



La Radiazione cosmica

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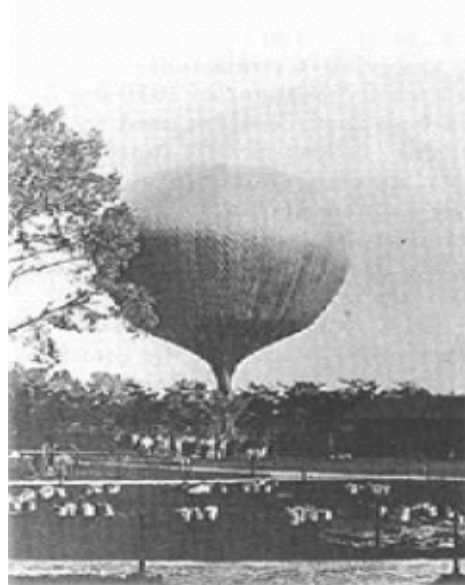
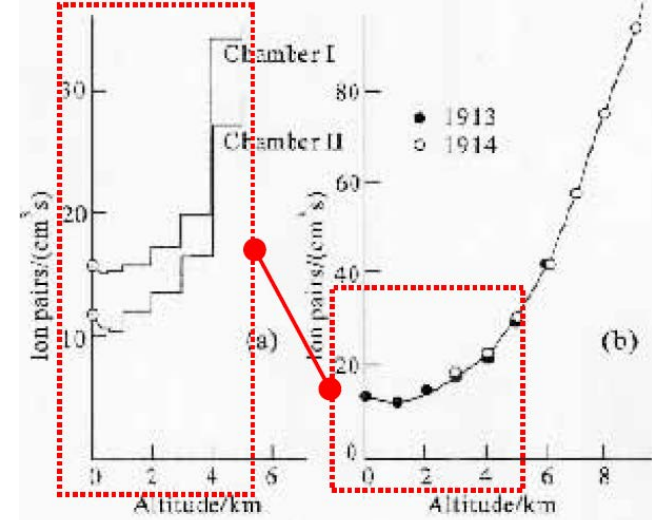


La scoperta e le prime misure



1887

1889



EXPLORER II – 11 Nov 1935 – 22000 m

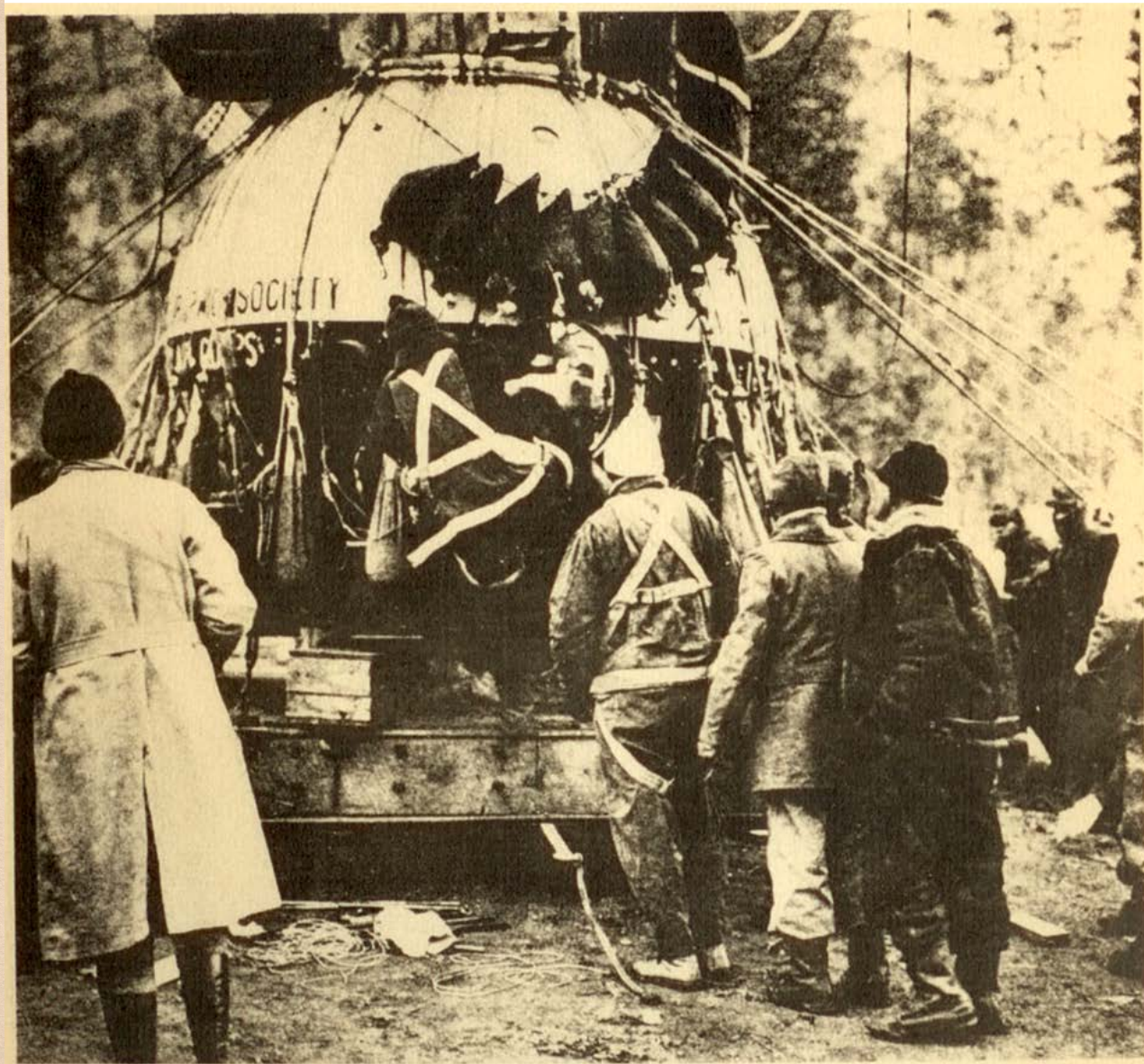
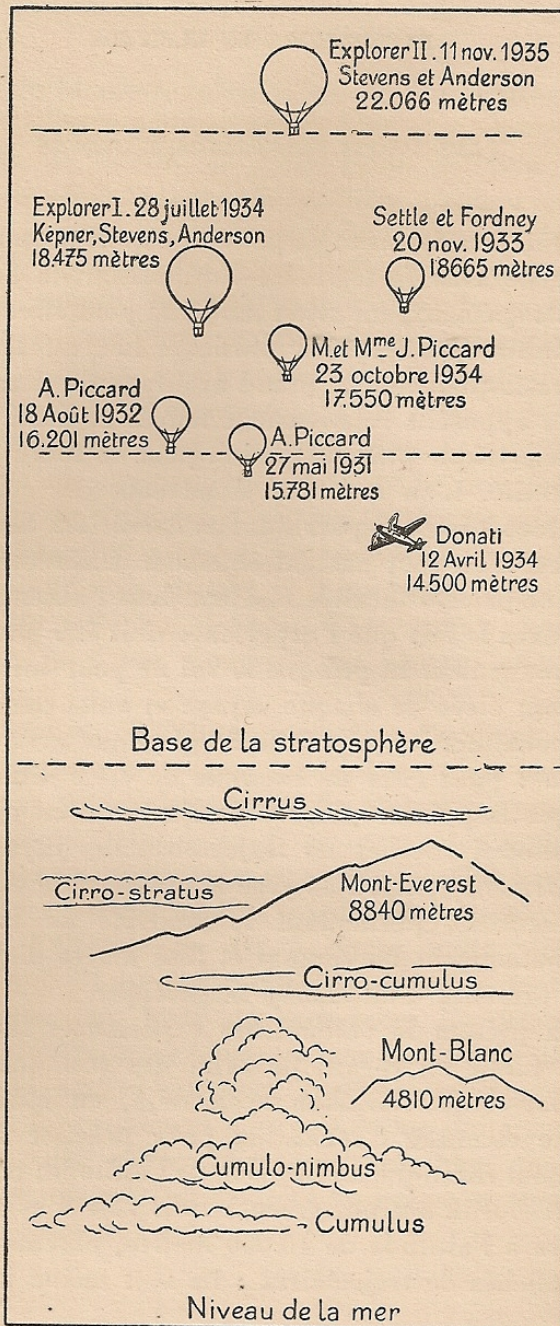


Fig. 39. — Les principaux vols stratosphériques.

Fondamentali i contributi italiani :

Fermi, Rossi, Occhialini, Conversi, ...

“ parrebbe ... che di tanto in tanto giungessero sugli apparecchi degli sciame molto estesi di corpuscoli i quali determinavano coincidenze fra contatori, anche piuttosto lontani l'uno dall'altro. Mi è mancato purtroppo il tempo di studiare più da vicino questo fenomeno ...”

