



La fisica delle stelle

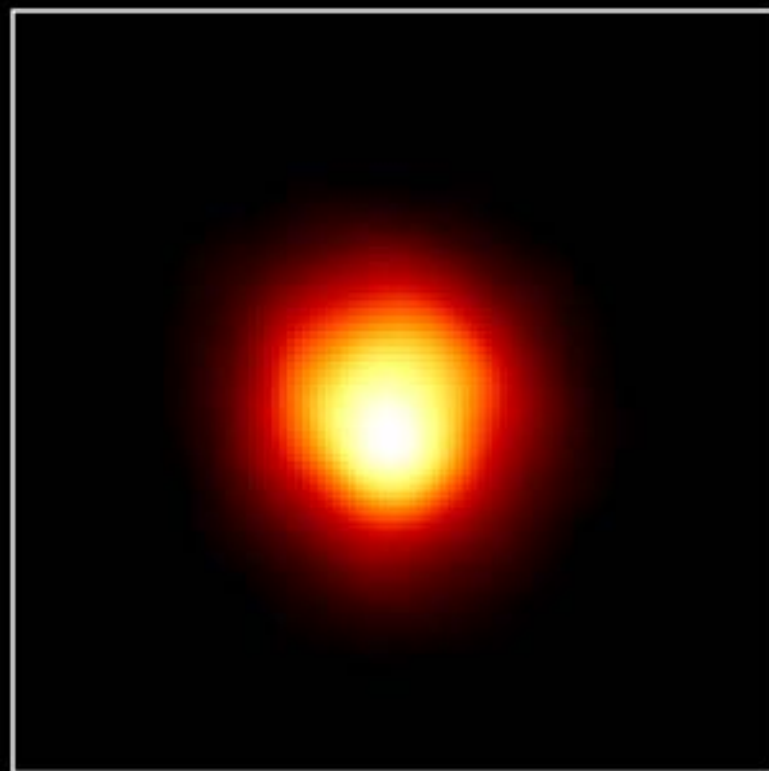
Lucio Gialanella

Dipartimento di Matematica e Fisica

Seconda Università di Napoli and INFN – Napoli



© Ladányi Tamás / astrophoto.hu



Size of Star



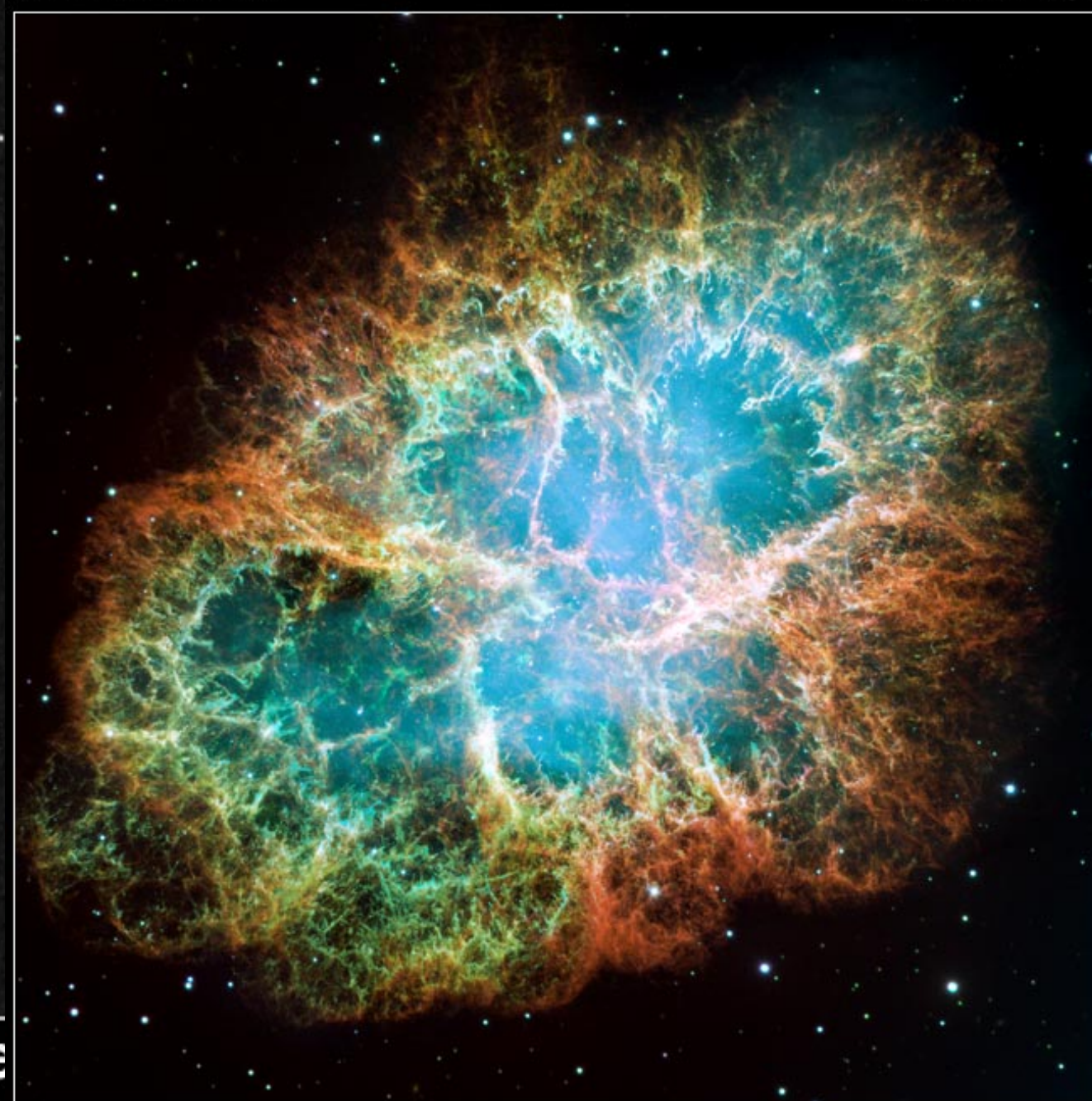
Size of Earth's Orbit

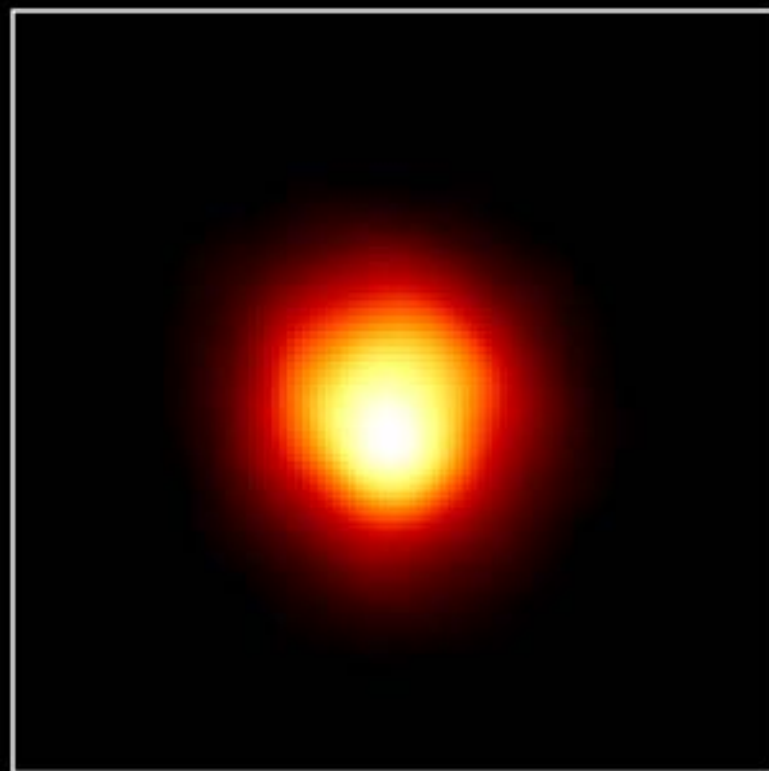


Size of Jupiter's Orbit

Atmosphere of Betelgeuse

PRC96-04 · ST ScI OPO · January 15, 1995 · A.





Size of Star



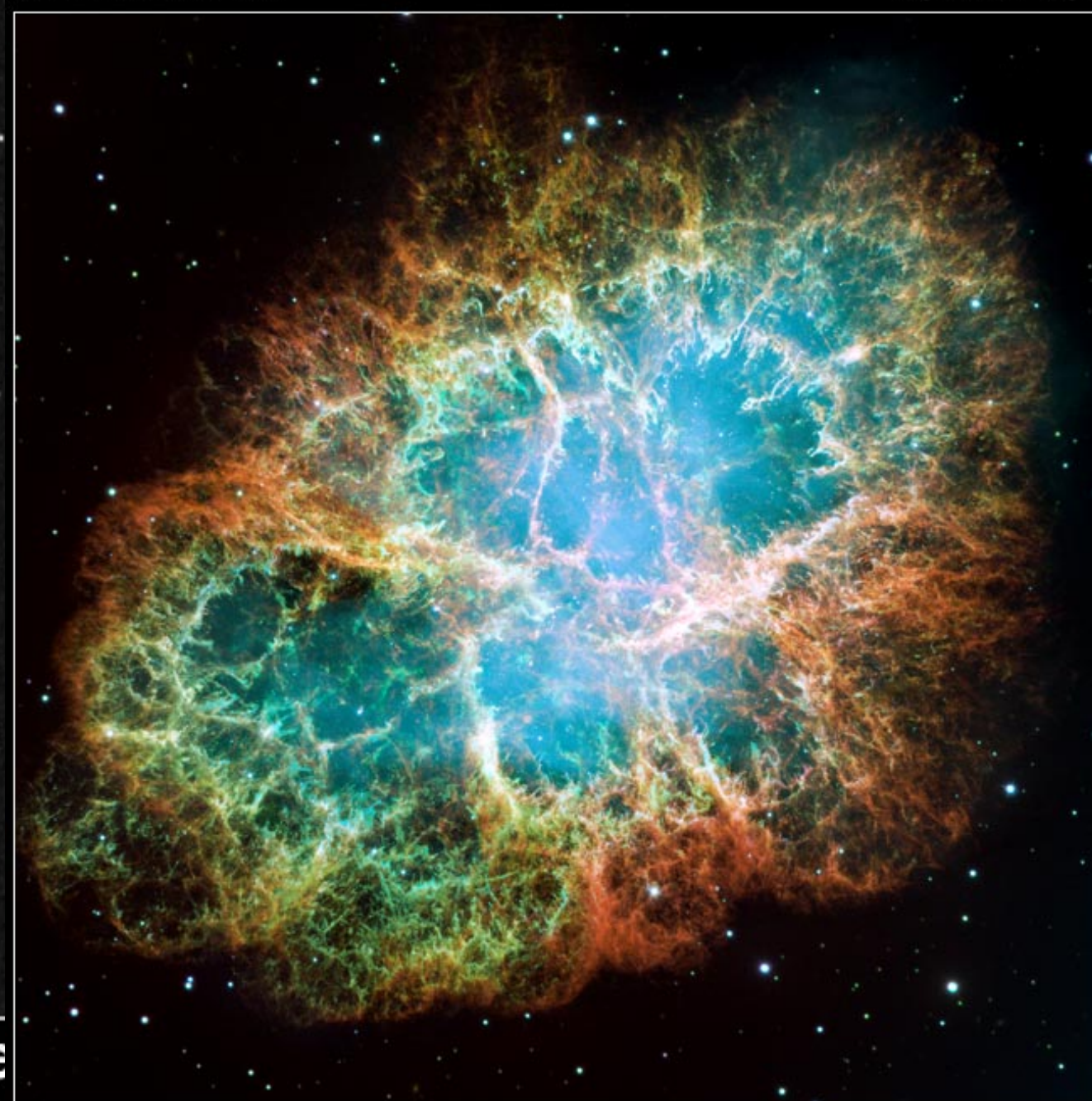
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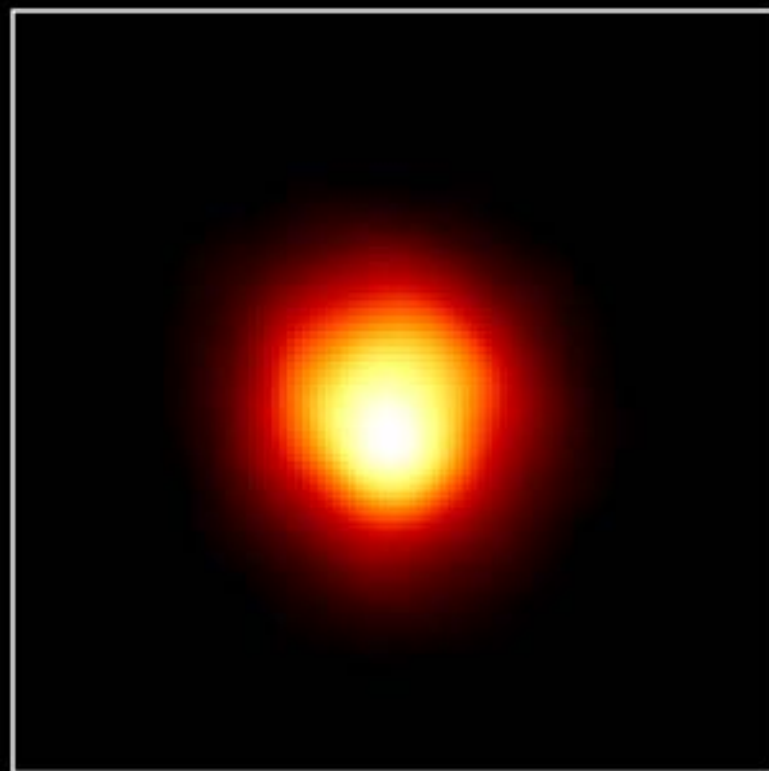


