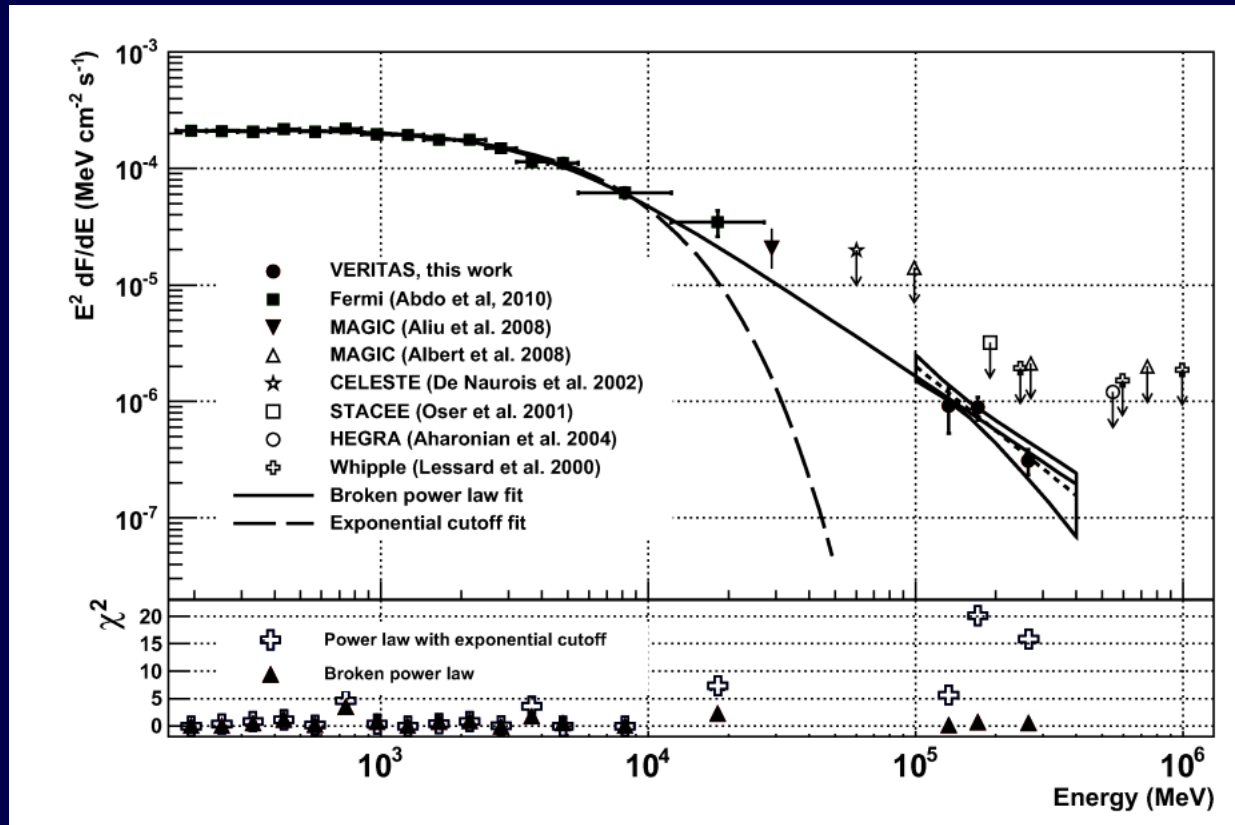


# Can CTAO lead to another pulsar revolution?

# Unexpected class of TeV emitters

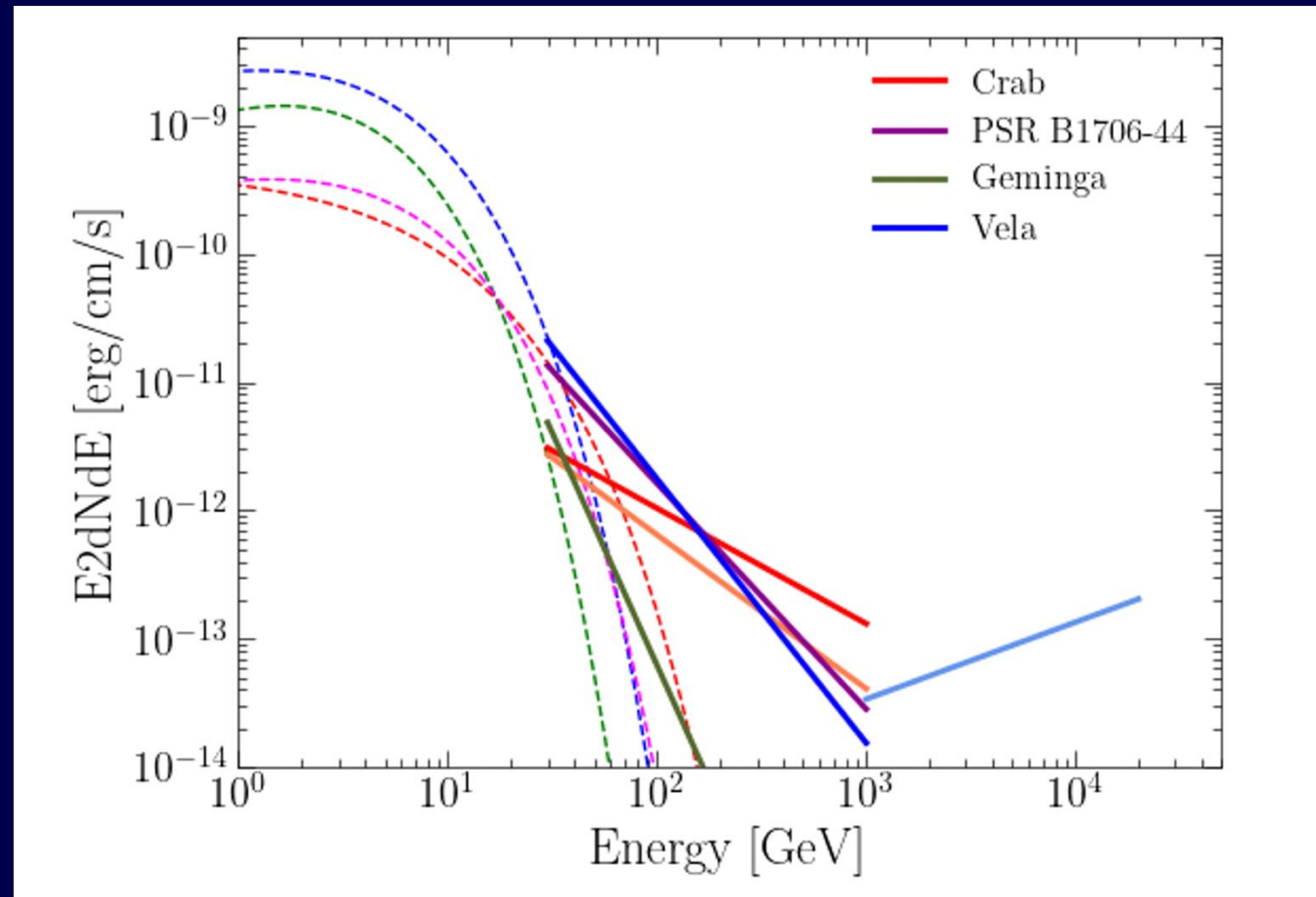
Clear deviation from the expected curvature cutoff: Crab pulsar



