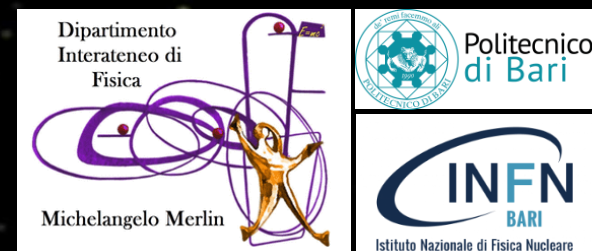


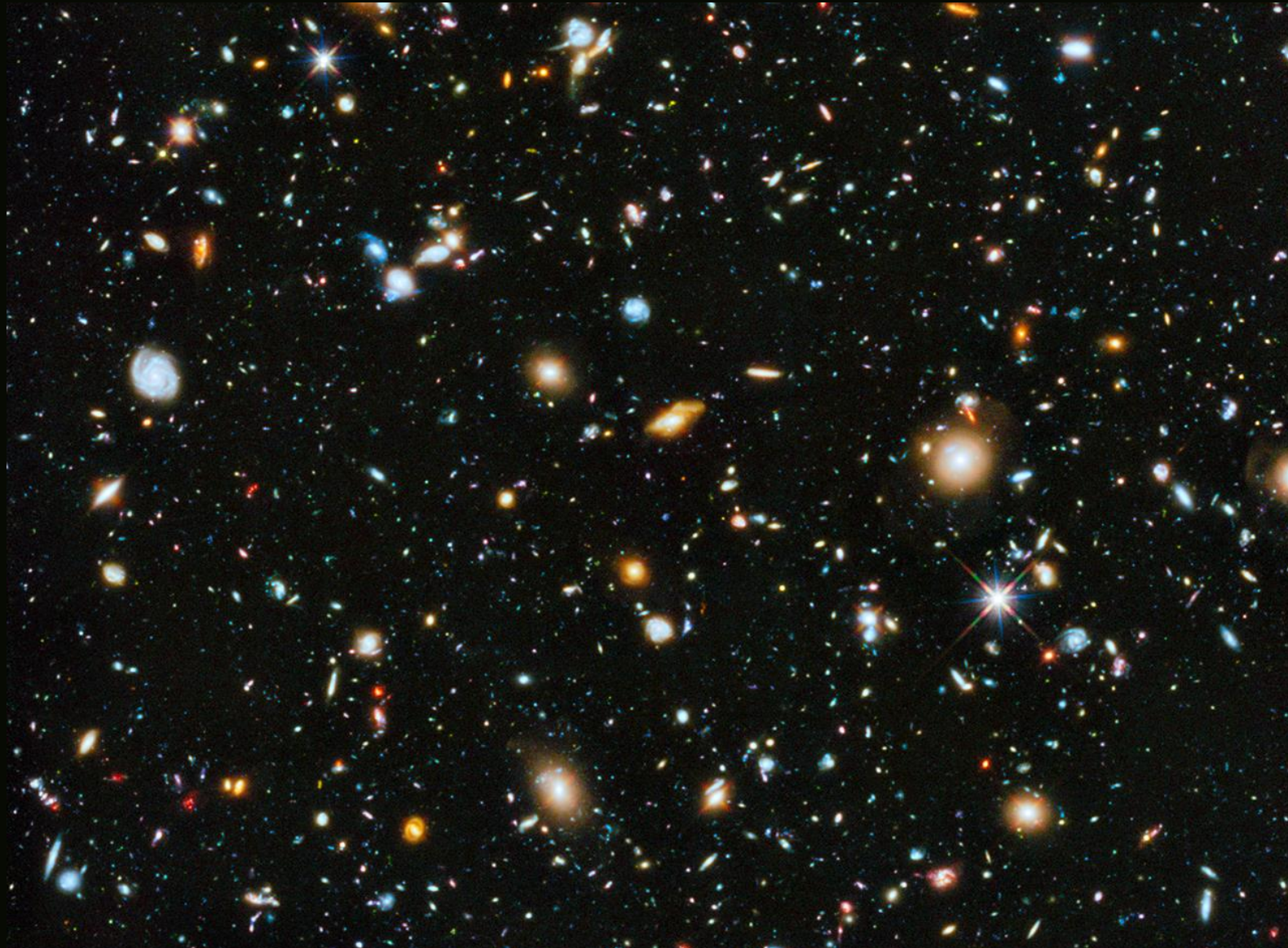
Alla scoperta dei misteri del cosmo: satelliti e telescopi per l'osservazione dell'Universo esplosivo

Prof.ssa Elisabetta Bissaldi

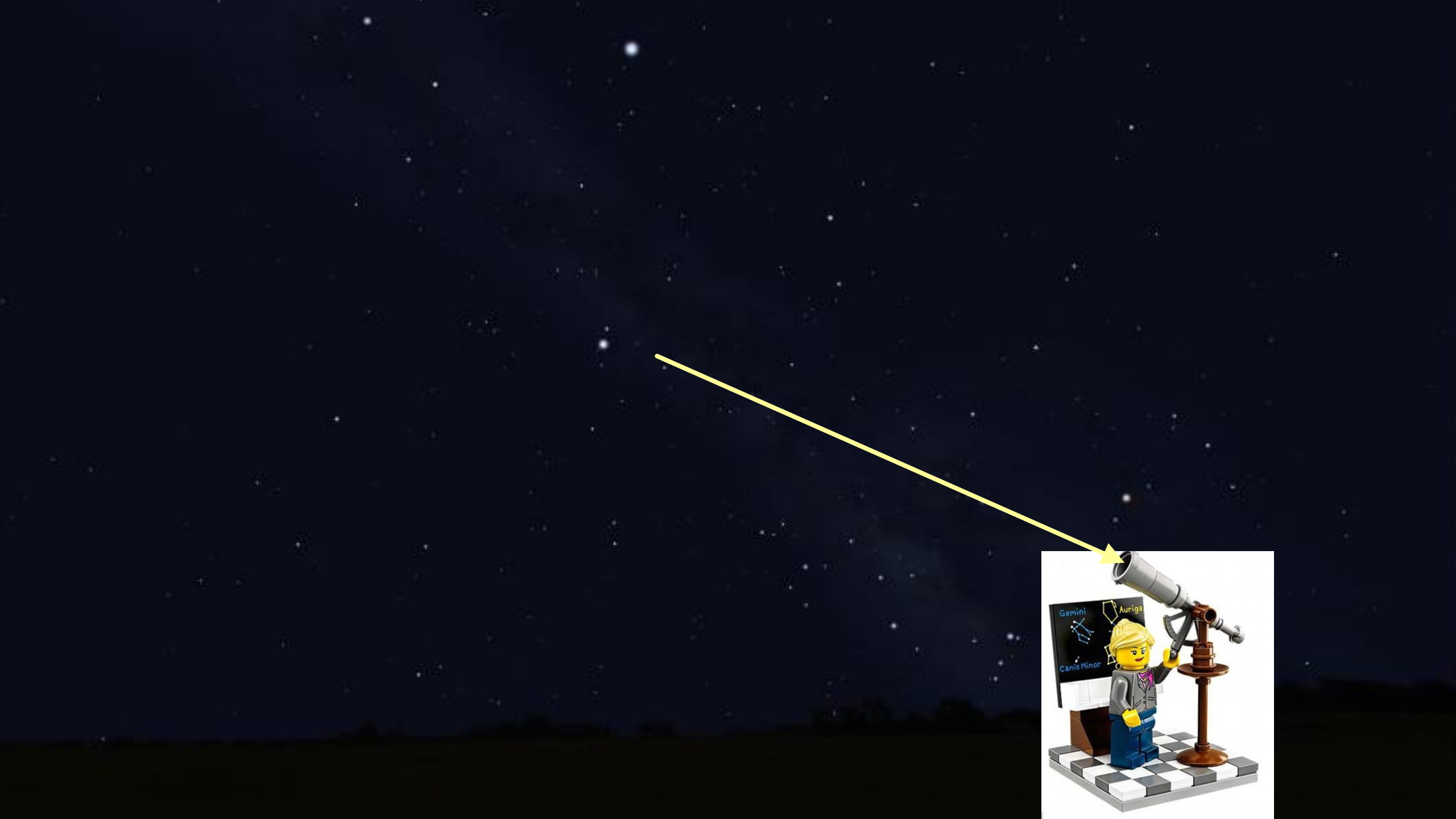
Dipartimento Interateneo di Fisica "M. Merlin"
Politecnico & INFN Bari – elisabetta.bissaldi@ba.infn.it

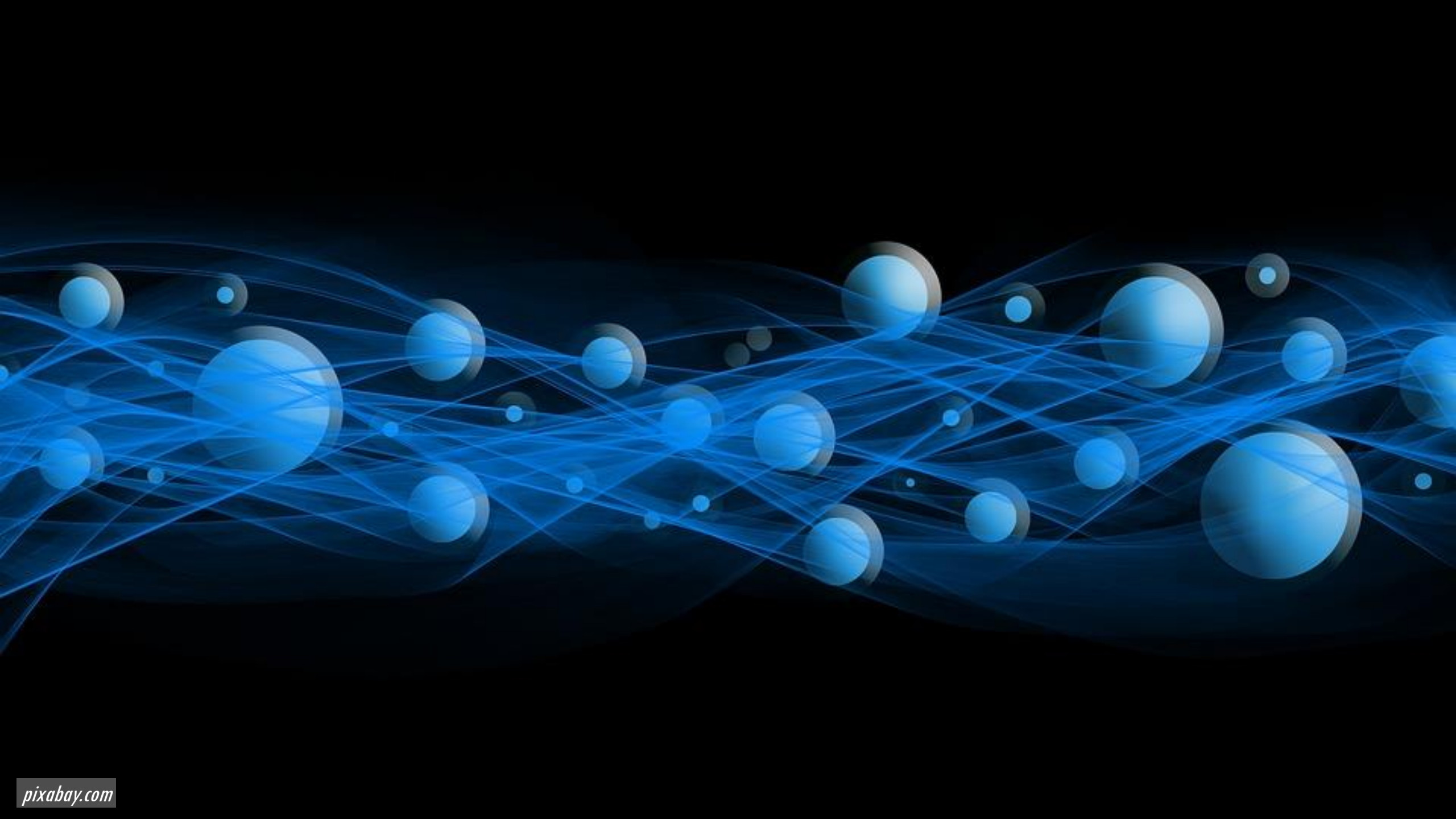


L'Universo: il più grande laboratorio di ricerca



(Image Credit: NASA; ESA; G. Illingworth, D. Magee, and P. Oesch, University of California, Santa Cruz; R. Bouwens, Leiden University; and the HUDF09 Team, 2012)

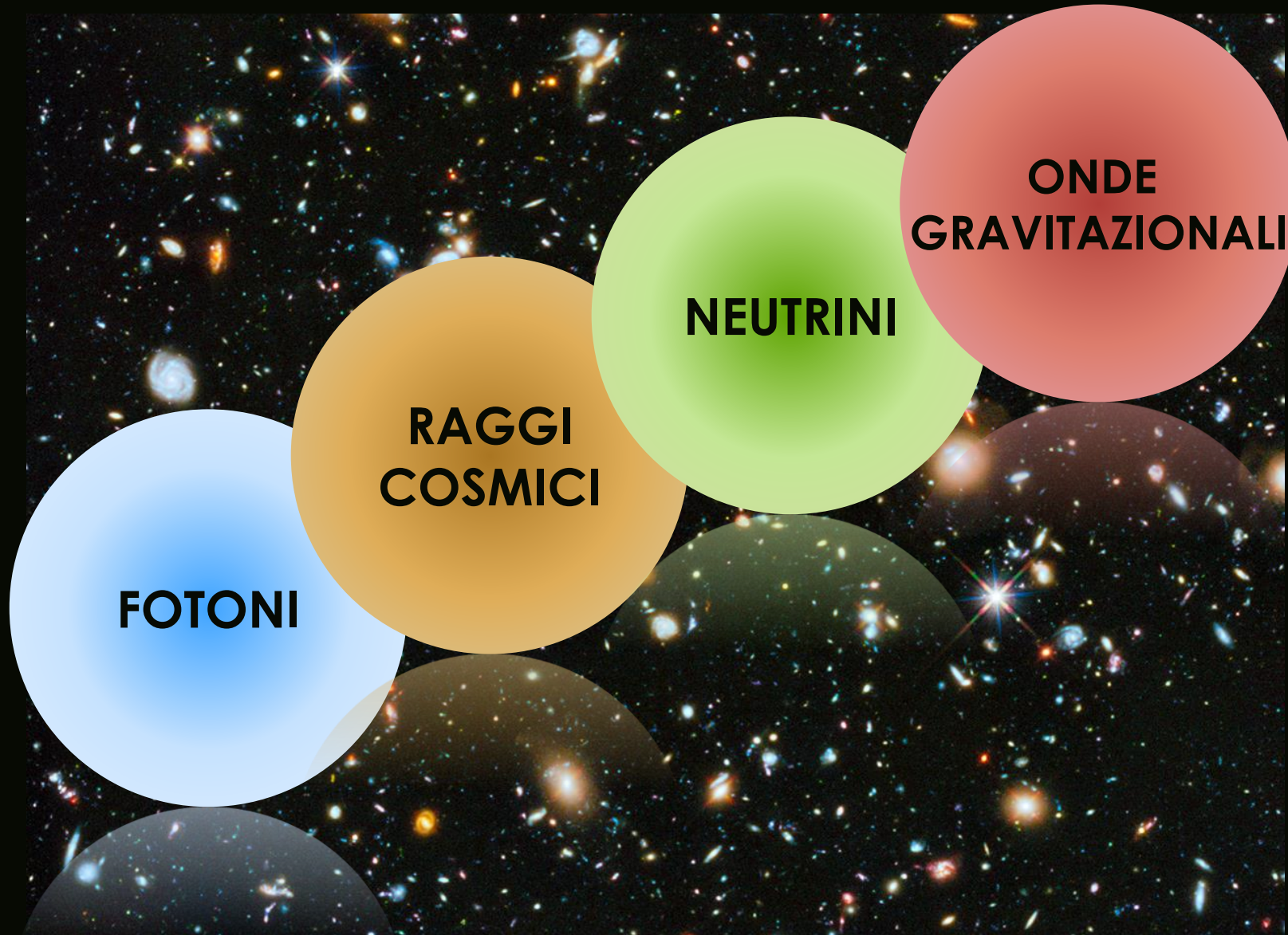




- **Radiazione elettromagnetica:**
«trasferimento di energia»
 - Modellizzato sotto forma di **onde elettromagnetiche**
(lunghezza d'onda/frequenza)
- Fisica quantistica:
ONDA = PARTICELLA
→ **fotone** (energia)



I messaggeri dell'Universo



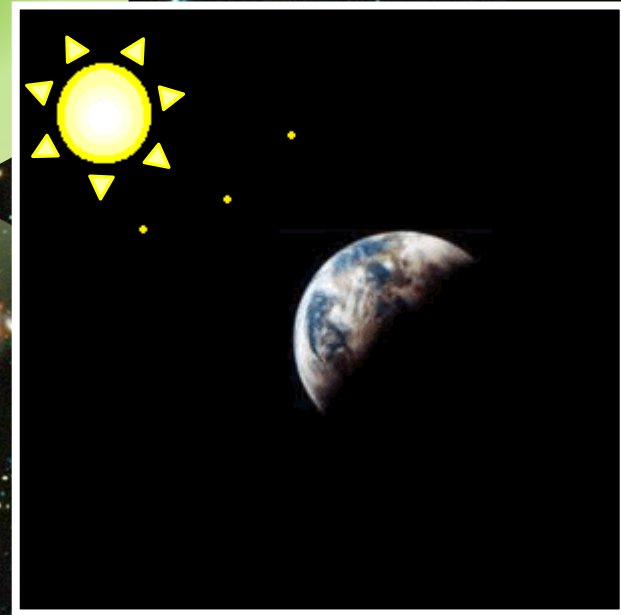
(Image Credit: NASA; ESA; G. Illingworth, D. Magee, and P. Oesch, University of California, Santa Cruz; R. Bouwens, Leiden University; and the HUDF09 Team, 2012)

I messaggeri dell'Universo

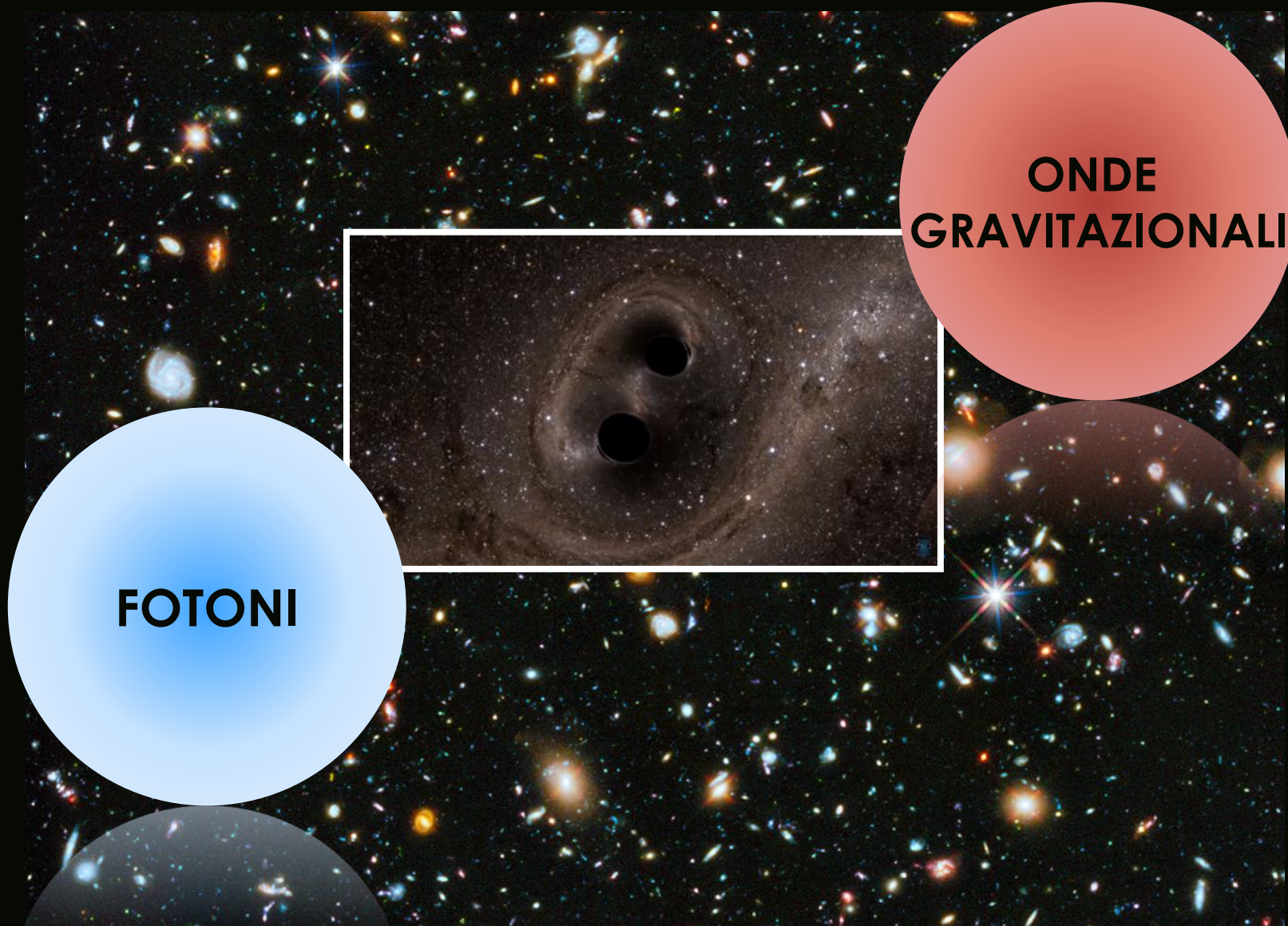


NEUTRINI

**RAGGI
COSMICI**



I messaggeri dell'Universo

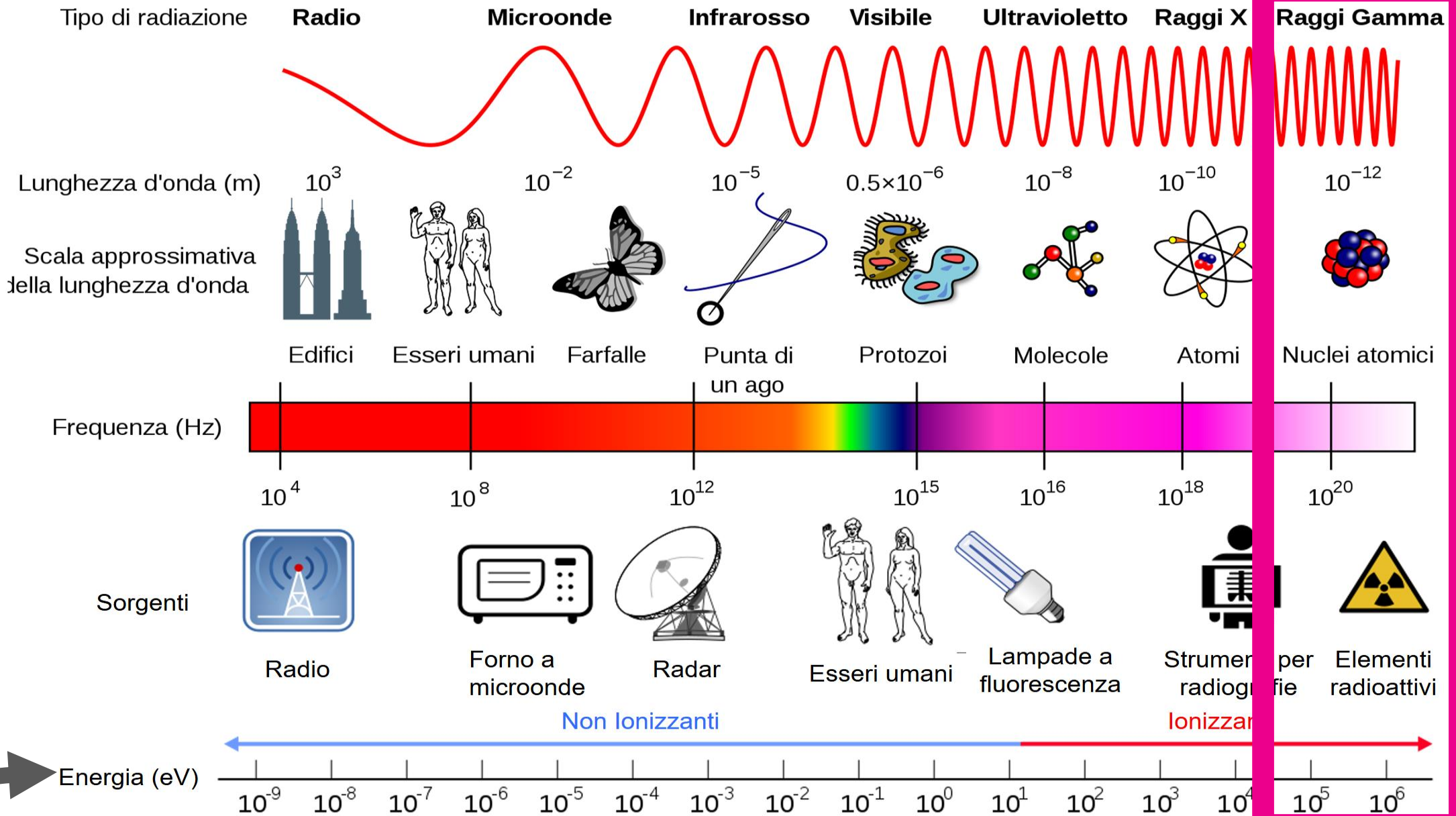


FOTONI

**ONDE
GRAVITAZIONALI**

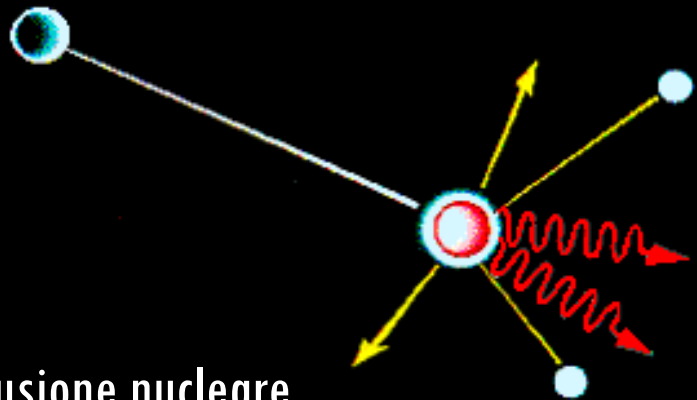
La Radiazione Elettromagnetica



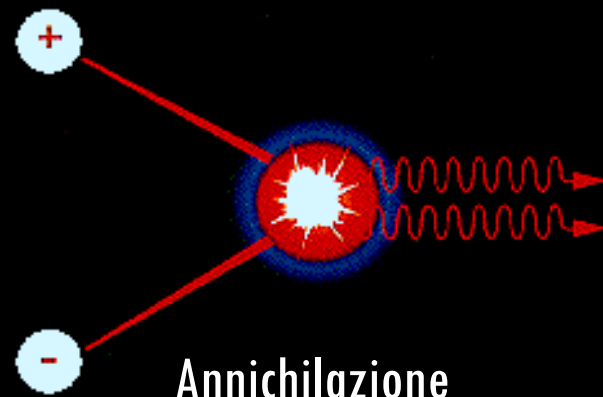


Un elettronvolt (eV) è un'unità di misura dell'energia molto usata in ambito atomico e subatomico

