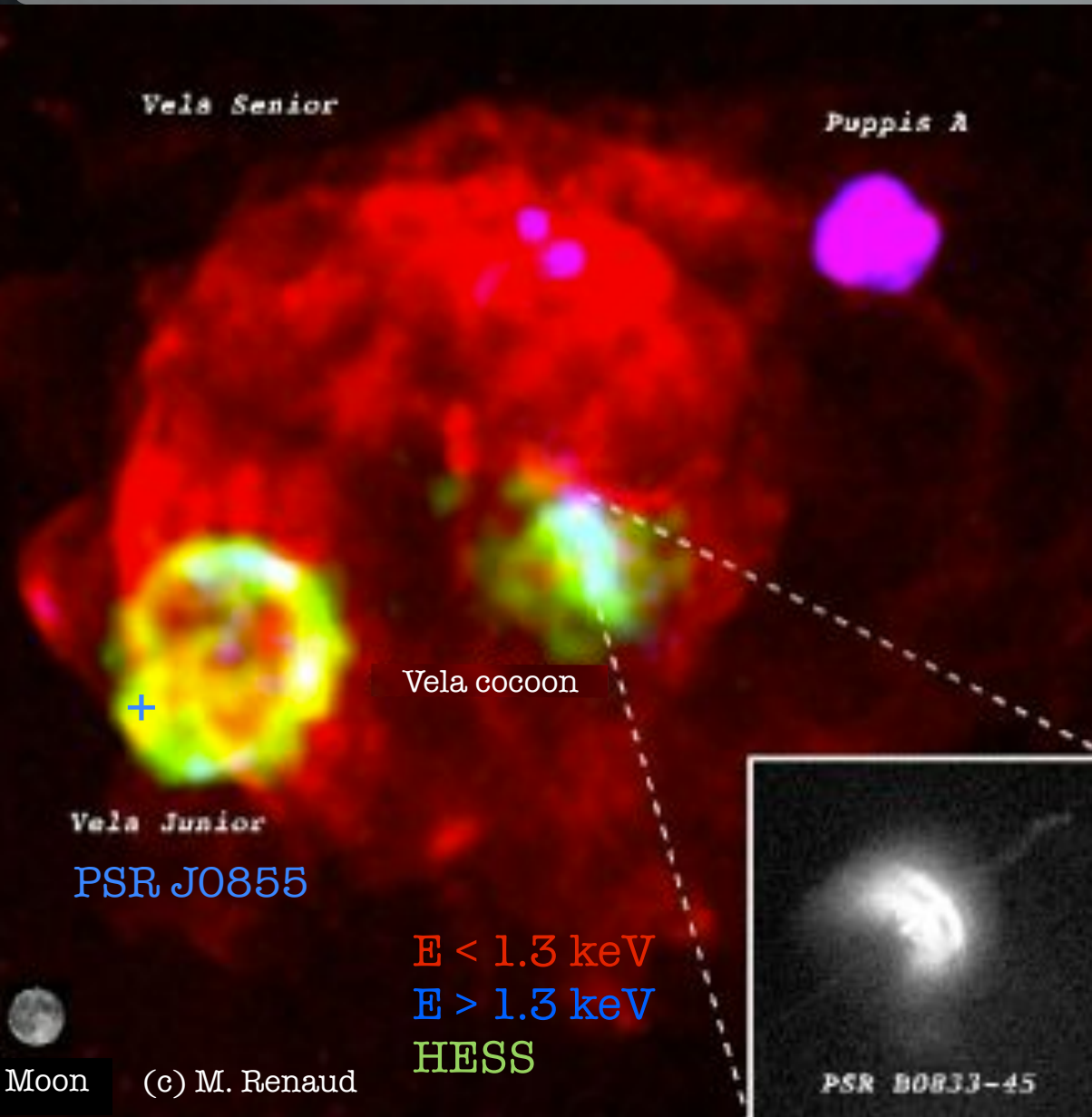


The energetic and nearby peanut nebula: PSR J0855 -4644



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NASA
Postdoctoral
Program ¹

(c) M. Renaud

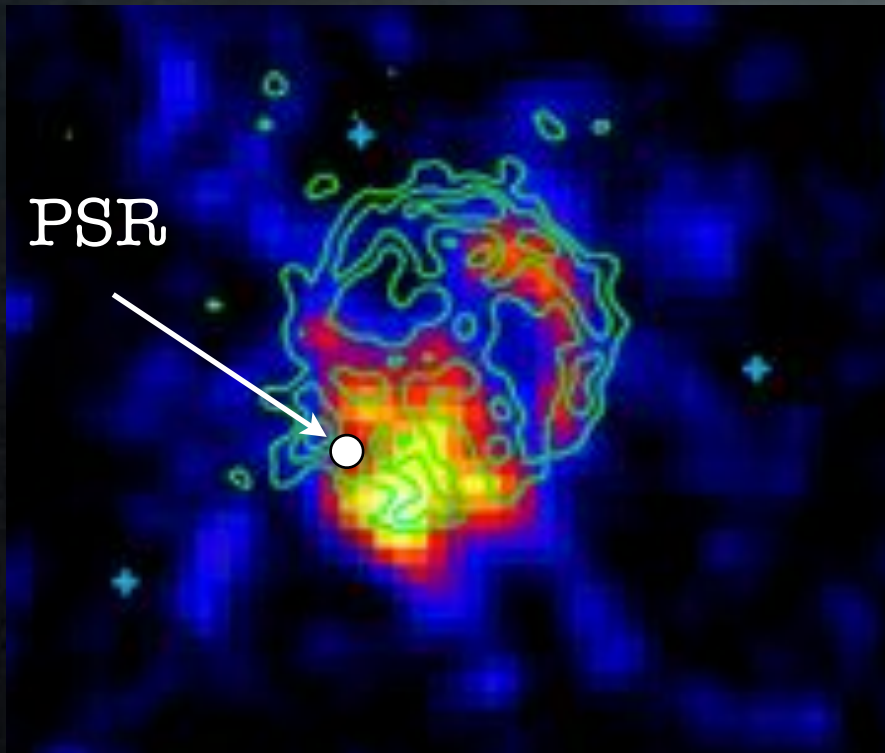
ALL ROADS LEAD TO THIS



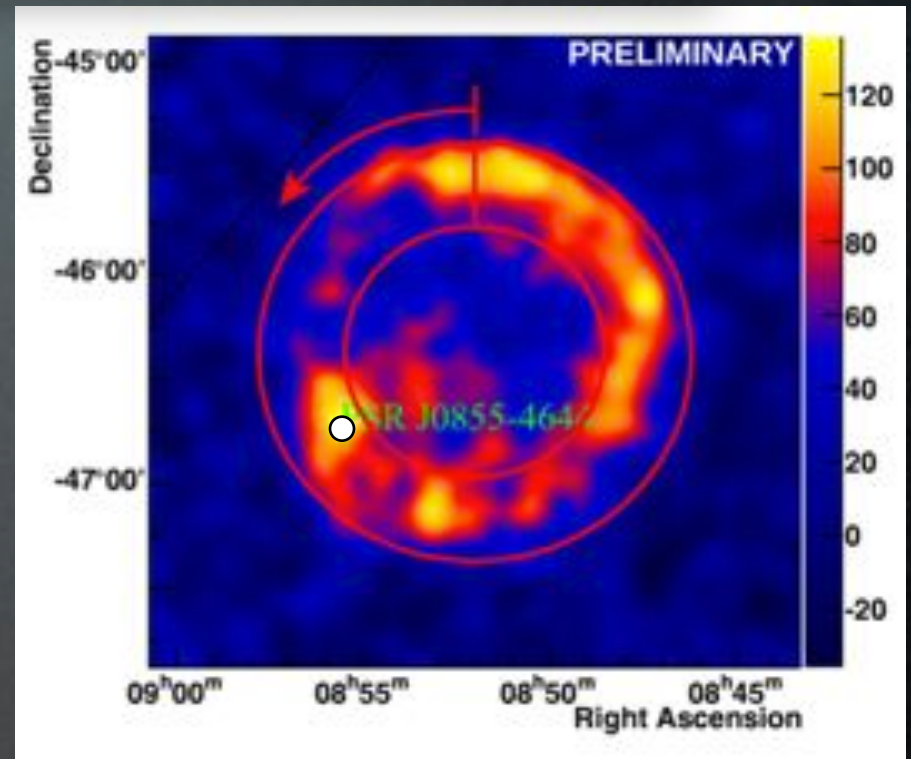
FAST & FURIOUS
6 MAY 24

Motivations to observe PSR J0855-4644

A possible contribution to GeV and TeV in Vela Jr SNR ?