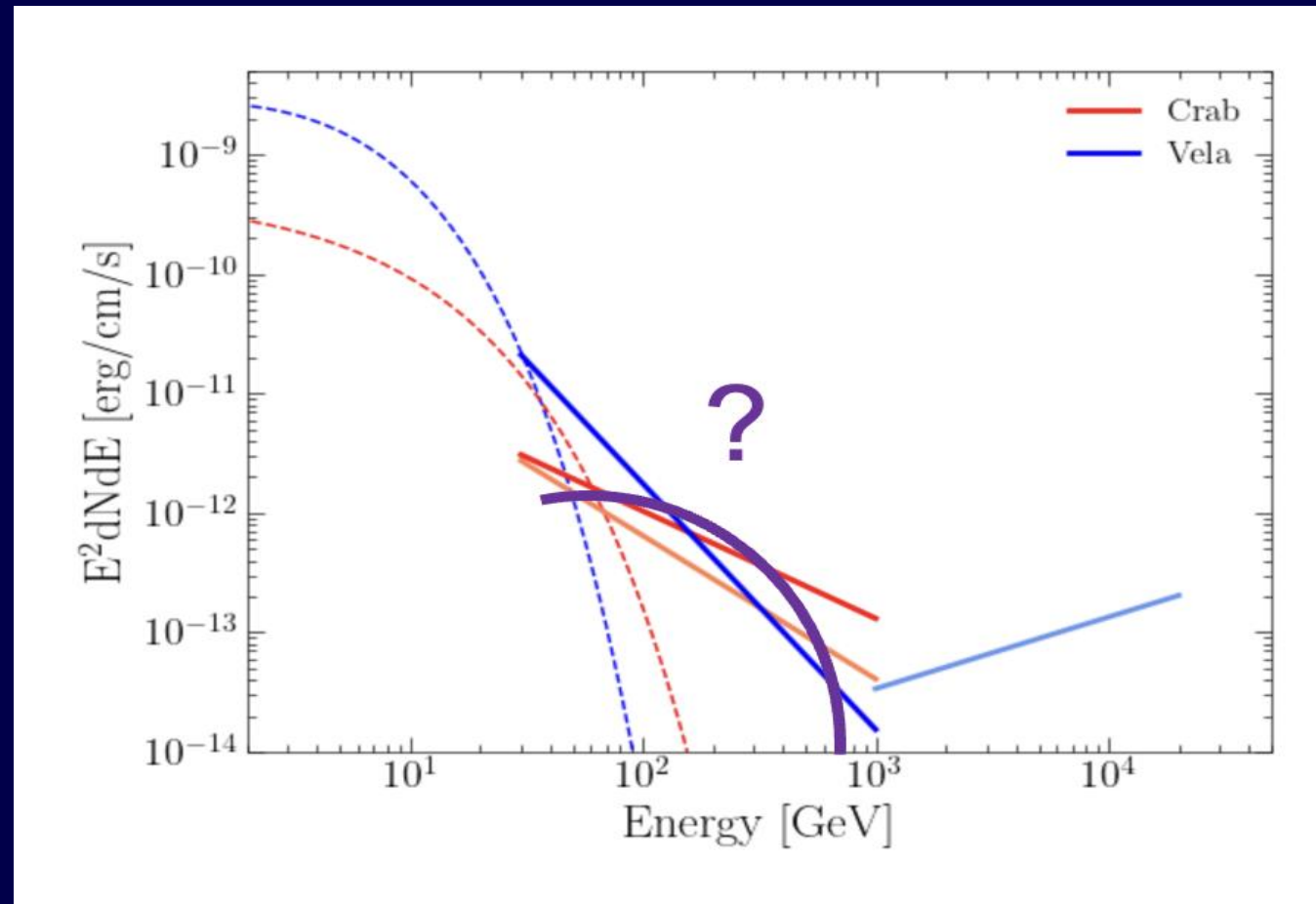
# The population of VHE pulsars

	Age [kyr]	D [kpc]	$\dot{E}/D^2$ [erg/s/kpc <sup>2</sup> ]	$E_{\text{max}}$ [TeV]	$\Gamma_{\text{vhe}}$
Crab	1.2	2	$5 \times 10^{38}$	1.5	3-3.5
Geminga	340	0.2	$7 \times 10^{35}$	0.070	5.62
PSR B1706-44	18	2.6	$6 \times 10^{35}$	0.075	3.76
Vela	11	0.3	$1 \times 10^{38}$	0.1	4.1
Vela+	-	-	-	-	-
PSR J1509-5850	154	3.5	$3.5 \times 10^{33}$	?	?