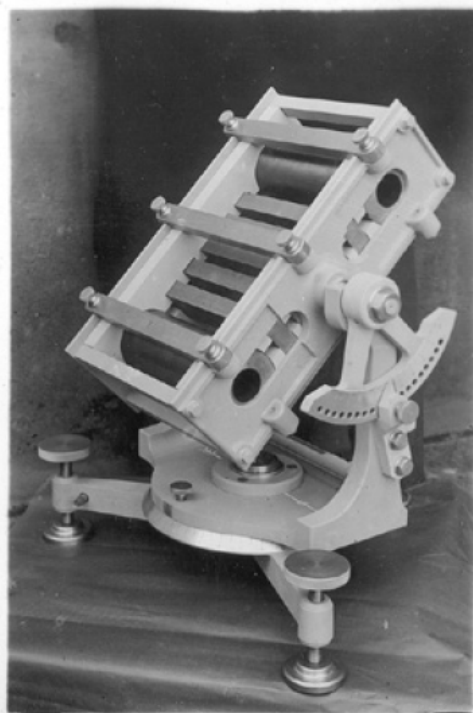
Bruno Rossi, Asmara (Eritrea) 1933

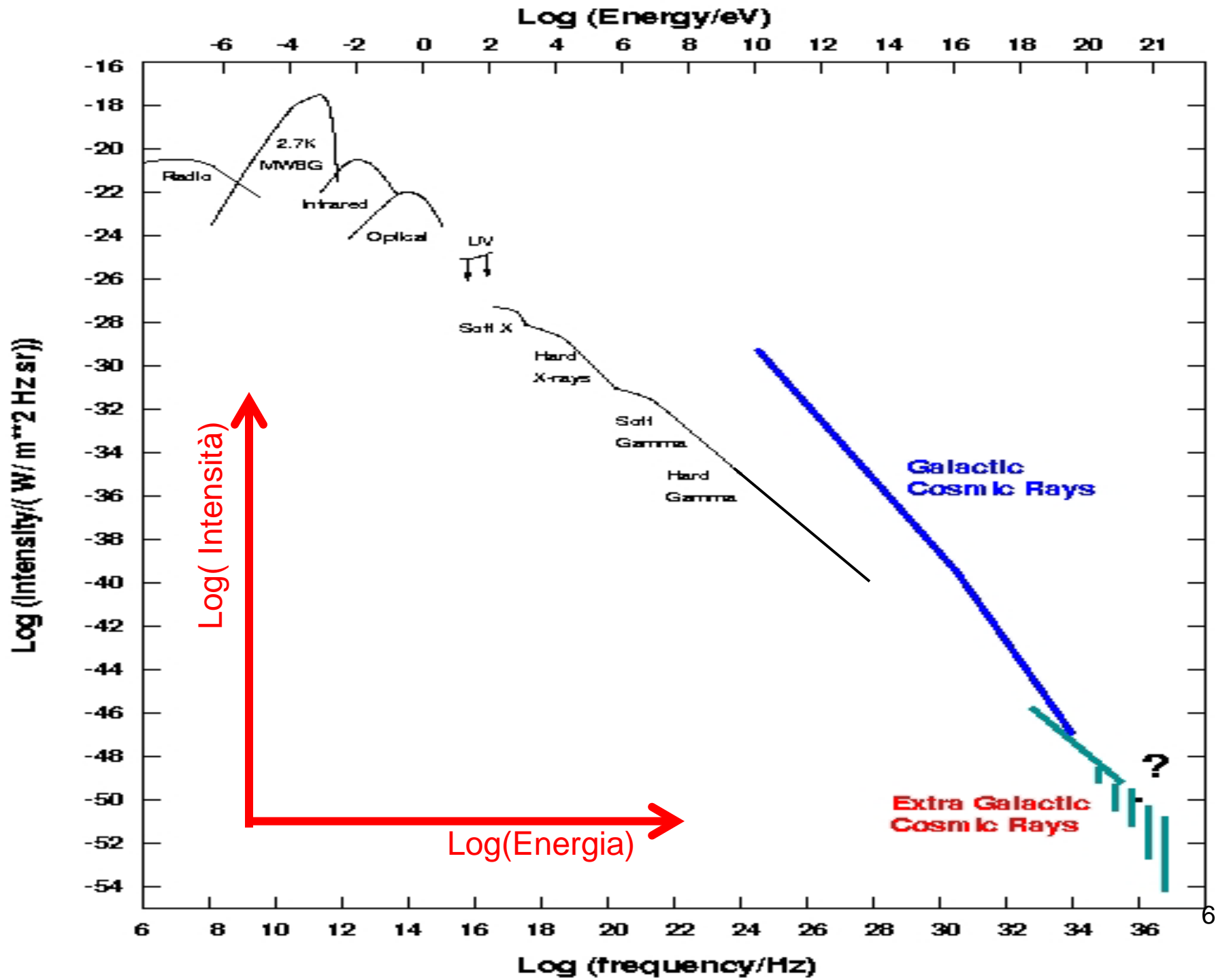
1-10-33

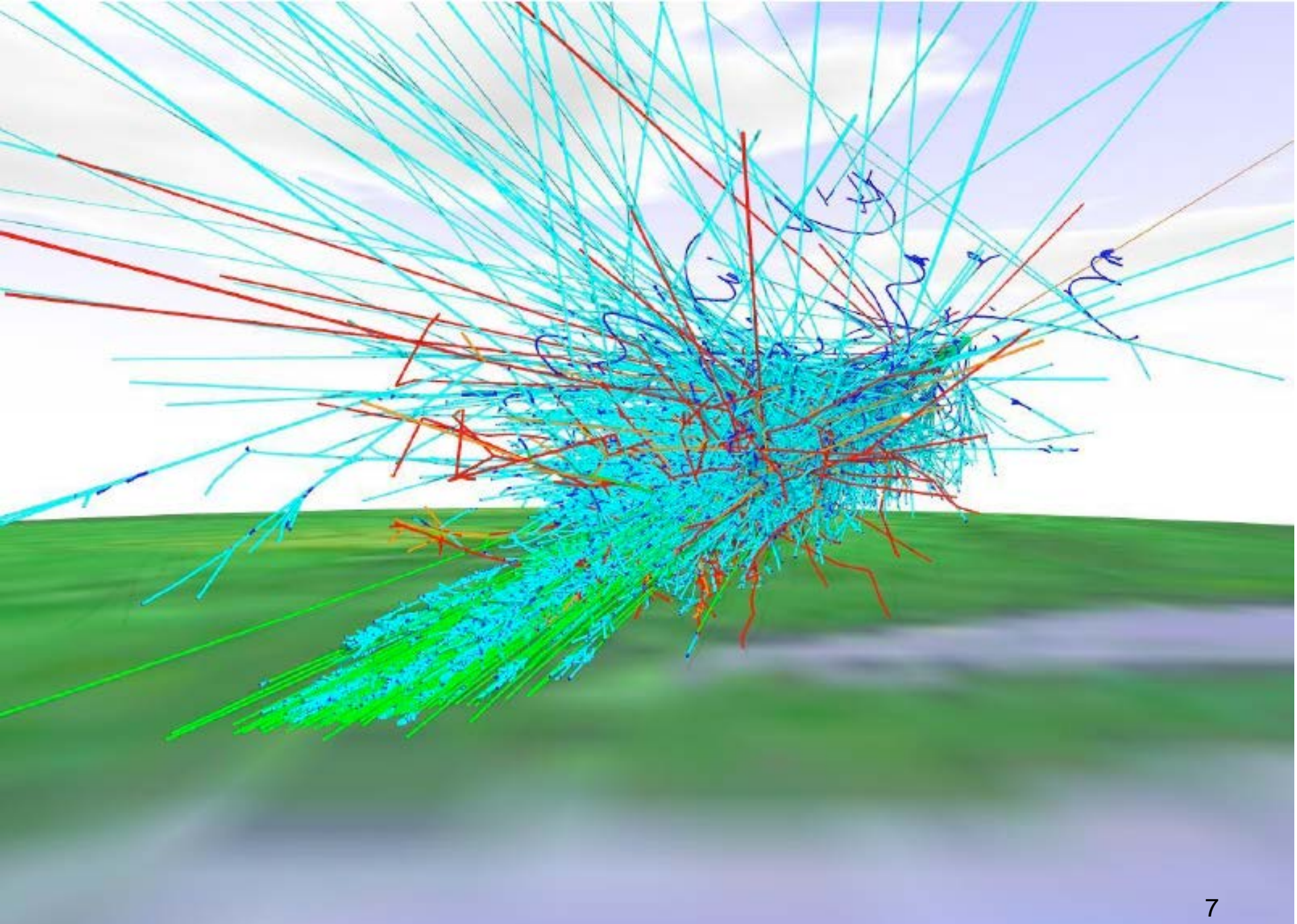
0°	15°	30°	45°	60°
21	20	20	16	20
29	22	30	25	30
30	31	30	31	30
30	31	30	21	30
20	24	20	22	20
130	128	130	115	130

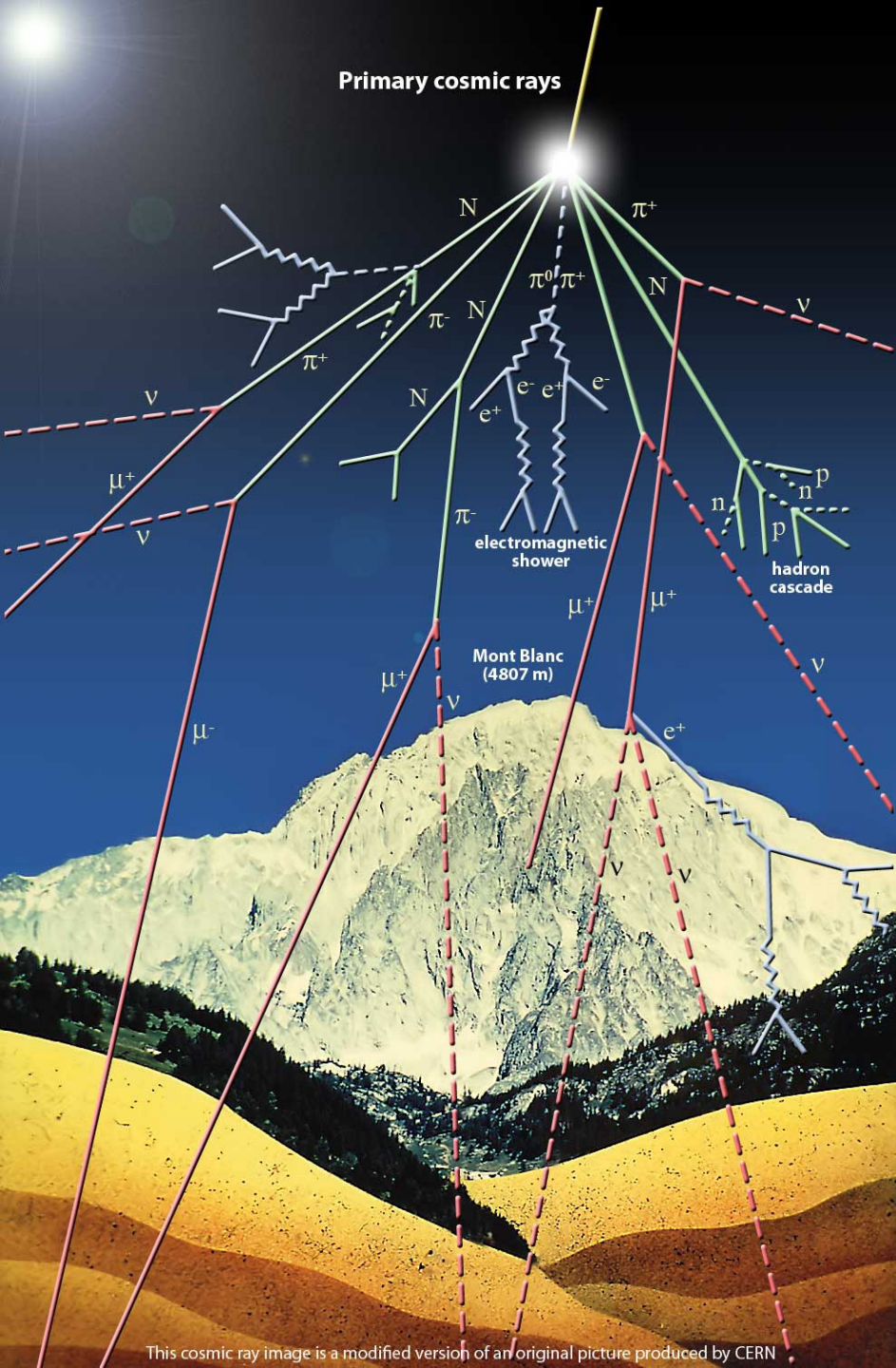
2-10-33

30	30	30	24	30	22	30	13	50	22
22	14	22	20	22	20	22	10	63	22
41	33	41	45	41	21	41	28	30	10
30	37	30	36	30	25	30	21		
123	114	123	128	123	98	123	72	143	54