Fermi TS map (Tanaka+11)



HESS excess map (Paz Arribas+12)

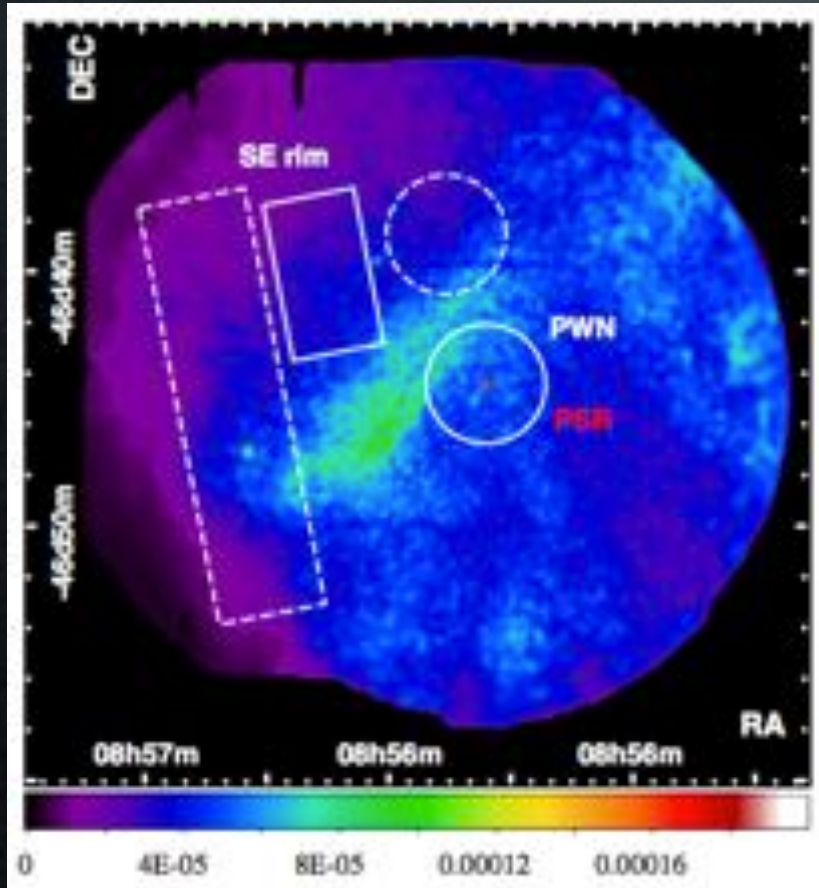
PSR J0855-4644

$P = 64 \text{ ms}$, $\dot{E} = 1.1 \times 10^{36} \text{ ergs/s}$, $\tau_c = 140 \text{ kyrs}$
 $d < 1 \text{ kpc}$ from X-ray N_h (instead of 4 kpc ; DM)
2nd most energetic pulsar within 1 kpc
Radio loud, gamma-quiet

Kramer+03

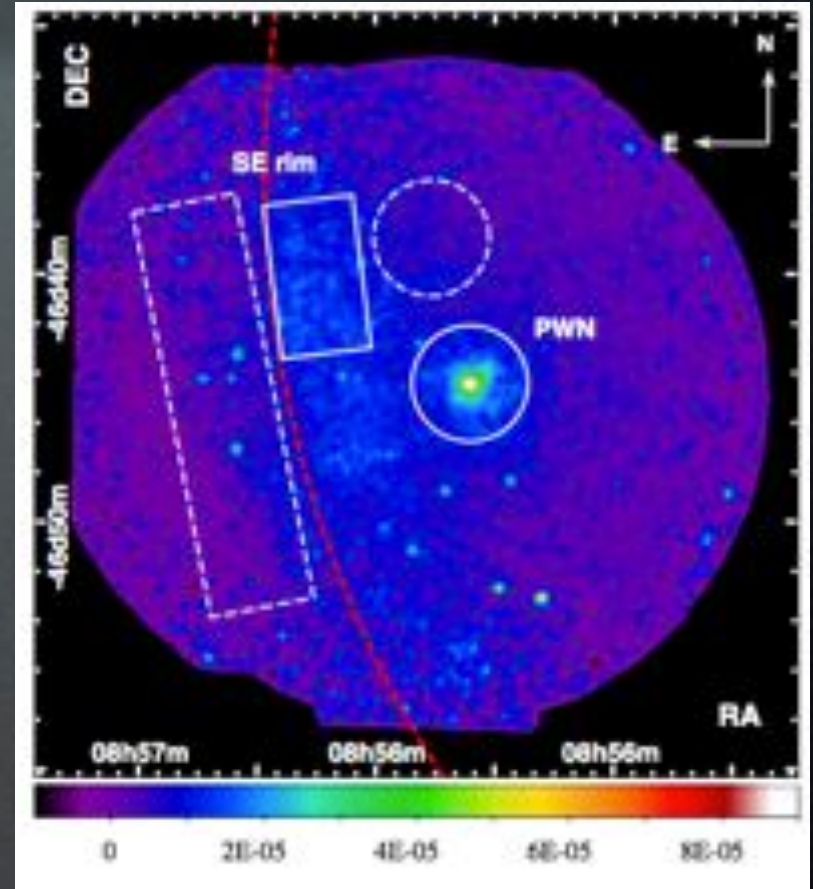
Acero+13

Fermi 2PC



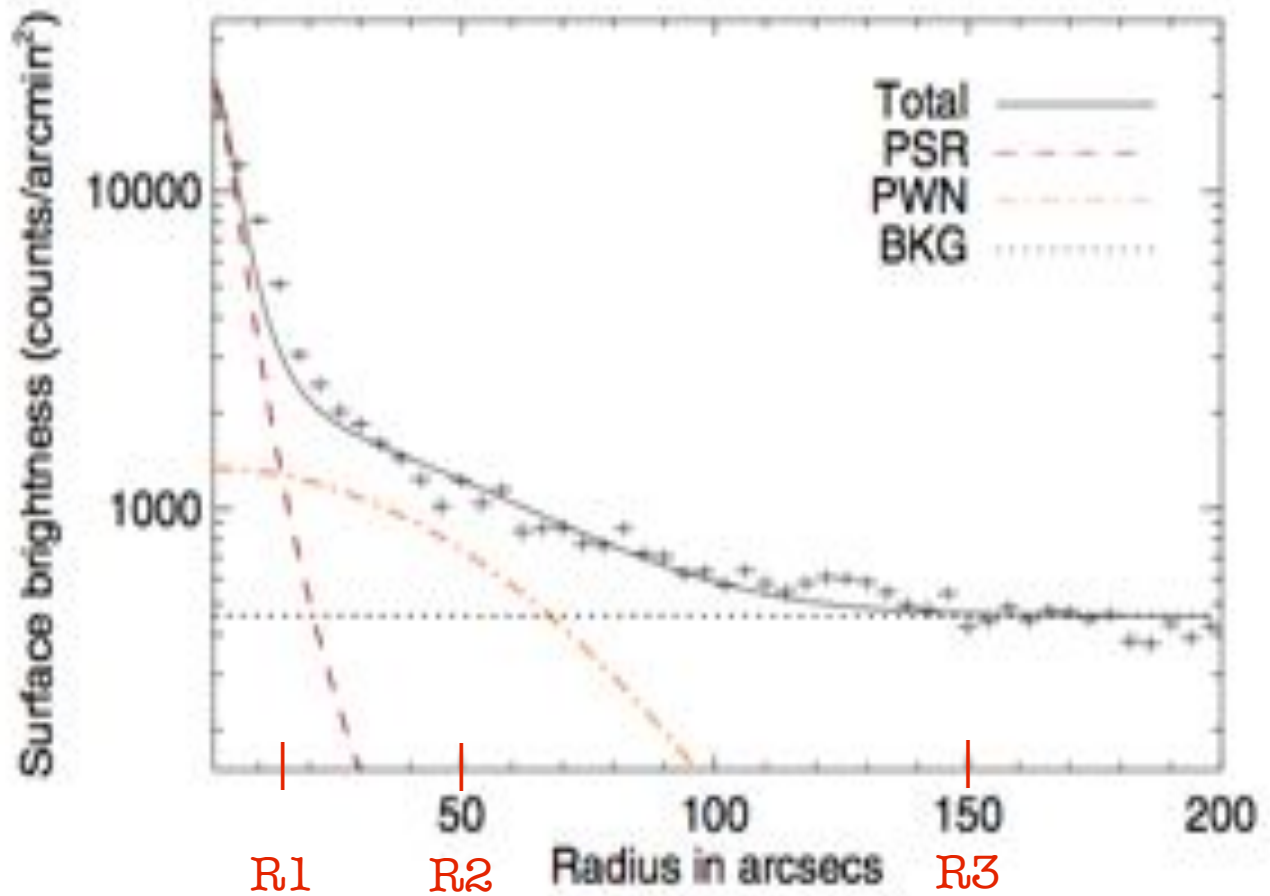
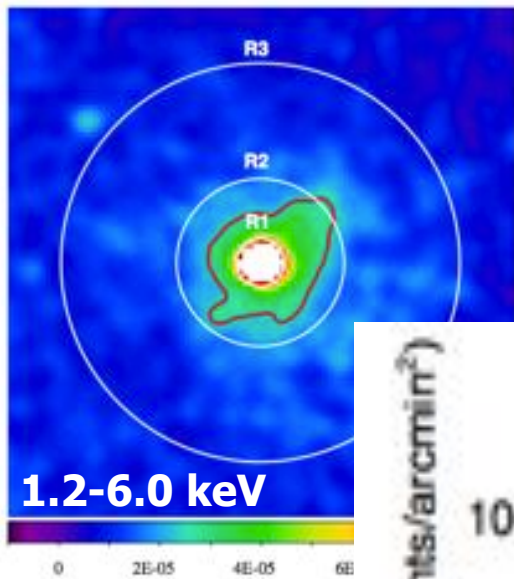
0.5-0.8 keV

