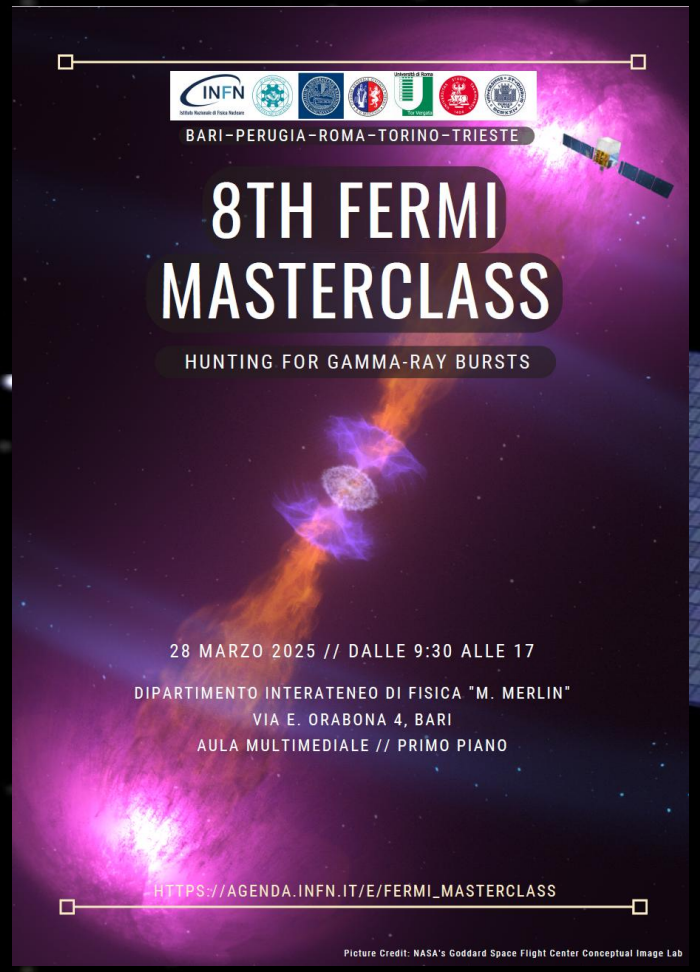
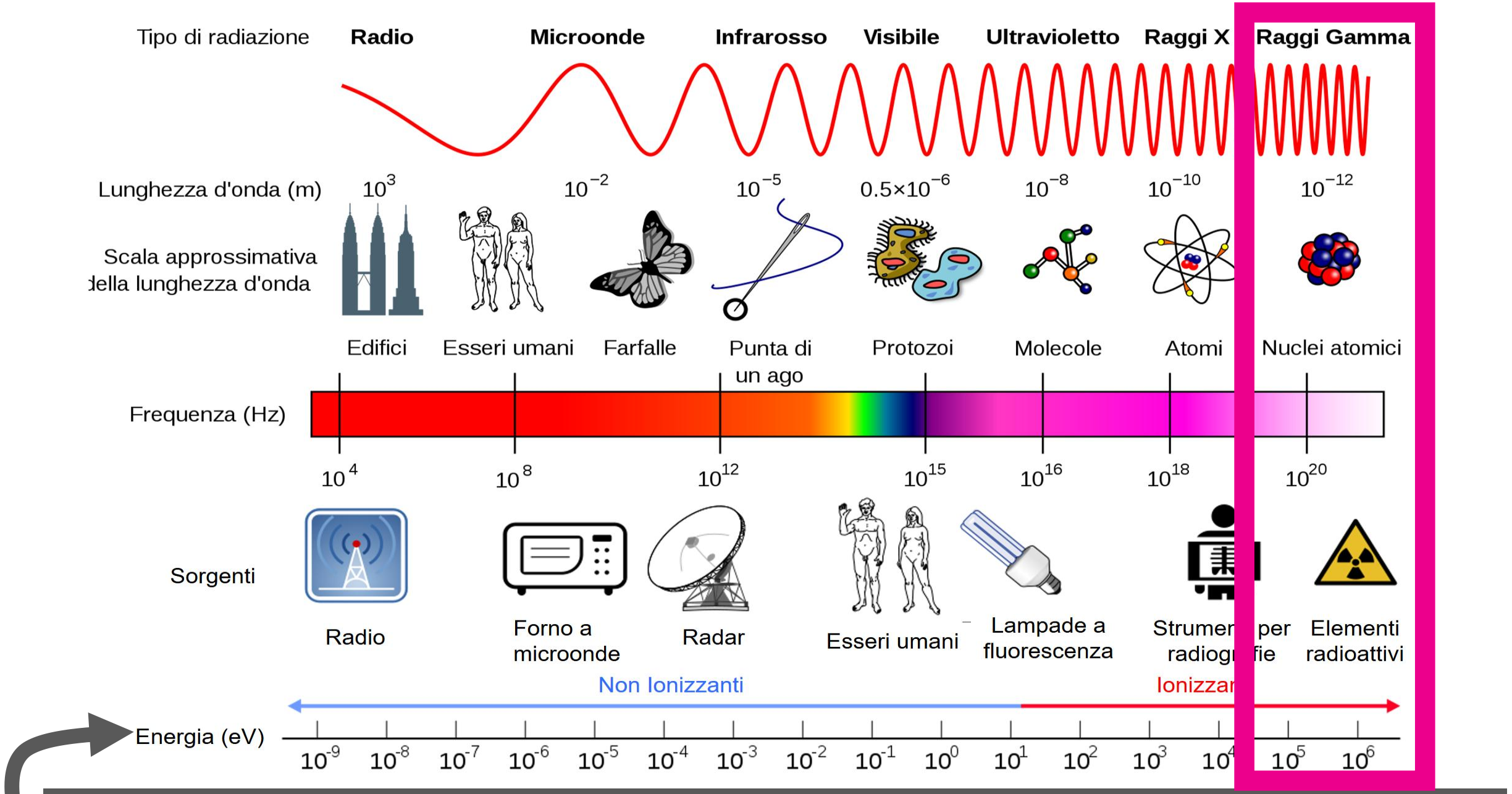


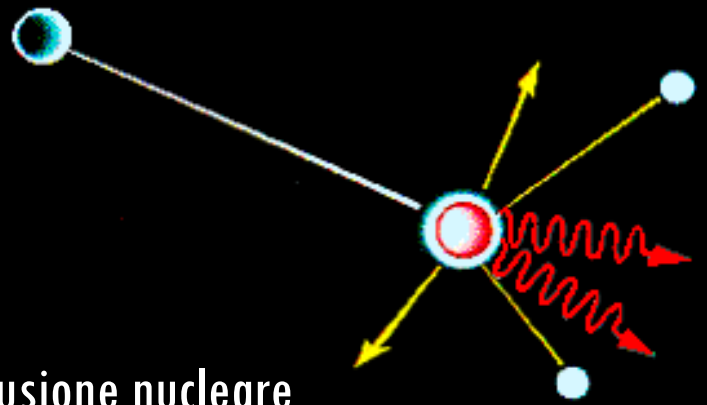
Gamma-Ray Bursts:
I lampi di raggi gamma

Prof.ssa Elisabetta Bissaldi

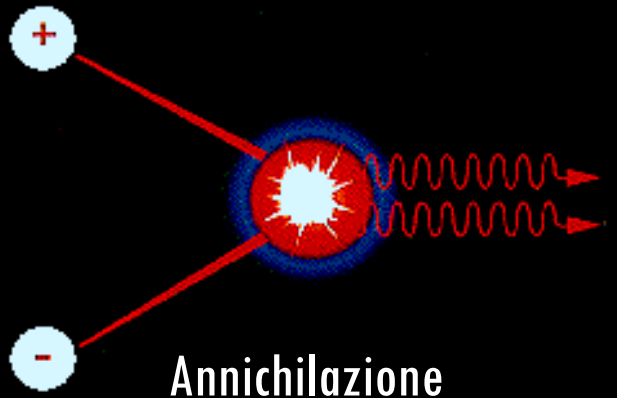
Dipartimento Interateneo di Fisica "M. Merlin"
Politecnico & INFN Bari – **elisabetta.bissaldi@ba.infn.it**



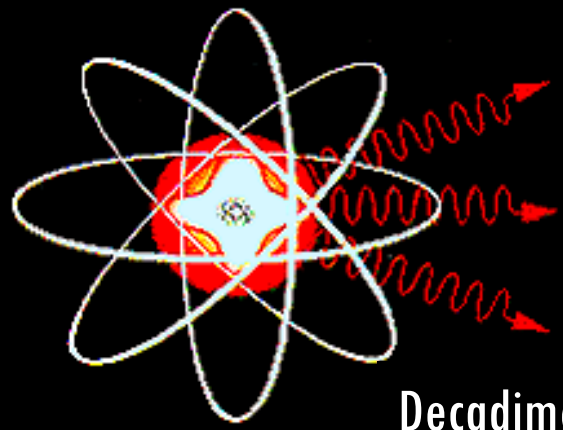
Un elettronvolt (eV) è un'unità di misura dell'energia molto usata in ambito atomico e subatomico



Fusione nucleare

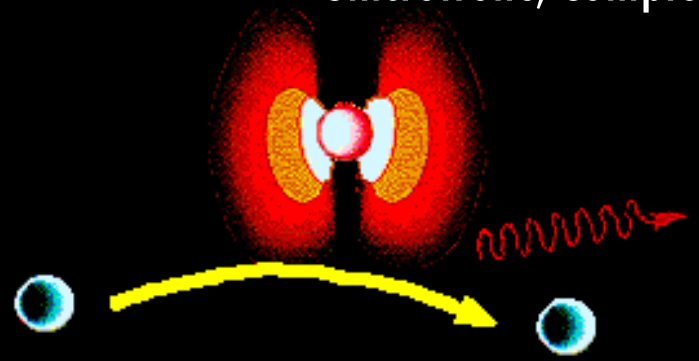


Annichilazione
elettrone-positrone



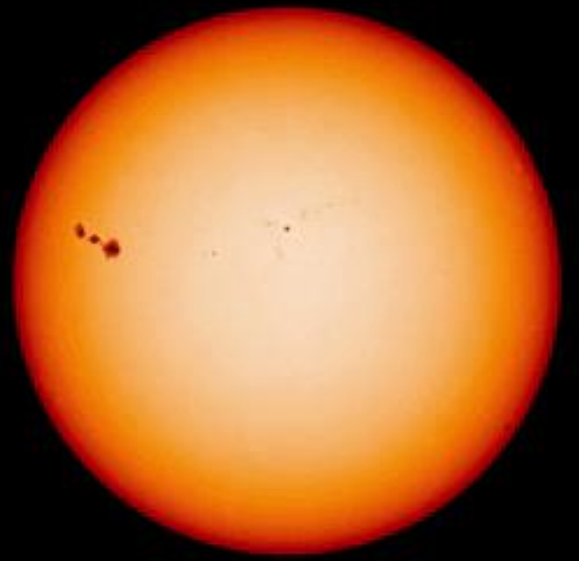
Decadimenti nucleari gamma

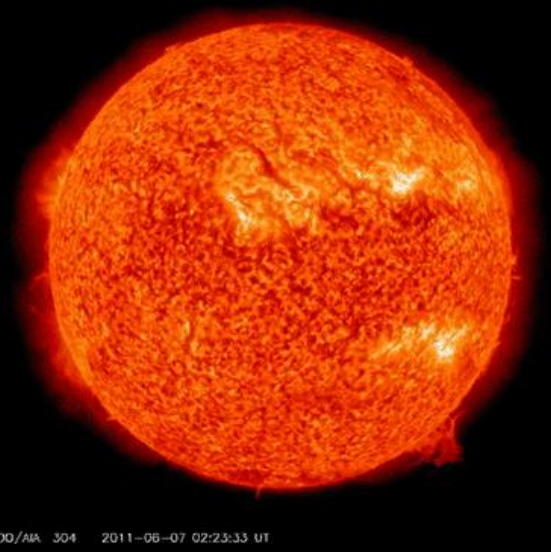
Accelerazione di particelle
cariche (Bremsstrahlung,
Sincrotrone, Compton)

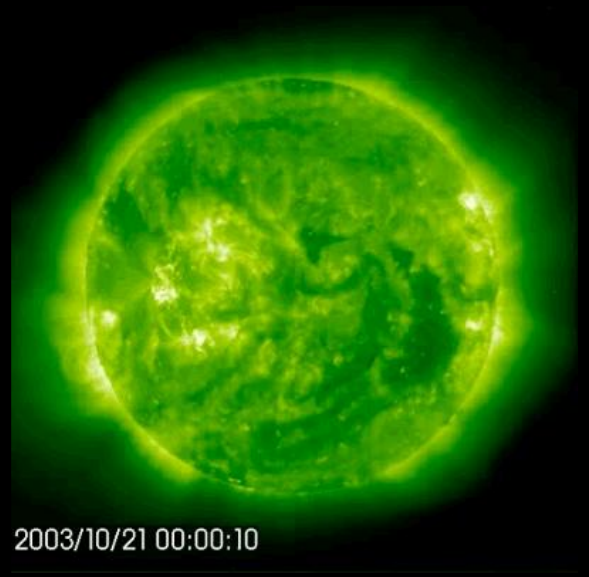


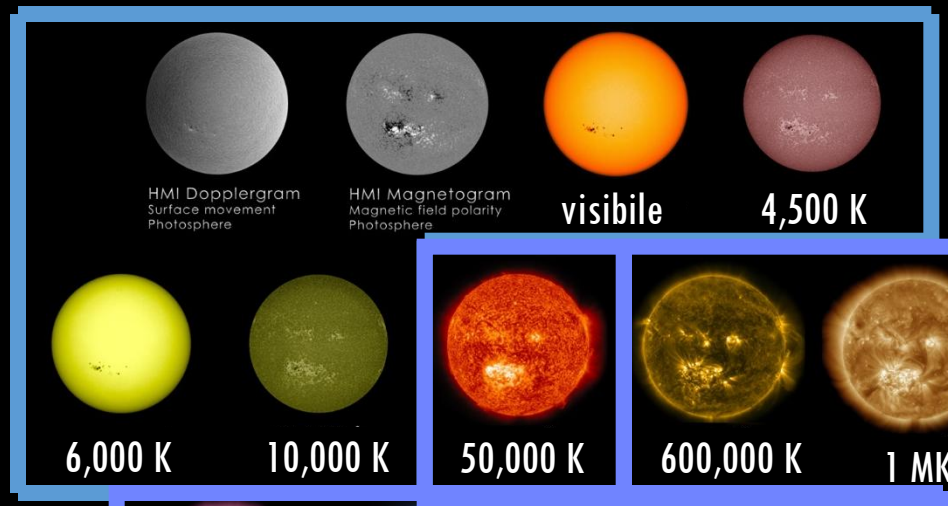
La stella più vicina: Il nostro Sole

Credits: NASA Solar Dynamics Observatory









Fotosfera

Cromosfera

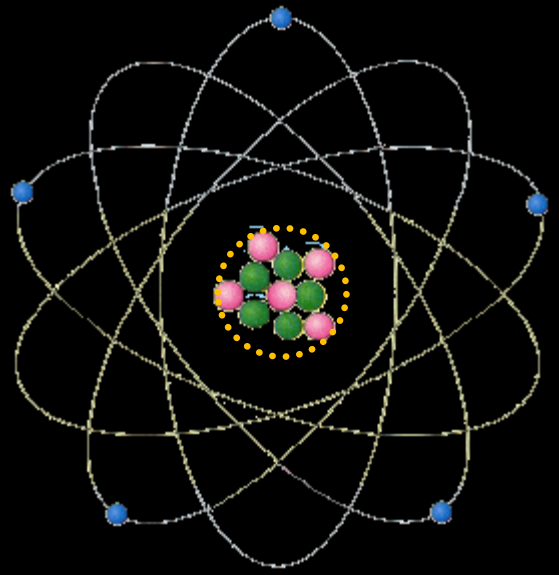
Corona

Regioni attive

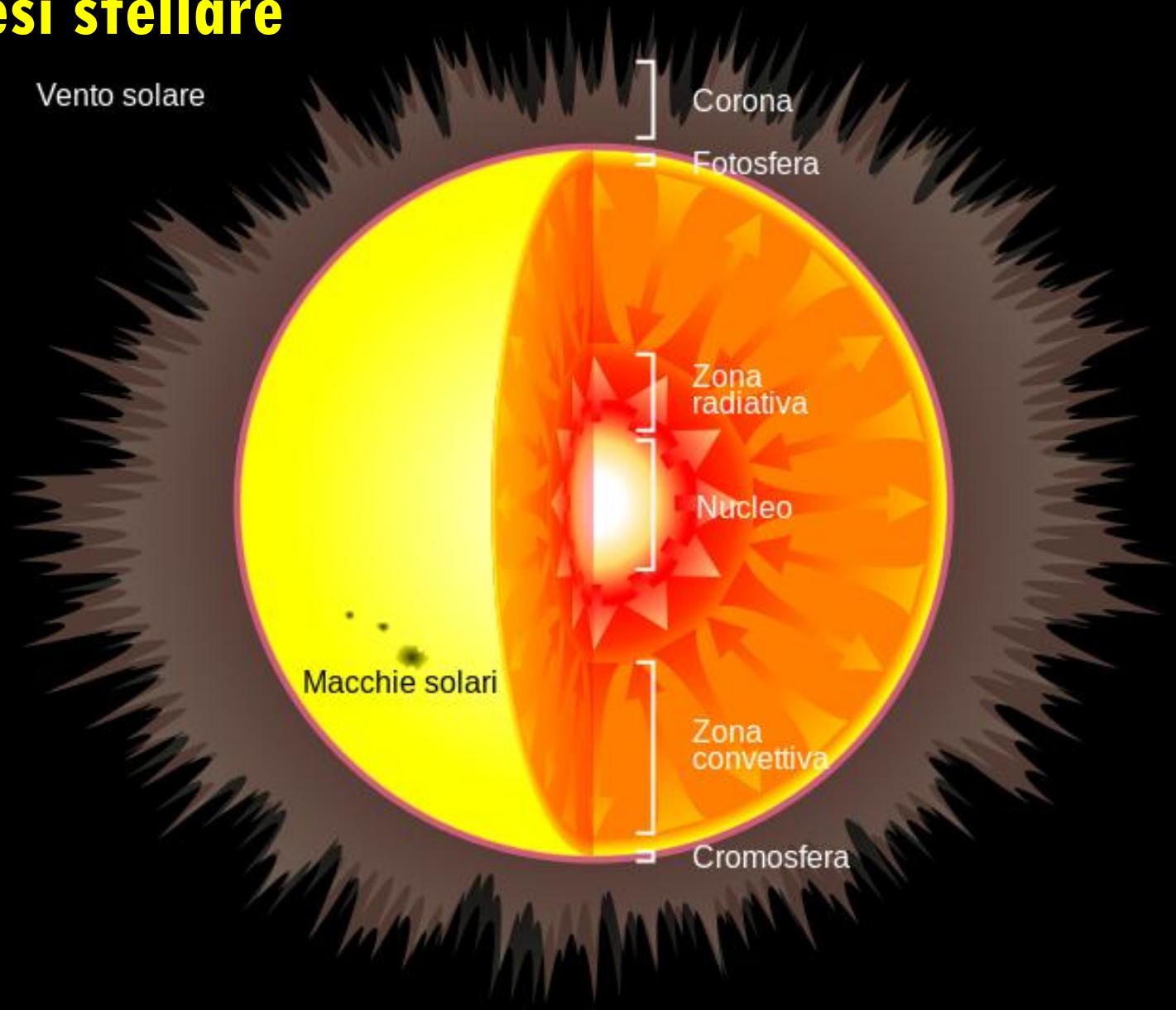
Regioni «flaring»

