

Astrofisica Nucleare e Subnucleare

Introduzione

Astrofisica Nucleare e Subnucleare

(Fisica Astroparticellare/Astrofisica Particellare)

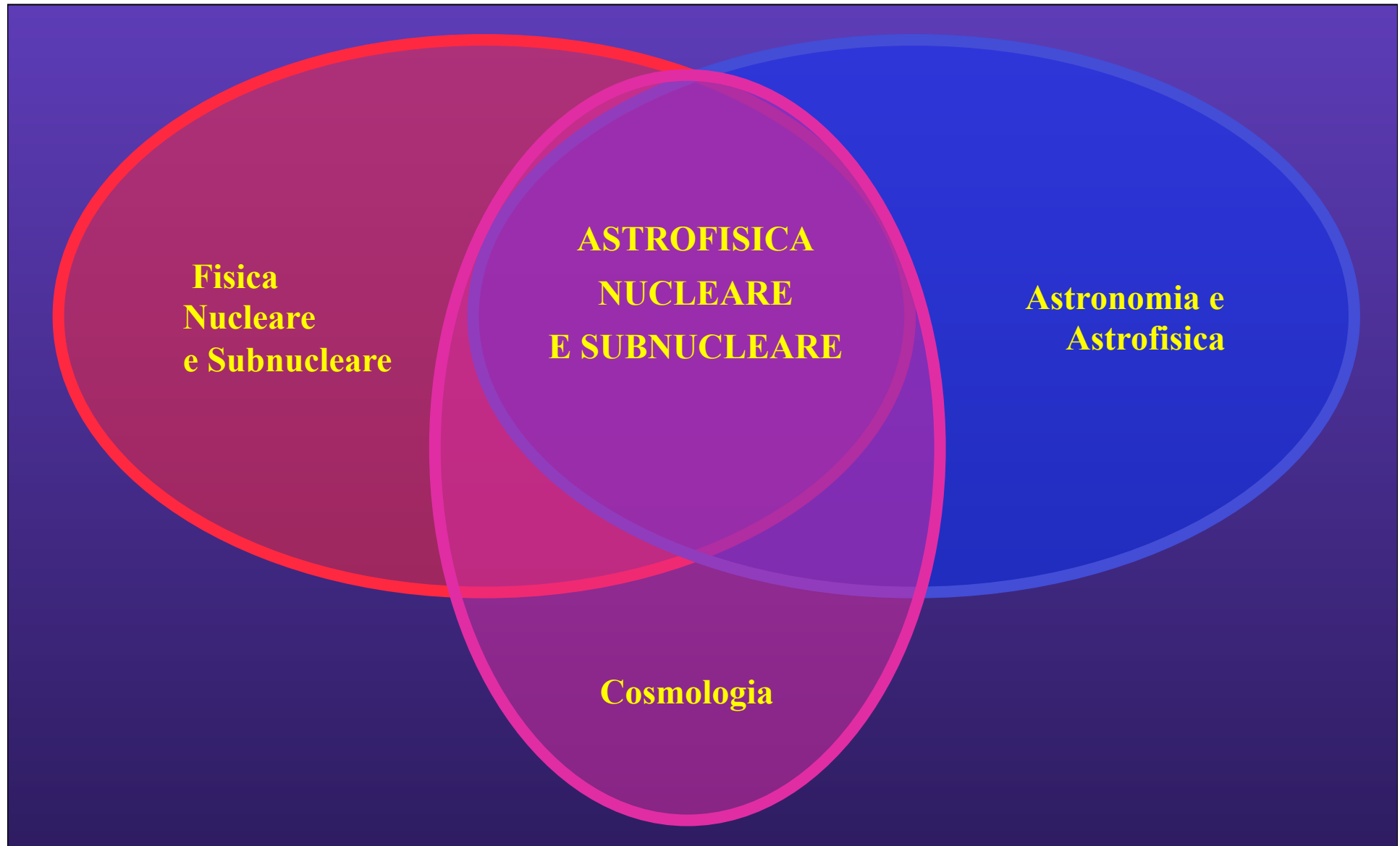
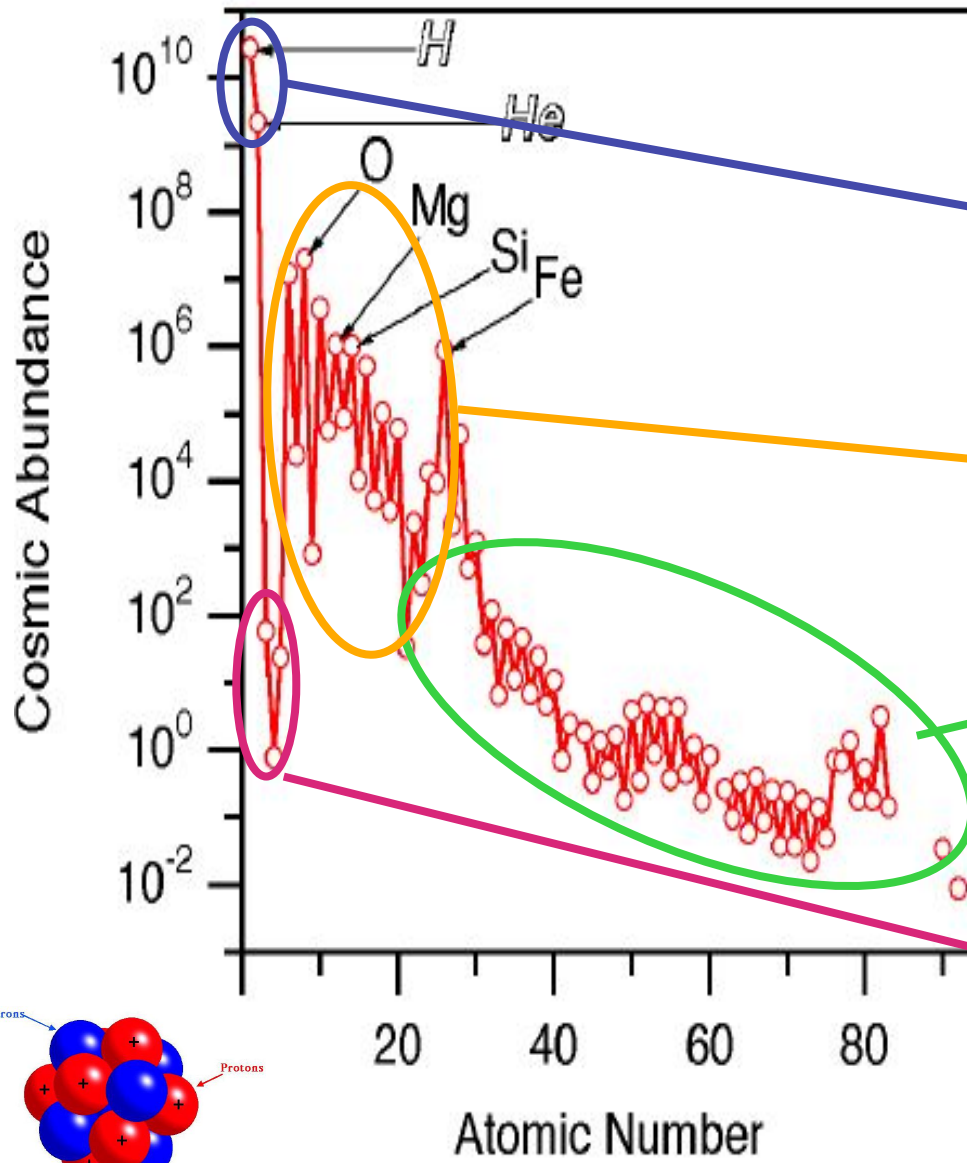


Tavola periodica degli elementi

Periodic Table of the Elements

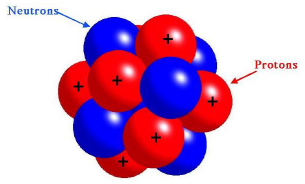
1	2											18	19	20					
3	4											13	14	15	16	17	18		
11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56
87	88	89	90	91	92	93	94	95	96	97	98	99	100	101	102	103	104	105	106
117	118	119	120	121	122	123	124	125	126	127	128	129	130	131	132	133	134	135	136



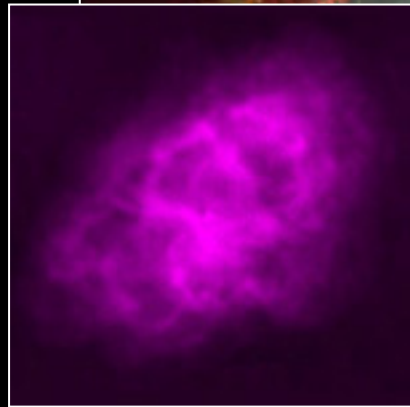
- Origine:**
- Big Bang Nucleosintesi
 - Stelle massive
 - Esplosioni di Supernova / Merging di Stelle di Neutroni
 - Interazioni con raggi cosmici

*Lanthanide Series
+ Actinide Series

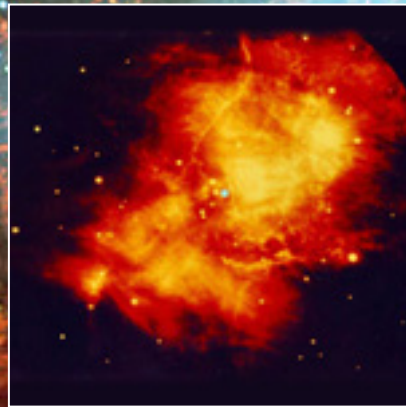
58	59	60	61	62	63	64	65	66	67	68	69	70	71
Ce	Pr	Nd	Pm	Sm	Eu	Gd	Tb	Dy	Ho	Er	Tm	Yb	Lu
90	91	92	93	94	95	96	97	98	99	100	101	102	103
Th	Pa	U	Np	Pu	Am	Cm	Bk	Cf	Es	Fm	Md	No	Lr



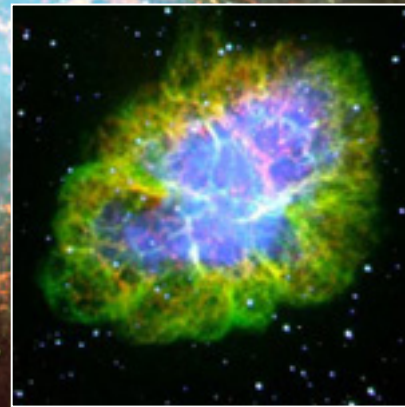
La nebulosa del Granchio (Crab Nebula) Supernova osservata dalla Cina nel 1054



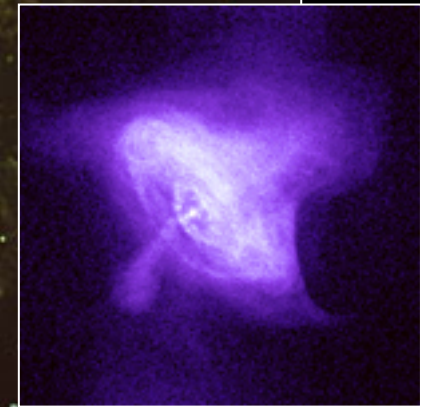
Radio



Infrarossi



Ottico



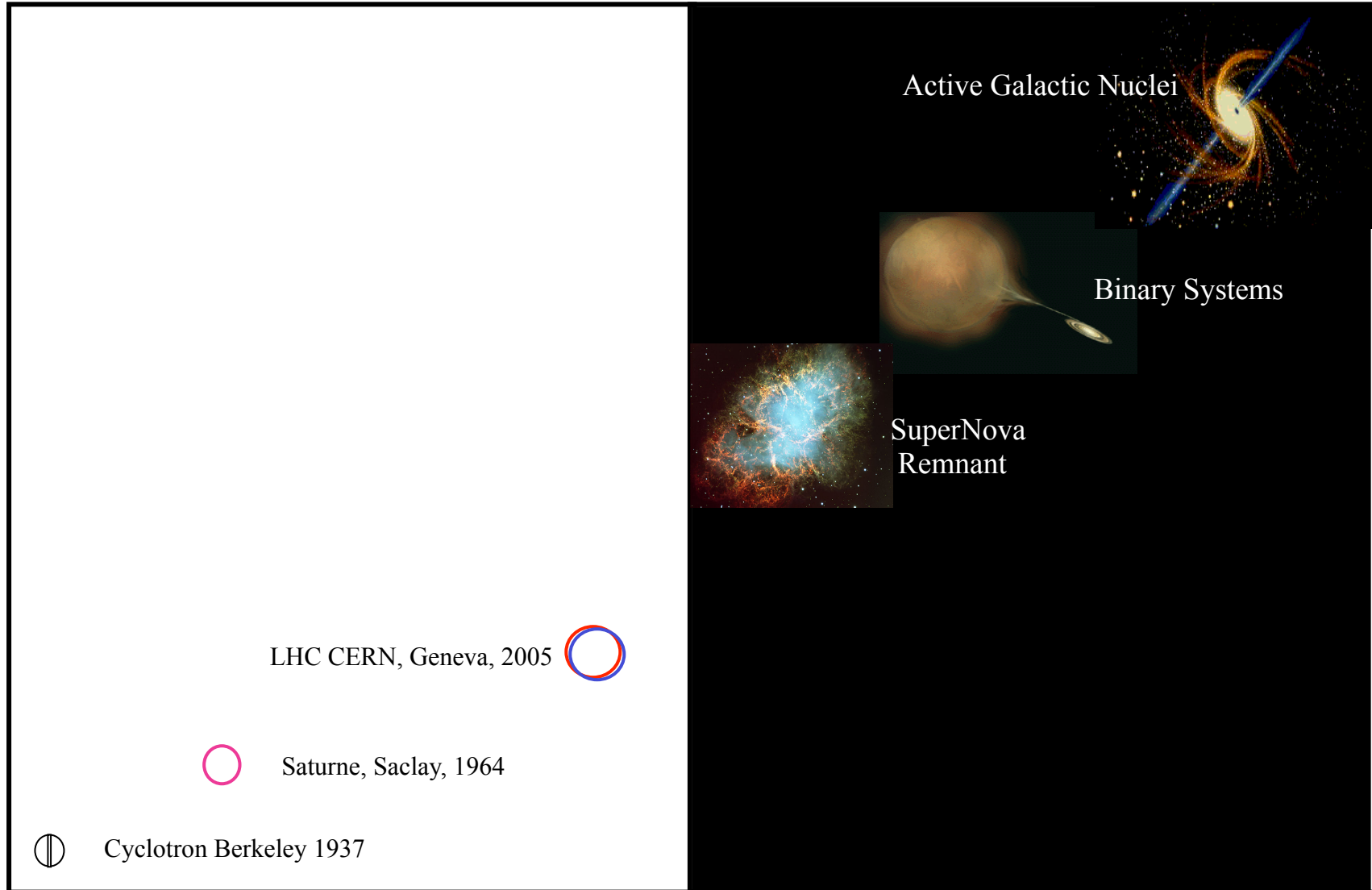
Raggi-X

Fisica Nucl. e S. \Rightarrow Astrofisica Nucl. e S.