Acero+13

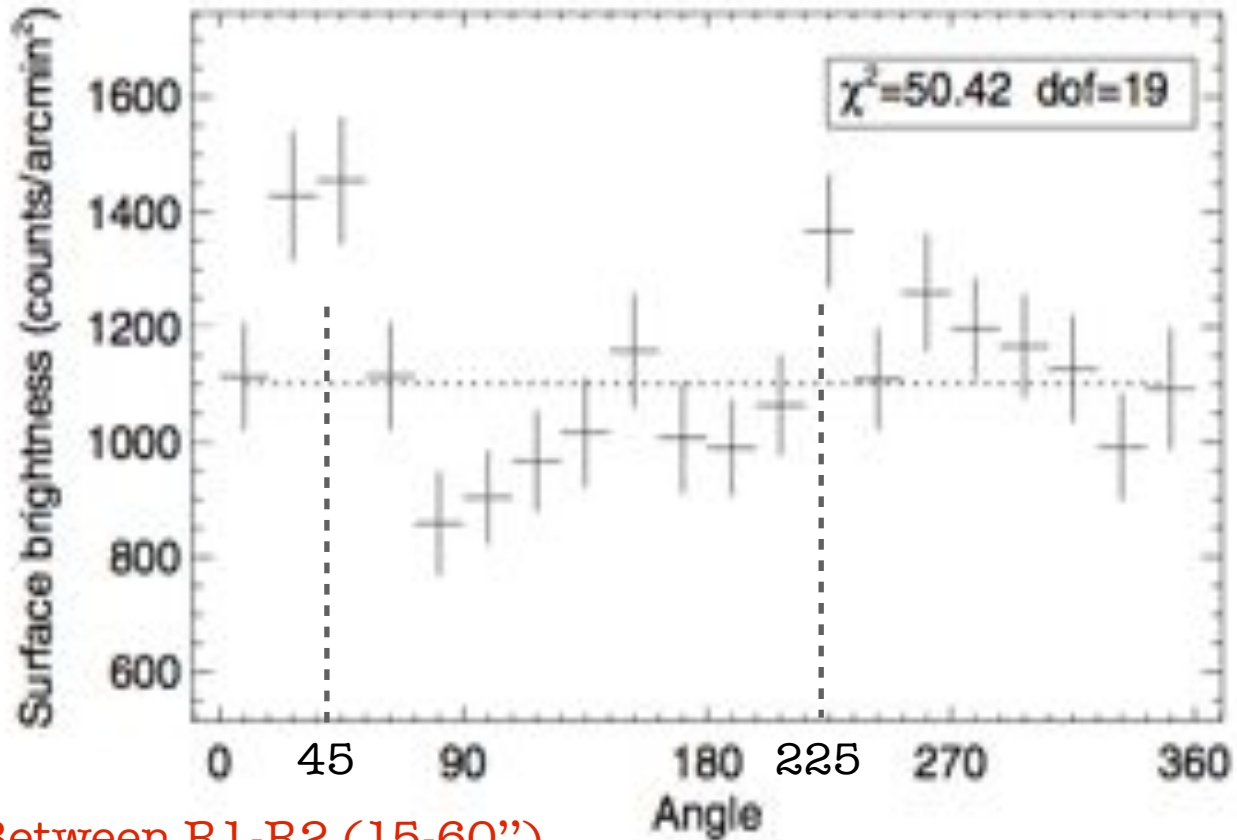
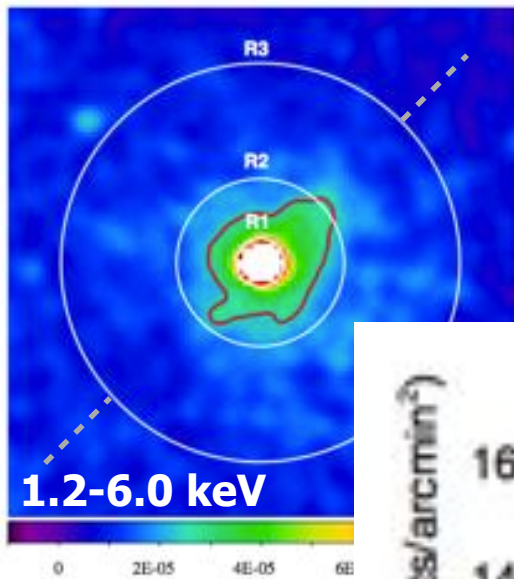


1.2-6.0 keV

PWN radial profile

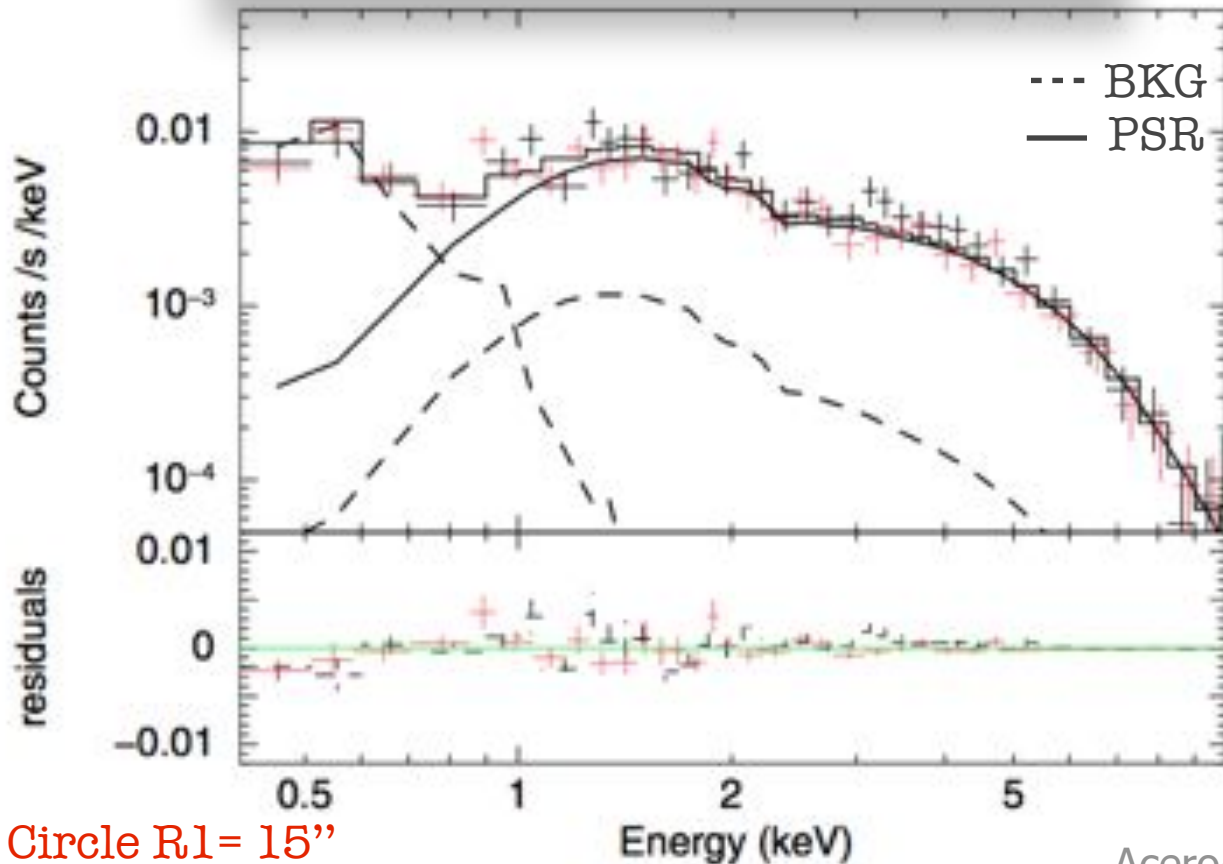
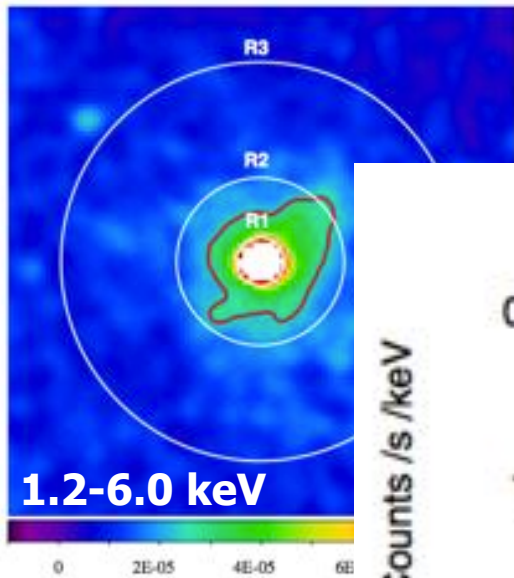