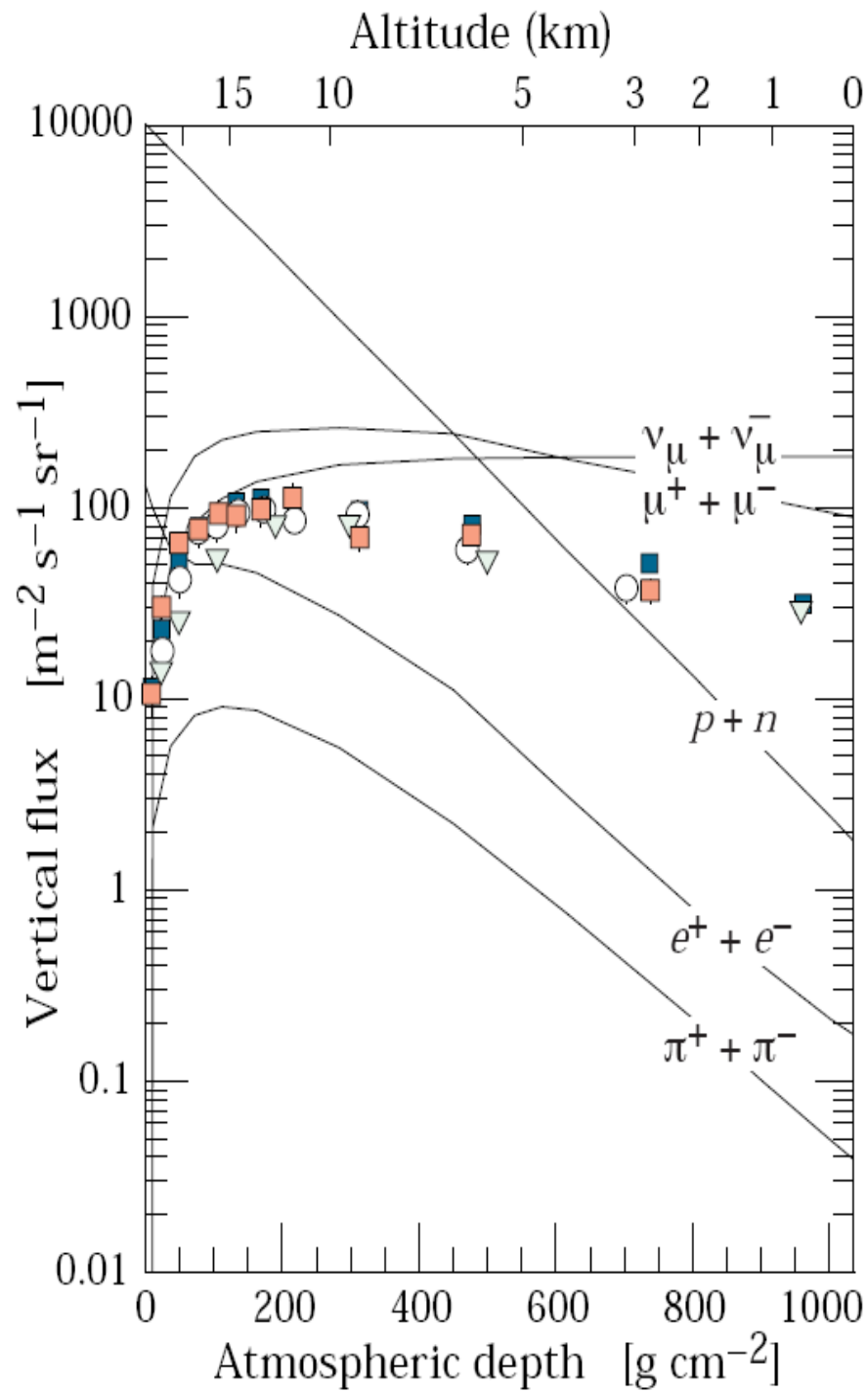


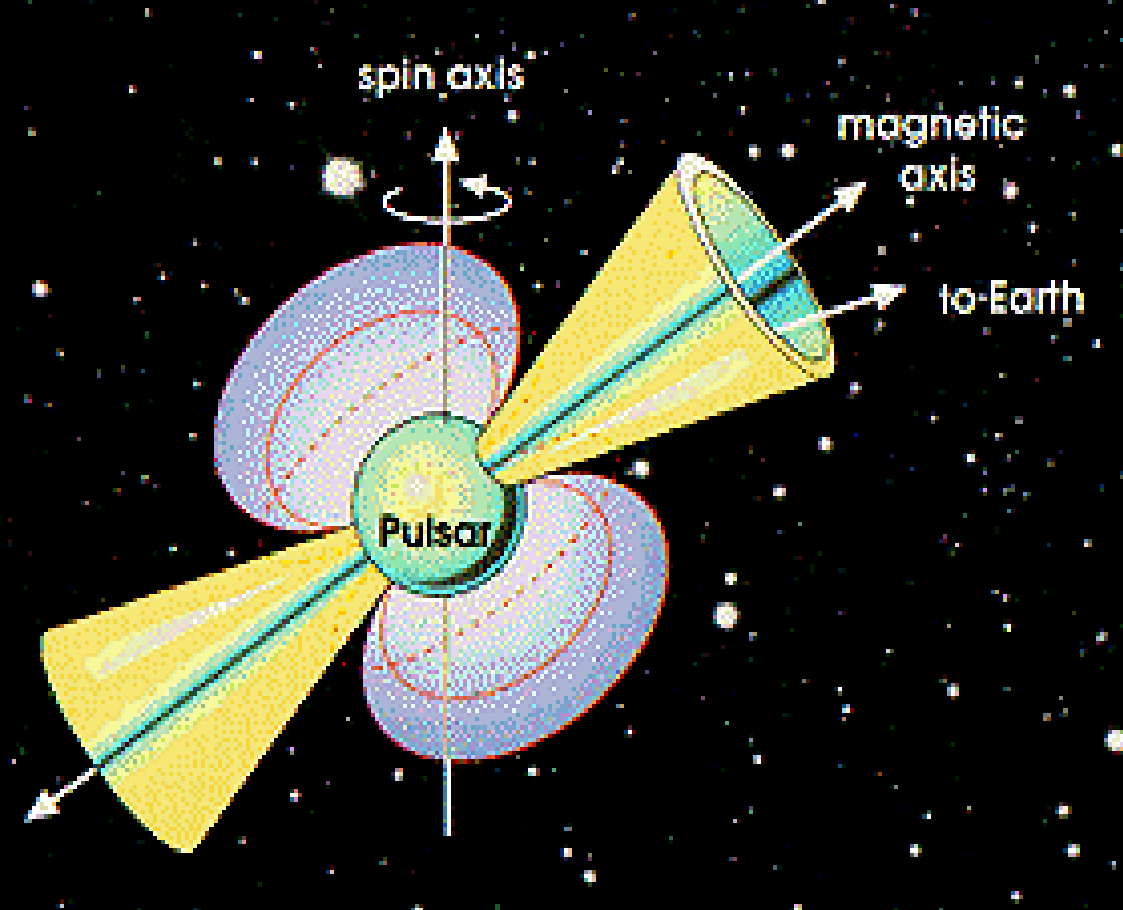






This cosmic ray image is a modified version of an original picture produced by CERN



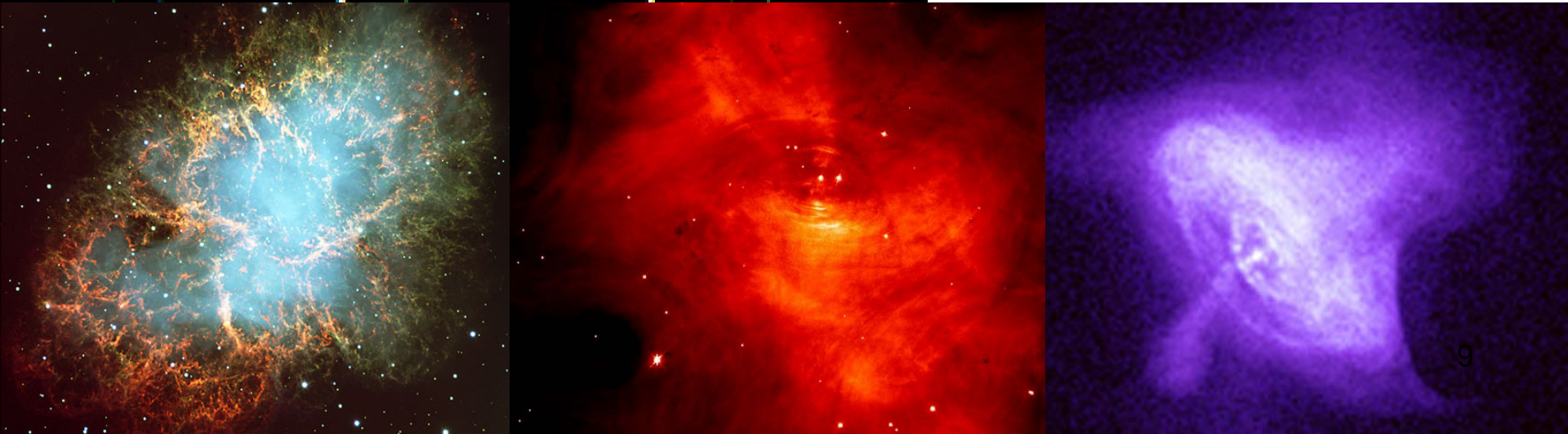


Stella di neutroni in rotazione ($T \sim 10^{-3} - 1$ s).
Campo magnetico estremamente intenso ($B \sim 10^{12}$ gauss).