Acceleratori Terrestri

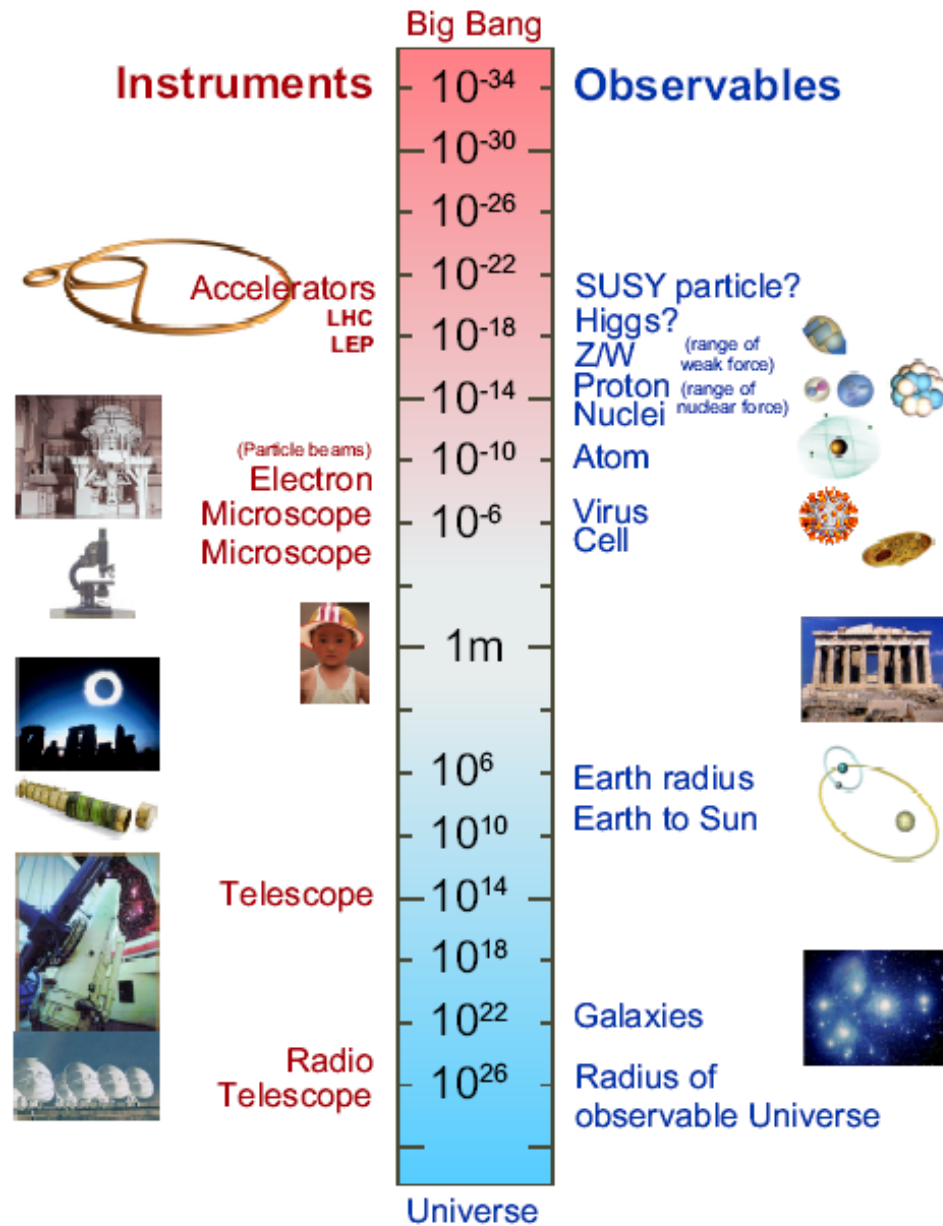
Acceleratori Cosmici

Diametro dell'acceleratore



Energia delle particelle accelerate

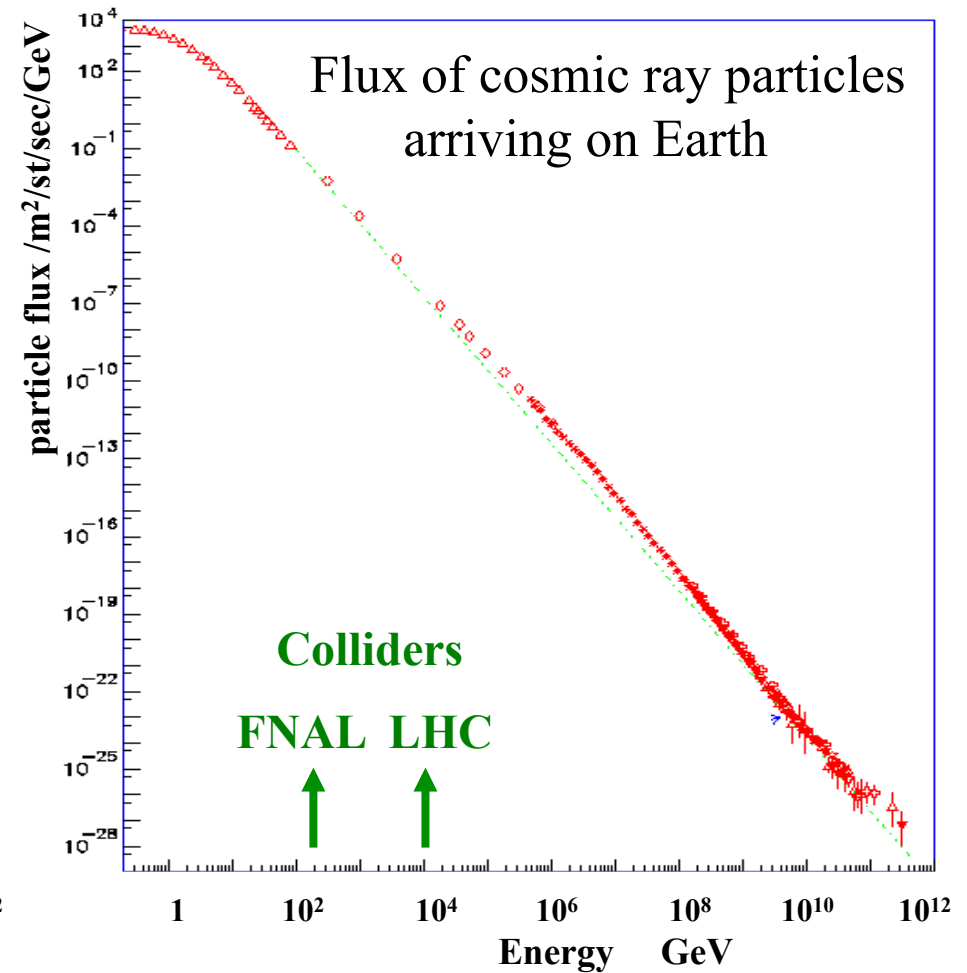
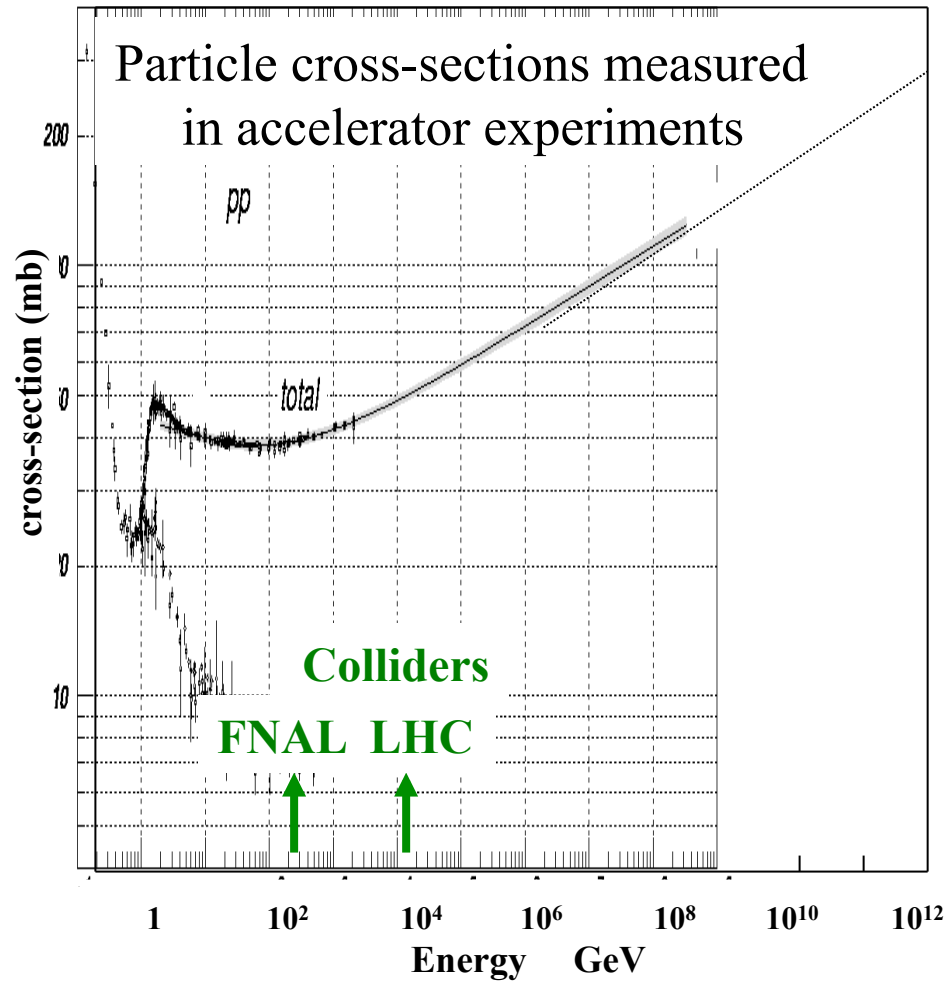
The size of things



Ultra High Energy from Cosmic Rays

From laboratory accelerators

From cosmic accelerators

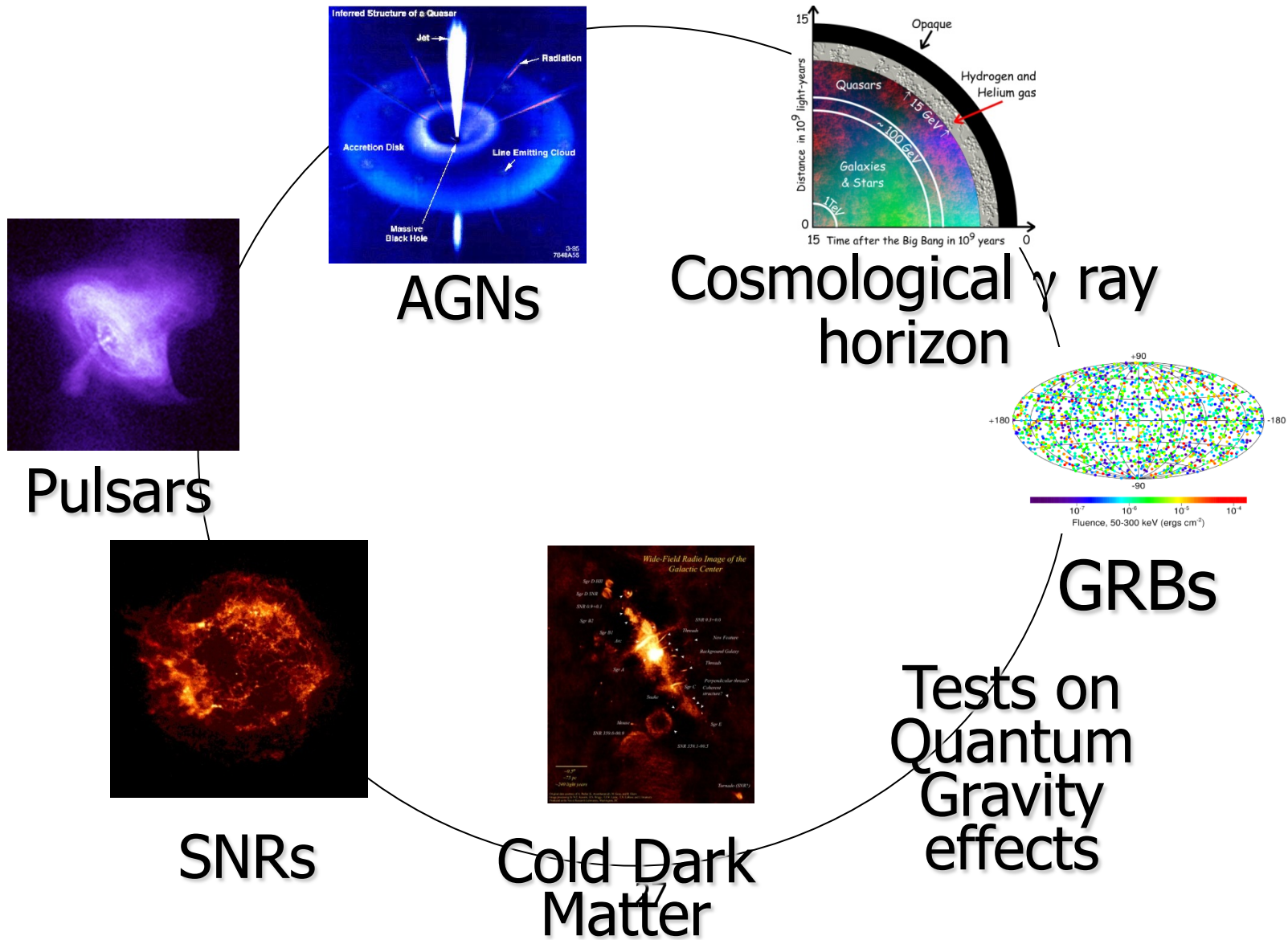


Ultra High Energy Particles arrive from space for free: make use of them

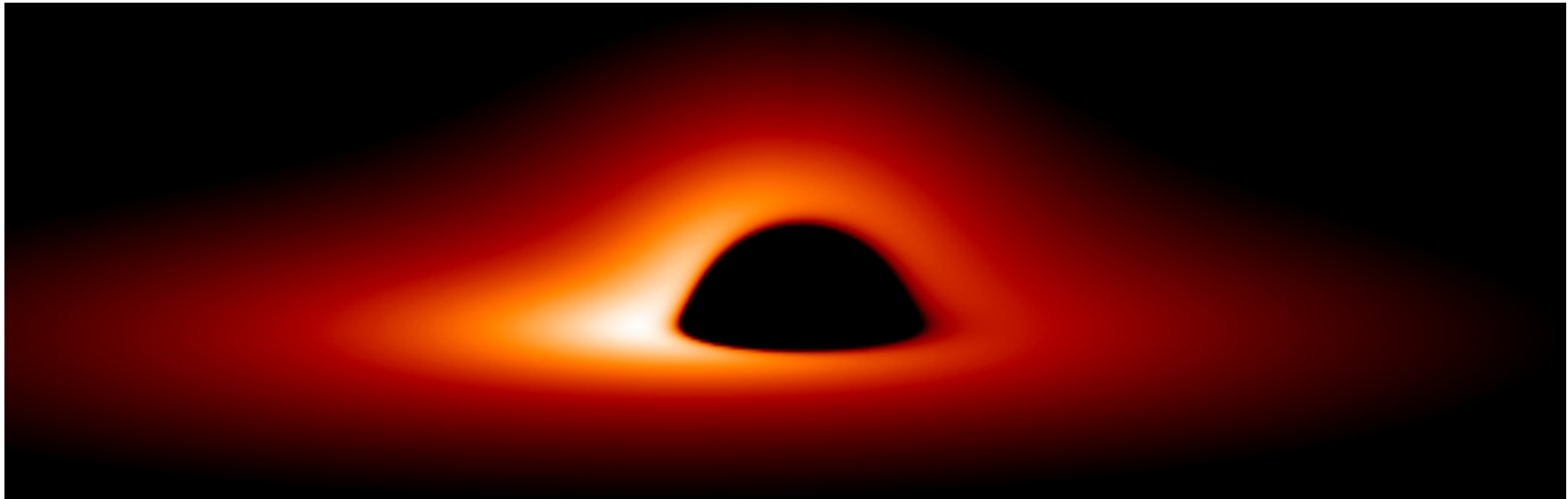
Astrofisica Nucleare e Subnucleare

Astrofisica Gamma – Overview

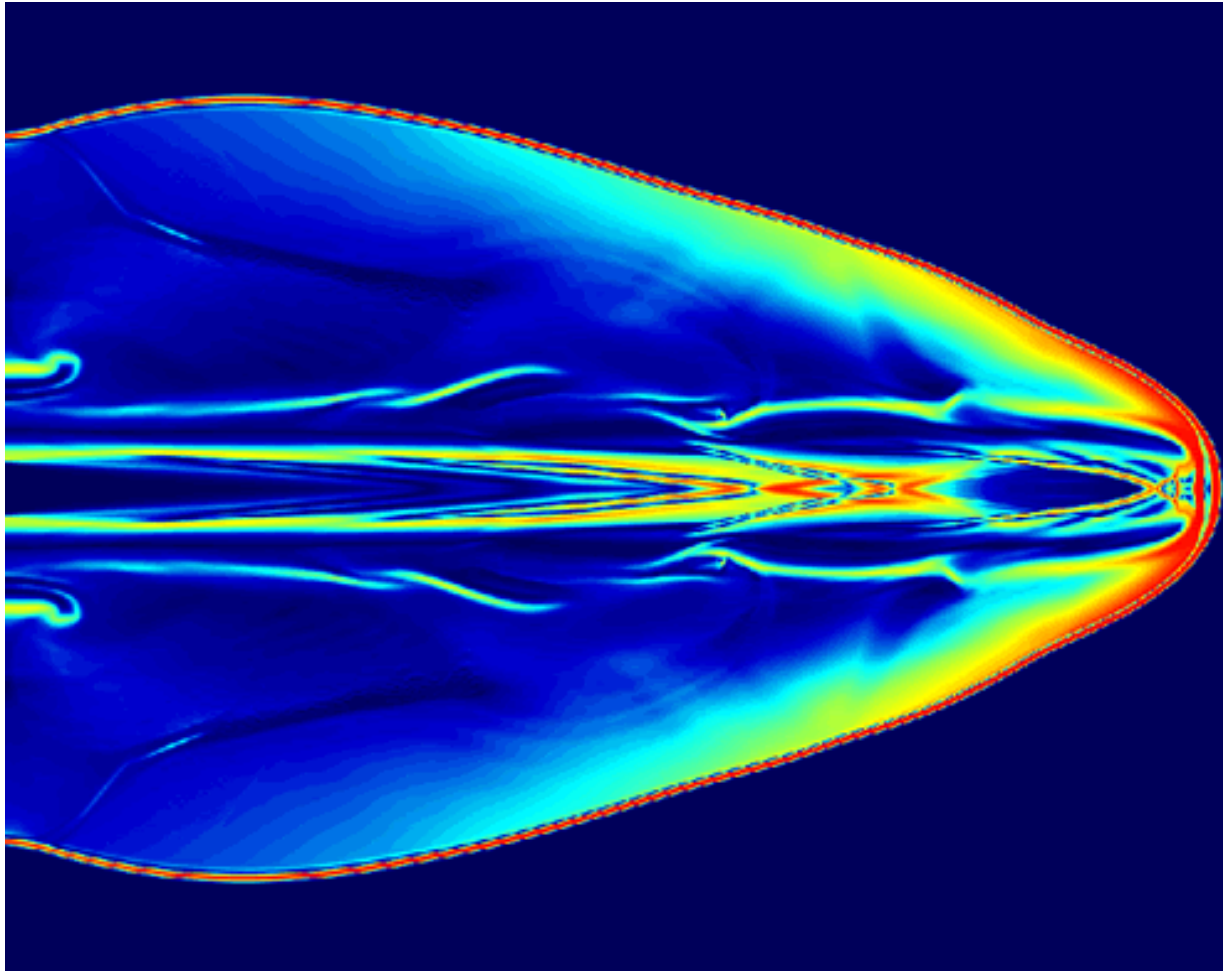
Science Objectives



Compact objects



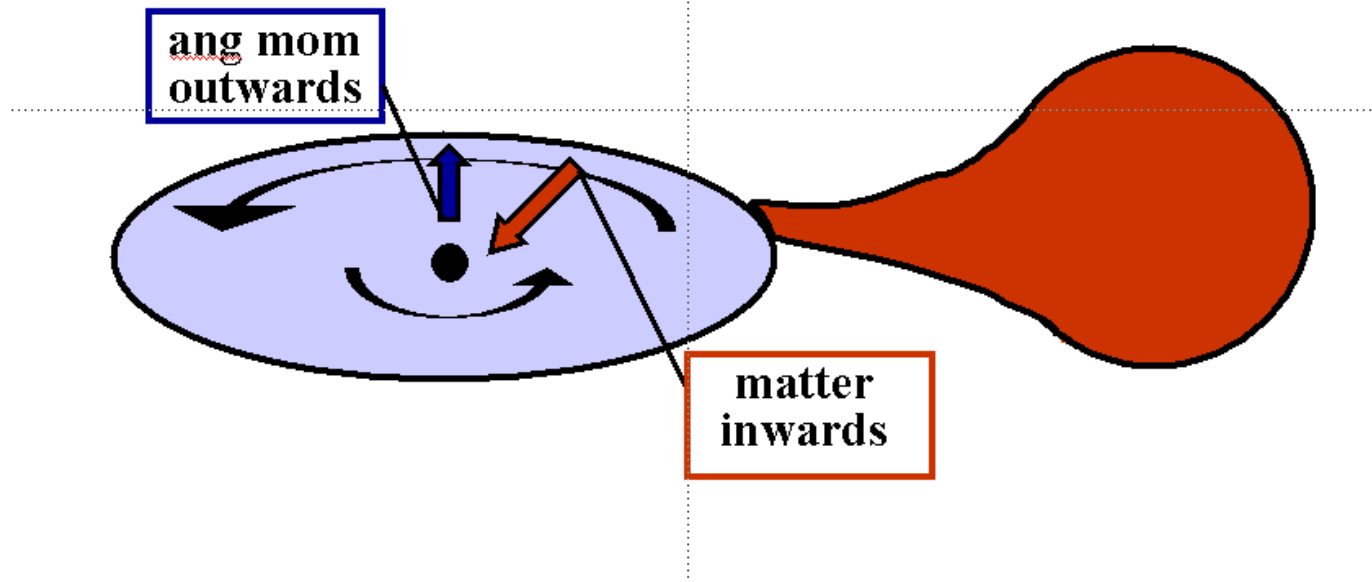
Jets



Accretion

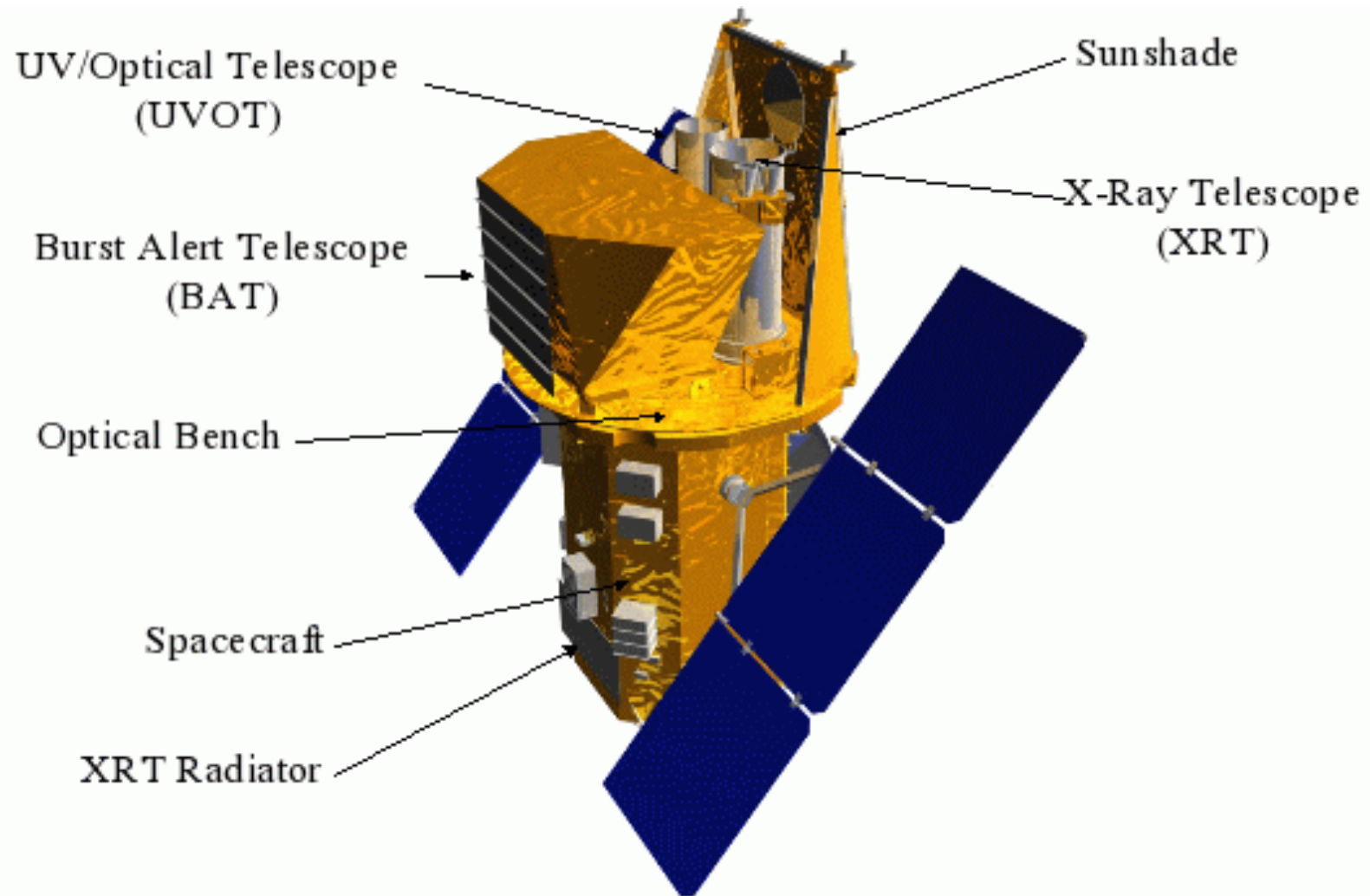
Accretion disk formation

Matter circulates around the compact object:

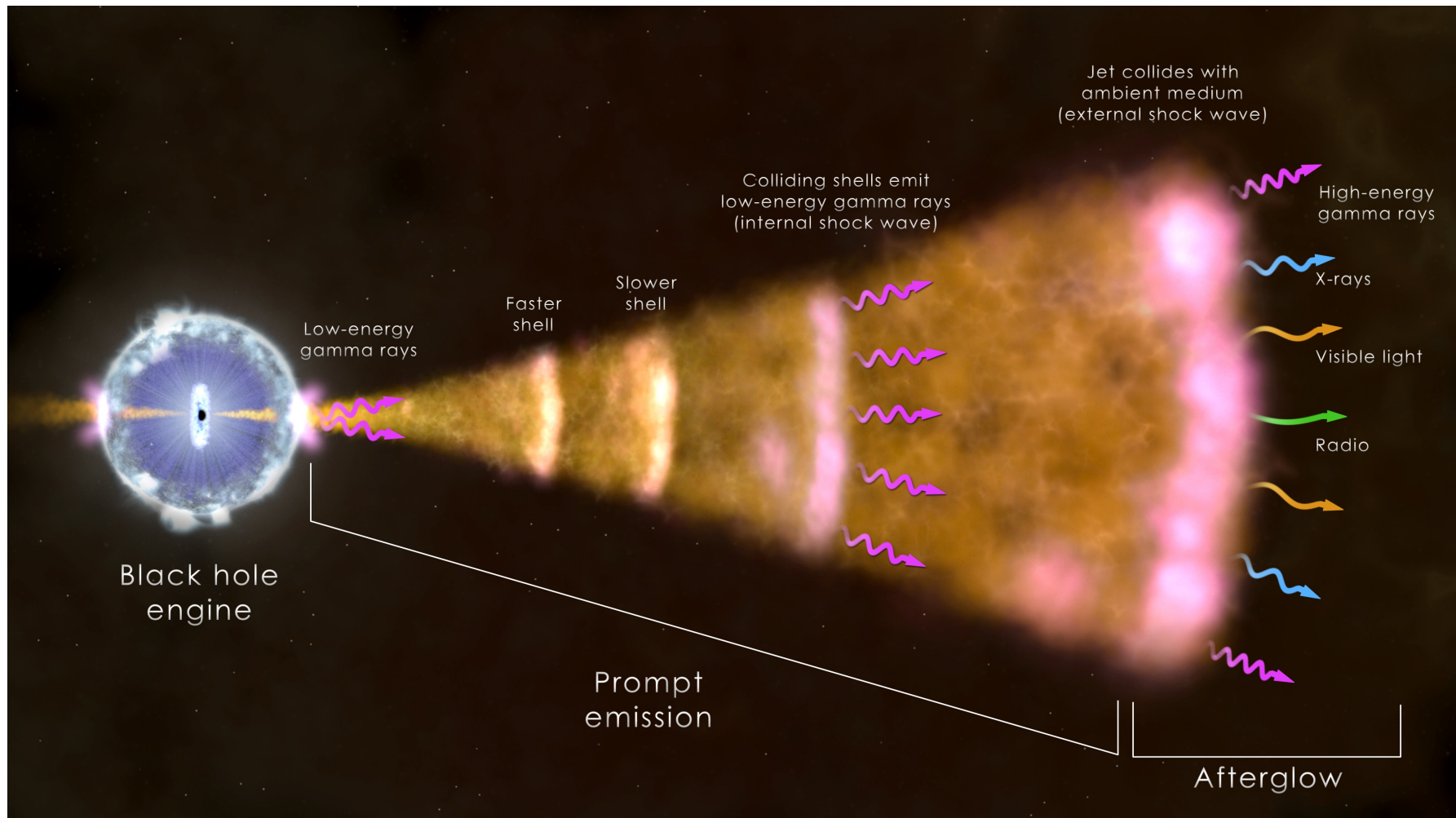


keV-MeV gamma-ray astrophysics

Swift



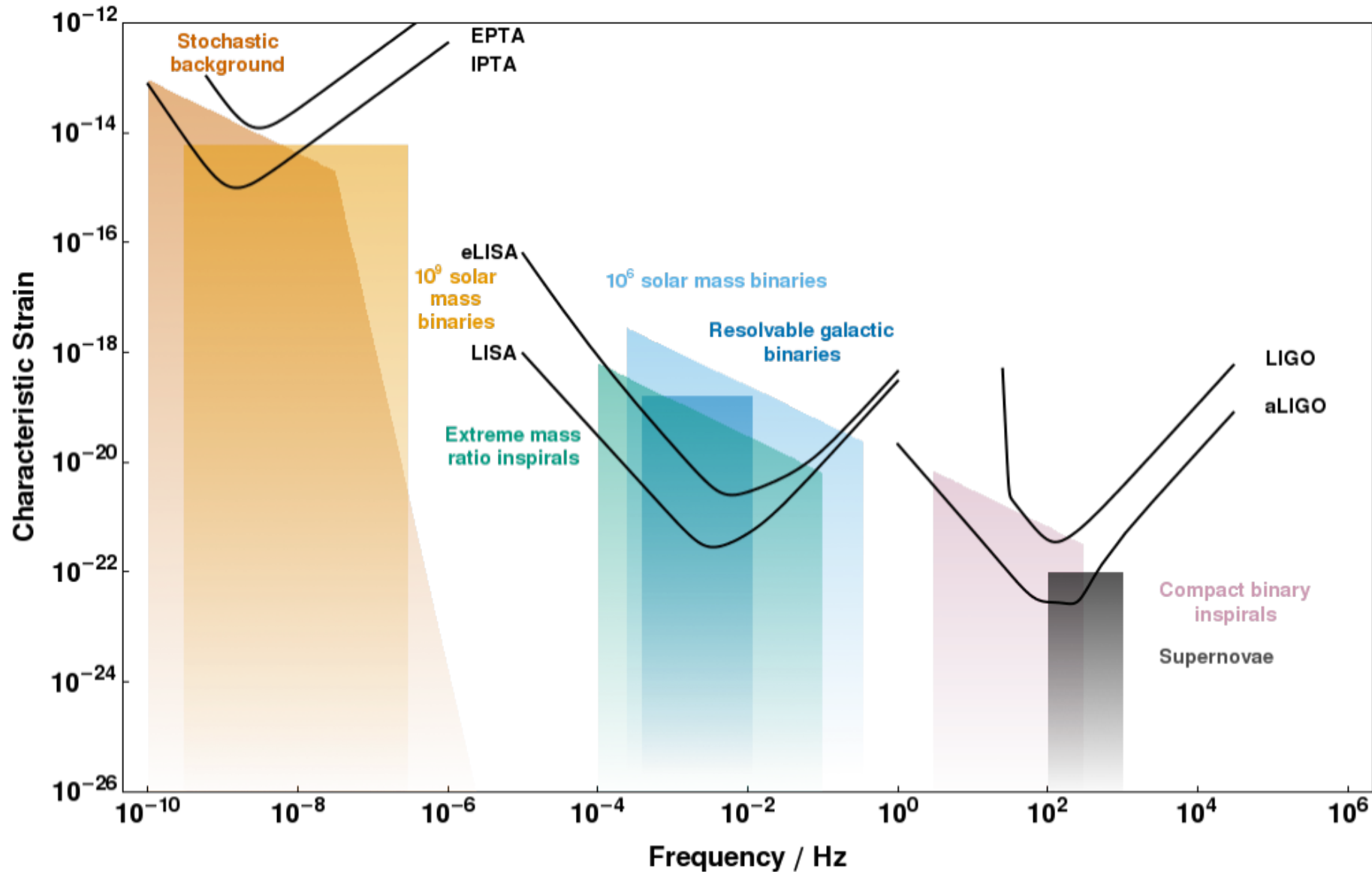
GRB



Gravitational Waves



Gravitational Waves

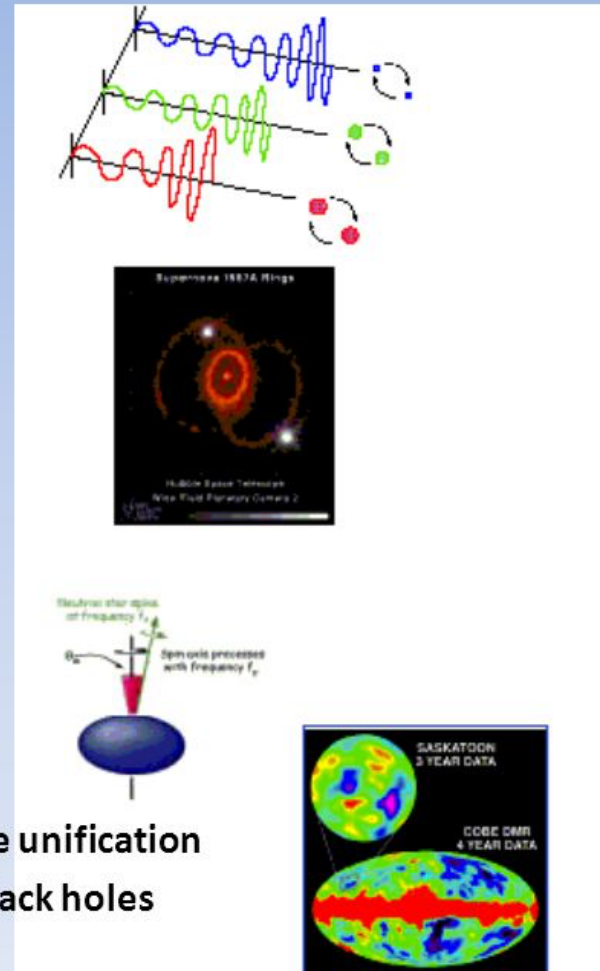


Gravitational Waves

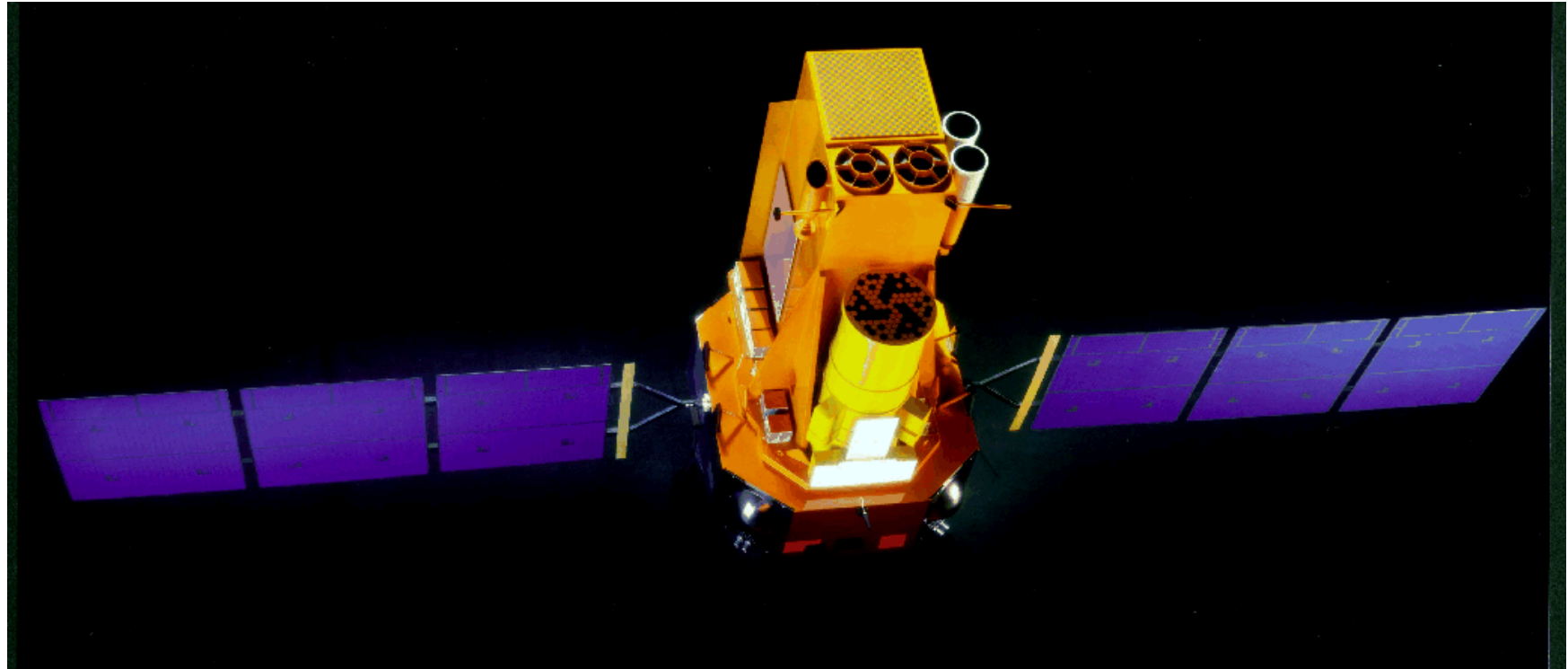
Astrophysical Sources for Terrestrial GW Detectors

- Compact binary inspiral: “chirps”
 - NS-NS, NS-BH, BH-BH
- Supernovas or GRBs: “bursts”
 - GW signals observed in coincidence with EM or neutrino detectors
- Pulsars in our galaxy: “periodic waves”
 - Rapidly rotating neutron stars
 - Modes of NS vibration
- Cosmological: “stochastic background” ?
 - Probe back to the Planck time (10^{-43} s)
 - Probe phase transitions: window to force unification
 - Cosmological distribution of Primordial black holes