PWN azimuthal profile



Between R1-R2 (15-60")

Pulsar X-ray spectrum



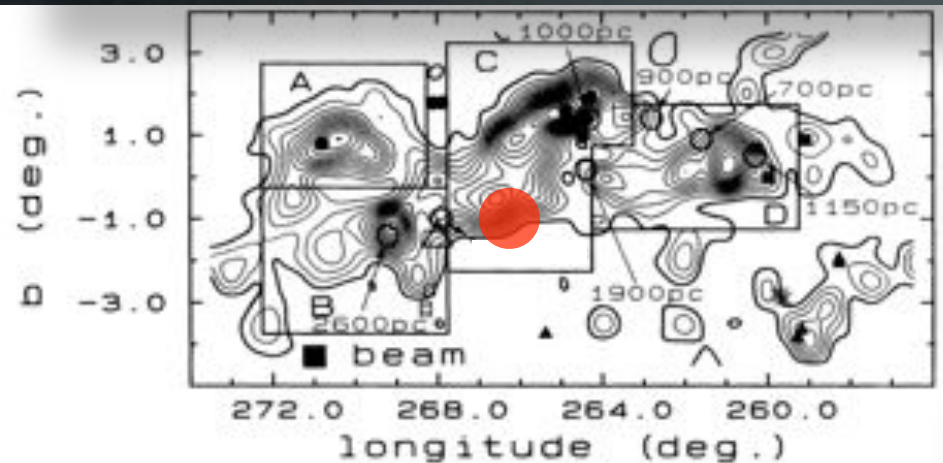
Circle R1 = 15''

Acero+13

Measuring the PSR absorption to estimate the distance

**Caveats : thermal bkg systematic uncertainty
possible PSR thermal contribution**

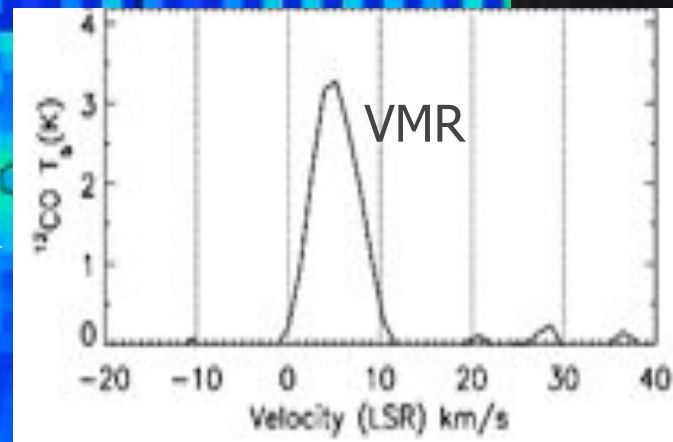
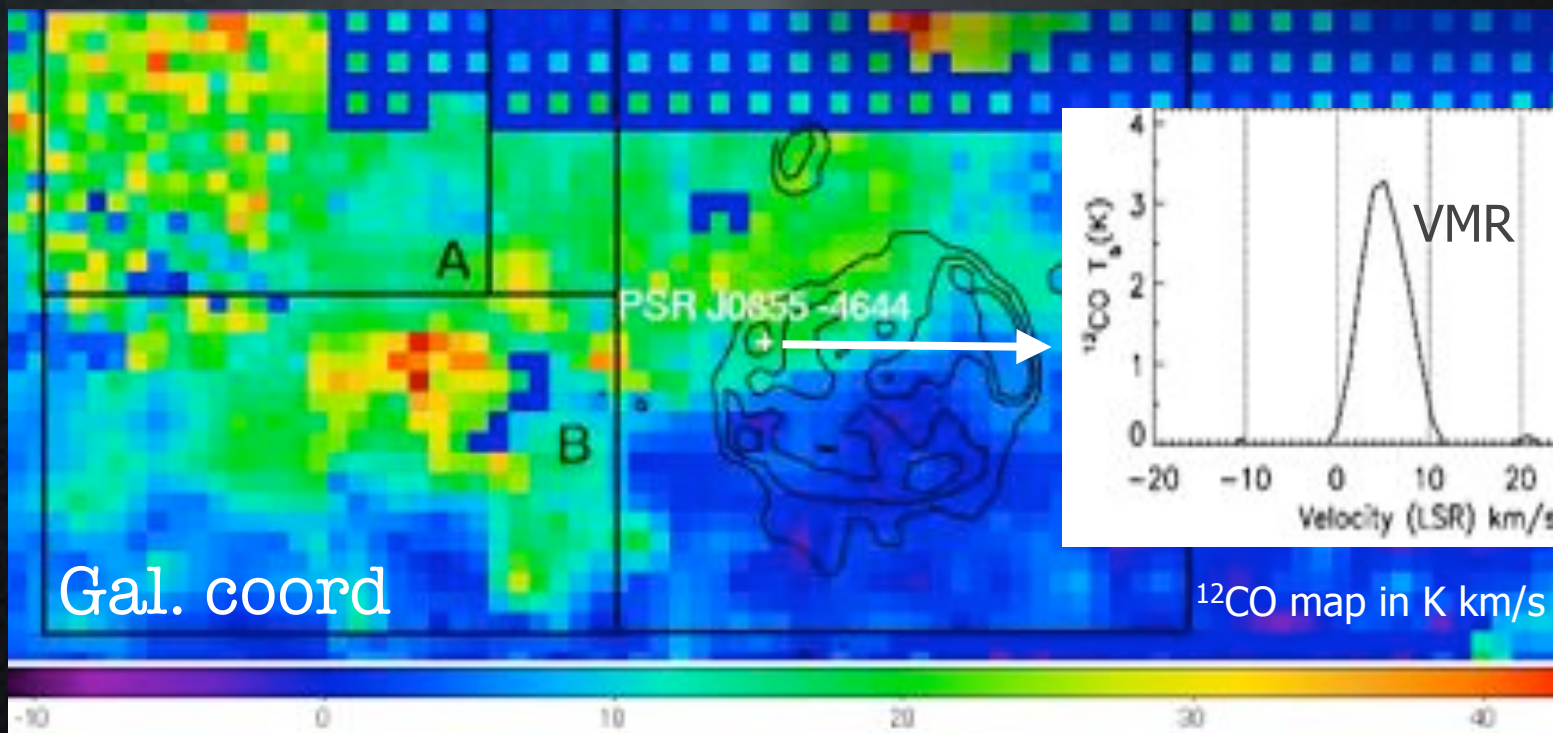
The Vela Molecular ridge