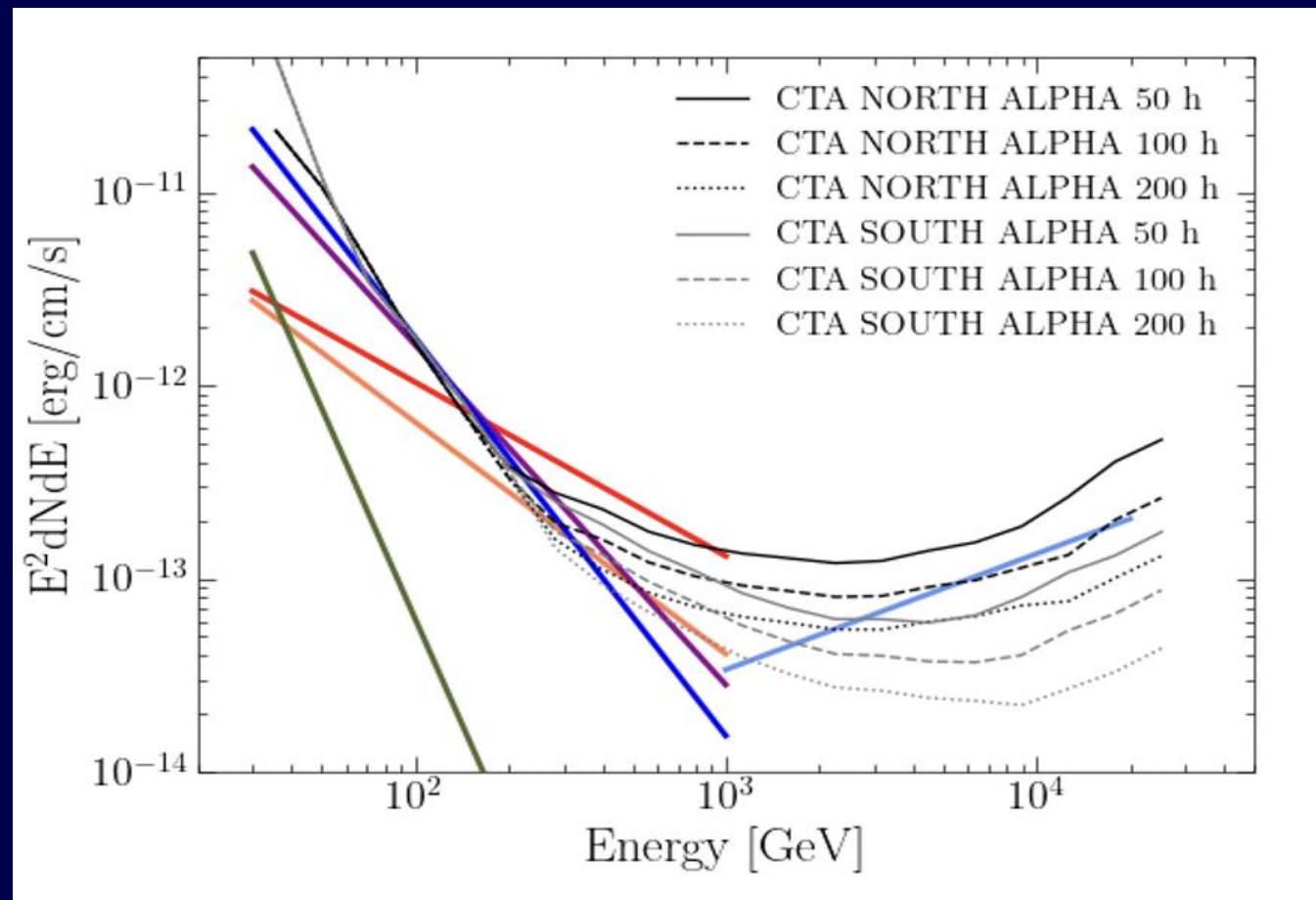
# The population of VHE pulsars



# The population of VHE pulsars



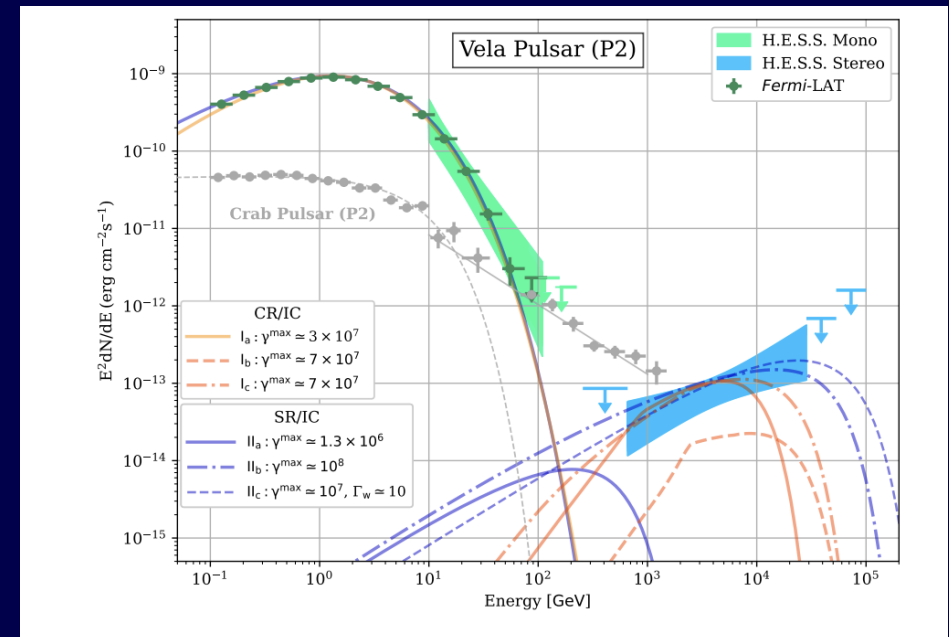
# The population of VHE pulsars



# What to plan for the future?

- Search for pulsed emission within the Galactic Plane Survey observations  
→ pulsar timing becomes fundamental!
- Identify potential candidates:
  - to get the ephemerides ready
  - to prepare deeper observations – if needed

Crab-like & Vela-like ?

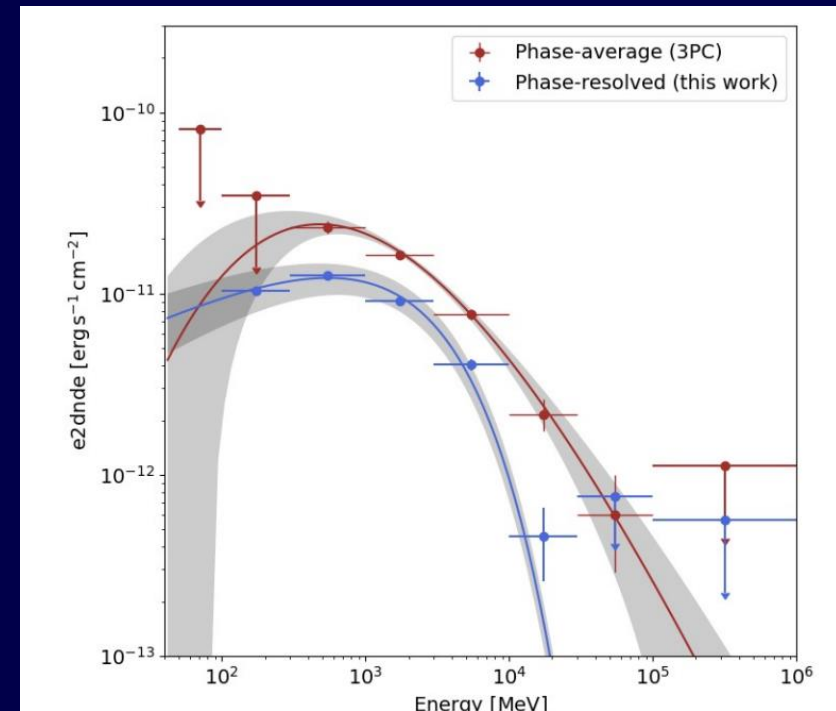


H.E.S.S. coll. 2023

# What to plan for the future?

- Extrapolation of the Fermi-LAT curves
  - Important to use phase-resolved SED
  - important to control the background in complex regions to avoid to overestimate the flux
- Phenomenological estimation of a new inverse Compton component
  - IC luminosity depends strongly on the low-energy photons