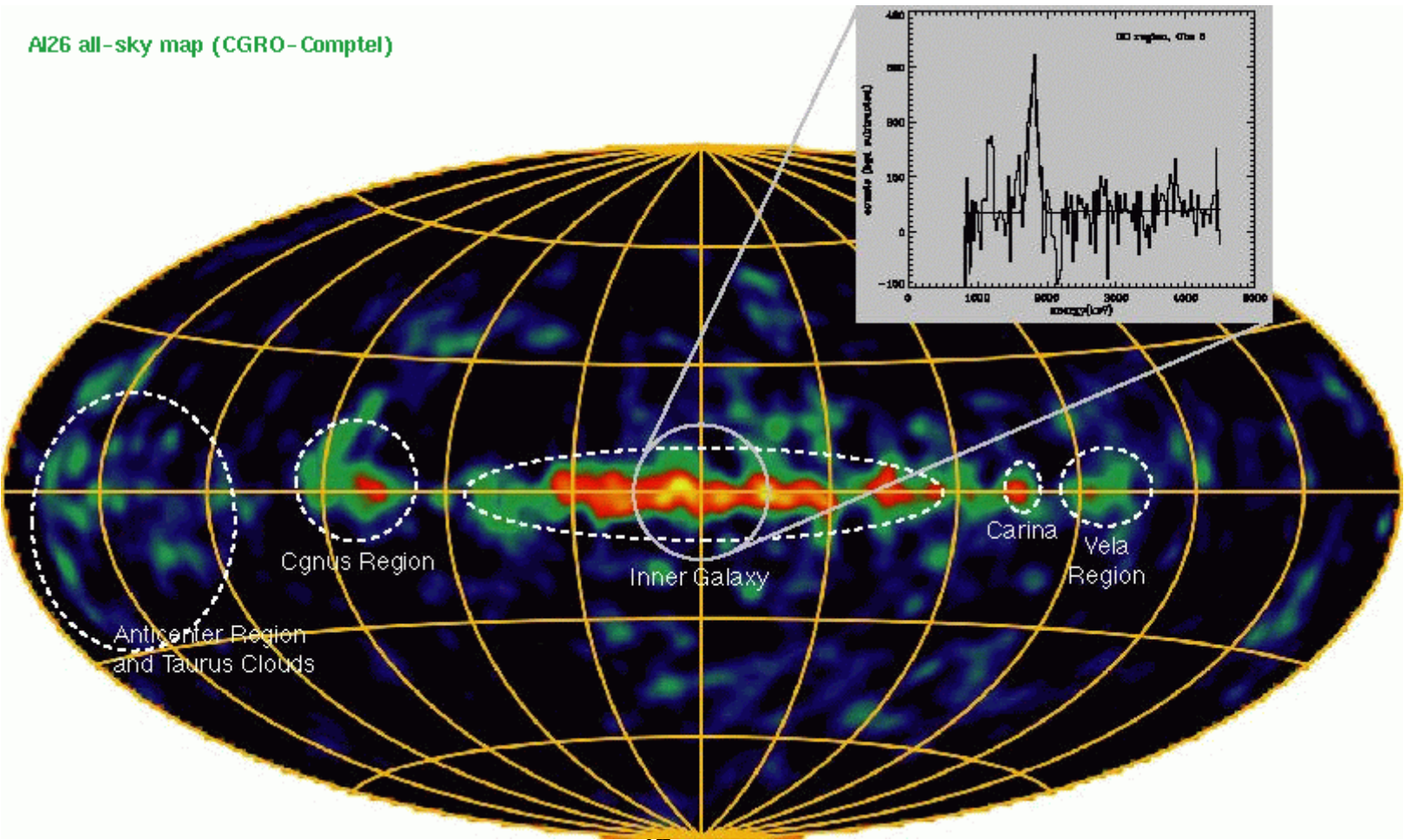
Courtesy: Stan Whitcomb



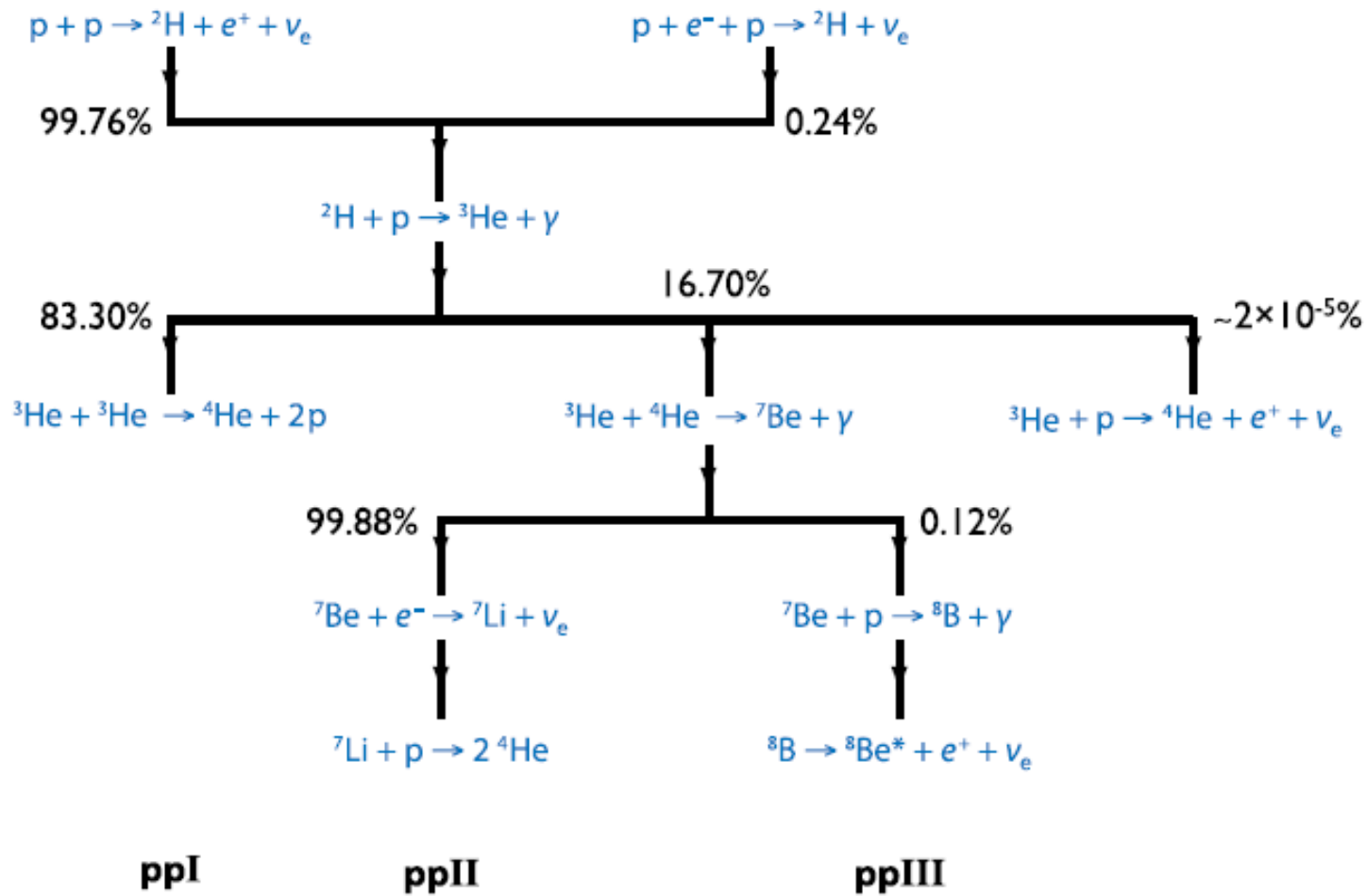
INTEGRAL



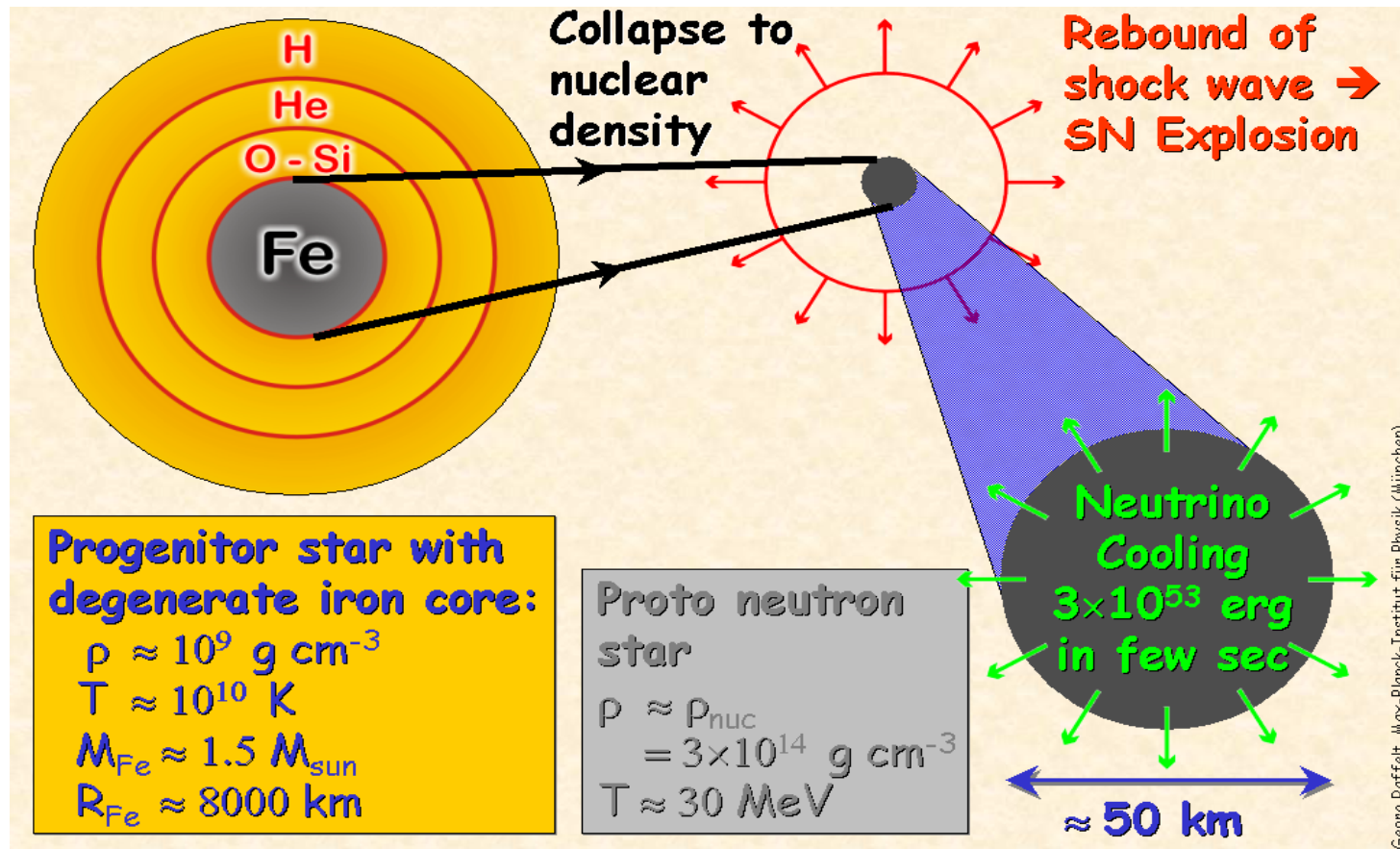
INTEGRAL

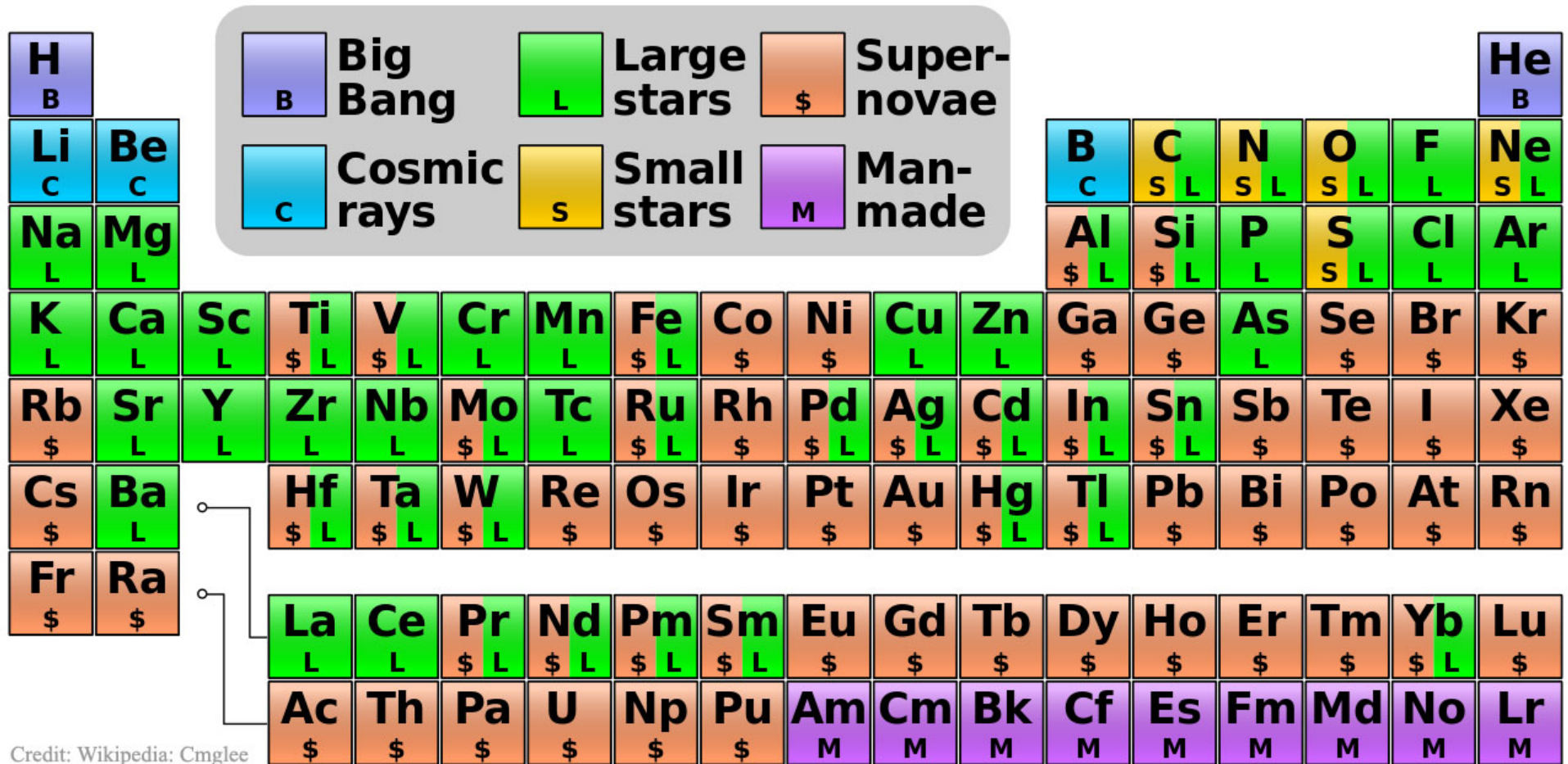


Solar Thermonuclear Cycles

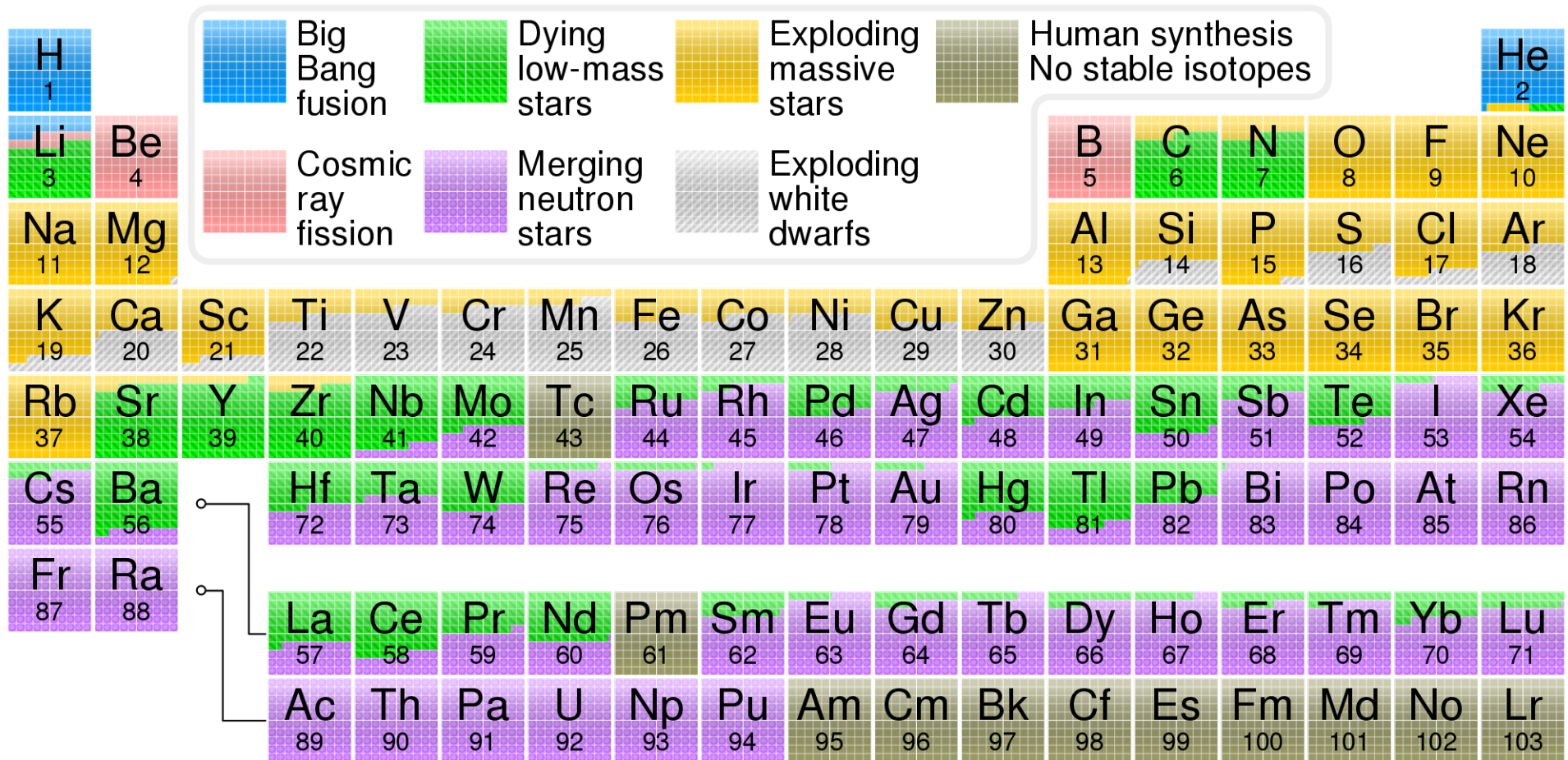


Stellar collapse and neutrinos






Credit: Wikipedia: Cmglee



Dopo GW 170817

GeV gamma-ray astrophysics

AGILE



agile

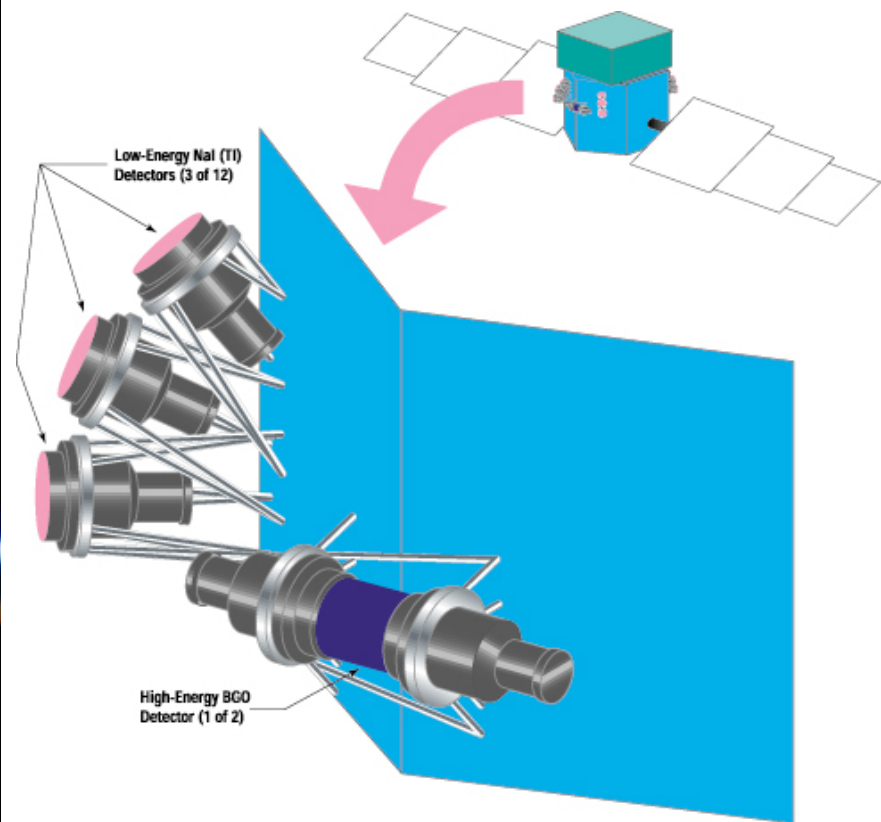
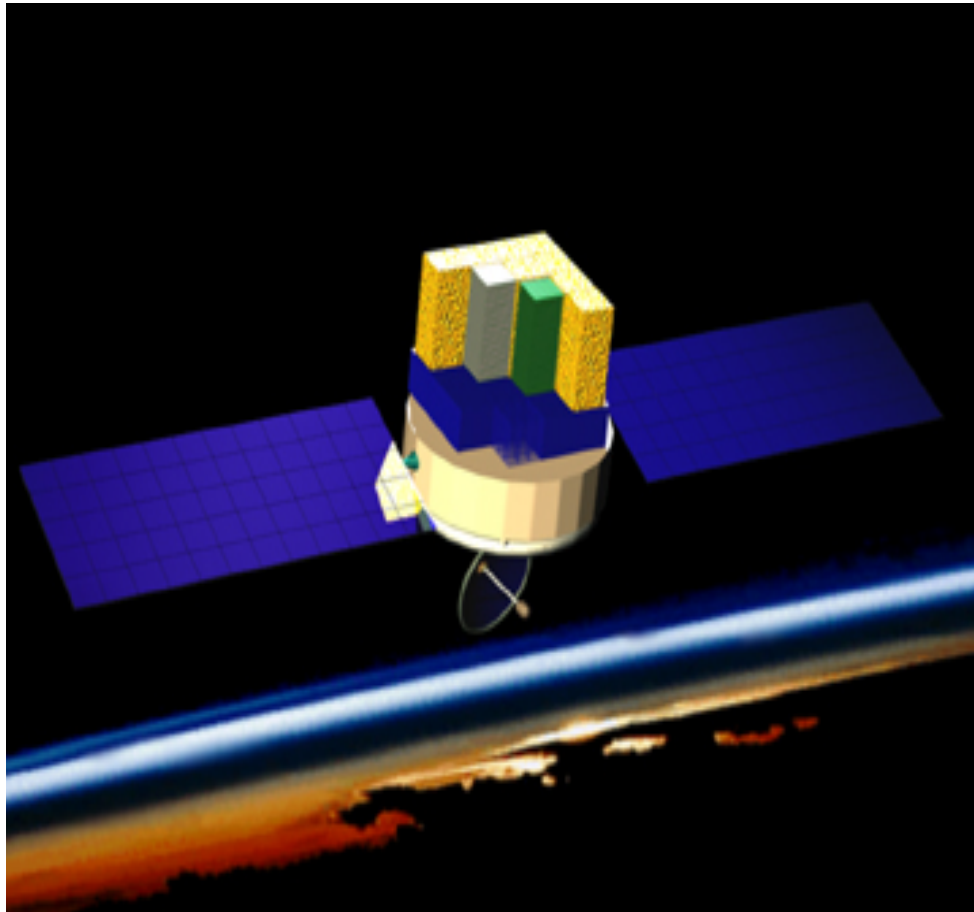
Astro-rivelatore Gamma a Immagini LEggero

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AGILE System Team
AGILE in ASI
AGILE Industrial Partners
AGILE Progress Status
Science with AGILE
AGILE Sensitivity
AGILE Selected Publications
AGILE latest review paper
Highlights
Education & Public Outreach
Public Information
AGILE Site

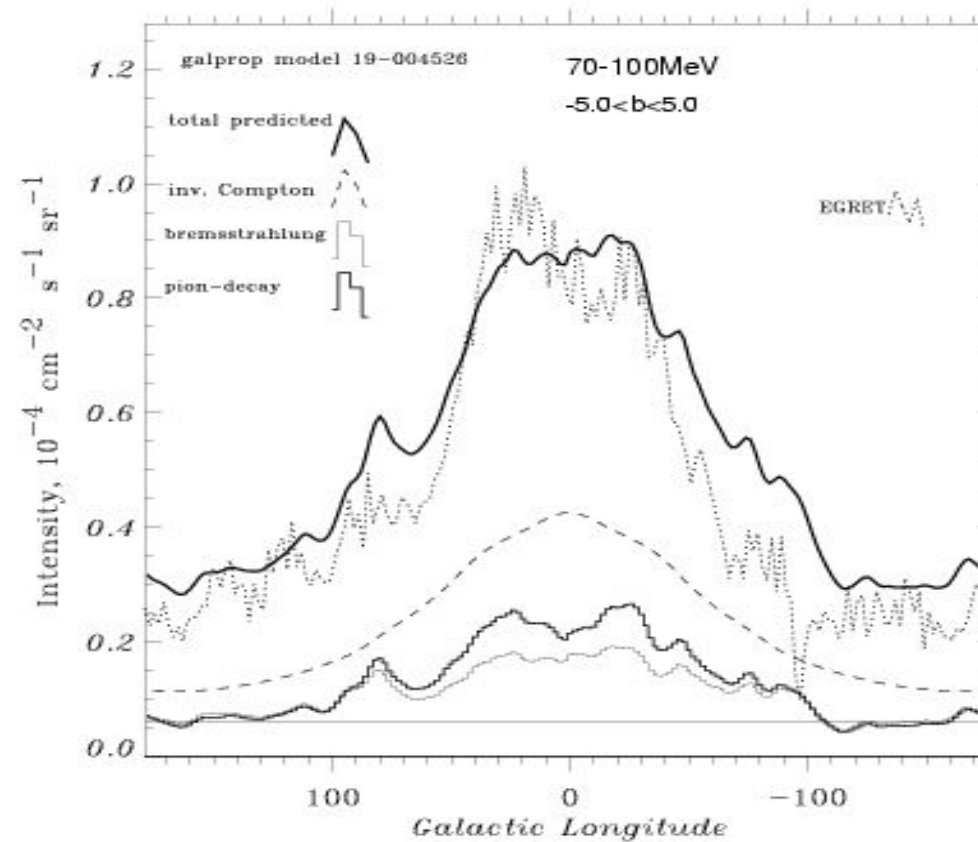


Logo:         