La nucleosintesi stellare

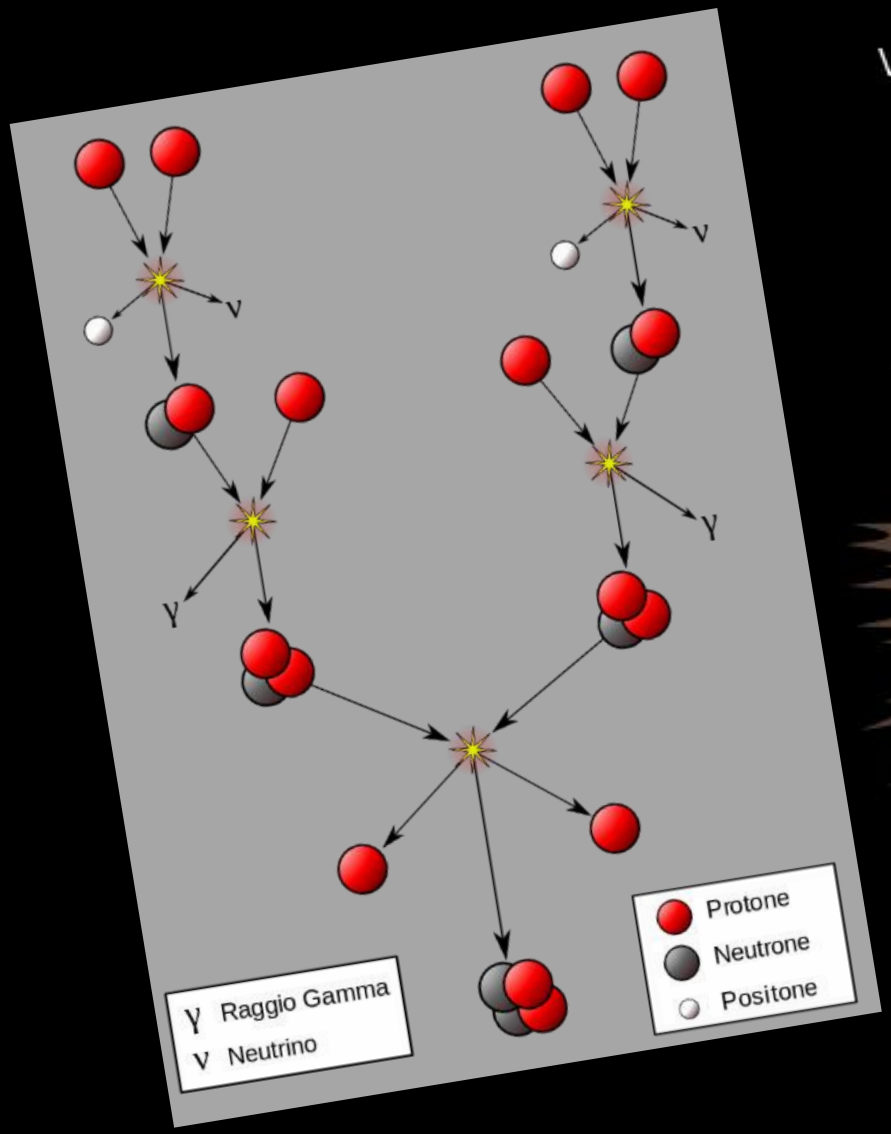
L'atomo

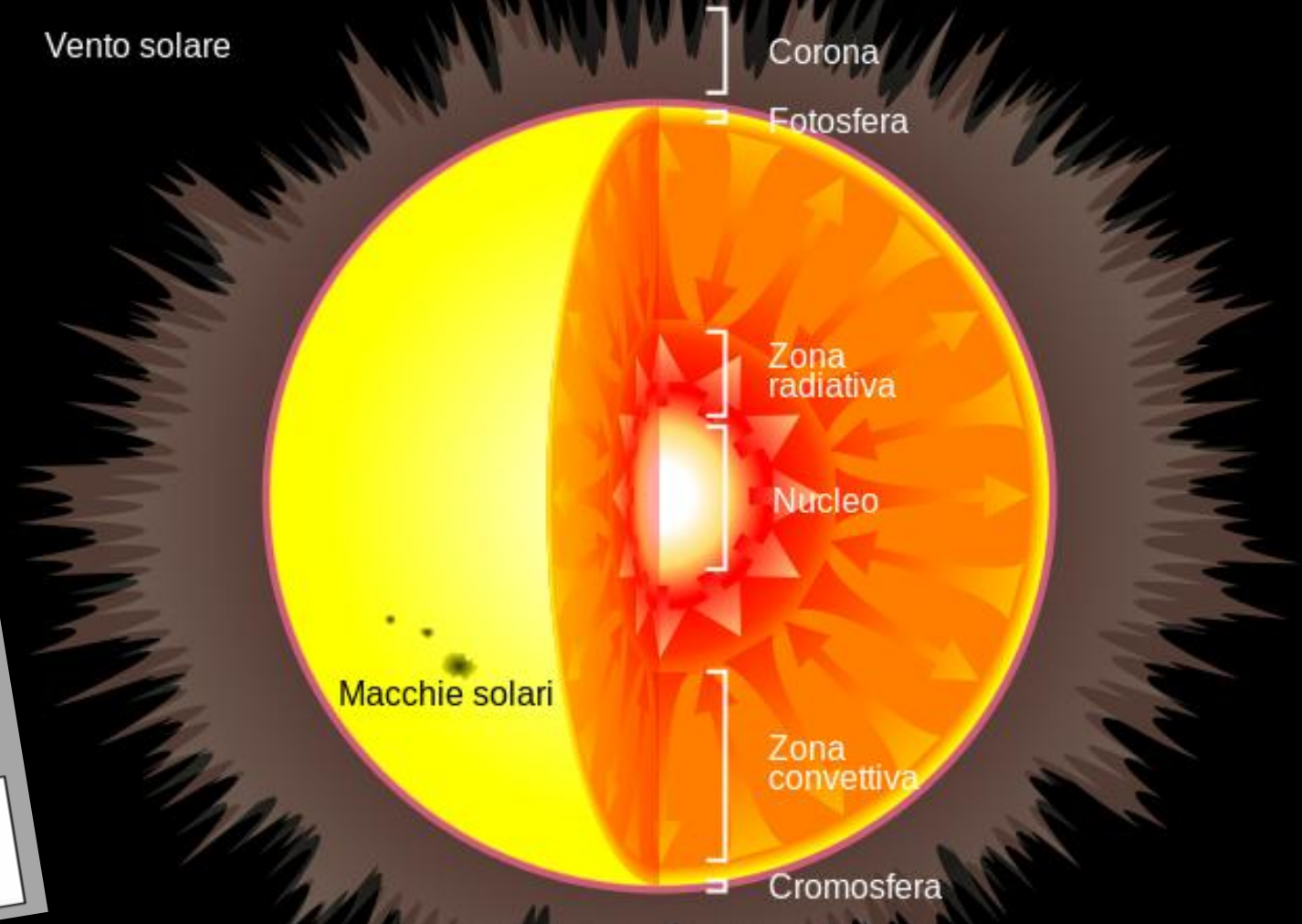


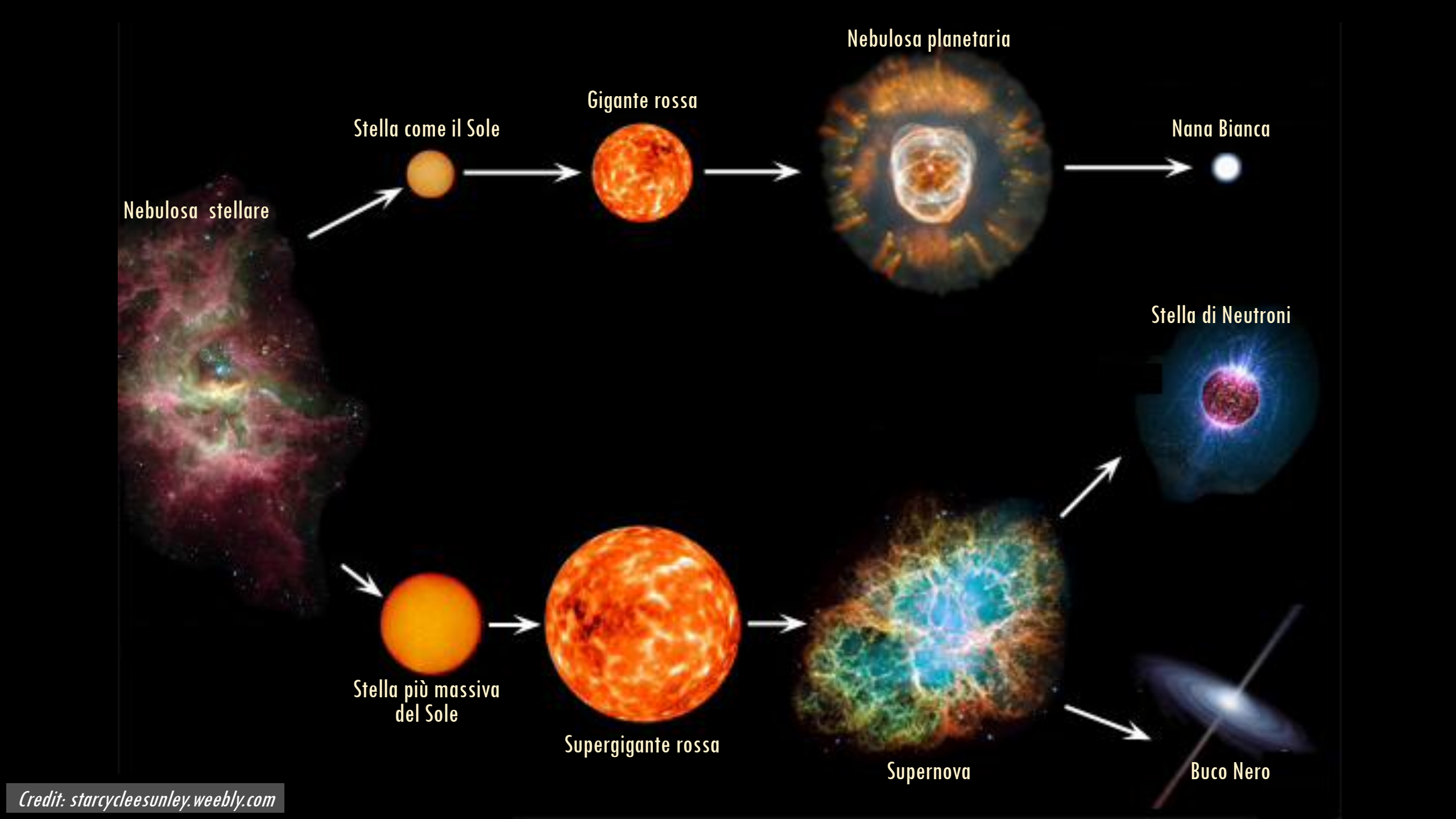
Protone
Neutrone
Nucleo
Elettrone



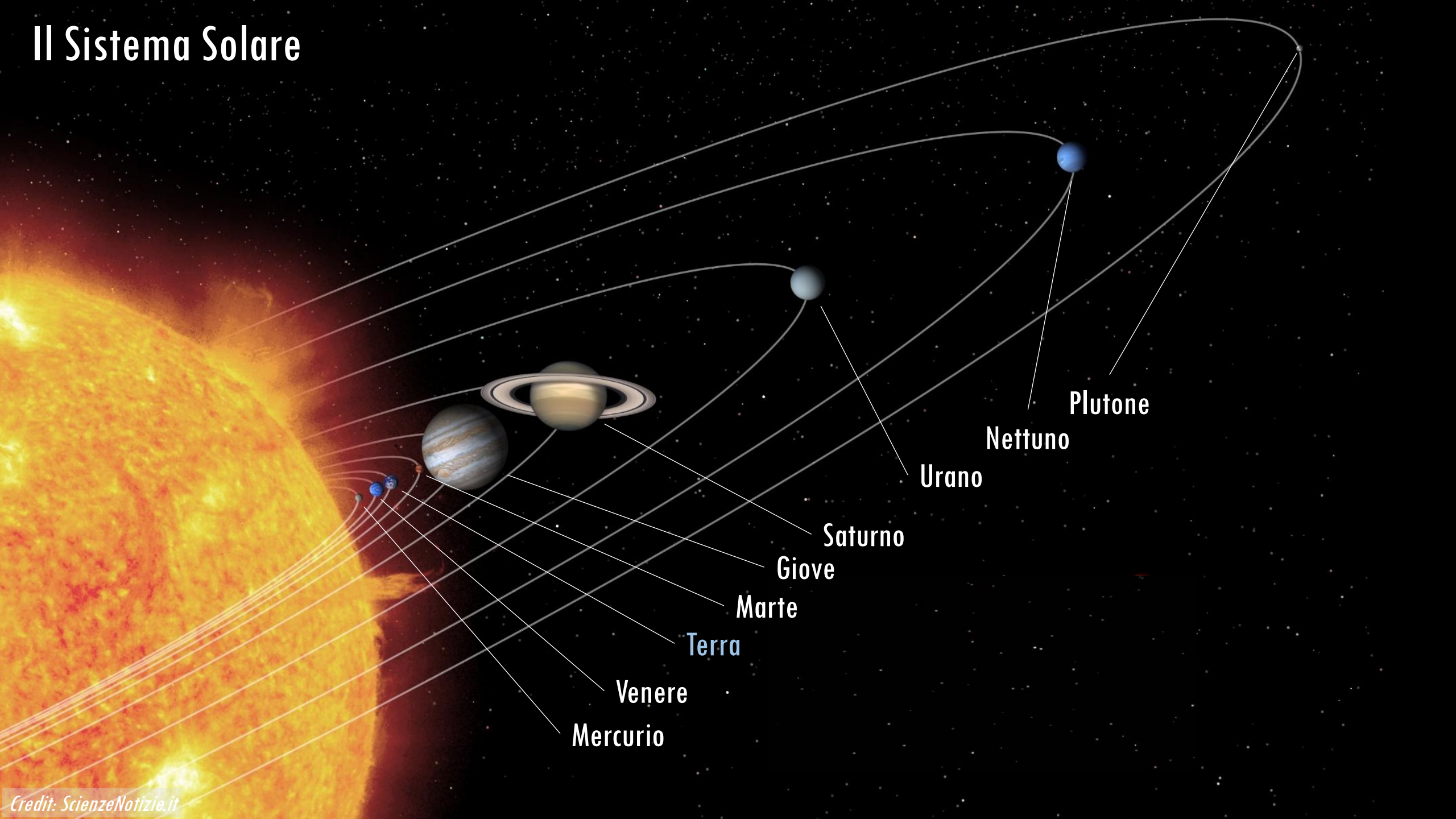
La nucleosintesi stellare





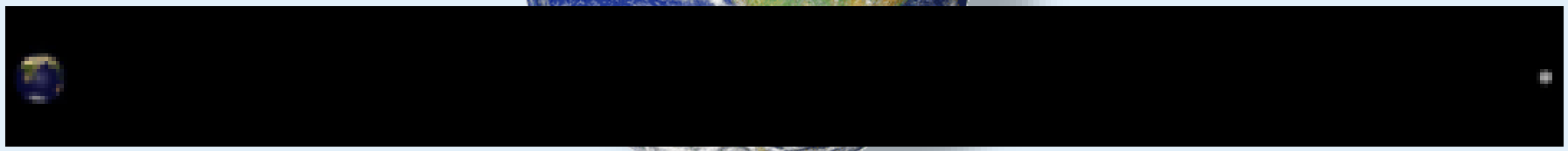

Nebulosa planetaria
Gigante rossa
Stella come il Sole
Nana Bianca
Nebulosa stellare
Stella di Neutroni
Stella più massiva del Sole
Supergigante rossa
Supernova
Buco Nero
Credit: starcycleesunley.weebly.com

Il Sistema Solare



Le distanze in Astronomia

- Lunghezza di un'aula: **~10 m**
- Lunghezza di un campo da calcio: **~100 m**
- Lunghezza del Dipartimento Interateneo di Fisica: **~150 m**
- Distanza dal Dipartimento alla Stazione di Bari Centrale: **~2.2 km**
- Distanza Bari – Trani: **~55 km**
- Distanza Bari – Roma: **~450 km**
- Distanza Bari – Sydney: **~16000 km**
- Diametro della Terra: **~12700 km**
- E dalla Terra alla Luna?



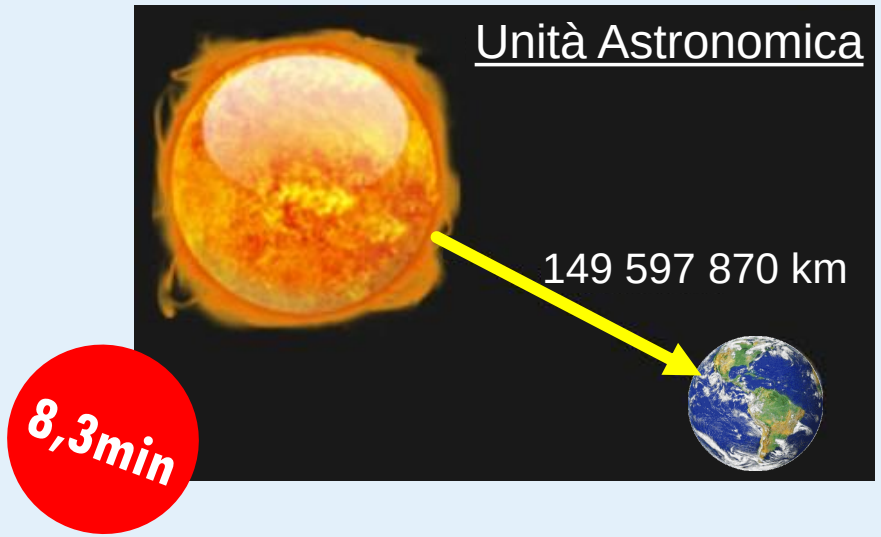
1,3 s

Le distanze in Astronomia

Nuove unità di misura

L'Unità Astronomica:

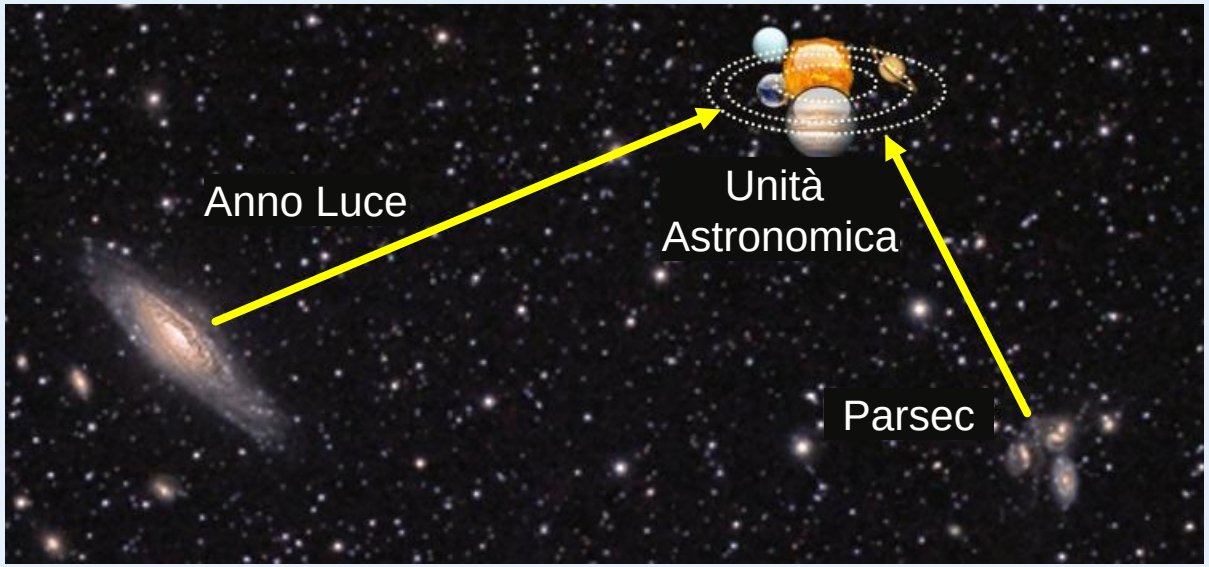
1 AU = ~150 milioni di km



L'Anno Luce:

1 ly = ~ 9500 miliardi di km

➔ Ricordando che v_{luce} = 300000 km/s



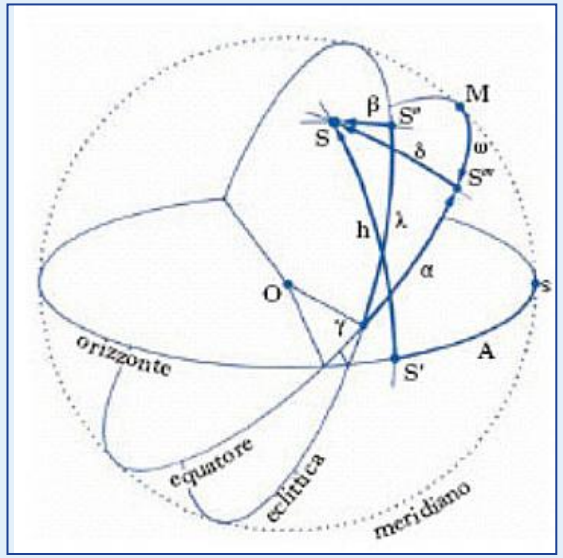
Il Parsec:

1 pc = ~31000 miliardi di km

Le coordinate astronomiche

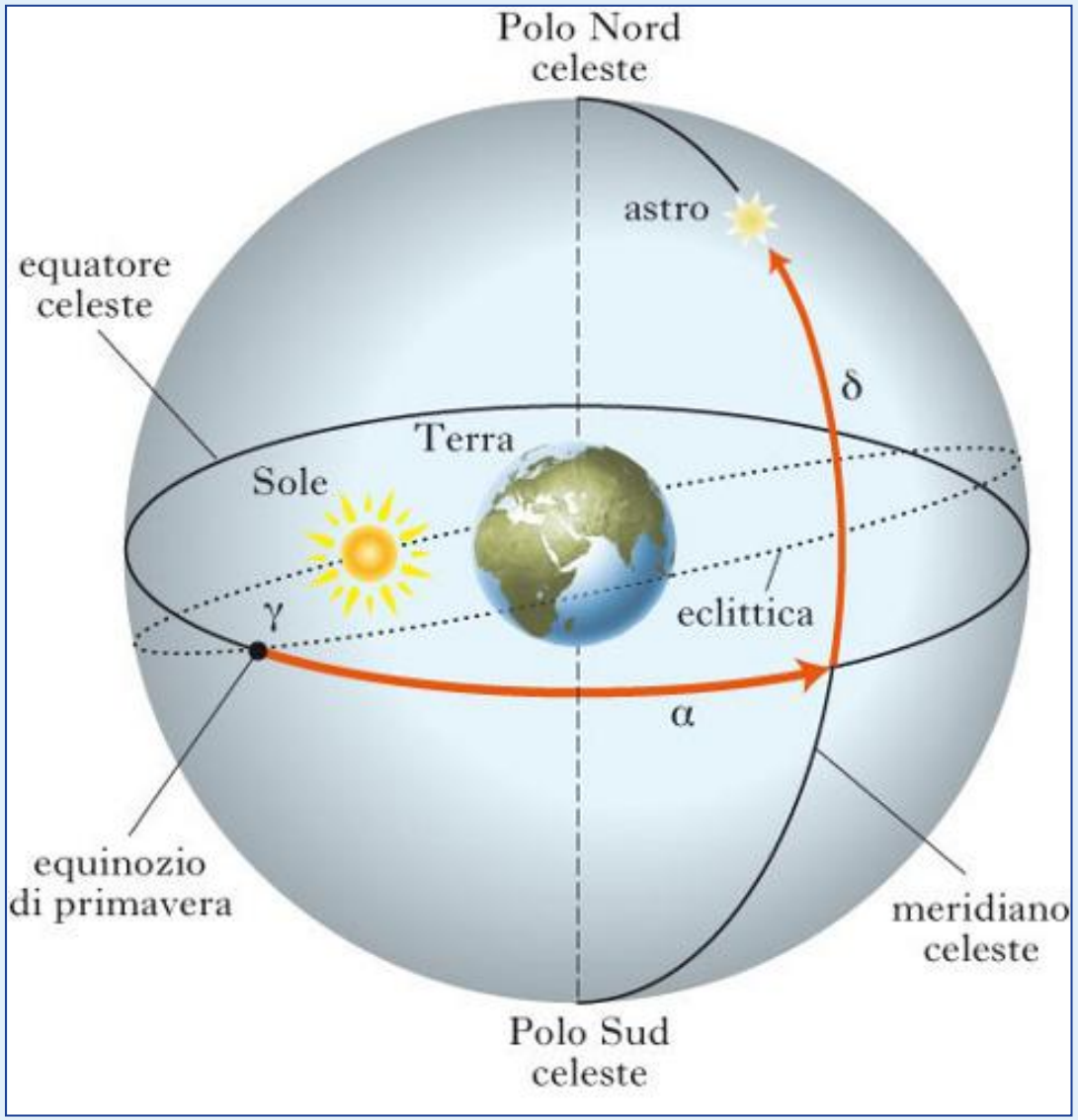
Diversi sistemi di coordinate astronomiche

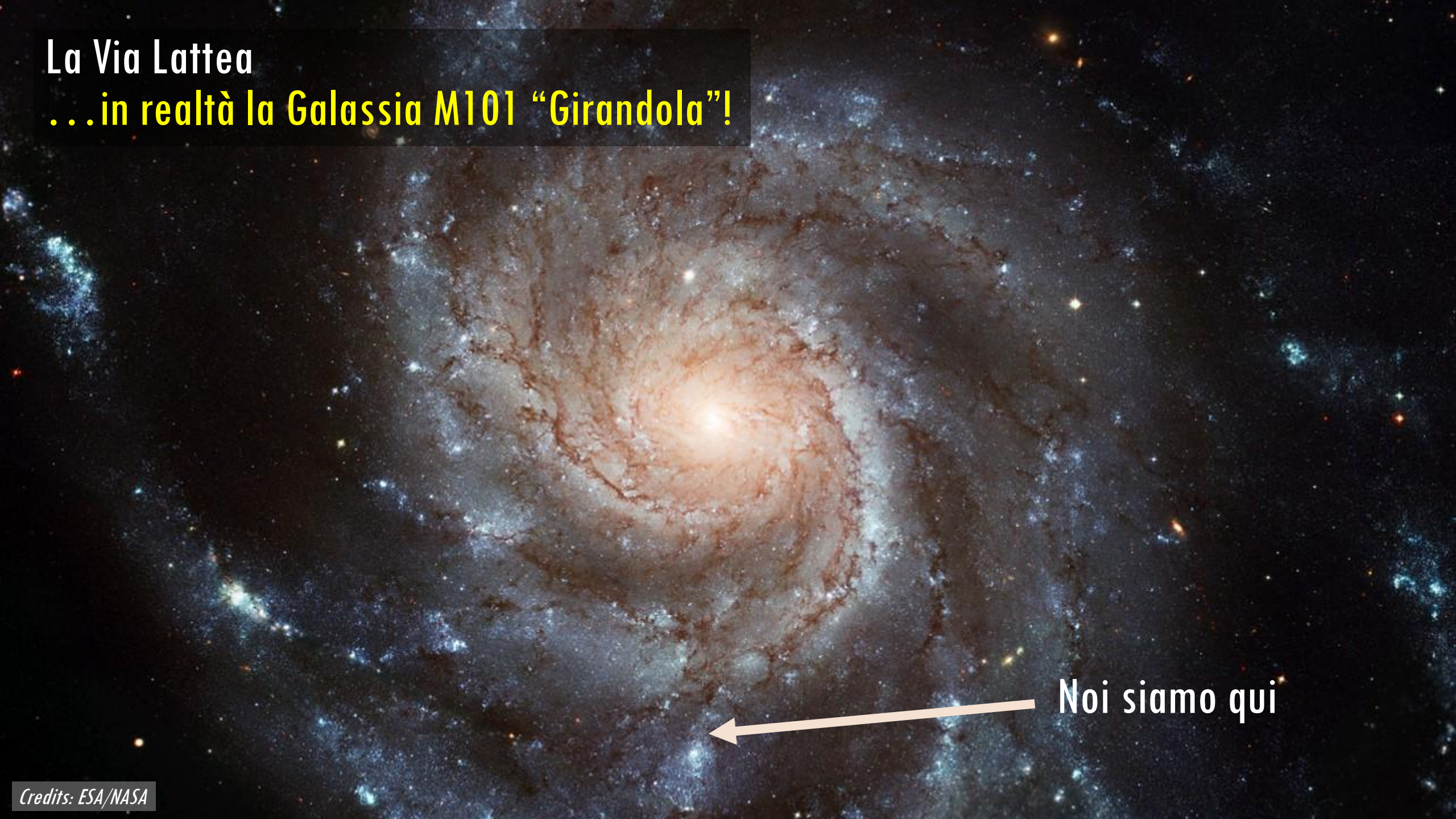
1. Orizzontale
2. Equatoriale
3. Eclitticale



Sistema di coordinate equatoriali assolute

- Cerchio base è **l'equatore celeste**
  - L'ascissa sferica è l'**ascensione retta α (RA)**
  - L'ordinata sferica è la **declinazione δ (Dec)**




La Via Lattea
. . . in realtà la Galassia M101 “Girandola”!
Noi siamo qui
Credits: ESA/NASA

La Via Lattea

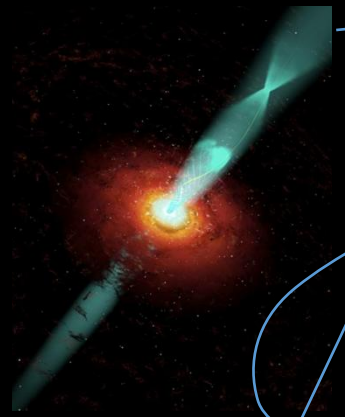
Very Large Area Telescope (VLT)

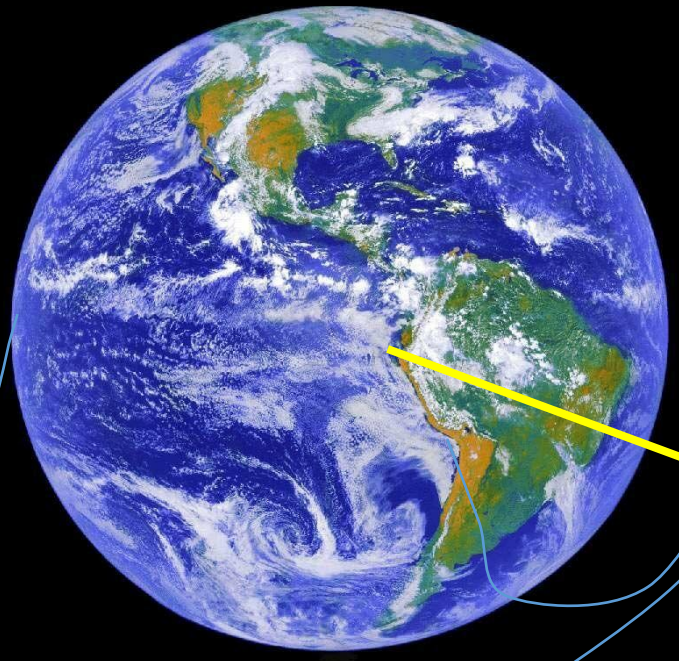
European Southern Observatory, Paranal, Cile

Credit: ESO

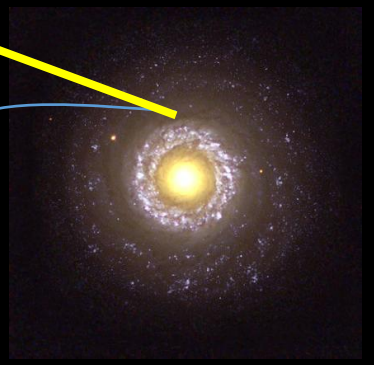
Propagazione di fotoni e raggi cosmici nella Via Lattea

Mentre i campi magnetici nello Spazio deviano i raggi cosmici carichi, **i fotoni giungono a noi indisturbati**, seguendo una traiettoria rettilinea,





Fotoni



Raggi cosmici carichi

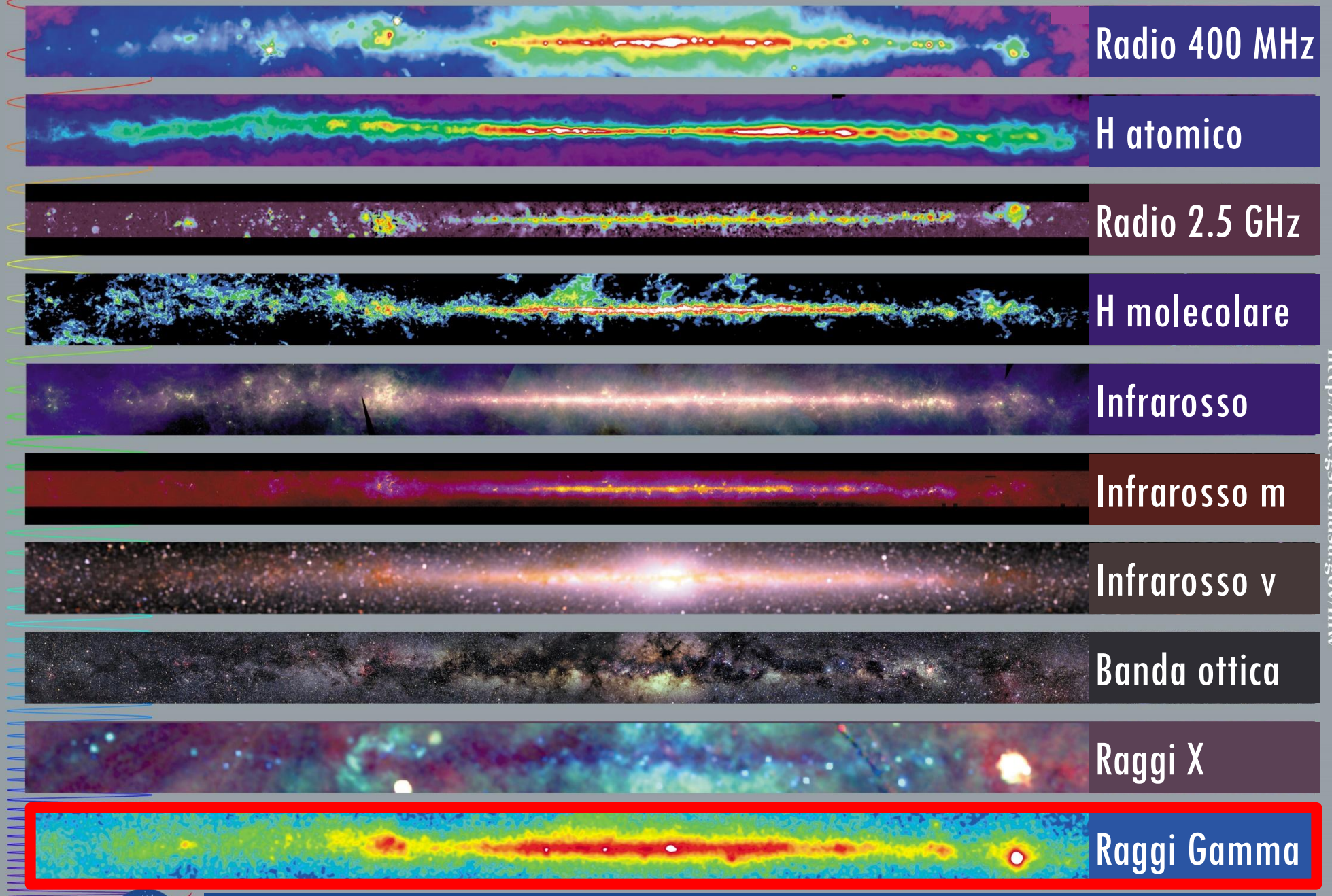
(Protoni, elettroni e nuclei atomici)

La Via Lattea

Gaia Early third Data Release (EDR3 2020)

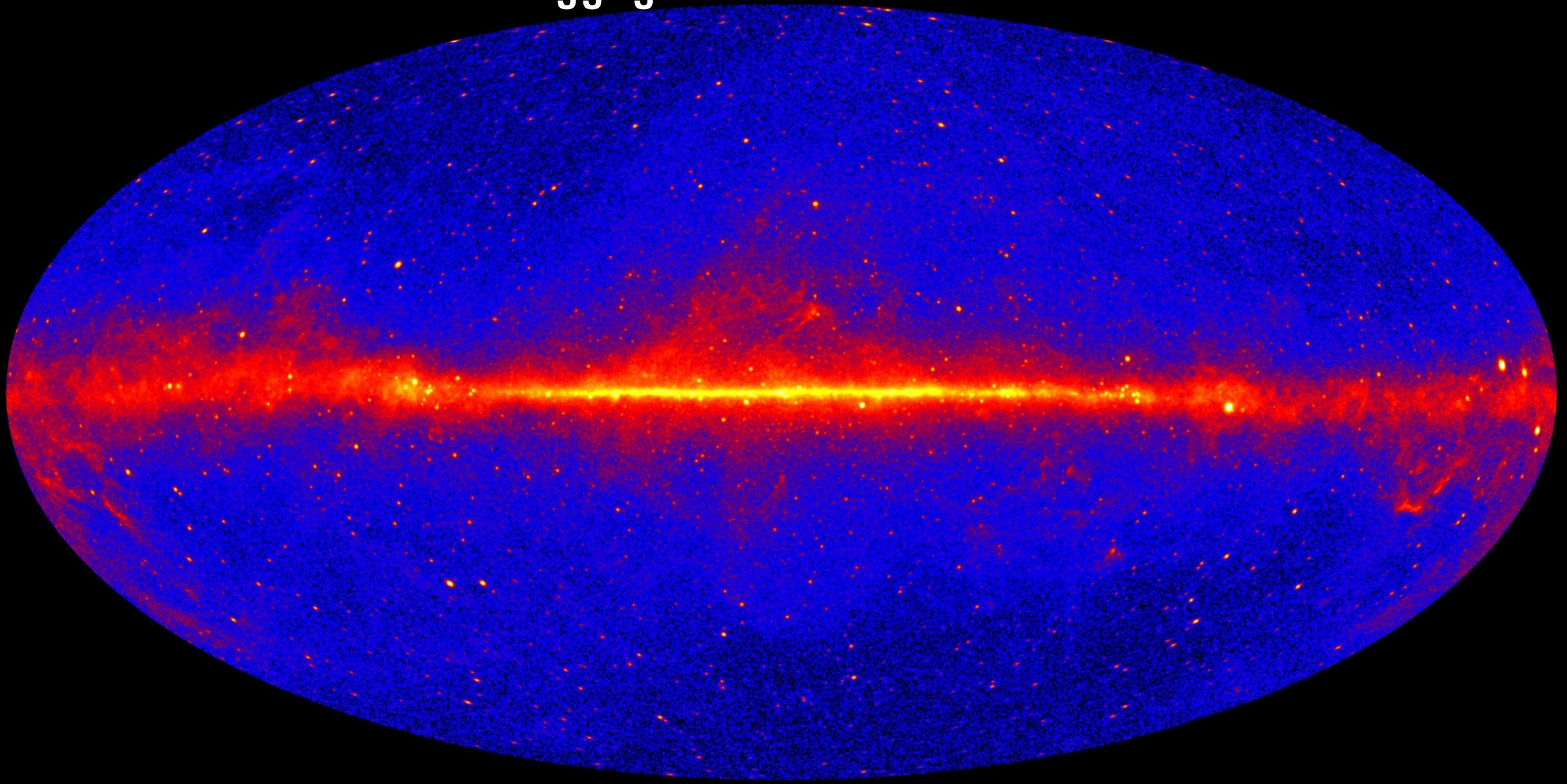
UN MILIARDO E 800 MILIONI di stelle mappate. . .!!!!