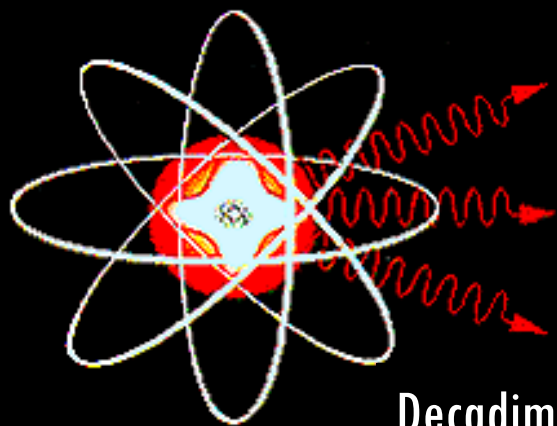




Fusione nucleare



Annichilazione
elettrone-positrone

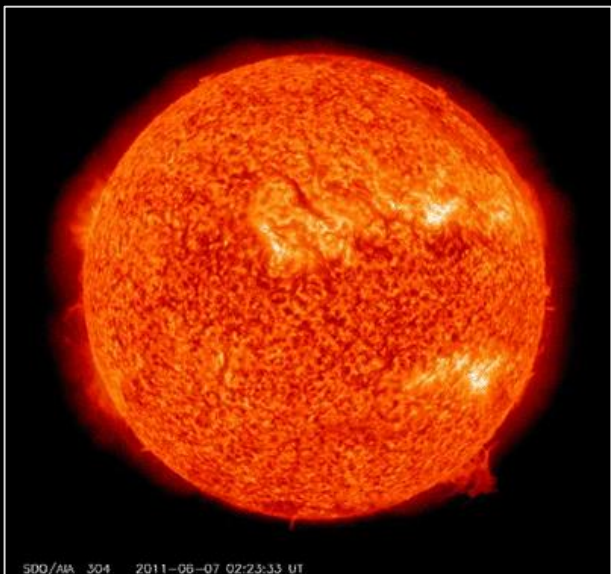
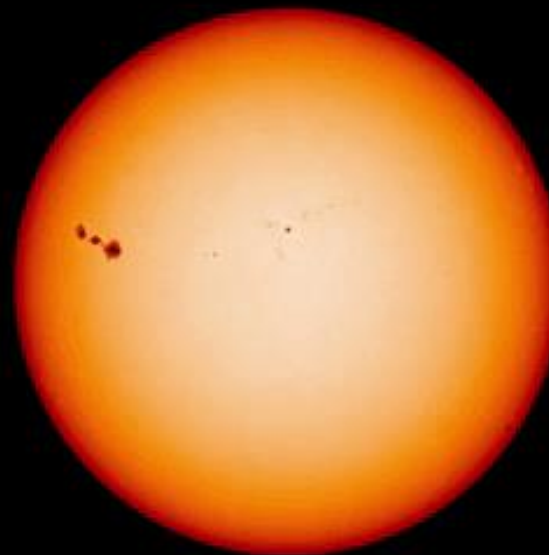


Decadimenti nucleari gamma

Accelerazione di particelle
cariche (Bremsstrahlung,
Sincrotrone, Compton)

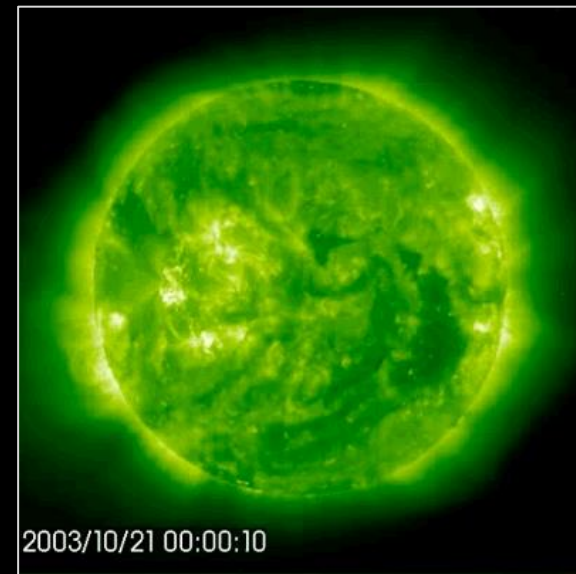


La stella più vicina: Il nostro Sole



HMI Dopplergram Surface movement Photosphere	HMI Magnetogram Magnetic field polarity Photosphere	visibile	4,500 K

Fotosfera



6,000 K	10,000 K	50,000 K	600,000 K	1 MK

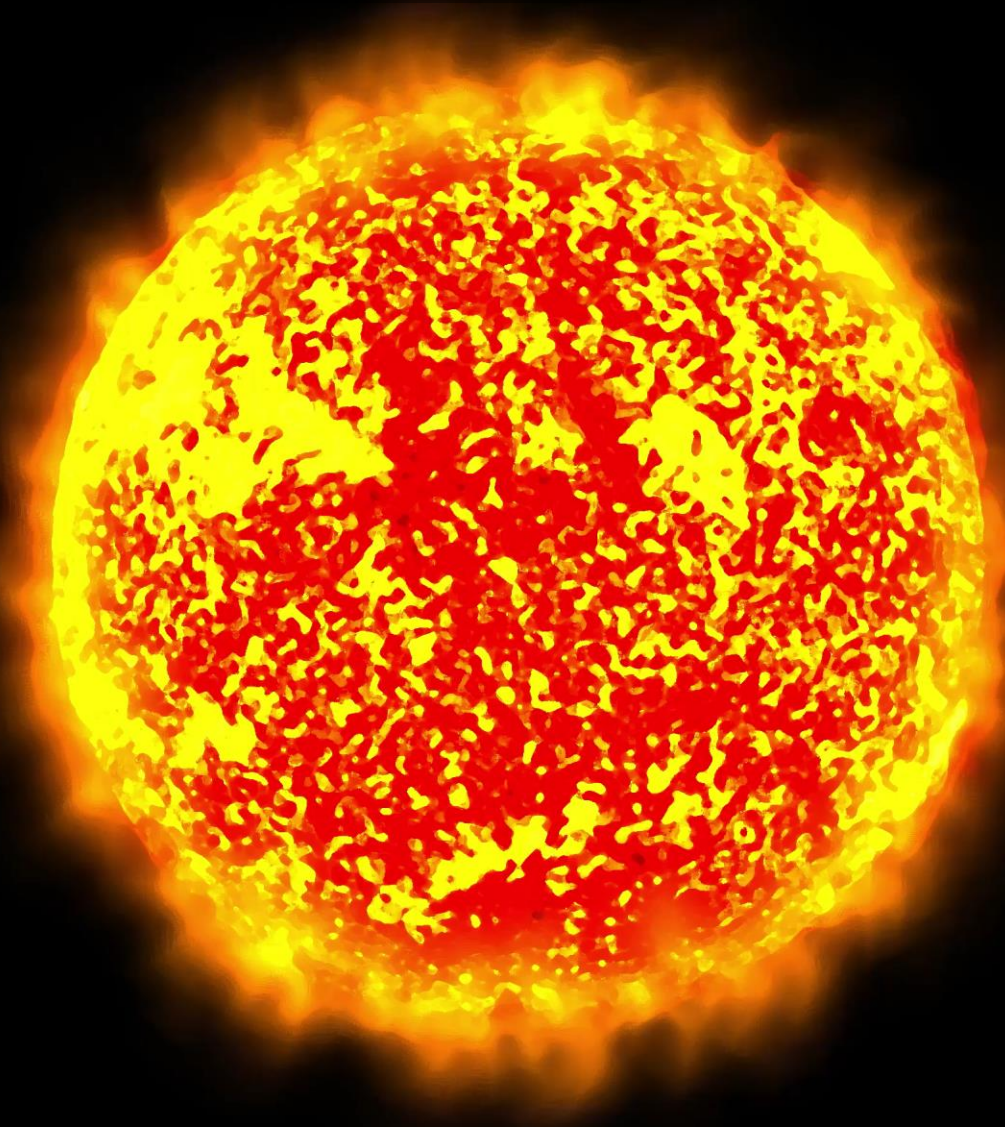
Cromosfera
Corona

Regioni attive

2 MK	2,5 MK	6 MK	10 MK

Regioni «flaring»