Size of Jupiter's Orbit

Atmosphere of Betelgeuse

PRC96-04 · ST ScI OPO · January 15, 1995 · A.





Size of Star



Size of Earth's Orbit



Size of Jupiter's Orbit

Atmosphere of Betelgeuse

PRC96-04 · ST ScI OPO · January 15, 1995 · A.

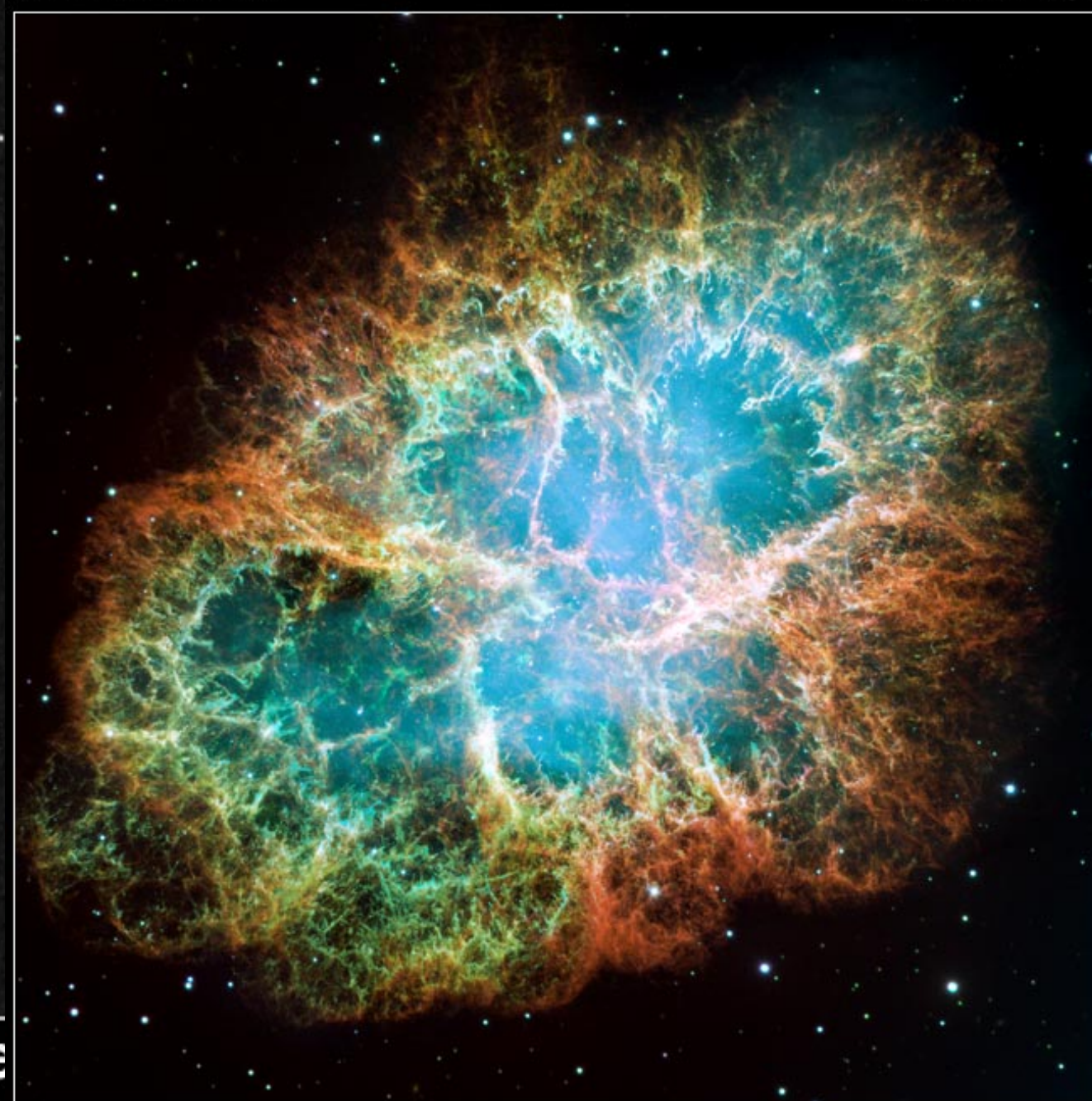


Diagramma HR

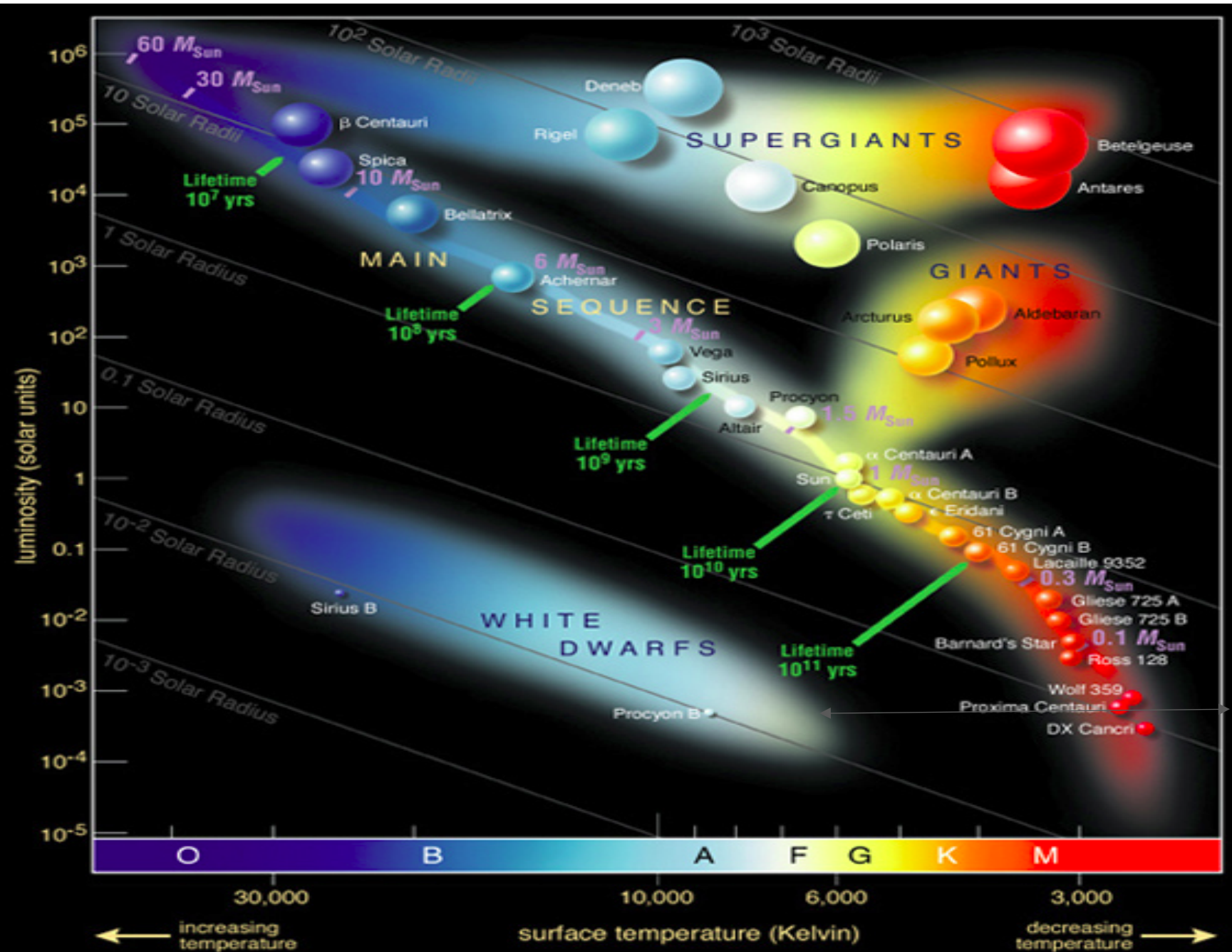
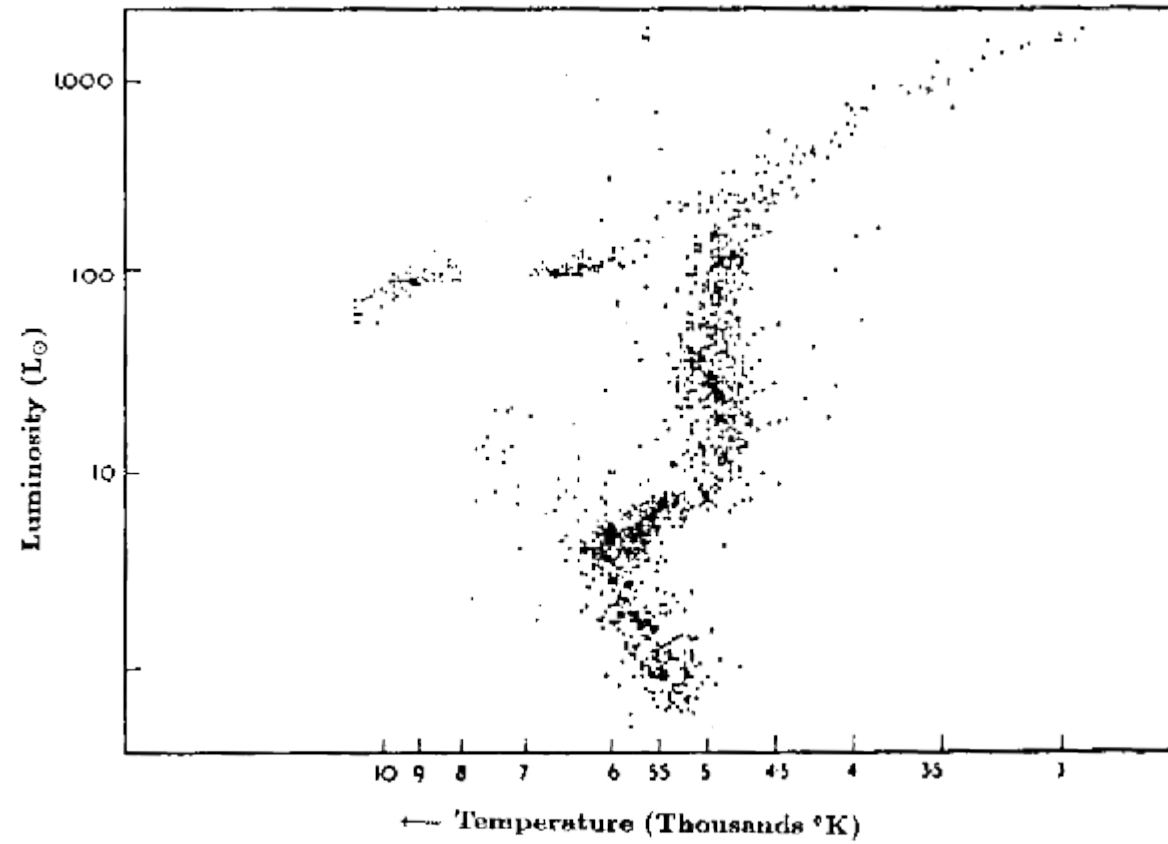
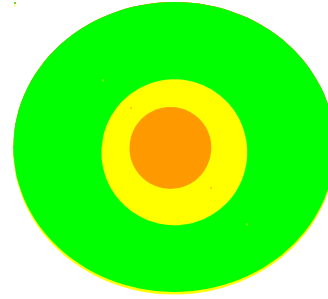