Osservate nei SNR.

Emissione "pulsata" osservata sino al GeV.

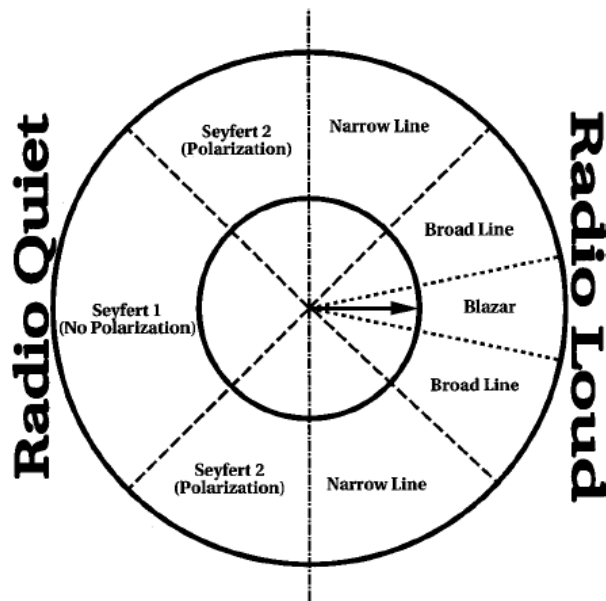
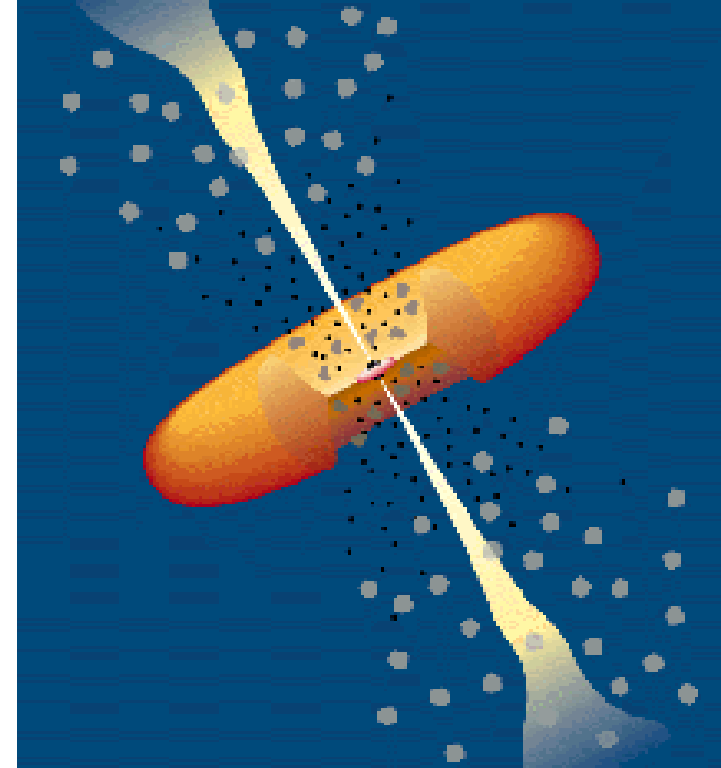
Emissione "continua" nella regione del TeV



Modello Unificato per gli AGN

Buco nero super-pesante
circondato da un disco di
accrescimento

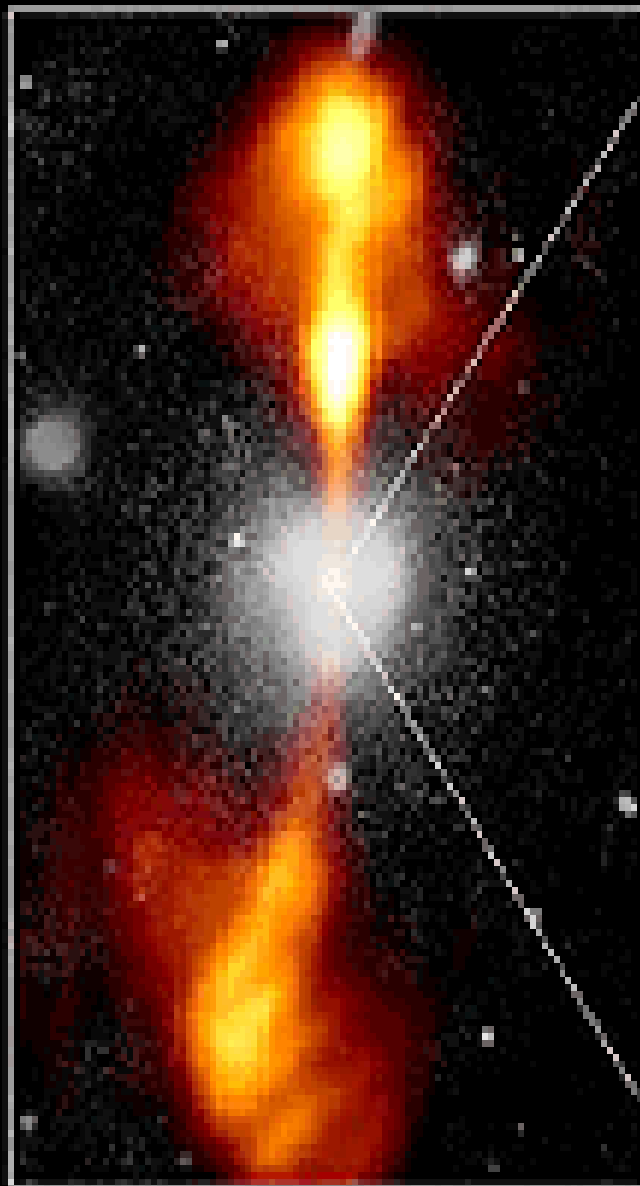
Accelerazione di particelle e
produzione di fotoni (e neutrini) di
alta energia all'interno dei jets



...ferma la proliferazione delle
definizioni di oggetti con diverse
caratteristiche

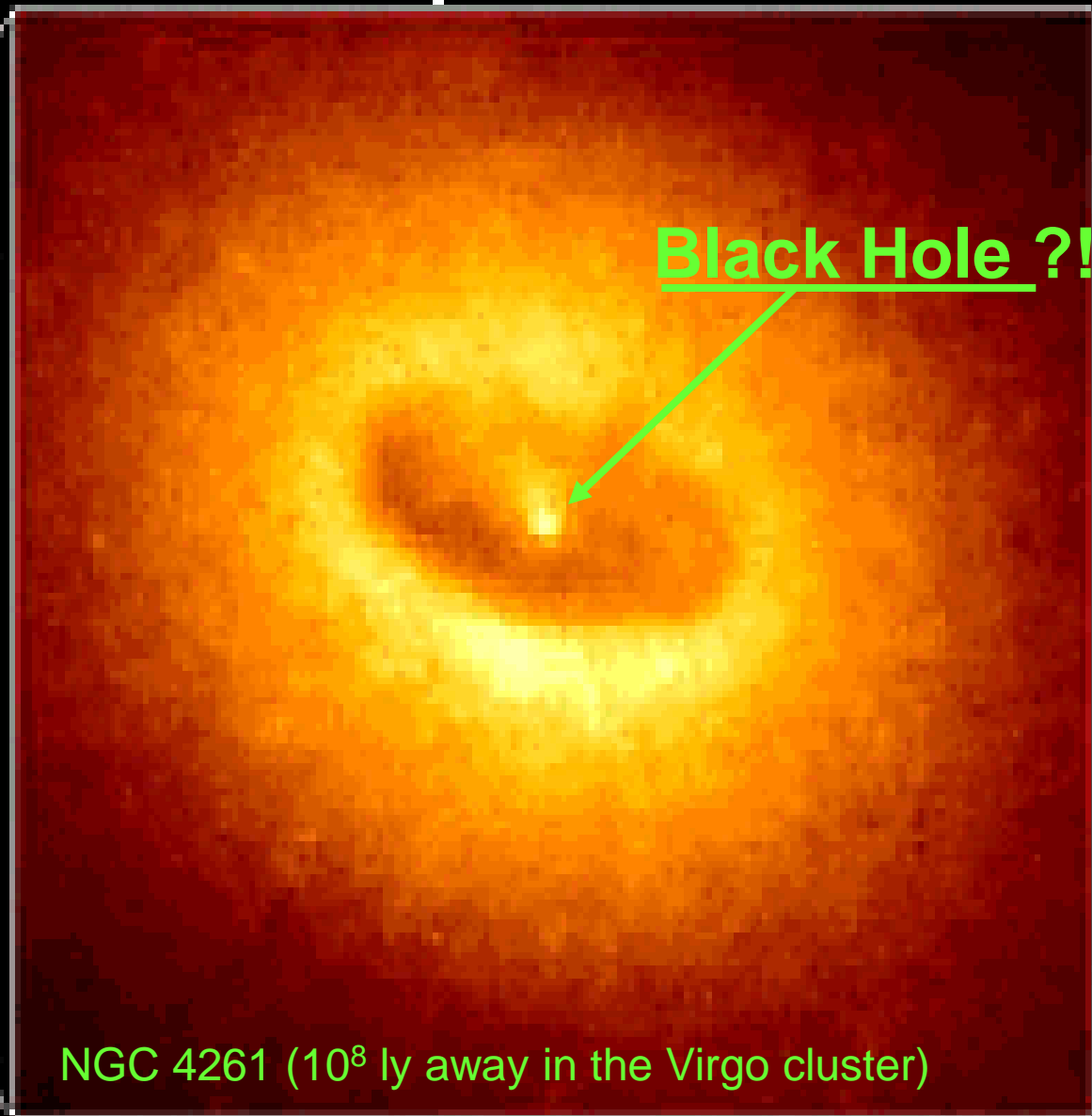
quasars, Seyfert galaxies (types I and II),
radio-quiet or radio-loud galaxies, Faranoff-
Riley galaxies (types I and II), narrow line,
broad line, no lines, highly polarized lines,
flat spectrum, steep spectrum, optically
violent variables, BL-Lac's,