Il nostro Sole



La nucleosintesi stellare

Vento solare

Corona

Fotosfera

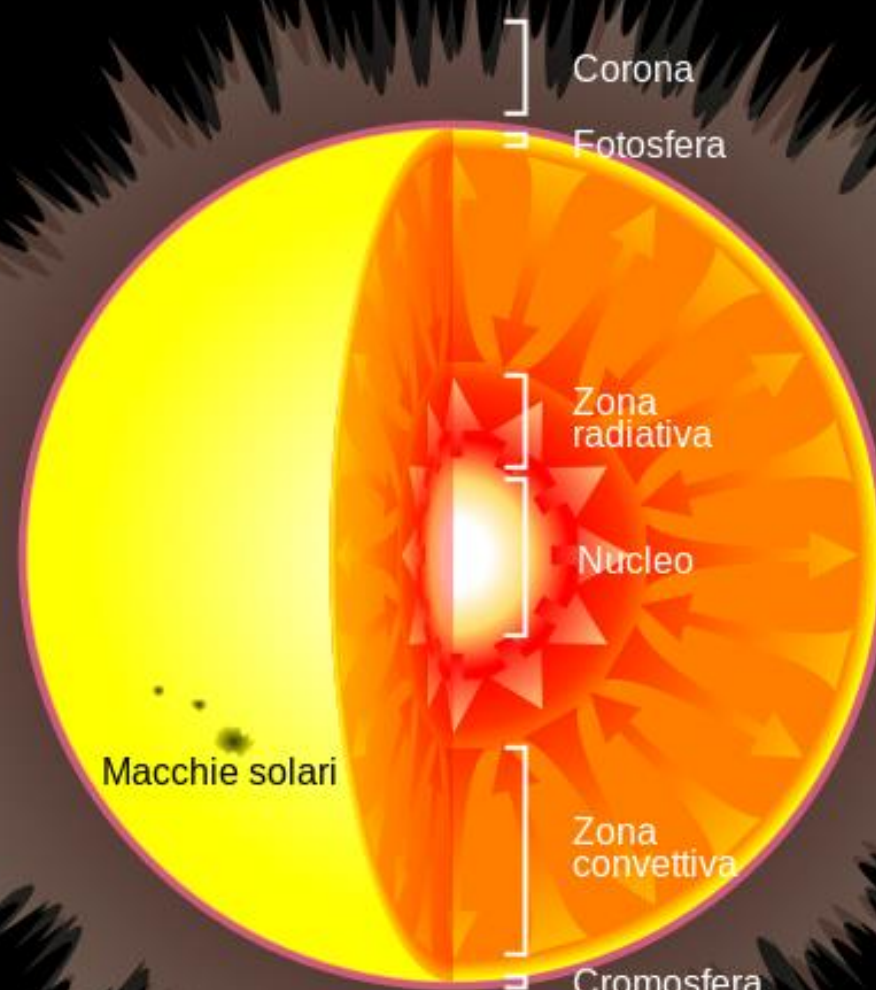
Zona
radiativa

Nucleo

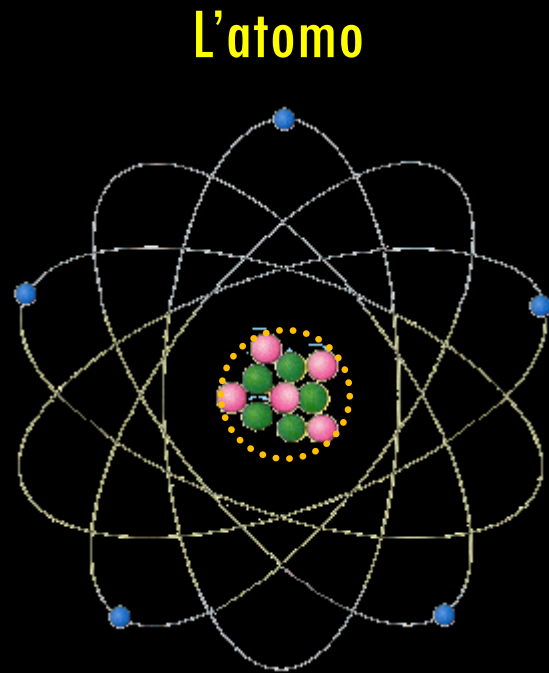
Zona
convettiva

Cromosfera

Macchie solari

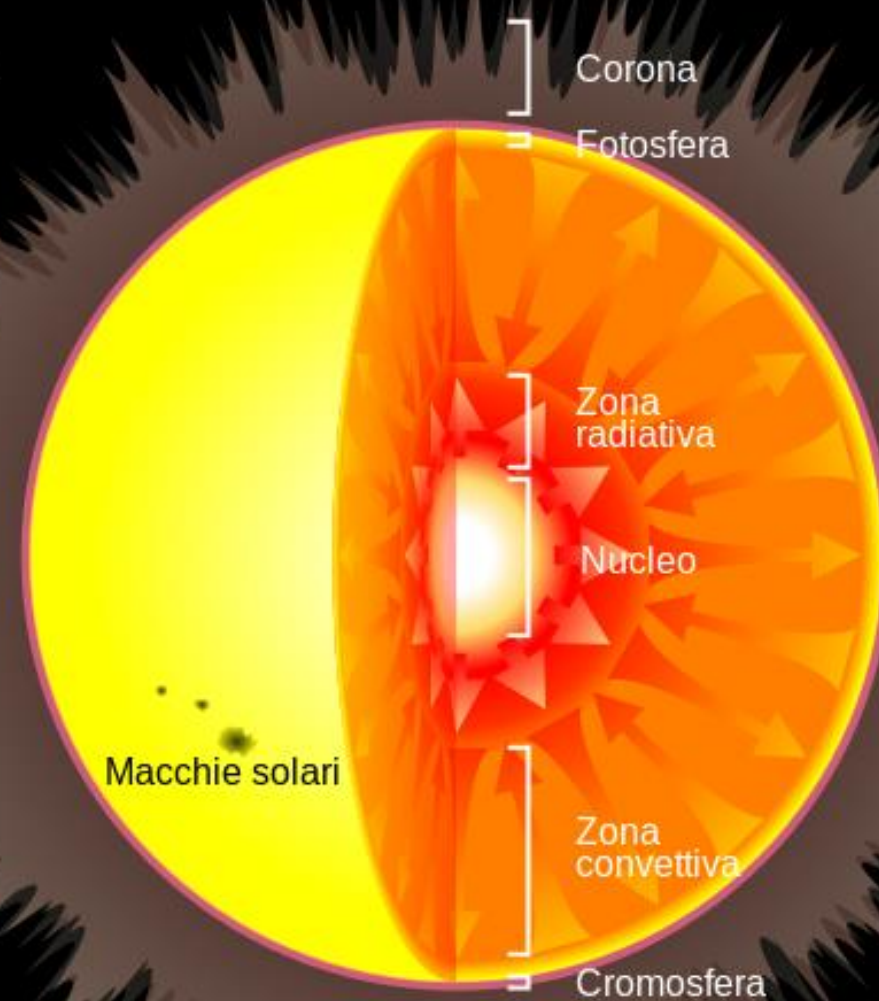


La nucleosintesi stellare

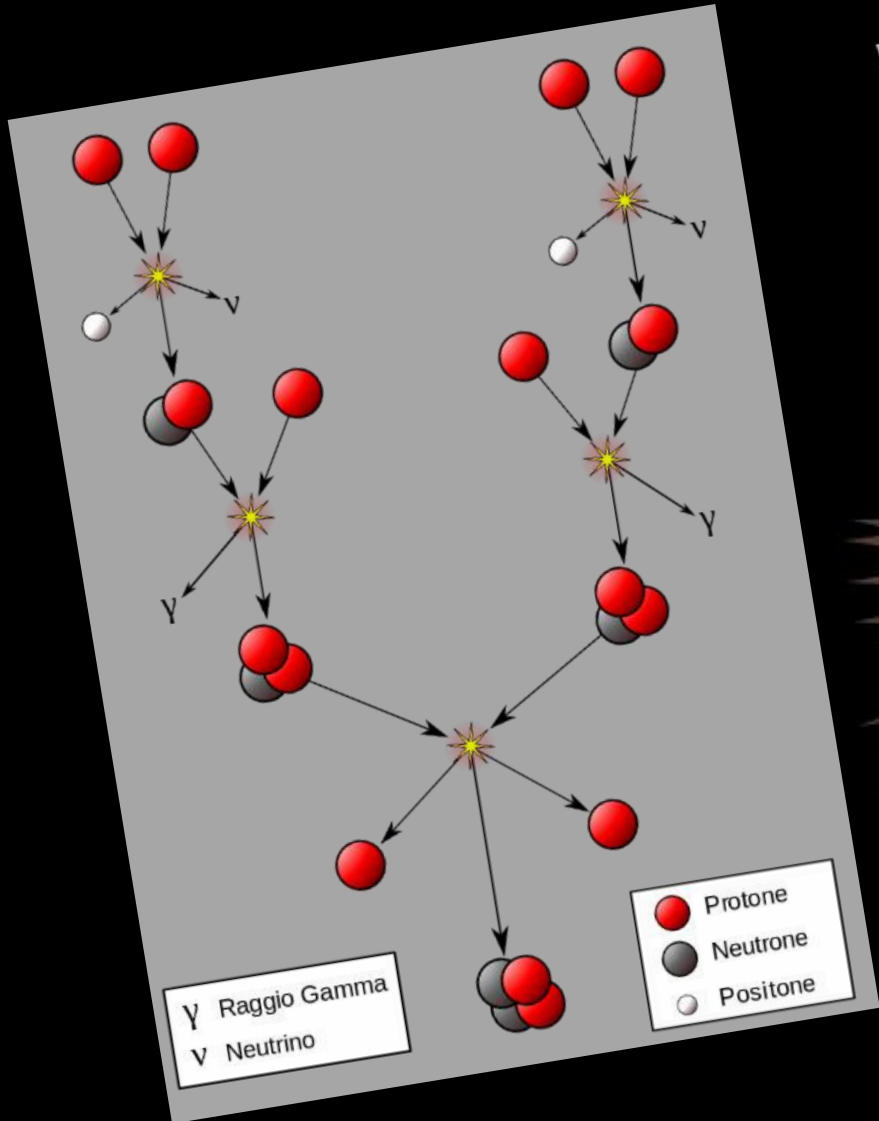


Protone
Neutrone
Nucleo
Elettrone

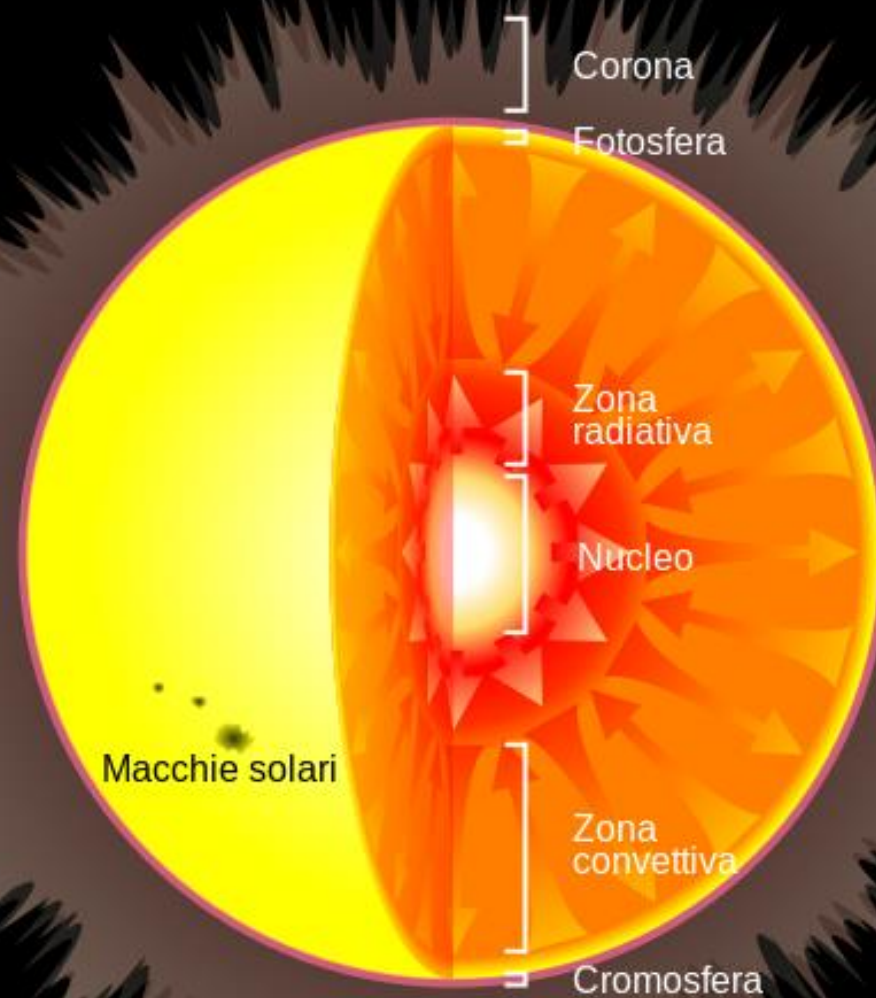
Vento solare

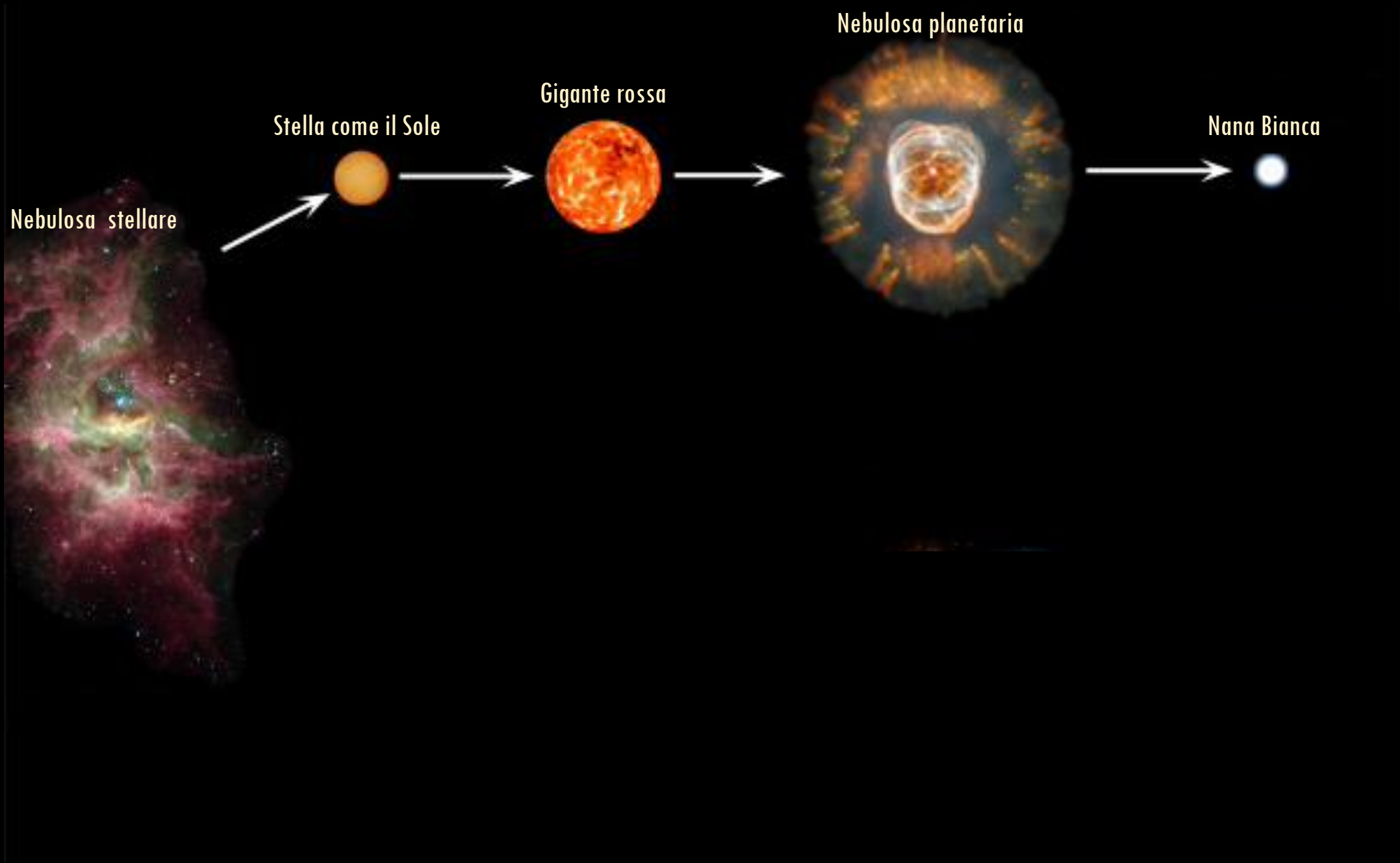


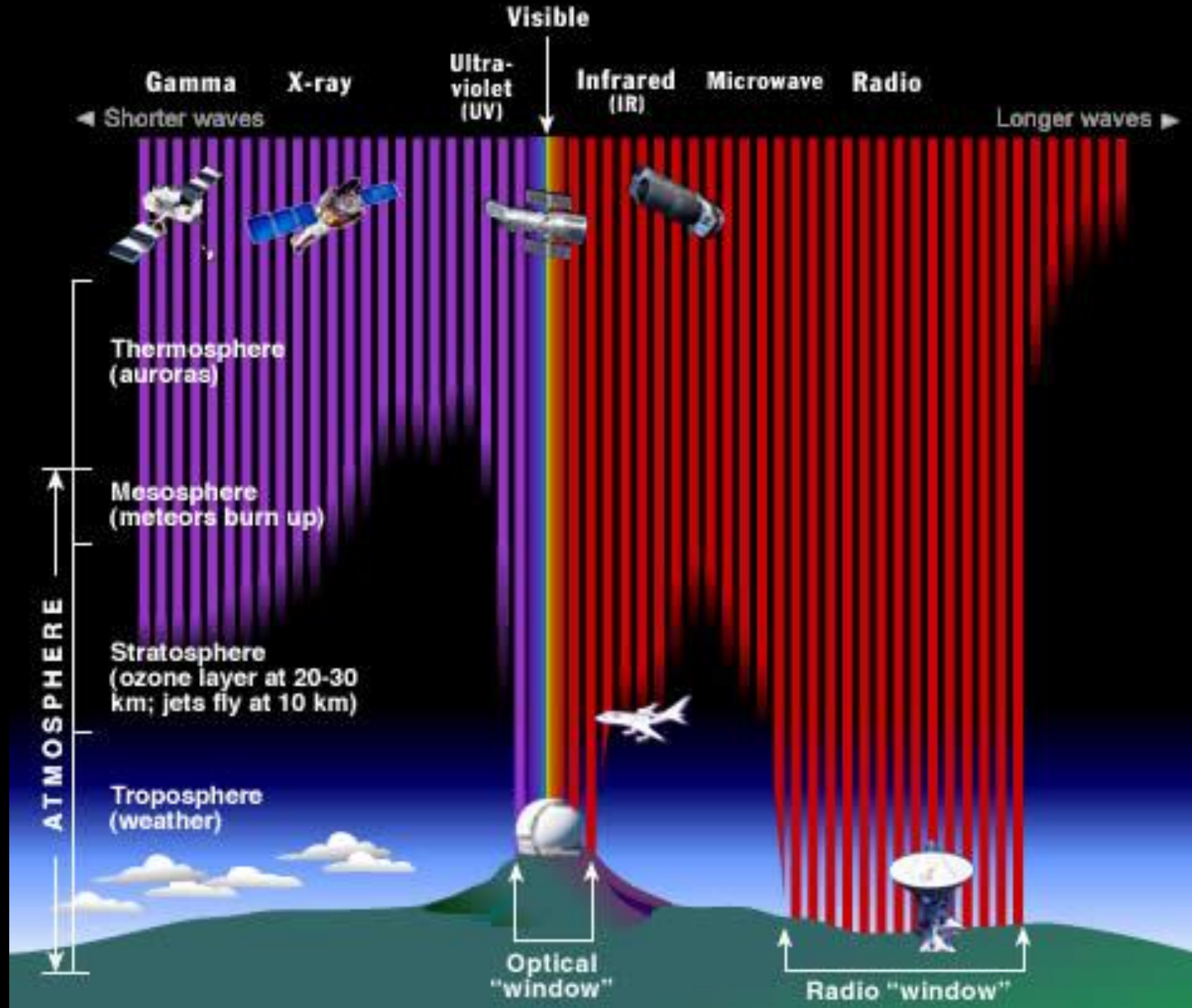
La nucleosintesi stellare



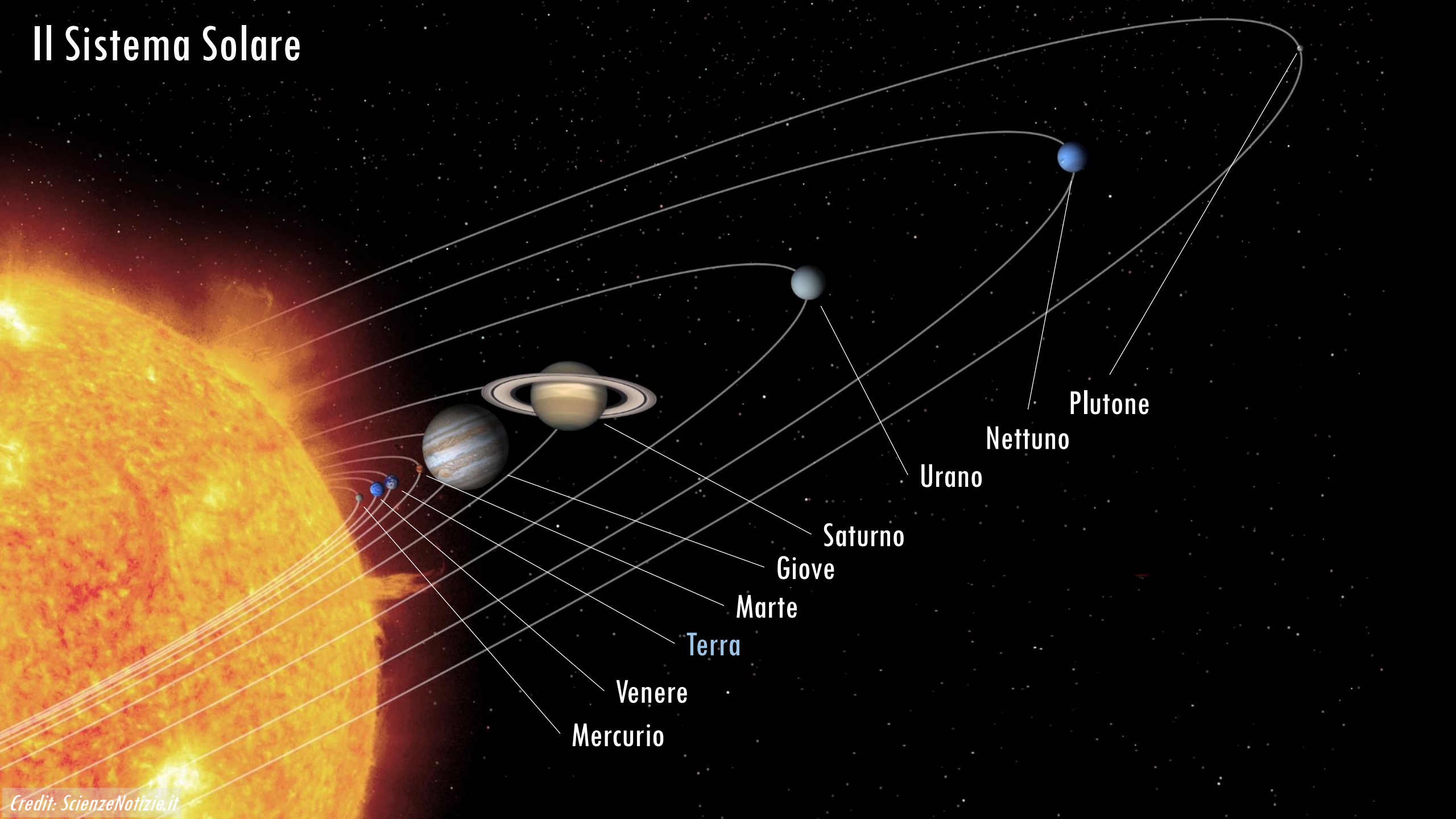
Vento solare







Il Sistema Solare



Mercurio

Venere

Terra

Marte

Giove

Saturno

Urano

Nettuno

Plutone

Le distanze in Astronomia

- Lunghezza di un'aula di scuola:
- Lunghezza di un campo da calcio:
- Lunghezza dell'edificio del Dipartimento di Fisica:
- Distanza dal Dipartimento alla Stazione di Bari Centrale:
- Distanza Bari – Trani:
- Distanza Bari – Roma:
- Distanza Bari – Sydney:
- Diametro della Terra:
- E dalla Terra alla Luna?



~10 m

~100 m

~150 m

~2.2 km

~55 km

~450 km

~16000 km

~12700 km

1,3 s

Le distanze in Astronomia

Nuove unità di misura

1. L'Unità Astronomica:

distanza media tra il pianeta Terra e il Sole

1 AU = ~150 milioni di km

2. L'Anno Luce:

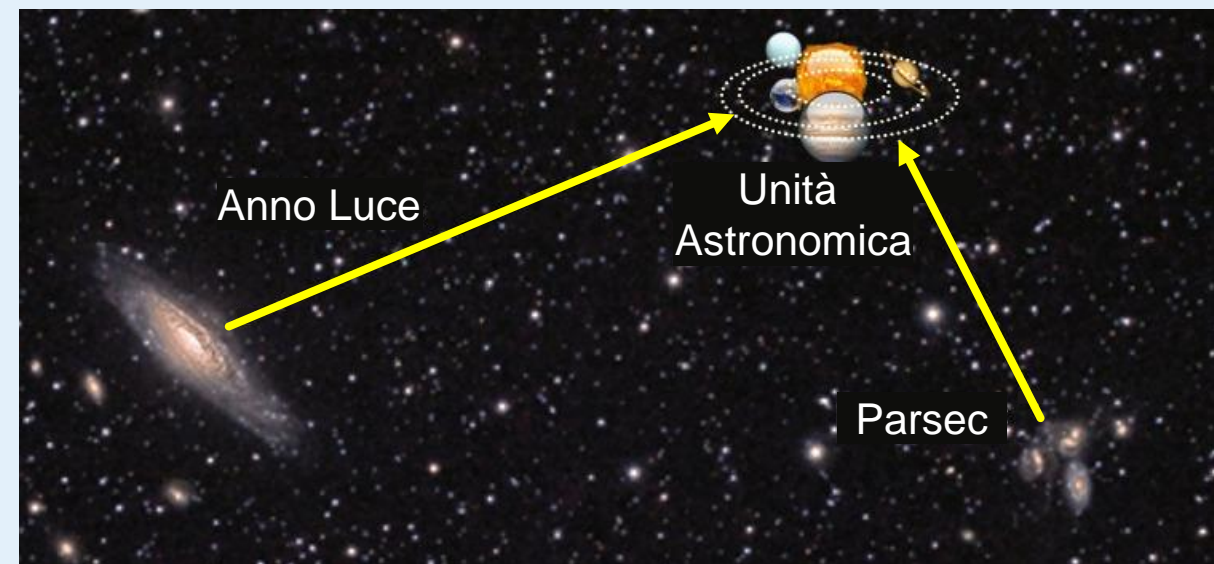
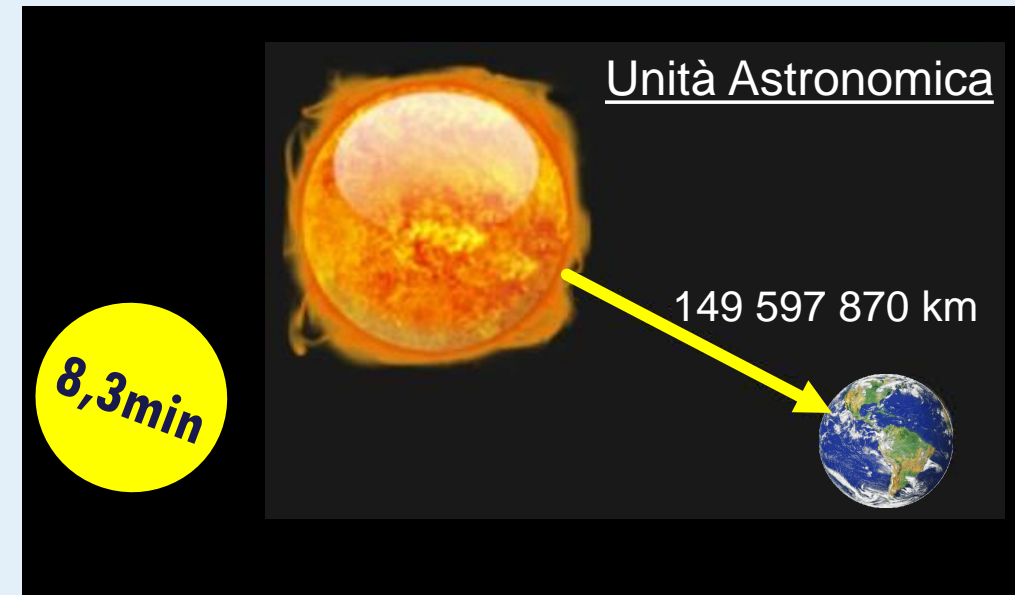
distanza percorsa dalla luce in un anno

1 ly = ~ 9500 miliardi di km

→ Ricordando che $v_{luce} = 300000 \text{ km/s}$

3. Il Parsec:

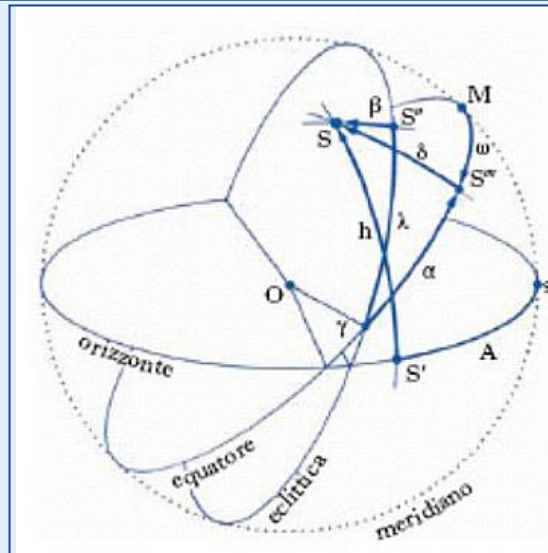
1 pc = ~31000 miliardi di km



Le coordinate astronomiche

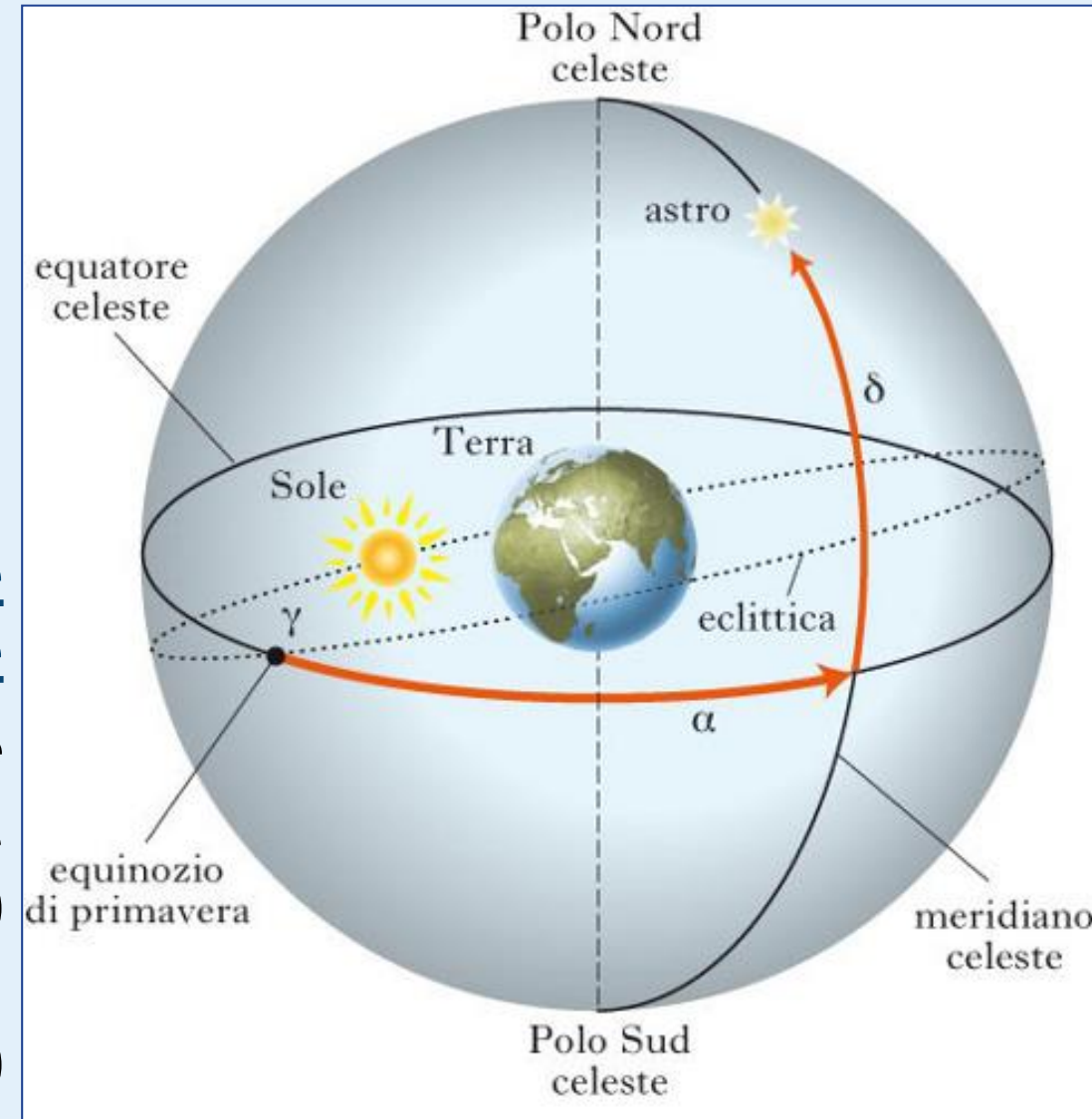
Diversi sistemi di coordinate astronomiche

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

La Via Lattea

Very Large Area Telescope (VLT)

European Southern Observatory, Paranal, Chile



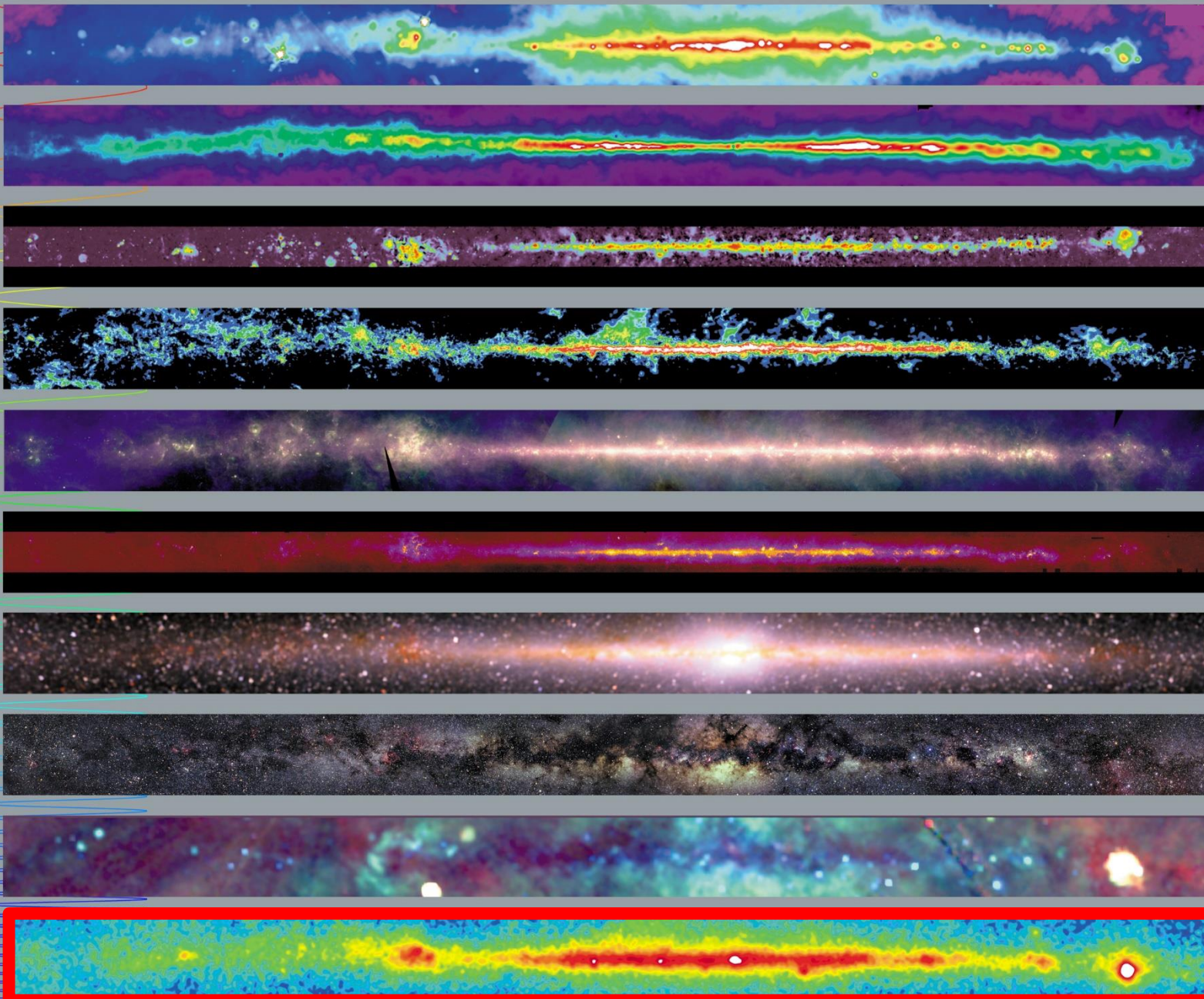
La Via Lattea

Gaia Early third Data Release (EDR3 2020)