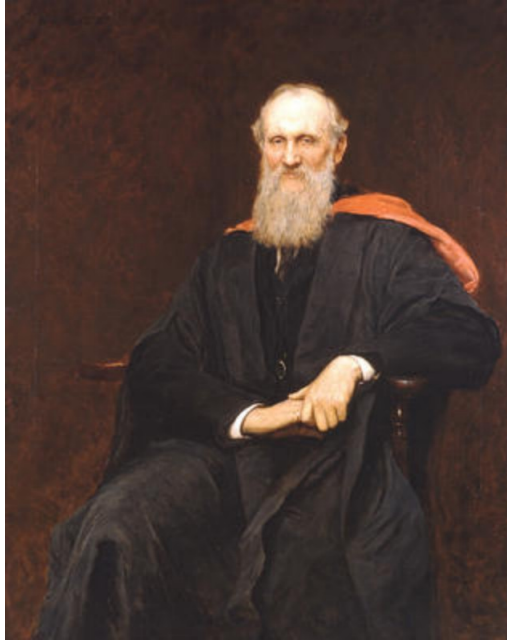
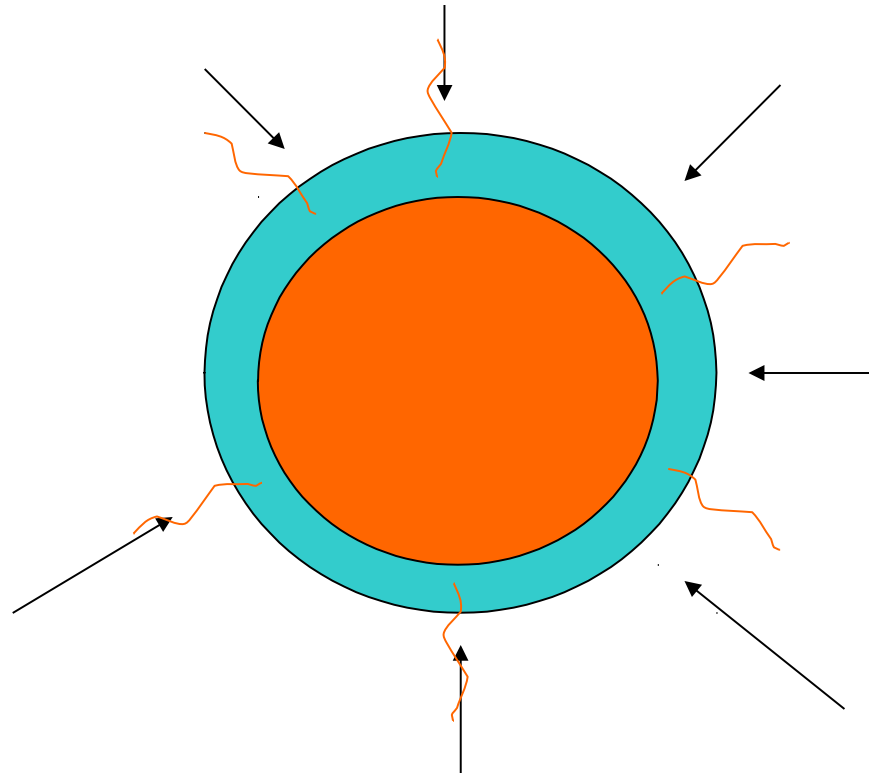


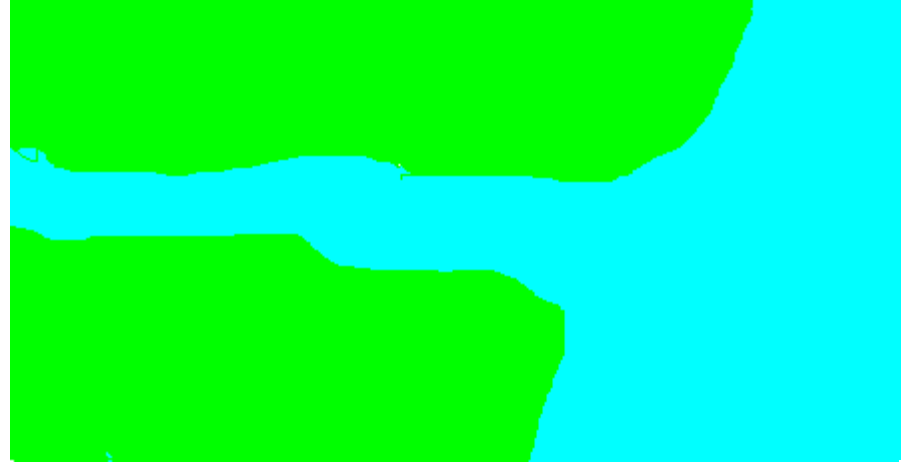
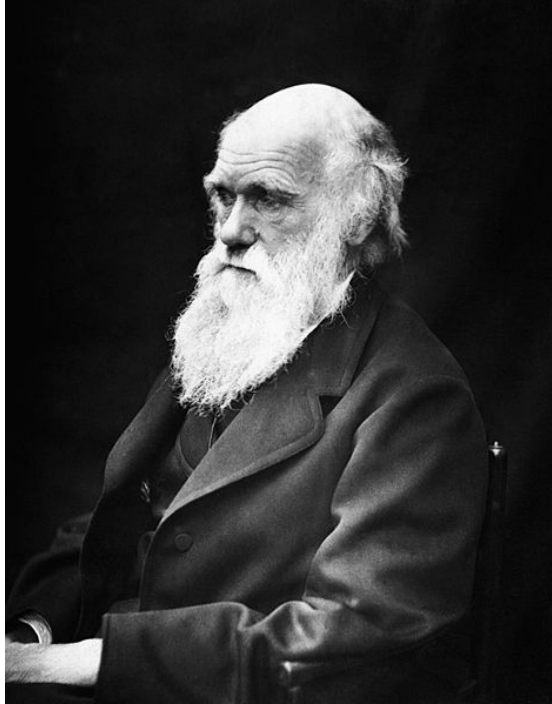
Diagramma HR per ammassi globulari





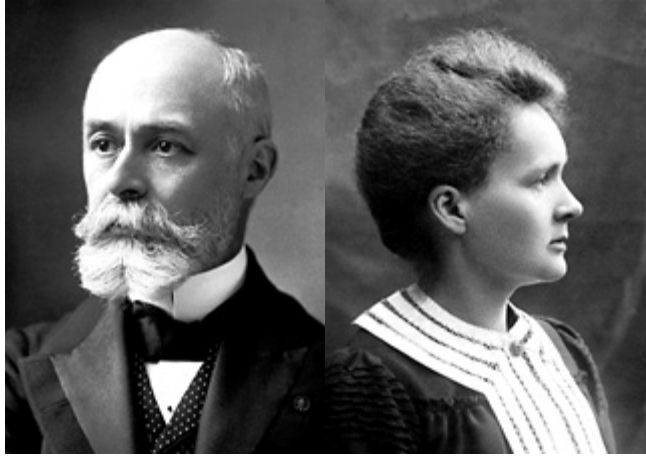
Energia potenziale gravitazionale
Luminosità/energia totale = 30 milioni di anni



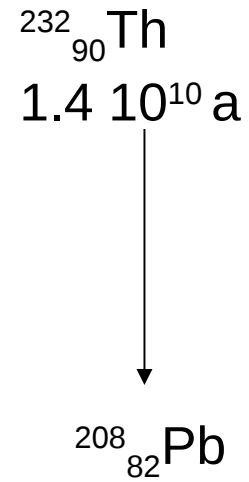
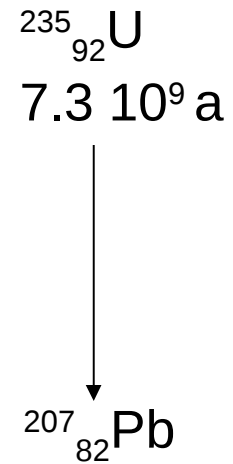
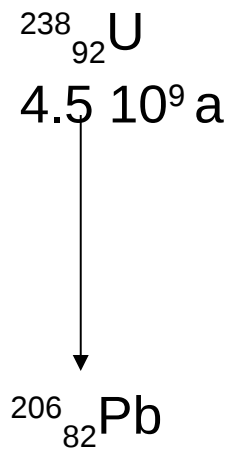