Credit: ESA/Gaia/DPAC



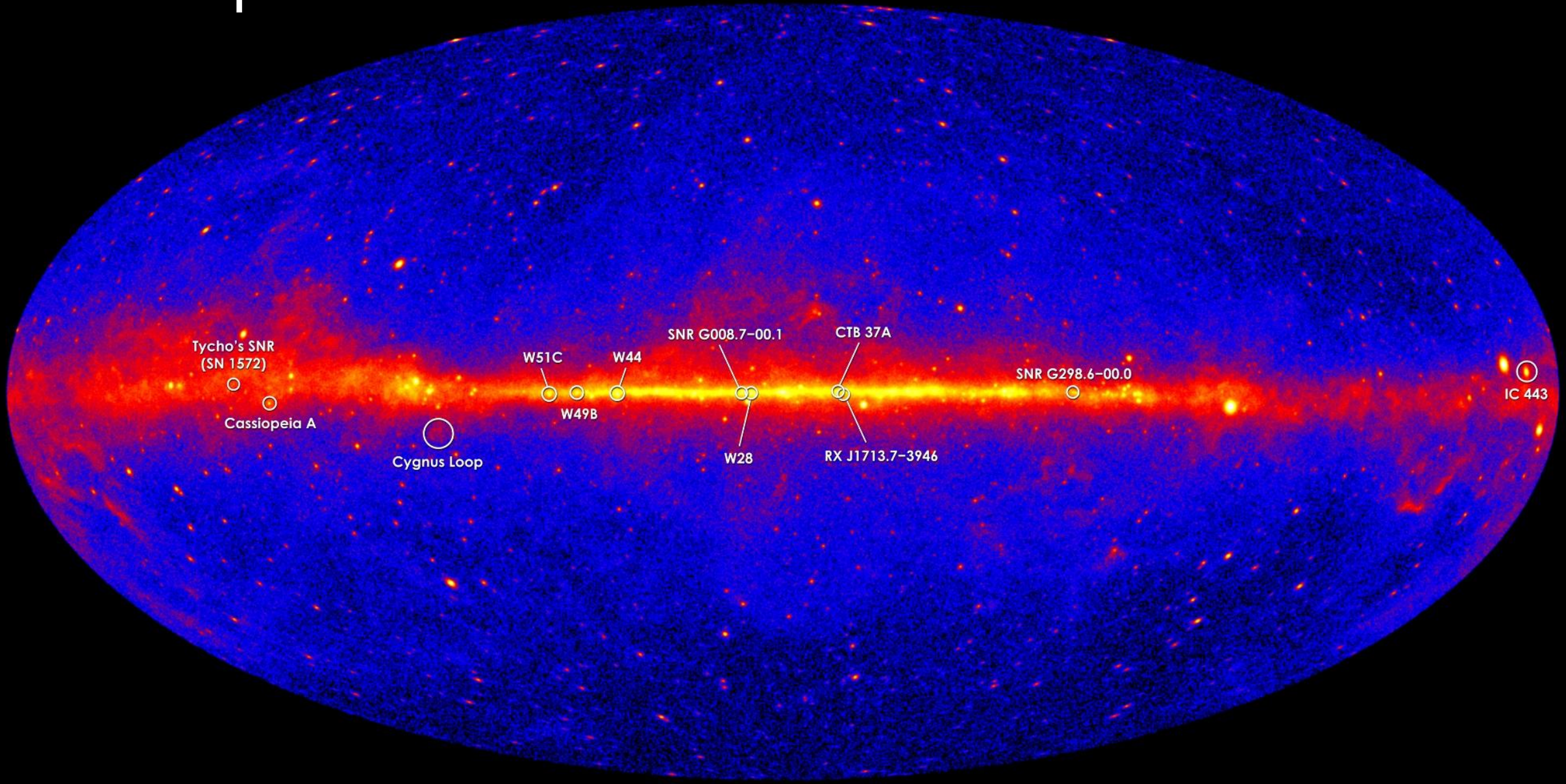
La Via Lattea vista a diverse frequenze

L'Universo osservato nei raggi gamma



Credit: NASA/DOE/Fermi LAT Collaboration/GSFC

I resti di Supernova

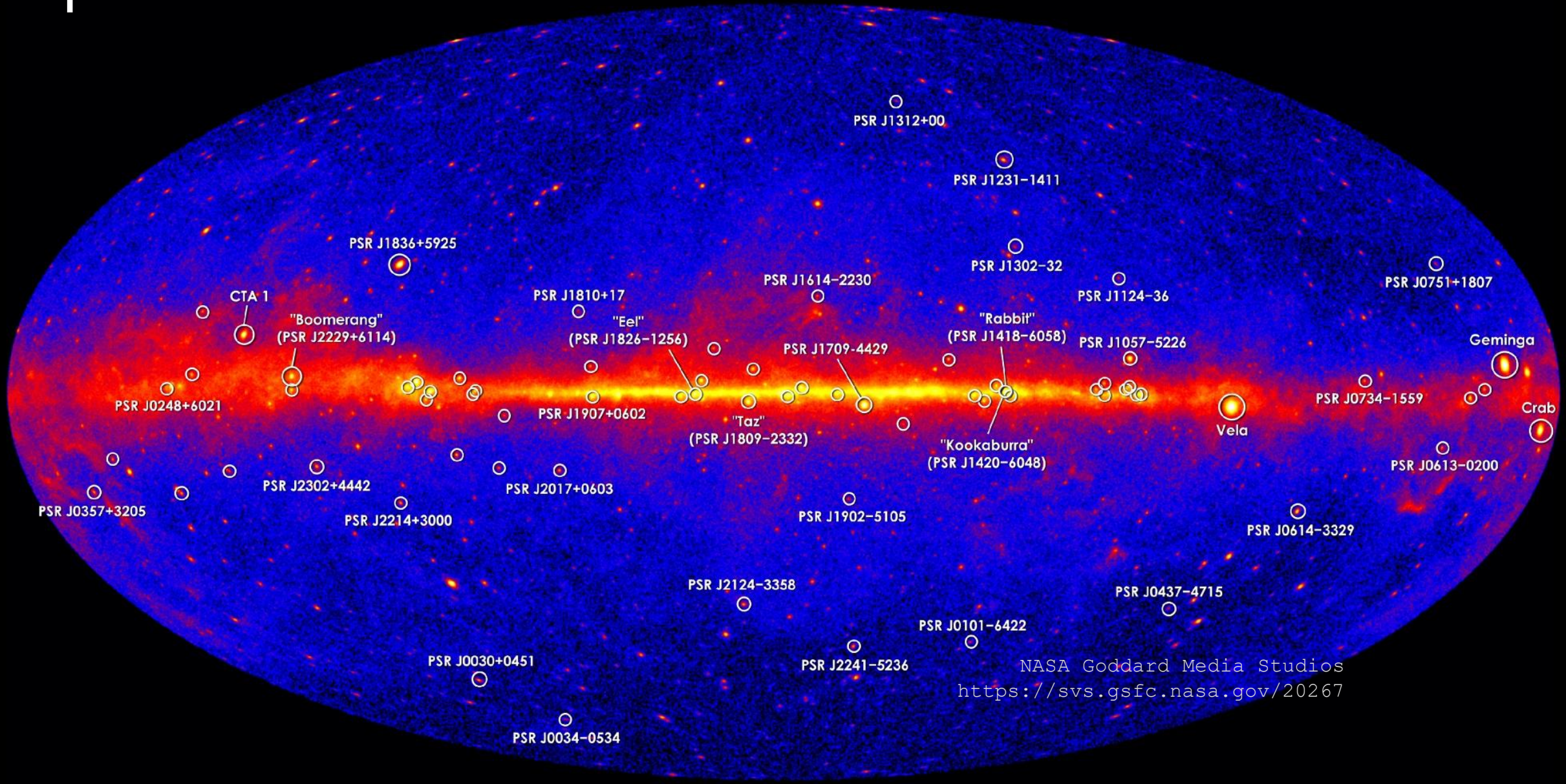


Credit: NASA/DOE/Fermi LAT Collaboration

I resti di Supernova

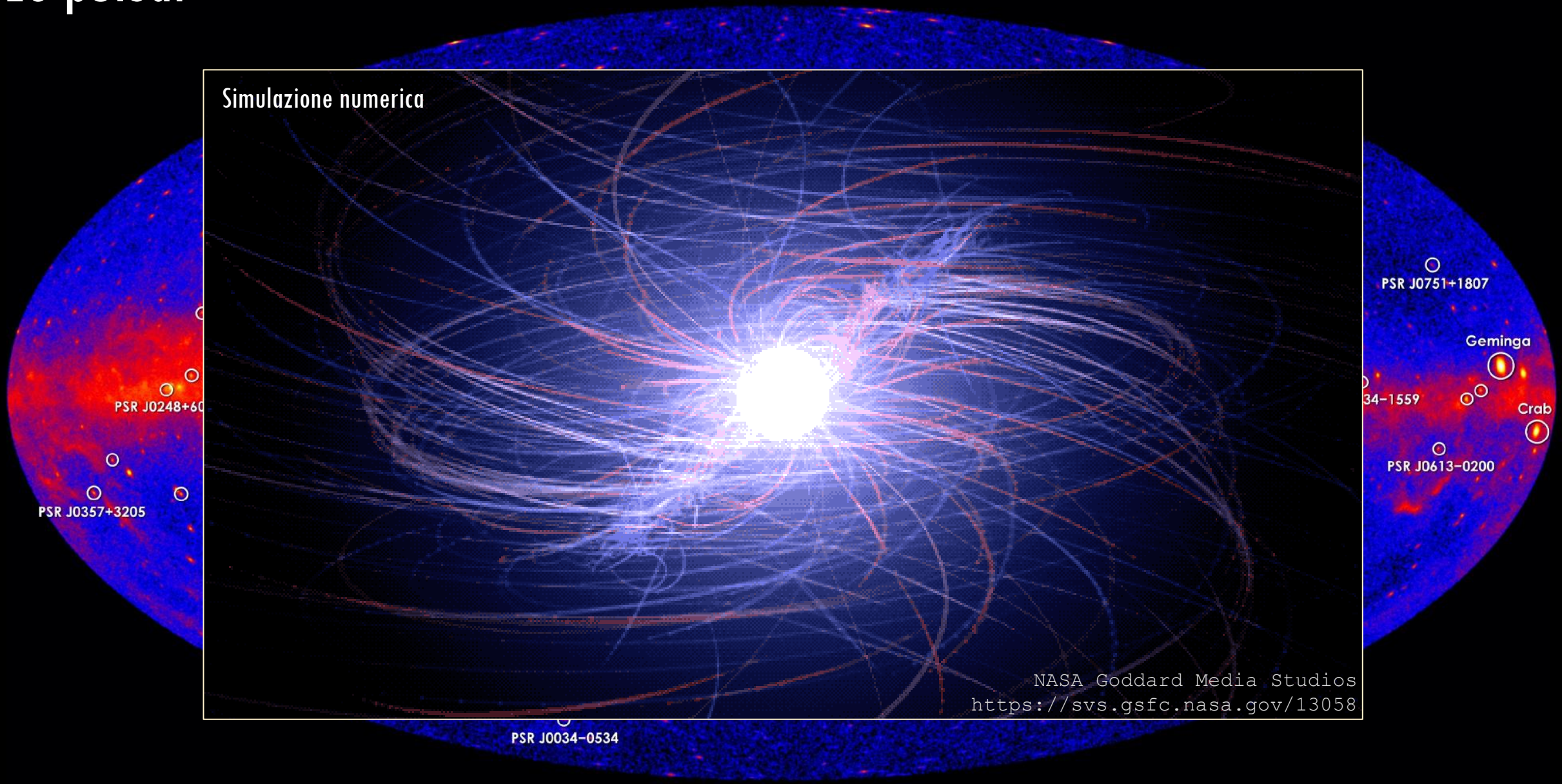
Credit: NASA/DOE/Fermi LAT Collaboration

Le pulsar



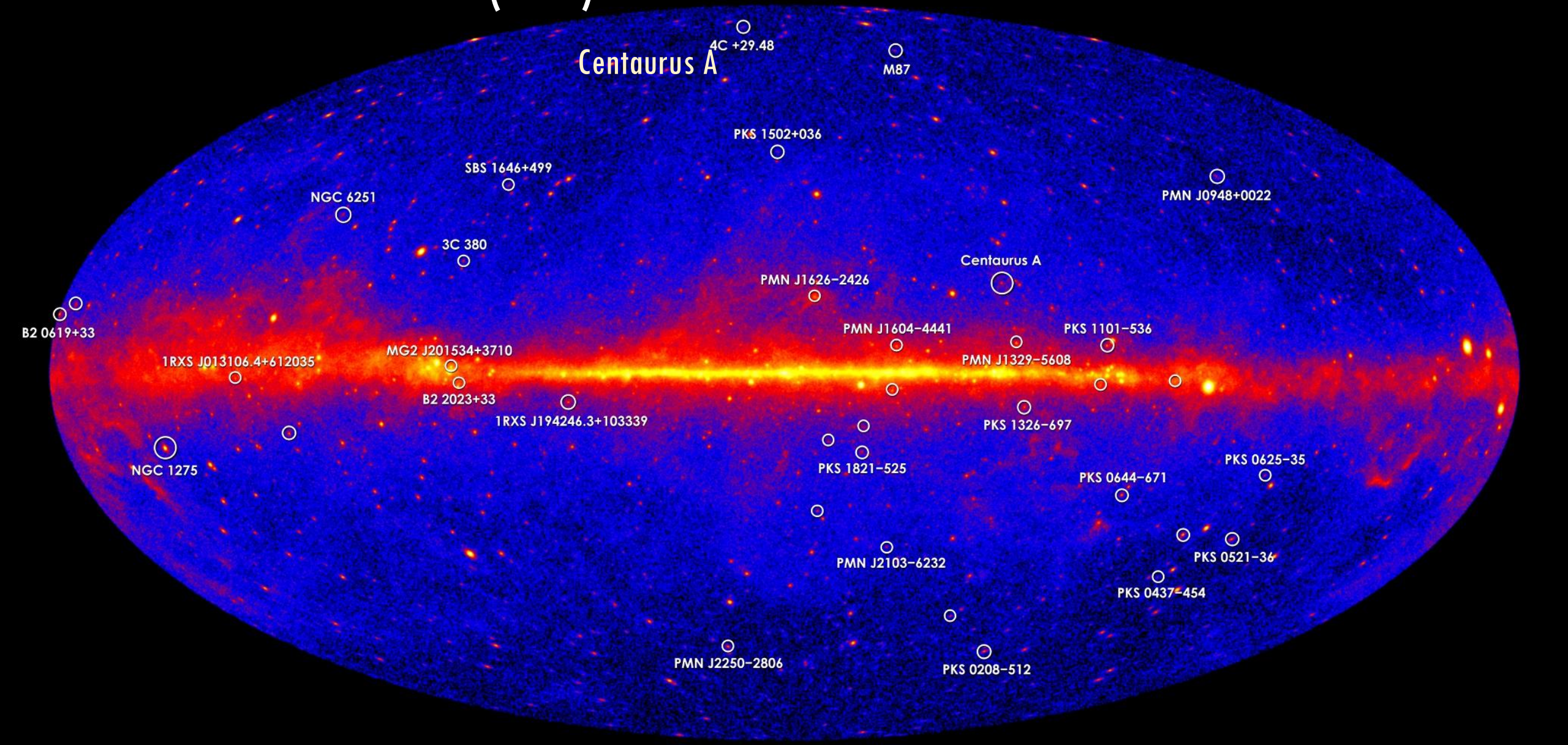
Credit: NASA/DOE/Fermi LAT Collaboration/CI Lab

Le pulsar



Credit: NASA/DOE/Fermi LAT Collaboration/GSFC

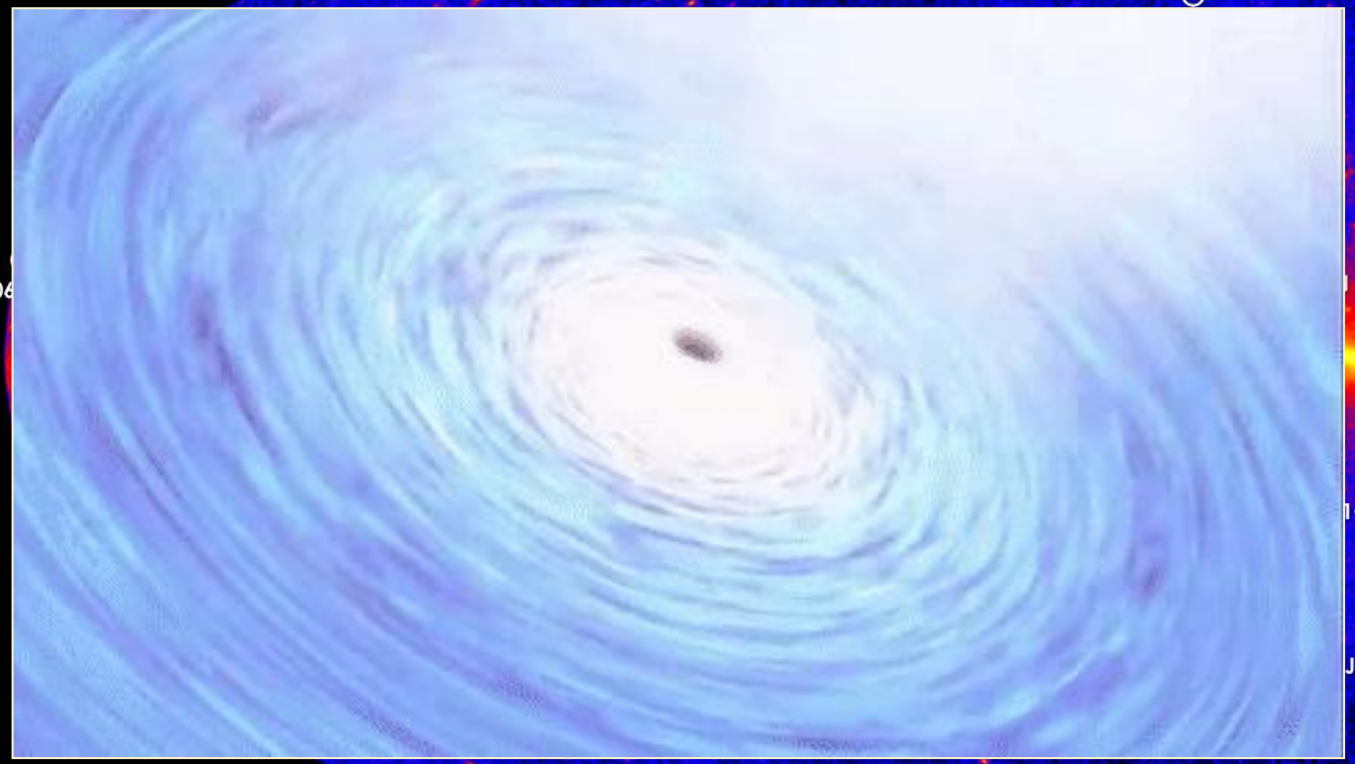
I Nuclei Galattici Attivi (AGN)