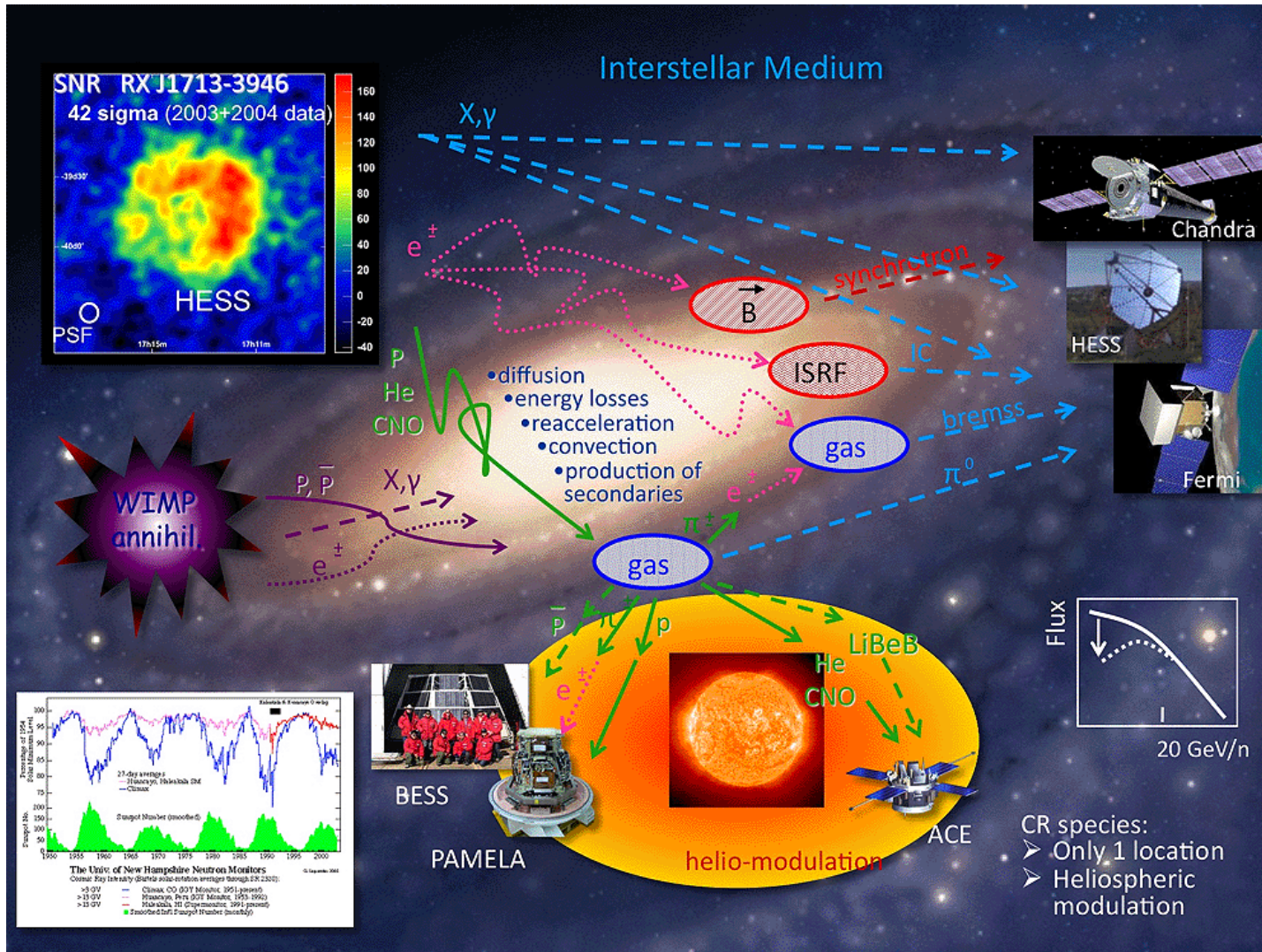
Fermi/GLAST



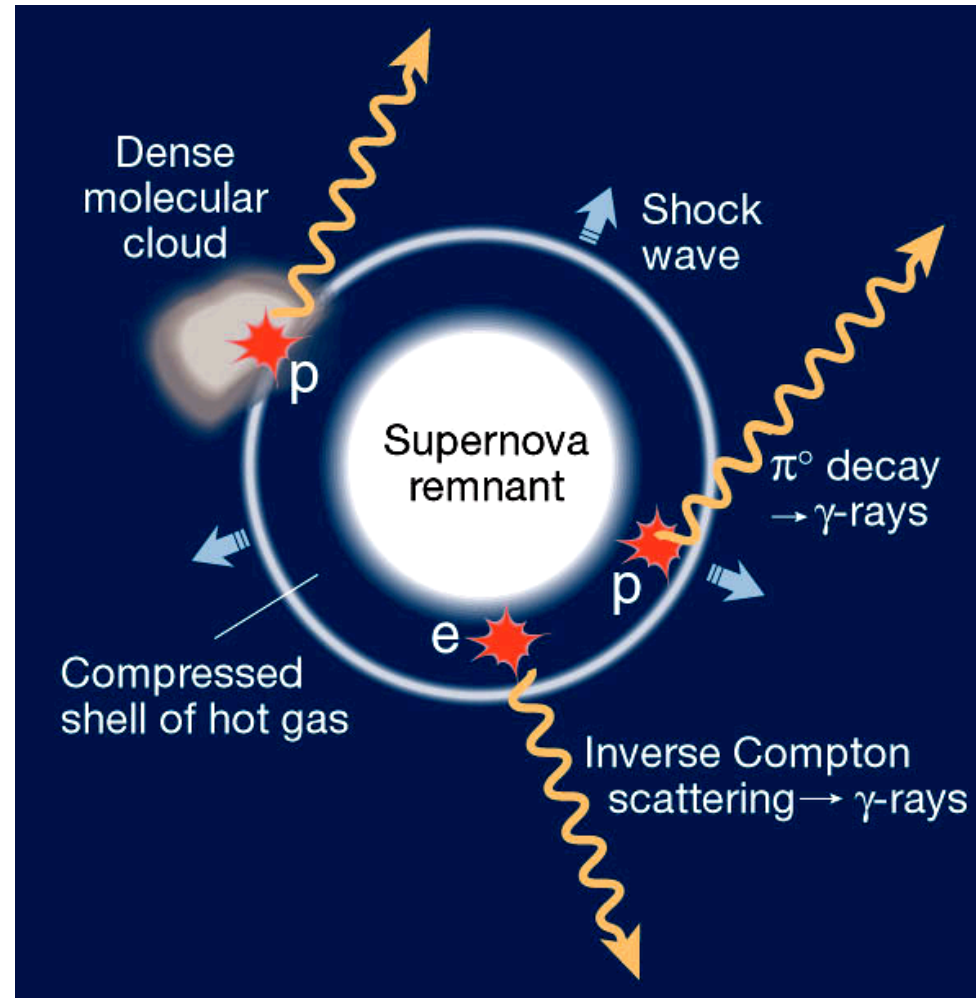
The galactic plane



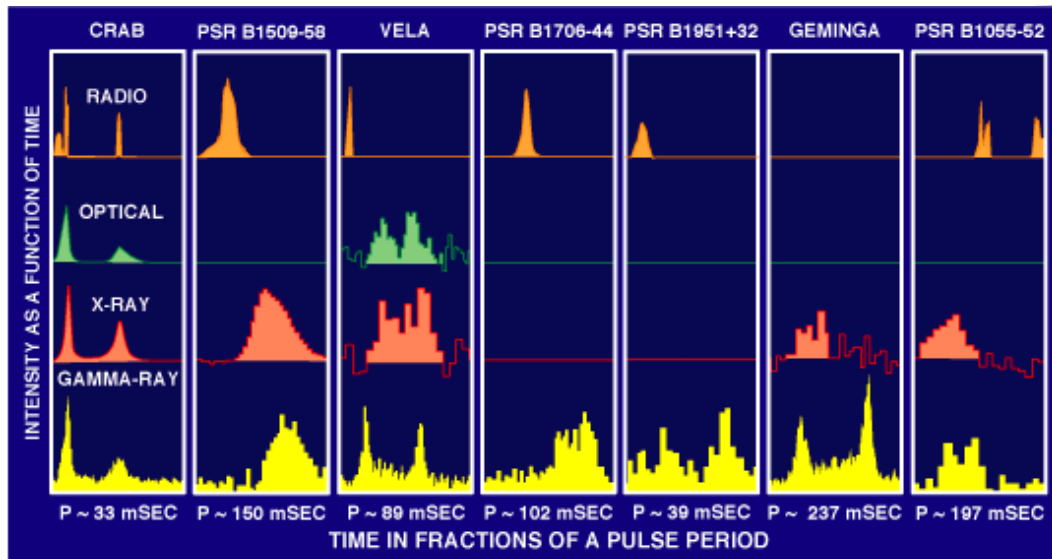
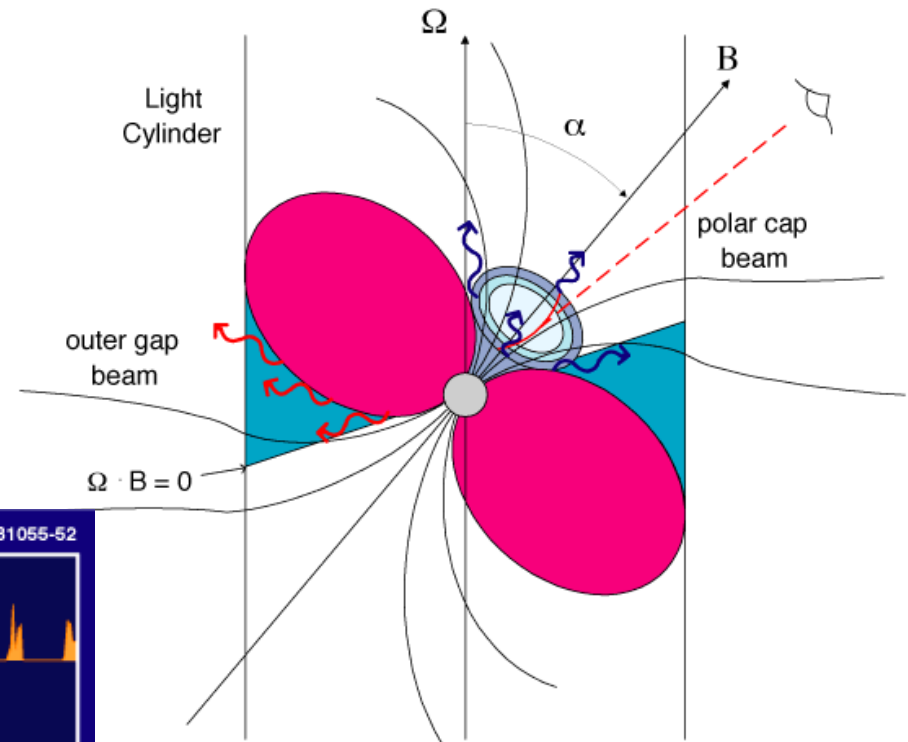
Cosmic Rays Propagation



Supernova Remnants

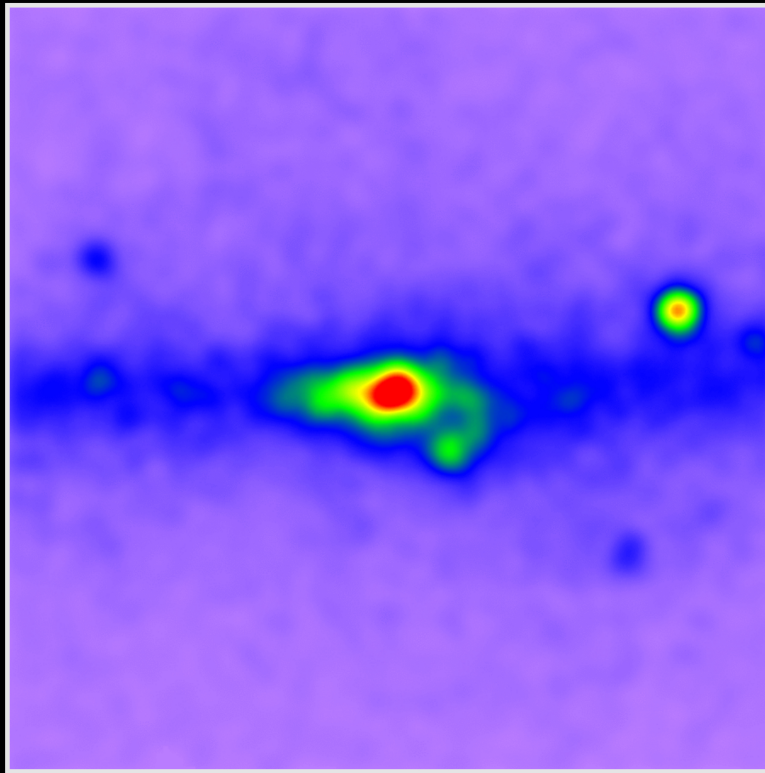


Pulsars

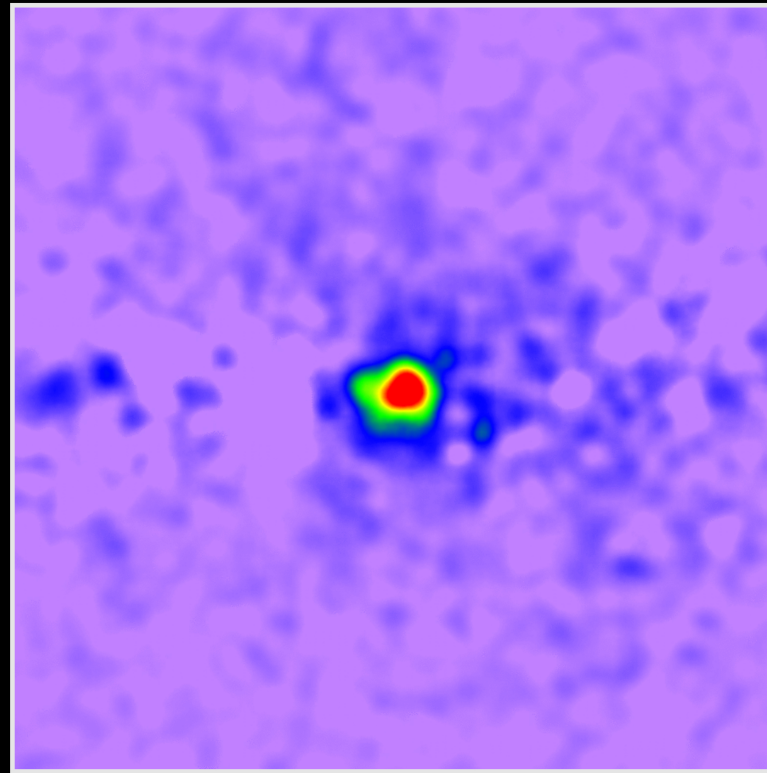


Dark Matter

Uncovering a gamma-ray excess at the galactic center



Unprocessed map of 1.0 to 3.16 GeV gamma rays



Known sources removed

Dark Matter

Evidence :

- Need to hold together Galaxy Clusters
- Explain Galaxy Rotation velocities

Astronomy object candidates :

Brown Dwarfs (stars mass $< 0.1 M_{\text{sun}}$ no fusion)

- some but not enough

White Dwarfs (final states of small stars)

- some but not enough

Neutron Stars/Black Holes (final states of big stars.)

- expected to be rarer than white dwarfs

Gas clouds

- $\sim 75\%$ visible matter in the universe, but observable

Particle Physics candidates:

Neutrinos

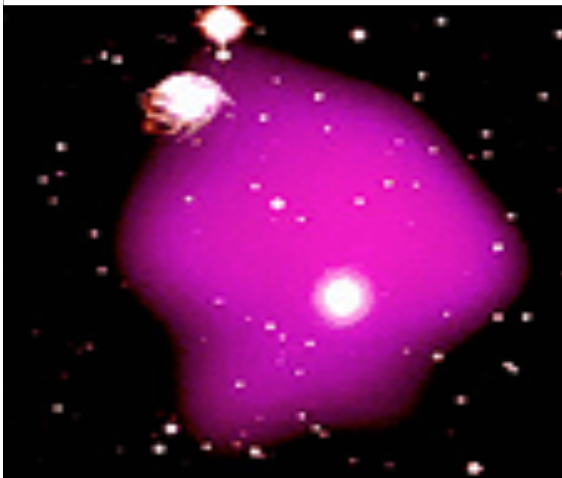
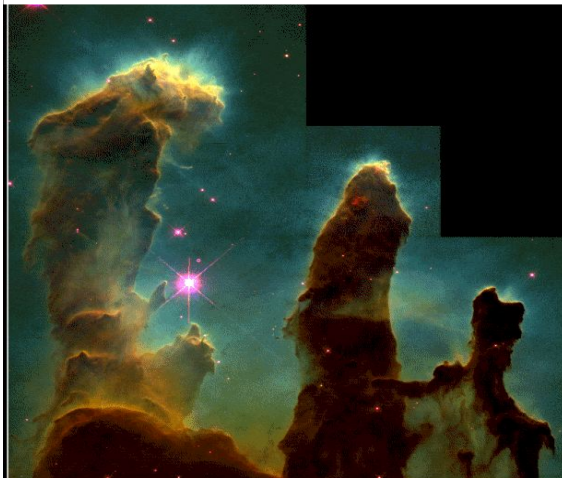
- Evidence for mass from oscillation, not enough

Axions

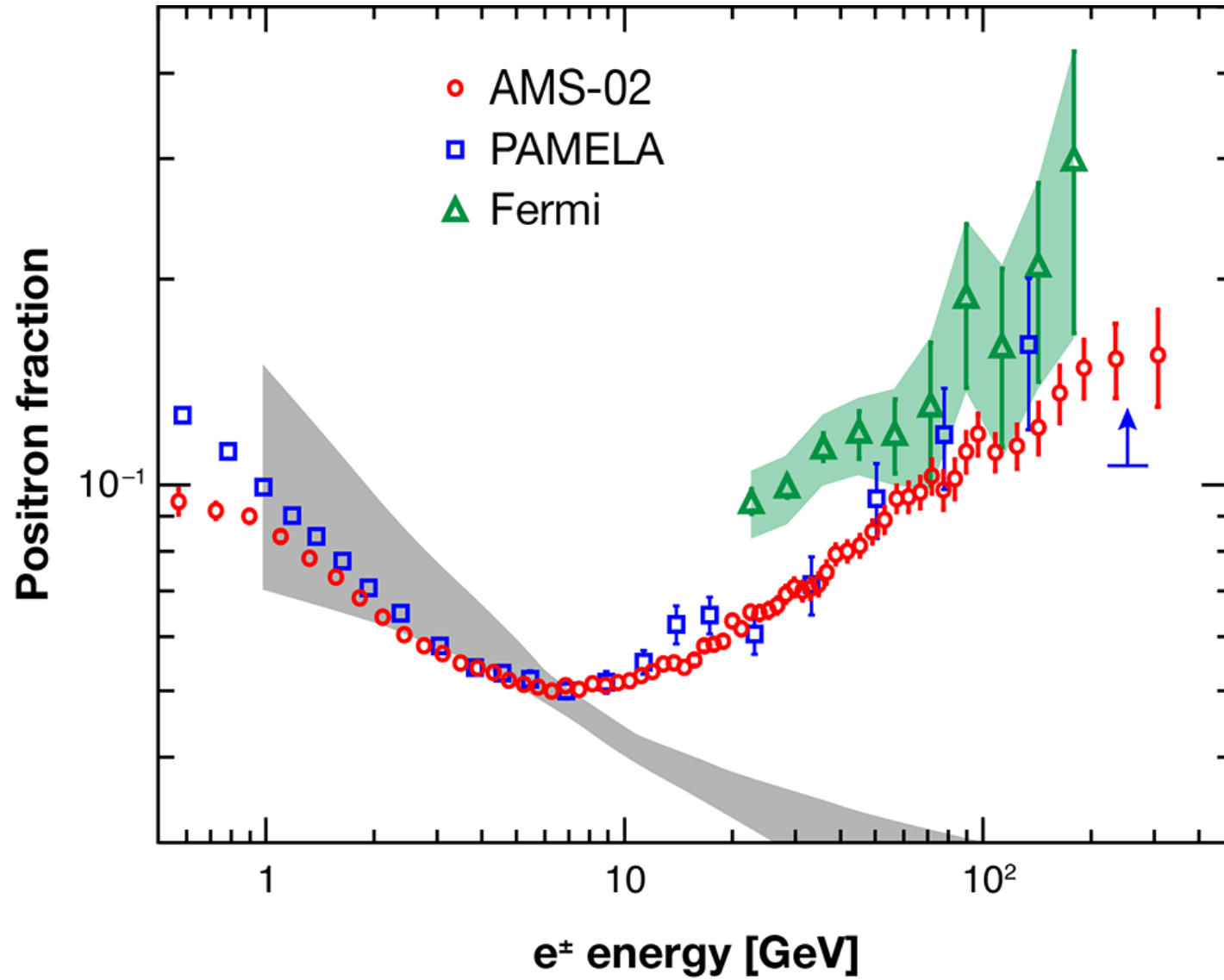
- Difficult to detect

Neutralinos

- Particle Physicist Favourite !

