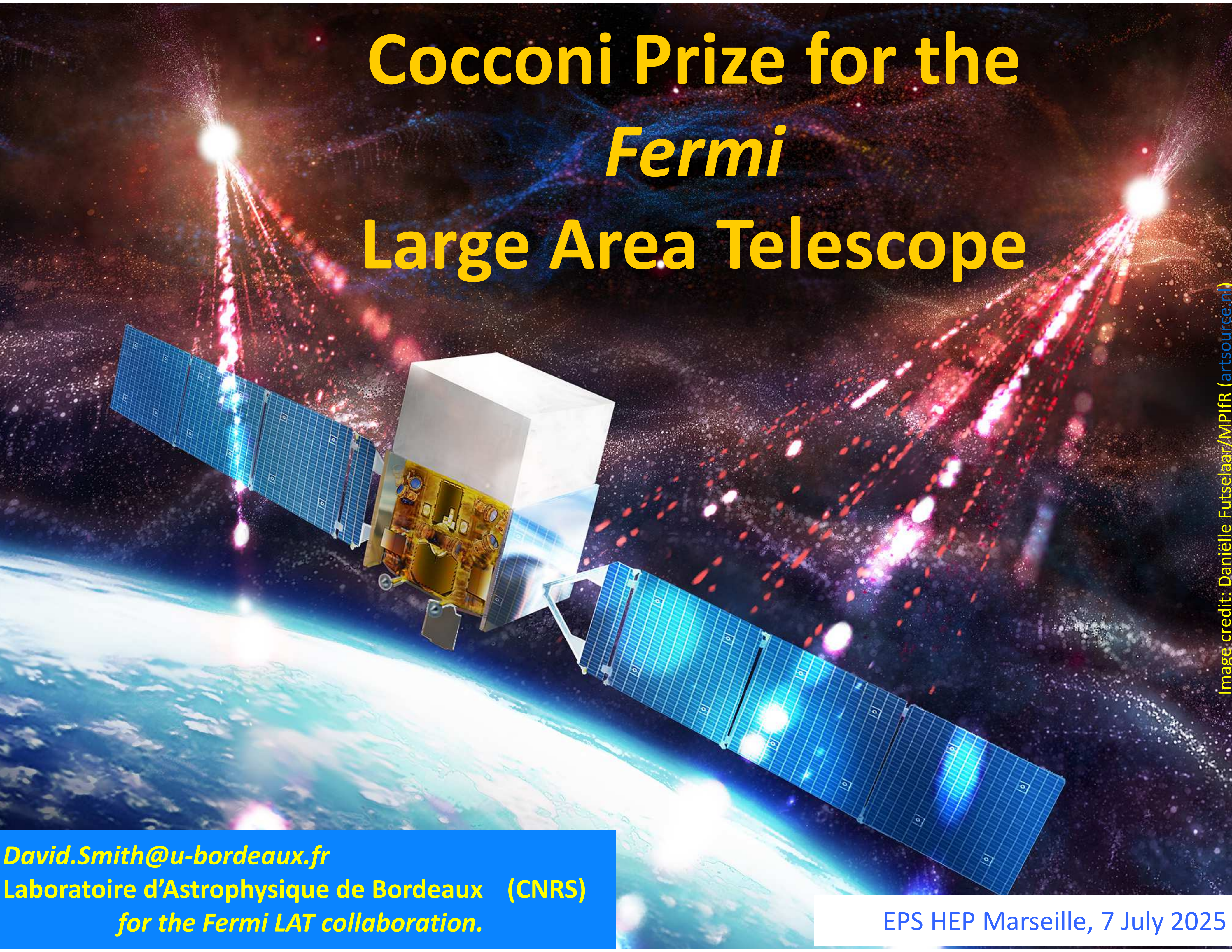
Cocconi Prize for the *Fermi* Large Area Telescope