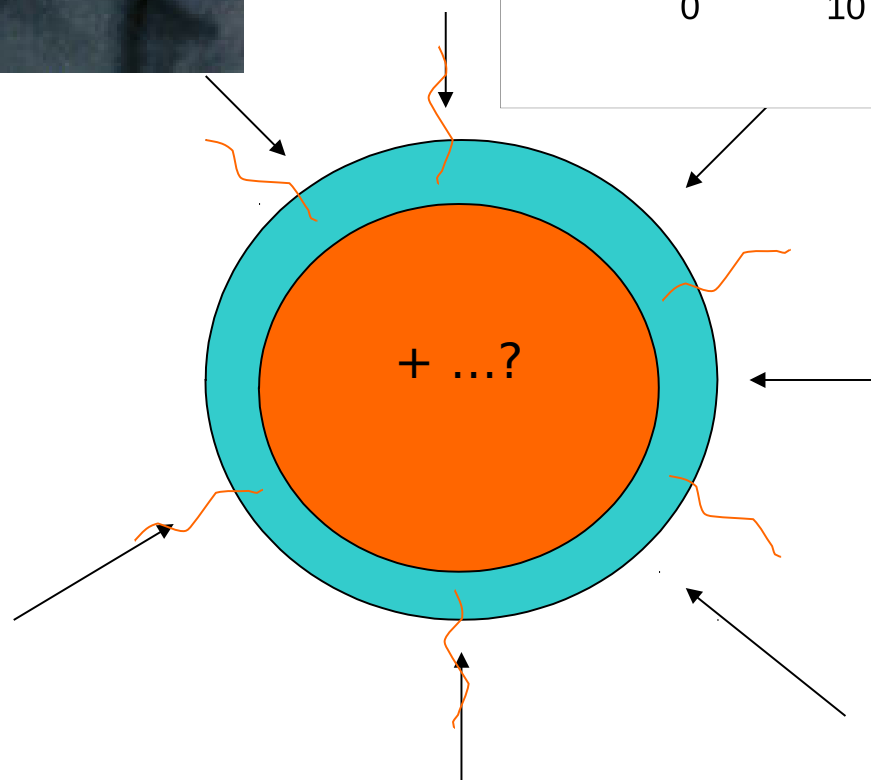
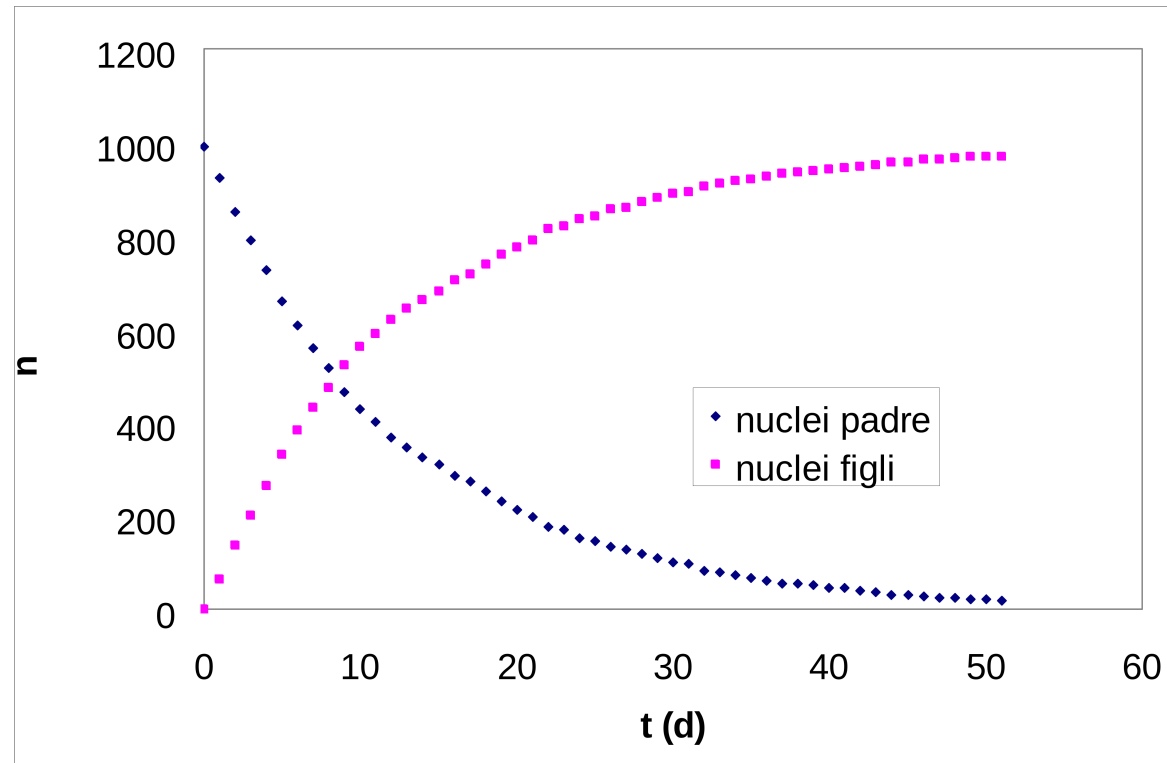
Evidenze biologiche e geologiche:

300-400 milioni di anni



Serie radioattive e reazioni nucleari

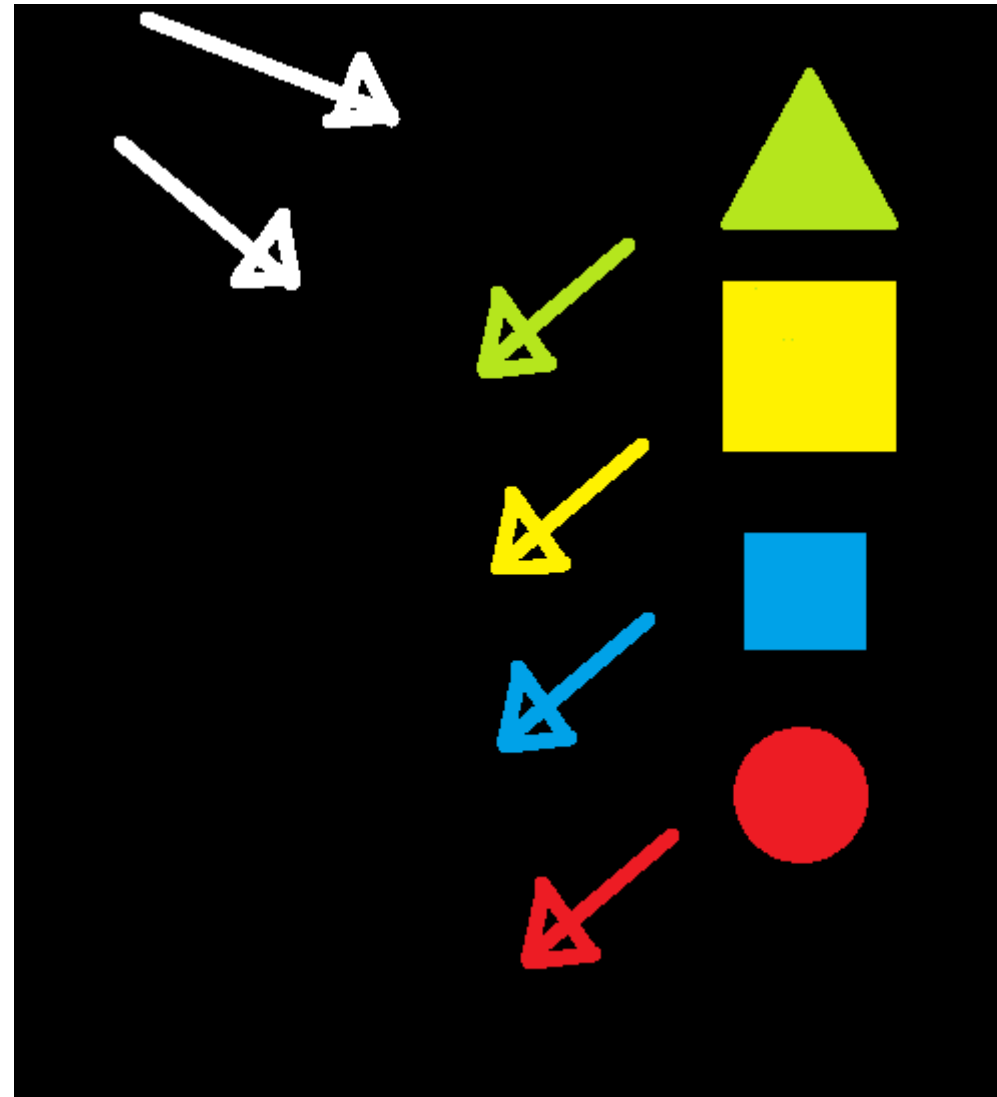




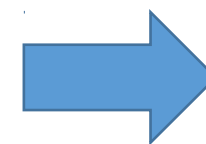
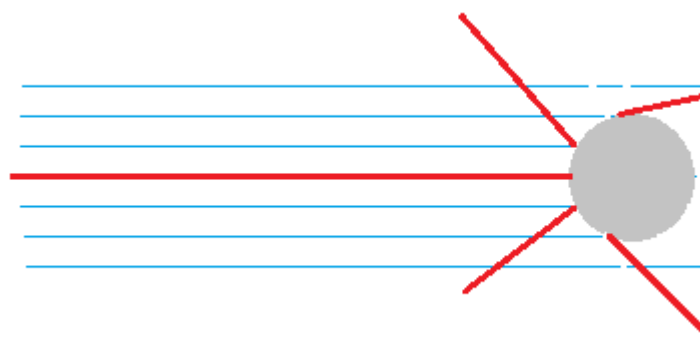
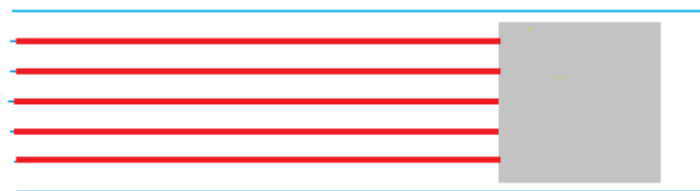
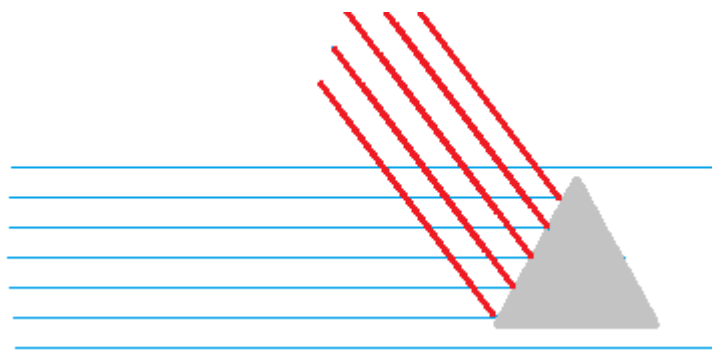
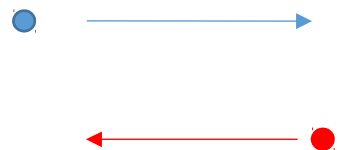
4.5 miliardi di anni

La Terra può essere più vecchia del Sole?