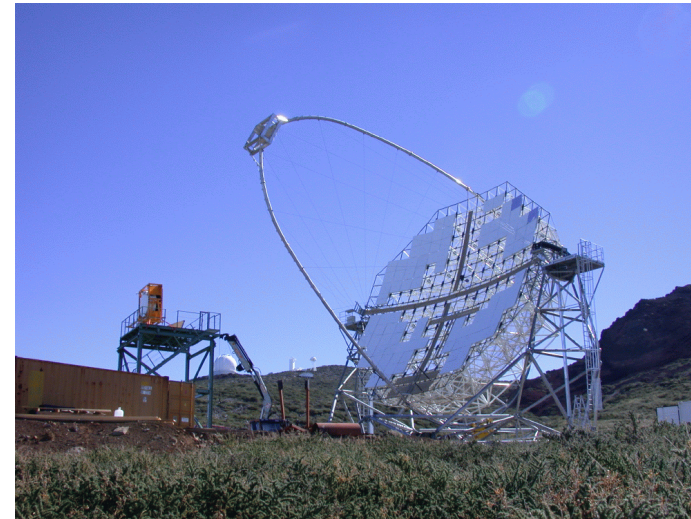
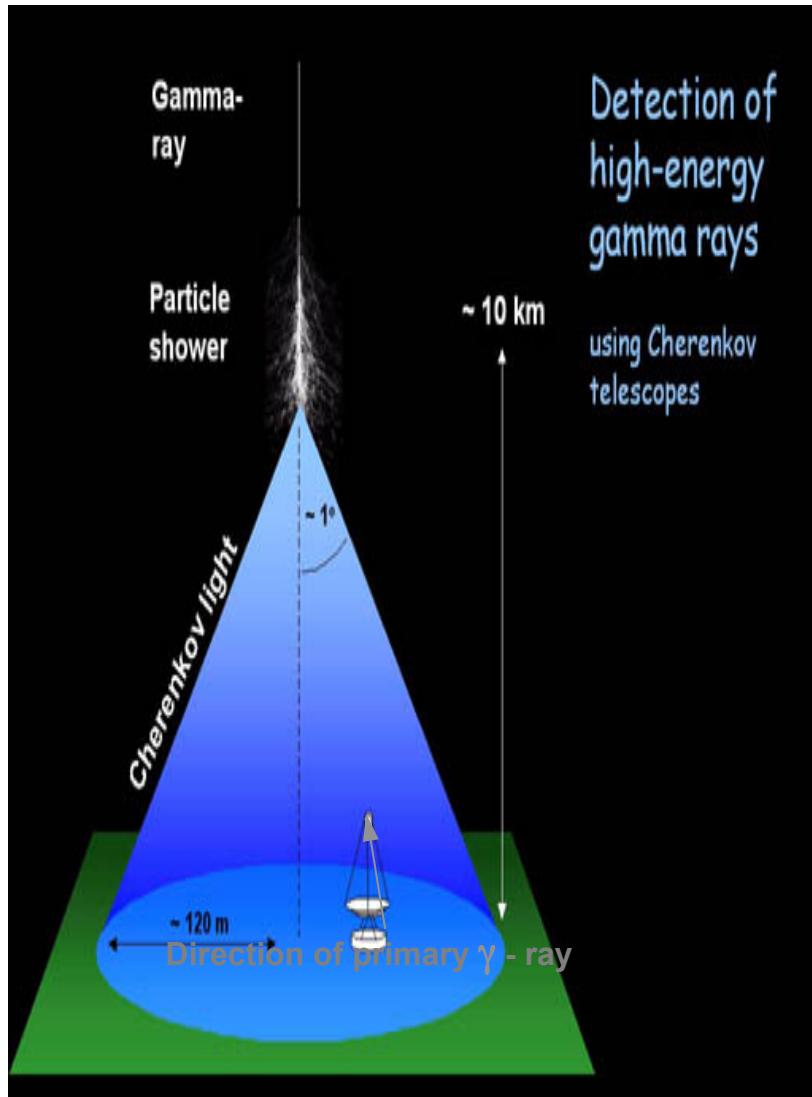


AntiMatter



TeV astrophysics

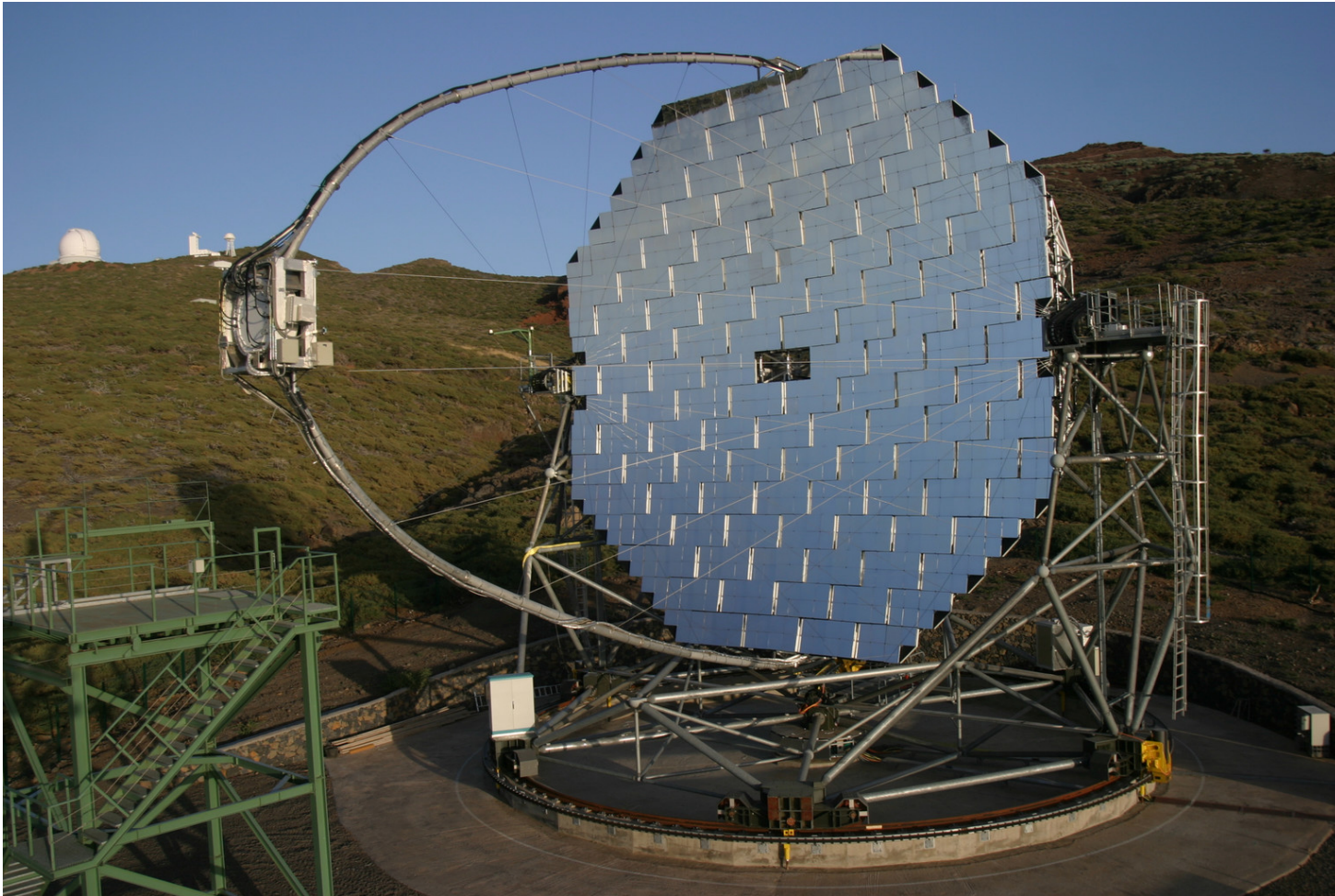
Imaging Atmospheric Cherenkov Telescopes



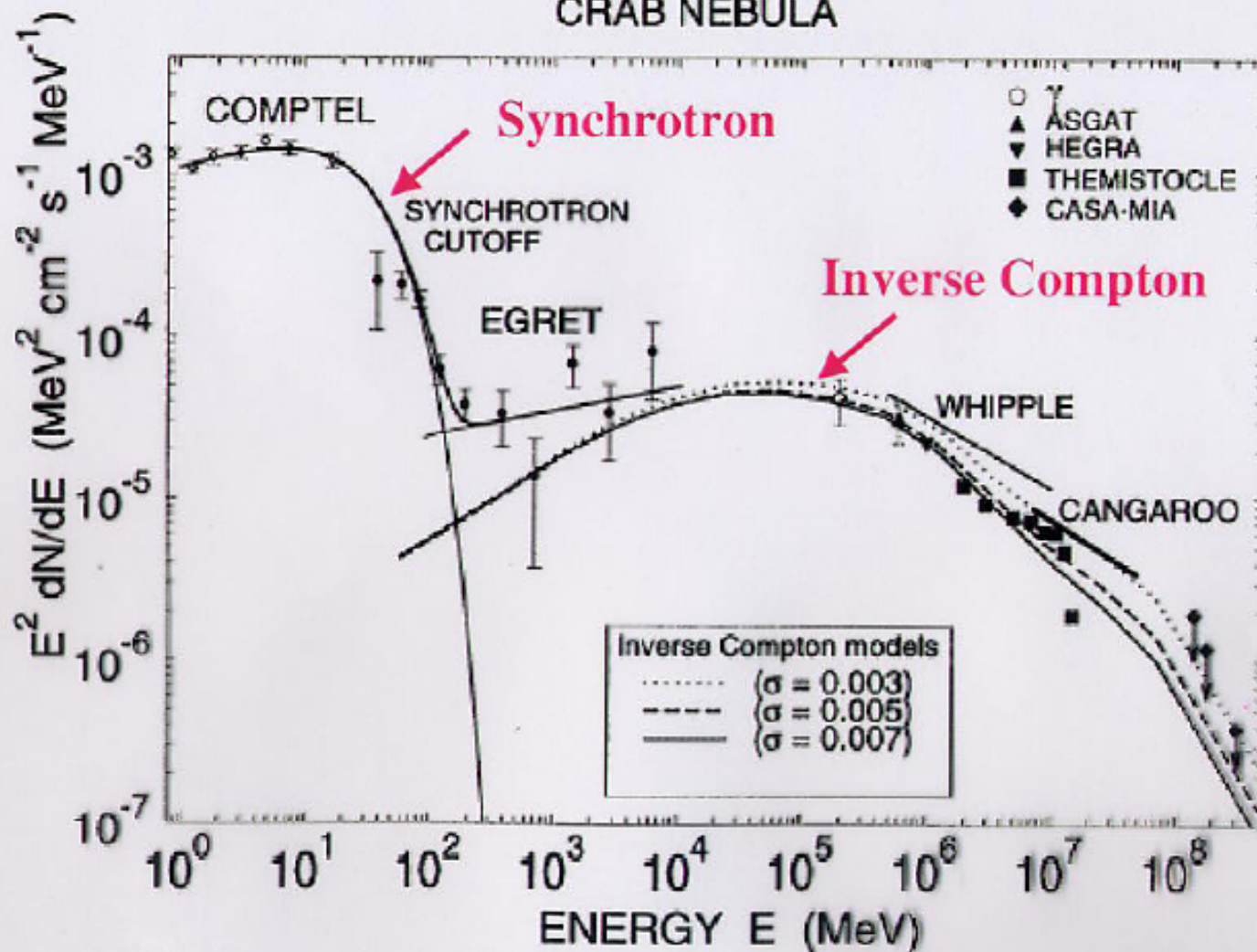
The principle:

A telescope placed inside the (huge) Cherenkov light pool can obtain an image of the development of the shower above the LONS fluctuations

MAGIC



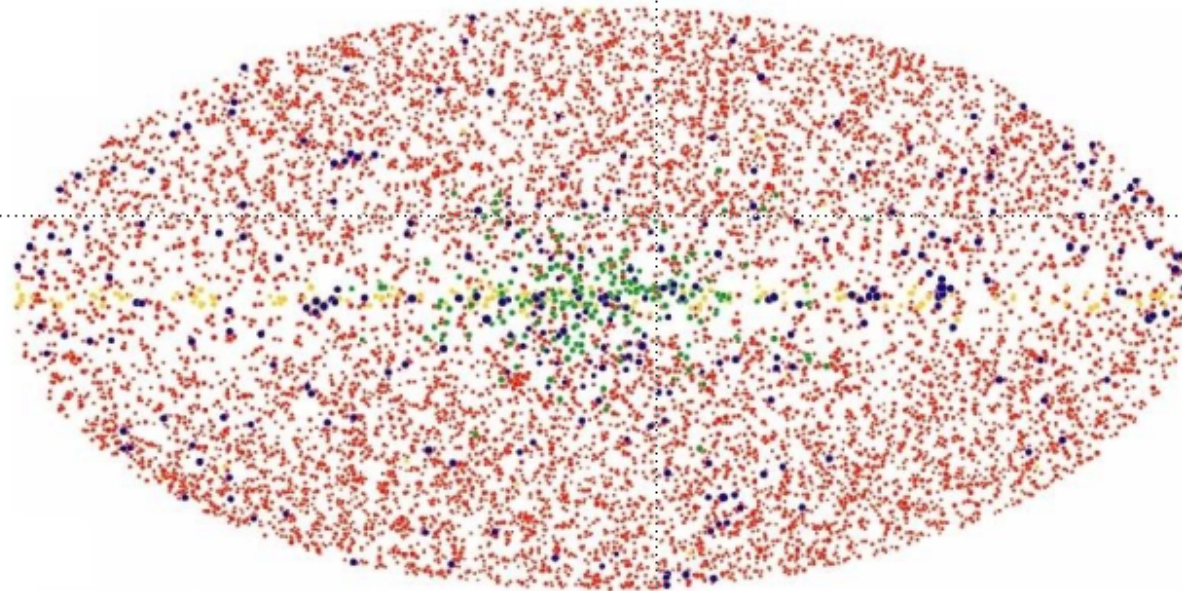
CRAB NEBULA



Active Galactic Nuclei

**5 σ Sources from Simulated
One Year All-sky Survey**

LAT 1st Catalog:
>9000 sources
possible

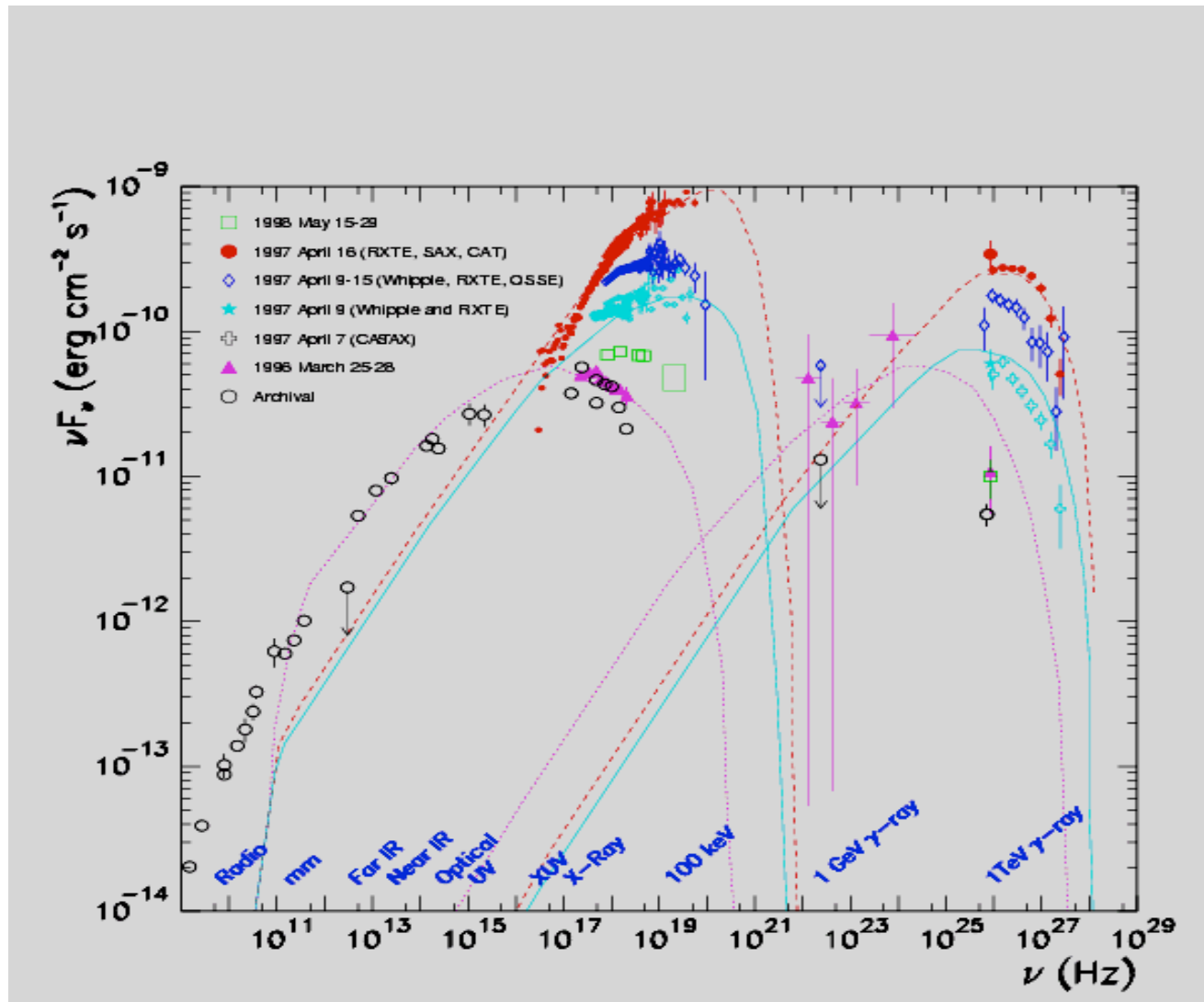


Results of one-year
all-sky survey.
(Total: 9900 sources)