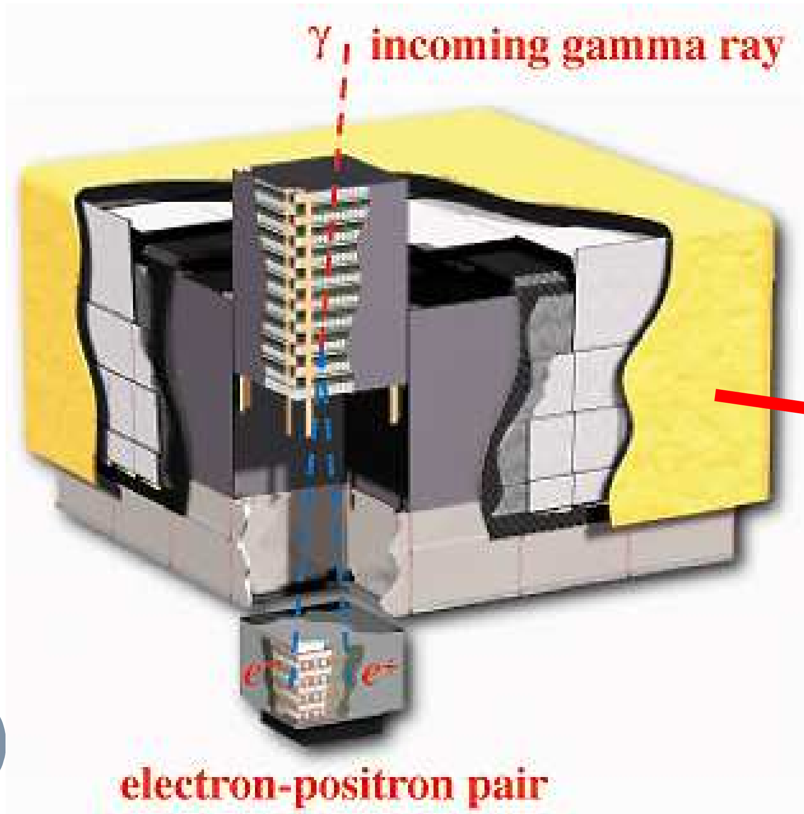


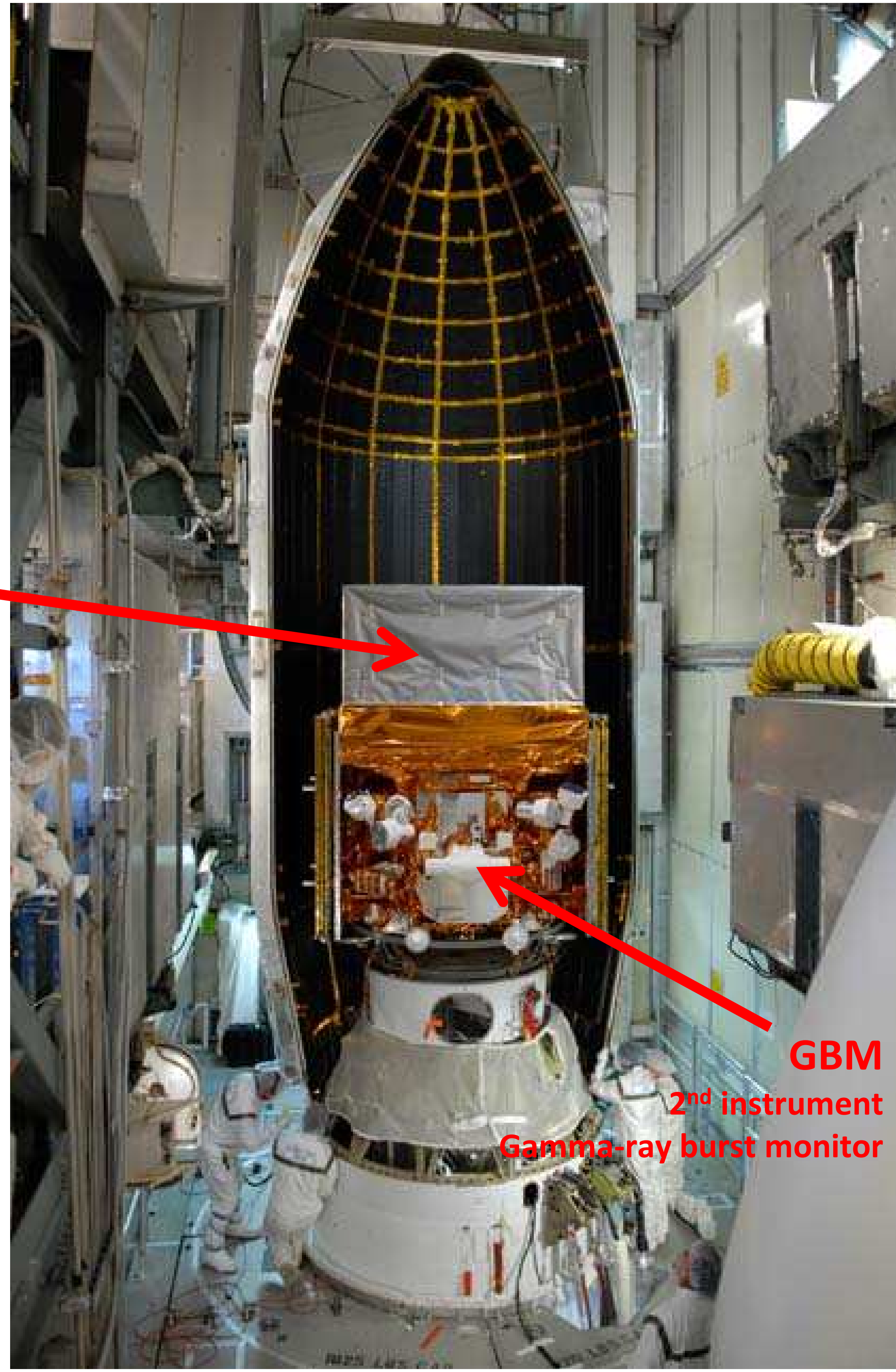
David.Smith@u-bordeaux.fr
Laboratoire d'Astrophysique de Bordeaux (CNRS)
for the Fermi LAT collaboration.