Ground-based Optical/Radio Image



380 Arcseconds
88,000 Lightyears

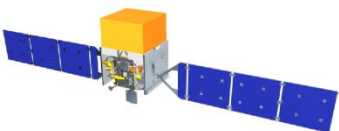
HST Image of a Gas and Dust Disk



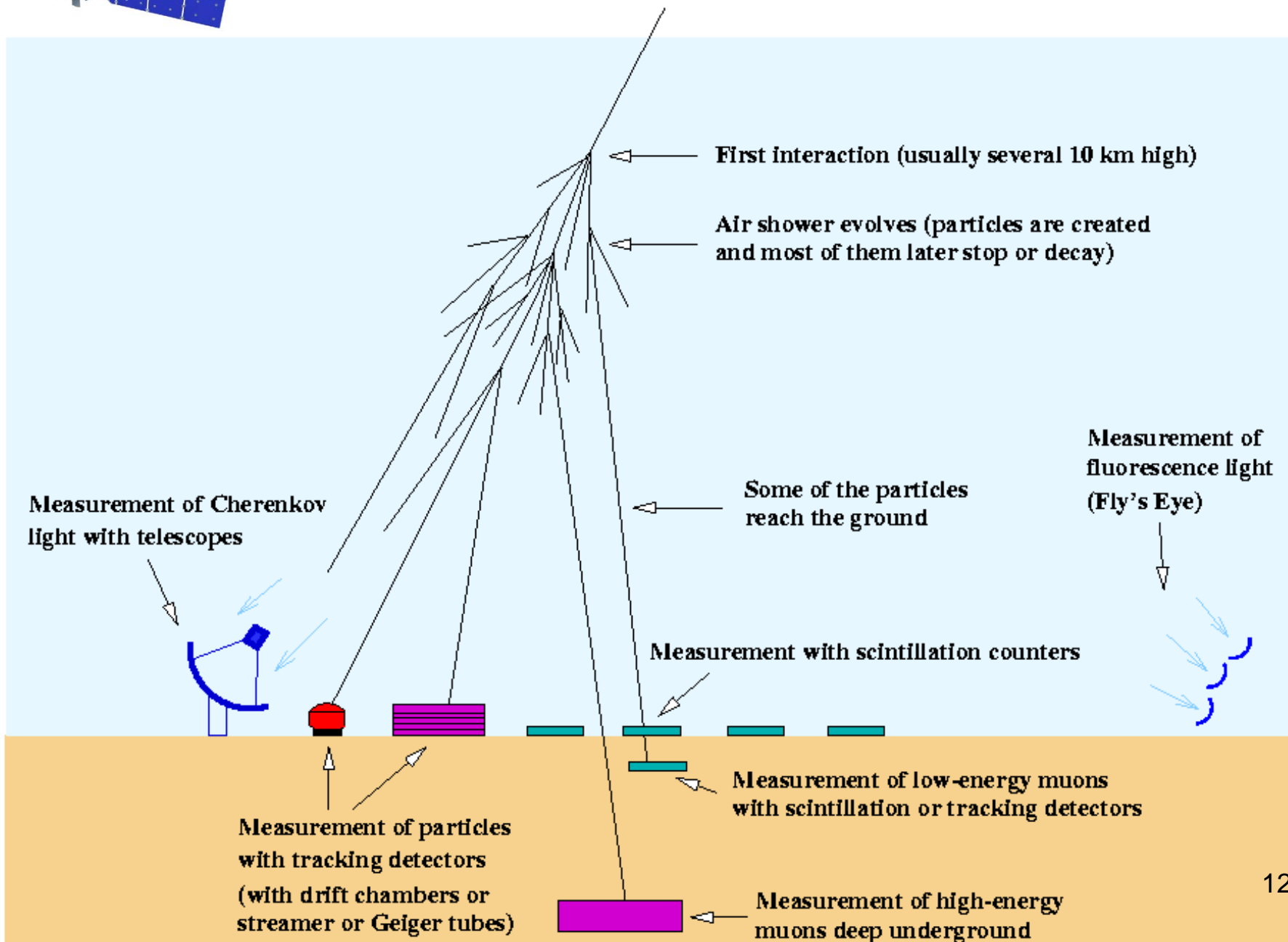
Black Hole ?!

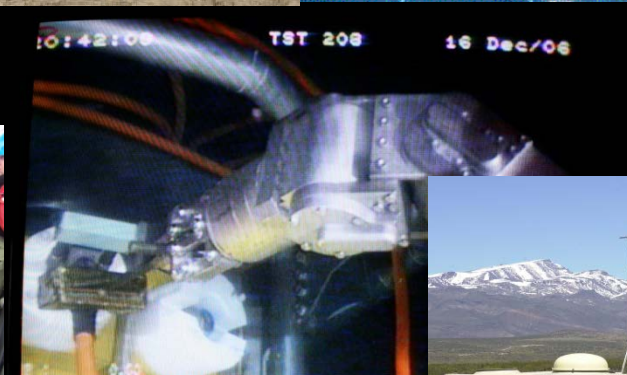
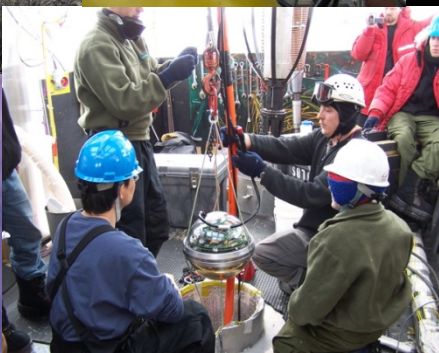
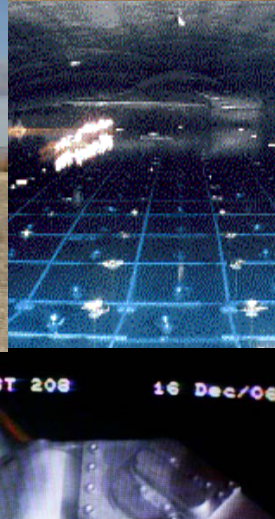
NGC 4261 (10^8 ly away in the Virgo cluster)

1.7 Arcseconds
400 Lightyears

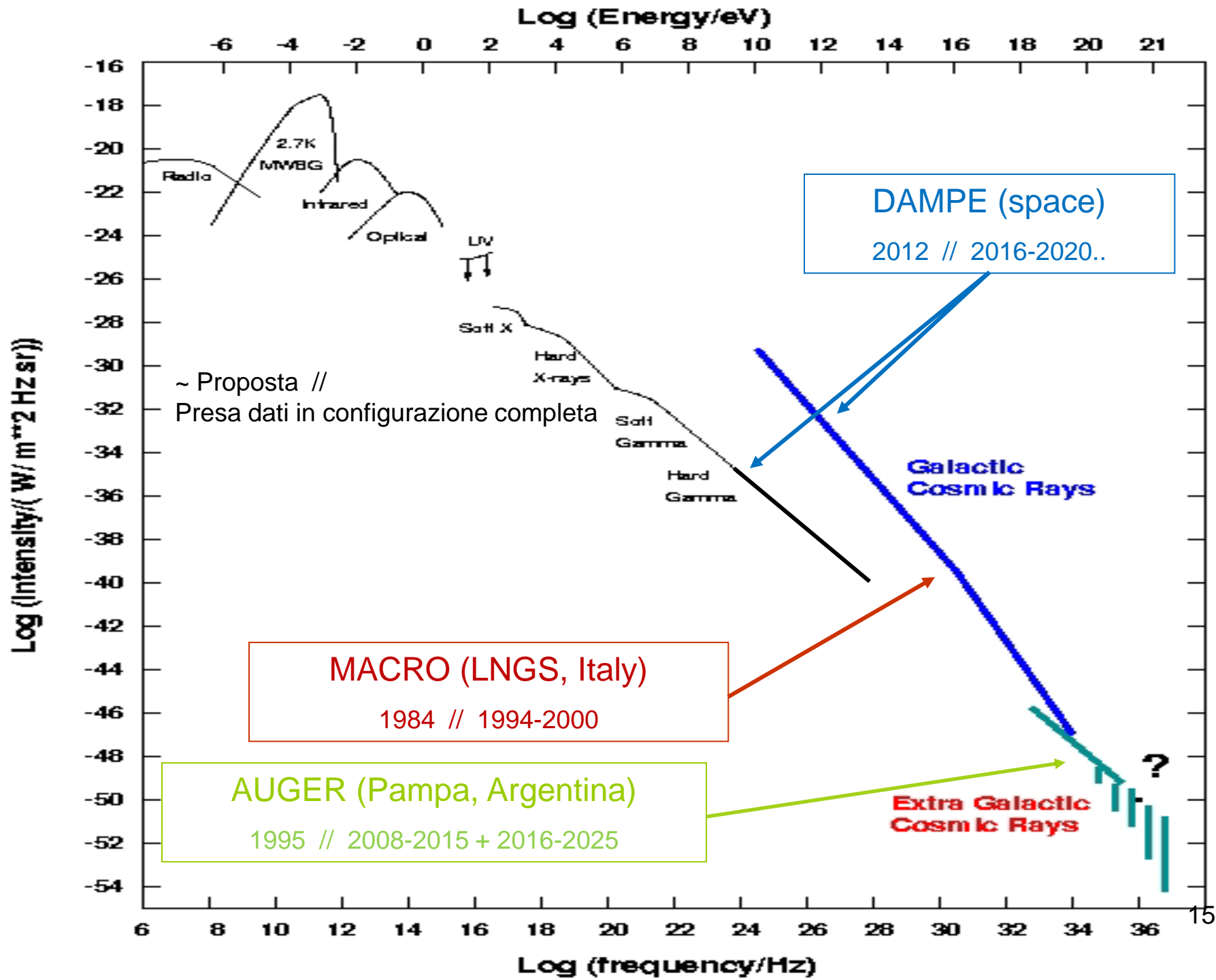


Measuring cosmic-ray and gamma-ray air showers





Alcuni esempi...