PSR J1833-1034

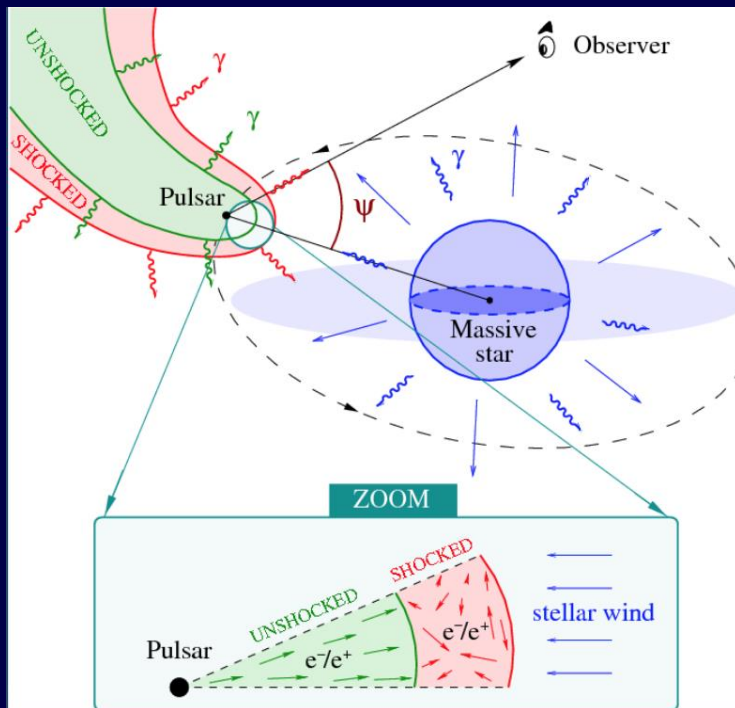


*Credits to M. Regnard & A. Djannati-Atäi*



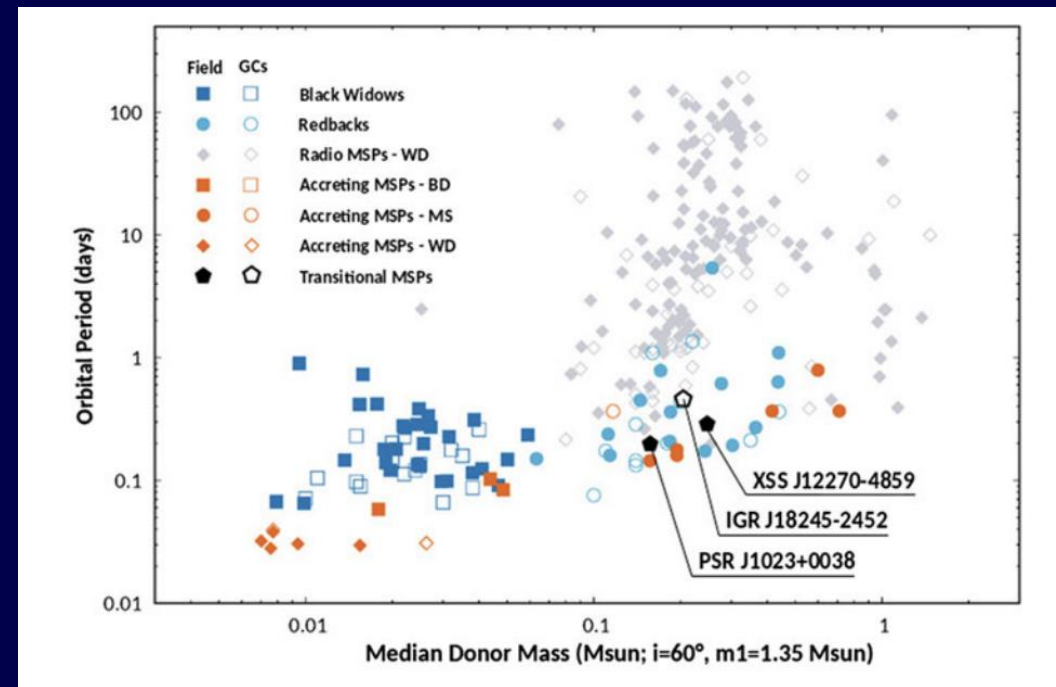
# Pulsars in binaries

## gamma-ray binaries



more PWN-like phenomenon in formation

## MSP in binaries



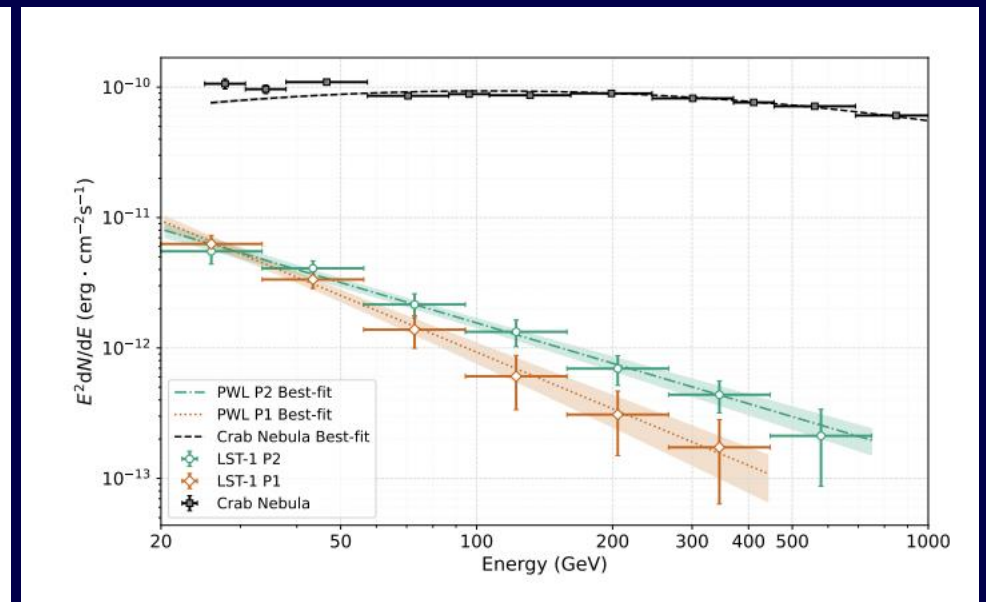
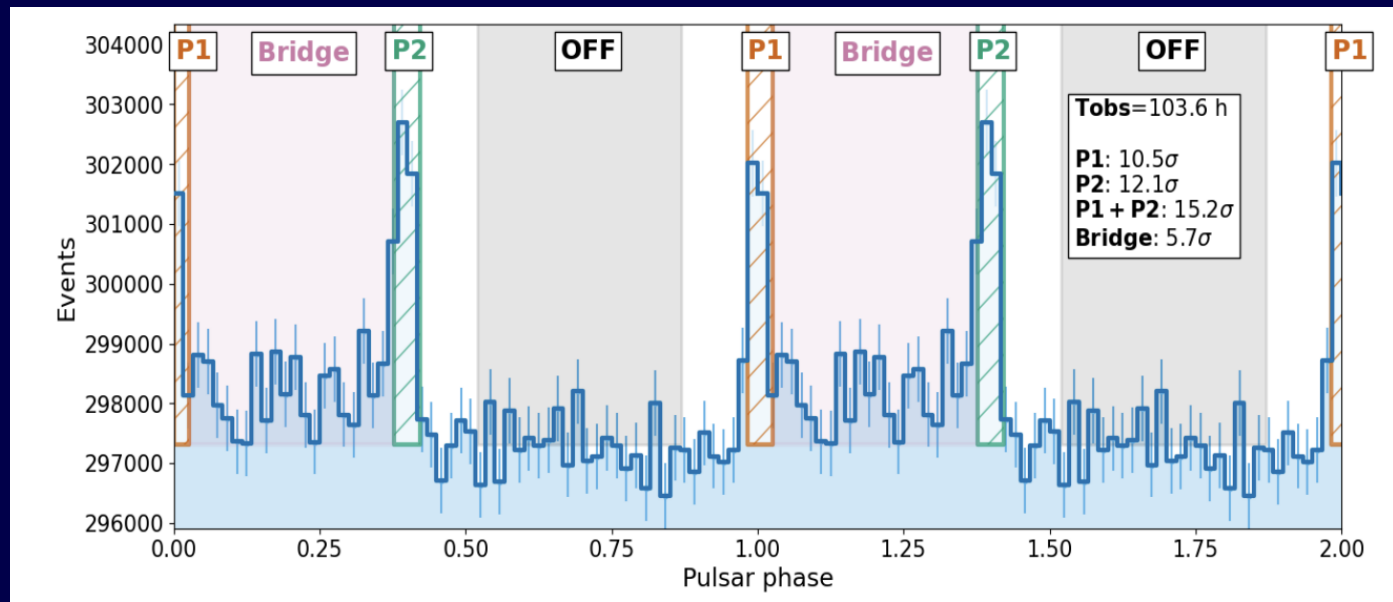
gamma-ray emission in the intrabinary shocks