EPS HEP Marseille, 7 July 2025


11 June 2008
Fermi
Gamma-ray
Space Telescope
Formerly "GLAST"

Large Area Telescope
30 MeV to 300 GeV





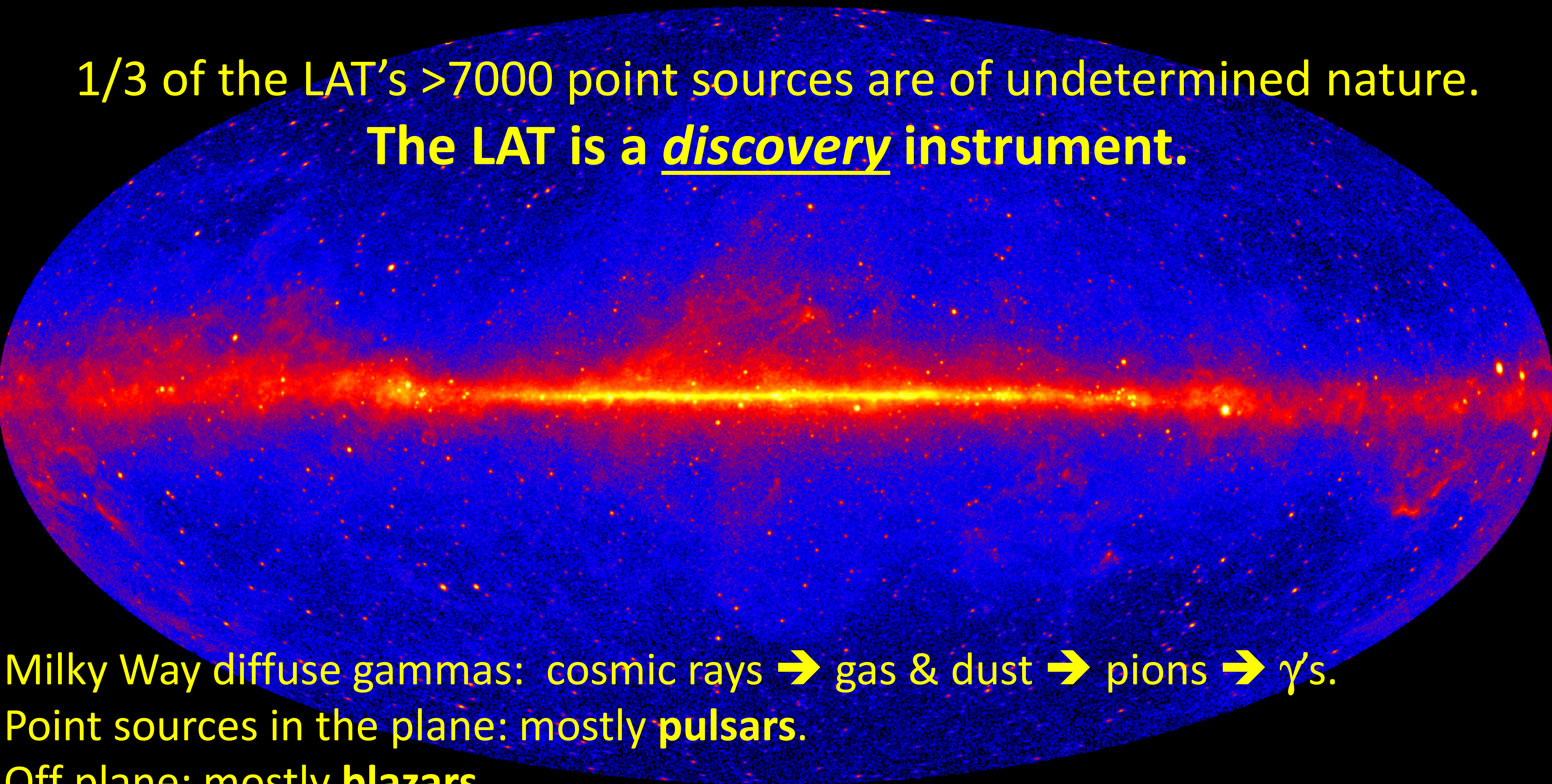
The whole sky, 8 times per day:

- Known and unknown sources.
  - Good localization.

Filming the gamma-ray sky since 2008…

1/3 of the LAT's >7000 point sources are of undetermined nature.

The LAT is a *discovery* instrument.