← Murphy+91 Cloud definition

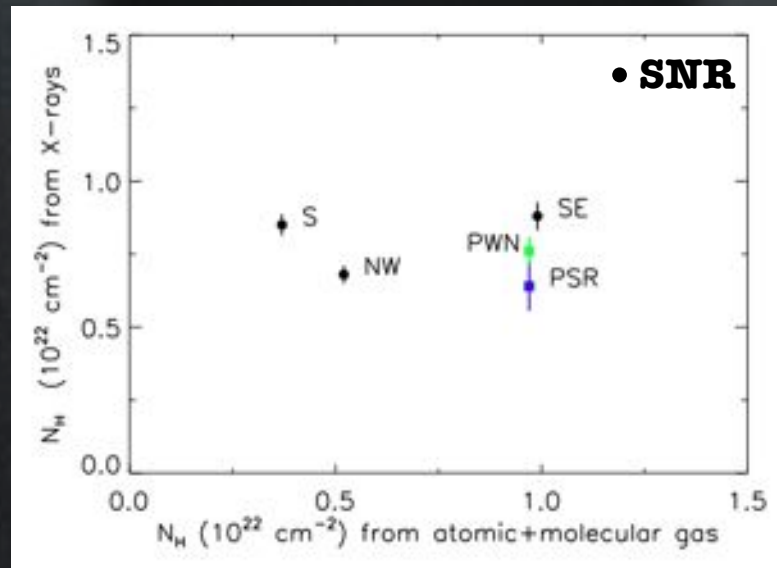
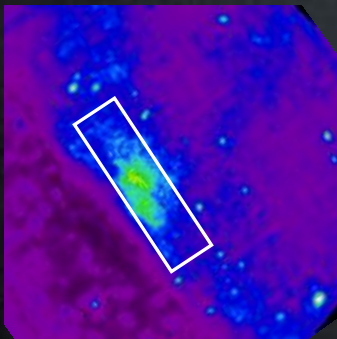
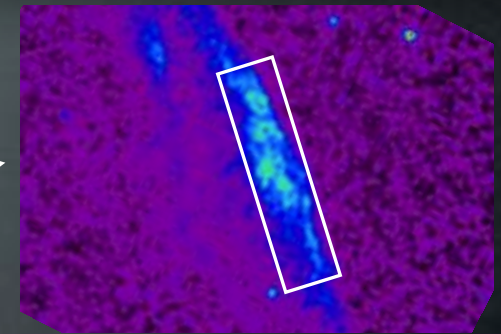
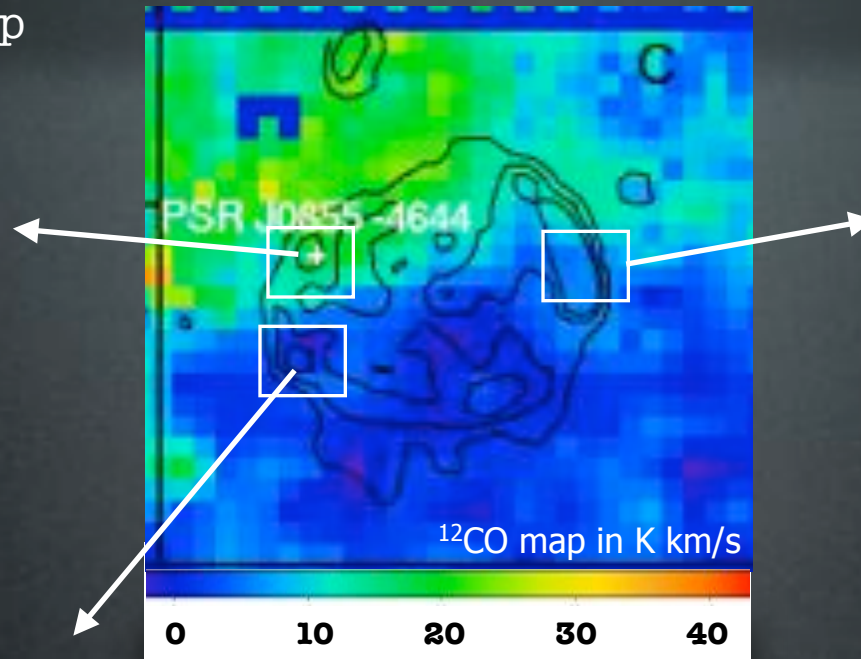
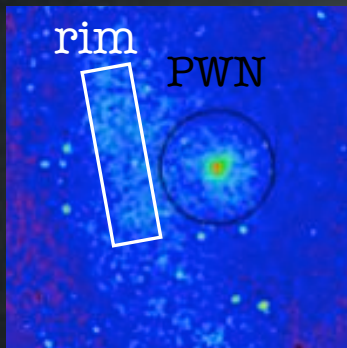
A,C,D clouds @ 700 ± 200 pc
(Liseau+92, Reynoso+96, Moriguchi+01)

^{12}CO integrated cube (Dame+01)



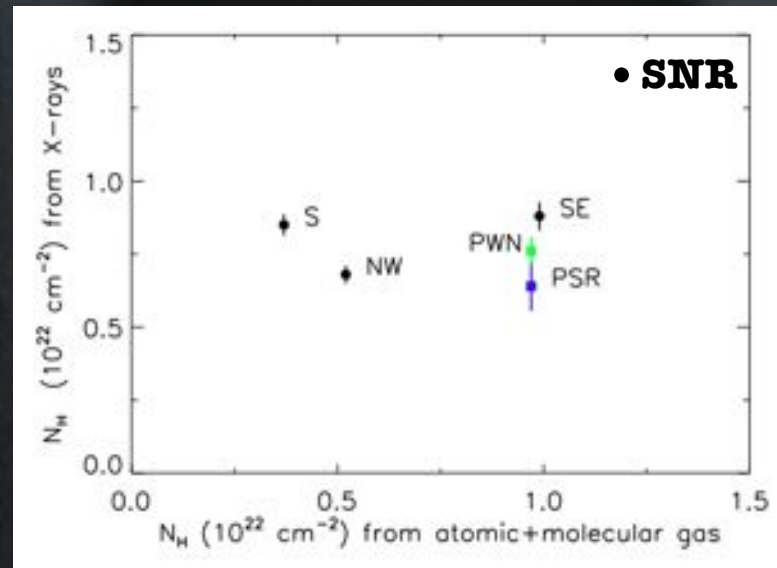
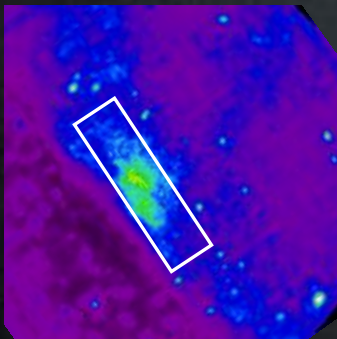
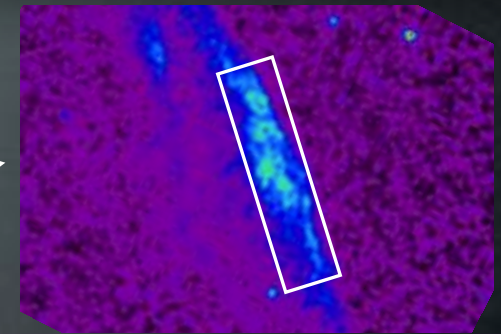
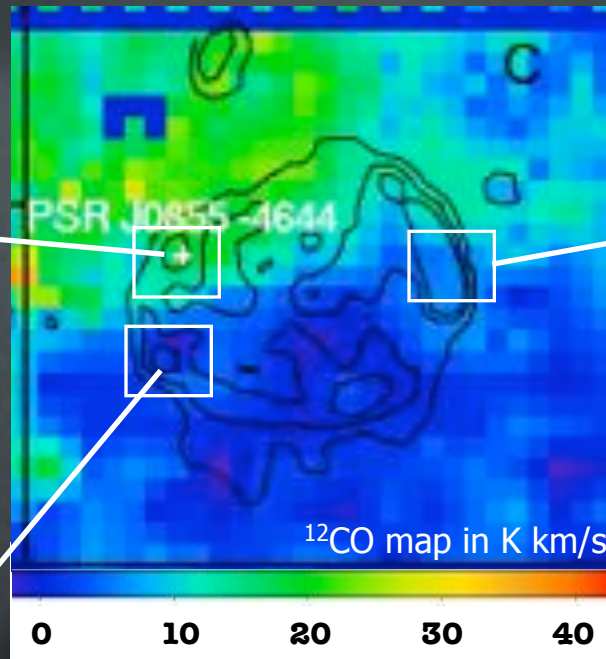
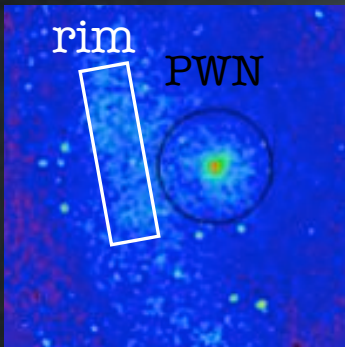
Is the Vela Jr SNR behind the VMR ?

XMM 1-6 keV map



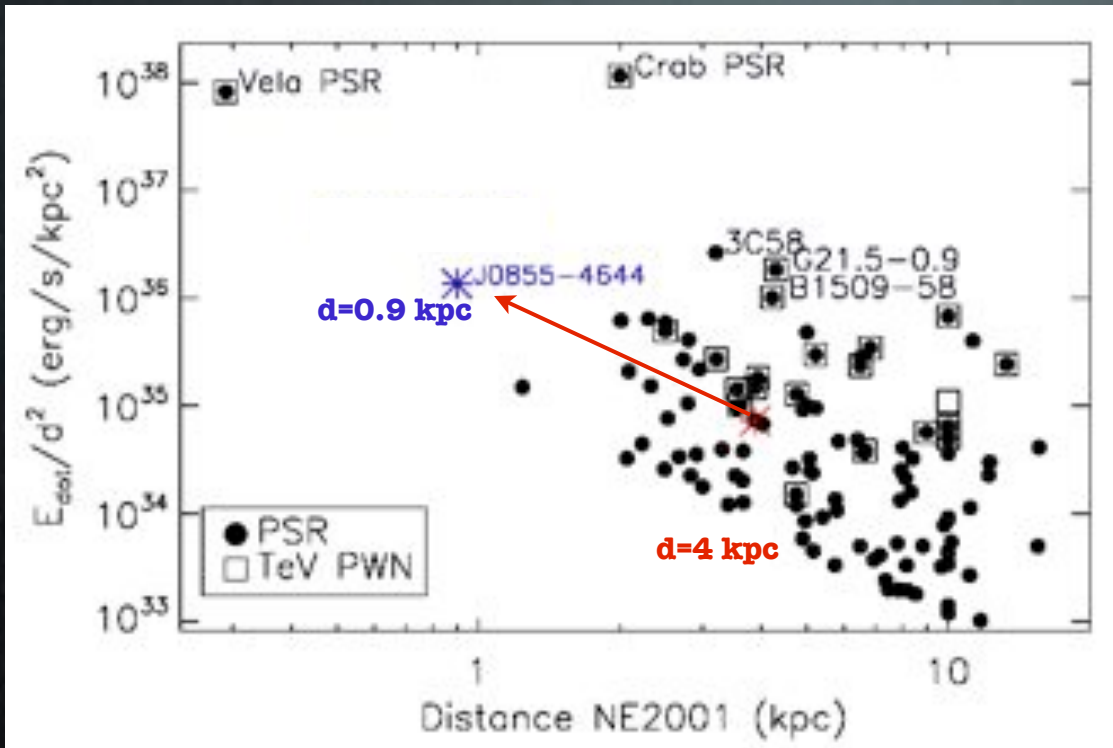
Is the Vela Jr SNR behind the VMR ?