# First results with the LST-1

## Crab pulsar

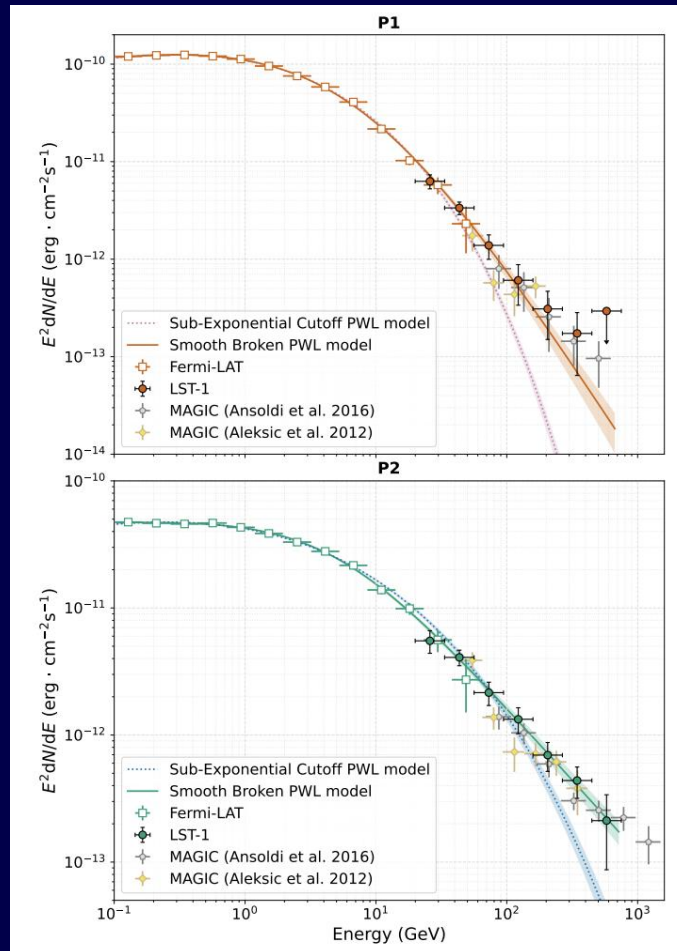
103 hr @  $z_d < 50^\circ$

LST coll. A&A 2024

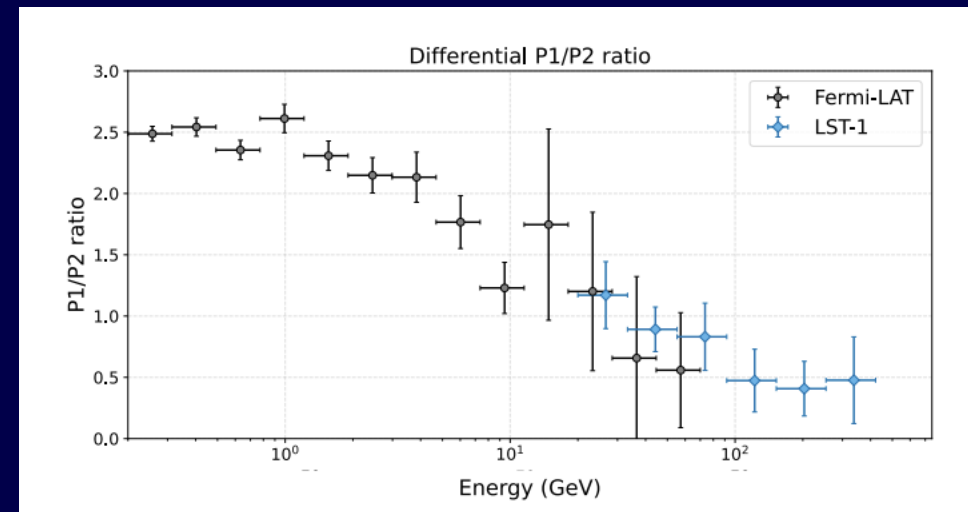


# Science verification: a success

## Crab pulsar



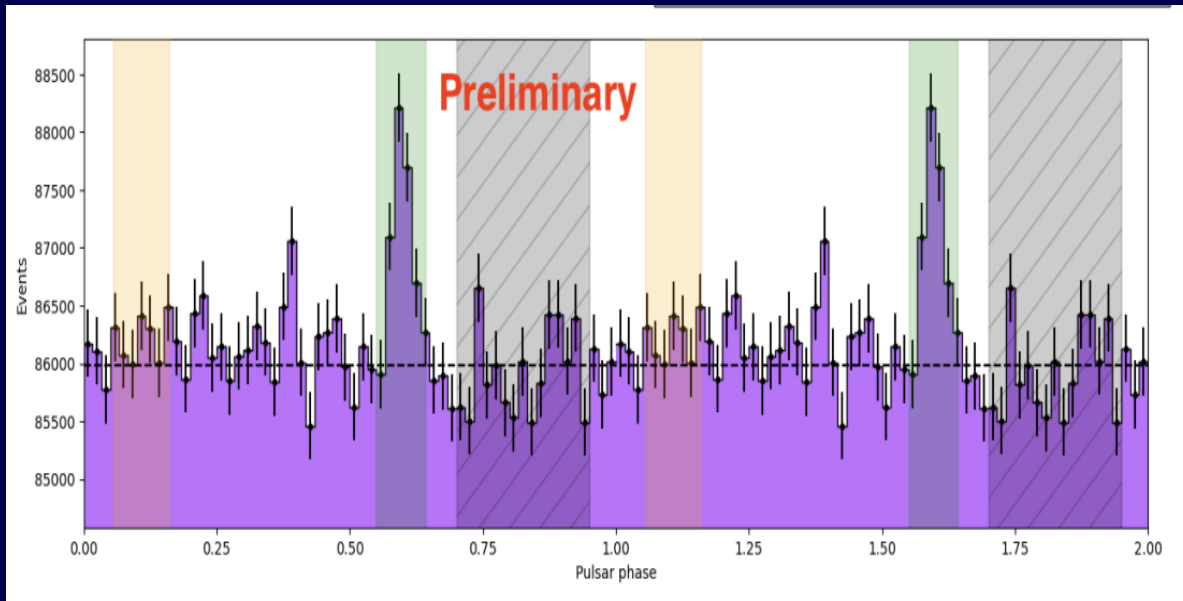
LST coll. A&A 2024