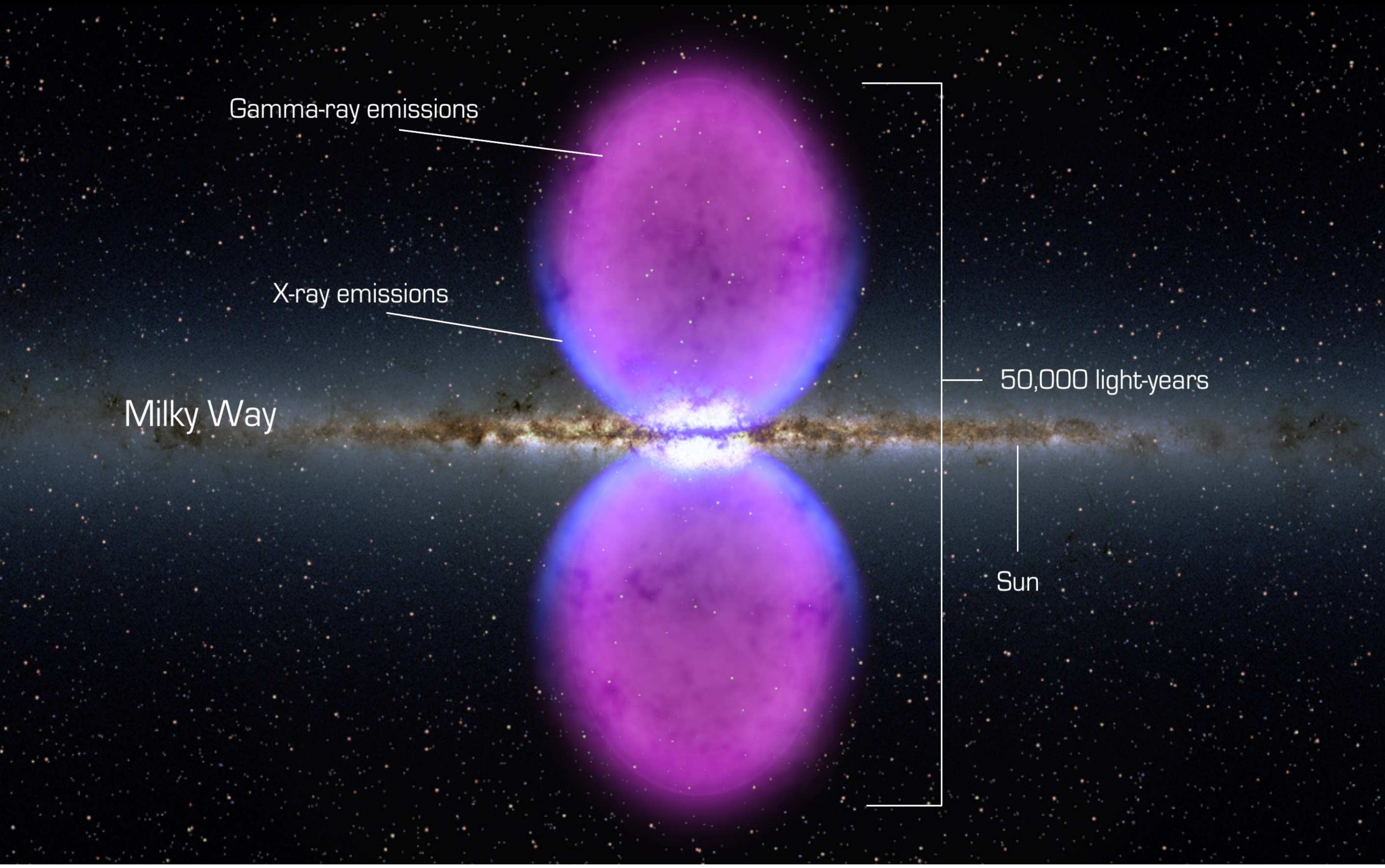


Milky Way diffuse gammas: cosmic rays → gas & dust → pions → γ's.

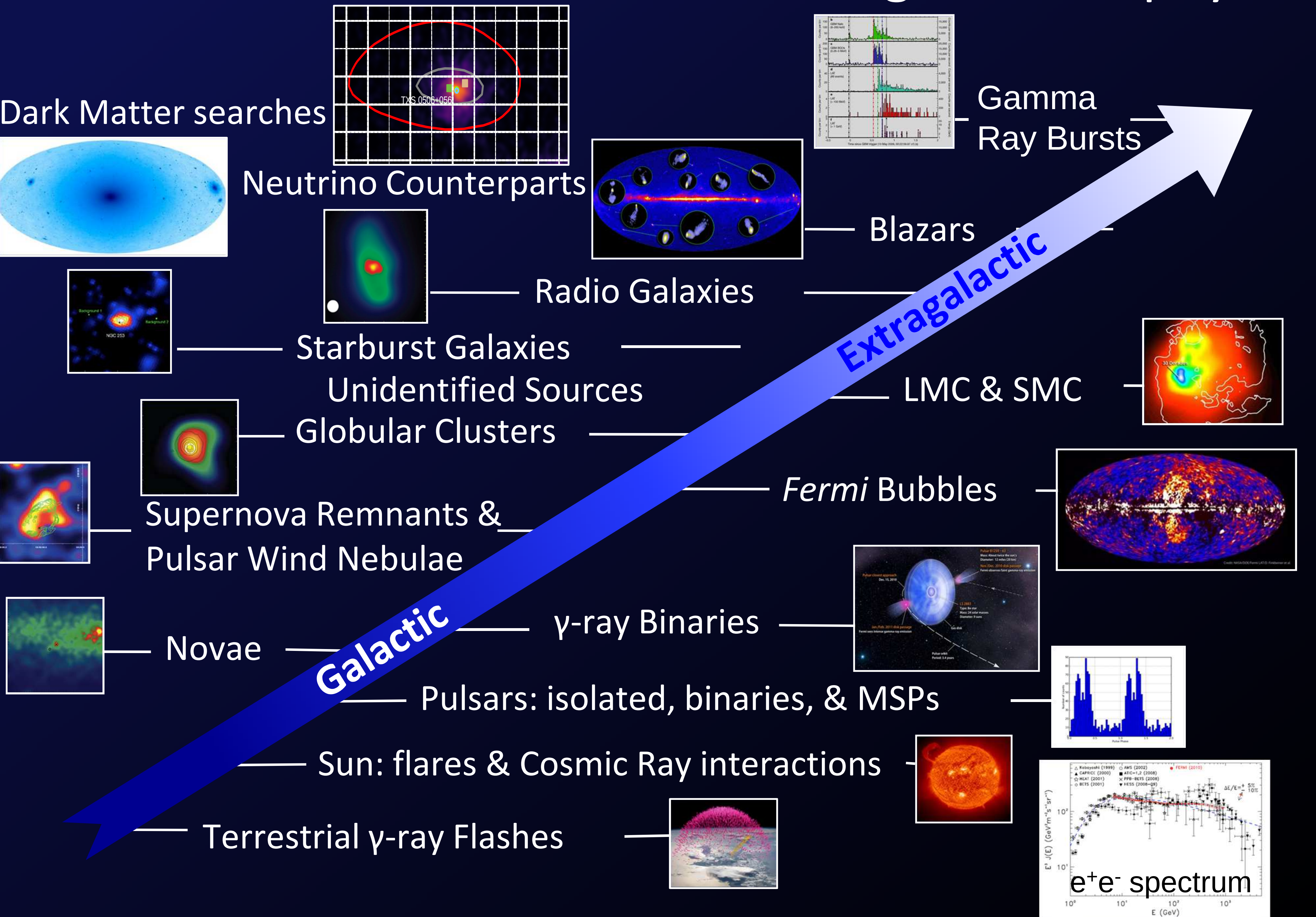
Point sources in the plane: mostly **pulsars**.

Off plane: mostly **blazars**.

The Fermi Bubbles:
Past activity at the heart of the Milky Way.



Fermi discoveries cover a broad range of astrophysics



Vanna Tongiorgi & Giuseppe Cocconi with a cosmic ray detector.

LIFE magazine, 8 November 1948.