MACRO

Laboratori Nazionali del Gran Sasso

Collaboration: **Italy-USA**

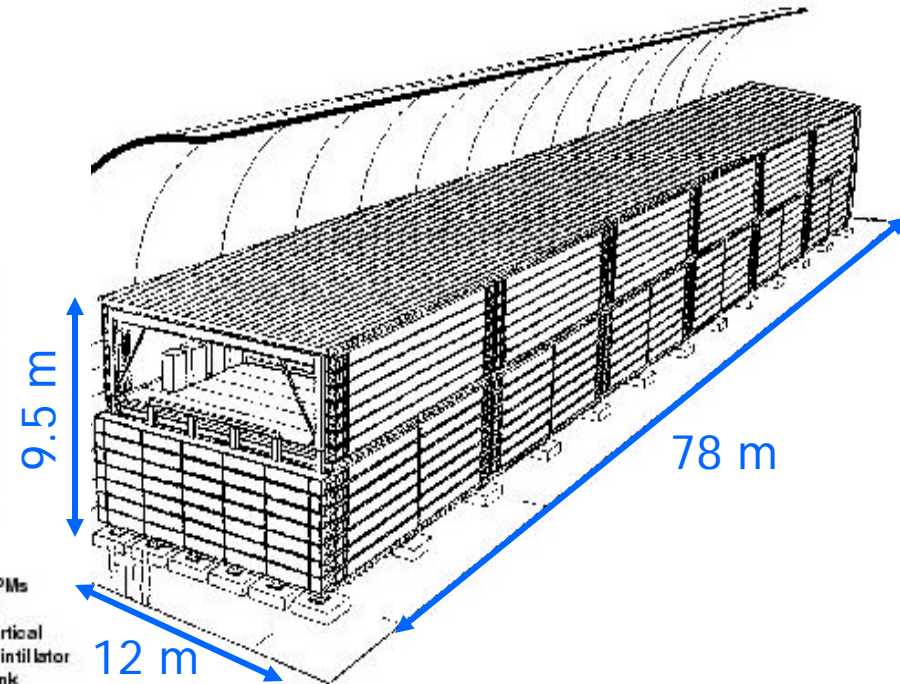
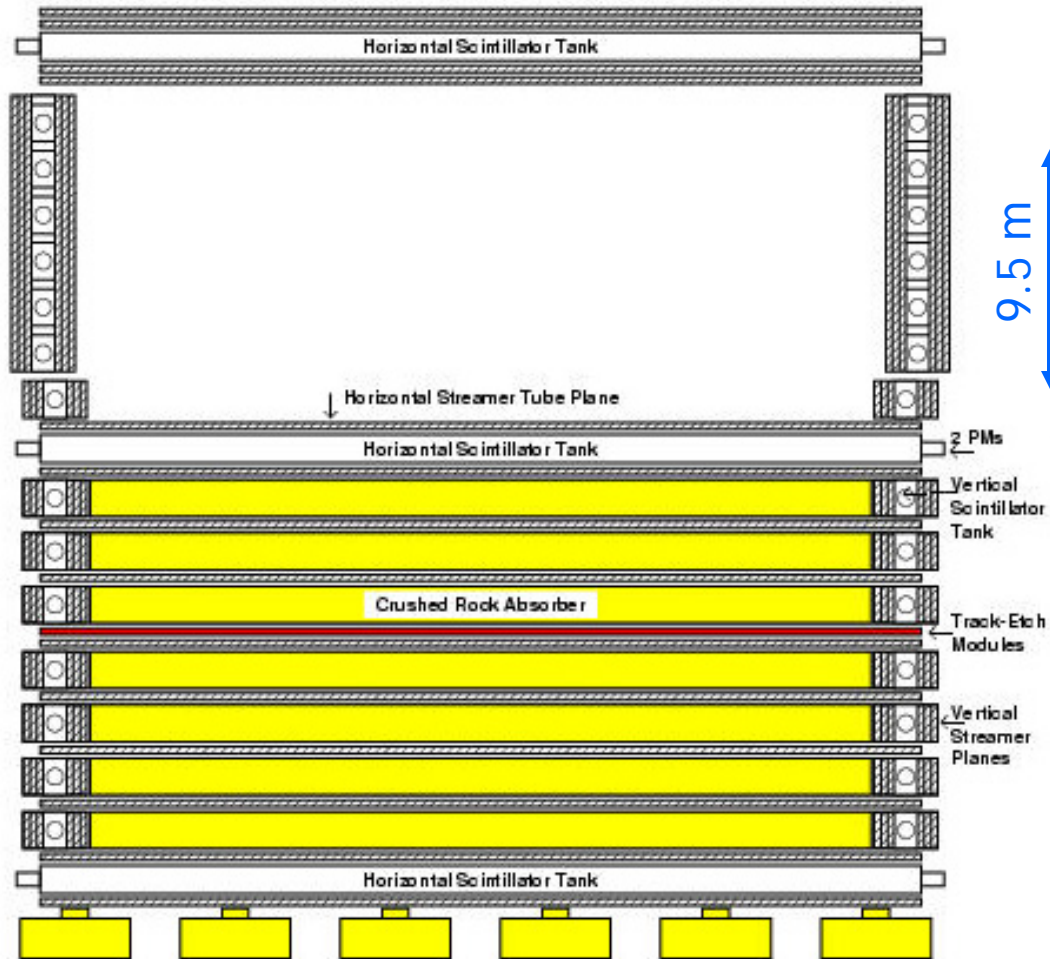
Location: **Hall B @ LNGS**



Physics goals

- ✓ GUT monopole search
- ✓ Atmospheric ν oscillations
- ✓ High Energy Cosmic Rays
- ✓ Indirect WIMP search
- ✓ ν burst from SN explosion
- ✓ ν astronomy
- ✓ LIP search
- ✓ Nuclearites, exotica

The MACRO detector



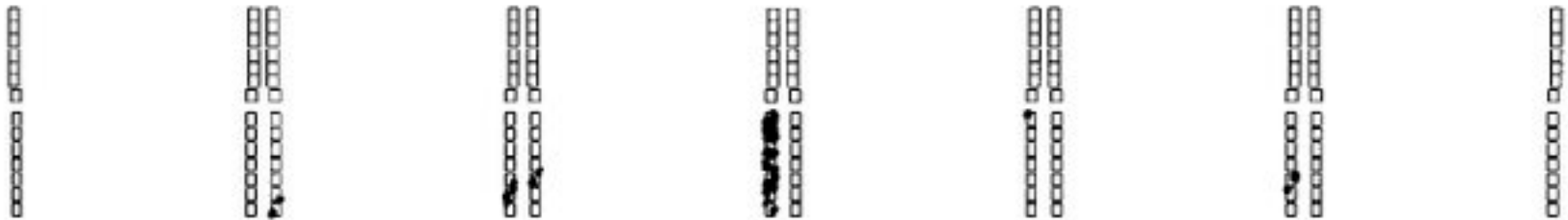
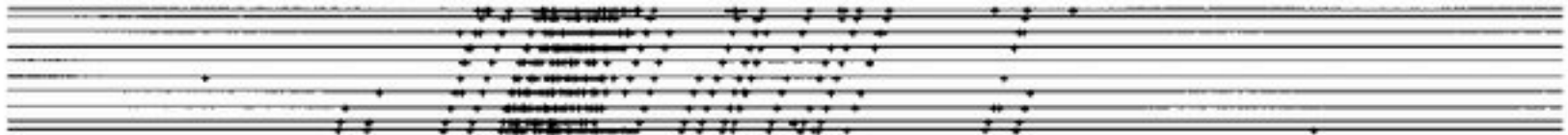
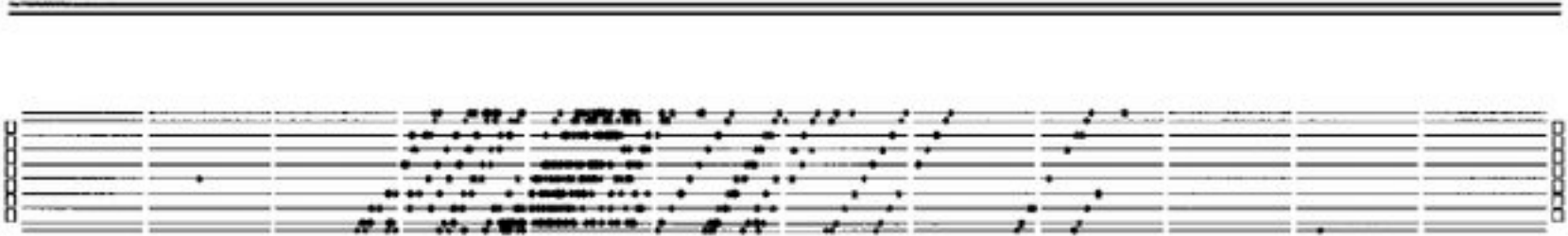
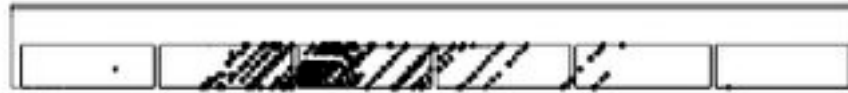
$A \sim 10000 \text{ m}^2\text{sr}$ $\langle h \rangle \sim 3800 \text{ mwe}$