# Science verification: a success

## Geminga pulsar

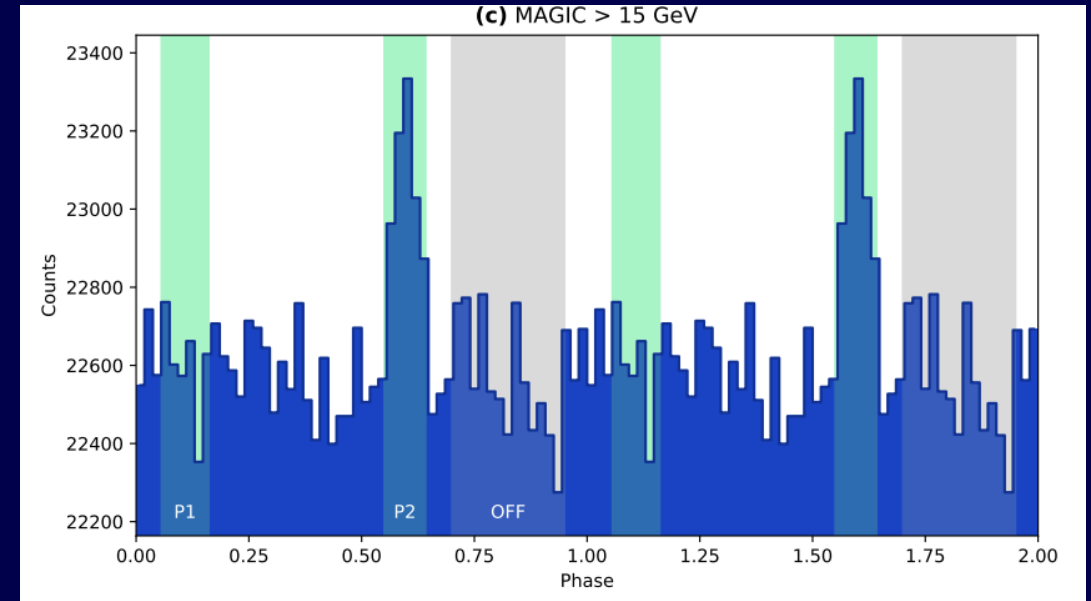
20 hr @  $z_d < 25^\circ$   $7.9\sigma$



*A. Mas-Aguilar + 2023 PoS(ICRC2023)*

at least similar threshold with std trigger

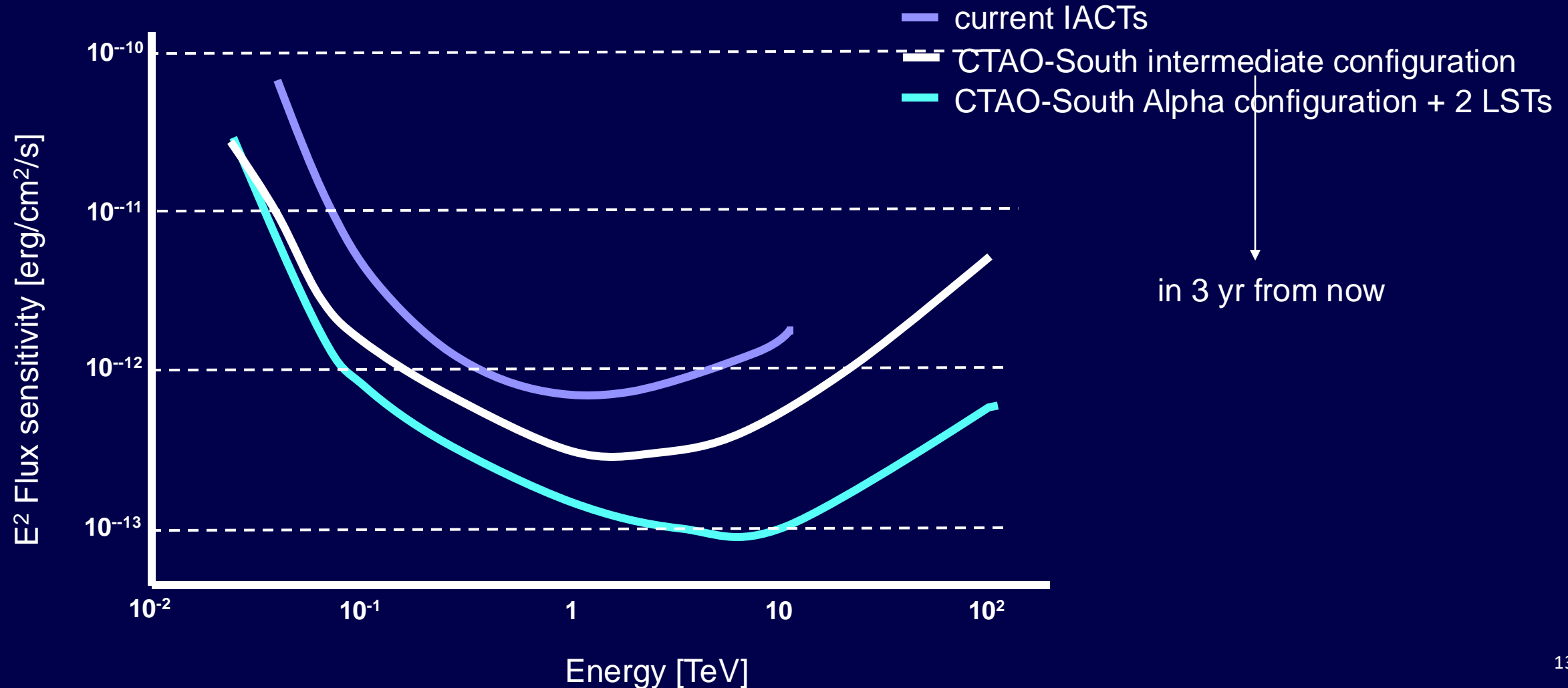
80 hr @  $z_d < 25^\circ$   $6.25\sigma$