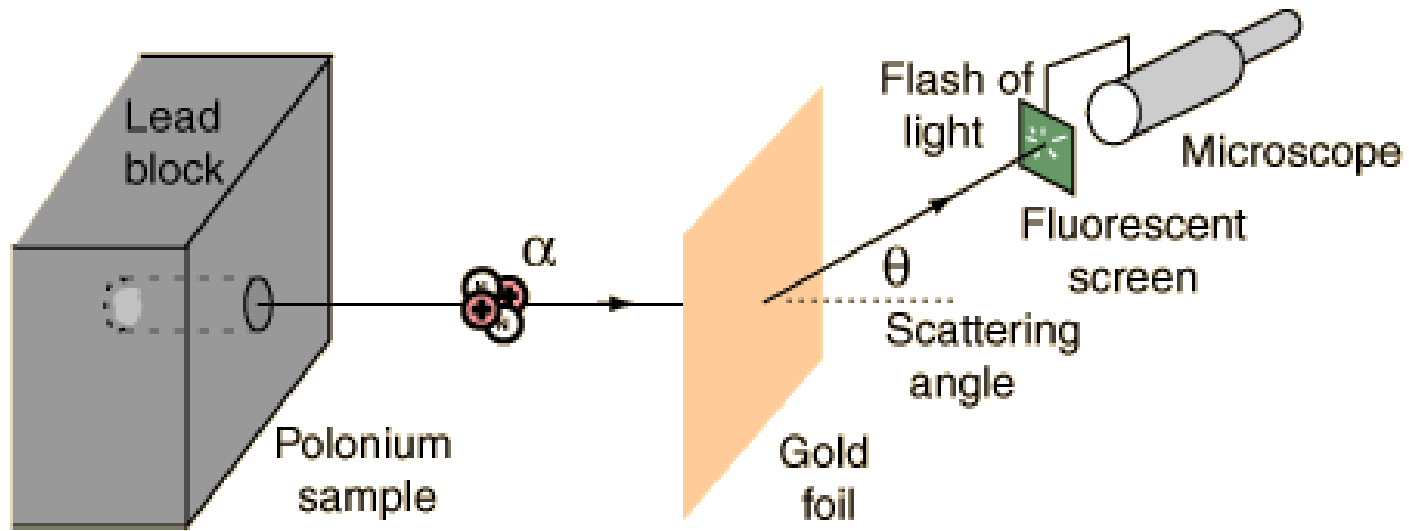
Come
vediamo?



n alternativa



Sezione d'urto
di interazione



<http://hyperphysics.phy-astr.gsu.edu/hbase/rutsca.html>

Modello atomico di Rutherford

$$R_N \approx 1.22 A^{1/3} 10^{-15} m$$

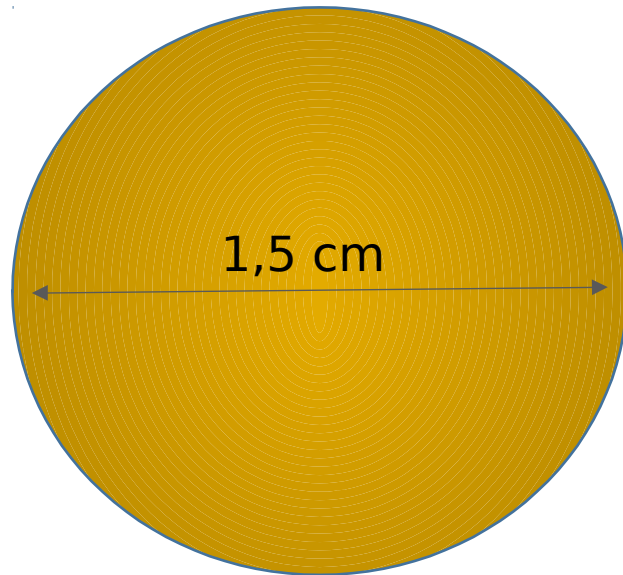
$$M_N \approx A \cdot 2 \cdot 10^{-27} kg$$

$$\rho_N = \frac{M_N}{\frac{4}{3}\pi R_N^3} \approx \frac{2 \cdot 10^{-27} kg}{8 \cdot 10^{-45} m^3} \approx 2.5 \cdot 10^{17} \frac{kg}{m^3}$$

In Europa ci sono circa 250 milioni di auto



In Europa ci sono circa 250 milioni di auto





$10^{-15} m$

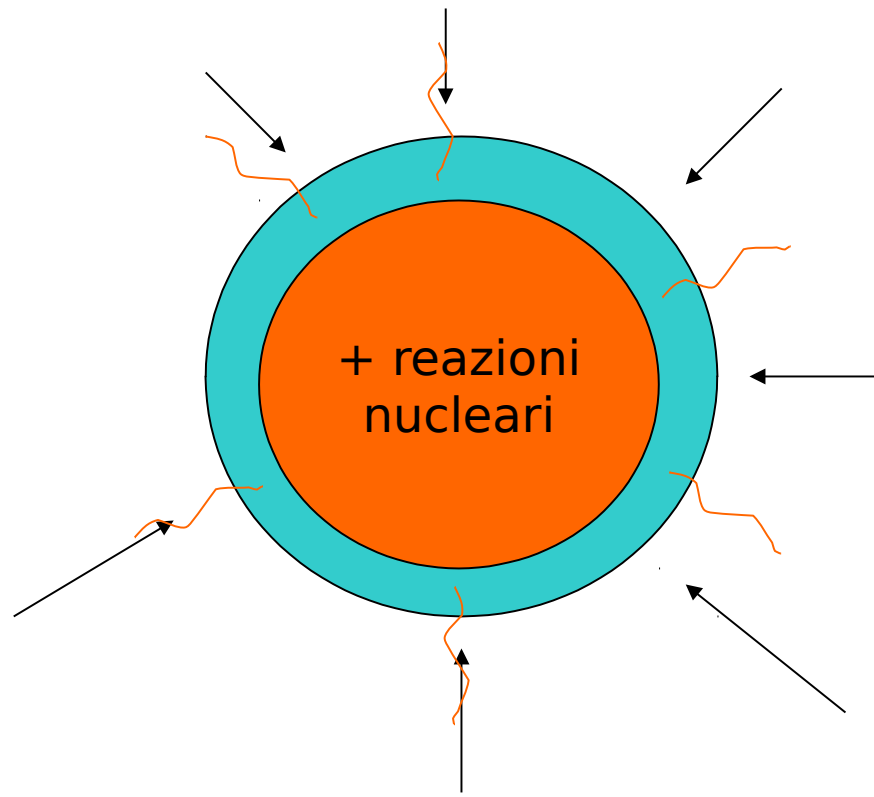
$10^{27} kg$

Modello atomico di Rutherford

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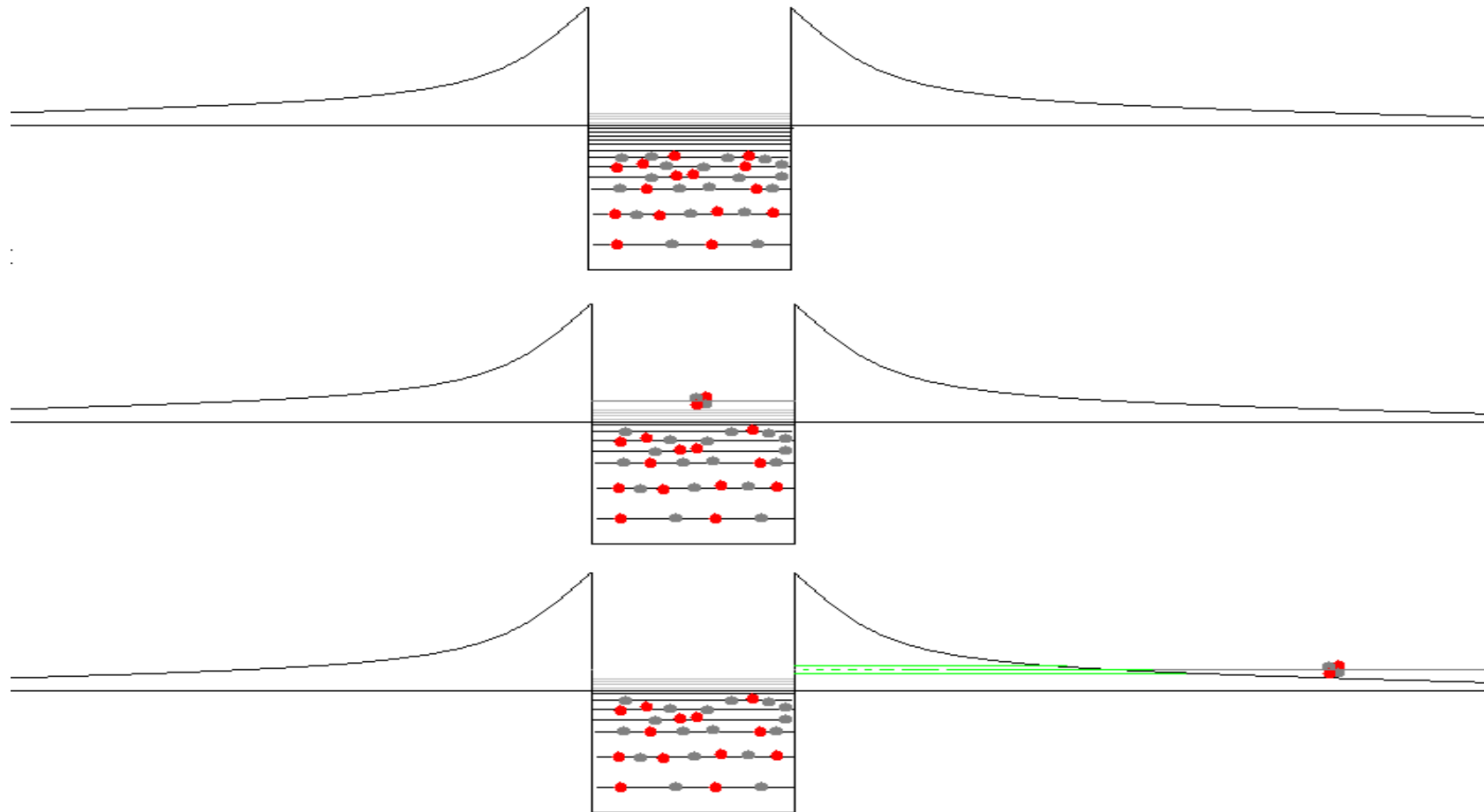
Ogni secondo 4
milioni di tonnellate di
materia solare
si trasformano in energia