⇒ Liquid scintillators

⇒ Streamer tubes

⇒ Nuclear track-etch

MACRO: event display



R= 6665 E= 9258 14-OCT-93 00:50:33 HT= FFFF-C209-FFFF-C208 ST= 0 M= 0

Studio della radiazione cosmica di altissima energia

$(10^{17}-10^{21})$ eV

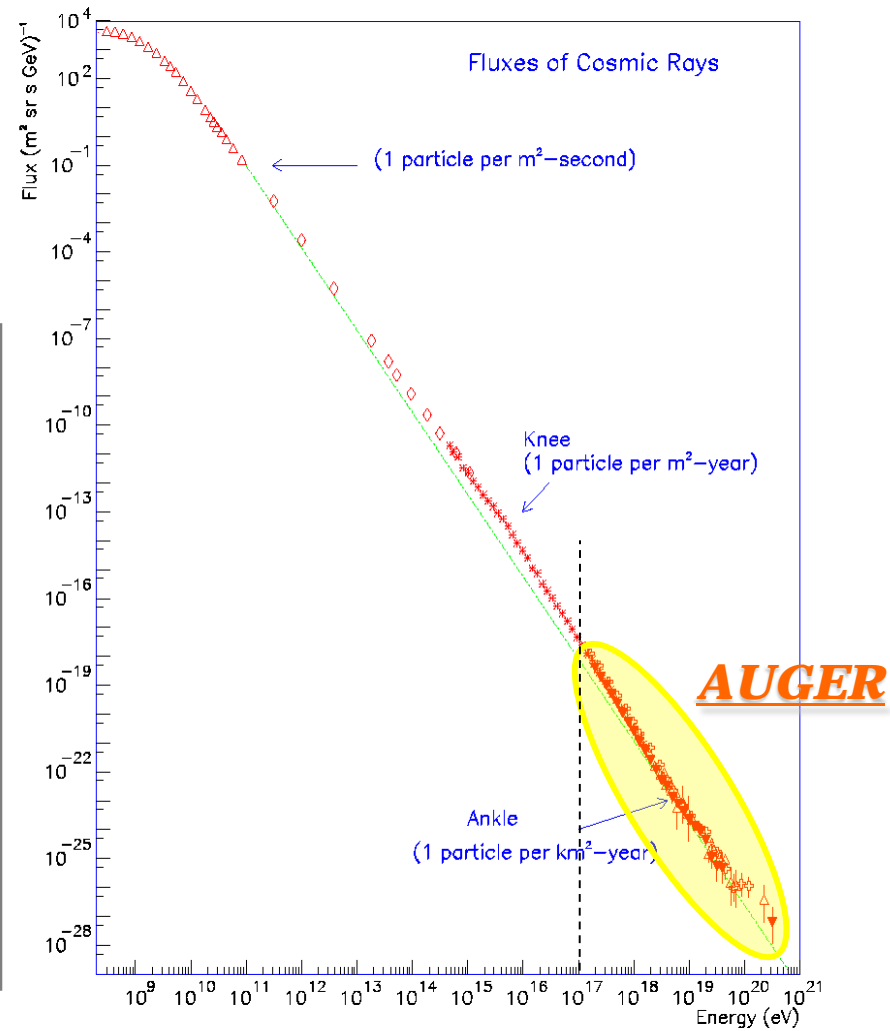
Flusso ad $E > 10^{19.5}$ eV molto basso

1 particella/(km² sr secolo)



Apparato di grandi dimensioni:
3000 km² (Auger)

30 eventi/anno



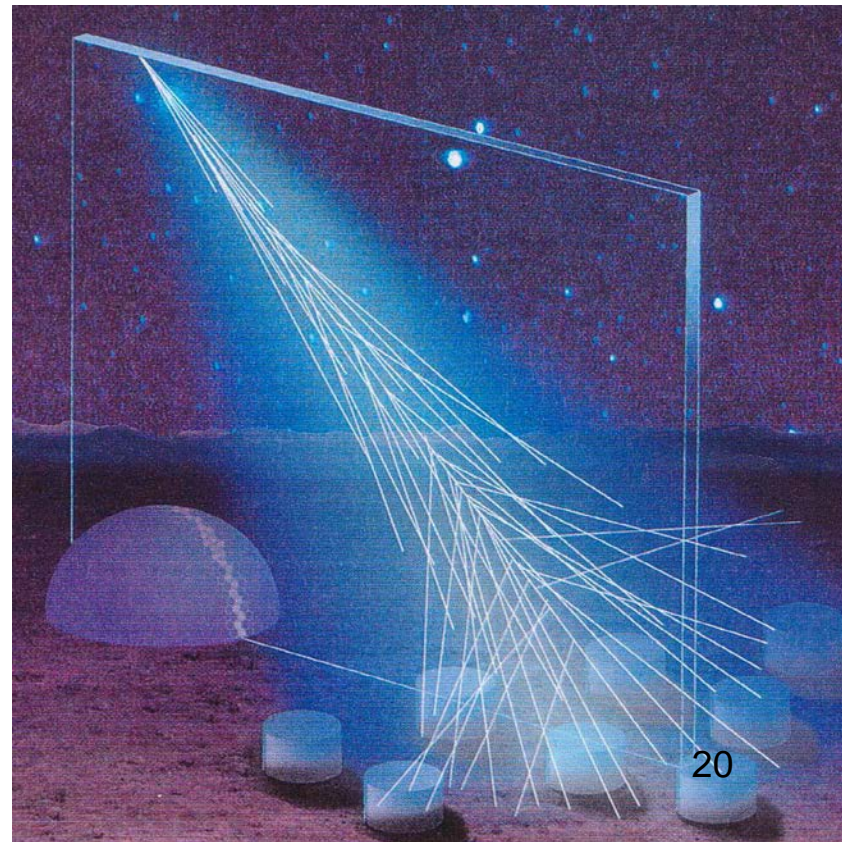
AUGER

Rivelatore di Fluorescenza (FD)

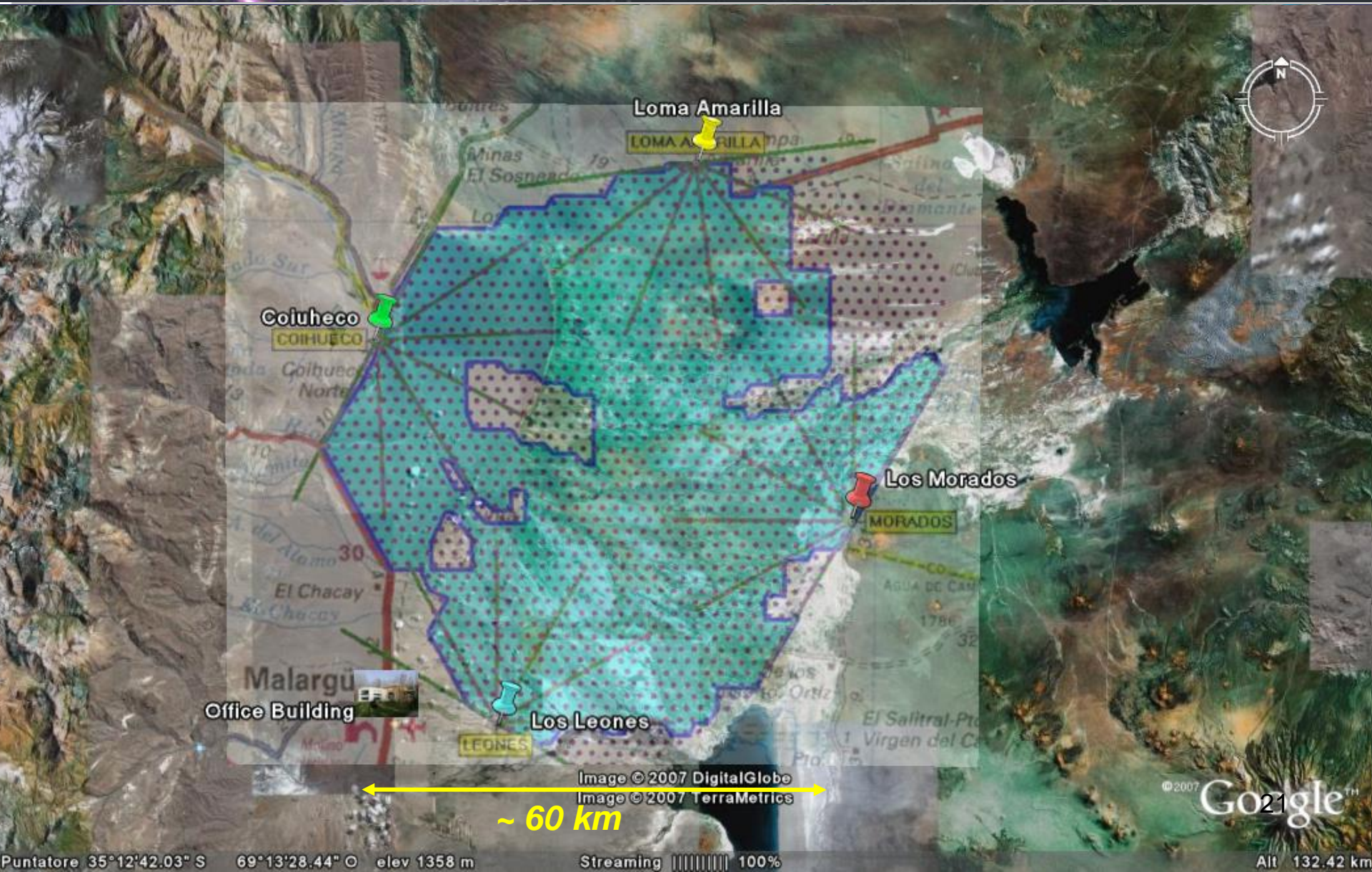
- Sviluppo della cascata di particelle in atmosfera
- Misura dell'energia e della direzione
- Funziona solo di notte, senza nubi e Luna (circa 12% del tempo)