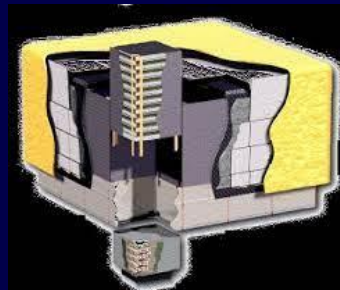
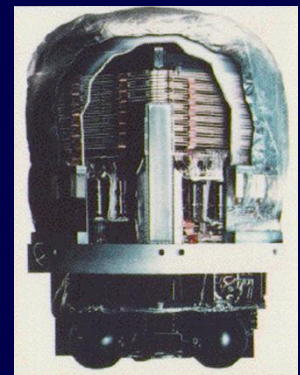
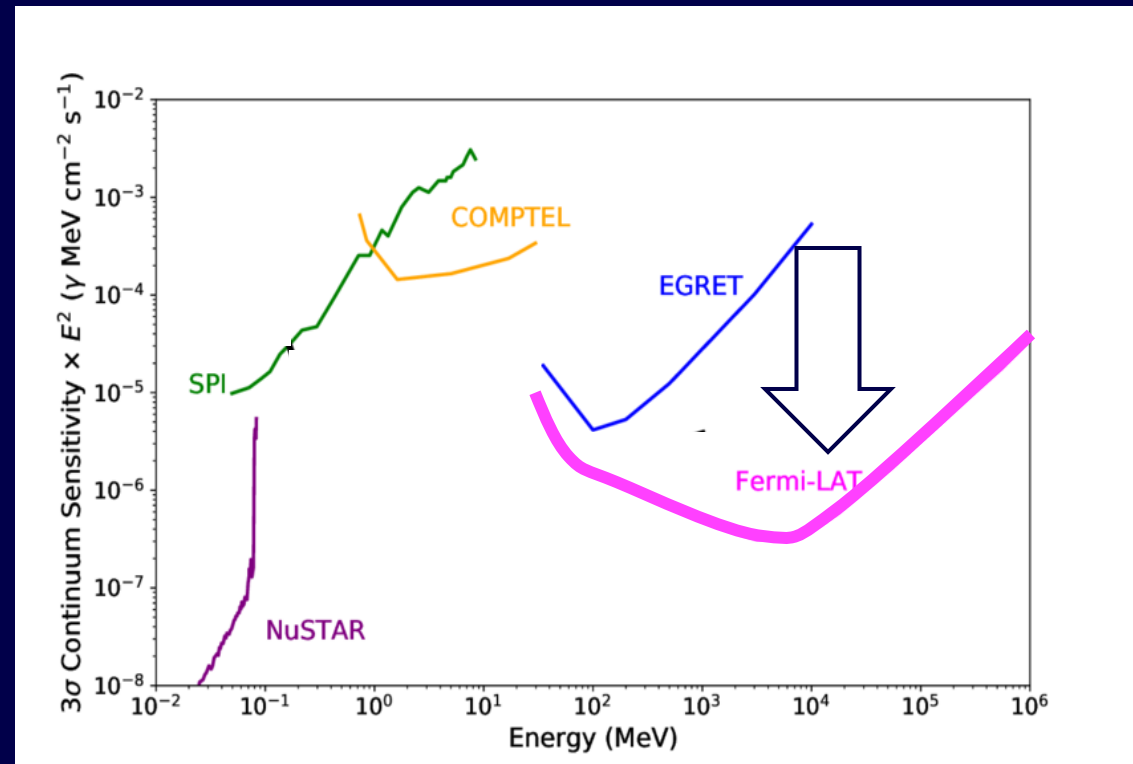
*MAGIC coll. A&A 2020*

$E_{th} \sim 15$  GeV with sum trigger

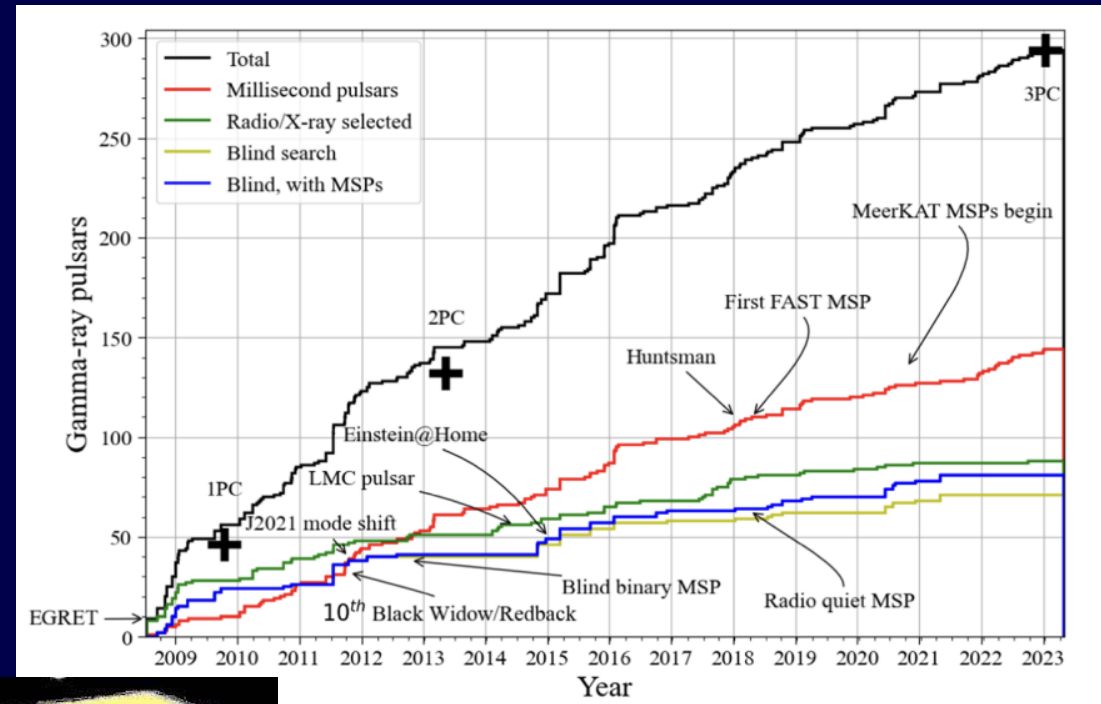
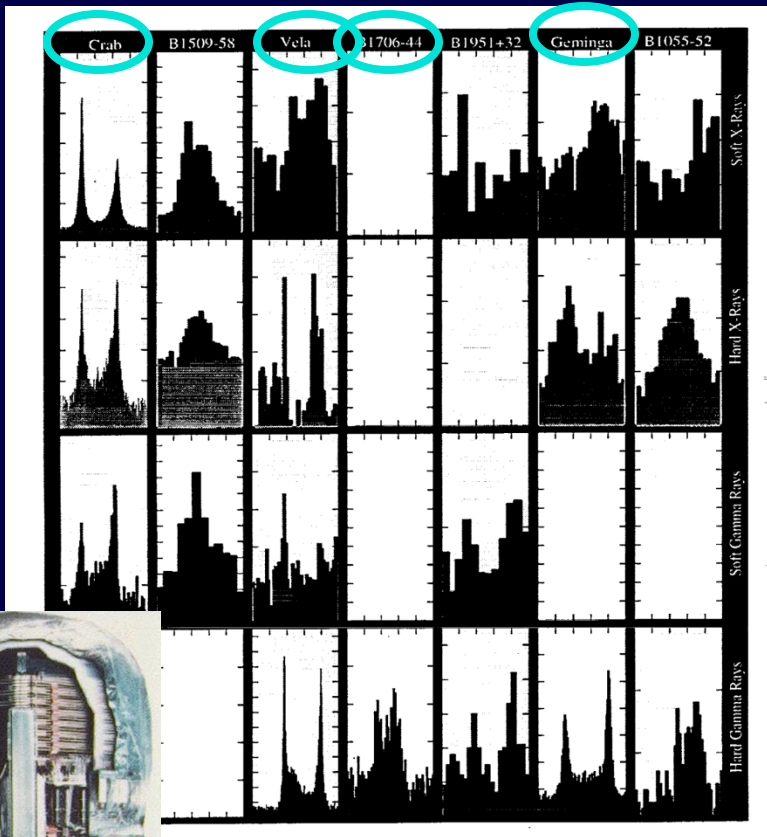
# A bright future ahead of us