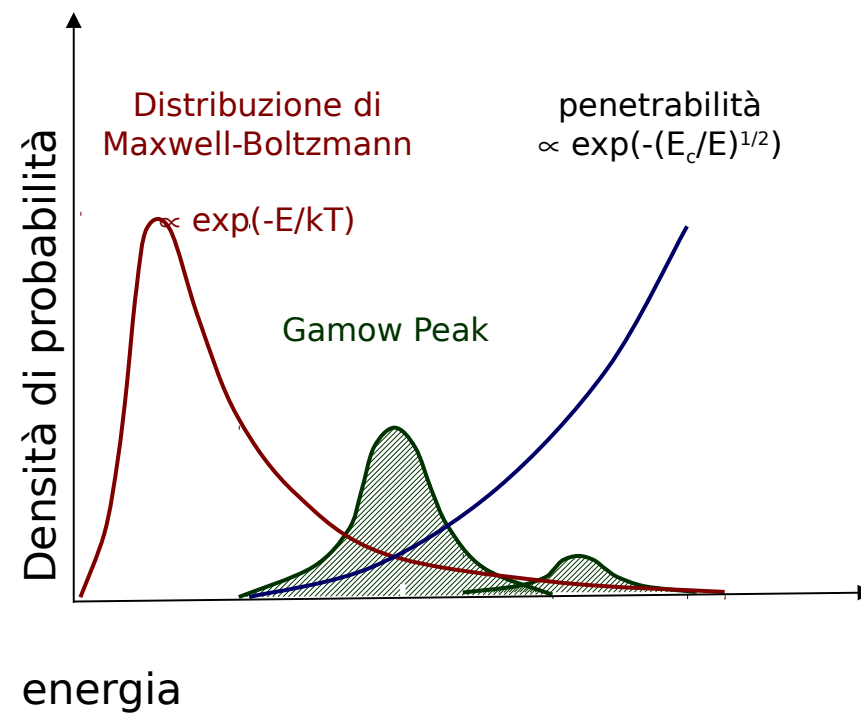
$$E=mc^2$$

Luminosità/energia totale = 10 miliardi di anni

Radioattività

decadimento α





$$E_0 = f(Z_1, Z_2, T)$$

$$E_0 = 1.22 (Z_1^2 Z_2^2 \mu T_6^2)^{1/3} \text{ keV}$$

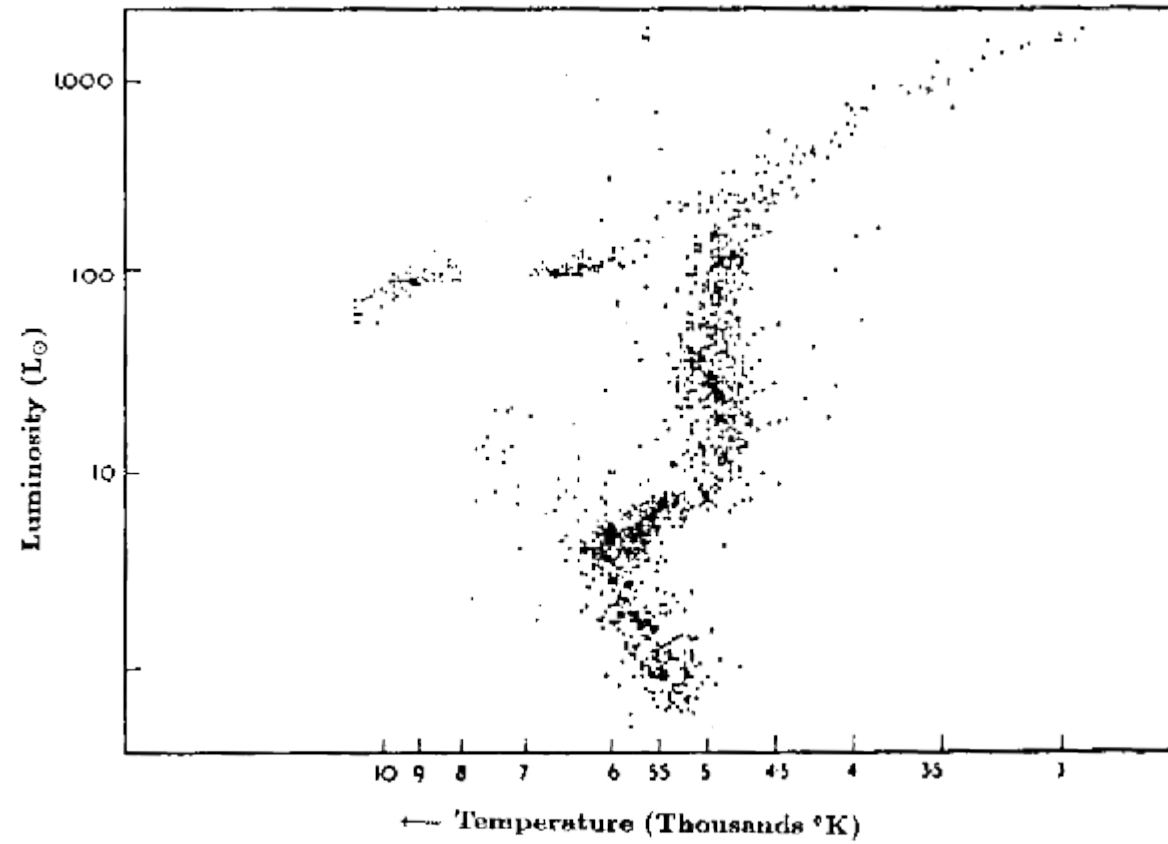
Sole : $T_6 = 15 \cdot 10^6$
K

reaction	$E_0(\text{keV})$	Integral
p+p	5.9	$7 \cdot 10^{-6}$
$\alpha + {}^{12}\text{C}$	56	$5.9 \cdot 10^{-56}$
${}^{16}\text{O} + {}^{16}\text{O}$	237	$2.5 \cdot 10^{-237}$

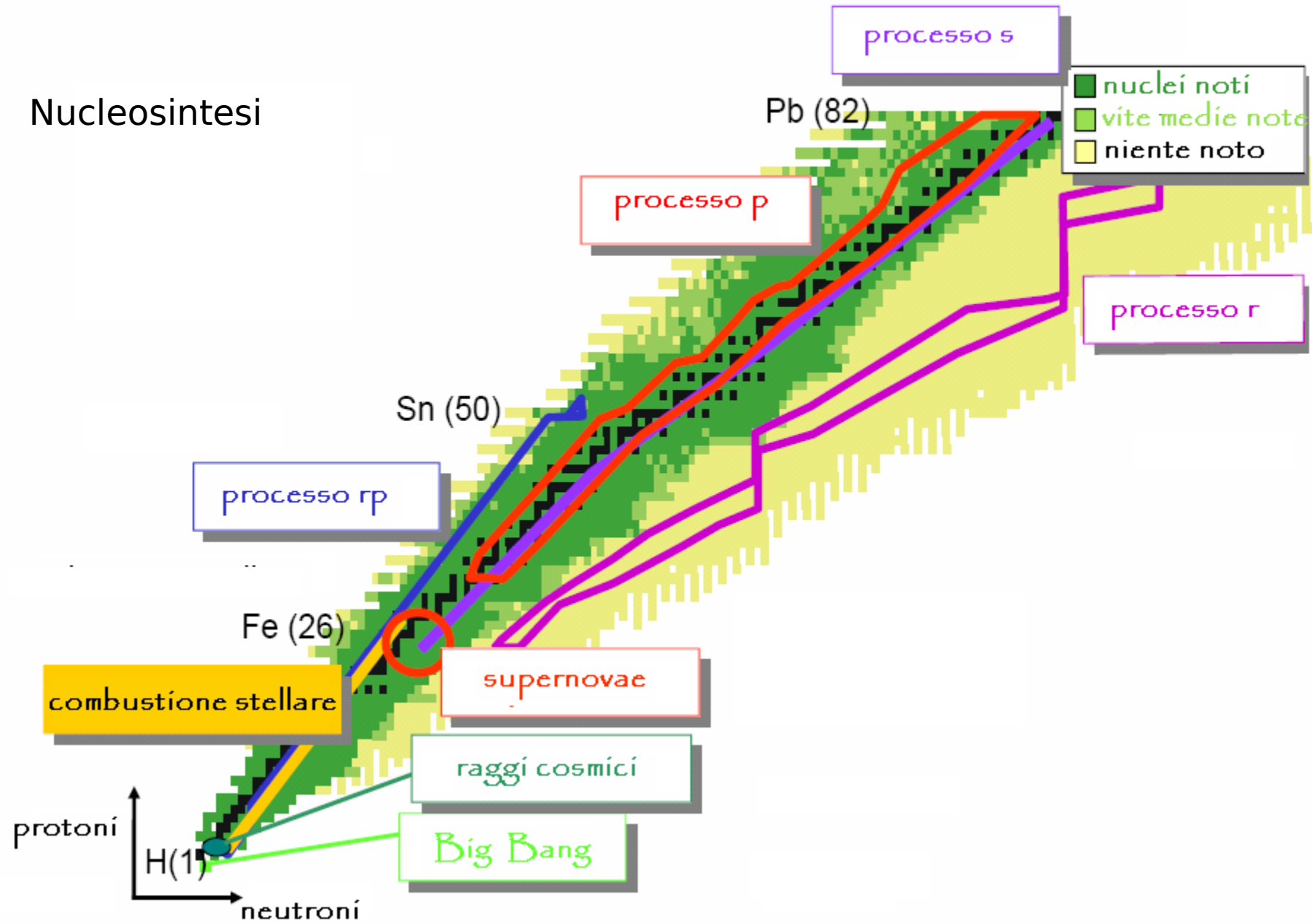
→ Fasi separate

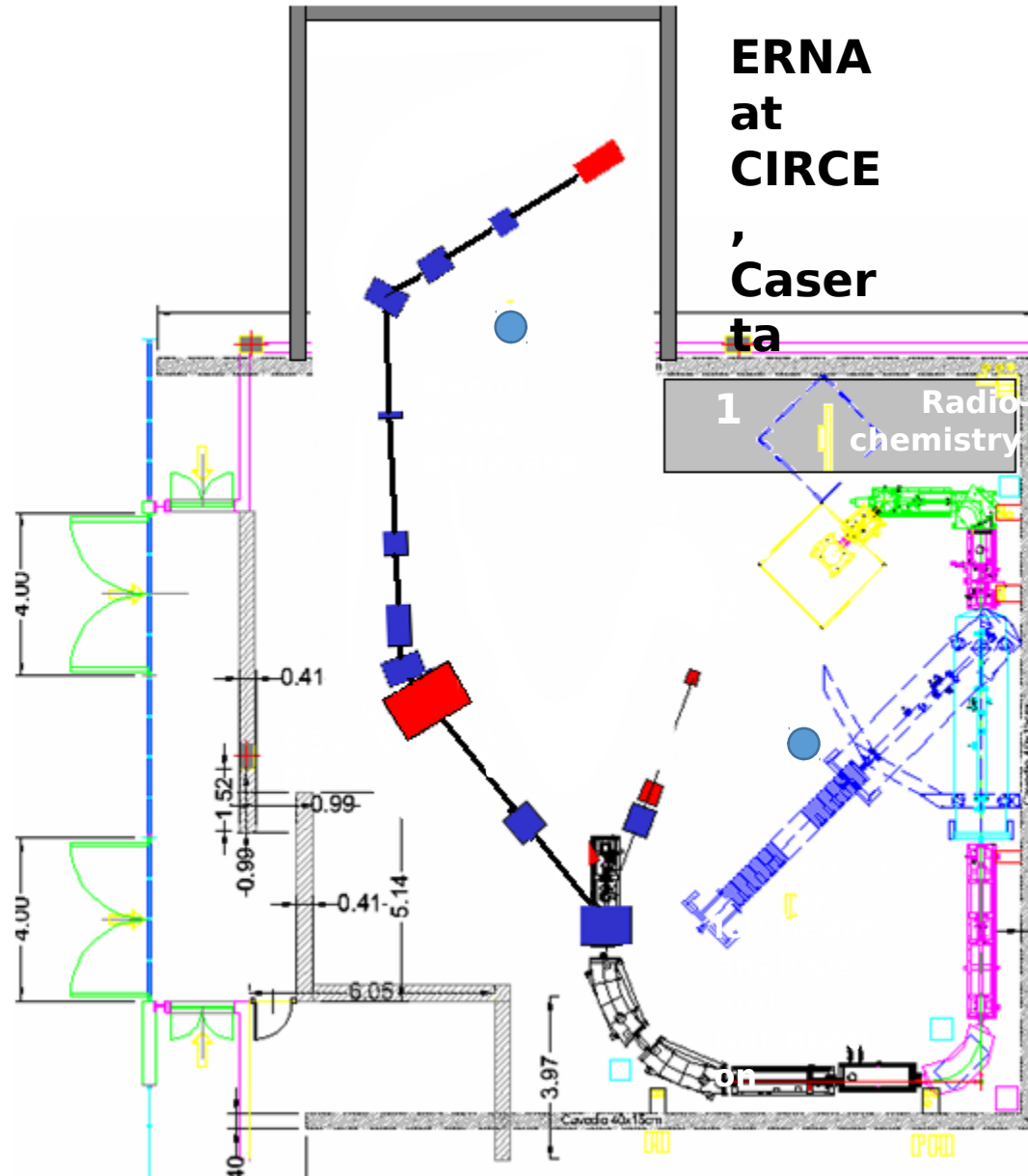
$$\Rightarrow 10^{-21} \text{ barn} < \sigma < 10^{-9} \text{ barn}$$

Diagramma HR per ammassi globulari



Nucleosintesi





**ERNA
at
CIRCE
,
Caser
ta**

3MV Pelletron
High intensity stable and
radioactive (${}^{7,10}\text{Be}$) ion beams
(possible ${}^{26}\text{Al}$)

Plans:

${}^7\text{Be}(p,\gamma){}^8\text{B}$

${}^{12}\text{C}(\alpha,\gamma){}^{16}\text{O}$

${}^{16}\text{O}(\alpha,\gamma){}^{20}\text{Ne}$

${}^{33}\text{S}(p,\gamma){}^{34}\text{Cl}$

${}^{14,15}\text{N}(\alpha,\gamma){}^{18,19}\text{F}$

SHE in nature

One Look Is Worth A Thousand Words--

One look at our line of Republic, Firestone, Miller and United States tires can tell you more than a hundred personal letters or advertisements.