Credit: NASA/DOE/Fermi LAT Collaboration

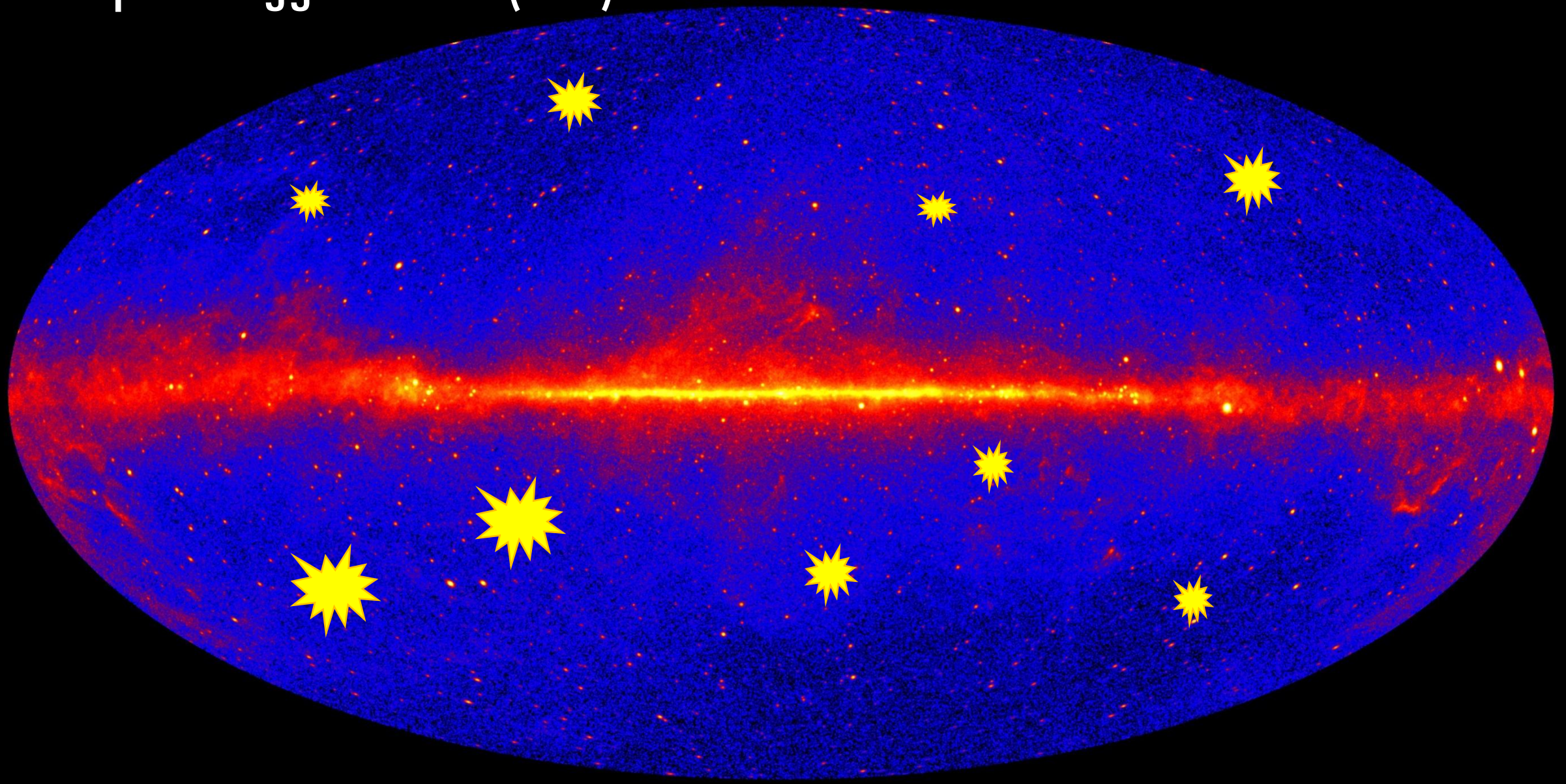
I Nuclei Galattici Attivi (AGN)

Rappresentazioni artistiche



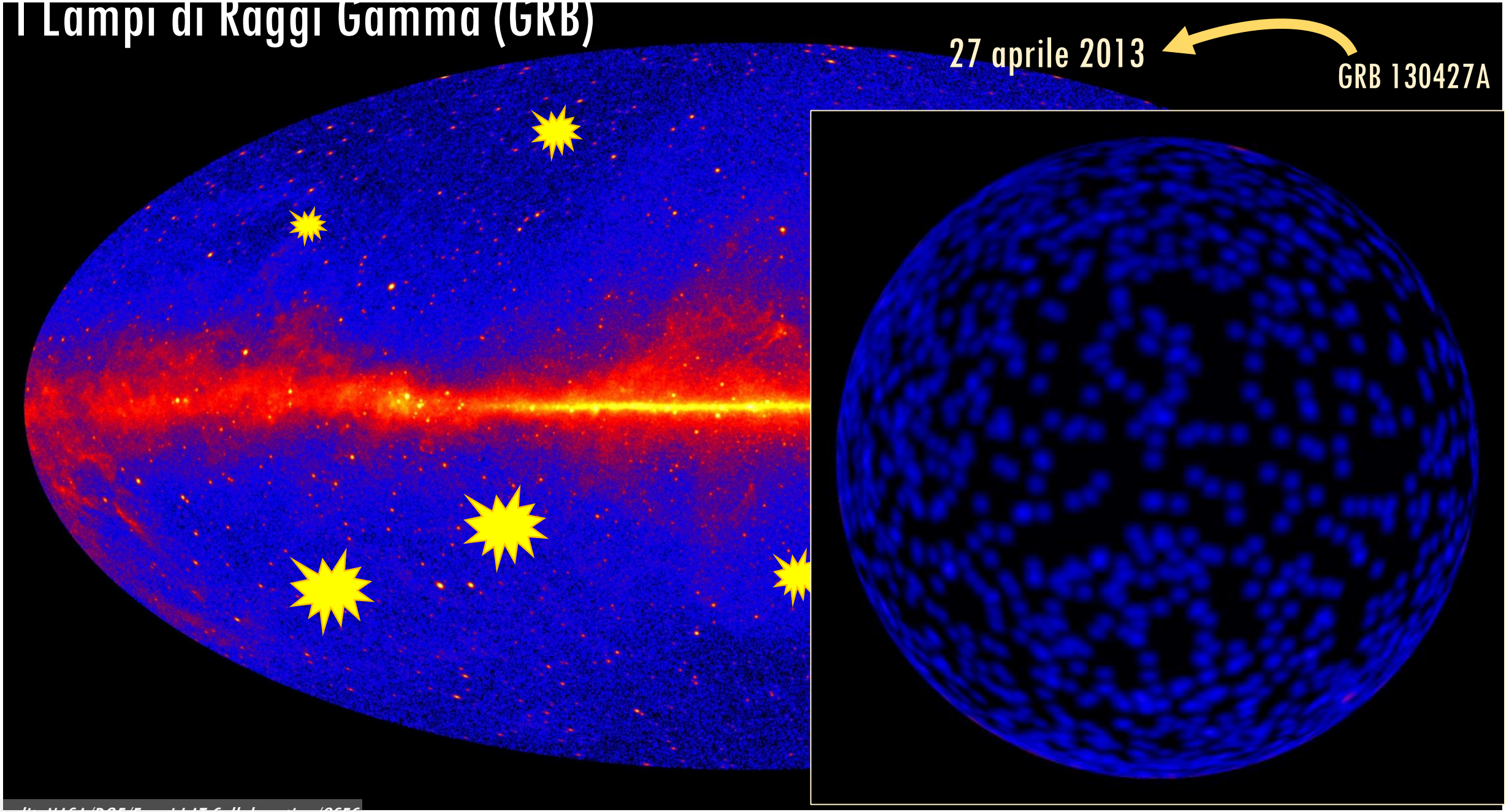
Credit: NASA/DOE/Fermi LAT Collaboration

I Lampi di Raggi Gamma (GRB)

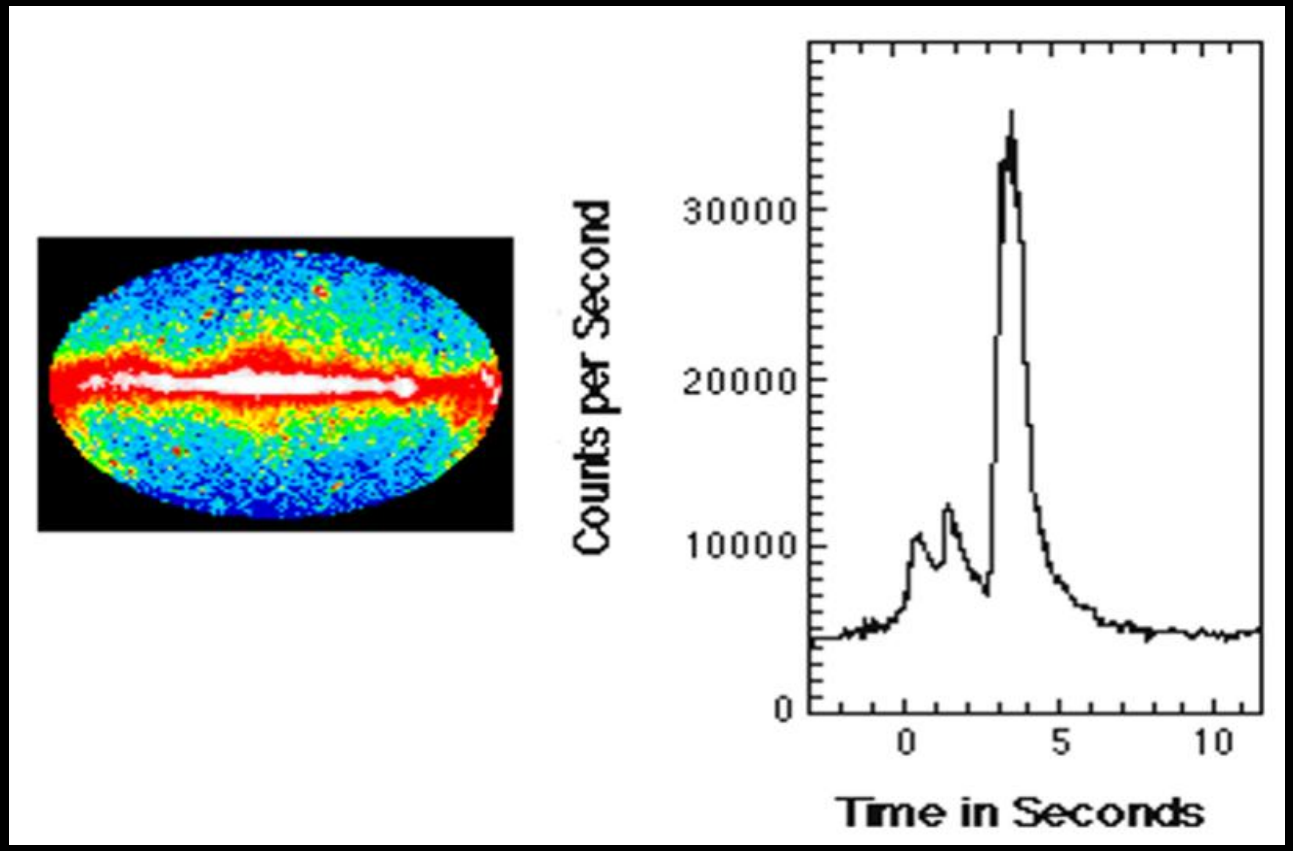


Credit: NASA/DOE/Fermi LAT Collaboration/GSFC

I Lampi di Raggi Gamma (GRB)

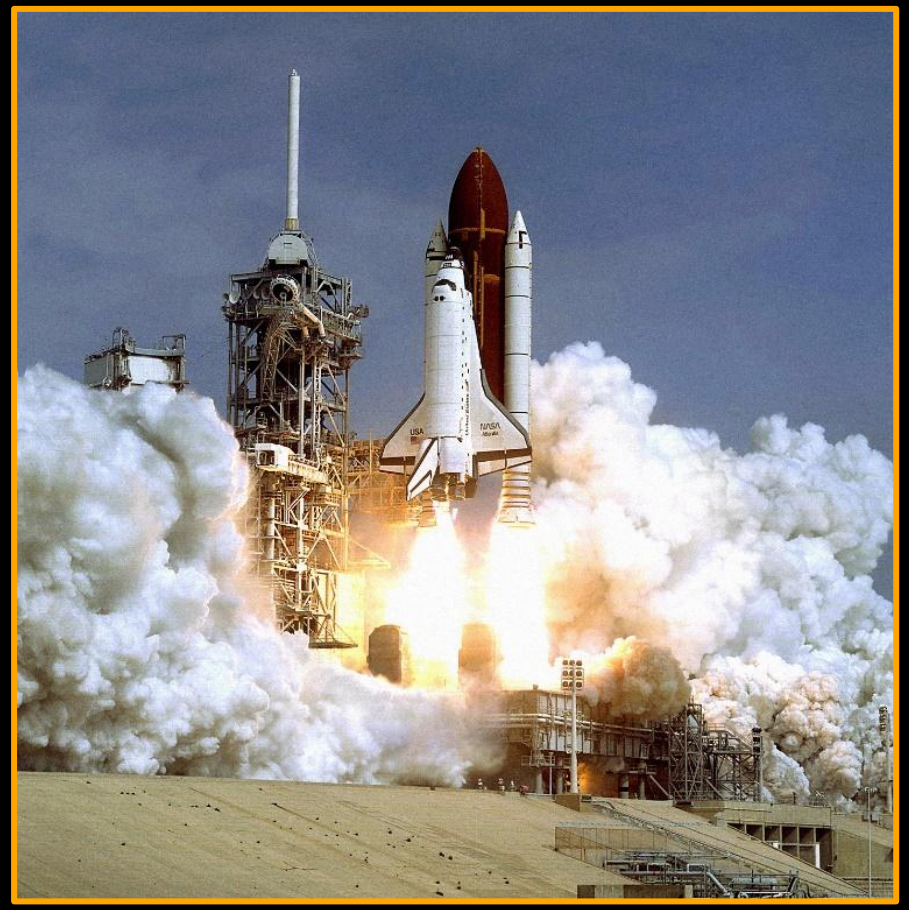


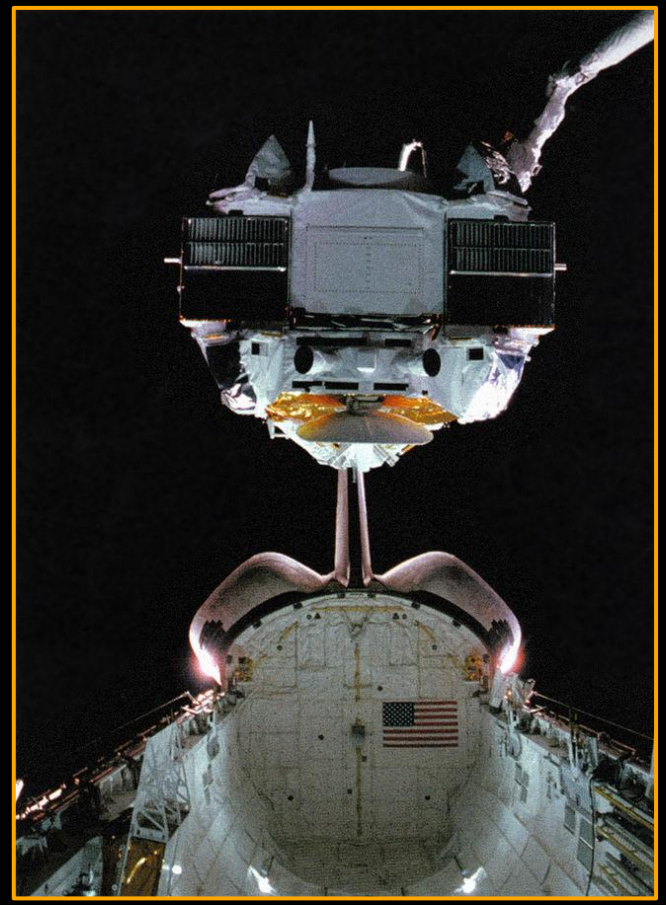
Osservazioni di GRB nella storia



Sateliti Vela:
monitoraggio del rispetto del Trattato tra USA, UK e URSS del 1963 sul **bando parziale dei test nucleari**

Osservazioni di GRB nella storia





(Image Credit: NASA/MSFC)

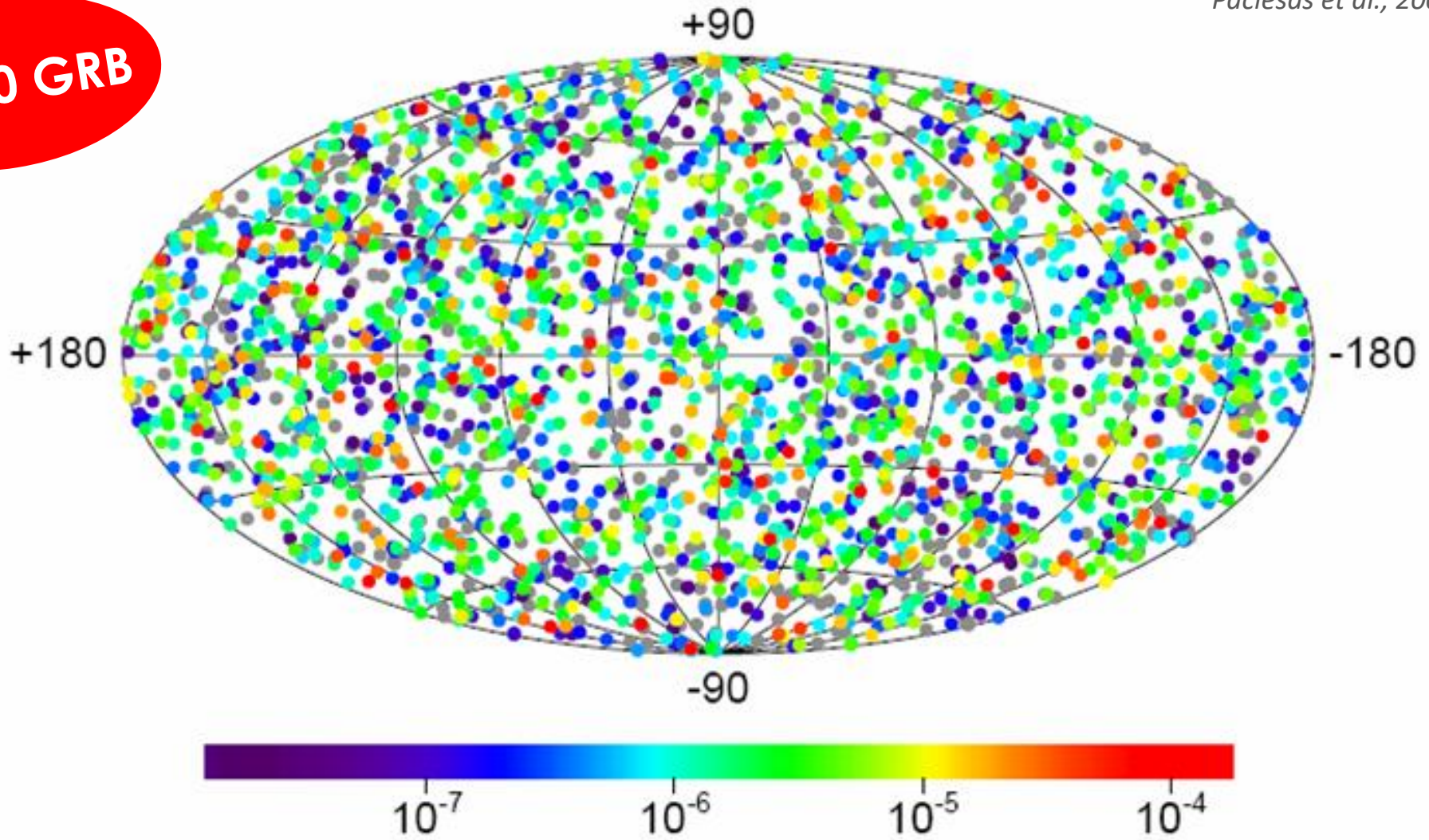
Grande Osservatorio NASA (1991 – 2000) :