# Conclusions

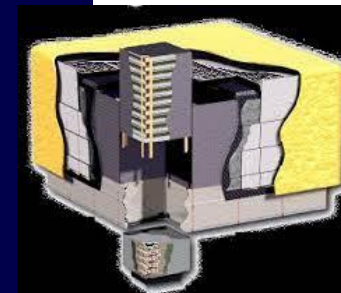


# Conclusions

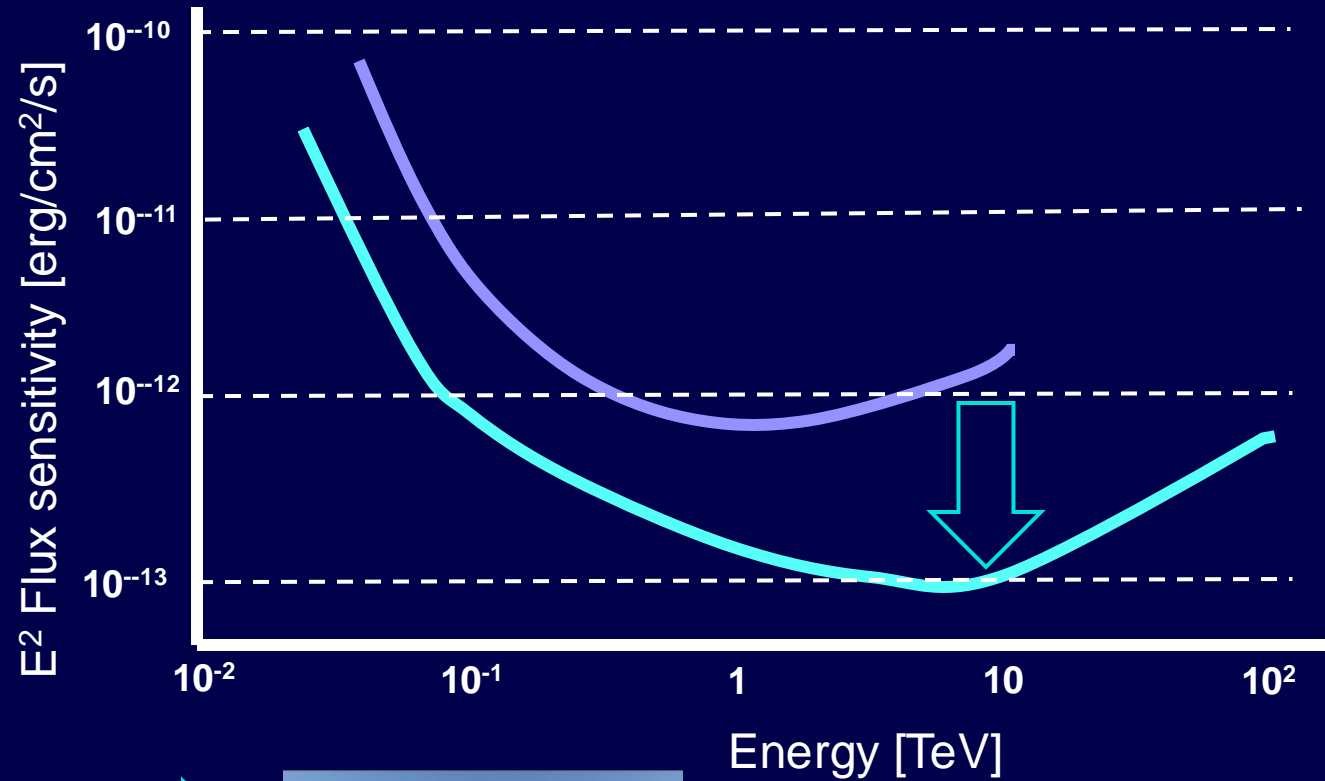


*Fermi/LAT coll. 2023 (3PC)*

*Thompson 2001*



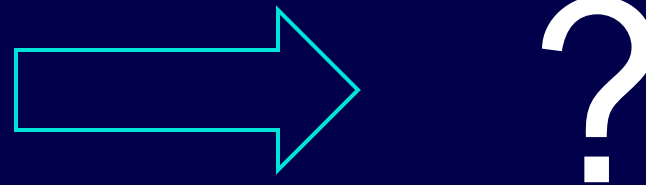
# Conclusions





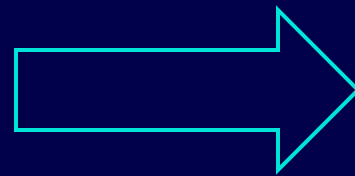
# Conclusions

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**We need to get prepared!**

- timing is fundamental!
- pulsar analysis within the science analysis tools



# Open questions for CTAO

- What's the nature of the tails above the curvature cutoff? Where is this radiation produced?
- What's the nature of the multi-TeV component?
- How many Crab-like and Vela-like pulsars?  
The detection of J1509 – a normal pulsar – is very promising!
- Can we constrain the Op/IR photon fields with the gamma ray results (→ electron density and max energy)?

Thank you