XMM 1-6 keV map



- No correlation
- VelaJr and PSR are in the foreground
- Method is based on relative values of N_{H} not absolute values

Changing distance changes everything



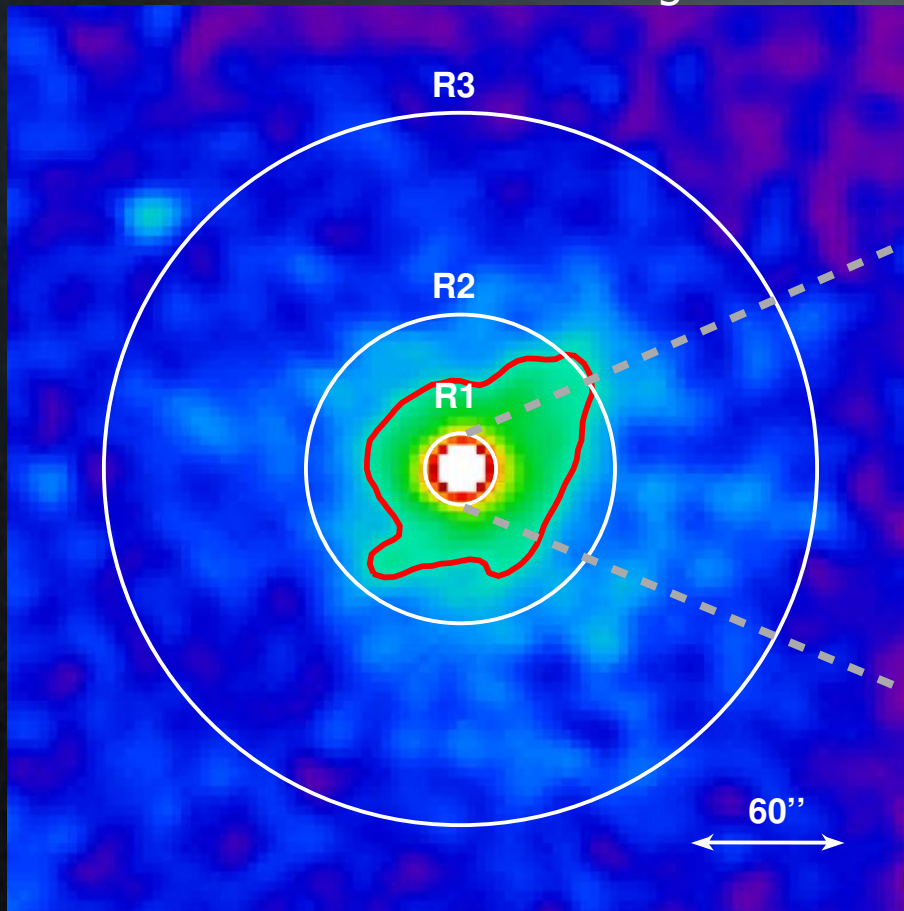
Only psr with $E_{\text{dot}} > 10^{35}$ ergs/s selected

In top 5 E_{dot}/d^2

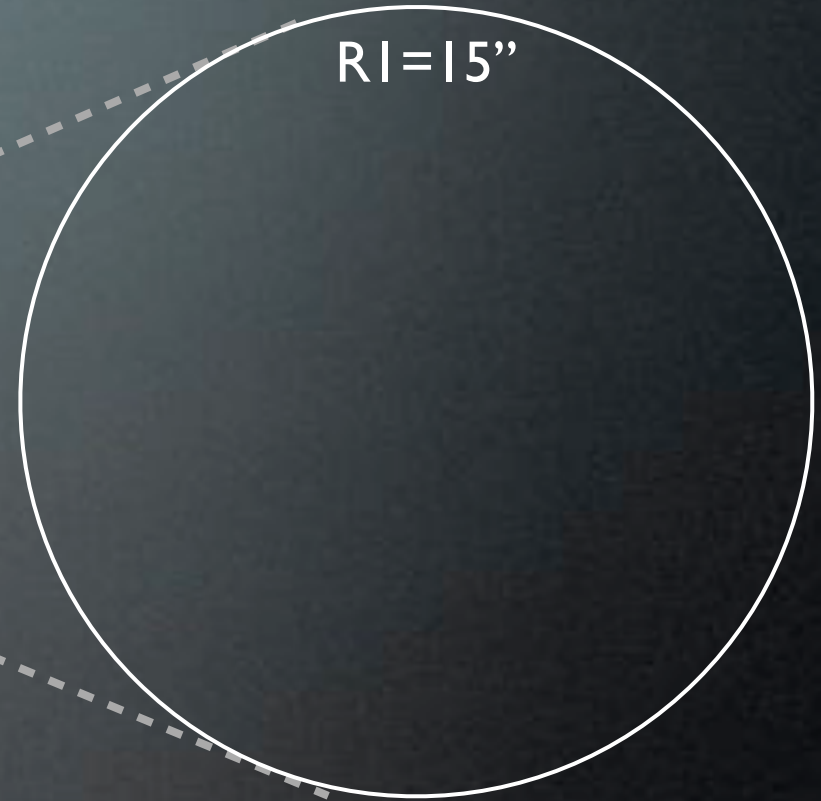
- A nearby & energetic pulsar
- Why wasn't it discovered before ?
 - ↓
 - ↓
 - Embedded in a complex region
- Radio loud - gamma quiet PSR