Compton Gamma Ray Observatory (CGRO)

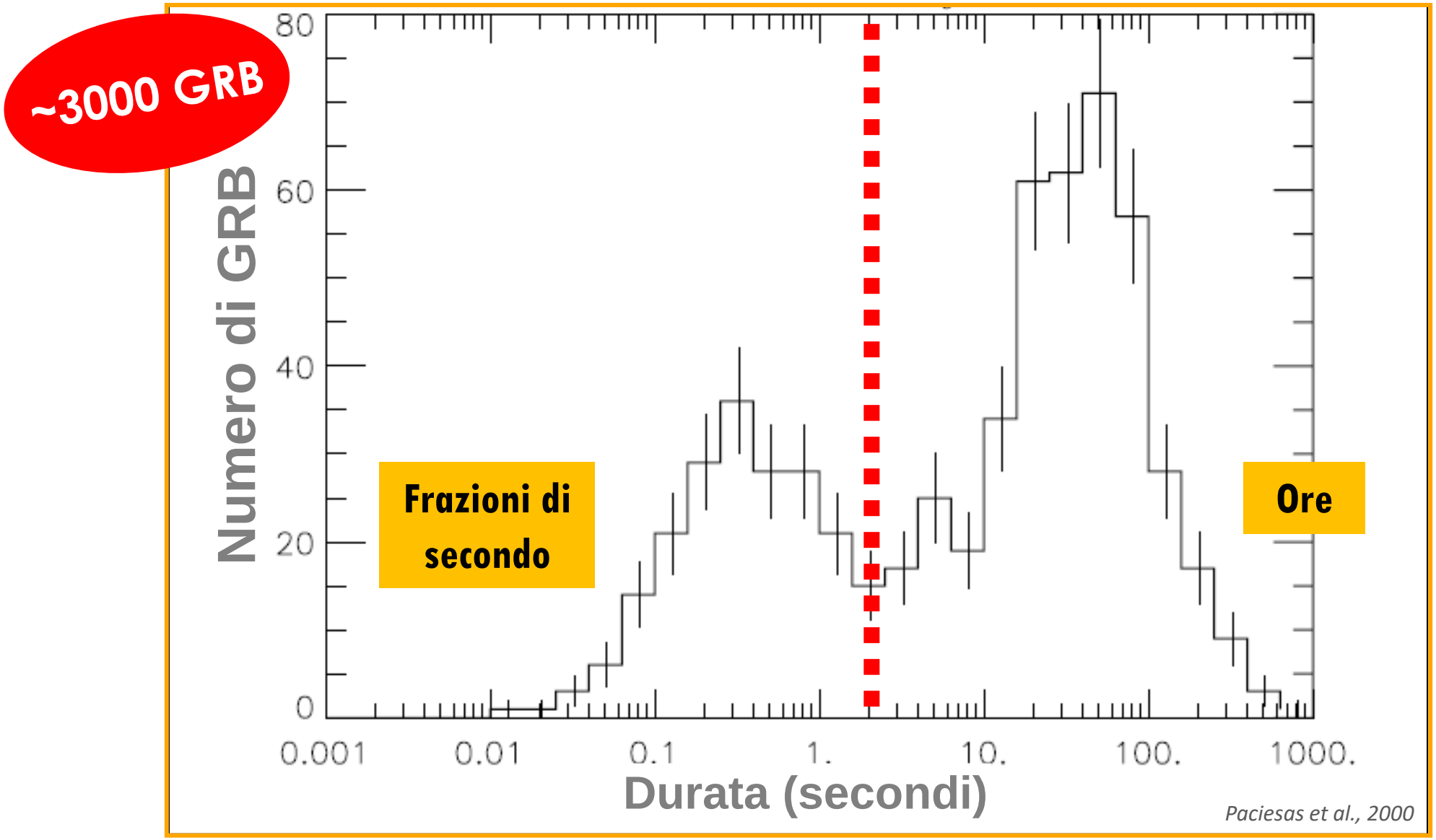
Strumenti a bordo: BATSE – EGRET – OSSE – Comptel

Il primo grande catalogo dei GRB osservati da BATSE

~3000 GRB

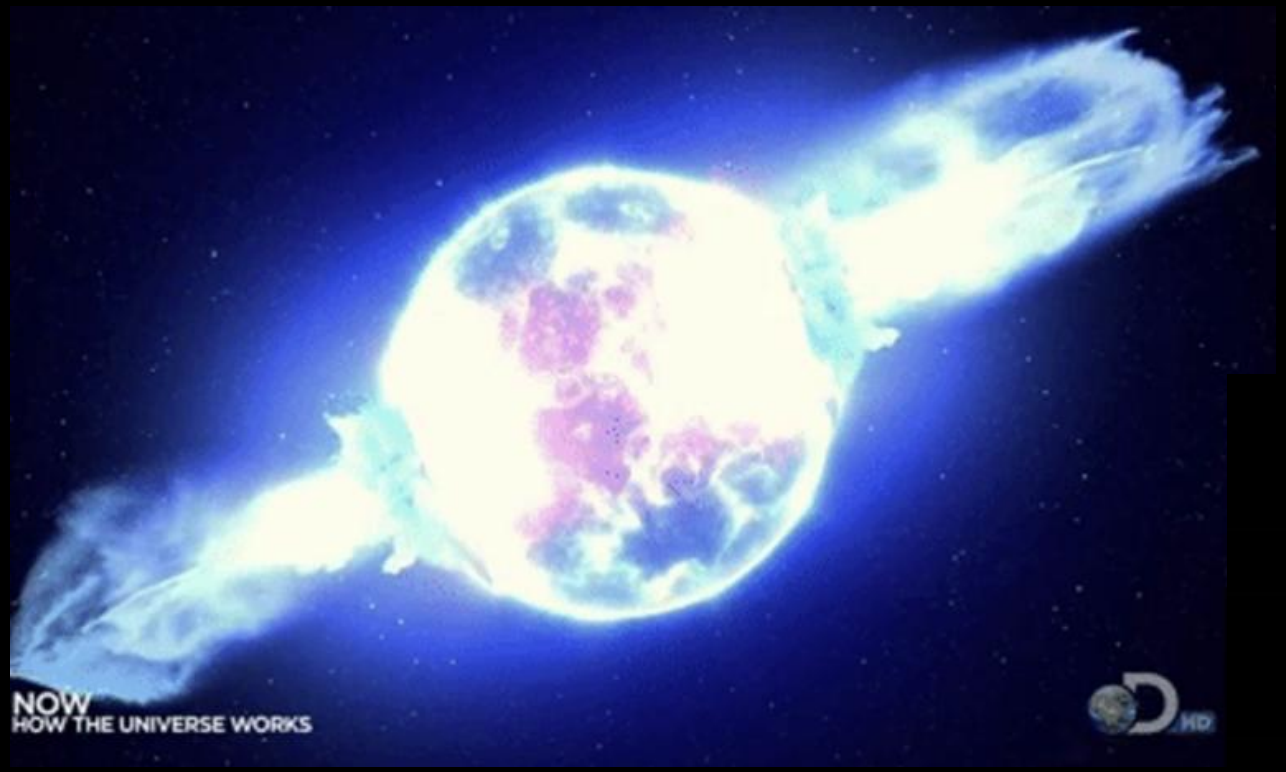


Il primo grande catalogo dei GRB osservati da BATSE



GRB lunghi – Long GRB (Durata > 2 secondi)

Collasso di una singola stella supermassiva



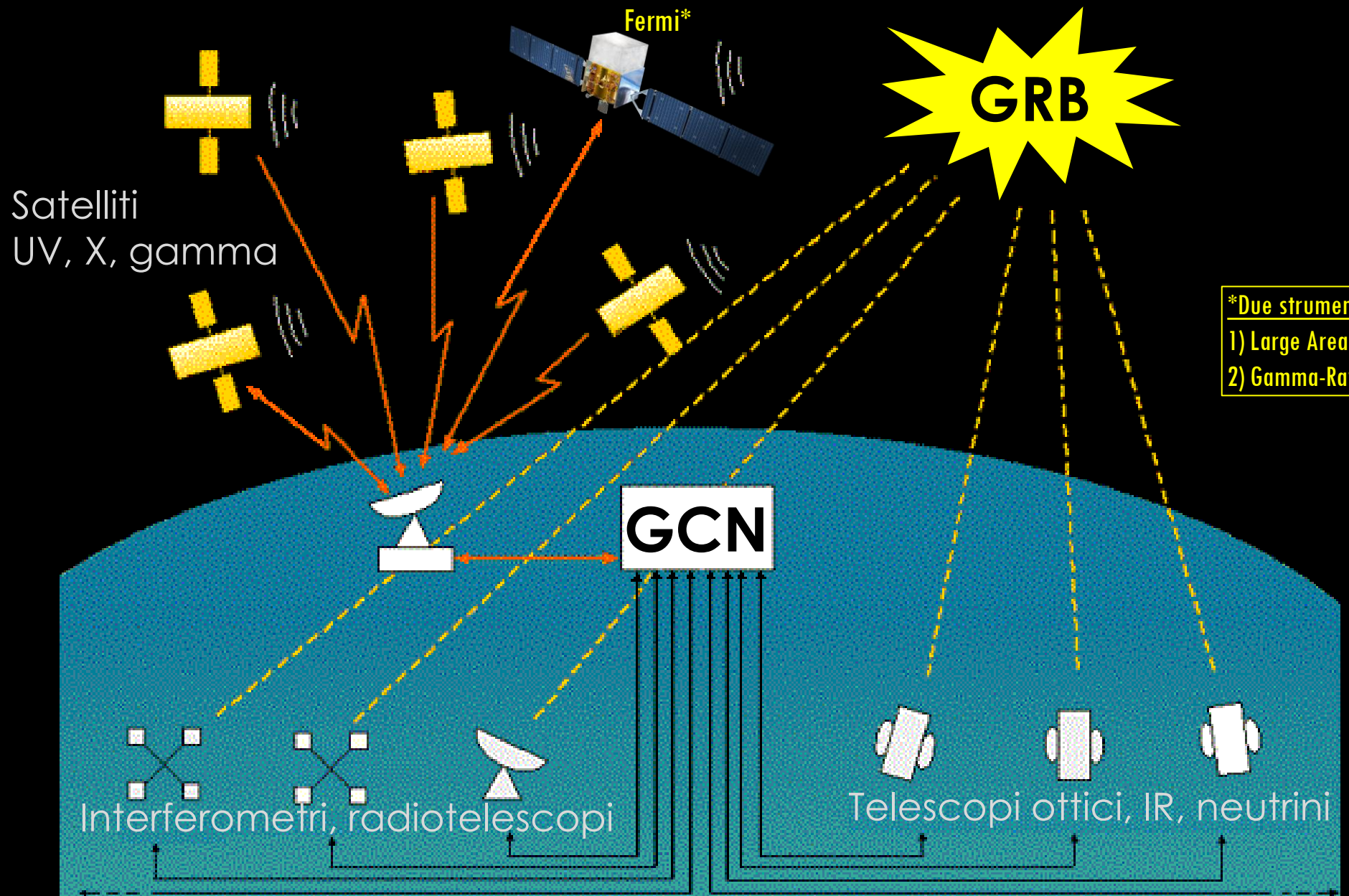
(Video Credit: How The Universe Works – Discovery Channel 2010)

GRB brevi – Short GRB (Durata < 2 secondi)

Fusione di due stelle binarie compatte

(Video Credit: NASA/Goddard & NRAO Outreach)

Tutti a caccia di GRB – GRB Coordinate Network



*Due strumenti scientifici:
1) Large Area Telescope (LAT)
2) Gamma-Ray Burst Monitor (GBM)

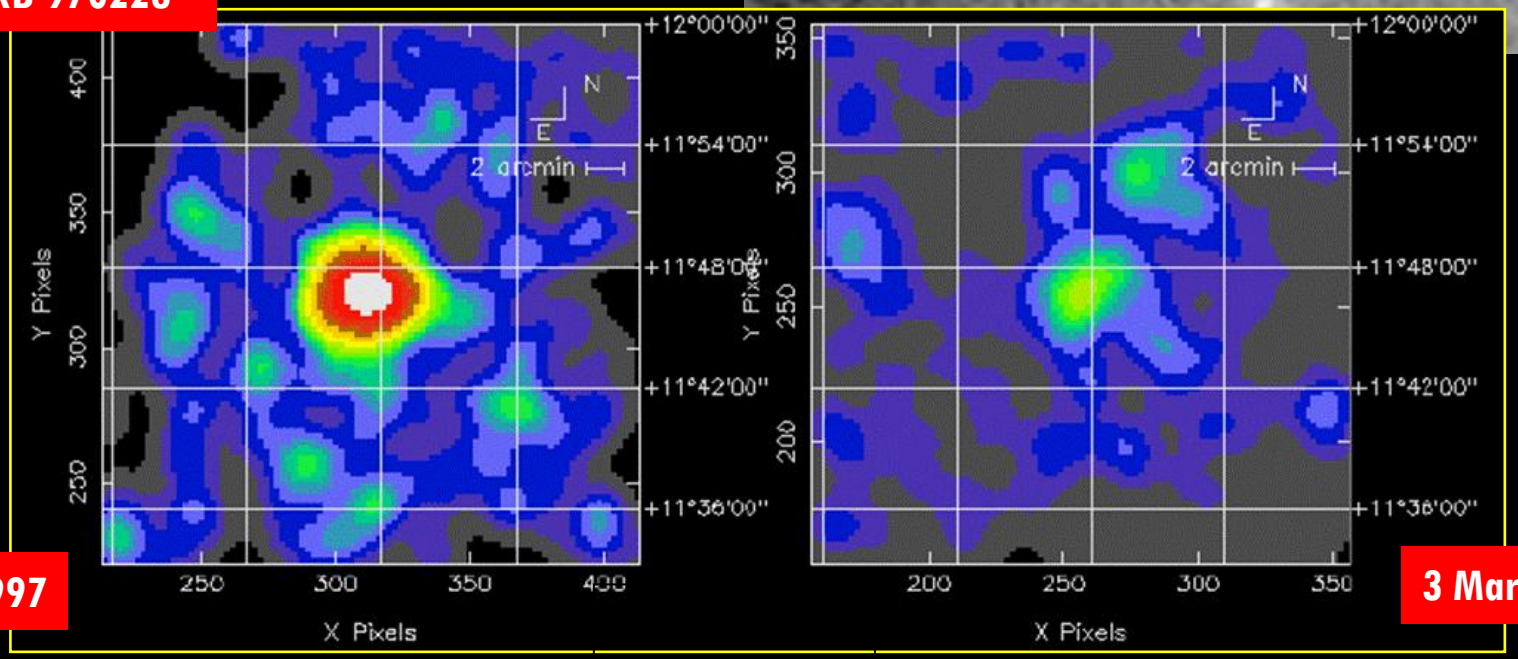
L'emissione ritardata o «afterglow»

Osservata a partire dagli anni '90 ad altre lunghezze d'onda (ottico, radio, X, etc)