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



La Via Lattea vista a diverse frequenze



Radio 400 MHz

H atomico

Radio 2.5 GHz

H molecolare

Infrarosso

Infrarosso m

Infrarosso v

Banda ottica

Raggi X

Raggi Gamma

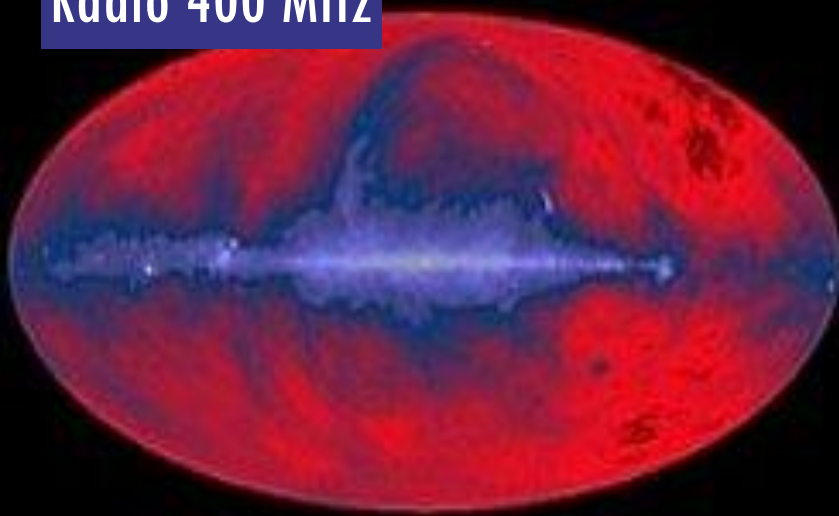
<http://adc.gsfc.nasa.gov/mw>



La Via Lattea vista a diverse frequenze

Il nostro Universo

Radio 400 MHz



Infrarosso



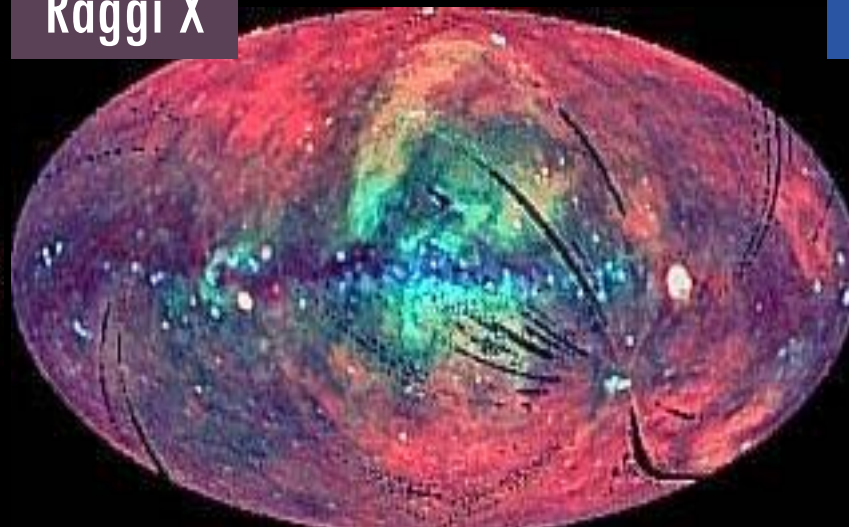
Banda ottica



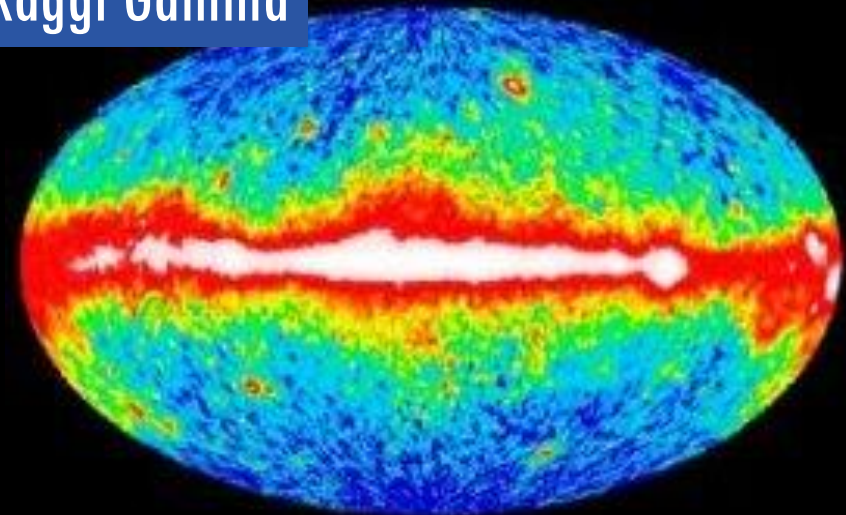
UV



Raggi X

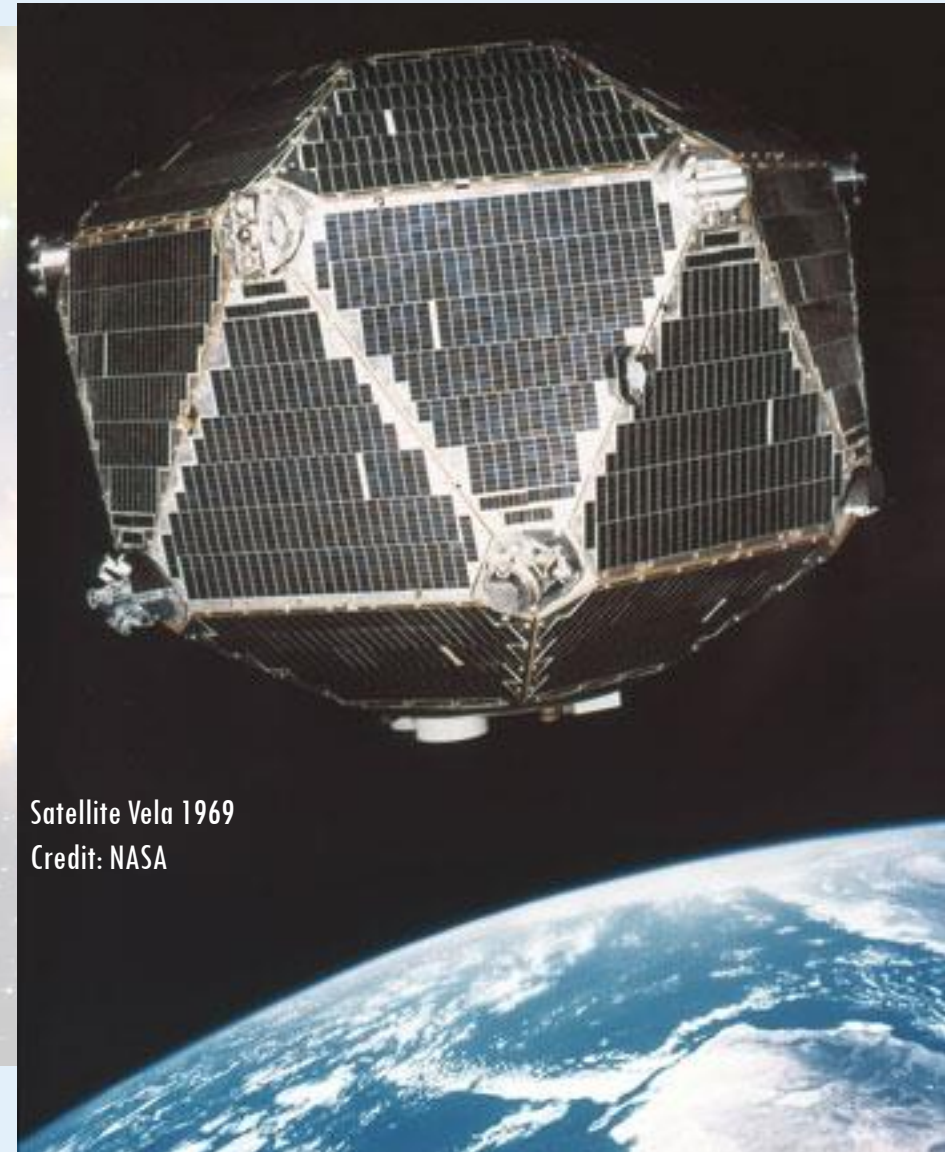


Raggi Gamma



Spesso definita **«astronomia dell'impossibile»** a causa delle difficoltà da superare per poterla praticare:

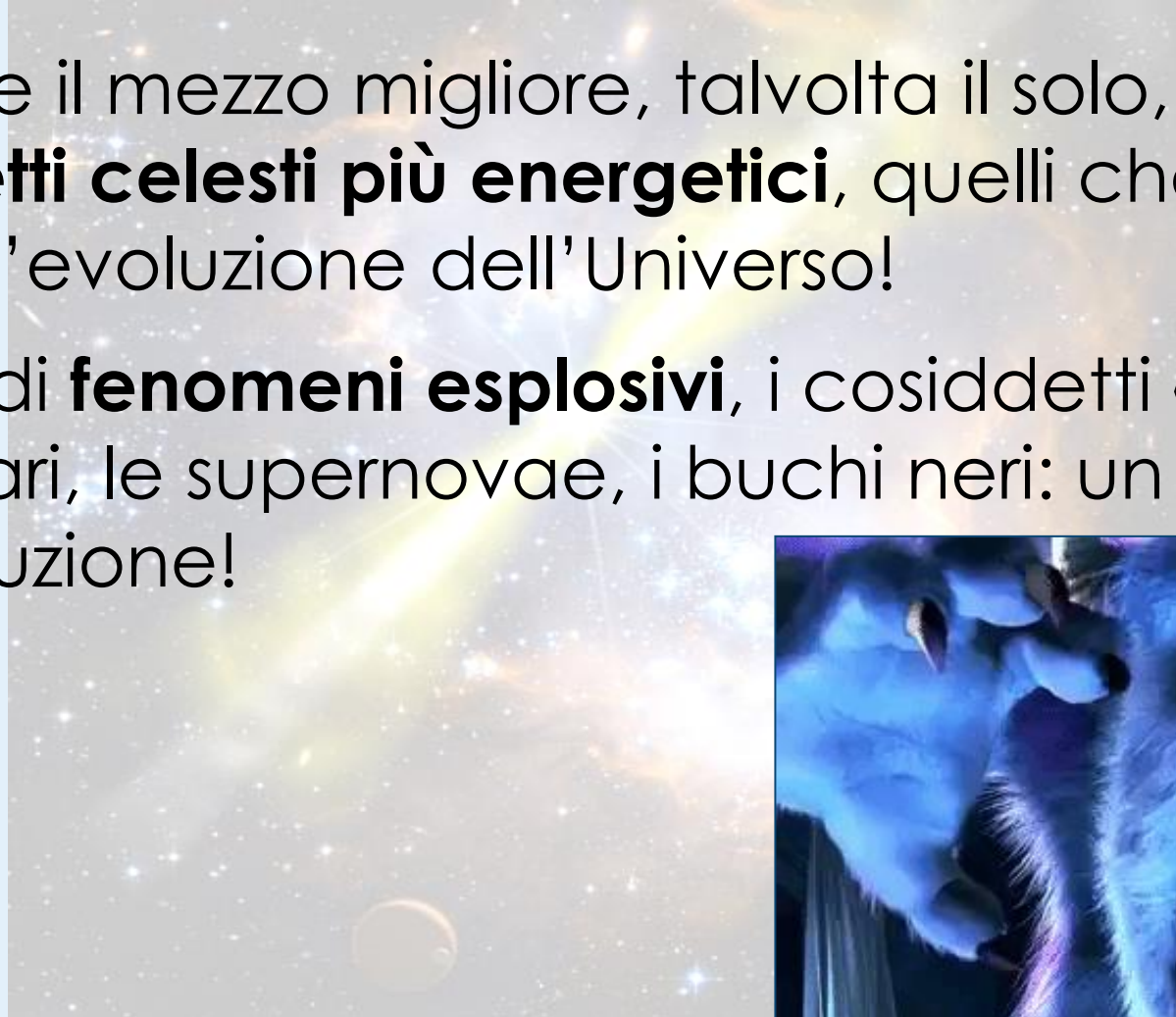
1. Necessità di utilizzare **rivelatori nello spazio**, quindi di **dimensioni contenute**
2. Scarsità di fotoni gamma, con conseguente aumento dei **tempi di osservazione**
3. Intensi flussi di particelle cariche producono un gran numero di raggi gamma secondari: **rumore di fondo**, estremamente difficile da attenuare



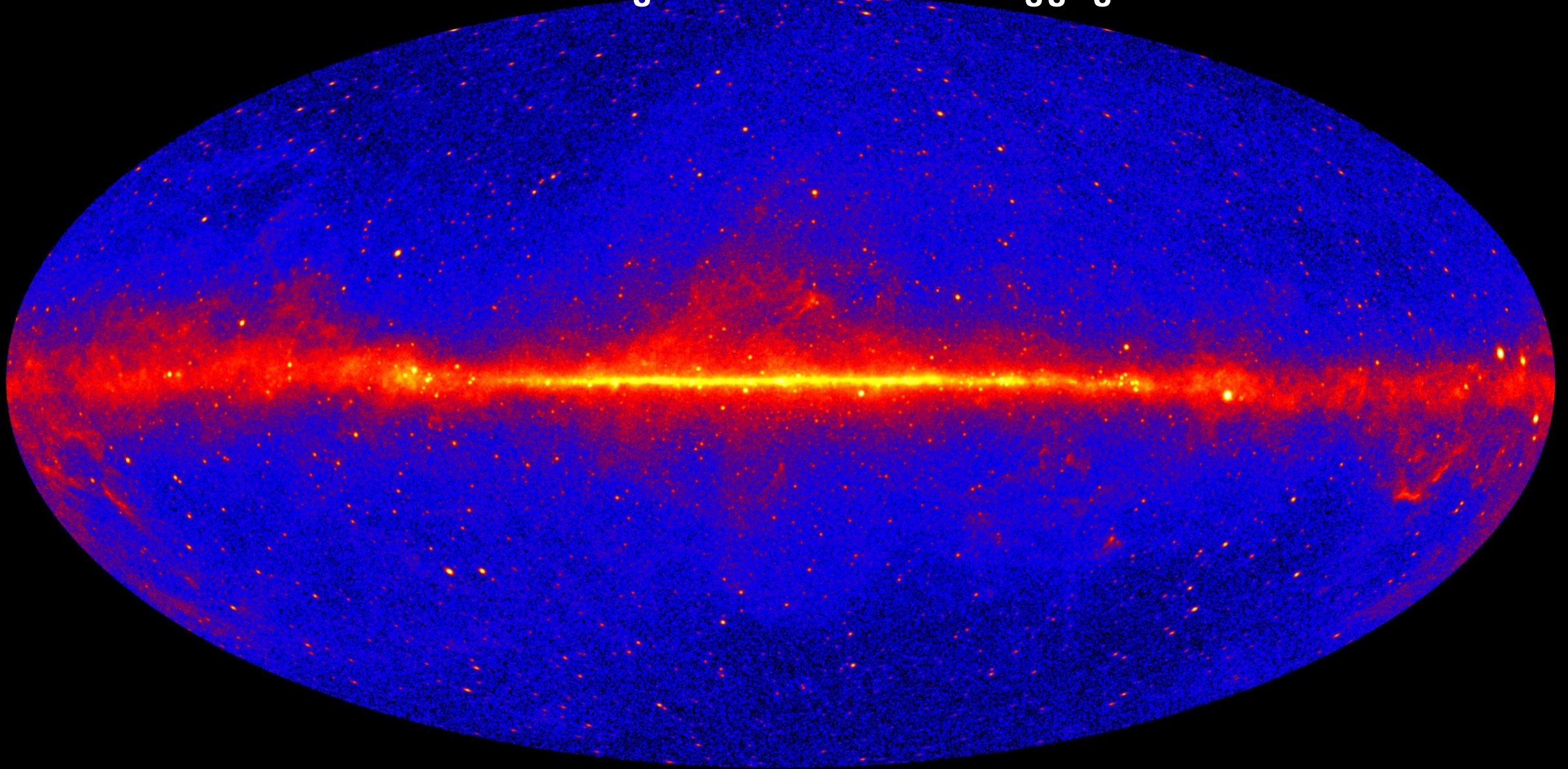
Satellite Vela 1969
Credit: NASA

Si presenta come il mezzo migliore, talvolta il solo, per scoprire e studiare gli **oggetti celesti più energetici**, quelli che giocano un ruolo chiave nell'evoluzione dell'Universo!

- Osservazione di **fenomeni esplosivi**, i cosiddetti «**mostri**», come i brillamenti solari, le supernovae, i buchi neri: un Universo in continua evoluzione!



Quali sono le sorgenti luminose nei raggi gamma?





Credit: NASA/Goddard Space Flight Center Scientific Visualization Studio

NASA GSFC Flickr Fotostream
<https://www.flickr.com/photos/gsfcc/5162413062>

I resti di Supernova

Nebulosa del Granchio (M1)

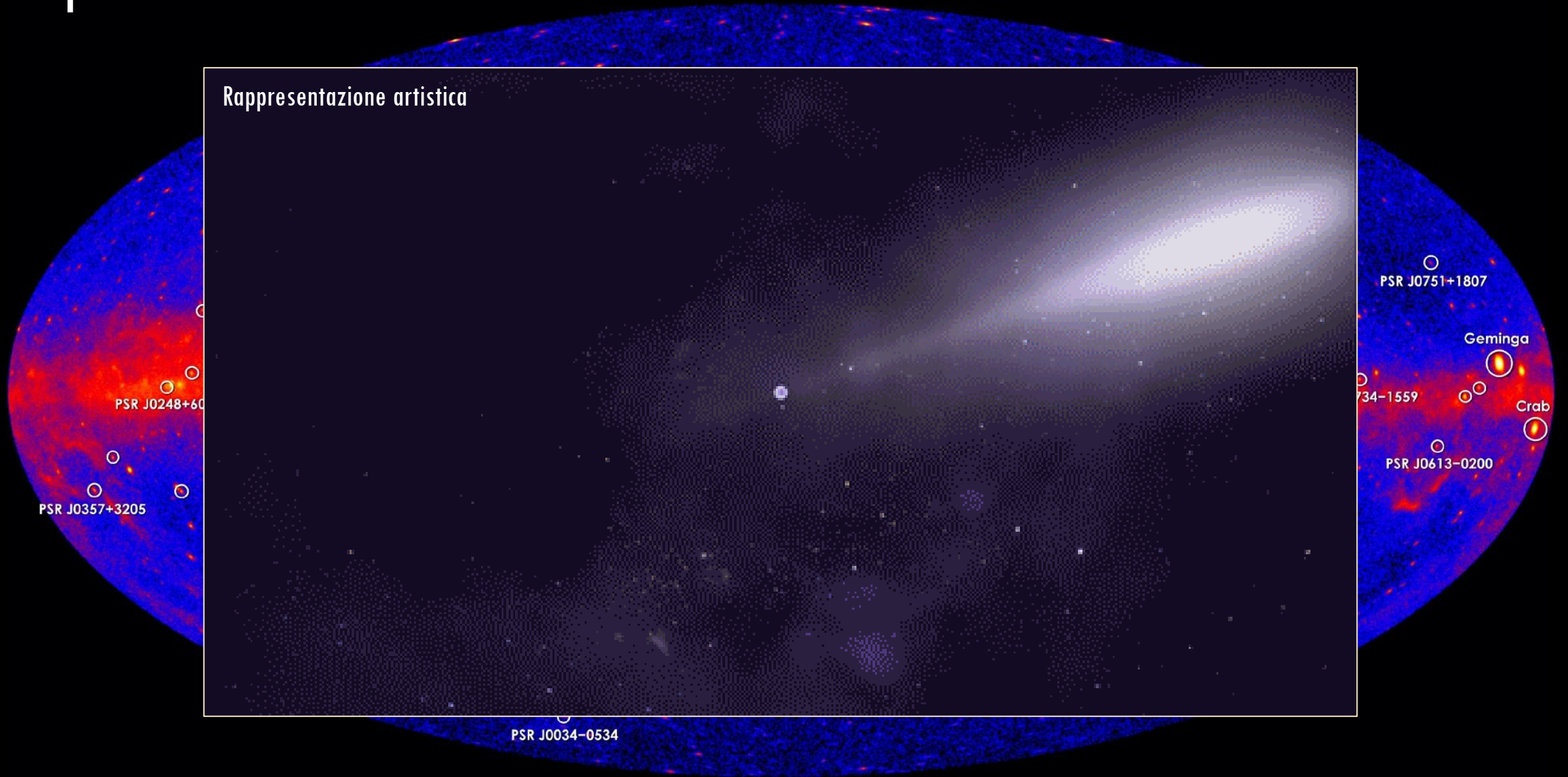
IC 443

Credit: NASA/DOE/Fermi-LAT/R.Buehler
Goddard Media Studios
<https://svs.gsfc.nasa.gov/10767>

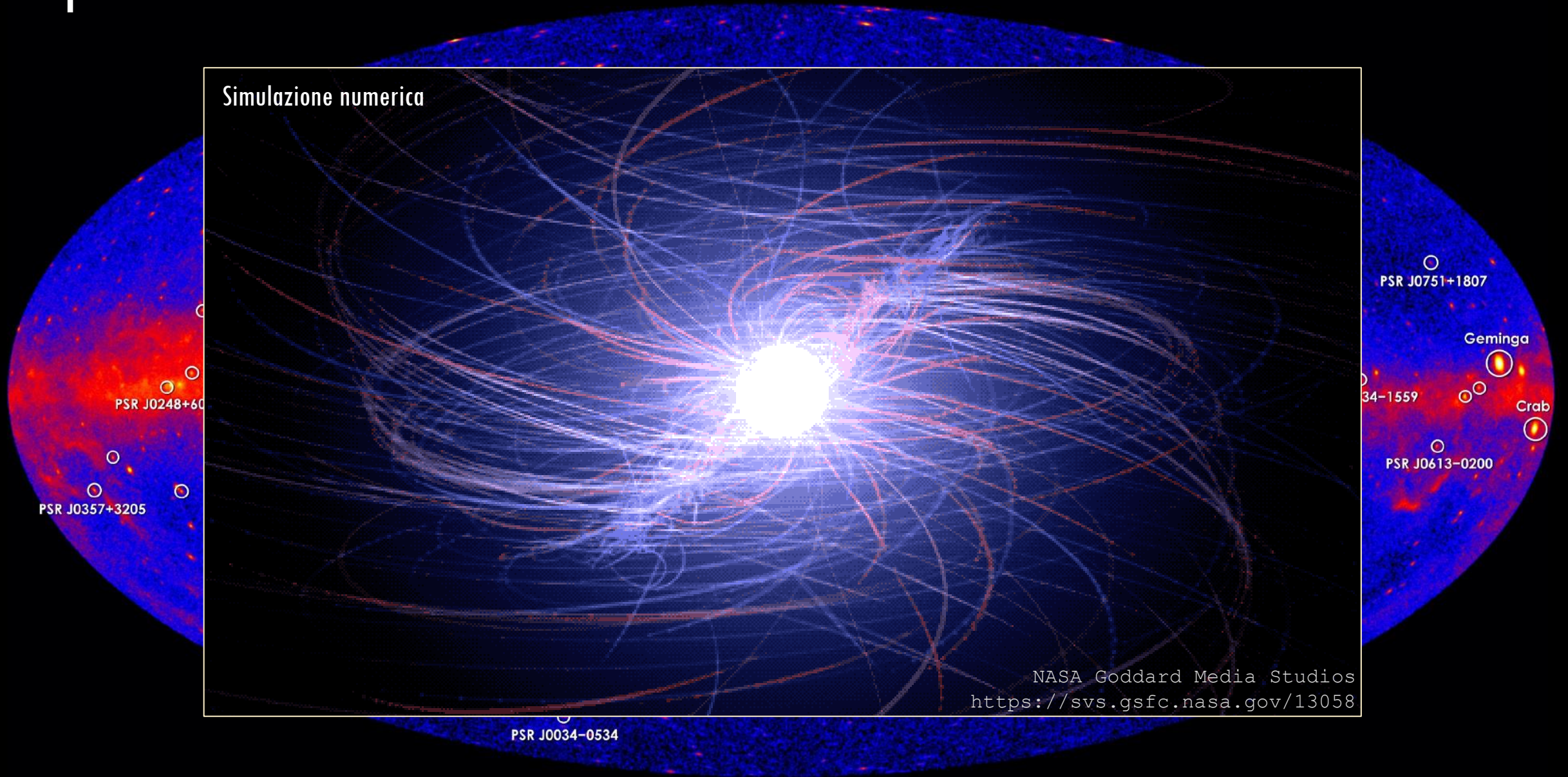


Credit: NASA, ESA, G. Dubner (IAFE, CONICET-University of Buenos Aires) et al.; A. Loll et al.; T. Temim et al.; F. Seward et al.; VLA/NRAO/AUI/NSF; Chandra/CXC; Spitzer/JPL-Caltech; XMM-Newton/ESA; and Hubble/STScI

Le pulsar

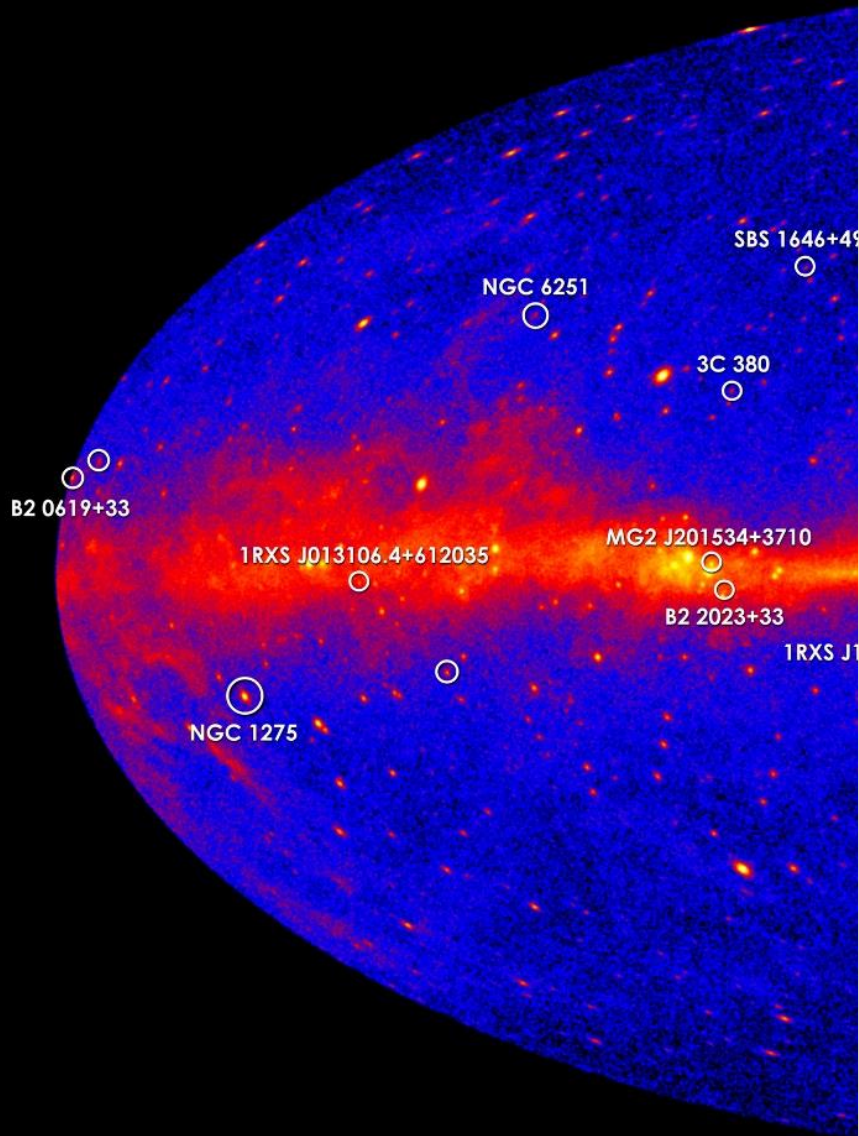


Le pulsar

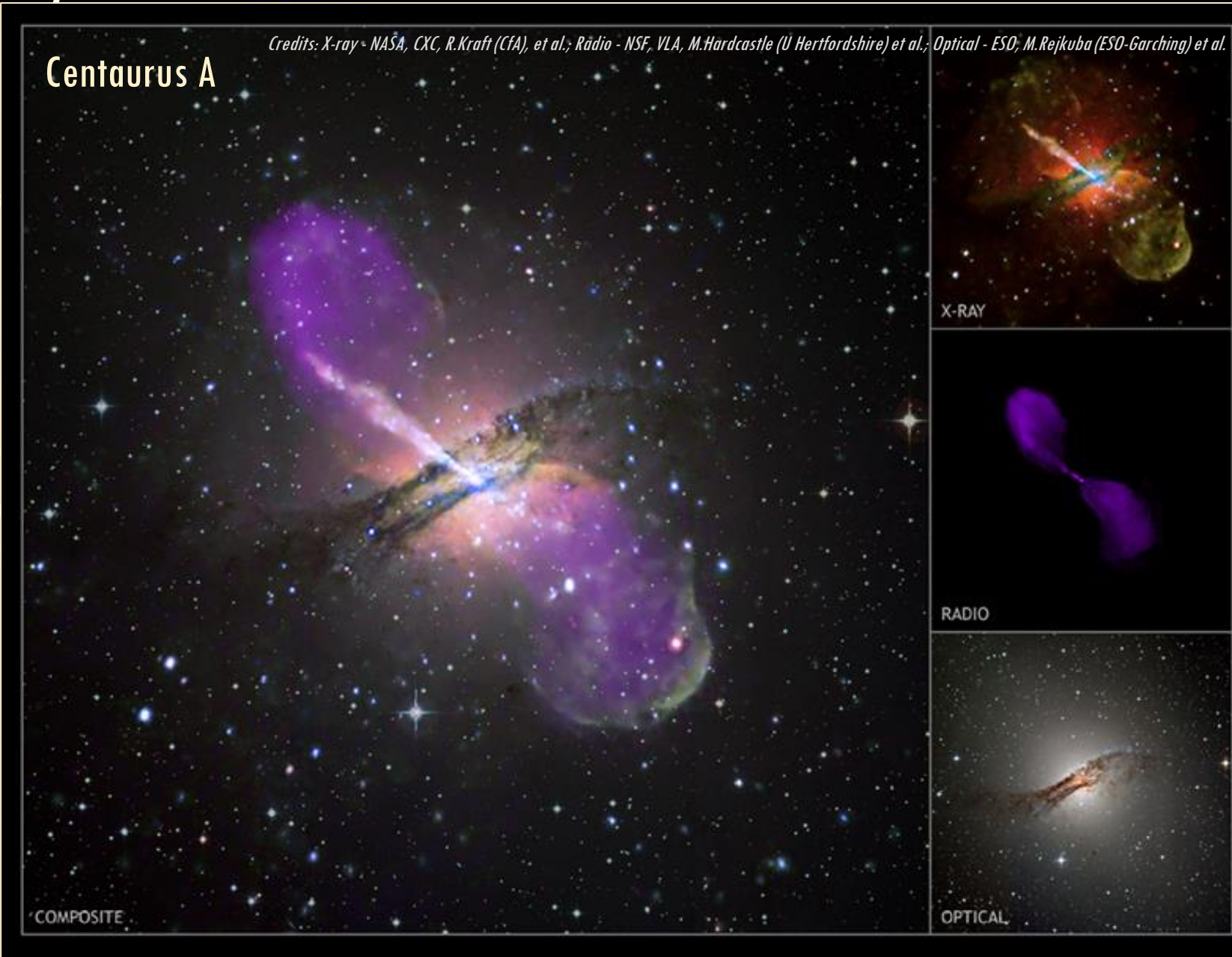


NASA Goddard Media Studios
<https://svs.gsfc.nasa.gov/13058>

I Nuclei Galattici Attivi (AGN)