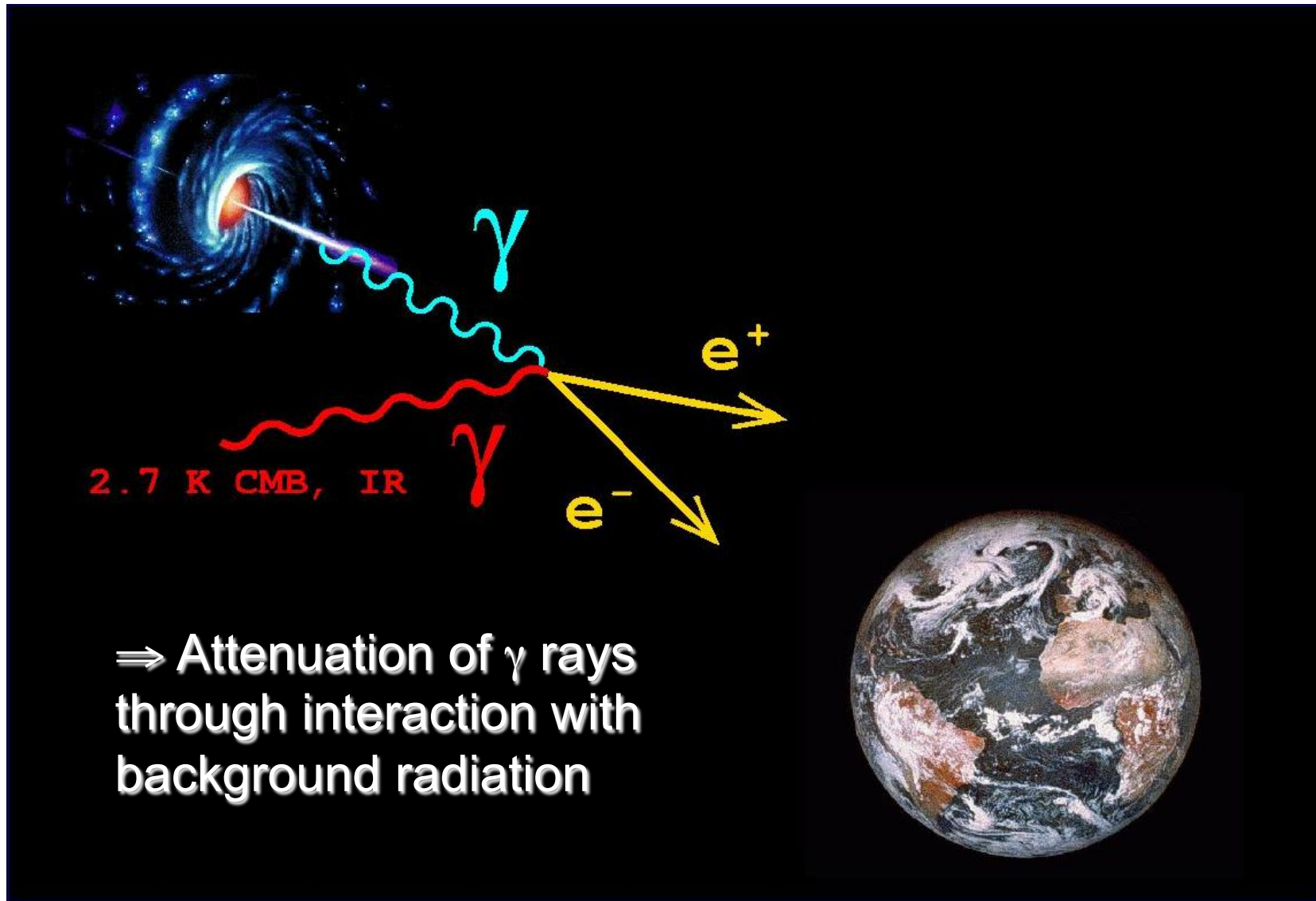
● AGN
● 3EG Catalog

● Galactic Halo
● Galactic Plane

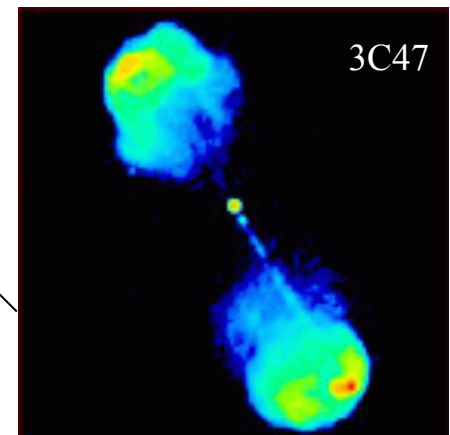
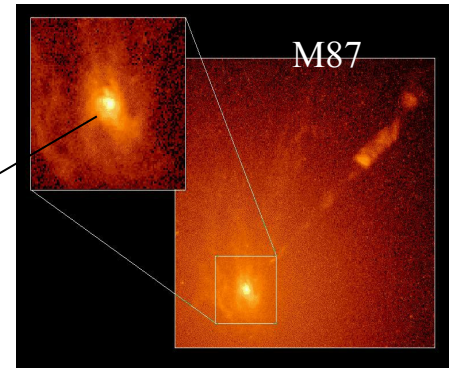
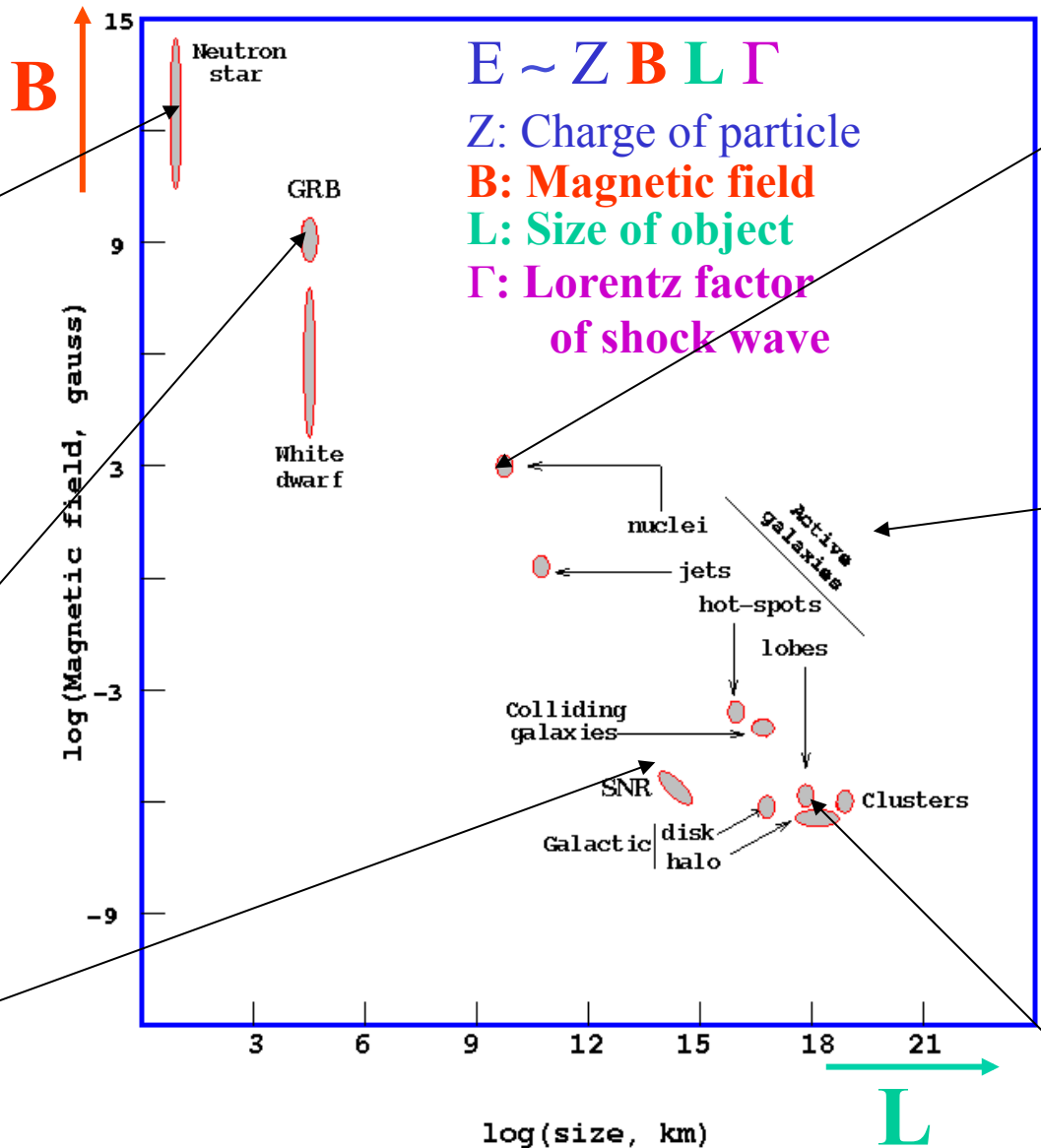
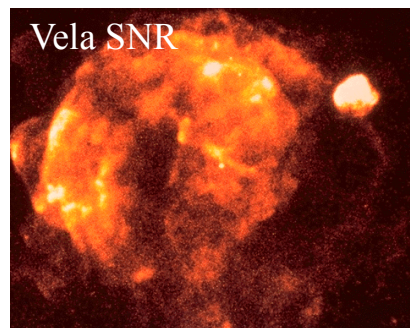
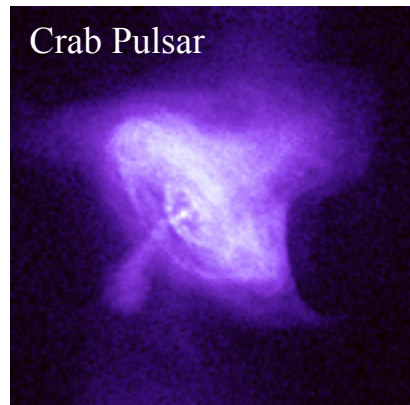
Active Galactic Nuclei



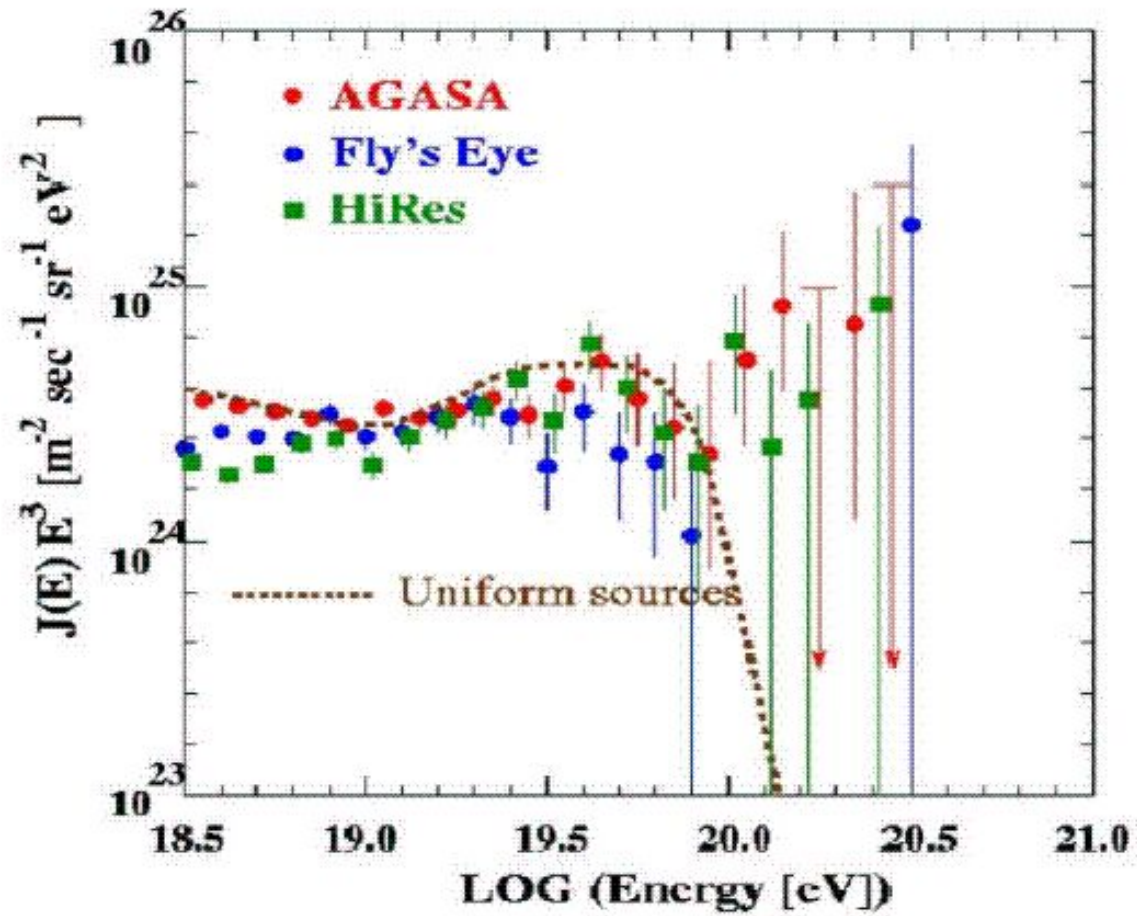
$$\gamma \gamma \longrightarrow e^+ e^-$$



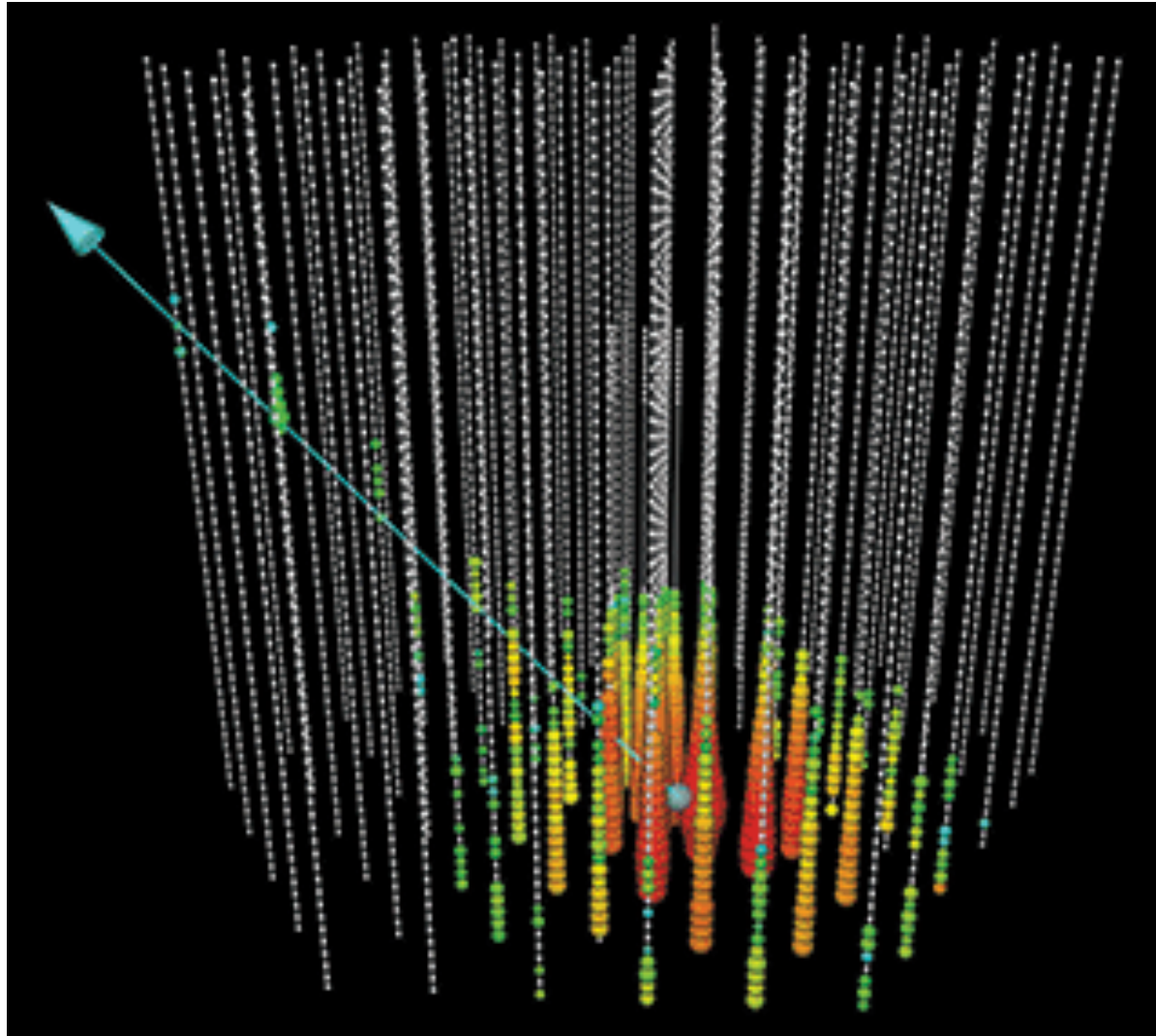
Acceleratori Cosmici: (Hillas Plot)



UHECR physics



HE neutrinos



Astrofisica Nucleare e Subnucleare

Introduzione - 2

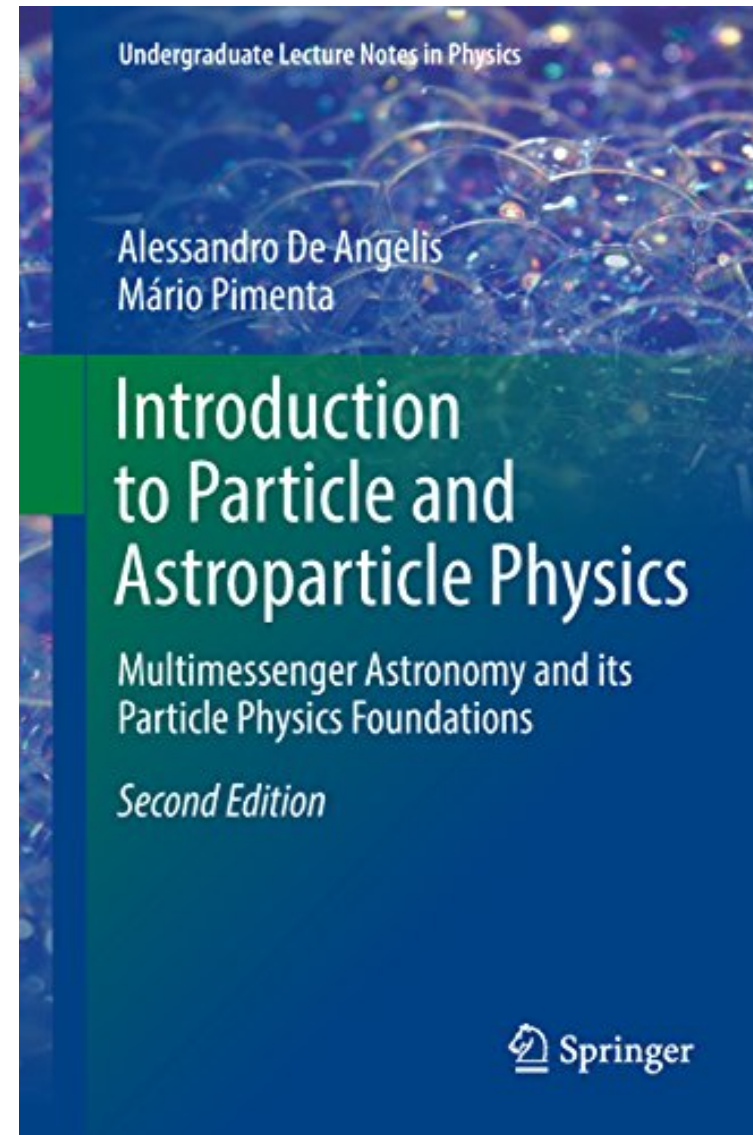
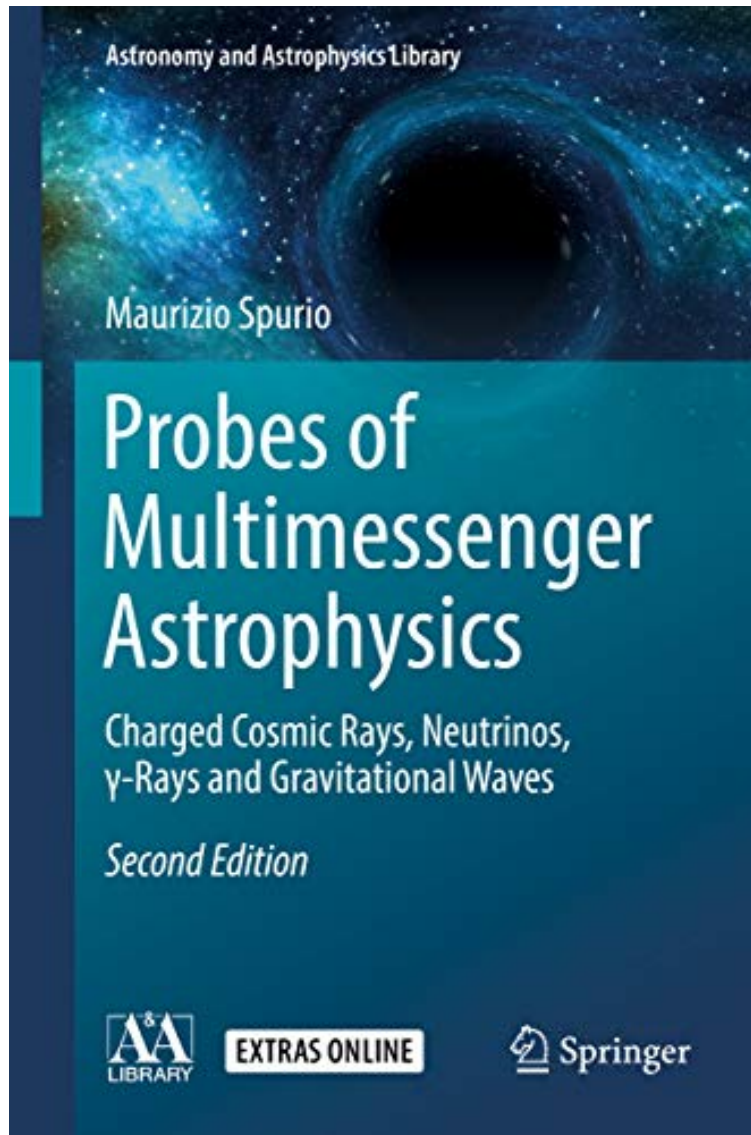
Organizzazione del corso

- Lezioni frontali
 - Introduzione agli argomenti di Astroparticelle e Astrofisica Nucleare
- Journal Club
 - Lettura di articoli di riferimento del settore
 - Discussione a lezione
- Seminari
 - Invito di esperti del settore (presso UniTs / INFN Ts / INAF Ts)