Inizio dello studio MULTIFREQUENZA dei GRB

Credit: Pi of the Sky

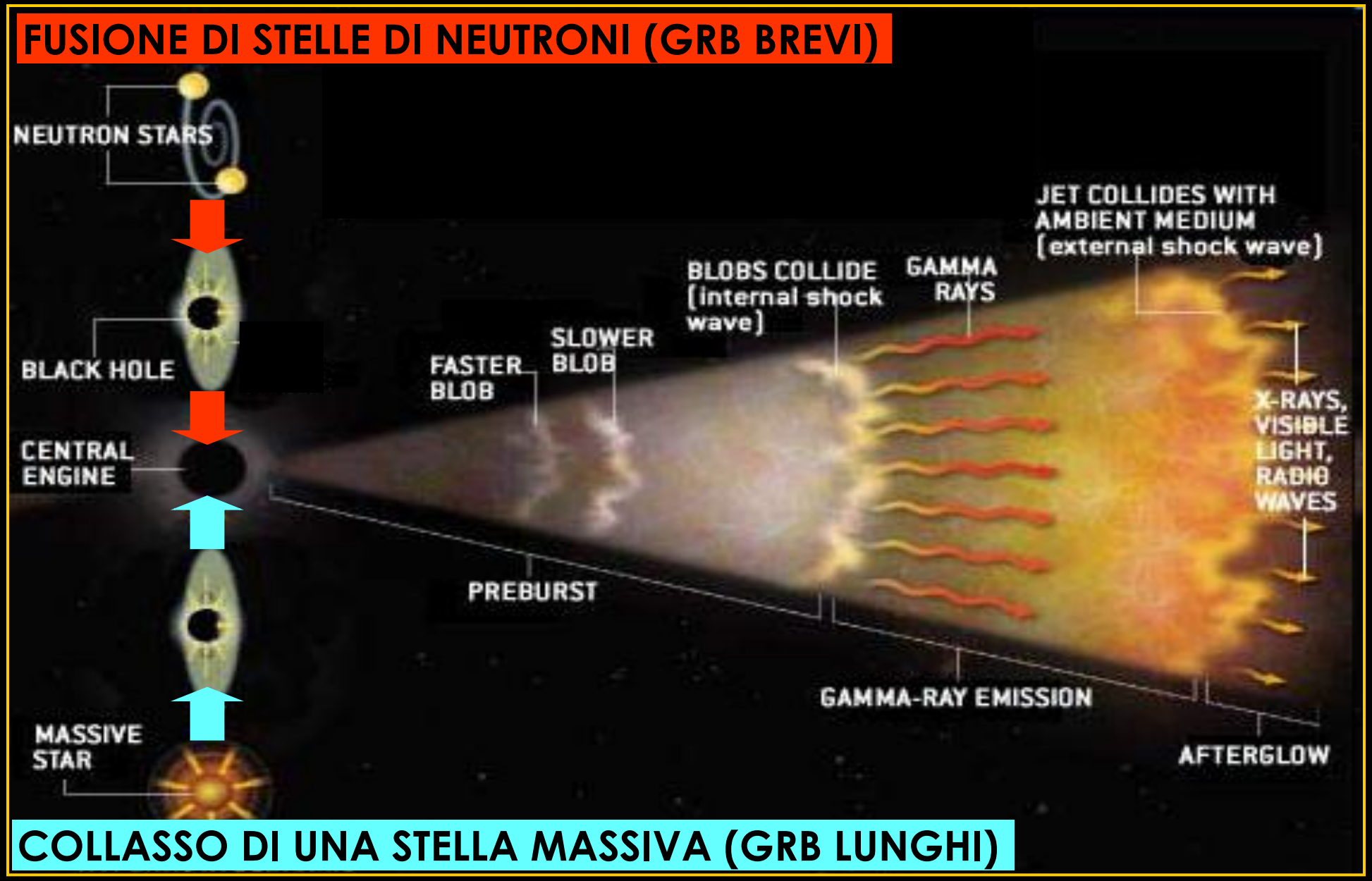
GRB 970228

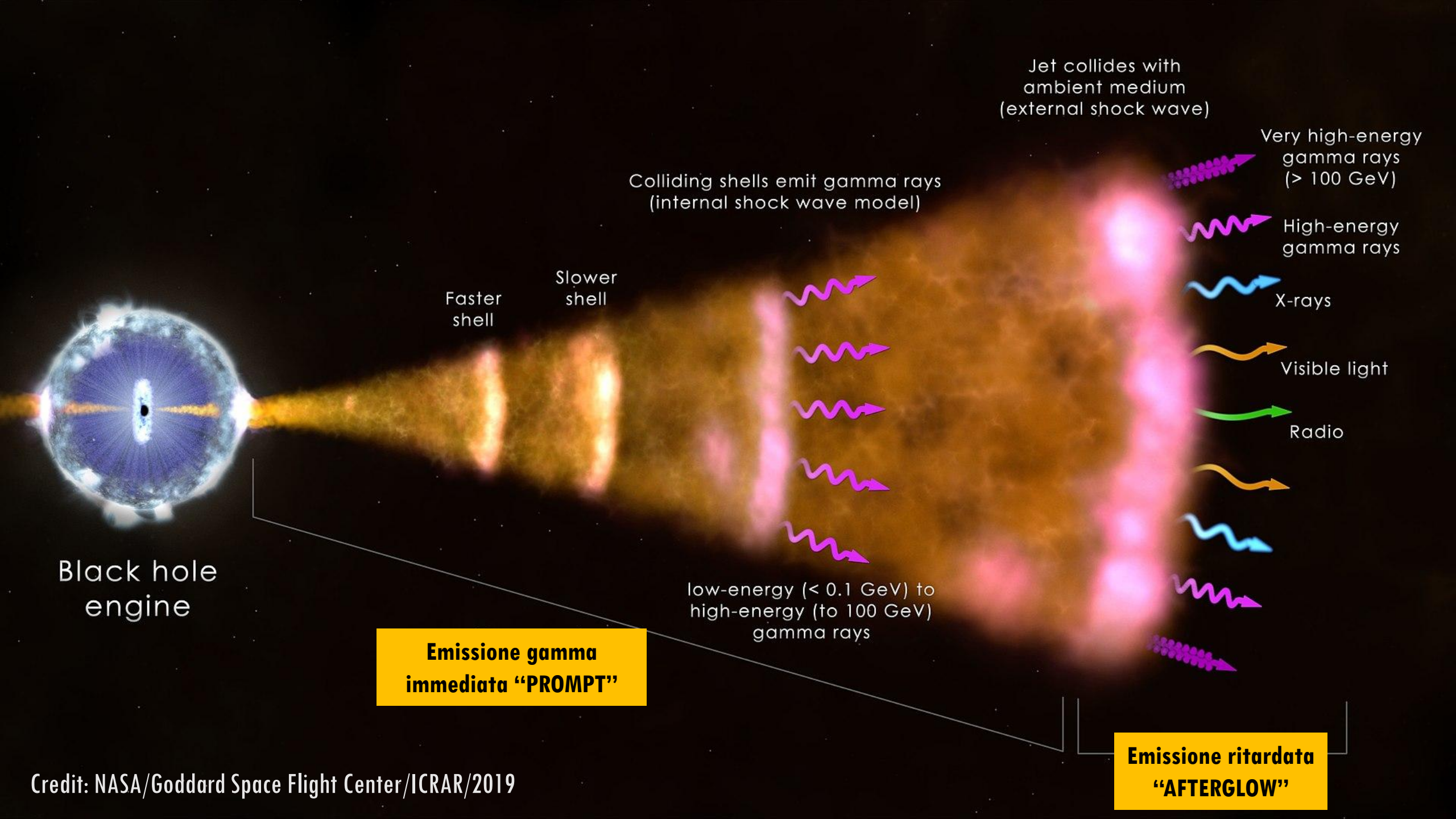


28 Feb 1997

3 Mar 1997

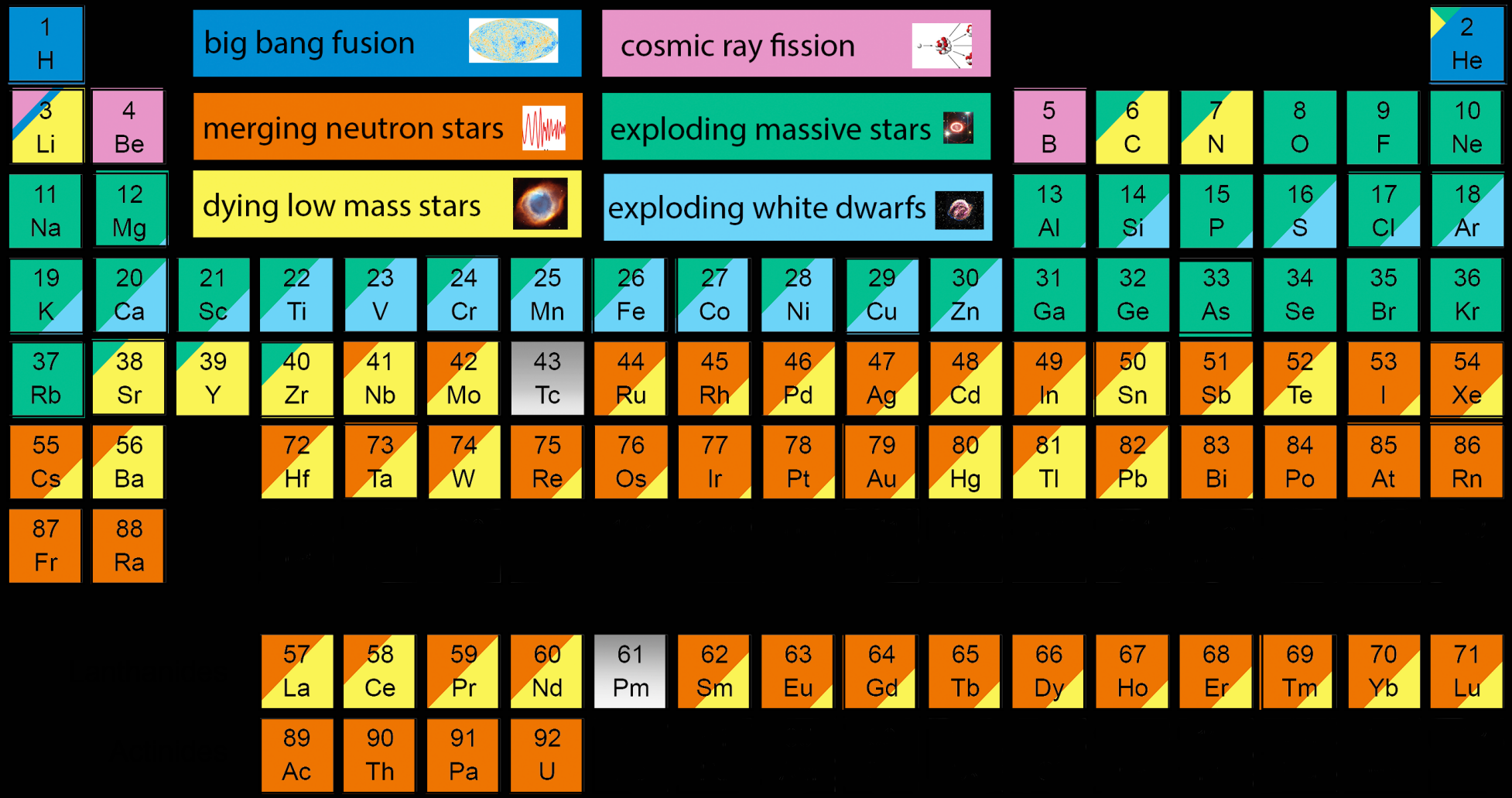
Modello teorico «fireball»





Credit: NASA/Goddard Space Flight Center/ICRAR/2019

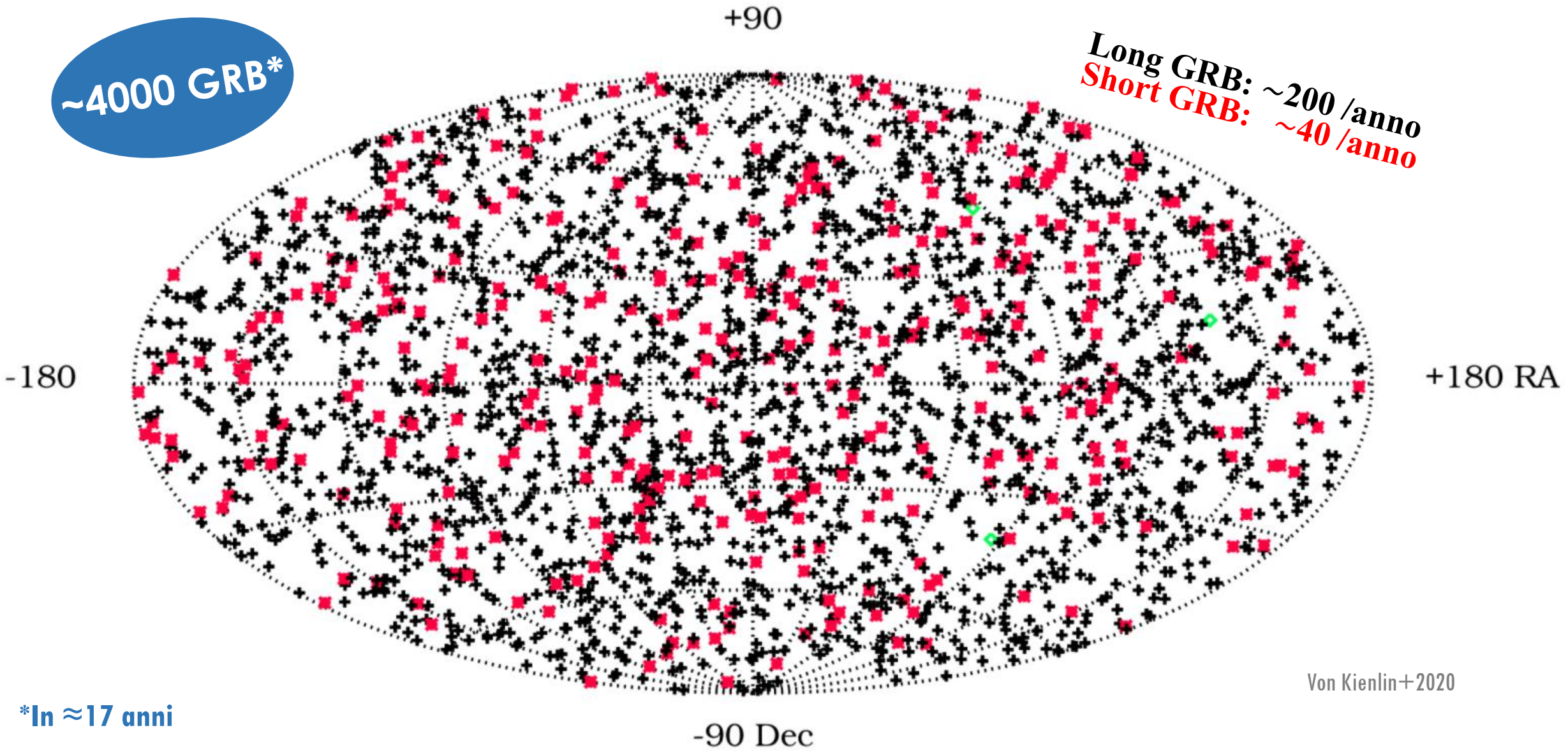
L'origine degli elementi del Sistema Solare



Graphic created by Jennifer Johnson

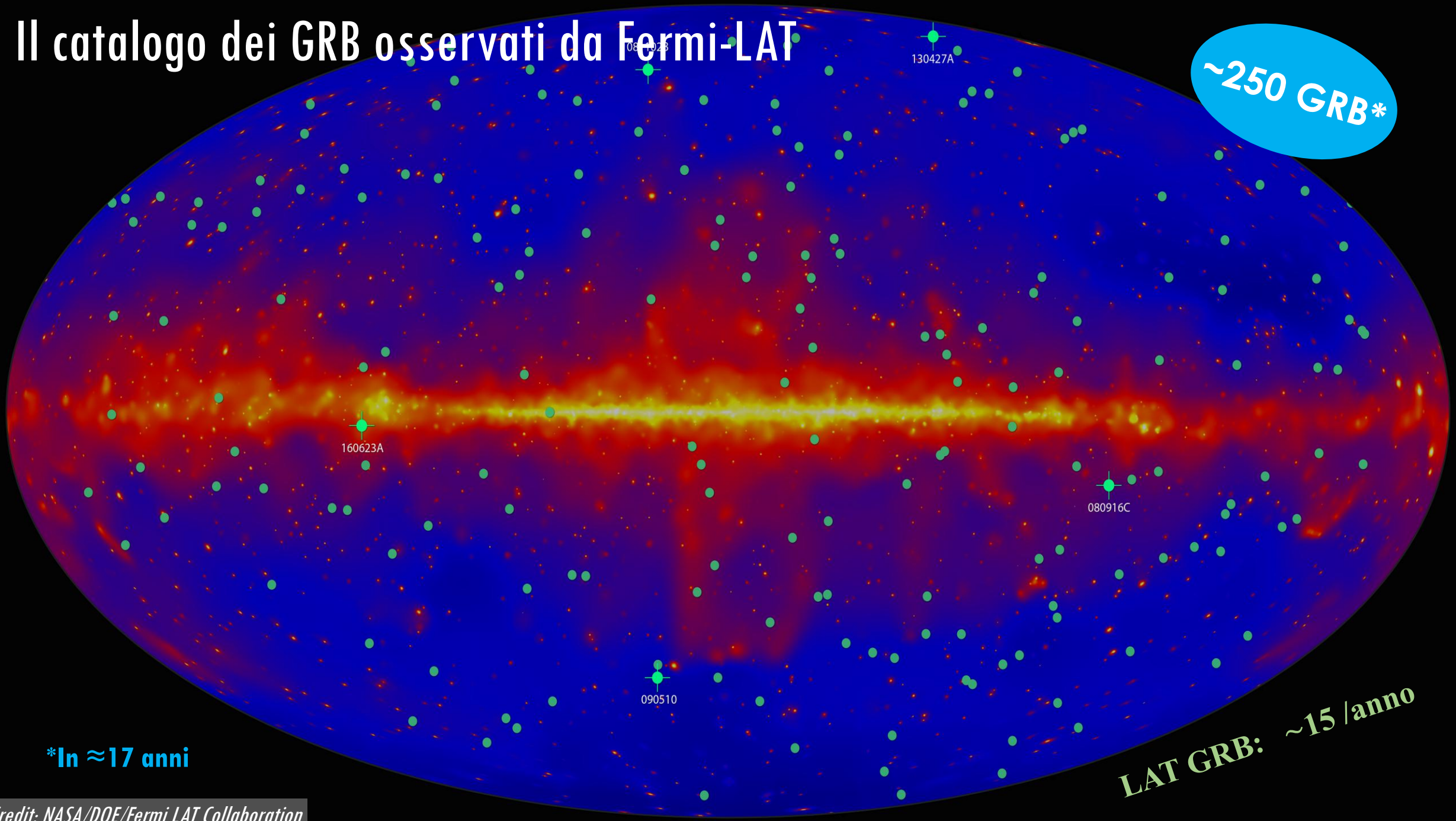
Astronomical Image Credits:
ESA/NASA/AASNova