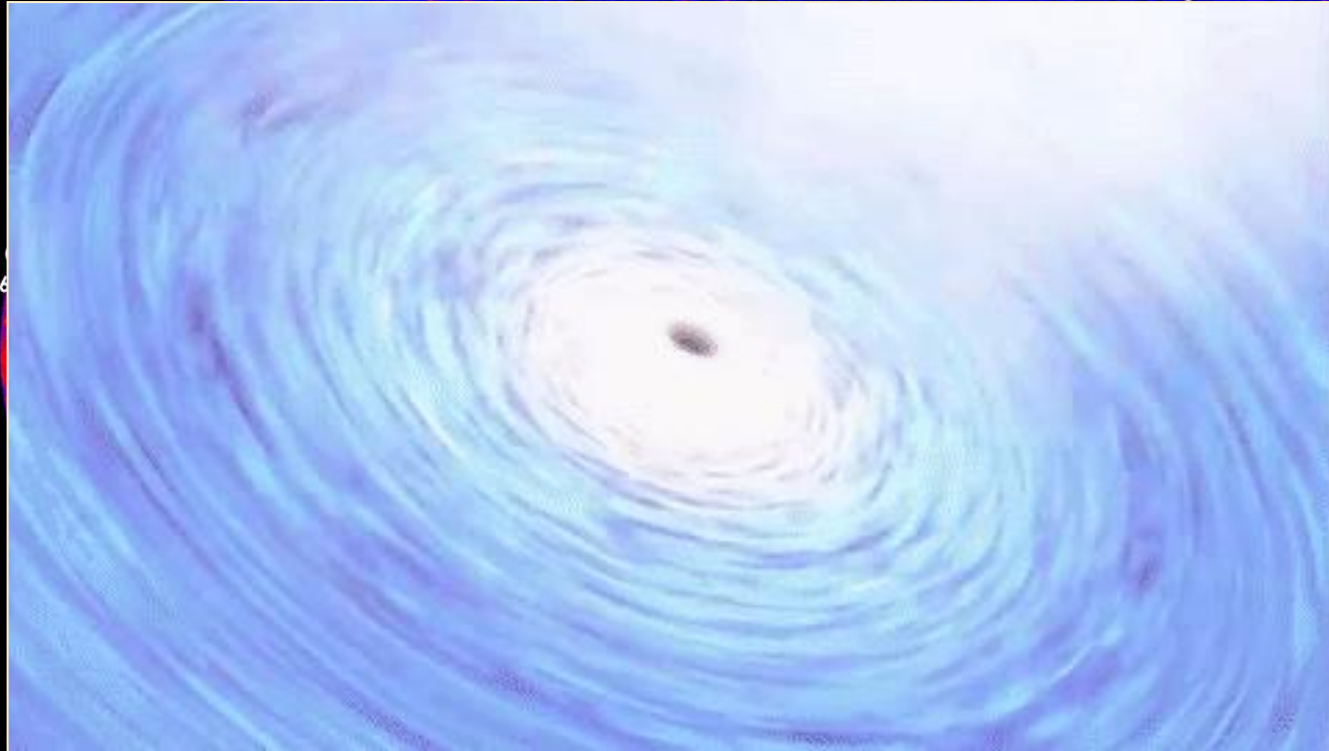


Credit: NASA/DOE/Fermi LAT Collaboration



I Nuclei Galattici Attivi (AGN)

Rappresentazioni artistiche



4C +29.48

M87

PKS 1502+036

B2 06

J1

1-5

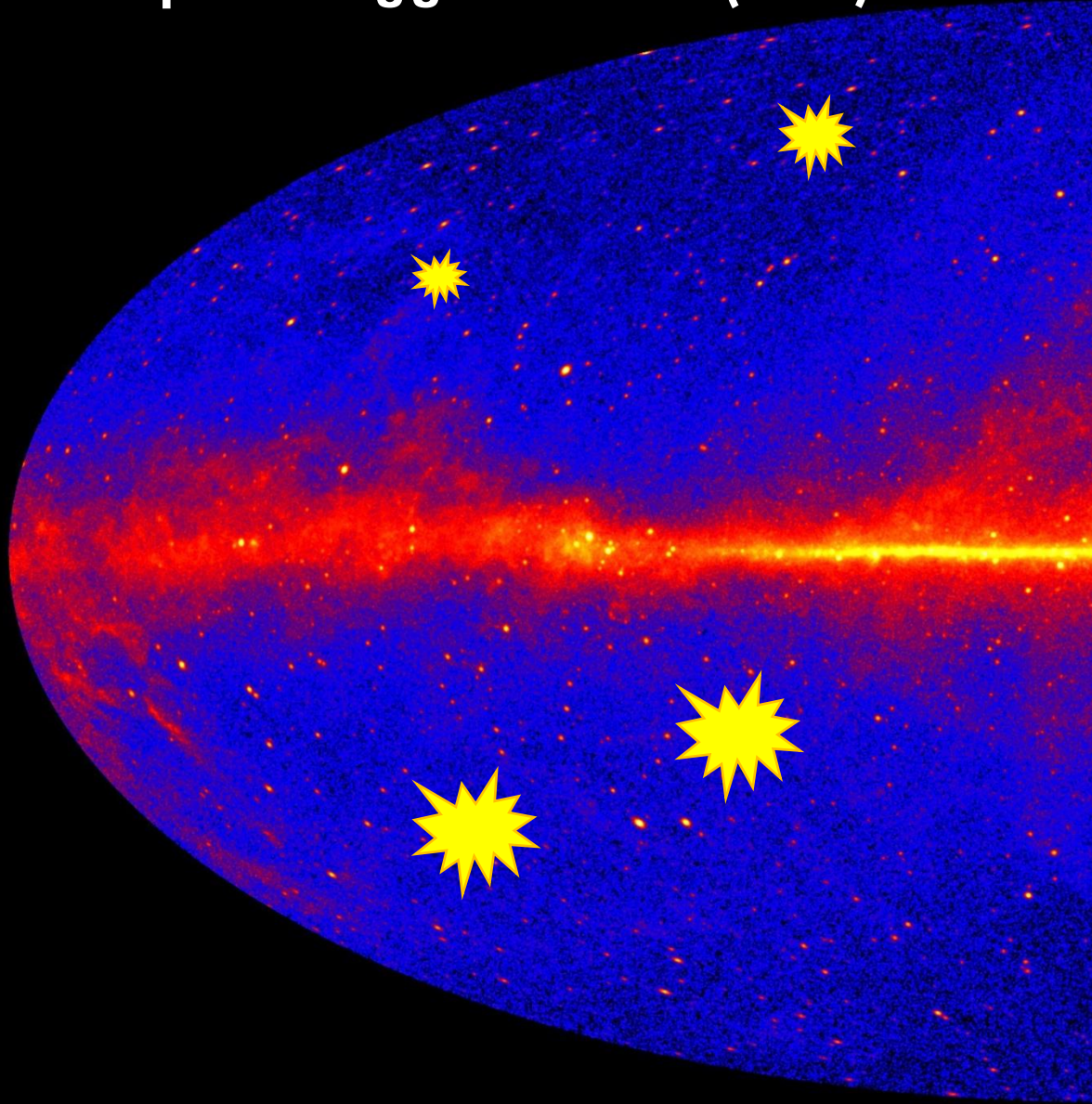
J21

PMN J2250-2806

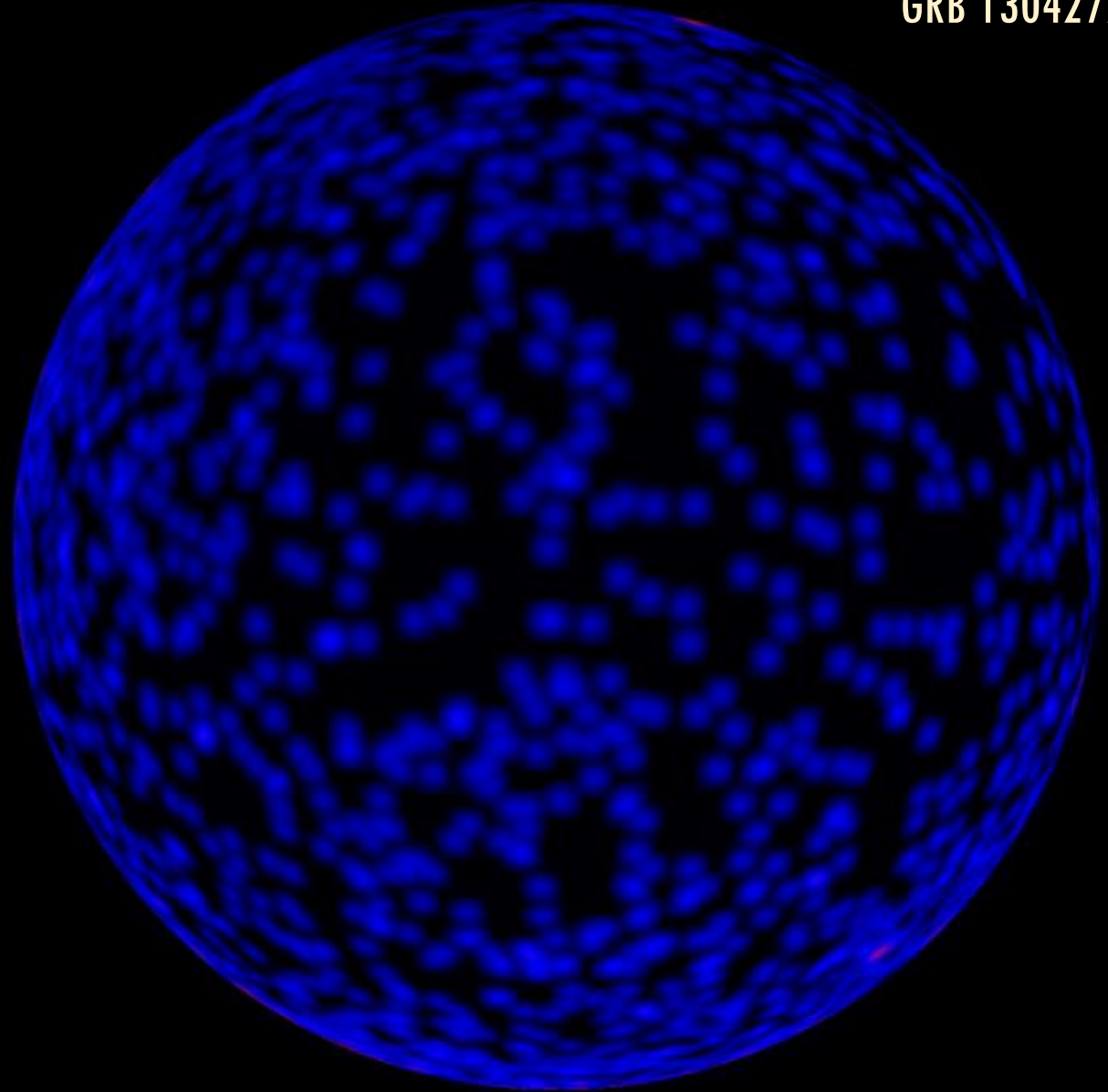
PKS 0208-512

Galassia Attiva 3C 279

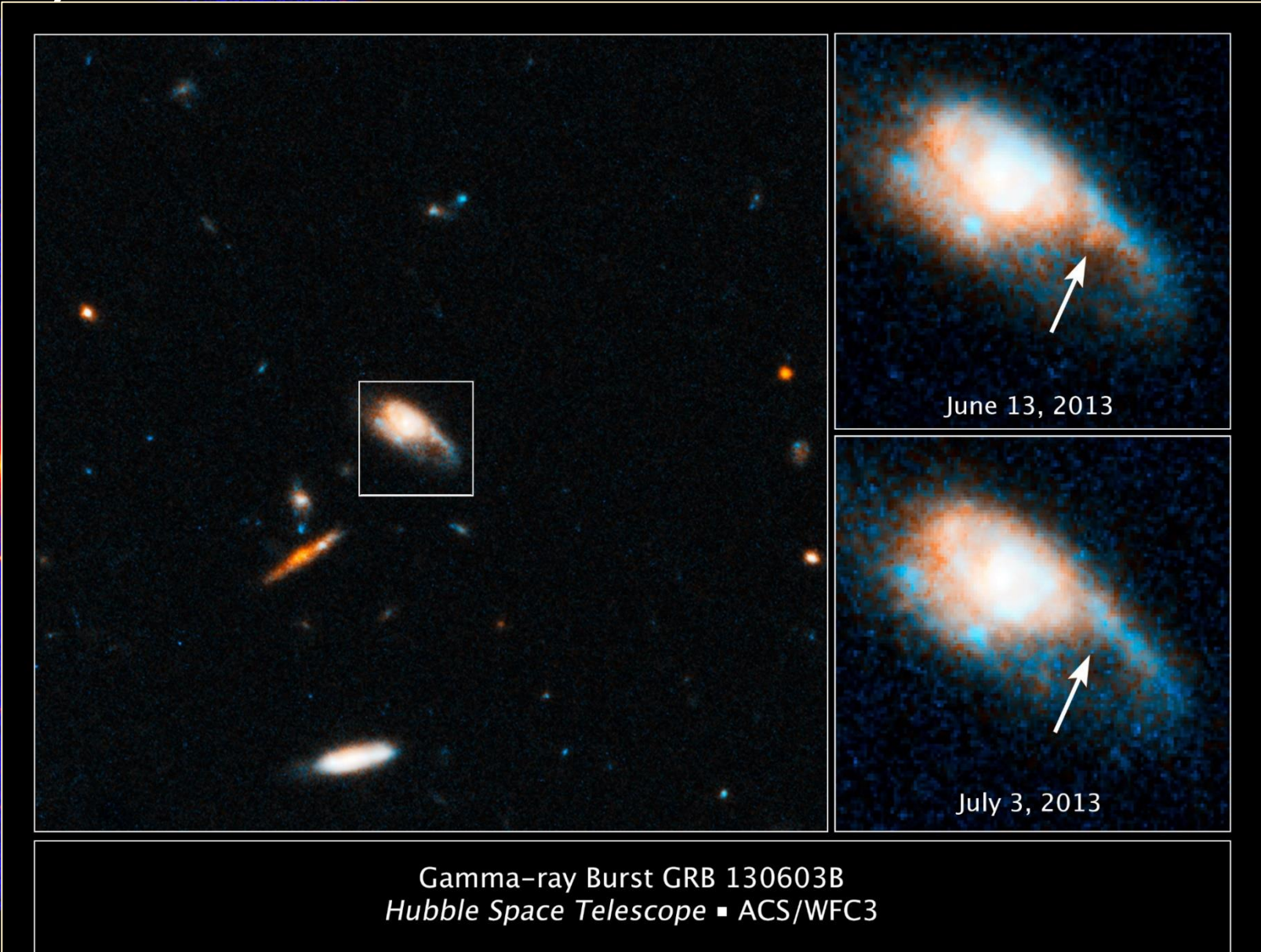
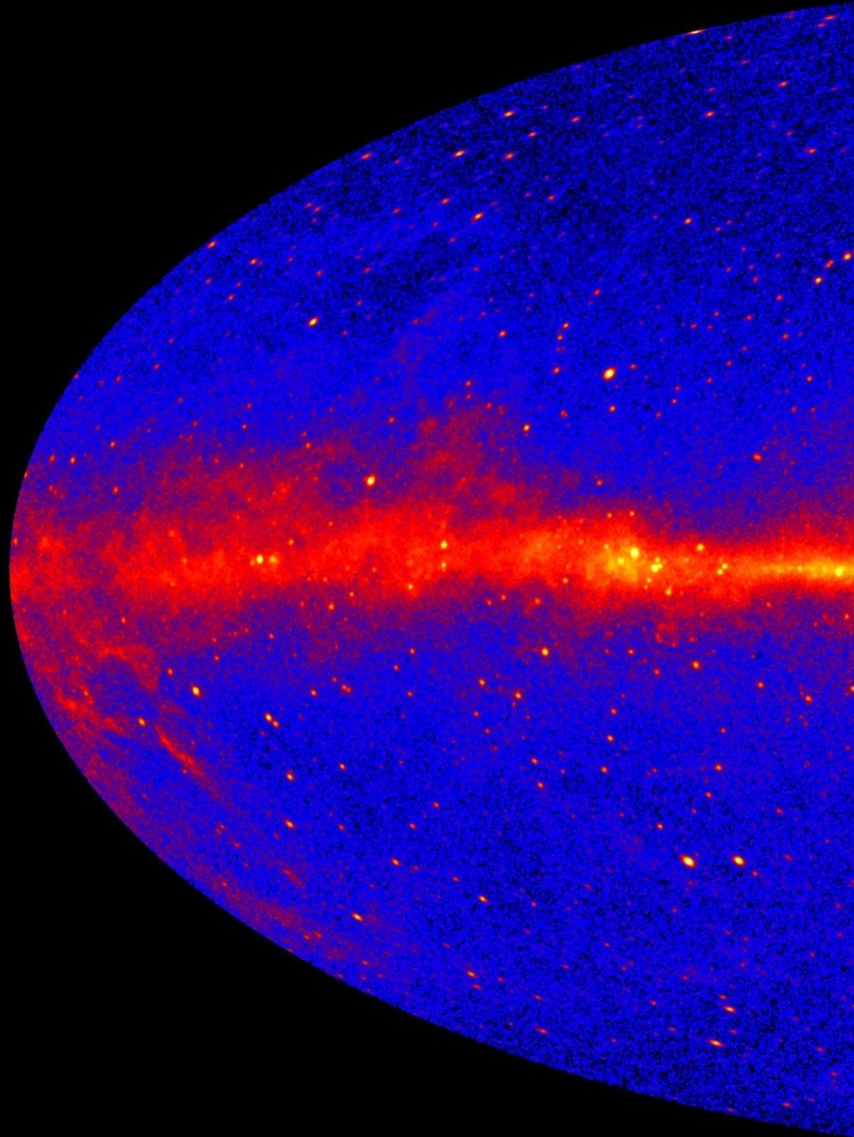
I Lampi di Raggi Gamma (GRB)



GRB 130427A



I Lampi di Raggi Gamma (GRB)



Gamma-ray Burst GRB 130603B
Hubble Space Telescope ■ ACS/WFC3

I Lampi di Raggi Gamma (GRB)

GRB di lunga durata — Stelle singole



GRB di breve durata — Stelle doppie





Credit: NASA/Swift/Cruz de Wilde



Il satellite Fermi

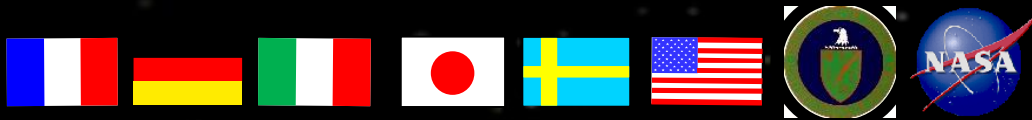


(Image Credit: NASA/Reid Weisman/Fermi/Sonoma State University)

Il satellite per raggi gamma «Fermi»

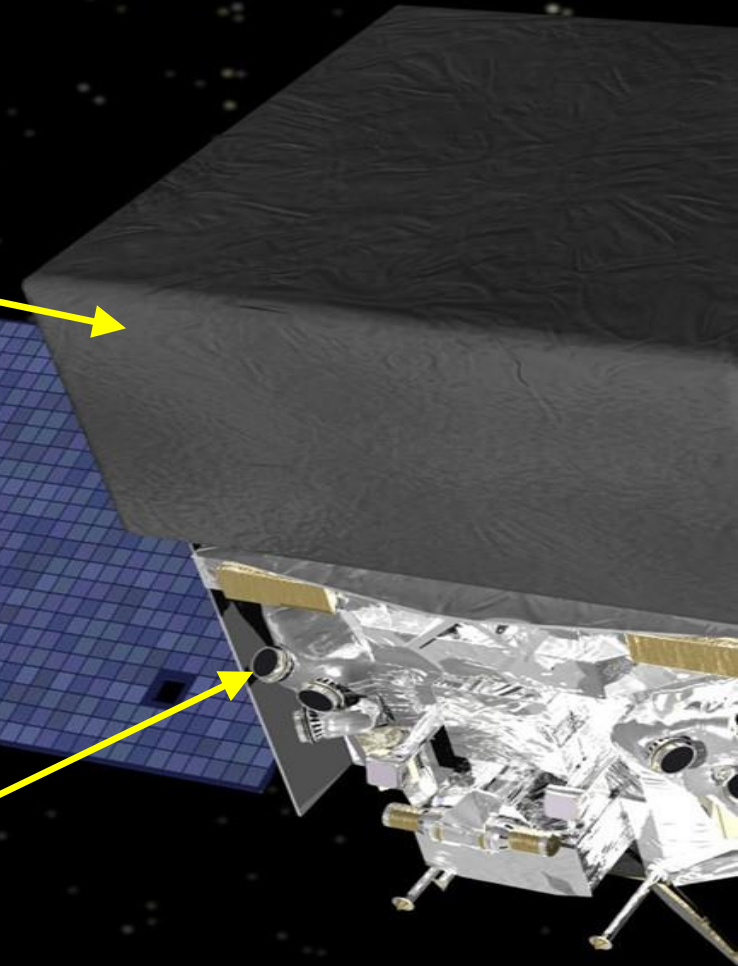
Il Large Area Telescope (LAT)

- Esplora l'Universo alle **altissime energie nel gamma**
- **Collaborazione Internazionale** tra la NASA e il DOE in USA e le agenzie spaziali in Francia, Germania, Italia, Svezia e Giappone



Il Gamma-ray Burst Monitor (GBM)

