in the SED modeling in parentheses.

The only one without RS interaction

⇩

Higher magnetic field

Take-home messages

G0.9+0.1 is a **young** (~ 2kyr) **PeVatron PWN**

NuSTAR data are fundamental to constrain E_{max}

More observations are needed: extend the sample of PeVatron PWNe

Thank you for the attention!

New Hard X-Ray and Multiwavelength Study of the PeVatron Candidate PWN G0.9+0.1 in the Galactic Center Region

Giulia Brunelli,[1,2] Kaya Mori,[3] Jaegeun Park,[4] Jordan Eagle,[5] Moaz Abdelmaguid,[6] Melania Nynka,[7] Hongjun An,[4] Aya Bamba,[8] Joseph D. Gelfand,[6] Gabriele Ponti,[9,10,11] Samar Safi-Harb,[12] Vito Sguera,[2] Cristian Vignali,[1,2] Jooyun Woo,[3] and Roberta Zanin[13]

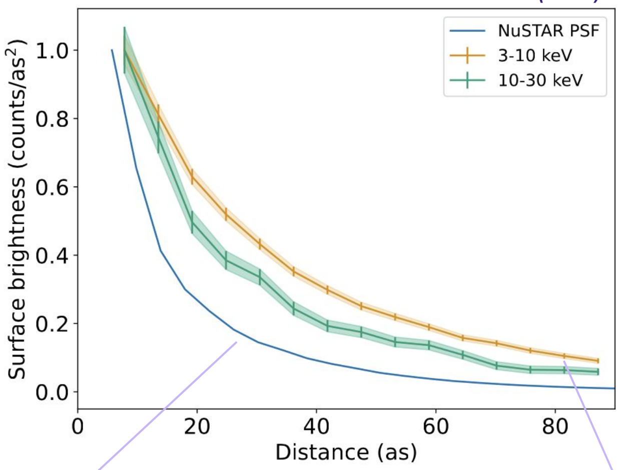
Stay tuned for the paper

Giulia Brunelli (UniBo/INAF-OAS)
giulia.brunelli@inaf.it

BACKUP

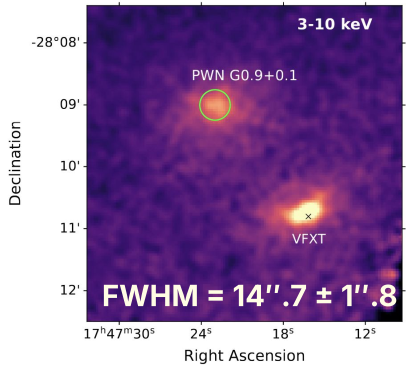
PWN G0.9+0.1 is affected by synchrotron burnoff

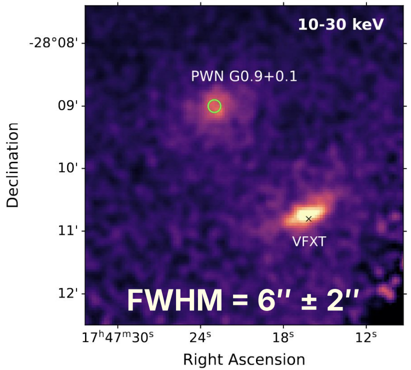
Brunelli et al (sub.)