The surprising Chandra observation

XMM 1.2-6 keV image

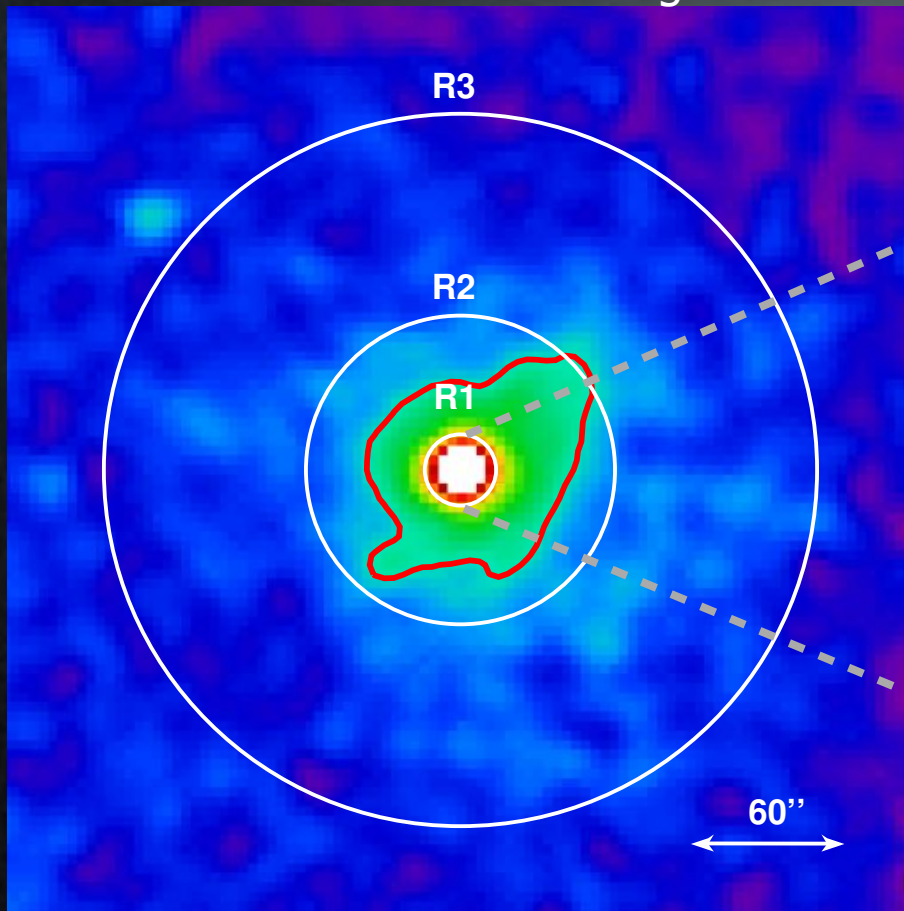


Chandra 0.8-8 keV image

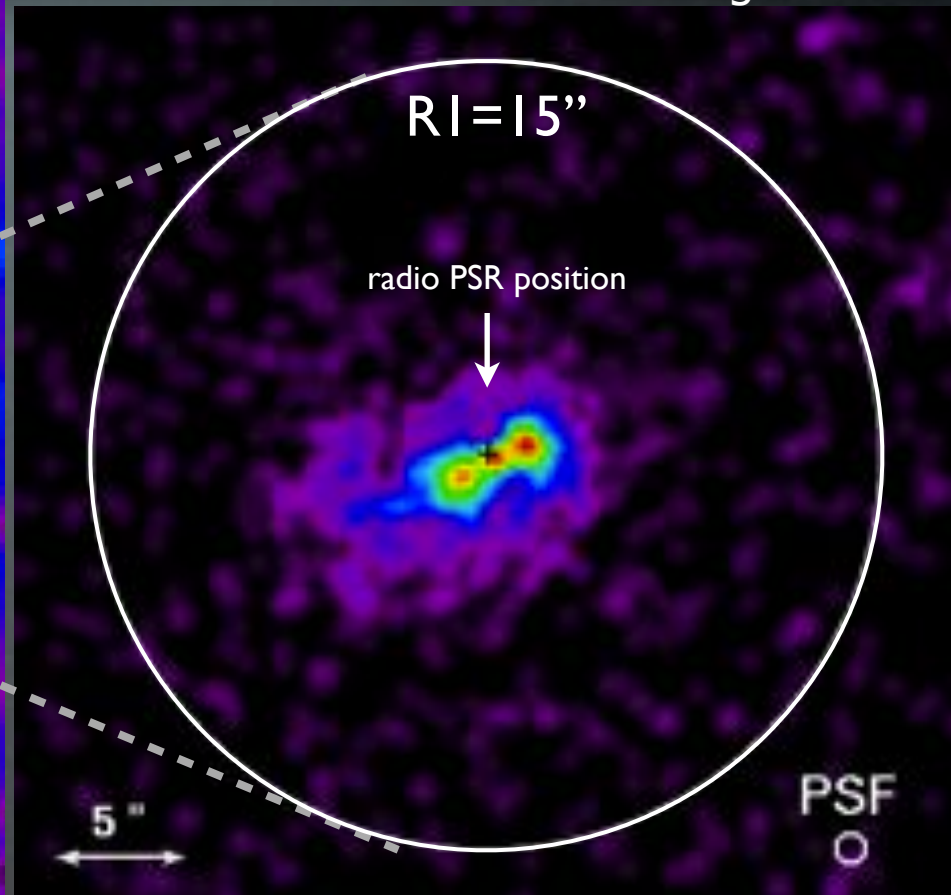


The surprising Chandra observation

XMM 1.2-6 keV image



Chandra 0.8-8 keV image



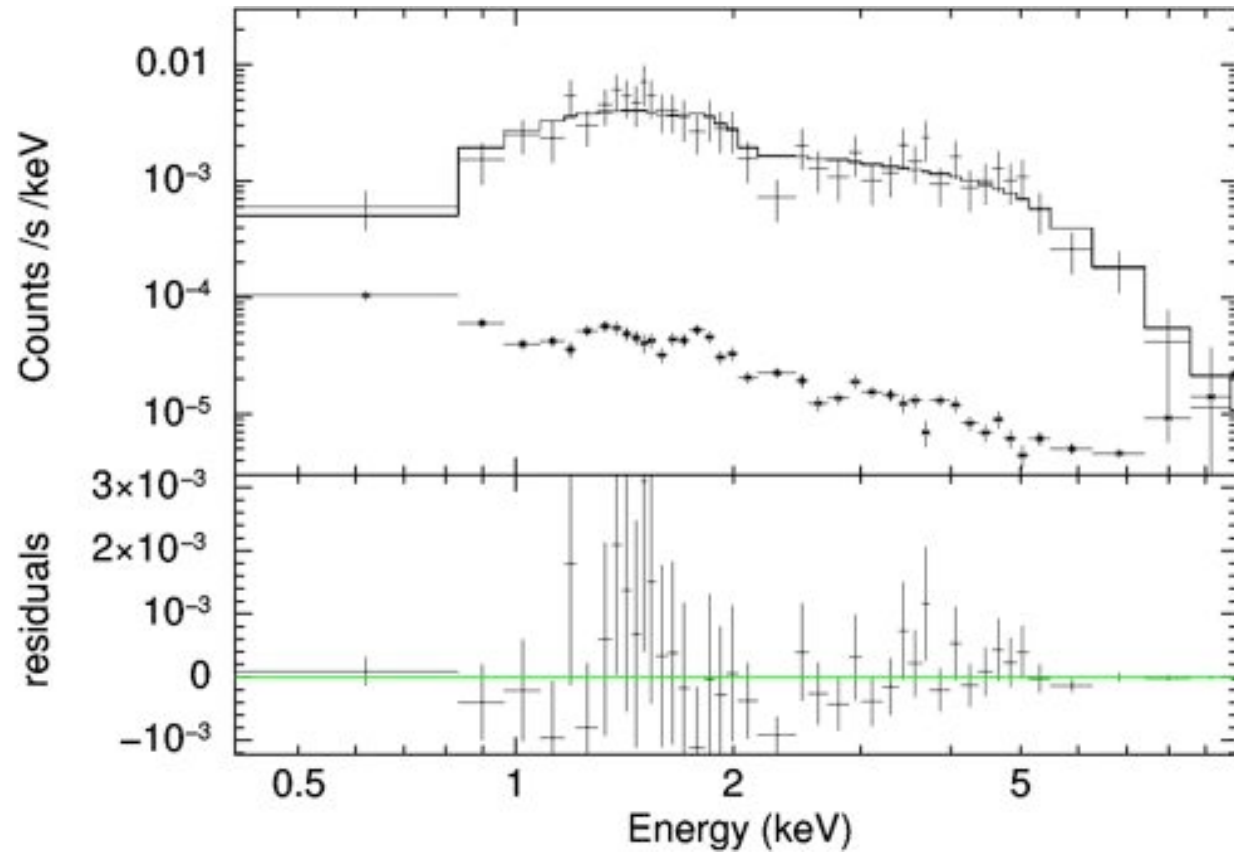
XMM and Chandra show complimentary science

The XMM point-like psr candidate is **not** the pulsar ;-)
PSR is only 5% of the flux in 15''

Confirming the XMM results

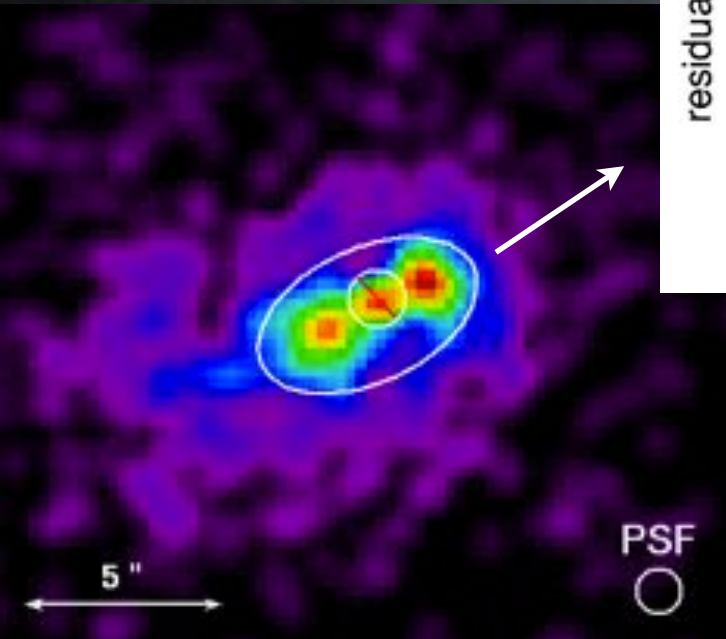
● XMM (R=15'')
 $N_H = (0.64 \pm 0.12) \times 10^{22} \text{ cm}^{-2}$

● Now Chandra (ellipse 3'')
 $N_H = (0.52 \pm 0.22) \times 10^{22} \text{ cm}^{-2}$