- Esplora l'Universo alle **basse e medie energie nel gamma**



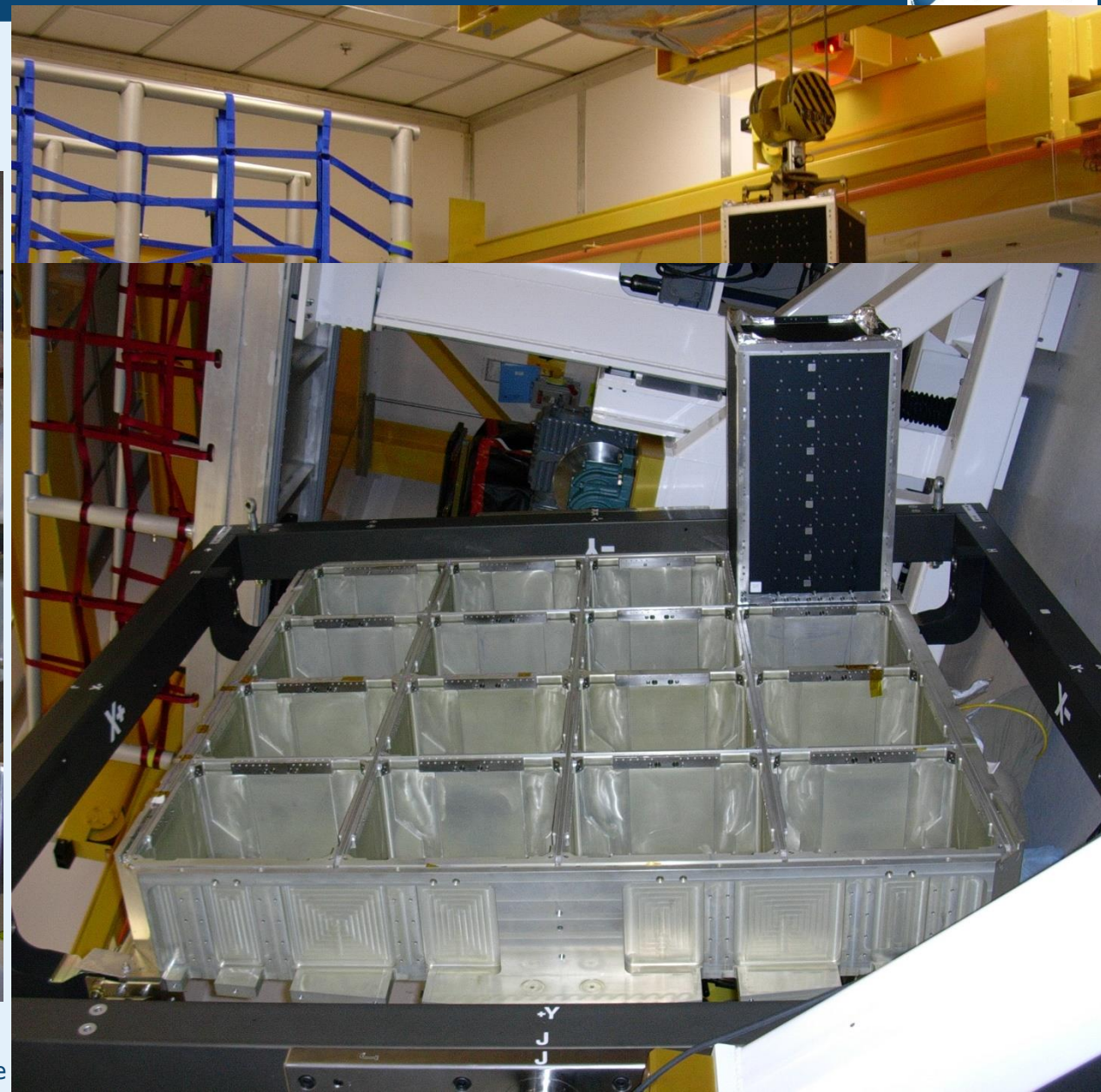
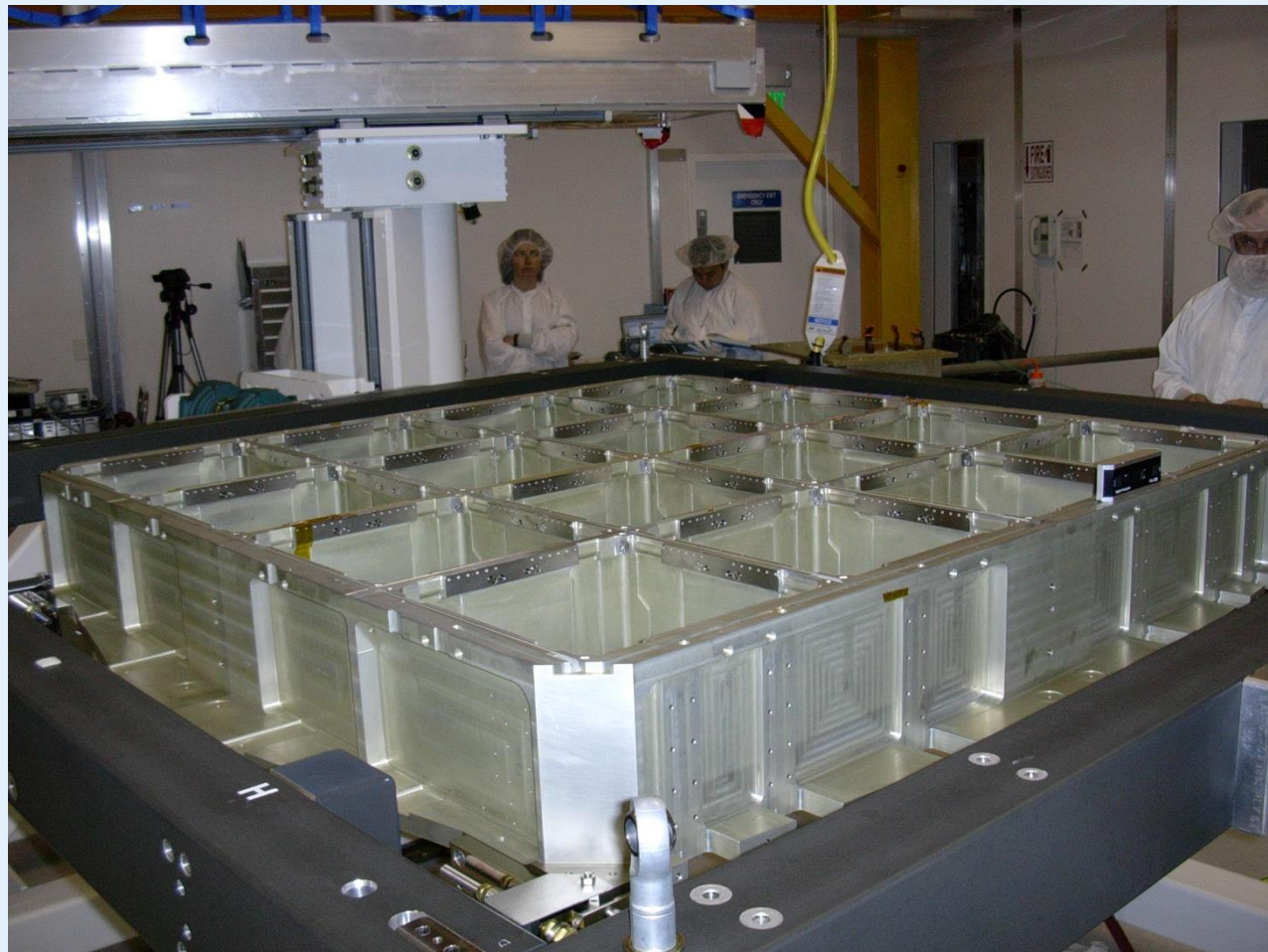


Credit: NASA's Goddard Space Flight Center/Gabby Garcia

NASA Goddard Media Studio
<https://svs.gsfc.nasa.gov/13272>

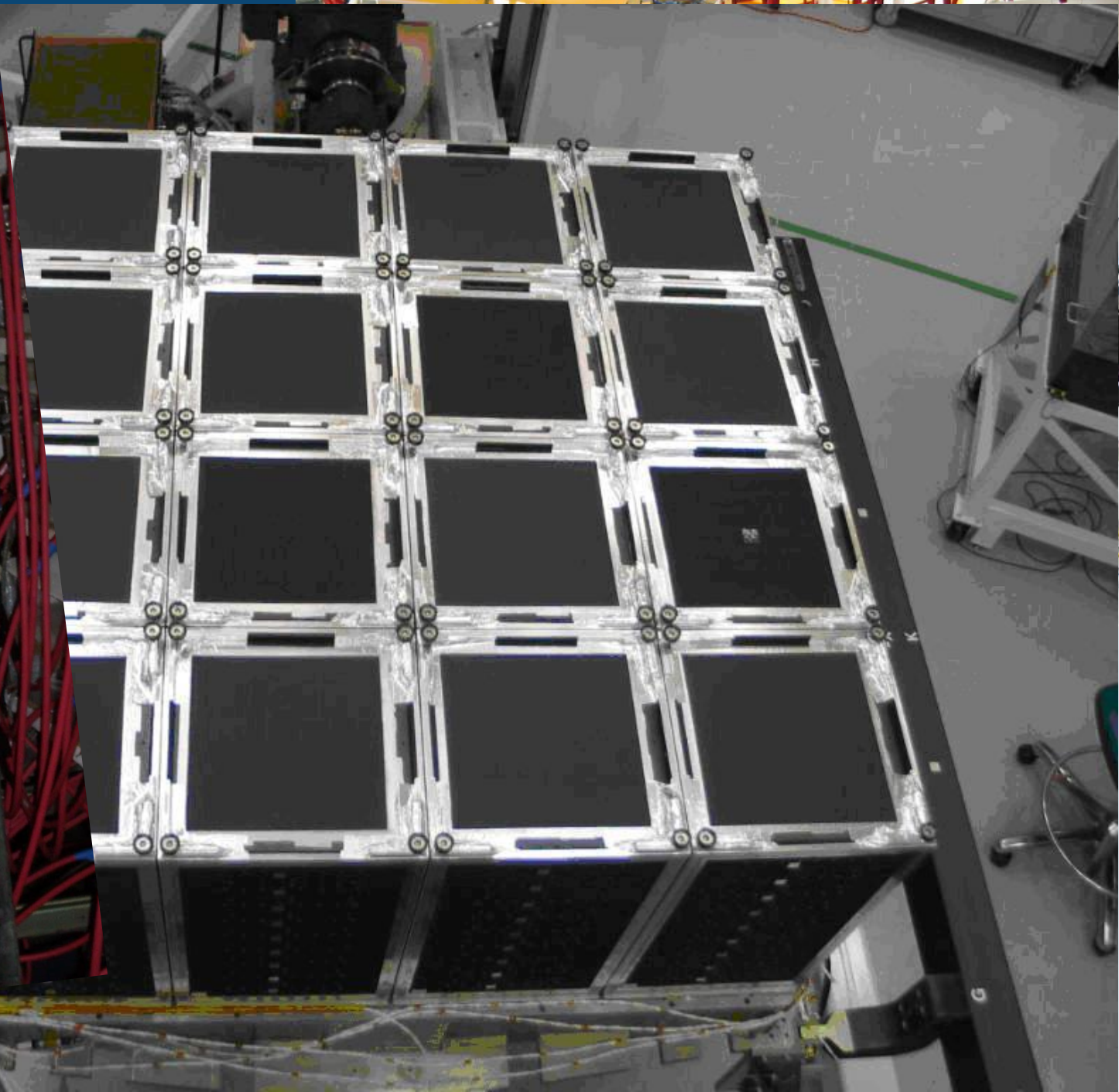
Come si costruisce un rivelatore (LAT)

2004-2005



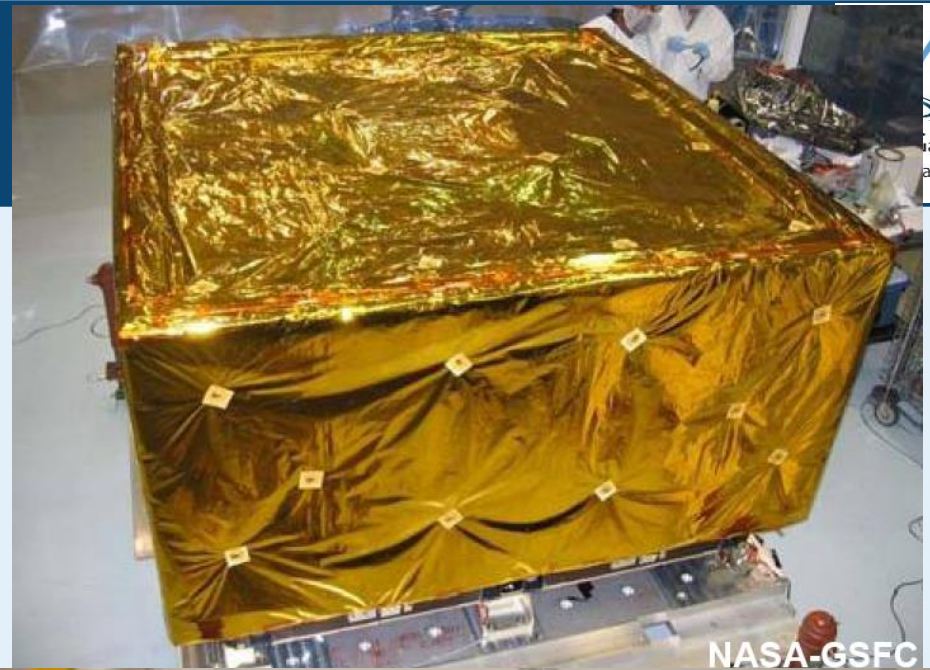
Come si costruisce un

2

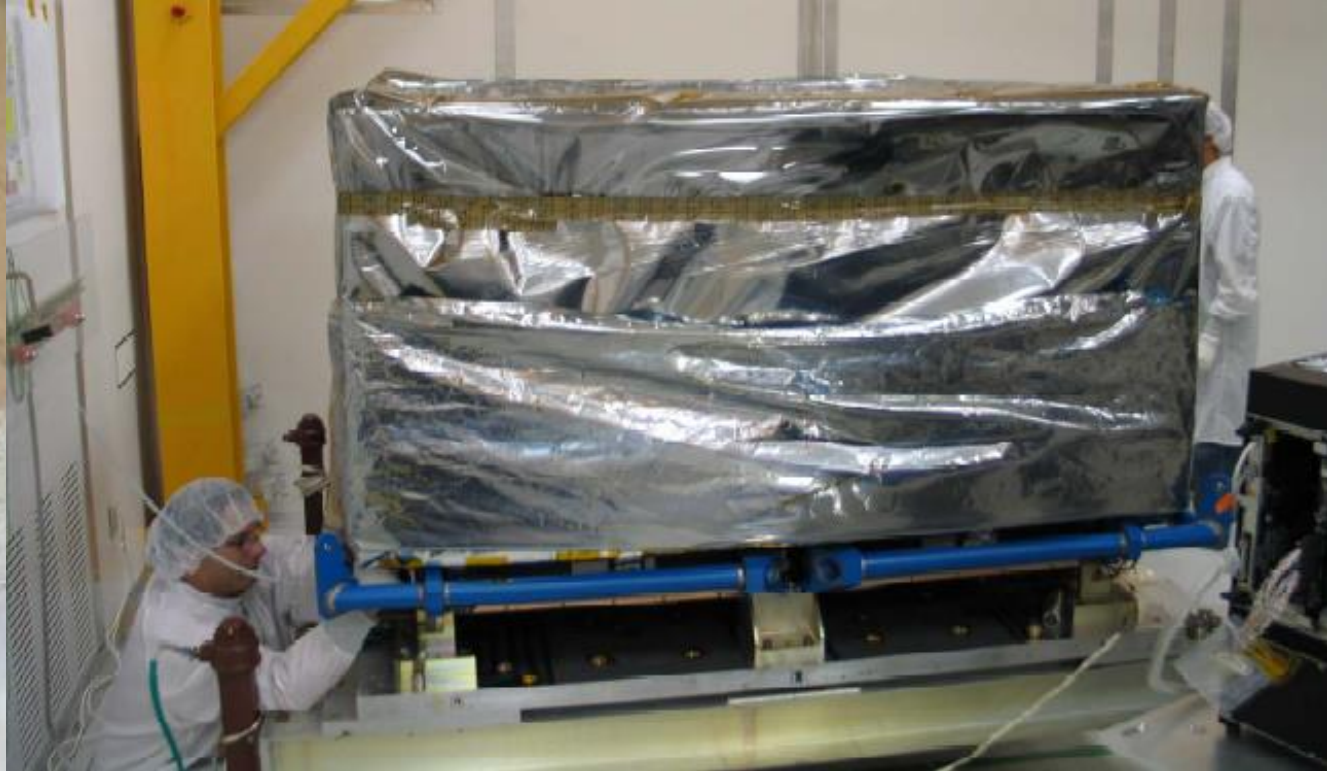


Come si costruisce un rivelatore (LAT)

2005-2006



NASA-GSFC



Come si costruisce un rivelatore (GBM)

Dr. Andreas von Kienlin e
Dr. Giselher Lichti

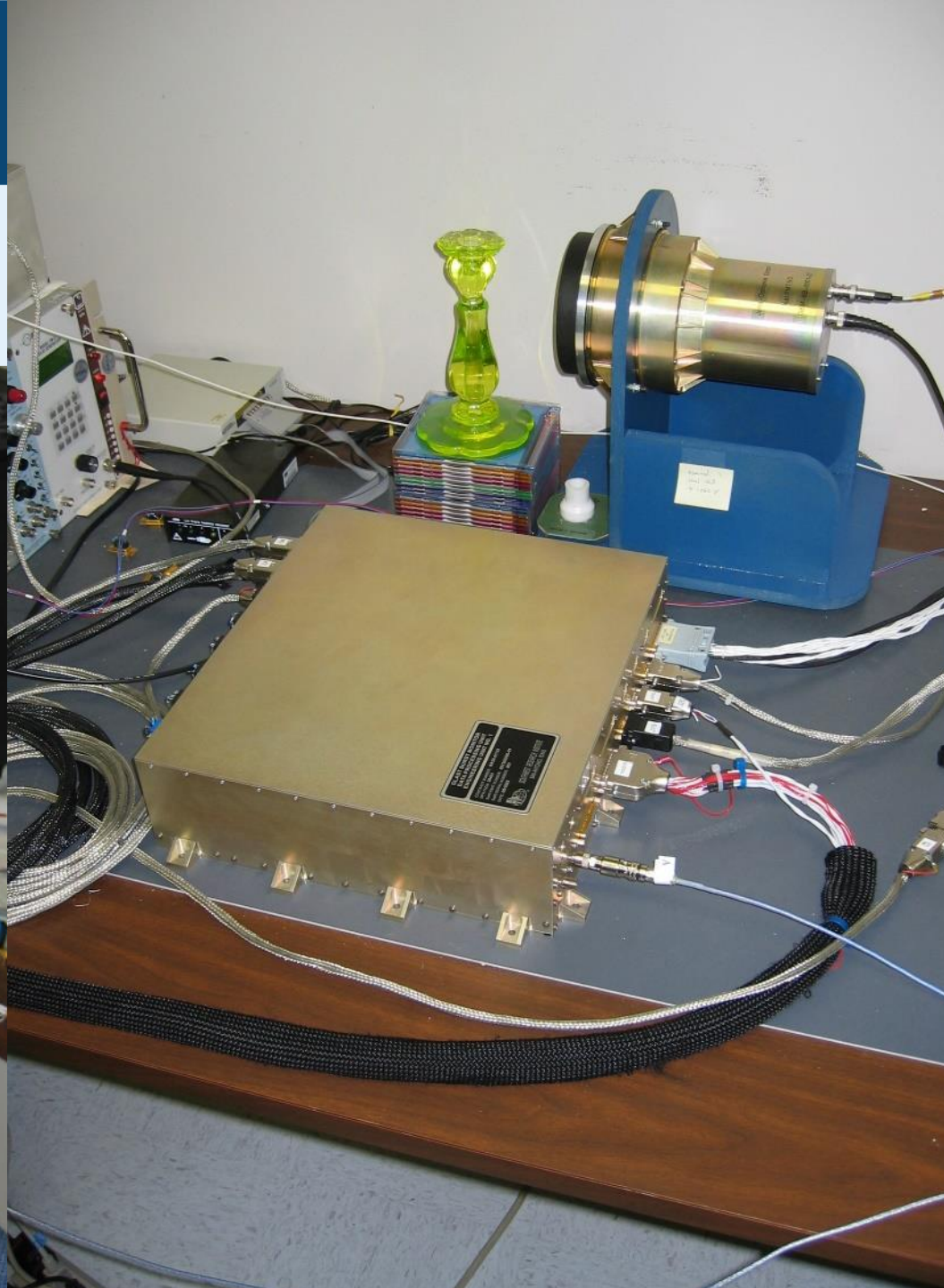
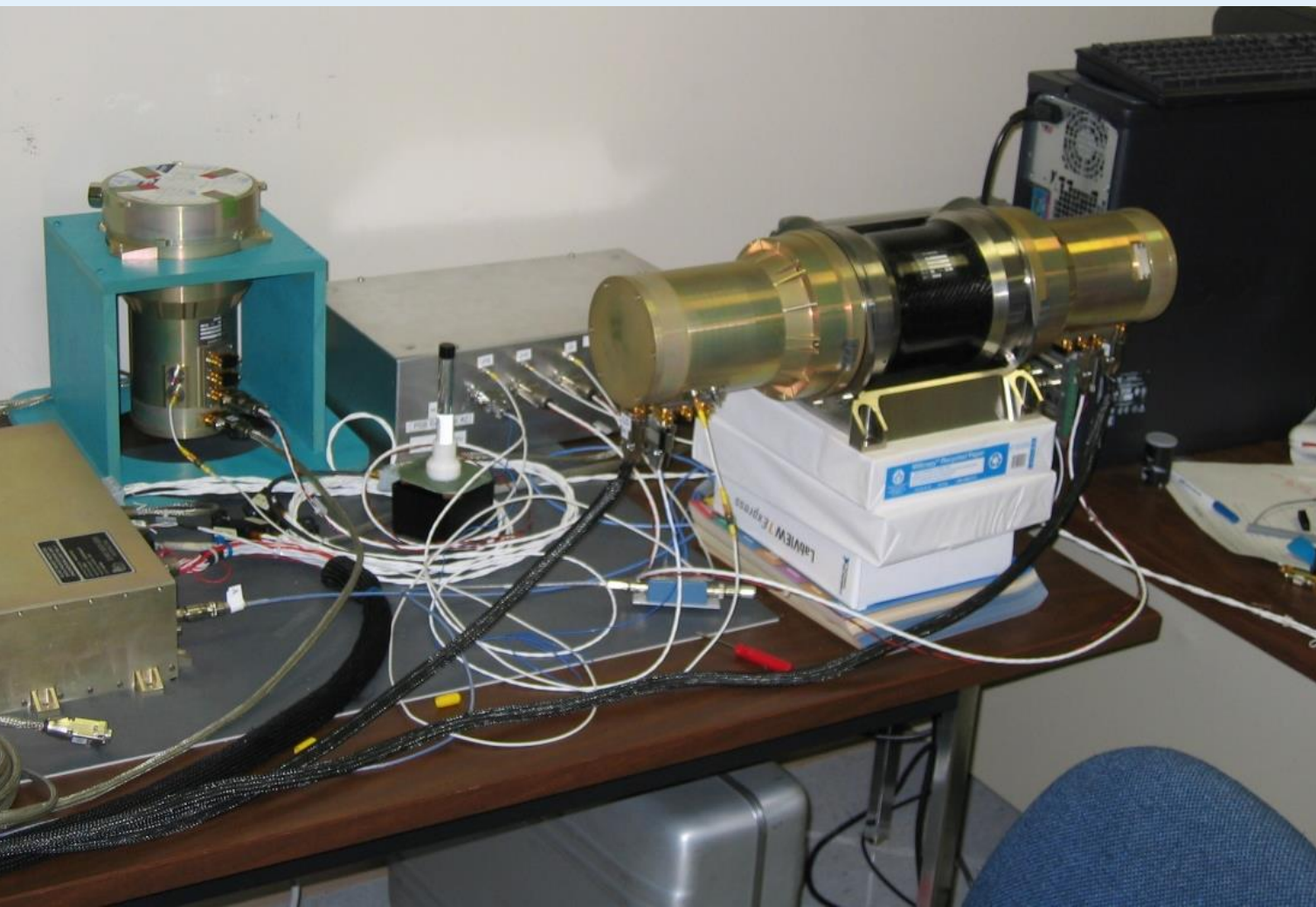
**Modelli dei rivelatori
presso il Max-Planck
Institut for Extraterrestrial
Physics, Monaco di
Baviera (Germani)**

Marzo 2004



Come si costruisce un rivelatore (GBM)

- **Prototipi (Germania) nel 2005**



Come si costruisce un rivelatore (GBM)