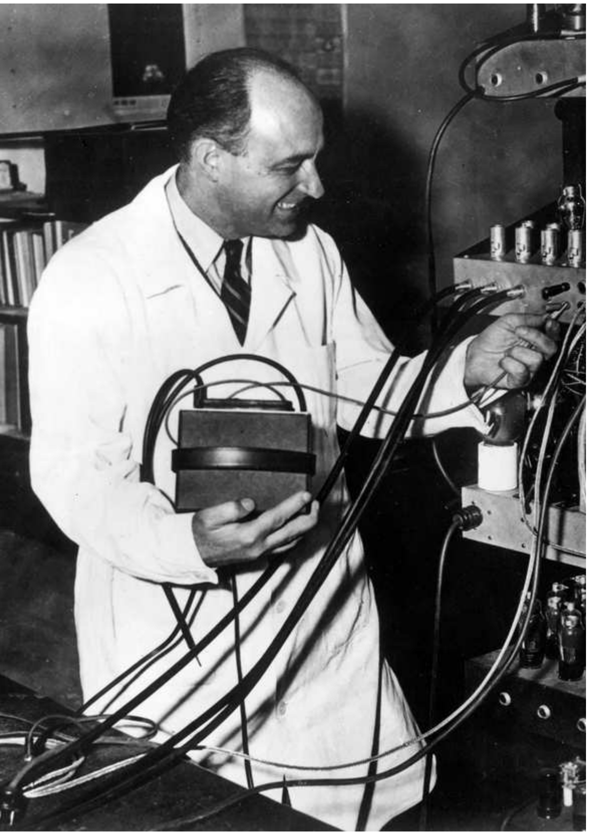
1938: GC founds cosmic ray research in Milan.
VT begins her thesis work.

1945: They wed.

1947: Hans Bethe has Cocconi become tenured Professor at Cornell. They both go.

1938: Cocconi (age 24) joins Fermi (age 37) in Rome.

They make cloud chambers
to study meson decay.



THE UNIVERSITY OF CHICAGO
CHICAGO 37 · ILLINOIS
INSTITUTE FOR NUCLEAR STUDIES

March 12, 1949

Professor G. Cocconi
Cornell University
Laboratory of Nuclear Studies
Ithaca, New York

Dear Cocconi:

Excuse my answering in English your letter, since by doing so I can dictate to my secretary. I have been very much interested by your statement that you have evidence of the existence of large showers up to 10^{17} eV.

The reason why, according to the theory on the origin of cosmic rays that I have proposed, no electrons should be found, is that I postulate the existence throughout the interstellar space of a magnetic field with an intensity of about 10^{-5} - 10^{-6} gauss. If this assumption is correct, the radiation loss for a fast electron is quite large and prevents it from acquiring a sizeable energy. This mechanism of energy loss by electrons is much more efficient in removing fast electrons than the mechanism of the inverse Compton effects discussed by Feenberg and Primakoff. On the other hand, the existence of this last effect is much less hypothetical because all that is needed to produce it is the existence of the stellar light in the space traversed by the cosmic rays during their life. I have not read the article of Feenberg and Primakoff with particularly great attention, but as far as I can see, their conclusions seem to me to be sound.

You probably know that Teller recently has maintained that the cosmic radiation may be of solar origin and may be held within the limits of the planetary system by some suitable kind of magnetic field. Even if this hypothesis is correct, one could hardly expect to find electrons of high energy in the cosmic radiation. Probably the main reason to eliminate them is the same inverse Compton effect considered by Feenberg and Primakoff, which becomes much stronger because the particles are supposed to travel in the vicinity of the sun and are exposed, therefore, to a much stronger radiation than they would be in the interstellar space.

For all these reasons, it seems to me highly improbable that electrons of as high energy as you mention could be found in the cosmic radiation. On the other hand, all these arguments should not be over estimated, and an experimental check on them, if possible, is certainly worth while.

I will send to you a copy of my manuscript, as soon as reprints are available.

Very sincerely yours,

Enrico Fermi

Enrico Fermi

EF:al
encl.

1949:
Fermi comments Cocconi's >10^{17} eV cosmics.

Vanna Tongiorgi Cocconi,
104 publications, 1948 to 1982.

Phys.Rev. 73 (1948) 923-924

On the Presence of Neutrons in the Extensive Cosmic-Ray Showers*

VANNA TONGIORGI
Laboratory of Nuclear Studies, Cornell University, Ithaca, New York