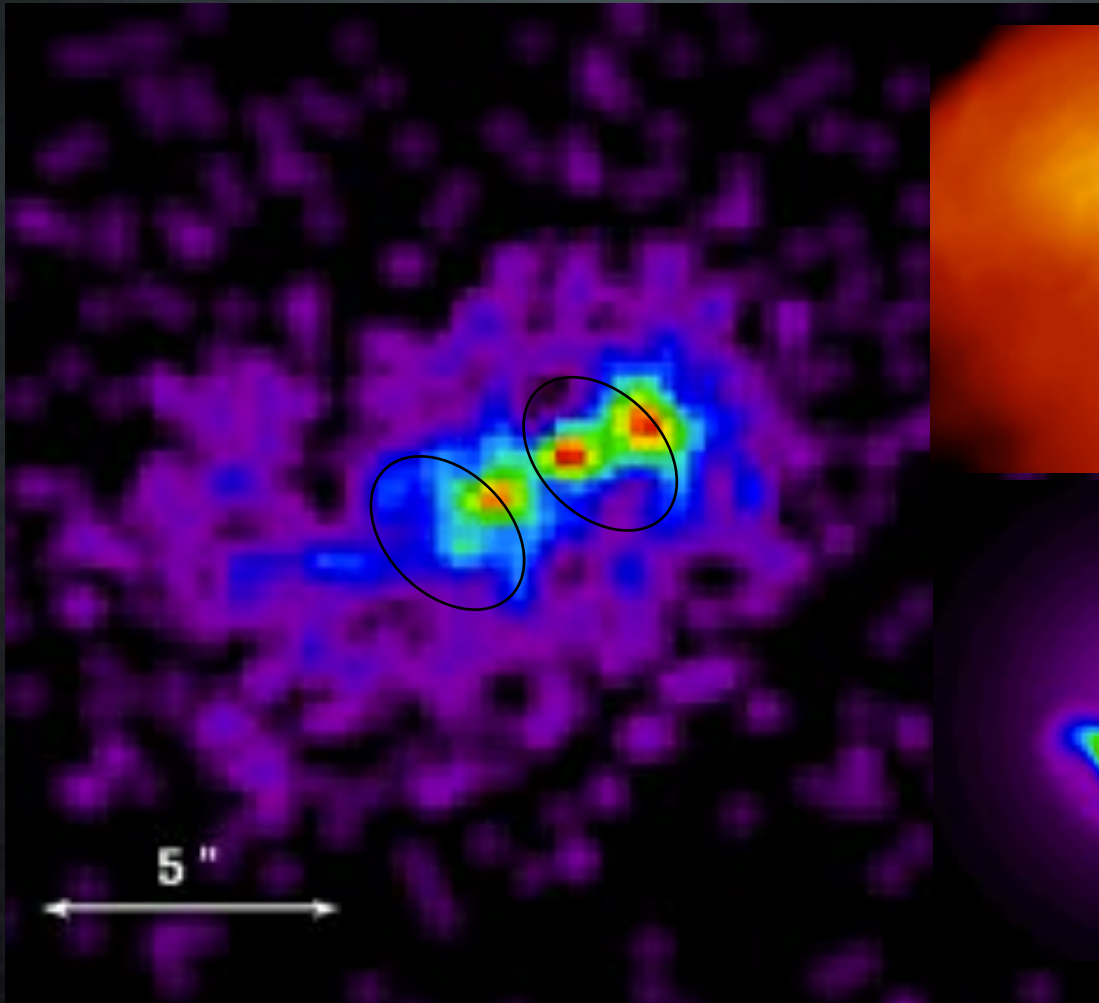


Reducing systematic uncertainties:

- 50 times less thermal emission (smaller area)
- No PSR model assumption

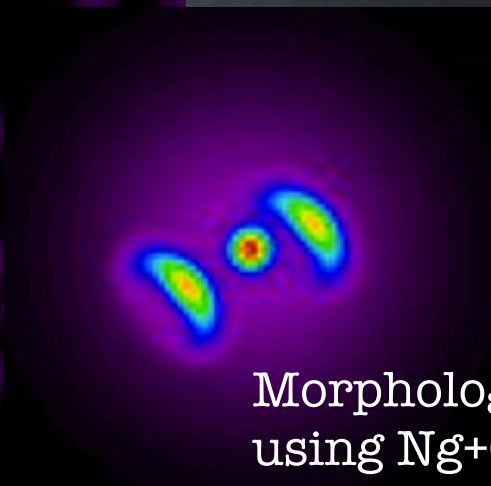


Double torus like Vela ?

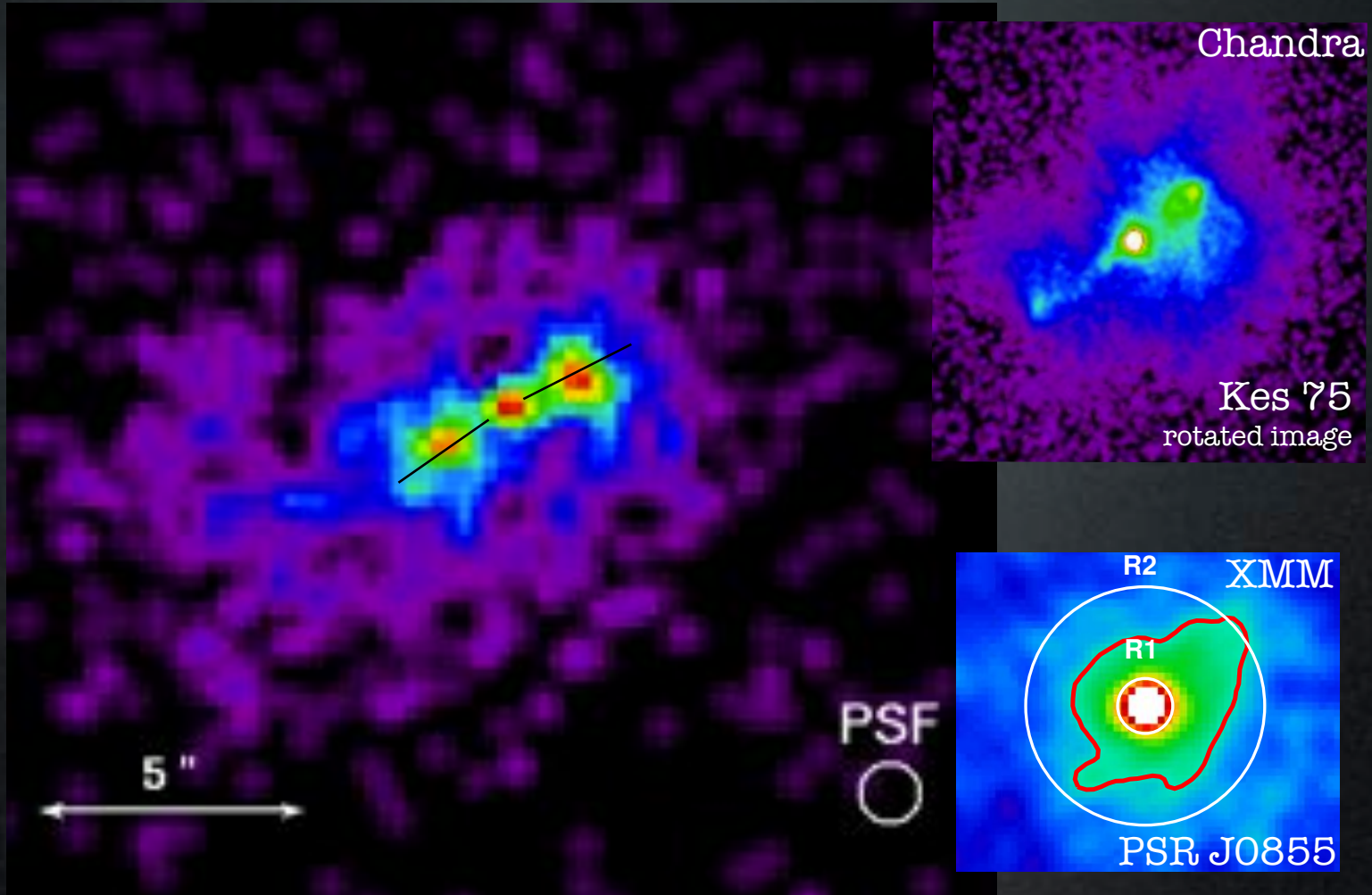


0.8-8 keV image

smooth=0.5"



Jets like Kes75 ?



If $V_{\text{jets}} \sim 0.1 c$ then proper motion in 1 yr is $8''$ @ 900 pc

Conclusion for PSR J0855-4644, the peanut nebula

**Why care : the 2nd most energetic @ $d < 1$ kpc
 γ -ray loud, radio quiet
Contribution in GeV/TeV ?**

- X-ray N_H (XMM+Chandra) and ISM ($^{12}\text{CO}+\text{HI}$) comparison :
 $d_{\text{PSR}} < d_{\text{VelaJr}} < 900$ pc
- Chandra view : Jets or torii or both ?
- Geometry is the key to understand the lack of γ -pulsation
- No PSR proper motion detected in radio (< 100 km/s)
-> PSR is not related to Vela Jr SNR