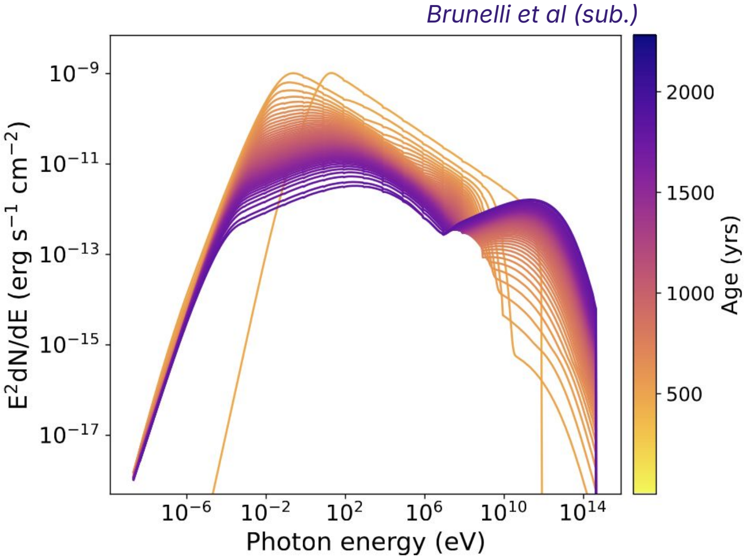
Extended source

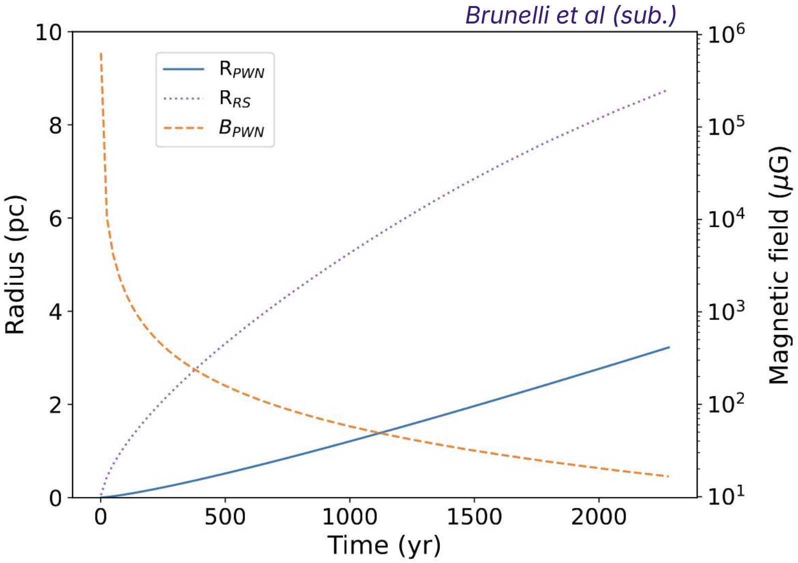
More extended at 3–10 keV





SED evolution for the one-zone model

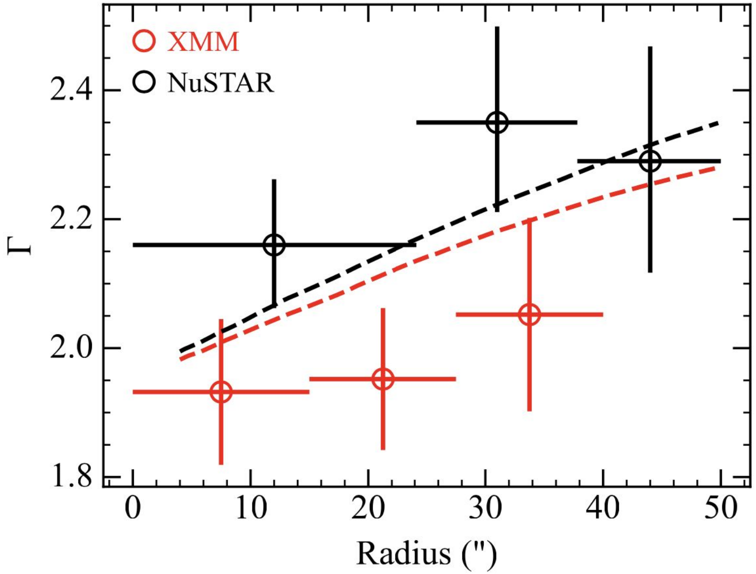




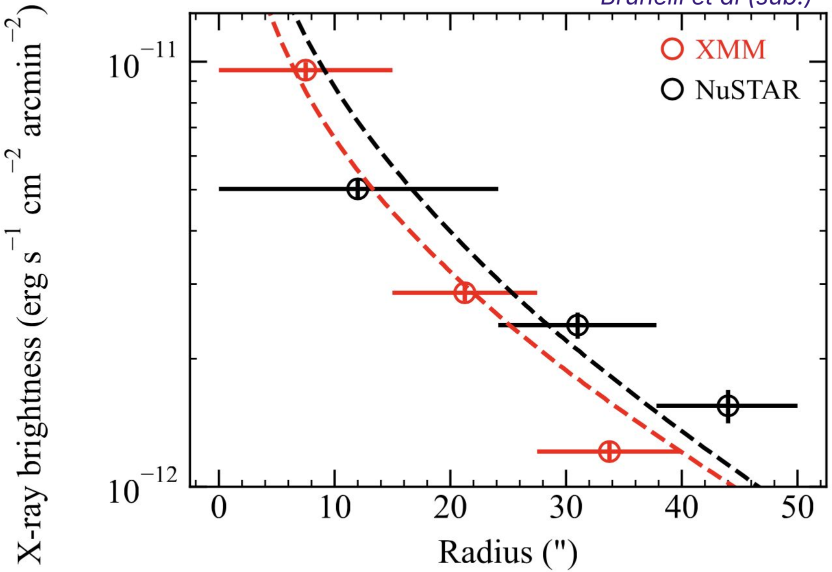
$R_{RS} > R_{PWN}$: **no interaction with SNR**

X-ray radial profiles for the multi-zone model

Brunelli et al (sub.)