March 2, 1948

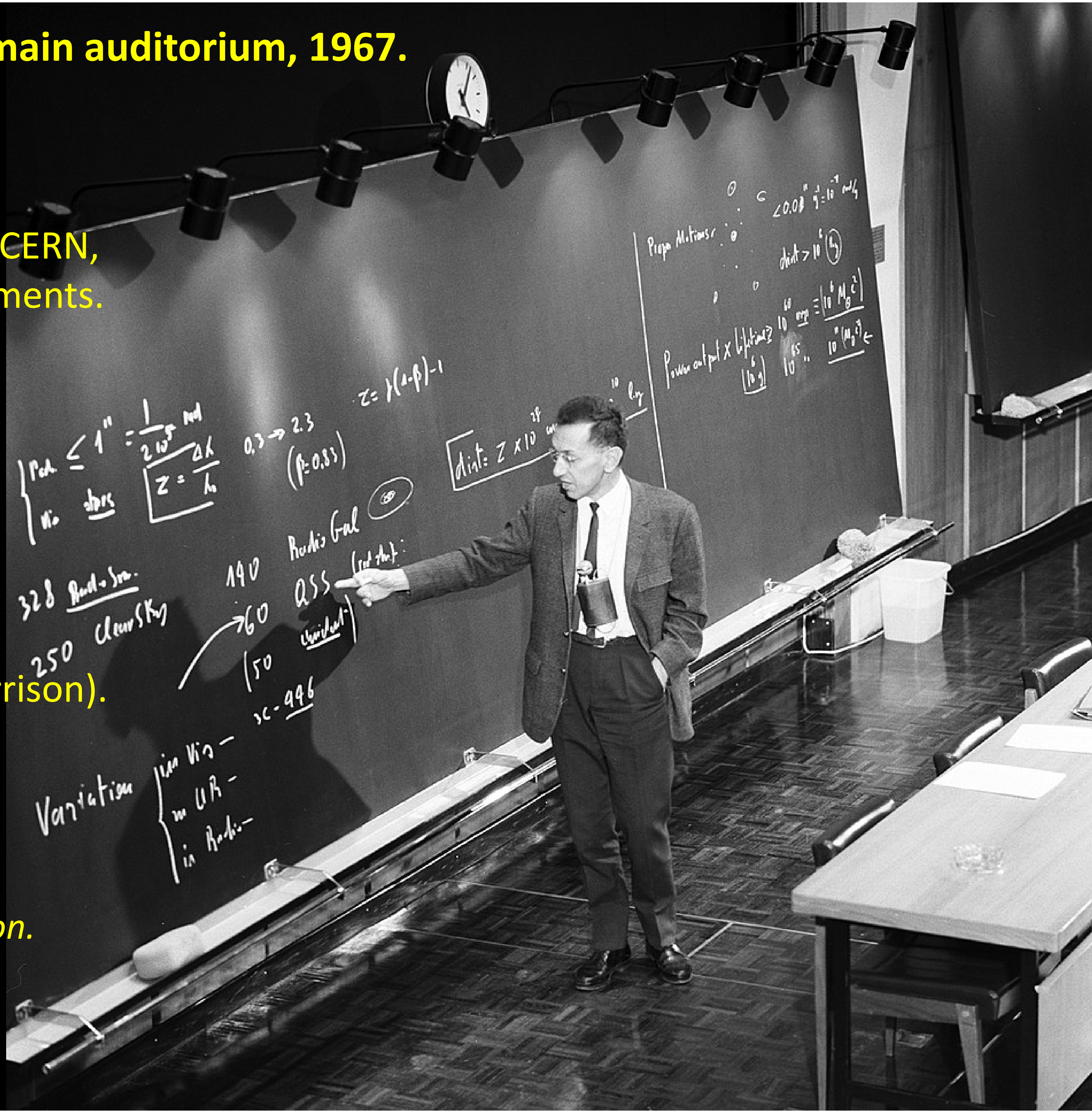
AN experiment has been performed in order to find out whether or not neutrons are present in the extensive showers of the cosmic radiation.

For studying neutrons associated with showers one has to record the coincidences between some Geiger counters struck by the electrons of the showers and a neutron detector: a BF_3 proportional counter surrounded by paraffin seems to be the simplest and most reliable one. However, a serious difficulty arises from the fact that, when an extensive shower falls on the recording system, the neutron counter is struck by such a large number of electrons that a pulse may occur as large as the pulse due to the α-particles produced in the BF_3 by the neutrons; also stars and slow protons associated with the showers may give rise to confusing records. By experimenting with

SPS inauguration, May 1977.

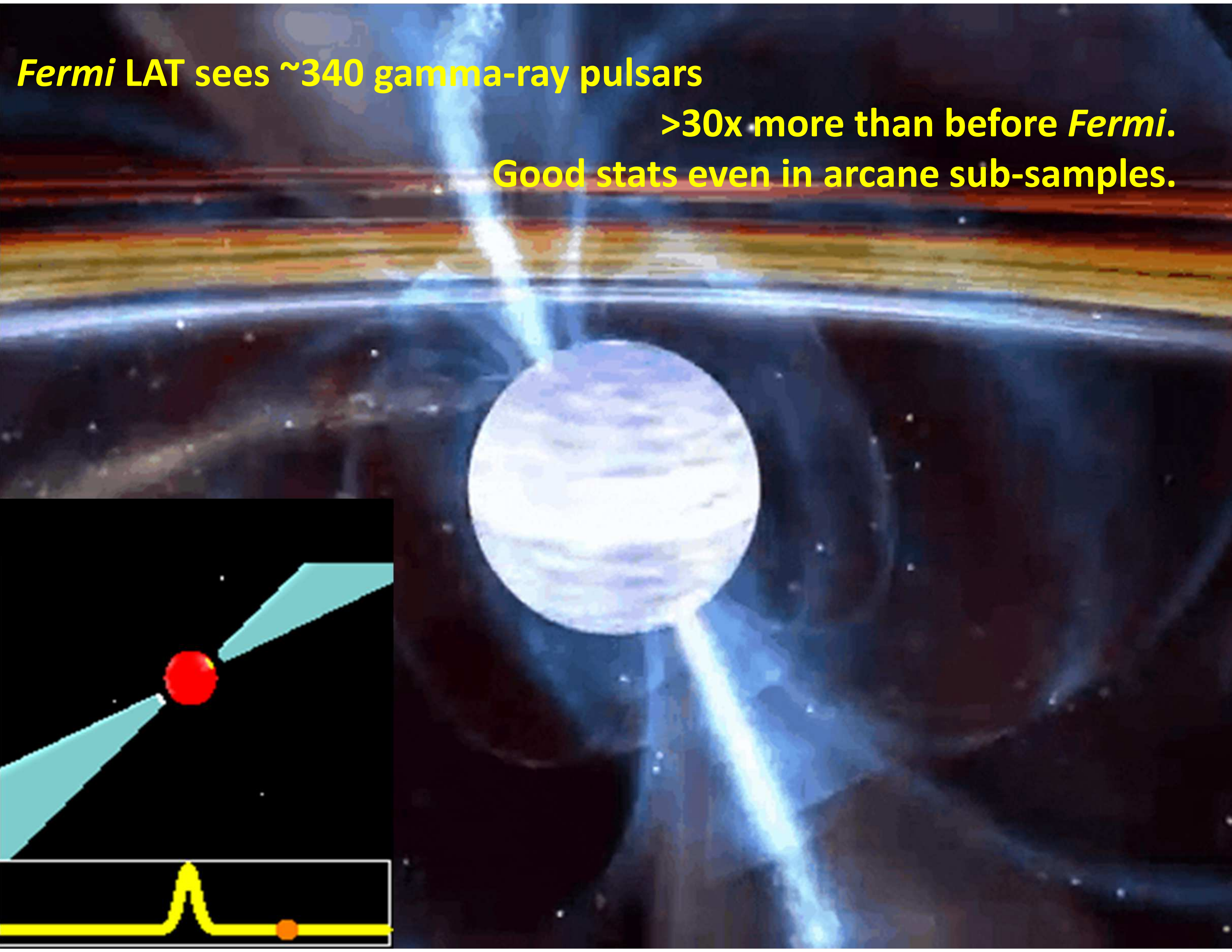
Cocconi in CERN's main auditorium, 1967.