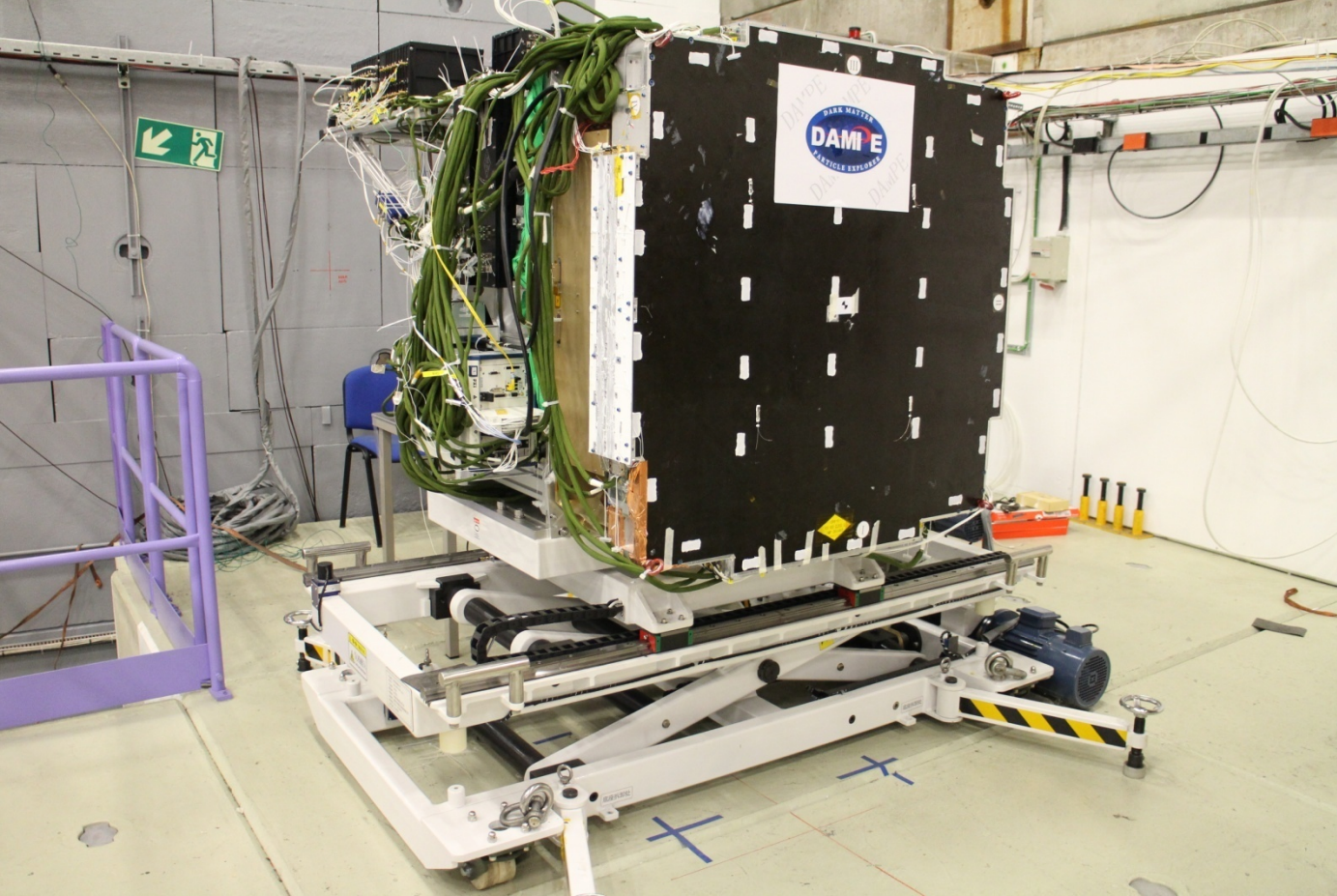
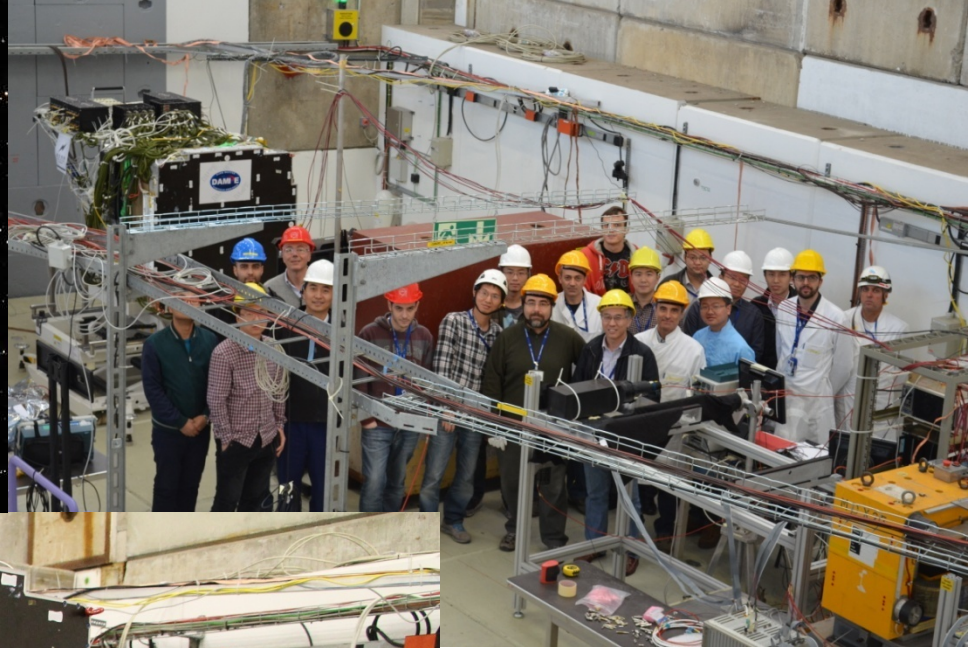
Rivelatore di Superficie (SD)

- Particelle cariche che arrivano a terra
- Misura direzione ed energia
- Sempre in funzione



Vista del Sito Sud da Google Earth





DAMPE Dark Matter Particle Explorer

Lancio: dic. 2015
Durata Missione: 3 yr

Collaborazione:
Cina
Italia
Svizzera

The launch: Dec 17th 2015, 0:12 UTC



Jiuquan Satellite Launch Center
Gobi desert

Orbit: sun synchronous , 500km

DAMPE → WUKONG



Photons

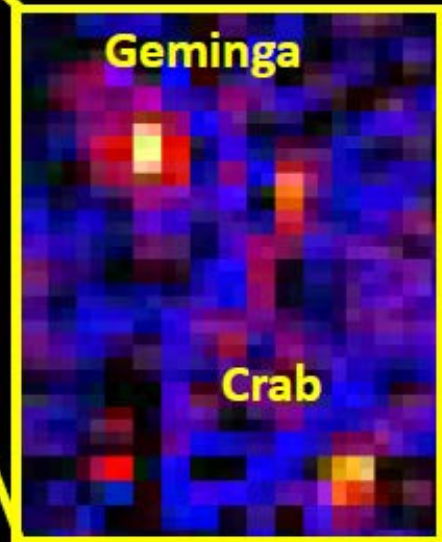
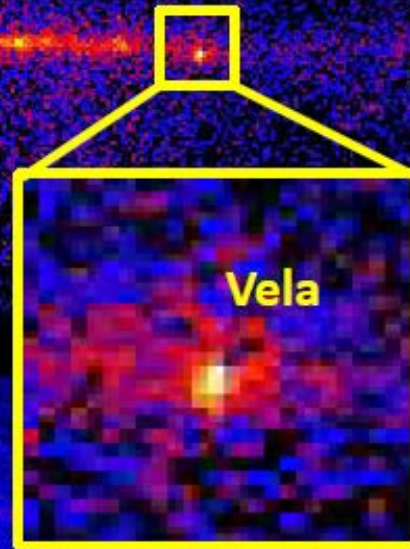
PRELIMINARY

DAMPE 165 days

$E > 1\text{GeV}$

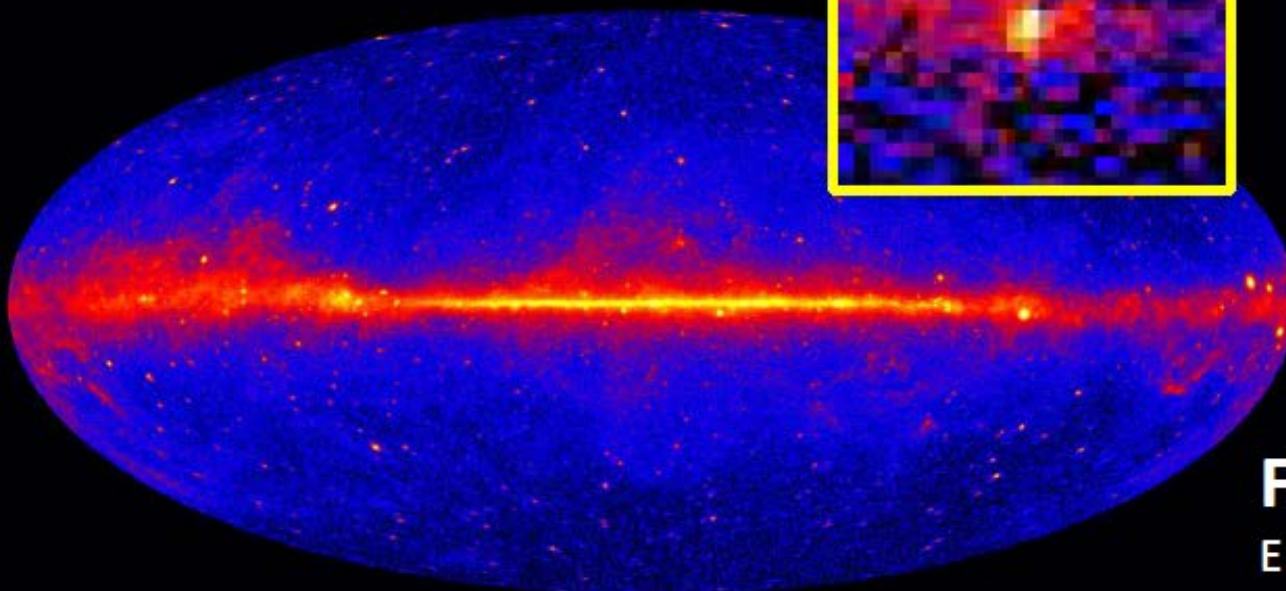
Counts / $(0.5^\circ)^2$ pixel

$\sigma_\theta \approx 0.2^\circ$ @ 3 GeV



FERMI 5 years

$E > 1\text{GeV}$

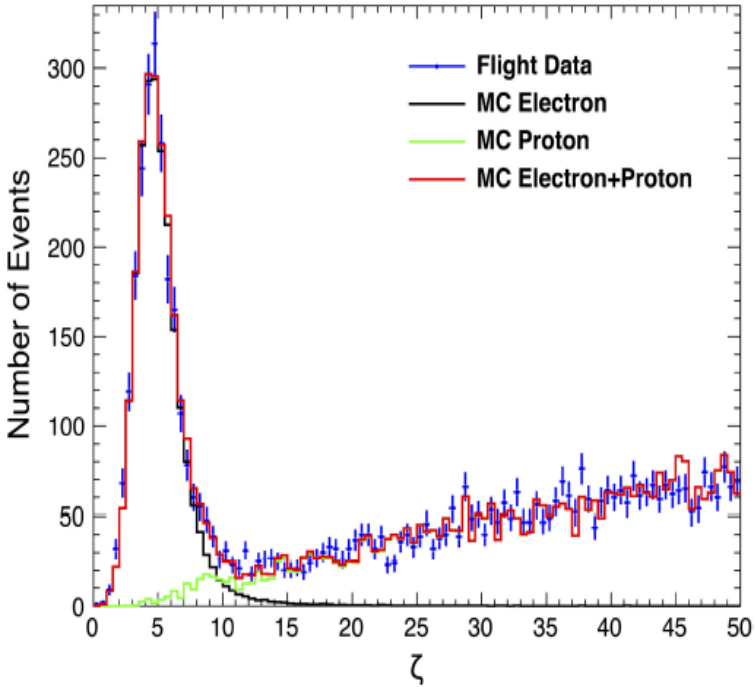


Nov 29, 2017: first DAMPE results



Direct detection of a break in the teraelectronvolt cosmic-ray spectrum of electrons and positrons

DAMPE Collaboration*



Electron / proton contributions at 0.5-1 TeV