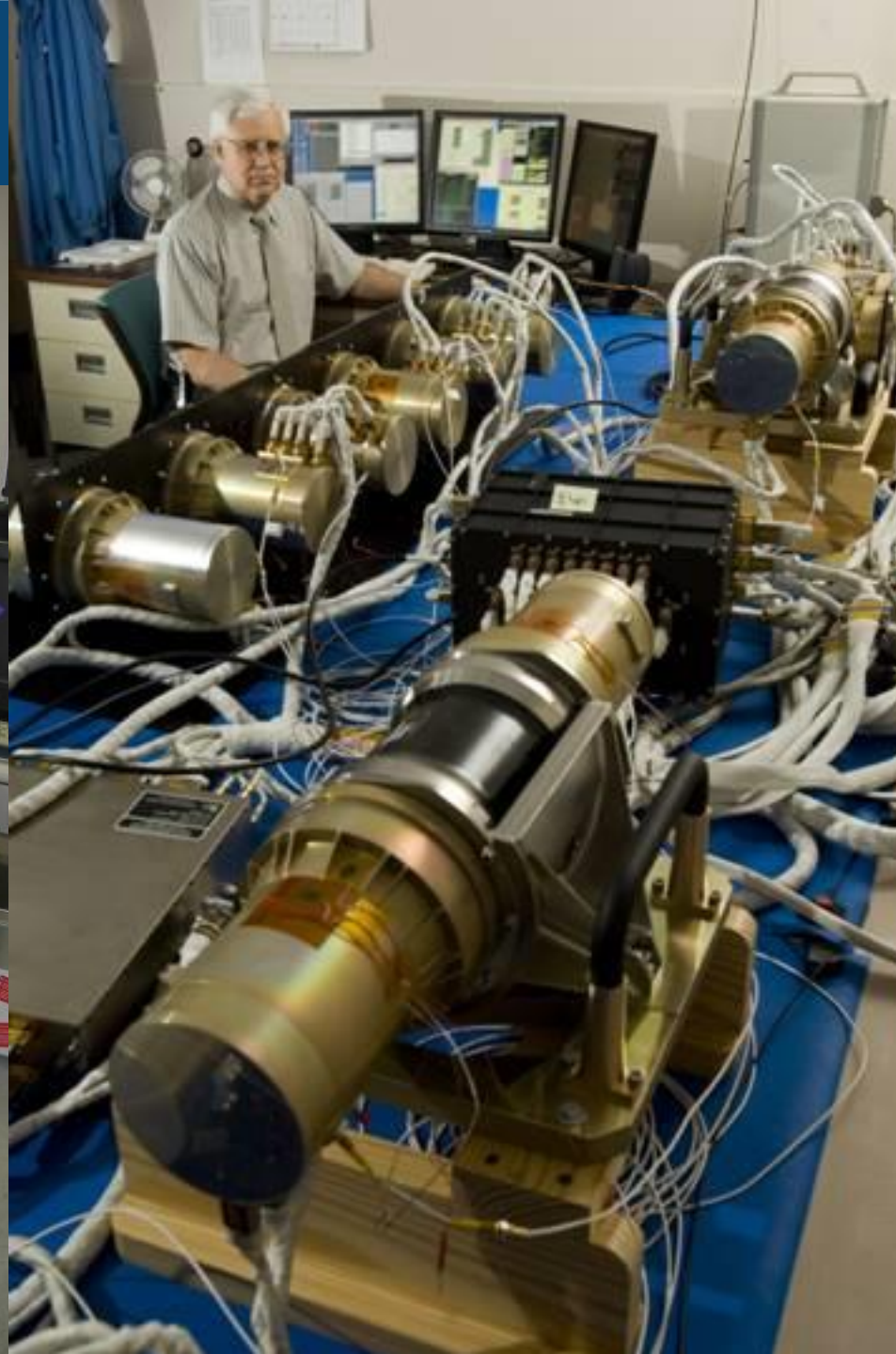
- **Maggio 2006**

Imballaggio e
spedizione dei
14 rivelatori dalla
Germania agli USA

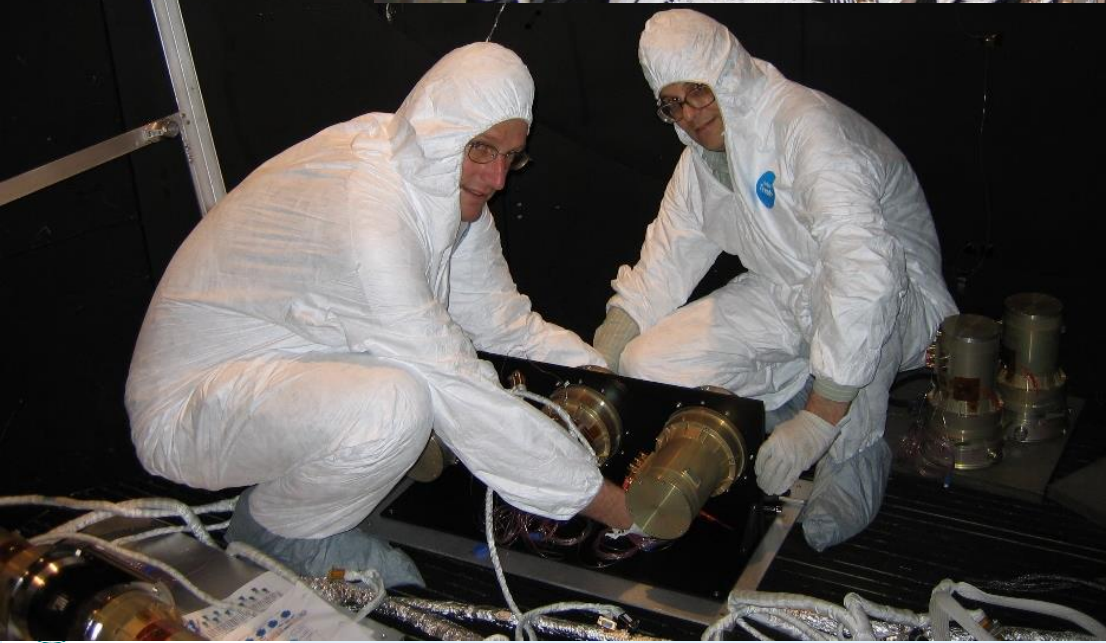


Come si costruisce un rivelatore (GBM)

«Battesimo»
Ottobre 2006



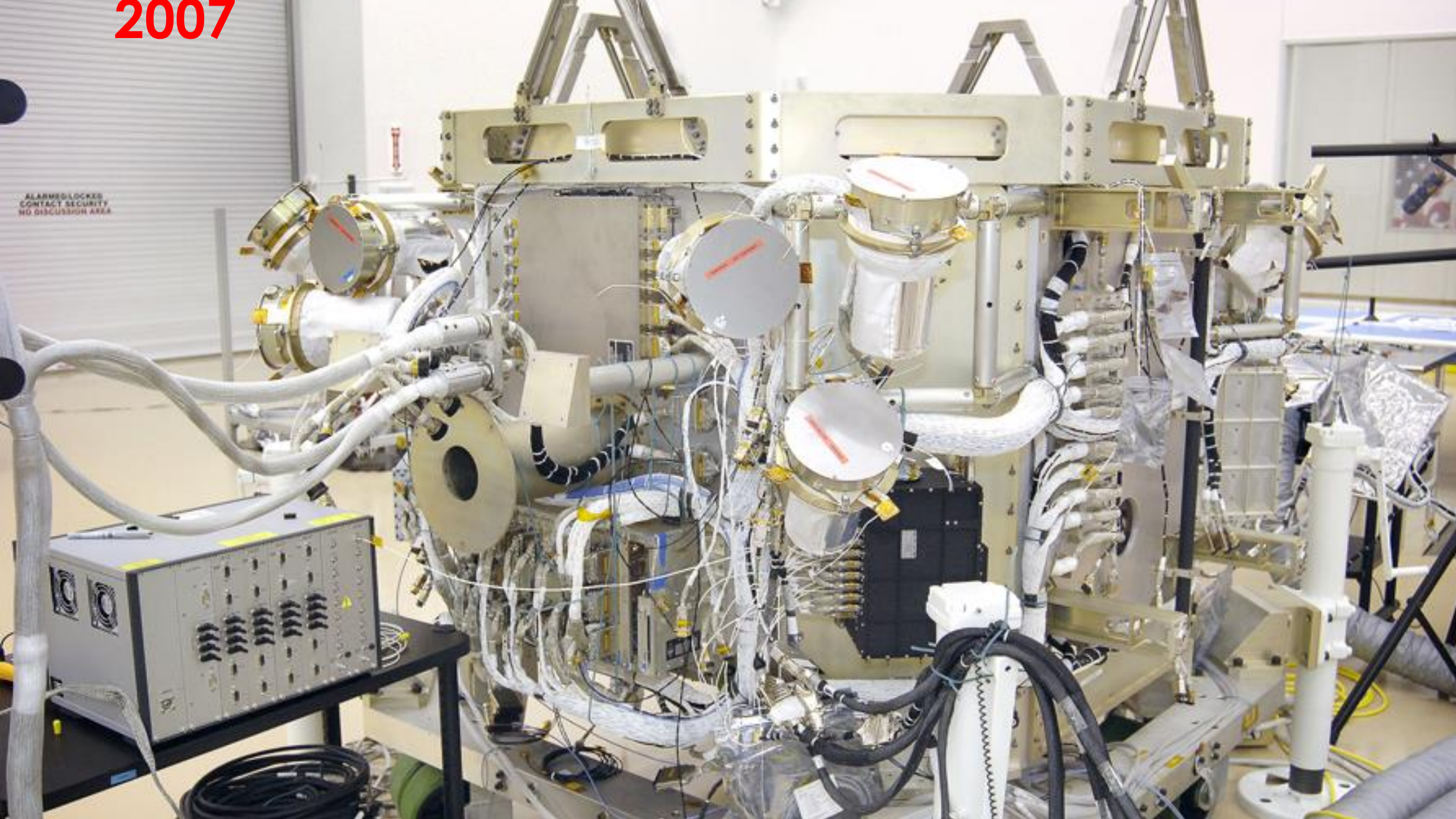
Calibrazione degli strumenti (GBM)



2007



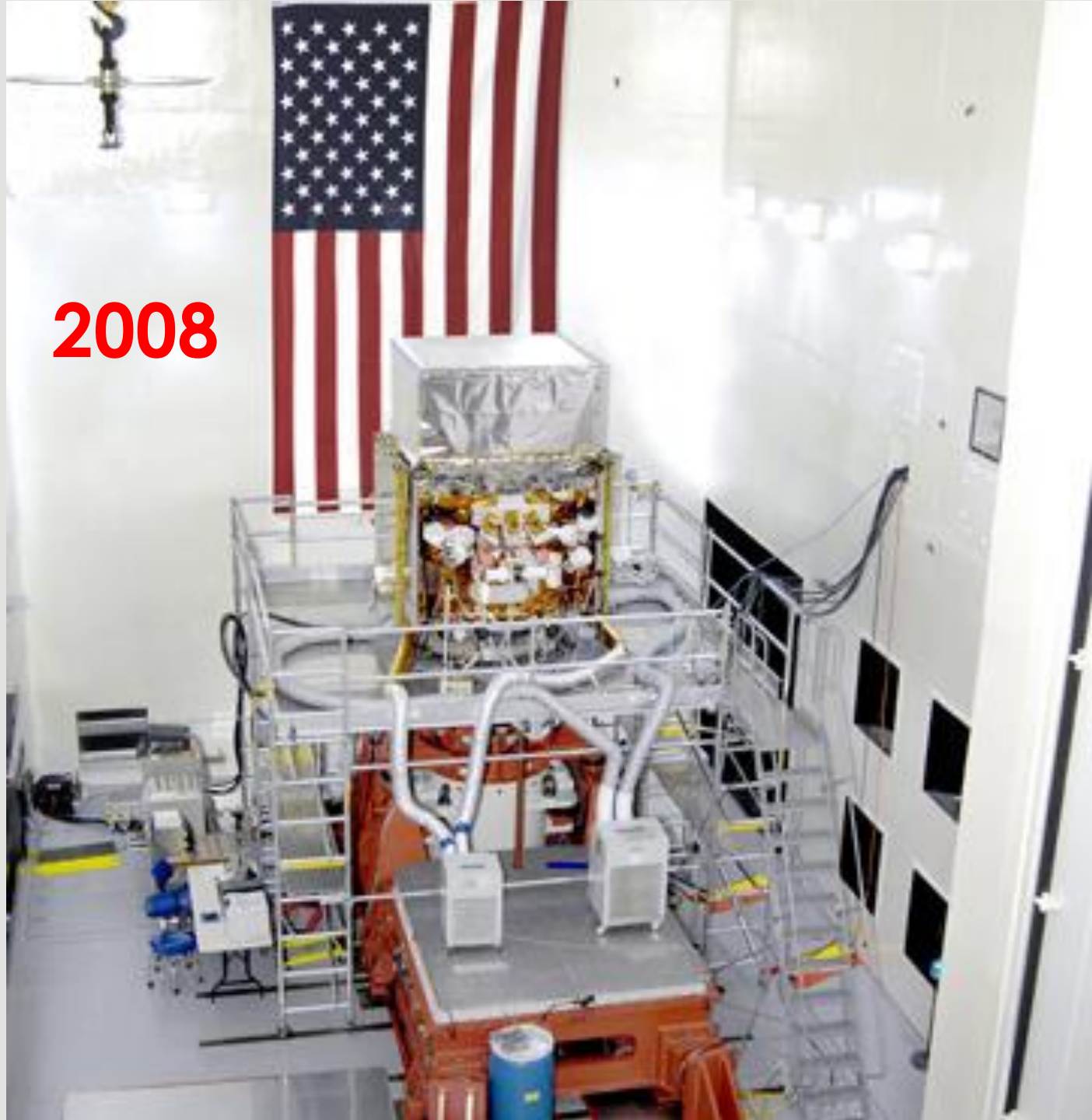
2007



ALARMED LOCKED
CONTACT SECURITY
NO DISCUSSION AREA



G070265-007



2008

2008



03. 04. 2008

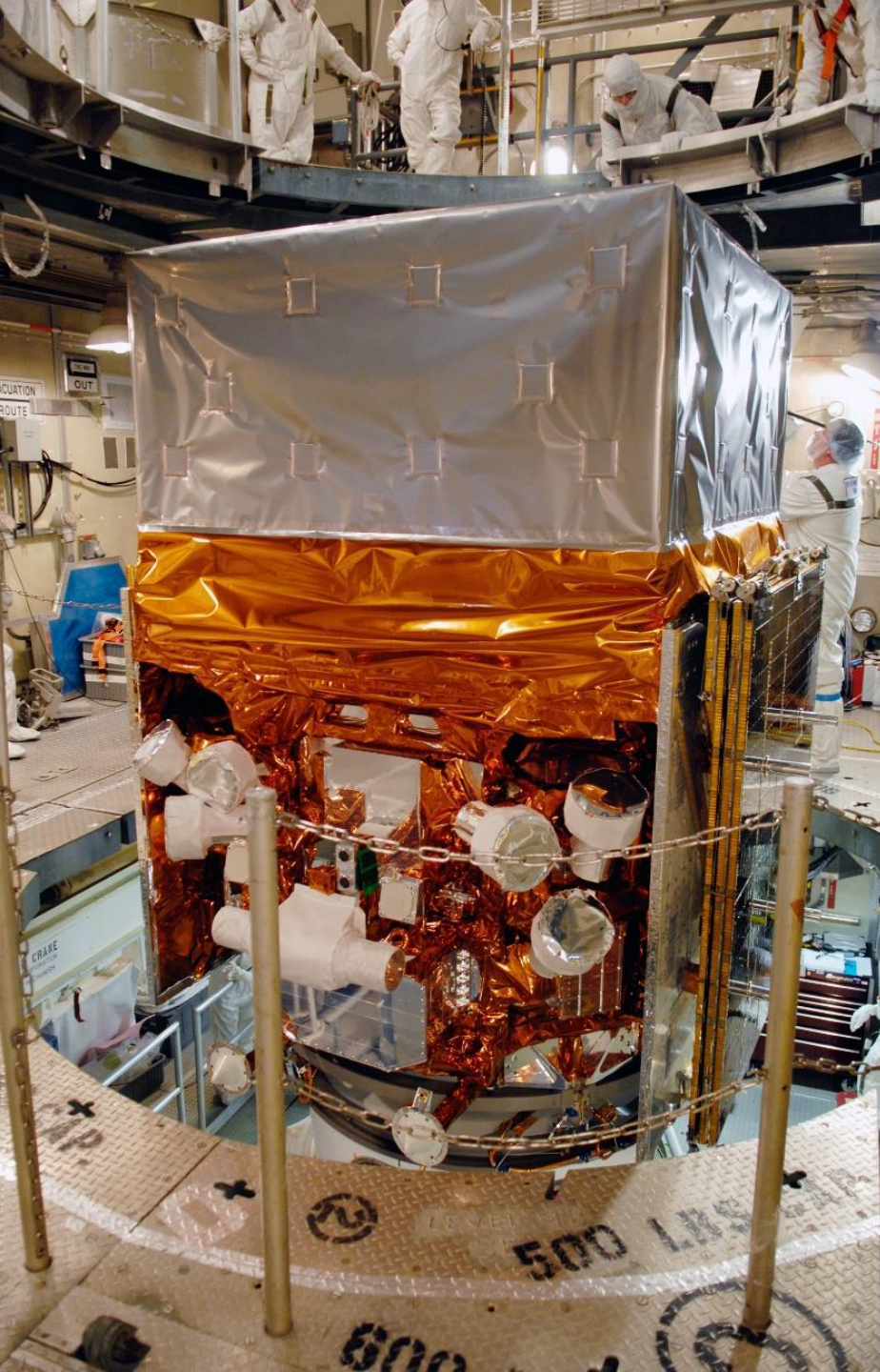


17. 05. 2008

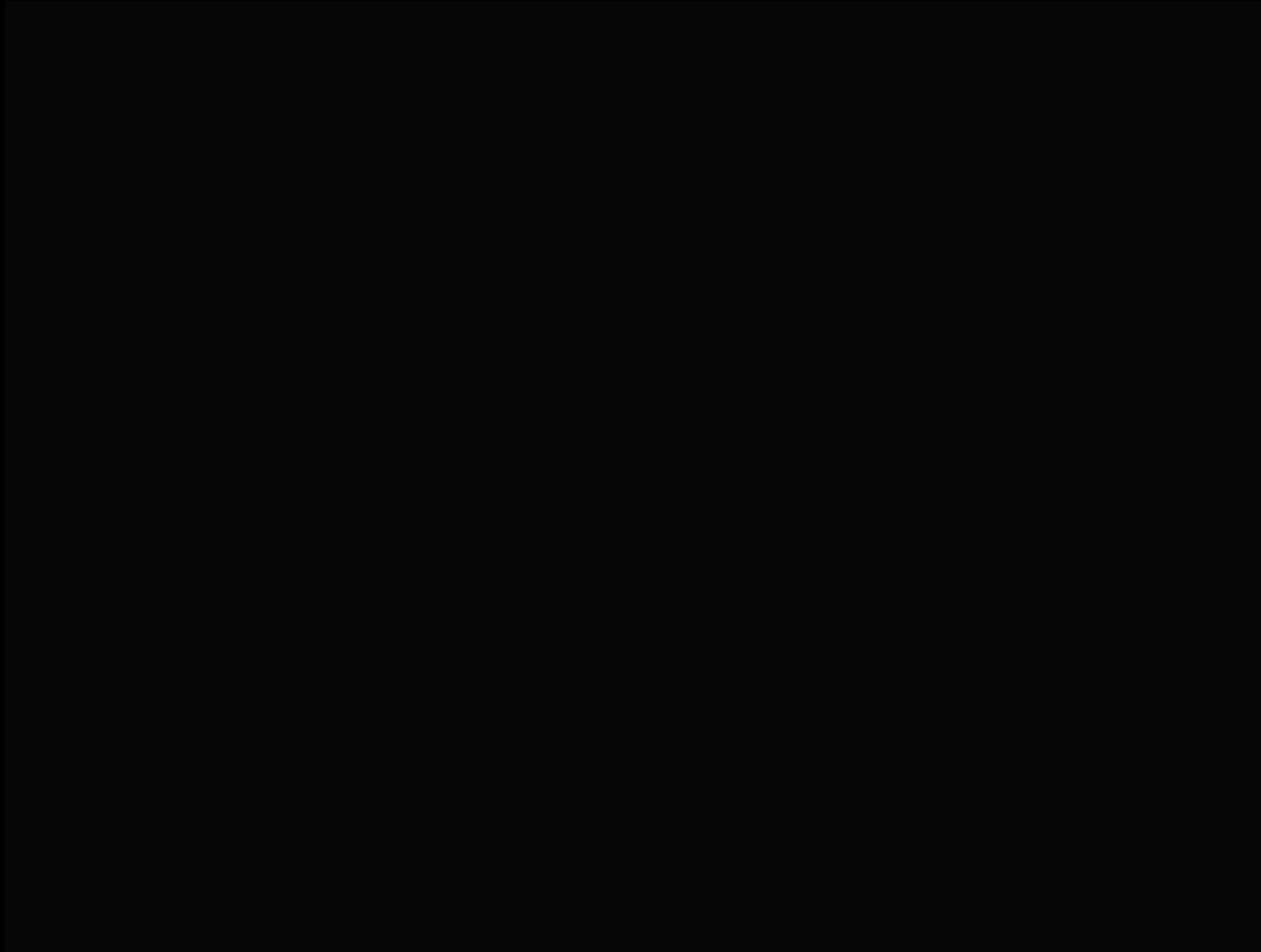


<http://mediaarchive.ksc.nasa.gov/>



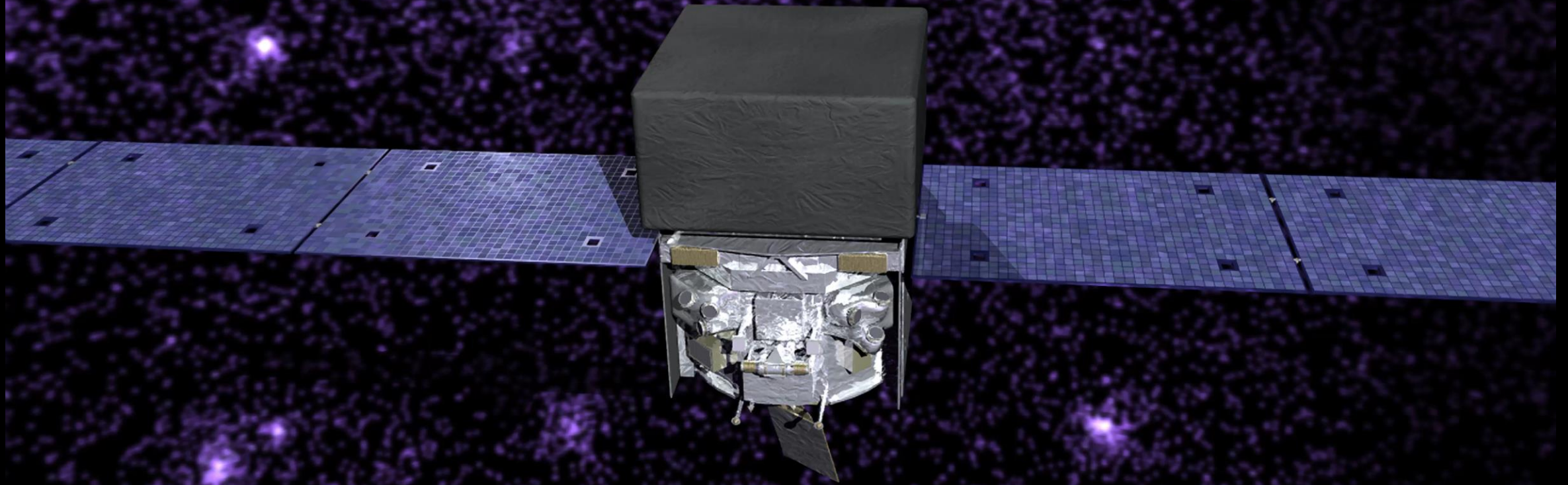


11 Giugno 2008: Il lancio a Cape Canaveral



Fermi Gamma-Ray Space Telescope

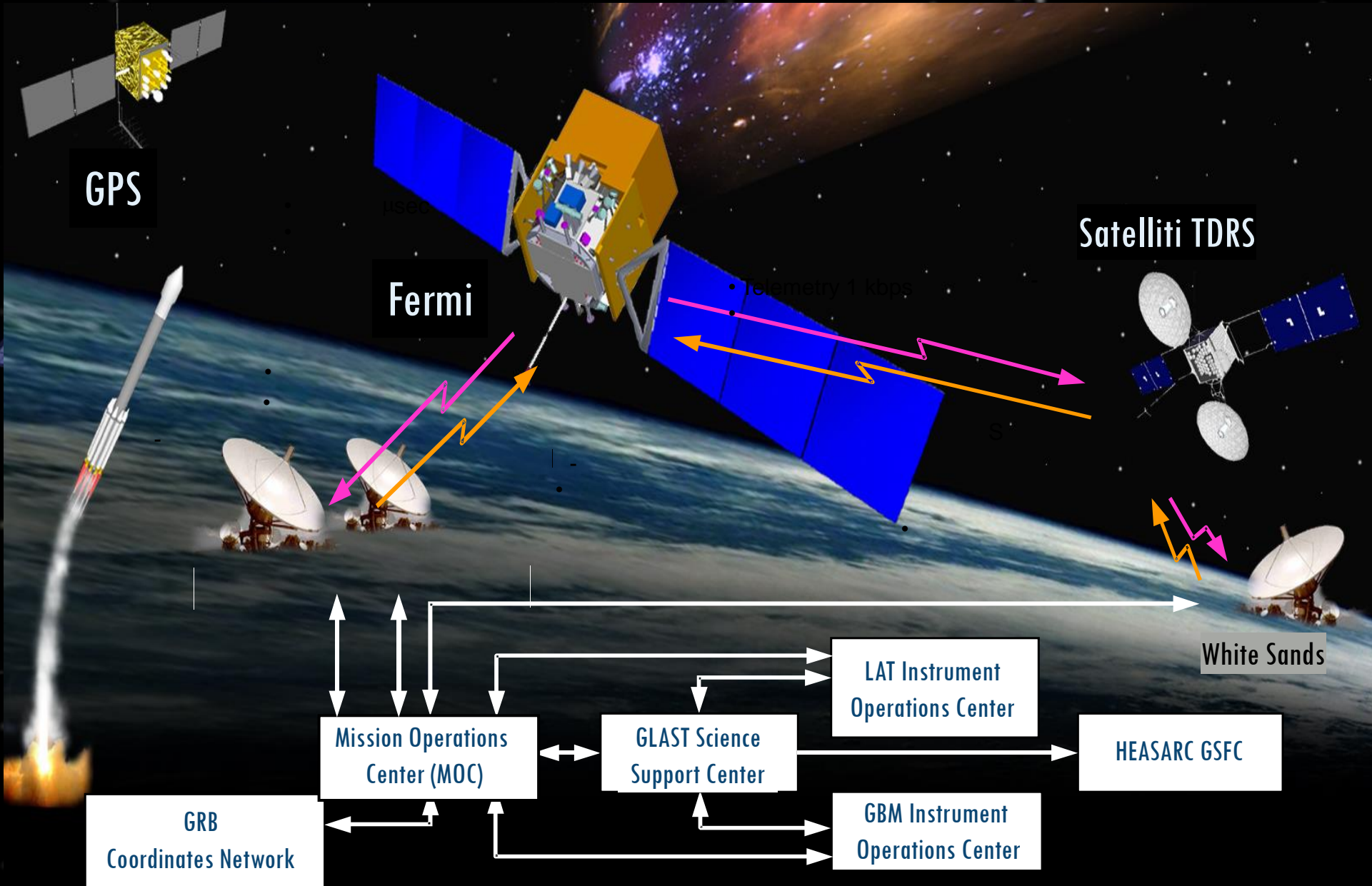
In orbita dal 2008



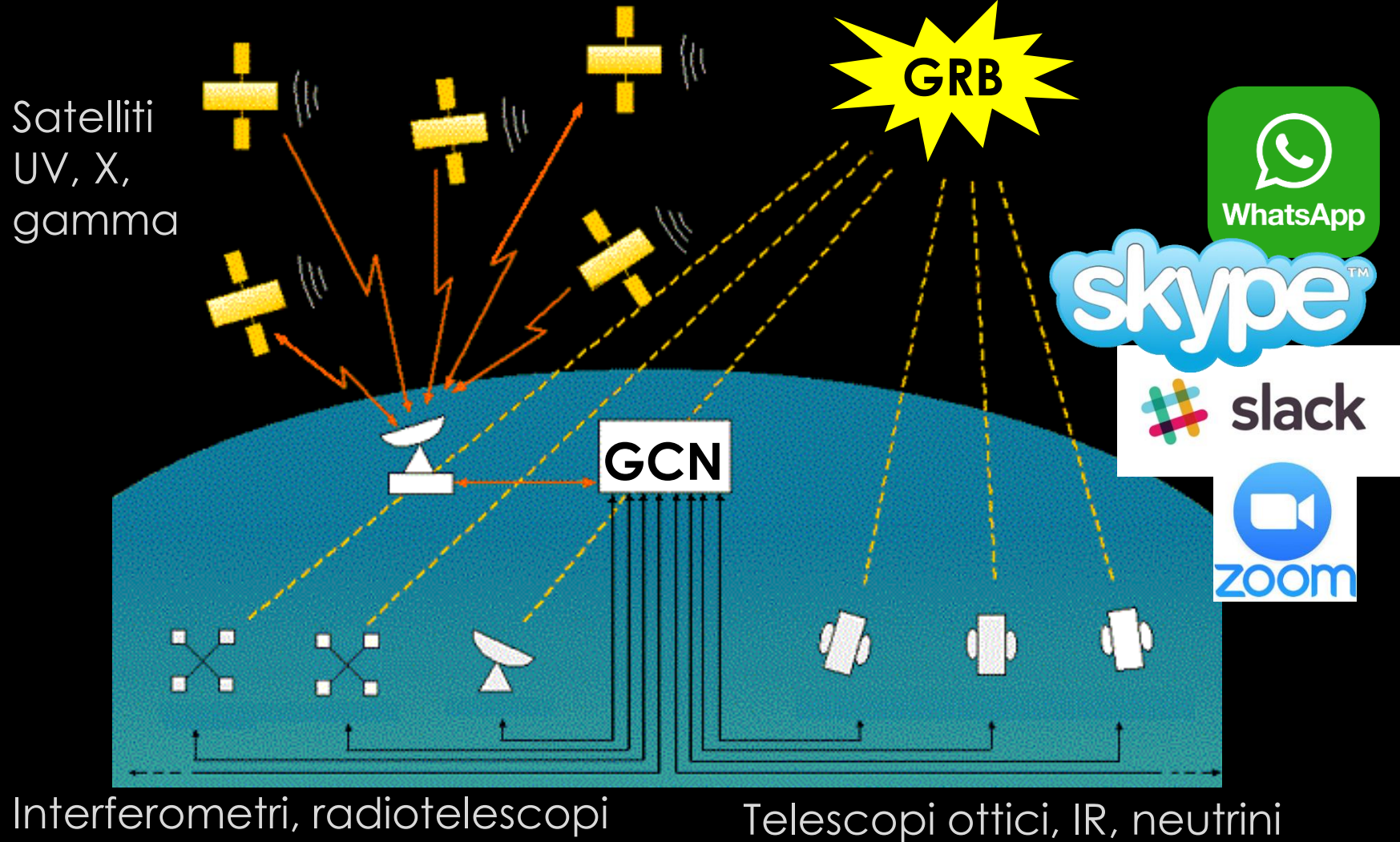
NASA Goddard Media Studio
<https://svs.gsfc.nasa.gov/13094>

Credit: NASA's Goddard Space Flight Center/CI Lab

Comunicazioni satellitari



Tutti a caccia di GRB!!!