1959-1961:
Cornell sabbatical at CERN,
to prepare PS experiments.



1959 Nature article
on SETI (with Ph Morrison).

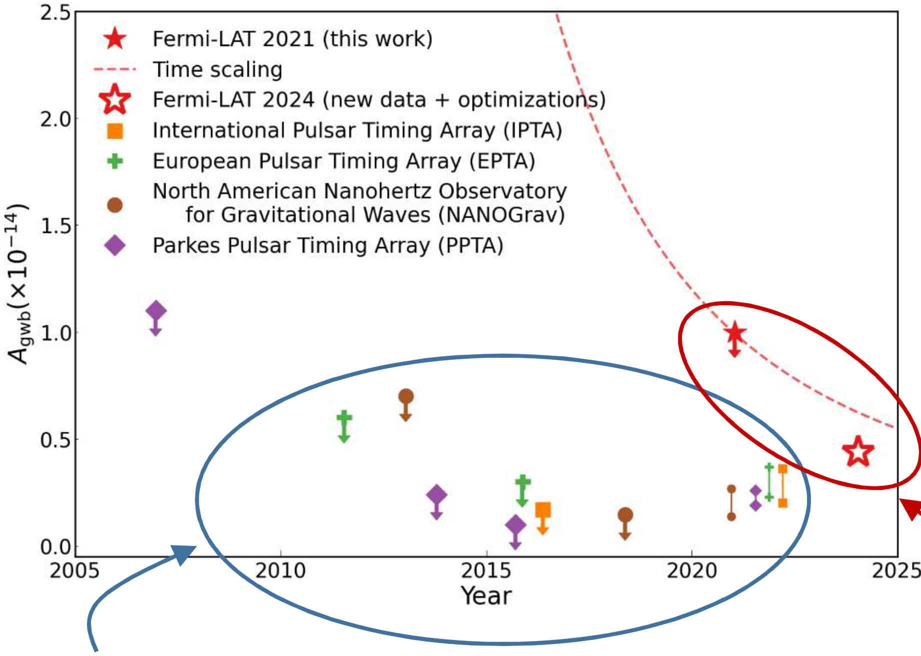
PS = Proton Synchrotron.
24 GeV in 1959.


Fermi LAT sees ~340 gamma-ray pulsars
>30x more than before *Fermi*.
Good stats even in arcane sub-samples.

Fermi LAT's timing is excellent.

Some millisecond pulsars MSPs) are Nature's most precise clocks.
Use them for nHz gravitational waves.

Ajello, *Science* **376**, 521–523 (2022)   29 April 2022

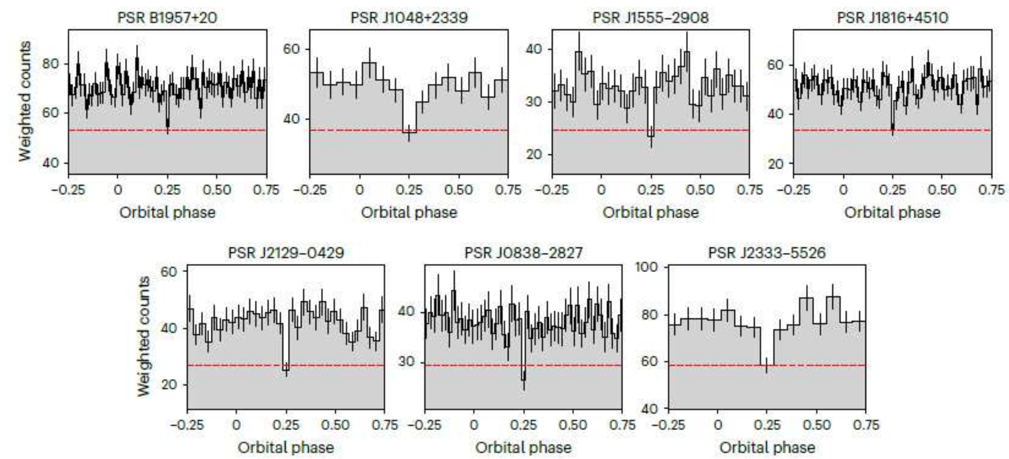


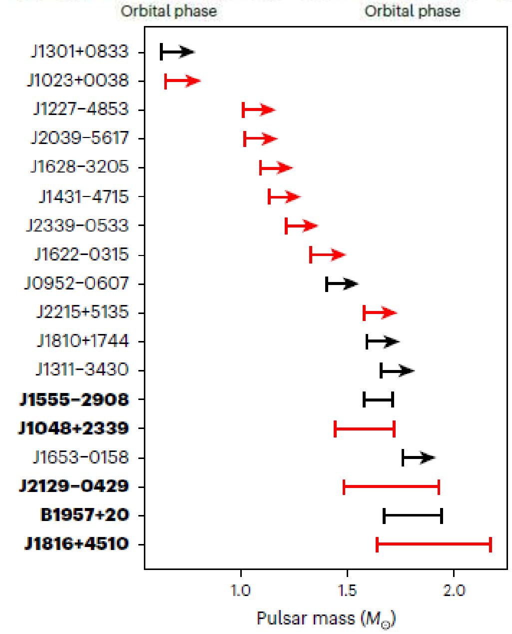
Radio pulsar upper limits, meas'ts.