WE WILL PROVE THEIR VALUE BEFORE YOU INVEST ONE DOLLAR IN THEM.

Ever consider buying Supplies from a catalog?

What's the use! Call and see what you are buying. One look at our display of automobile and motorcycle accessories will convince you of the fact.

THAT WE HAVE EVERYTHING FOR THE AUTO

Piqua Auto Supply House

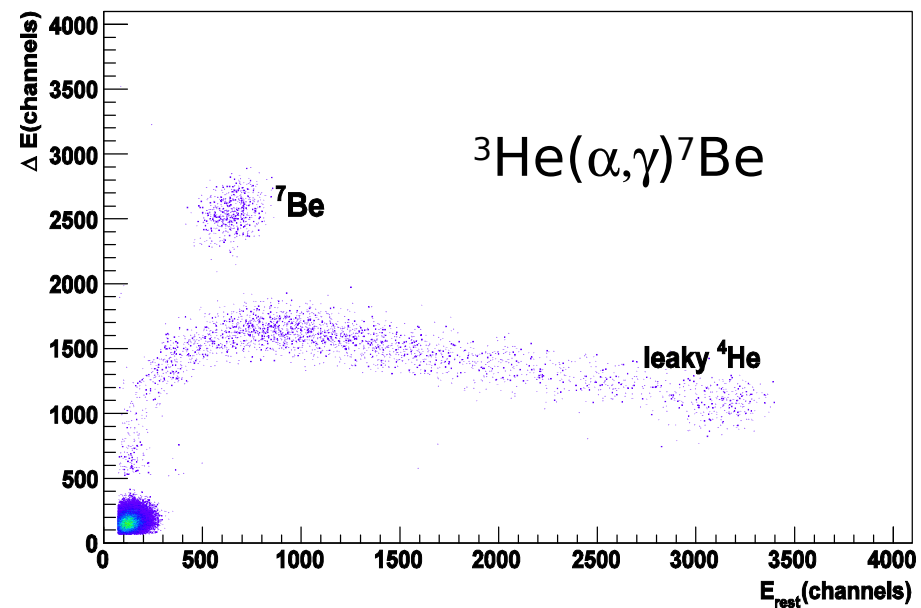
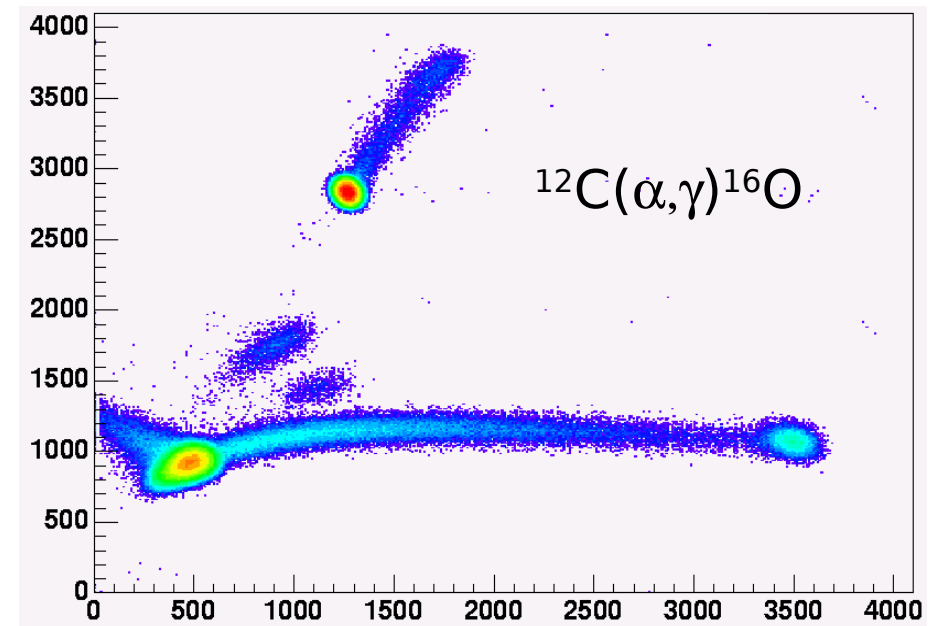
133 N. Main St.—Piqua, O.