Tracking satellitare

N2YO.com

Tracking **19636** objects as of 8-Apr-2019
HD Live streaming from Space Station

1,700 objects crossing your sky now

ISS will cross your sky
in 1h 23m 42s

Find a satellite...

[N2YO.com on Facebook](#) [Advanced](#)

Like 20K

Home

Most tracked

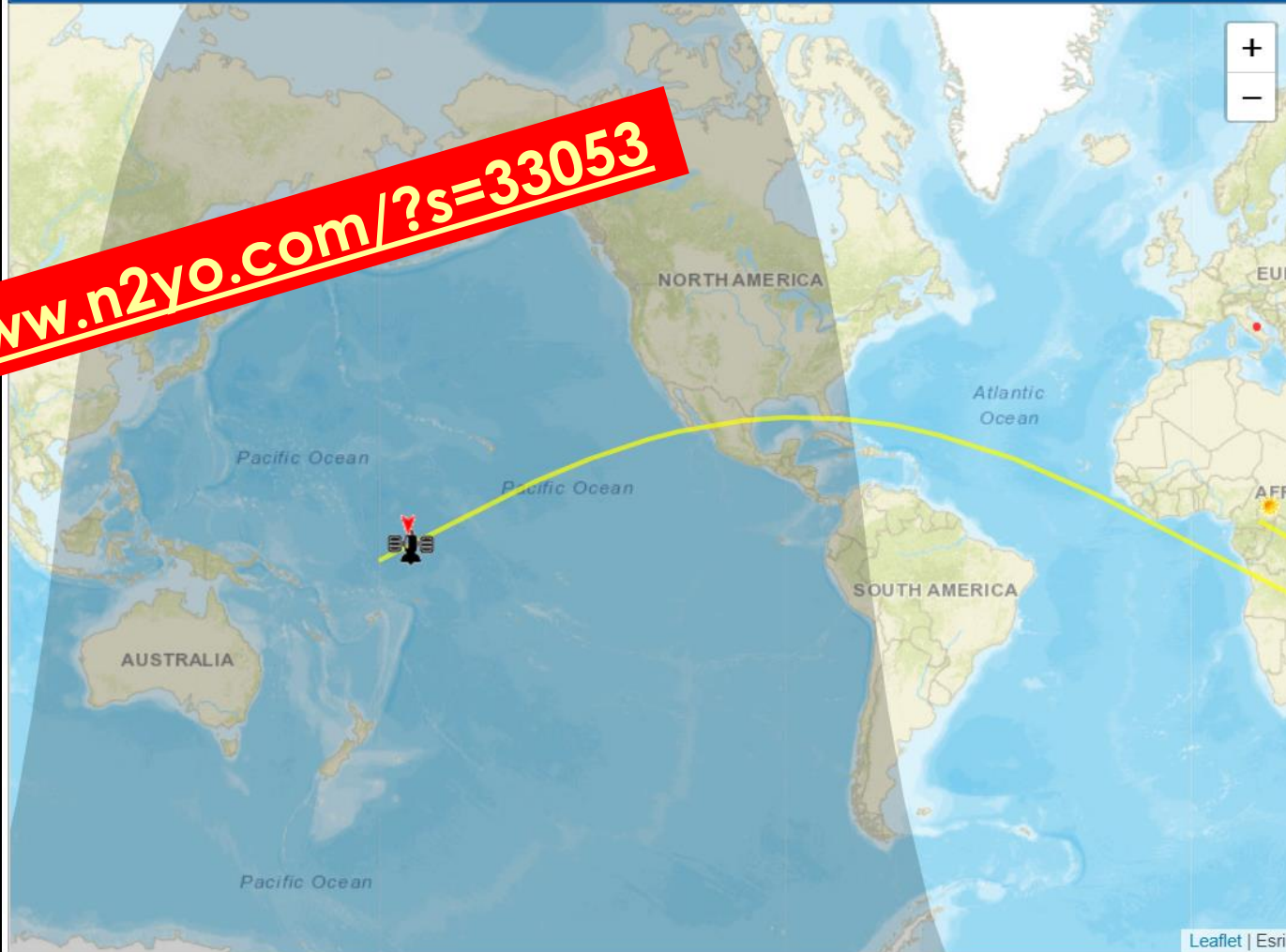
Just launched

Satellites on orbit

Alerting tools

More stuff

Sign in



<http://www.n2yo.com/?s=33053>

GLAST

NORAD ID:	33053
LOCAL TIME:	12:51:31
UTC:	10:51:31
LATITUDE:	-1.64
LONGITUDE:	-173.48
ALTITUDE [km]:	522.32
ALTITUDE [mi]:	324.55
SPEED [km/s]:	7.6
SPEED [mi/s]:	4.72
AZIMUTH:	10.1 N
ELEVATION:	-68
RIGHT ASCENSION:	12h 33m 01s
DECLINATION:	-22° 23' 52"
Local Sidereal Time:	24h 50m 20s

The satellite is in Earth's shadow

SATELLITE PERIOD: 96m

10-DAY PREDICTIONS FOR
GLAST

[Make A Donation](#)

Resources

- [IP2Location IP Geolocation](#)
- [Find your Magnetic Declination](#)
- [Space Station HD Live!](#)
- [Last Minute Stuff!](#)

Your current location

Your IP address: **151.57.87.250**
Latitude: **43.21255°**
Longitude: **13.29008°**
Magnetic decl.: **2° 56' E**
Local time zone: **GMT+2**

Draw orbits Draw footprint Keep selection centered

[Large map](#)



Tweet **459** Following **25** Follower **53.600** Mi piace **35**

Segui

NASAFermi

@NASAFermi

NASA's Fermi Gamma-Ray Space Telescope studies the extreme energy universe!

In Orbit

nasa.gov/fermi

Iscritto a giugno 2008

82 foto e video



Tweet Tweet e risposte Contenuti



NASAFermi @NASAFermi · 23 mar

It's #FermiFriday! Flares visualized as raindrops, gravitationally lensed pirates, and donuts hiding inside a black hole. For AGN Month, we've collected animations and confections inspired by the many active galaxies seen by @NASAFermi.

Check it out at go.nasa.gov/2HZnsb4



Nuovo su Twitter?

Iscriviti ora per ottenere la tua cronologia personalizzata!

Iscriviti

Potrebbero piacerti · Aggiorna



NASA Spitzer
@NASAspitzer



Chandra Observatory
@chandraxray



NASA Blueshift
@NASABlueshift



NASA Goddard
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ESA Herschel
@ESAHerschel



<https://twitter.com/NASAUniverse>



NASA Fermi
Gamma-ray Space
Telescope

@nasafermi

Home

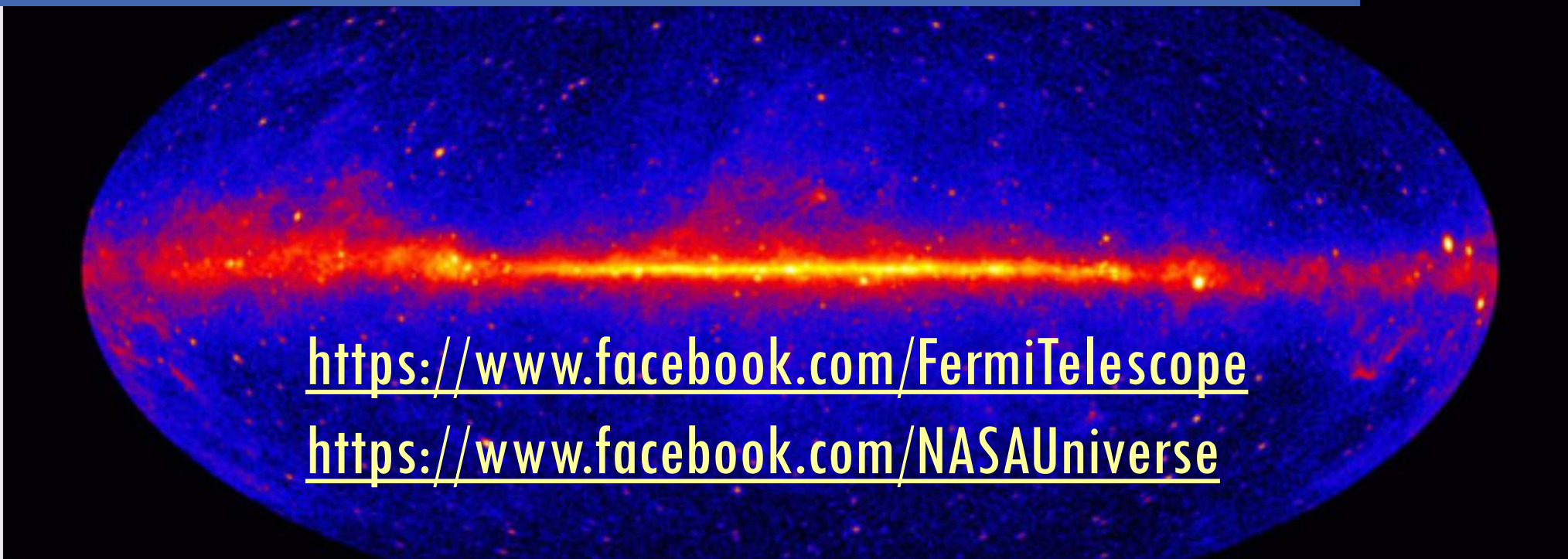
Informazioni

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Pagina seguita

Condividi



Invia un messaggio



NASA Fermi Gamma-ray Space Telescope

23 marzo alle ore 21:11 · 🌐

It's #FermiFrida



Flares visualize indrops, gravitationally lensed pirates, and donuts hiding inside a black hole. For AGN Month, we've collected animations and confections inspired by the study of active galaxies seen with NASA's Fermi Gamma-ray Space Telescope.

Cerca post in questa Pagina

Italiano · English (US) · Deutsch · Español · Français (France)

2007



2008



2016



2018



2019



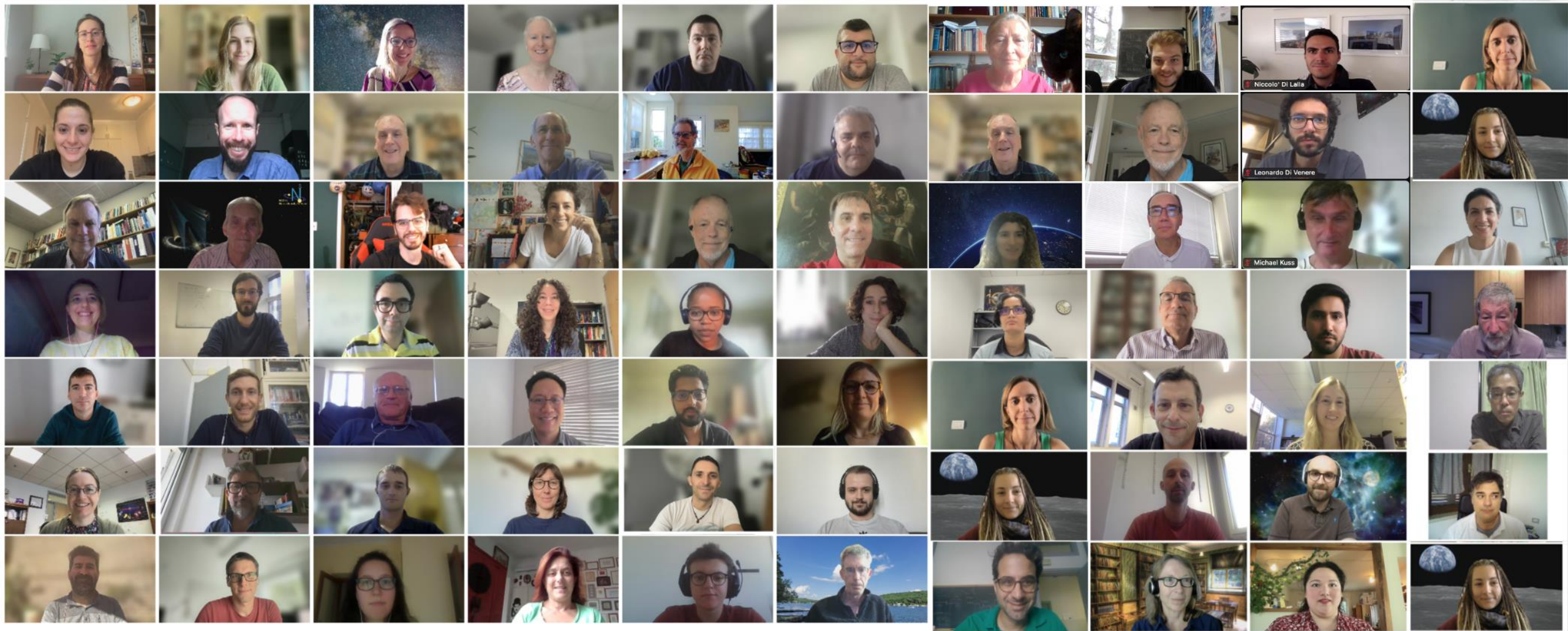
The image is a dense, repeating grid of small, square portraits of people. The portraits are arranged in a regular pattern across the entire frame. A vertical band of color runs down the center, transitioning from a reddish-pink hue on the left to a blue hue on the right. The portraits themselves are mostly dark and indistinct, but some are highlighted with a white or light-colored glow, particularly in the central band. In the upper right corner, there is a bright yellow rectangular box containing the year '2020' in black, bold, sans-serif font.

2020

A large, dense mosaic of many small, square portraits of people, likely from a video conference. The portraits are arranged in a grid and feature a color gradient from blue on the left to red and yellow on the right. A yellow rectangular box is positioned on the right side of the image, containing the year "2021" in black text.

2021

2023



2024

IFT

ICMAT



Fermi
Gamma-ray Space Telescope



Fermi-LAT Collaboration
2024 spring meeting

Madrid
March 11-15, 2024



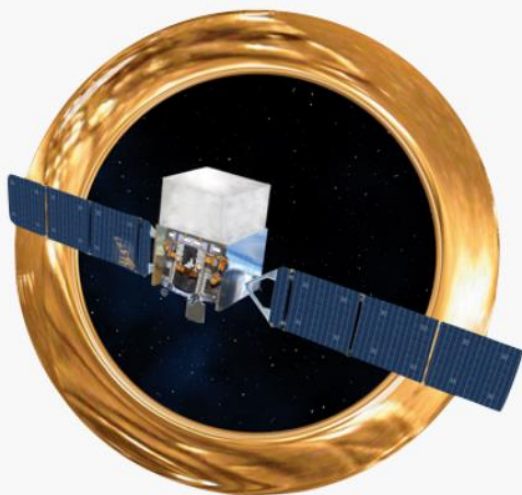
Fermi

Gamma-ray Space Telescope



- Home
- What is Fermi
- Science
- Fermi@10**
- Support Center
- Mission Page
- Students/Teachers

June 11, 2018 is Fermi's Tenth Launch Anniversary



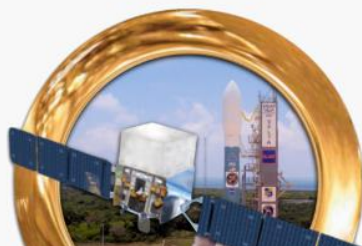
Welcome to a Fermi's 10th year!

We'll be celebrating throughout 2018, sharing Fermi's influence on science, technology, and art. If you want to stay on top of all the Fermi fun, be sure to follow/friend NASA Fermi on Facebook and Twitter!

Here are some of the great features you can look forward to:



<https://fermi.gsfc.nasa.gov/fermi10/>





Fermi's Decade of Gamma-ray Discoveries

Fermi 10-year Sky Map

This all-sky view, centered on our Milky Way galaxy, is the deepest best-resolved portrait of the gamma-ray sky to date. It incorporates observations by NASA's Fermi Gamma-ray Space Telescope from August 2008 to August 2018 at energies greater than 1 billion electron volts (GeV). For comparison, the energy of visible light falls between 2 and 3 electron volts. Lighter shades indicate stronger emission. NASA/DOE/Fermi LAT Collaboration

2023: Fermi 15

GRB 130427A

On April 27, 2013, a blast of light from a dying star in a distant galaxy became the focus of astronomers around the world. The explosion, known as a gamma-ray burst and designated GRB 130427A, was detected by Fermi for about 30 hours. The burst included a 95 GeV gamma ray, the most energetic light yet detected from a GRB. NASA/DOE/Fermi LAT Collaboration

Solar Flare

Although our Sun is not usually a bright gamma-ray source, solar flares can briefly outshine everything else in the gamma-ray sky. On March 7, 2012, Fermi detected flares erupting on the side of the Sun not visible to the spacecraft. The flares produced accelerated particles that fell onto the side of the Sun facing Earth, resulting in gamma rays Fermi could detect. NASA/SDO

PSR J1744-7619

Discovered by Einstein@Home, a distributed computing project that analyzes Fermi data using home computers, PSR J1744-7619 is the first gamma-ray millisecond pulsar that has no detectable radio emission. NASA/DOE/Fermi LAT Collaboration/SSU/RA/Sabinett

ASASSN-16ma

Fermi has discovered several novas, outbursts powered by thermonuclear eruptions on white dwarf stars. This was a surprise because novas weren't expected to be powerful enough to produce gamma rays. One event, dubbed ASASSN-16ma, shows that both gamma rays and visible light seem to be produced by the same physical process. NASA/DOE/Fermi LAT Collaboration

<https://heasarc.gsfc.nasa.gov/docs/objects/heapow/archive/technology/fermi15.html>

Fermi Mission
NASA/Goddard/Fermi LAT Collaboration

Fermi Bubbles

Fermi data revealed vast gamma-ray bubbles extending tens of thousands of light-years from the Milky Way's plane. The Fermi Bubbles may be related to past activity of the supermassive black hole at our galaxy's heart. NASA/Goddard

Galactic Center

The central region of the Milky Way is brighter in gamma rays than expected. Whether this excess is a collection of undiscovered millisecond pulsars or possibly evidence of annihilation of dark matter particles remains a mystery and will be part of Fermi's ongoing studies. NASA/Goddard/A. Melinger, CMU, T. Linden, Univ. of Chicago

IC 443, the Jellyfish Nebula

The shock waves of supernova remnants like the Jellyfish Nebula can accelerate protons to near the speed of light. When they slam into nearby gas clouds, gamma rays are produced. Fermi detects this emission, confirming that supernova remnants accelerate high-energy cosmic rays. NASA/DOE/Fermi LAT Collaboration/NGAO/AURA/NSF. JPL-Caltech/UCLA

Crab Nebula

The Crab Nebula, a young supernova remnant containing a pulsar, surprised Fermi astronomers with gamma-ray flares driven by the most energetic particles ever traced to an astronomical object. To account for the flares, electrons near the pulsar must be accelerated to a quadrillion (10¹⁵) times greater than visible light. 10/11 Heiter et al.

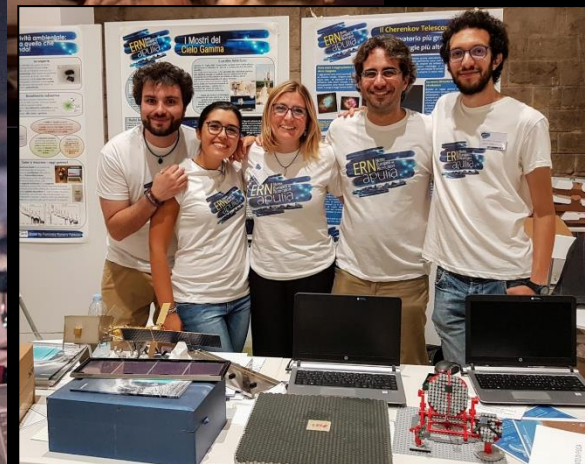
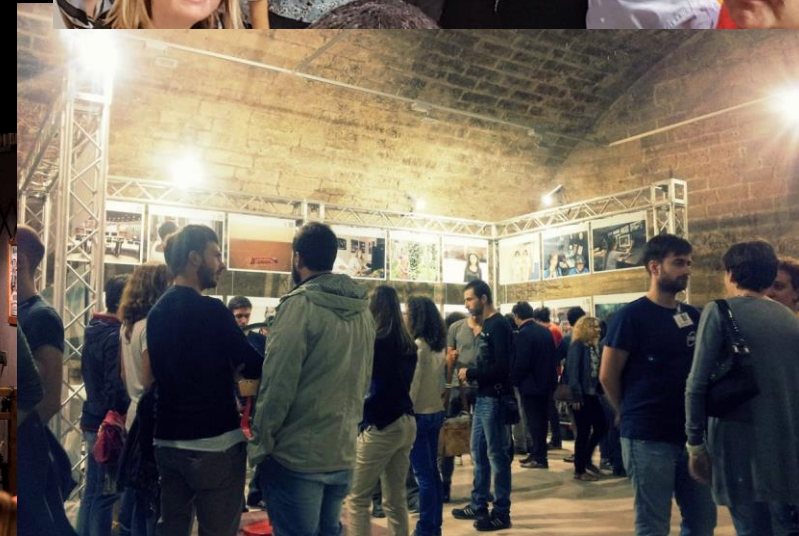


DIPARTIMENTO INTERATENEO DI FISICA "M. Merlin"

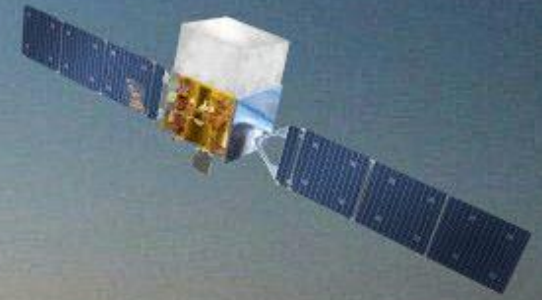


Attività Locale di Divulgazione

- SCUOLE SUPERIORI: Giornate di Ricerca, Masterclass, «Physicist On-Call»
- NOTTE EUROPEA DEI RICERCATORI: Stand espositivi + Seminari
- ALTRE ATTIVITA': Seminari su invito (STEM@Socrate, Log@Ritmi)



Grazie per l'attenzione



Elisabetta Bissaldi

elisabetta.bissaldi@ba.infn.it