Gamma upper limit,
predicted measurement.

Others ("*spiders*") are (relatively!) poor clocks.
Use eclipses to measure neutron star masses,
to constrain the nuclear Equ'n of State.

Clark, Nature Astro ***7****, 451, 2023.*





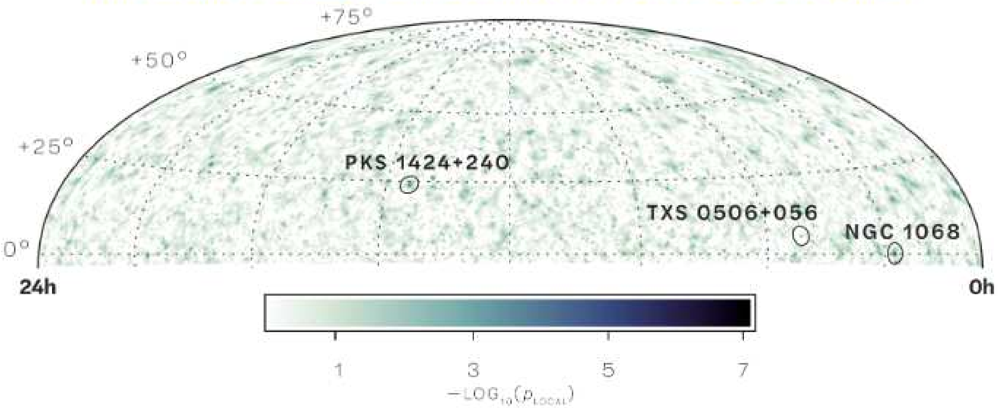
Fermi LAT guides neutrino astronomers to potential PeV sources

"Neutrino astronomy lives & dies by trials"

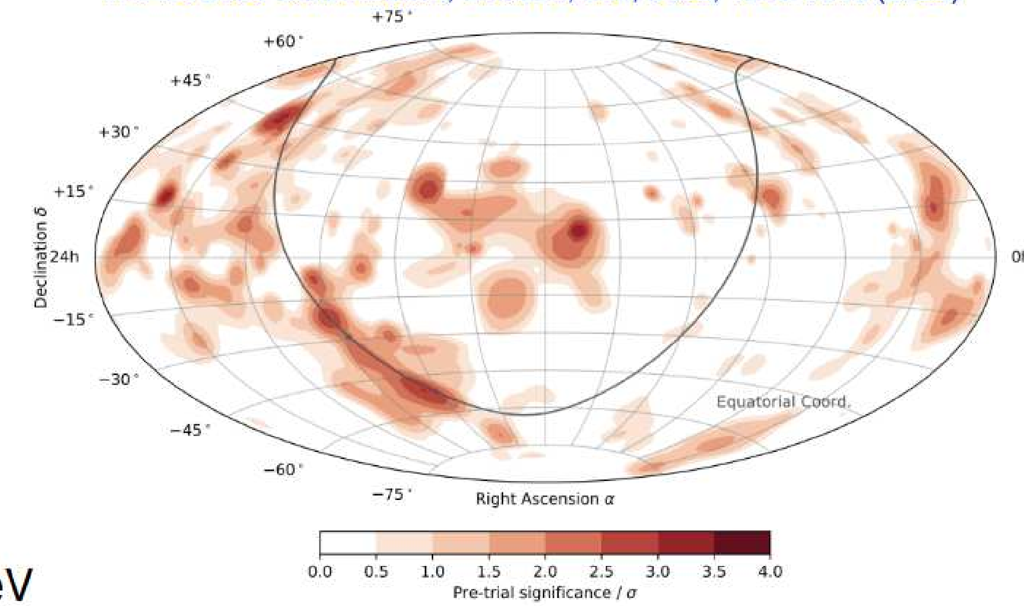
- N.K. Neilson, Drexel U.

Current Status of the Neutrino Sky

The IceCube Collaboration, Science, 378, 6619, 538-543 (2022)



The IceCube Collaboration, Science, 380, 6652, 1338-1343 (2023)



- Diffuse astrophysical neutrinos detected up to PeV
- It is difficult to find astrophysical neutrino sources in IceCube data —> why we need multi messenger
  - A few AGNs are promising:
    - Seyferts NGC 1068 @ 4.2σ, NGC 4151 @ 2.9σ (The IceCube Collaboration 2024 arXiv:2406.06684)
    - Blazars TXS 0506+056 @ 3.5σ, PKS 1424+240 @ 3.7σ
  - The Galactic plane detected @ 4.5σ

Slide from Qi Feng, 11th Fermi Symposium (2024)

--- Thank you Thank you Thank you ---

A Cocconi prize for *Fermi* is _***so***_ welcome:

Cocconi & Fermi invented our domain -- We proudly follow in their steps.

THANKS TO THE EPS HEP DIVISION FOR THIS HONOR !

--- Links about Vanna & Giuseppe ---

https://www.aif.it/fisico/biografia-vanna-tongiorgi-cocconi/

https://www.aif.it/fisico/biografia-giuseppe-cocconi/

https://cerncourier.com/a/giuseppe-cocconi-and-his-love-of-the-cosmos/

https://it.wikipedia.org/wiki/Giuseppe_Cocconi
(It’s the most complete in Italian, but from there you can navigate to English or French, which are good too.)