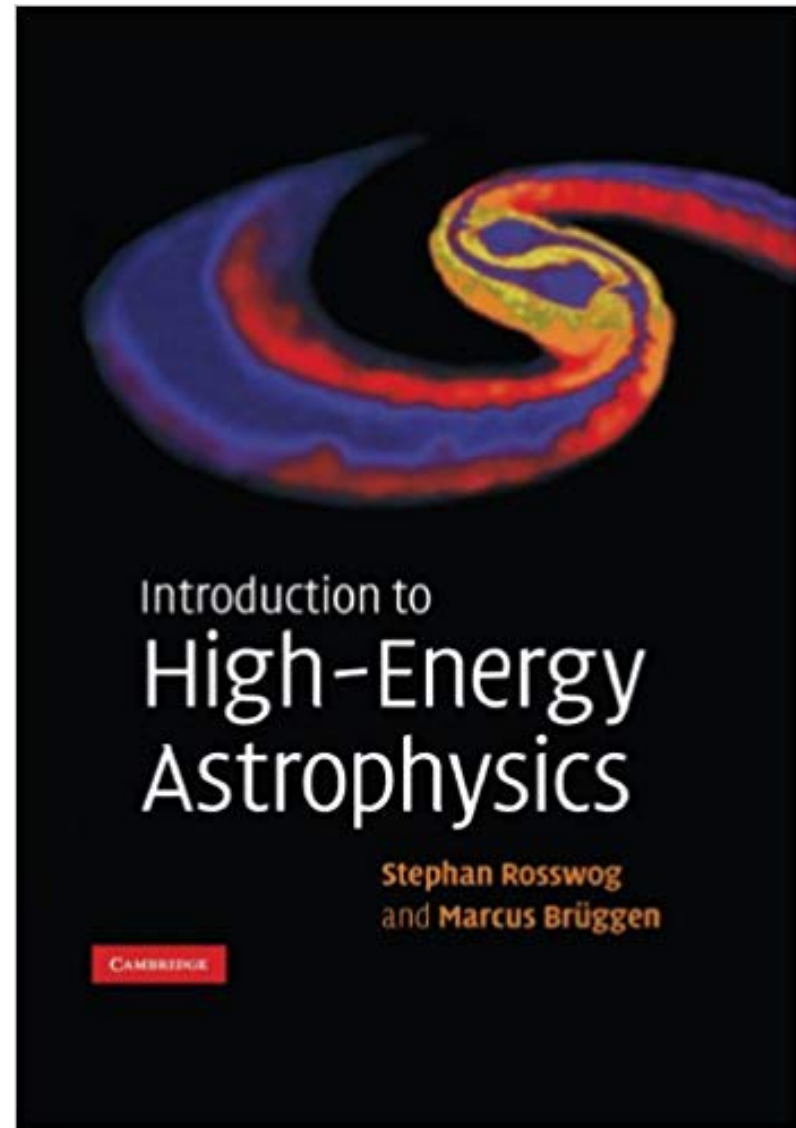
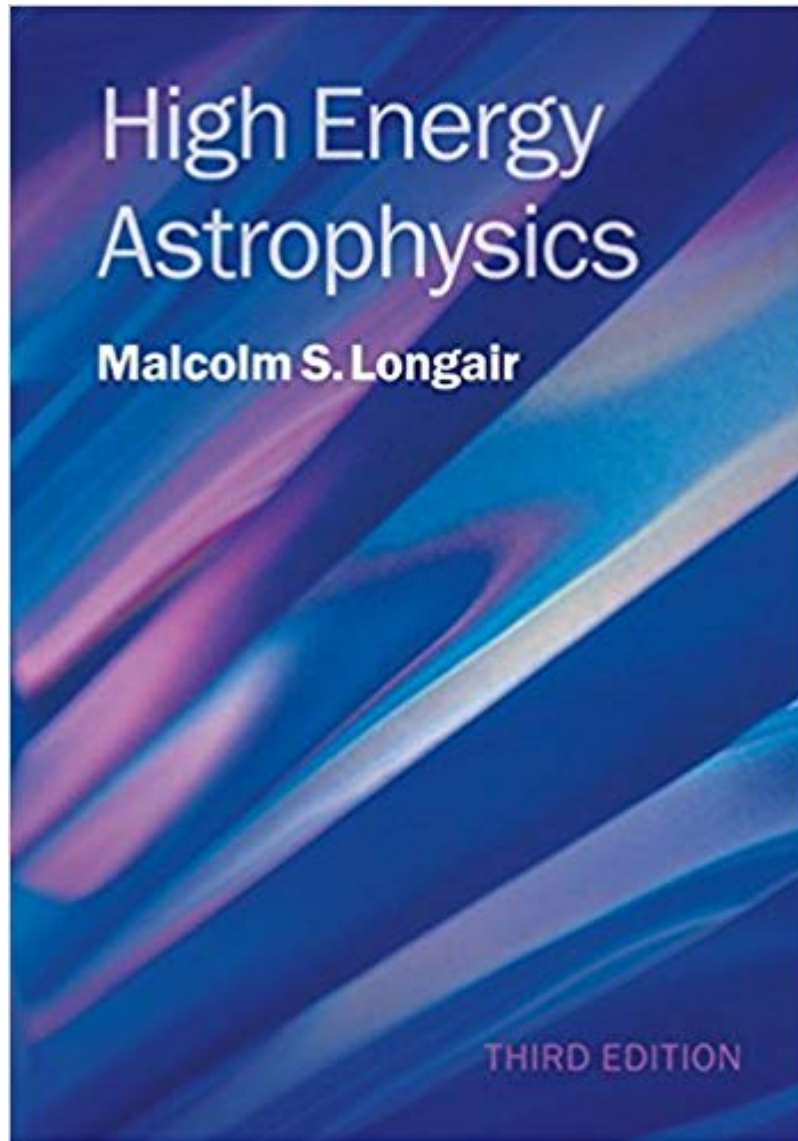
Data Analysis

- Gamma Ray data analysis
 - Analysis of MeV GRB data
 - Analysis of GeV Gamma ray data
 - Analysis of TeV Gamma ray simulated data
- Analysis of Multiwavelength data
 - Look for CR open data
- Simulations of Astroparticle experiments
 - G4 simulation toolkit introduction

Testi



Testi

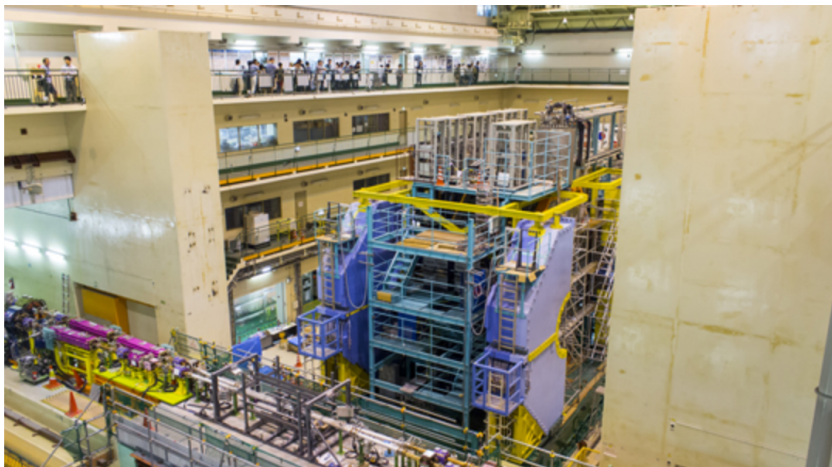


Astrofisica Nucleare e Subnucleare

Introduzione - 3

L'INFN

La fisica delle Astroparticelle



NEWS INFN

1 2 3 4 5

CIRCOLANO I PRIMI FASCI NELL'ACCELERATORE SUPERKEKB

Il 2 marzo 2016 per la prima volta sono stati iniettati e fatti circolare stabilmente dei fasci di particelle negli anelli dell'acceleratore SuperKEKB nel laboratorio KEK a Tsukuba, in Giappone. "È un traguardo importante nella messa a punto della macchina acceleratrice progettata per arrivare a una luminosità mai raggiunta finora, ben quaranta volte più alta..."
[Read more](#)

LINEE DI RICERCA

- 1 fisica delle **PARTICELLE** 
- 2 fisica delle **ASTROPARTICELLE** 
- 3 fisica **NUCLEARE** 
- 4 fisica **TEORICA** 
- 5 ricerca **TECNOLOGICA** 

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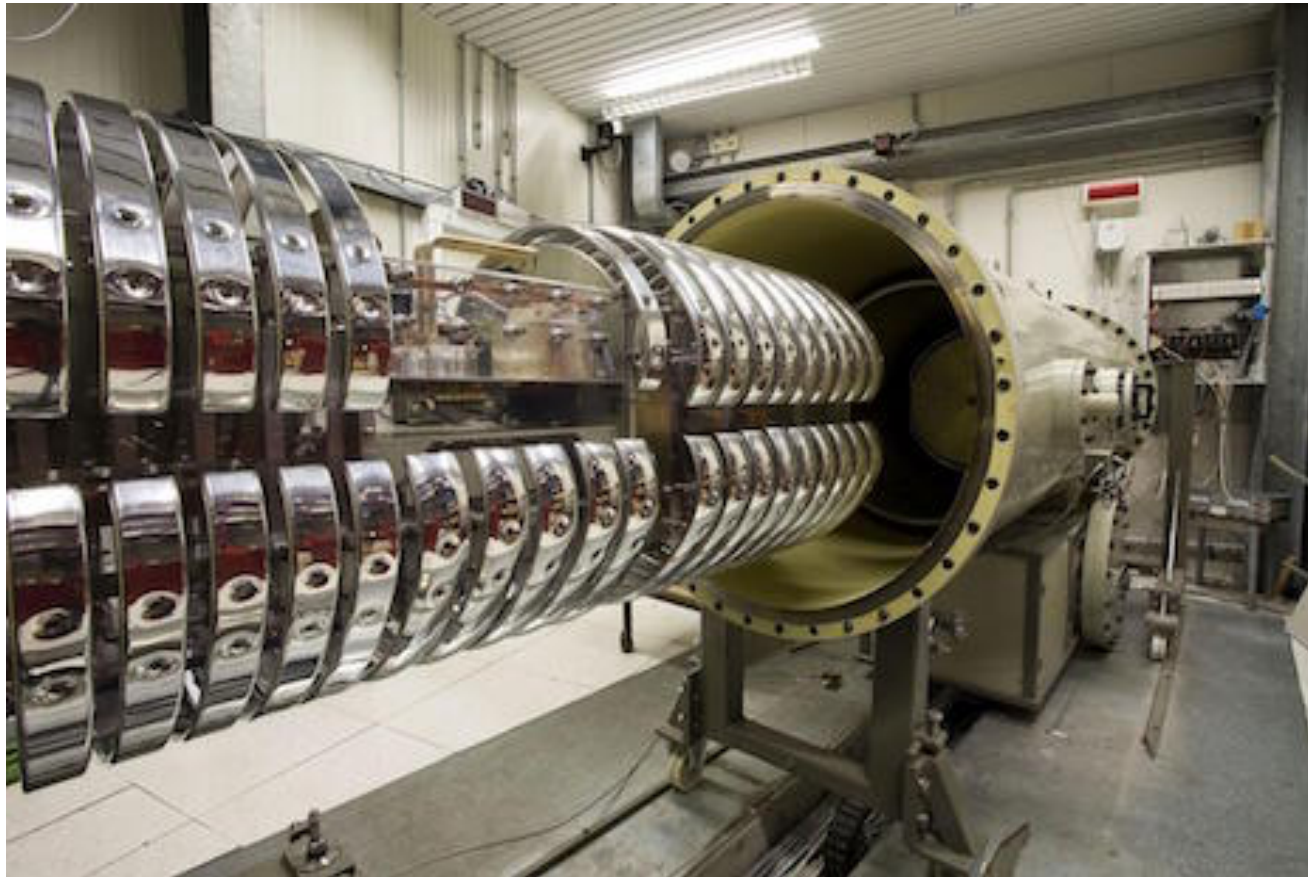


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I laboratori del Gran Sasso



I meccanismi delle Stelle



L'esperimento LUNA

La Materia Oscura



L'esperimento DAMA

I laboratori Nazionali del Sud



Istituto Nazionale di Fisica Nucleare Laboratori Nazionali del Sud



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Laboratory

- Home
- Accelerators
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Users

- LNS Users Group
- User support
- Access info
- Guest house
- Contacts
- Scientific Committee
- Online Submission

Utilities

- Document server
- Phonebook
- Webmail
- New webmail
- LNS visits calendar

Announcements

Publicati i risultati di una interessante ricerca sui capodogli, in transito nello Jonio, grazie all'ascolto dei loro suoni. Info sulla rivista Plos one.

Upcoming Events

- Tue 26-Apr-2016 Joint LIA COLL--AGAIN
- Wed 7-Sep-2016 III ELIMED Workshop

LNS activity overview

 <p>Nuclear Physics</p>	 <p>Accelerators</p>	 <p>Astroparticle Physics</p>
 <p>Detector systems</p>	 <p>Ion Sources</p>	 <p>Theory</p>
 <p>INFN-Energy</p>	 <p>Protontherapy</p>	 <p>Multidisciplinary facilities</p>



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JOBS

- Job opportunities
- LNS presentation
- Presentazione LNS
- Recent events/news

Focus on

- SMO
- CATANA
- CHIMERA
- FRIBS
- MAGNEX
- Irradiation Facility
- NUMEN

Service links

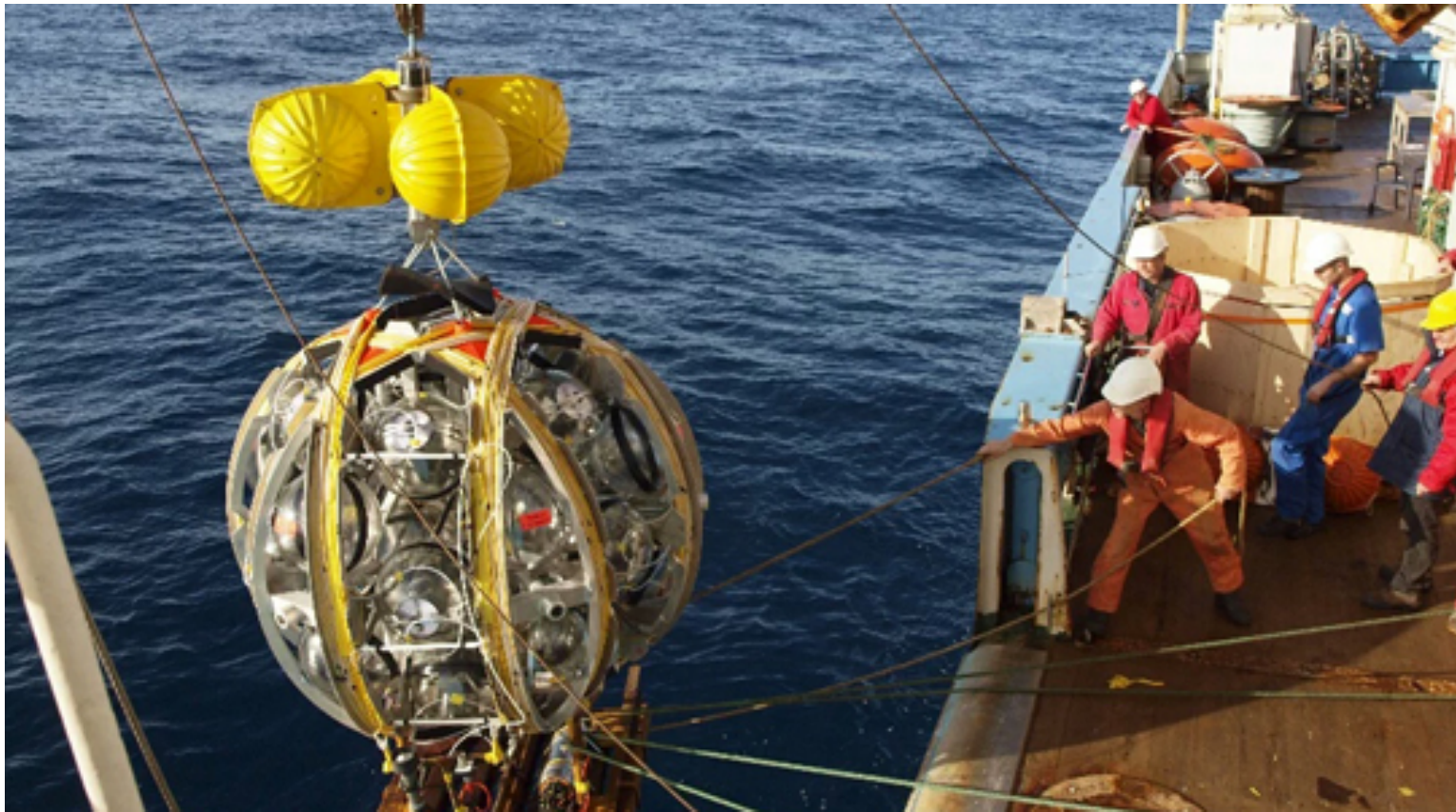
- Avvisi aggiudicazione
- Administration
- Fattura elettronica (e-Invoice)
- Secretariat
- Meeting rooms (internal)

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I neutrini astrofisici



I neutrini astrofisici



I laboratori Nazionali di Legnaro



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LNL Seminars

[Managing a high intensity high energy cyclotron for medical applications](#)

Dr. Ferid Haddad and Dr. Nicolas Varmentot (GIP Arronax, France)

Thursday, 21 January 2016 from 15:00 to 16:00 C. Villi meeting room

[Sviluppo e caratterizzazione della sorgente di ionizzazione al plasma del progetto SPES](#)

Dr. Fabio Visentin

Friday, 22 January 2016 from 14:15 to 15:15 Rostagni meeting room

[Archiver Appliance to EPICS control systems](#)

Dr. Thomas Birke (Helmholtz-Zentrum Berlin für Materialien und Energie GmbH)

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Benvenuti ai Laboratori Nazionali di Legnaro (LNL)



I LNL sono uno dei quattro laboratori nazionali dell'Istituto Nazionale di Fisica Nucleare (INFN). La missione principale dei LNL riguarda la ricerca di base nella fisica e astrofisica nucleare assieme alle applicazioni di tecnologie nucleari.

Più di 800 ricercatori da ogni parte del mondo partecipano ai programmi di ricerca in corso. Ai LNL prestano servizio 250 persone, metà di quali sono dipendenti dell' INFN (fisici, ingegneri, tecnici ...), la restante parte proviene da università e centri di ricerca nazionali o stranieri. Il bilancio dei LNL si aggira sui 20 milioni di Euro all'anno, di cui metà dedicata alle spese di gestione e ricerca, l'altra metà al personale. Punti di forza dei laboratori sono la realizzazione di acceleratori di particelle nucleari e lo sviluppo di rivelatori di radiazioni nucleari.

LNL Events

[Intense and Powerful Accelerator Beams for industrial and energy application \(IPAB2016\)](#)

14 - 15 March 2016, INFN-LNL

[All events](#)

USEFUL LINKS

[INFN Portal](#)

[INFN Amministrazione Centrale](#)

[INFN Presidenza](#)

[Travelling](#)

www.lnl.infn.it

Le onde gravitazionali

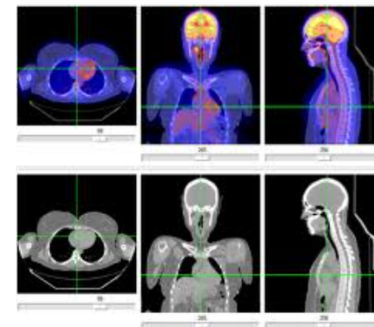


Il progetto SPES



SPES: il progetto principale del laboratorio

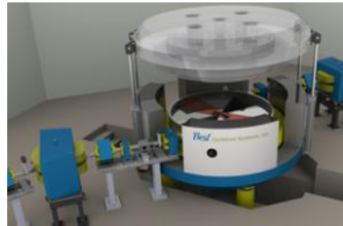
- **SPES= Selective Production of Exotic Species**
- **studio di nuclei atomici prodotti nelle fasi avanzate dell'evoluzione stellare**
- **produzione di radioisotopi di interesse sanitario**
- **In breve , dalle stelle alla società**



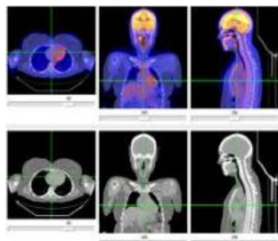
Il progetto SPES



Le quattro fasi del progetto SPES



**Ciclotrone e
infrastruttura**



**Radioisotopi per
la salute**



**Facility per fasci
di ioni radioattivi**



**Sorgenti di
neutroni basate
su acceleratori**

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