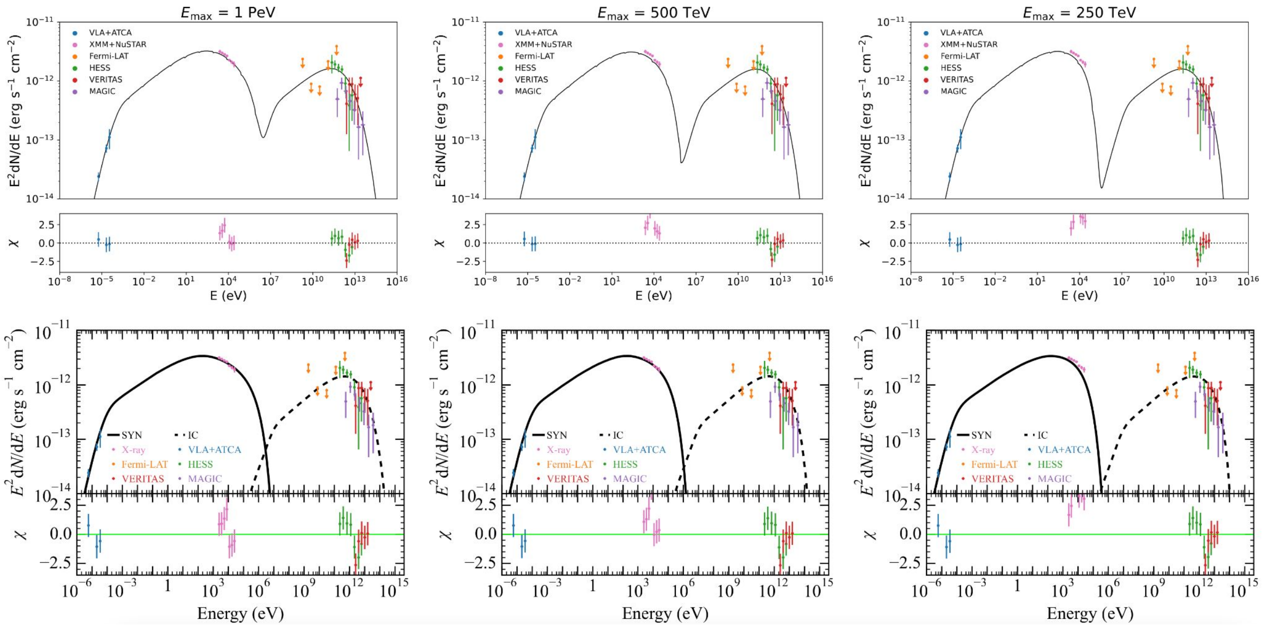
Brunelli et al (sub.)



Decreasing E_{max} in the model

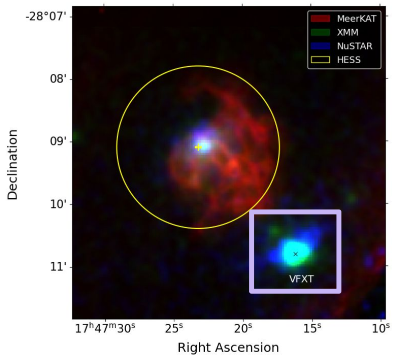
One-zone model

Multi-zone model



Progressively worse residuals

Renewed activity from XMMU J174716.1–281048

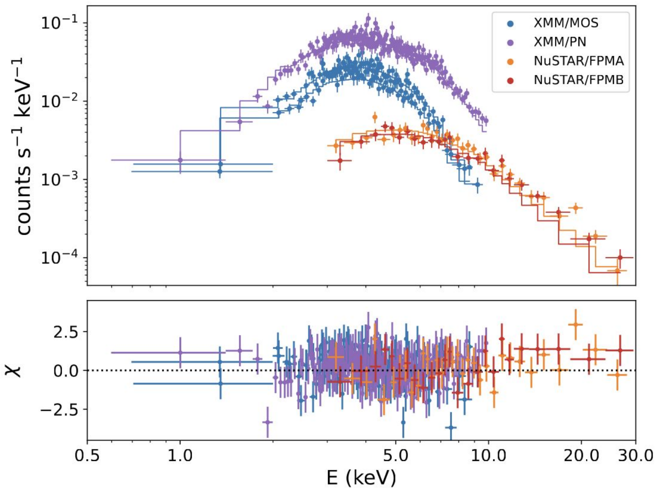


Quiescent state:
$L_{2\text{–}10\ \mathrm{keV}}$ (2015) ≤ $4.6 \cdot 10^{33}$ erg/s

1) First detection in 10–30 keV
2) $L_{3\text{–}10\ \mathrm{keV}}$ (NuSTAR) = $(3.2 \pm 0.2) \cdot 10^{34}$ erg/s
→ XMM 2003: $L_{3\text{–}10\ \mathrm{keV}}$ = $(3.4 \pm 0.1) \cdot 10^{34}$ erg/s

The source is possibly back in outburst

Brunelli et al (sub.)



Joint XMM+NuSTAR spectrum:
Γ = 2.07 ± 0.07 (0.5–30 keV)