Il catalogo dei GRB osservati da Fermi-GBM



*In ≈17 anni

Il catalogo dei GRB osservati da Fermi-LAT



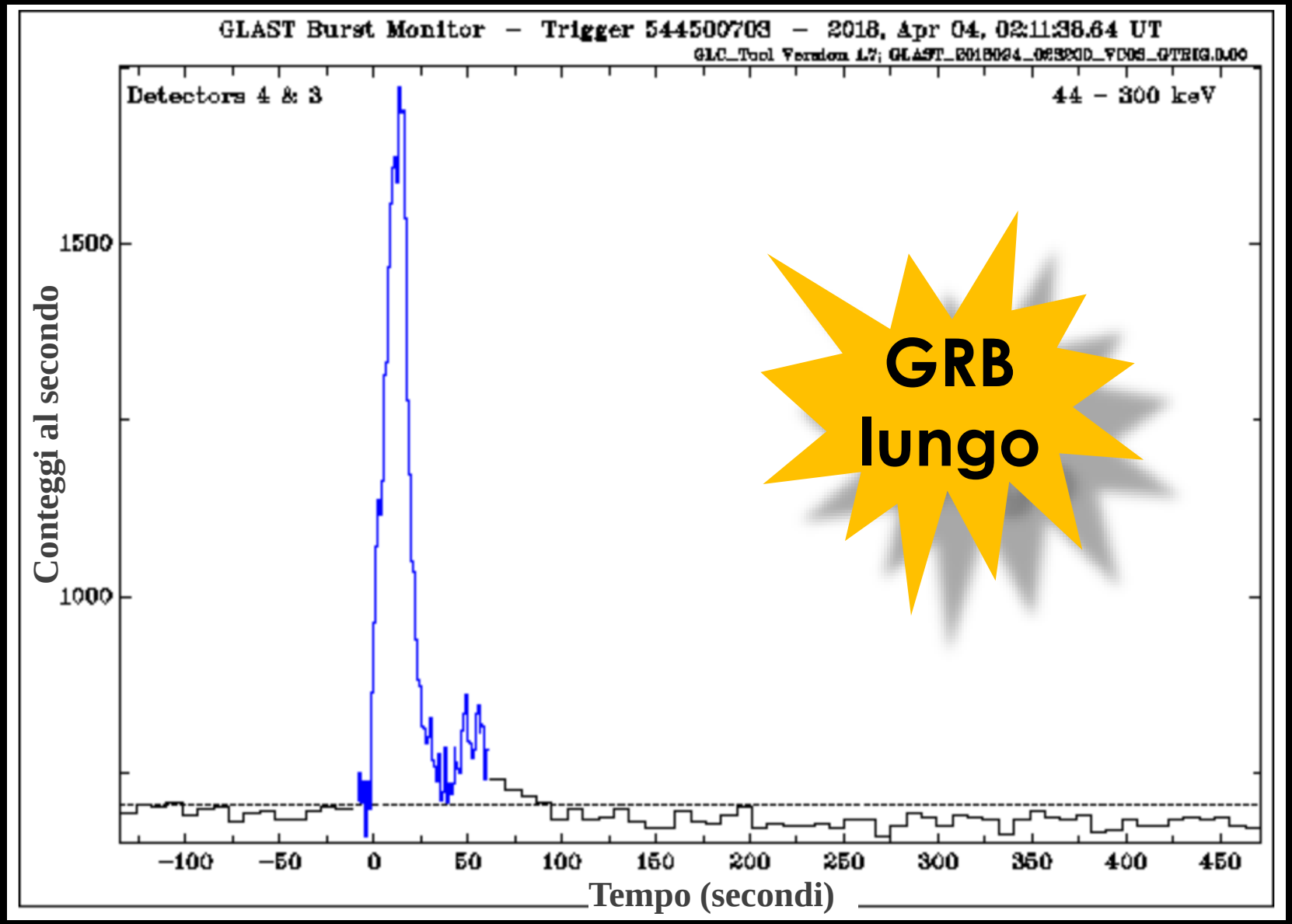
~250 GRB*

*In ≈17 anni

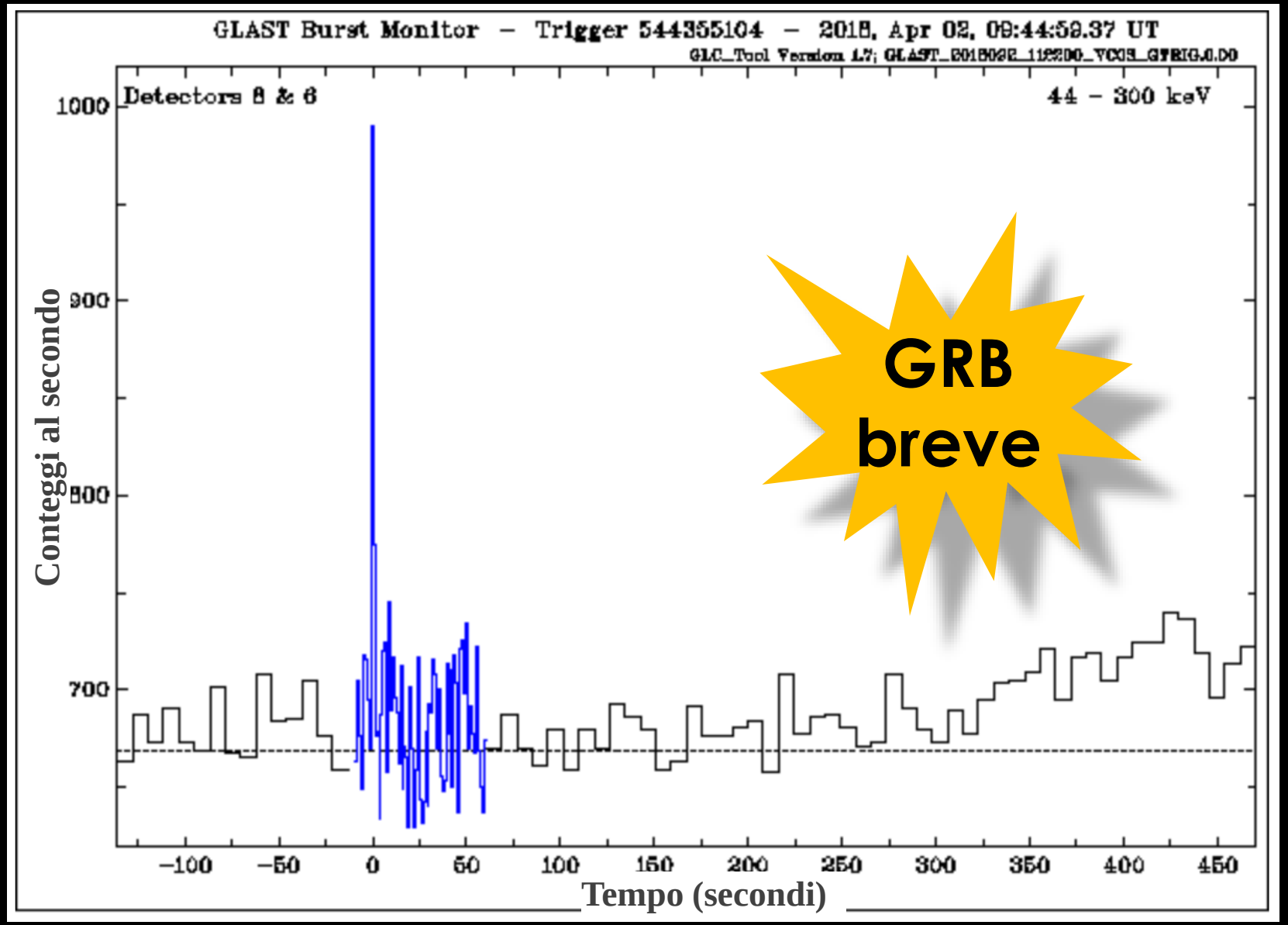
LAT GRB: ~15 /anno

Credit: NASA/DOE/Fermi LAT Collaboration

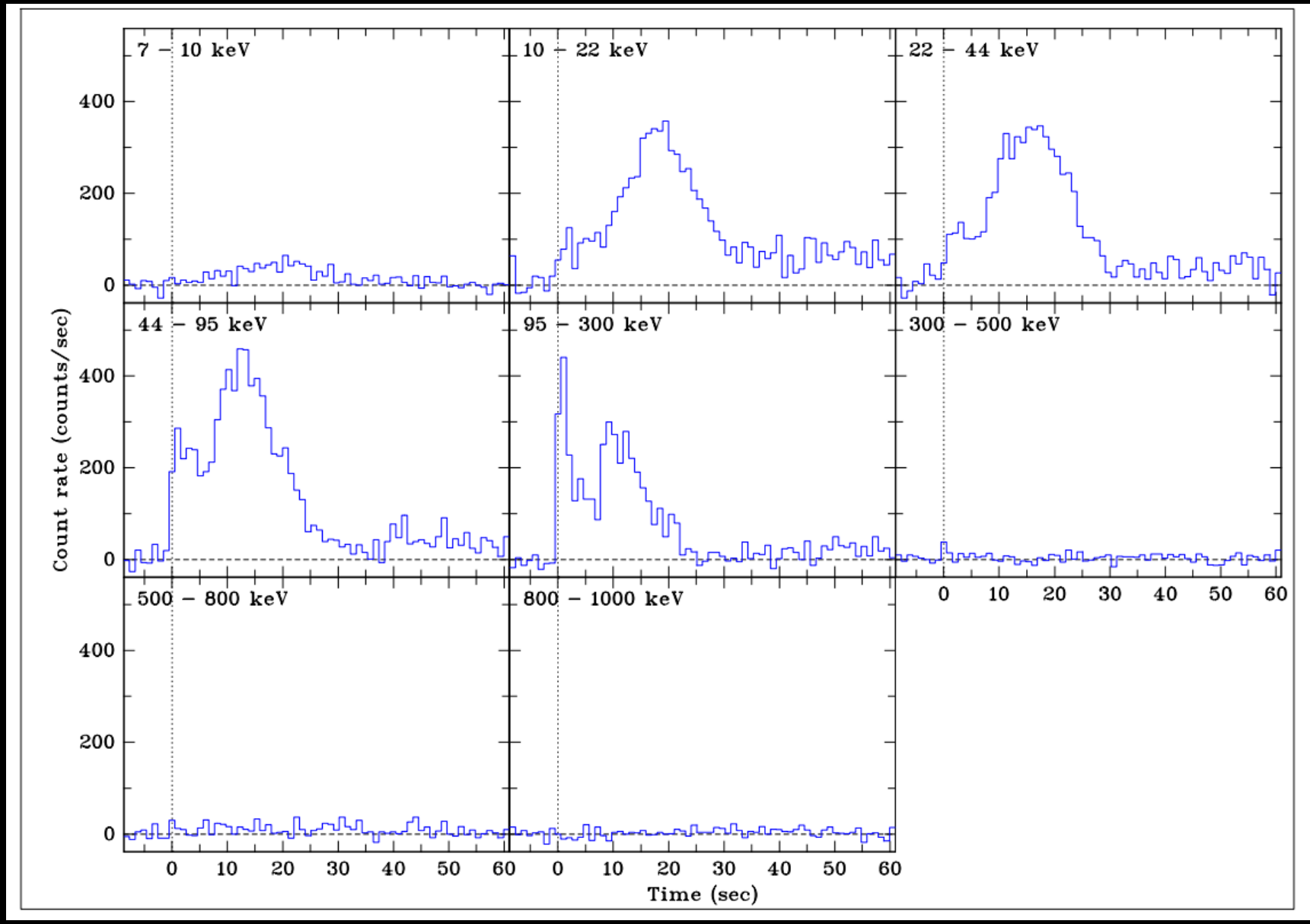
Come è fatto un GRB visto da Fermi-GBM?



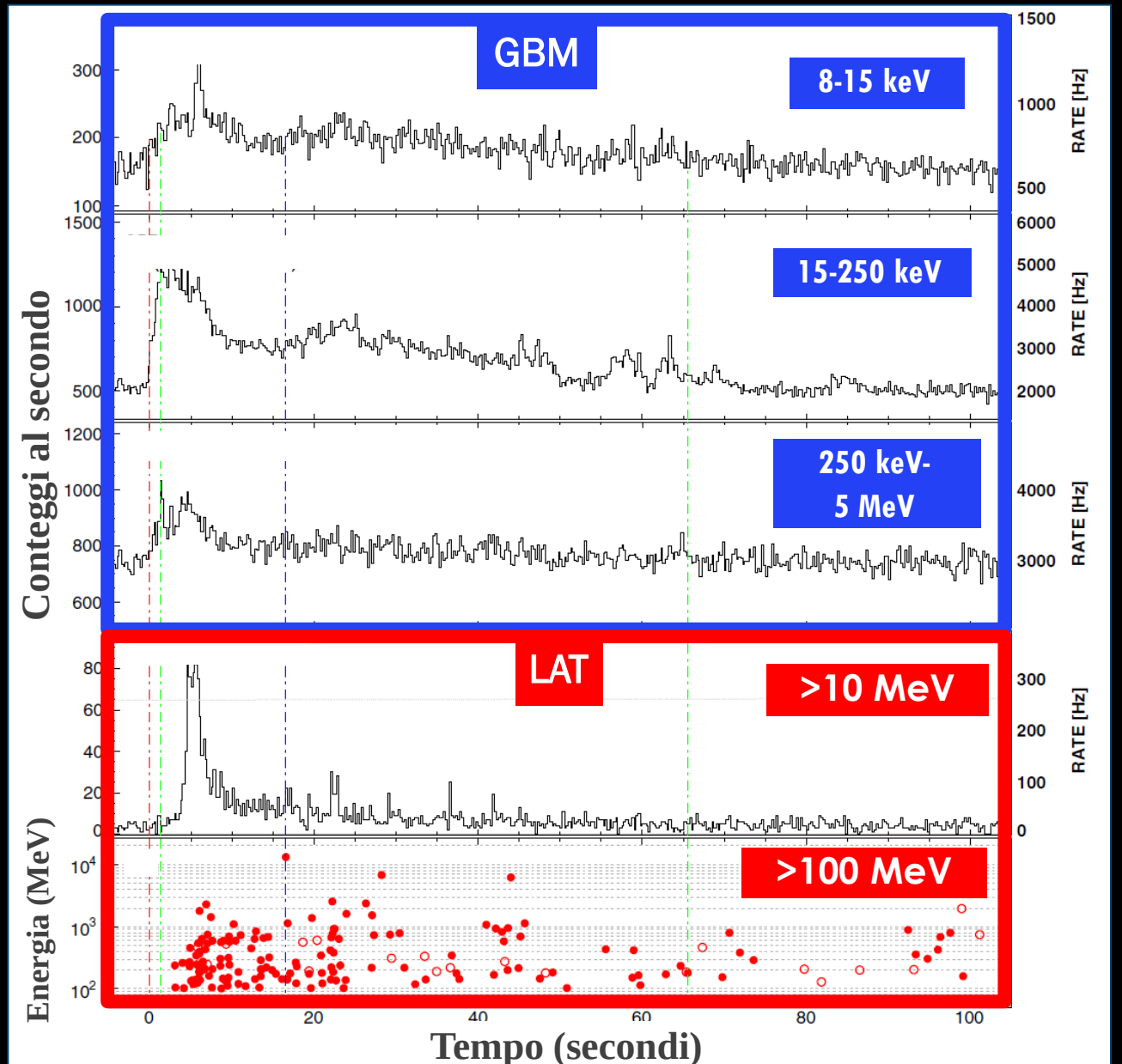
Come è fatto un GRB visto da Fermi-GBM?



La forma del GRB cambia al variare dell'energia!



GRB 080916C osservato sia da Fermi-GBM che da Fermi-LAT

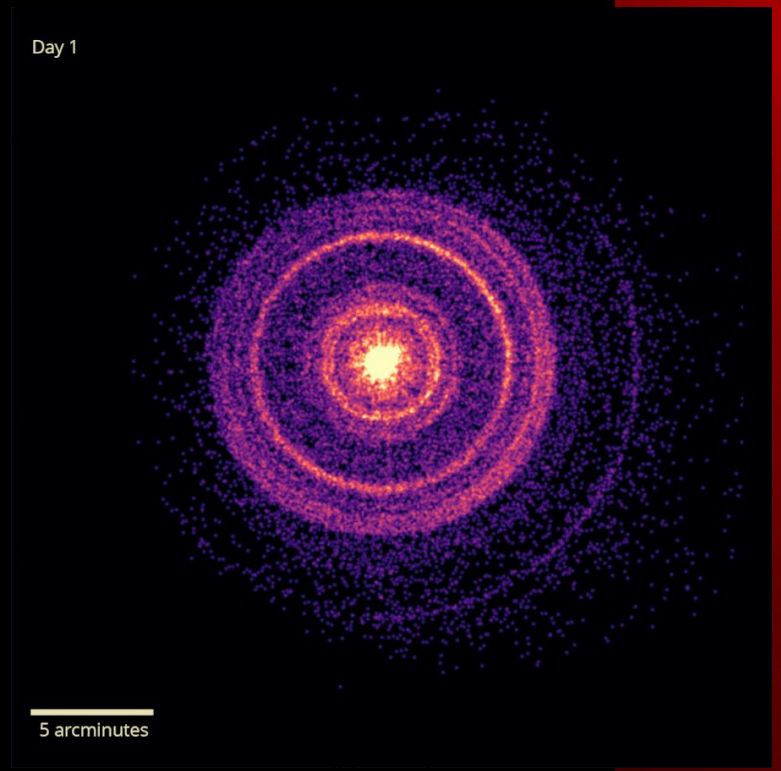


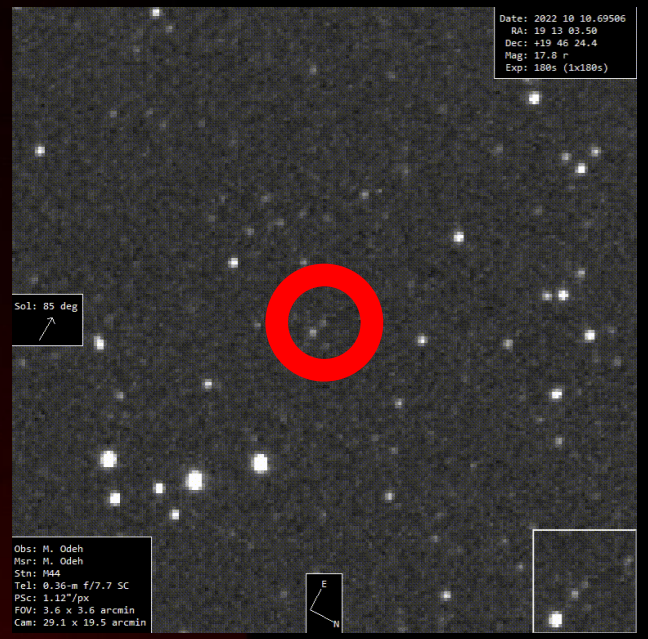
«BOAT» GRB 221009A

Brightest of All Times

Astronomy Picture of the Day

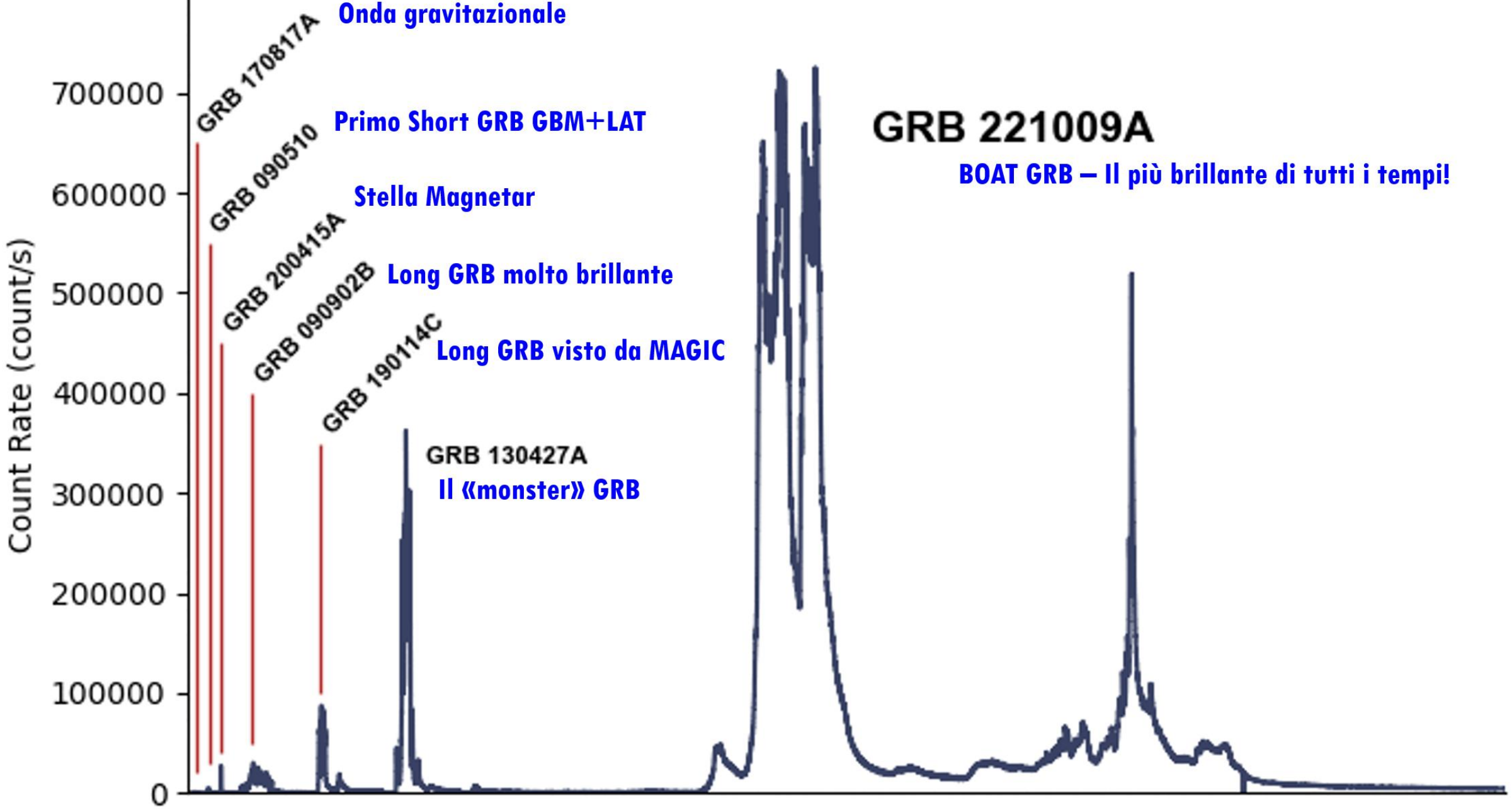
15 Ottobre 2022





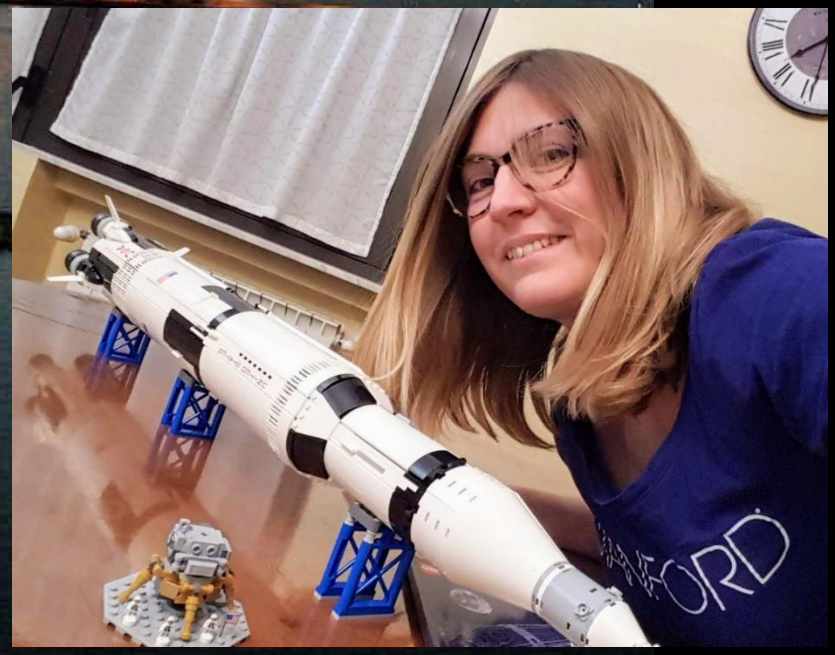
https://apod.nasa.gov/apod/ap221015.html?fbclid=IwAR0dtOruG18ZOg9a-AhjcLkfPfvsok_C5Dvn-sjK7YpBQB5Pt_g_RShYsUE

Image Credit: NASA, DOE, Fermi LAT Collaboration, R.Pillera



Credit: A. Goldstein/Fermi-GBM

Grazie per l'attenzione



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