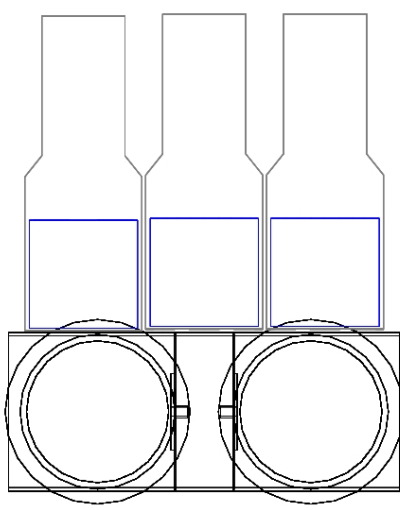
Recoil detection

Soppressione del
fascio incidente

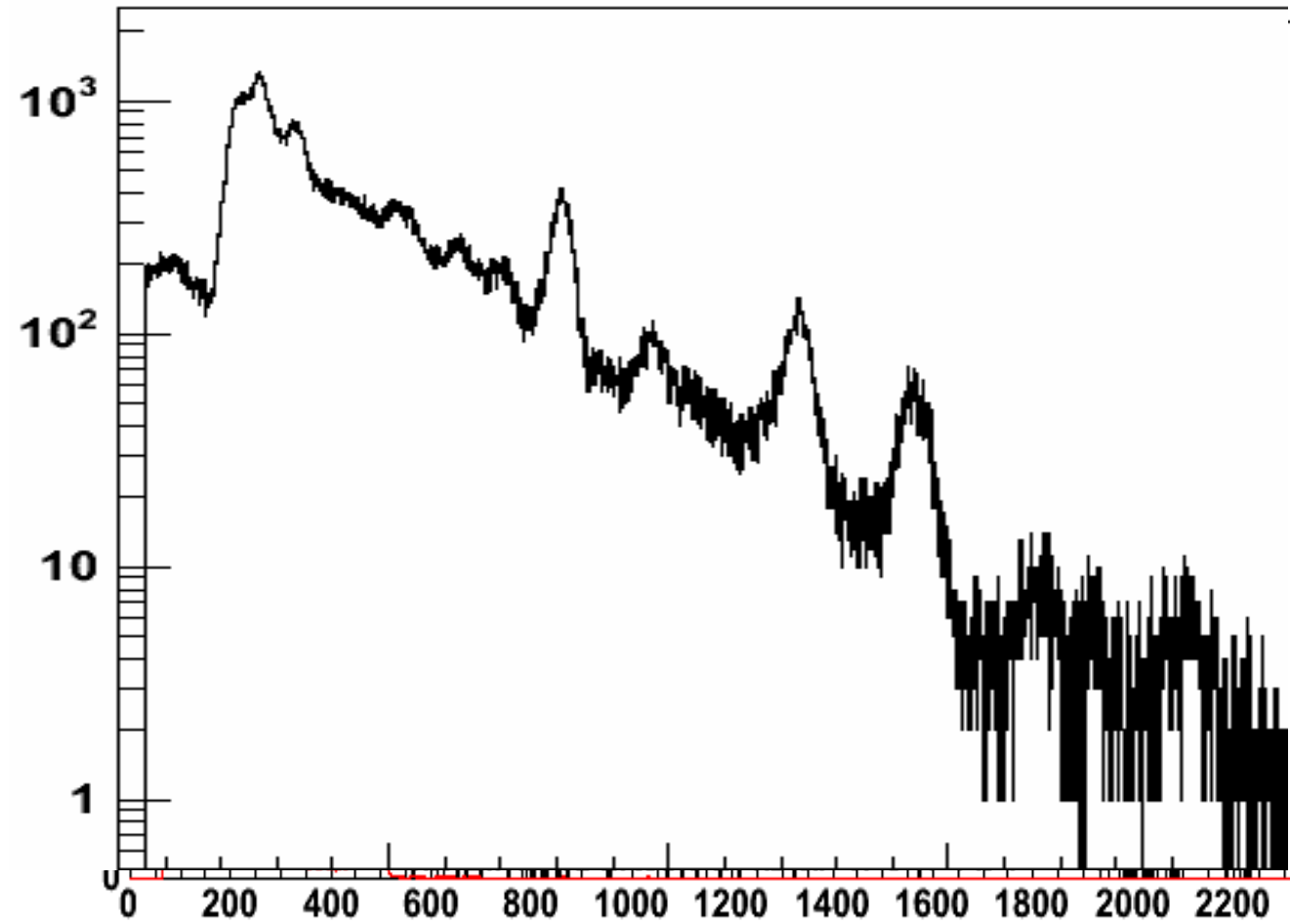
Separatore: 10^{-10} - 10^{-11}

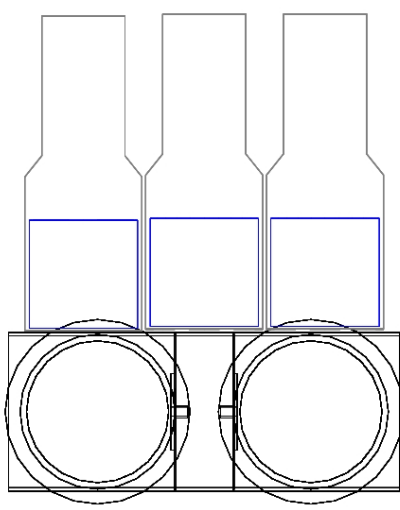
Rivelatore : 10^{-3} - 10^{-6}



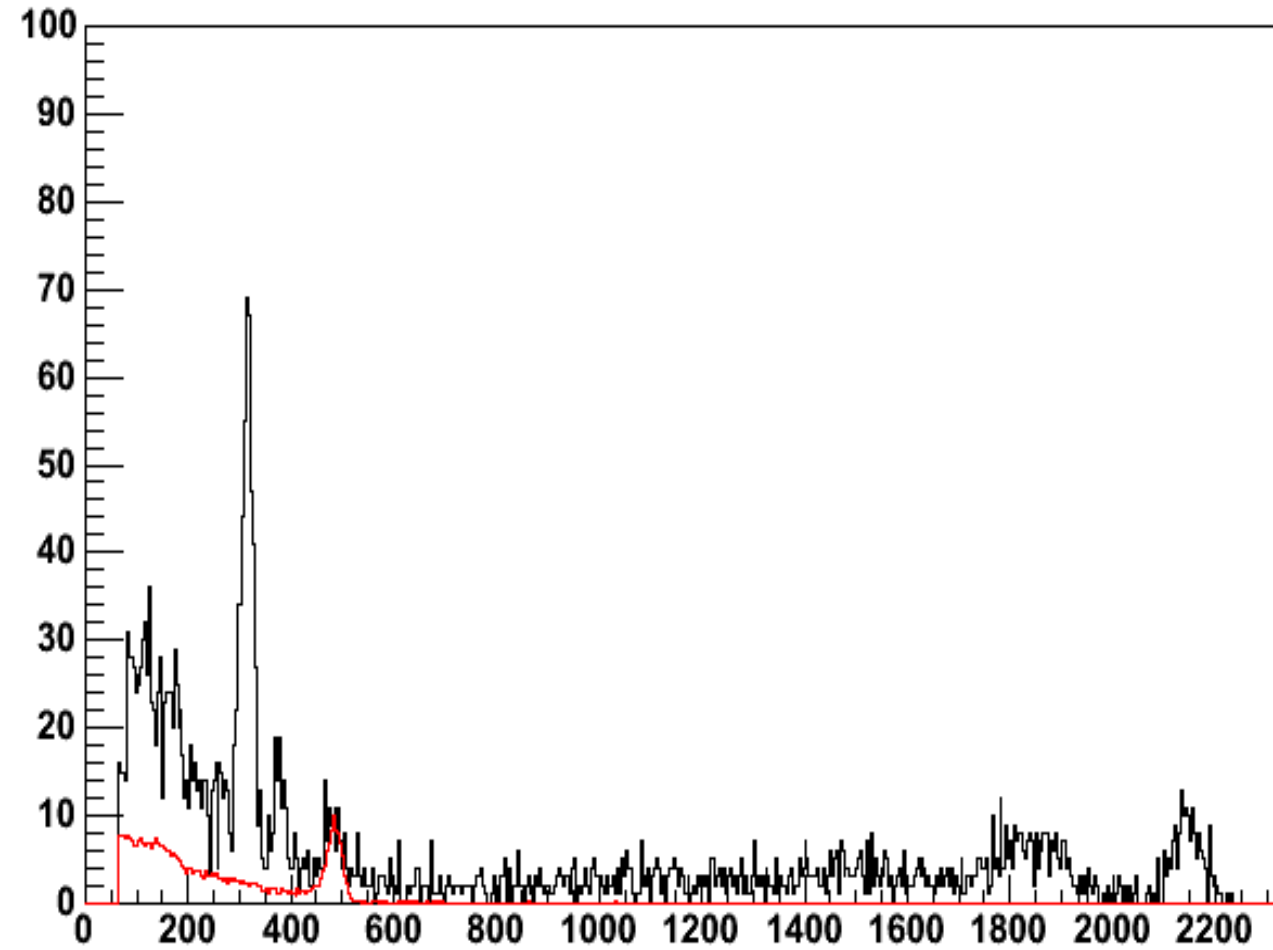


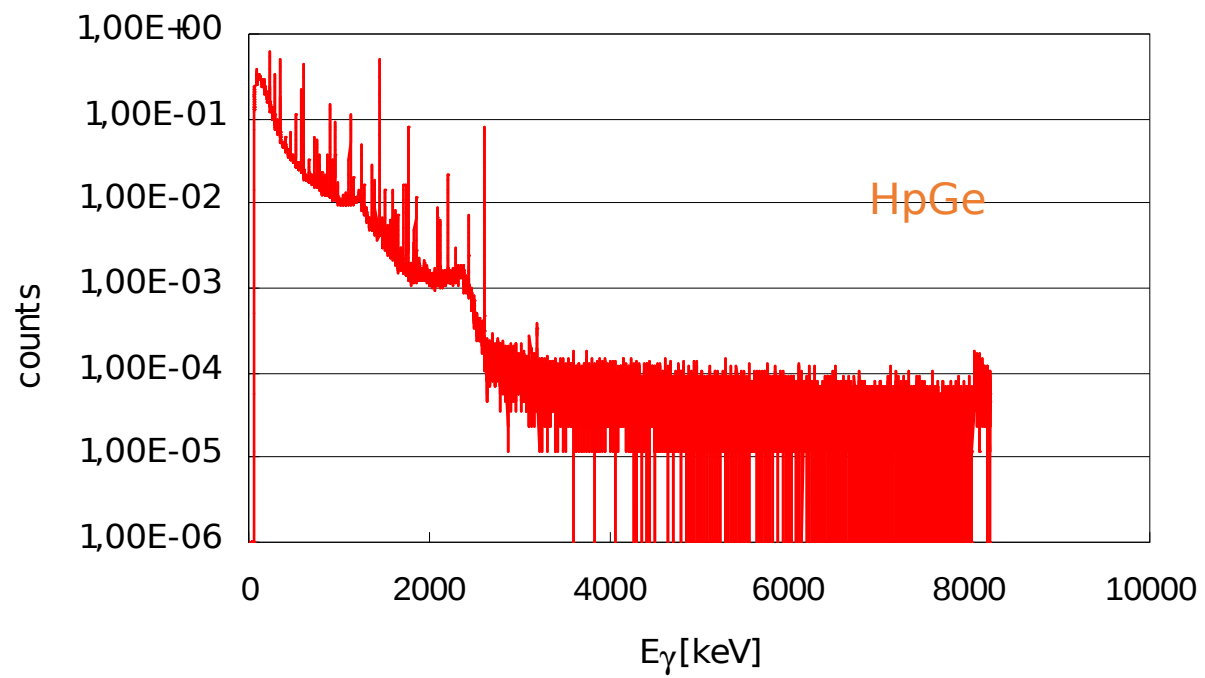
${}^3\text{He}(\alpha, \gamma){}^7\text{Be}$ – γ measurements





$^3\text{He}(\alpha, \gamma)^7\text{Be}$ – γ measurements

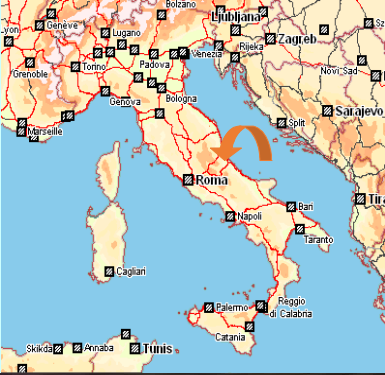




0.5 Counts/s

Laboratory for Underground Nuclear Astrophysics

LUNA site



LNGS
(shielding $\equiv$ 4000 m w.e.)

LUNA 1
(1992-2001)
50 kV

LUNA 2
(2000□...)
400 kV

LUNA MV
2018

Radiation

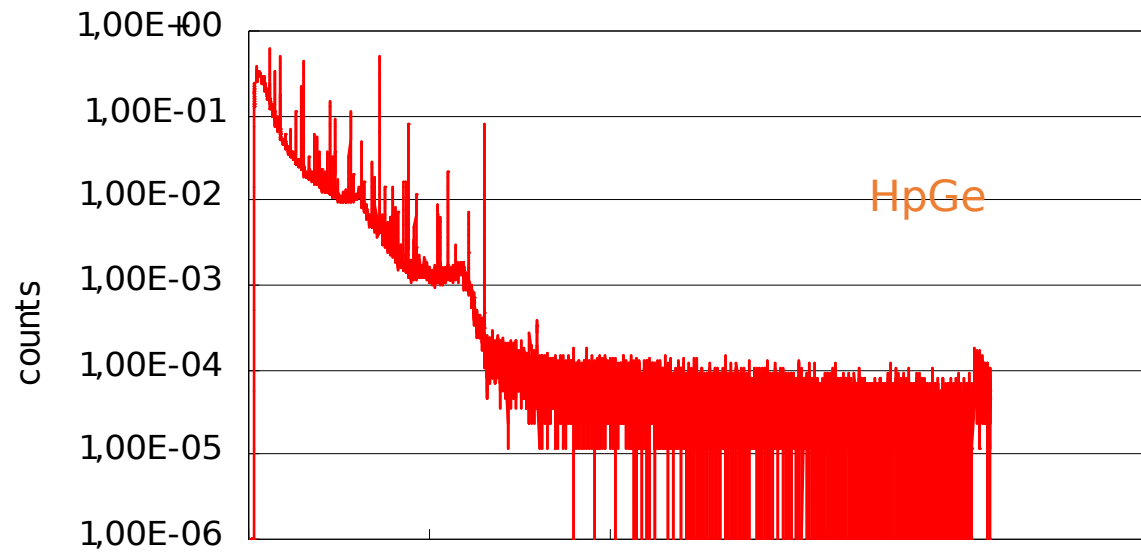
LNGS/surface

Muons
Neutrons

10^{-6}

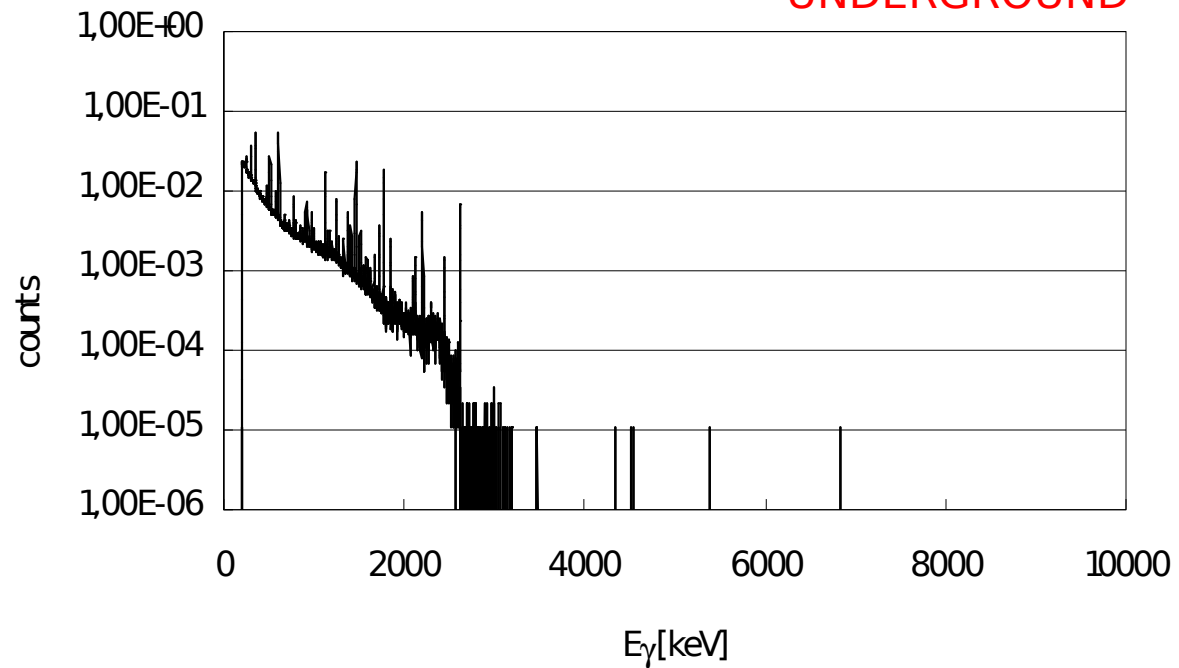
10^{-3}

Courtesy LUNA collaboration



0.5 Counts/s

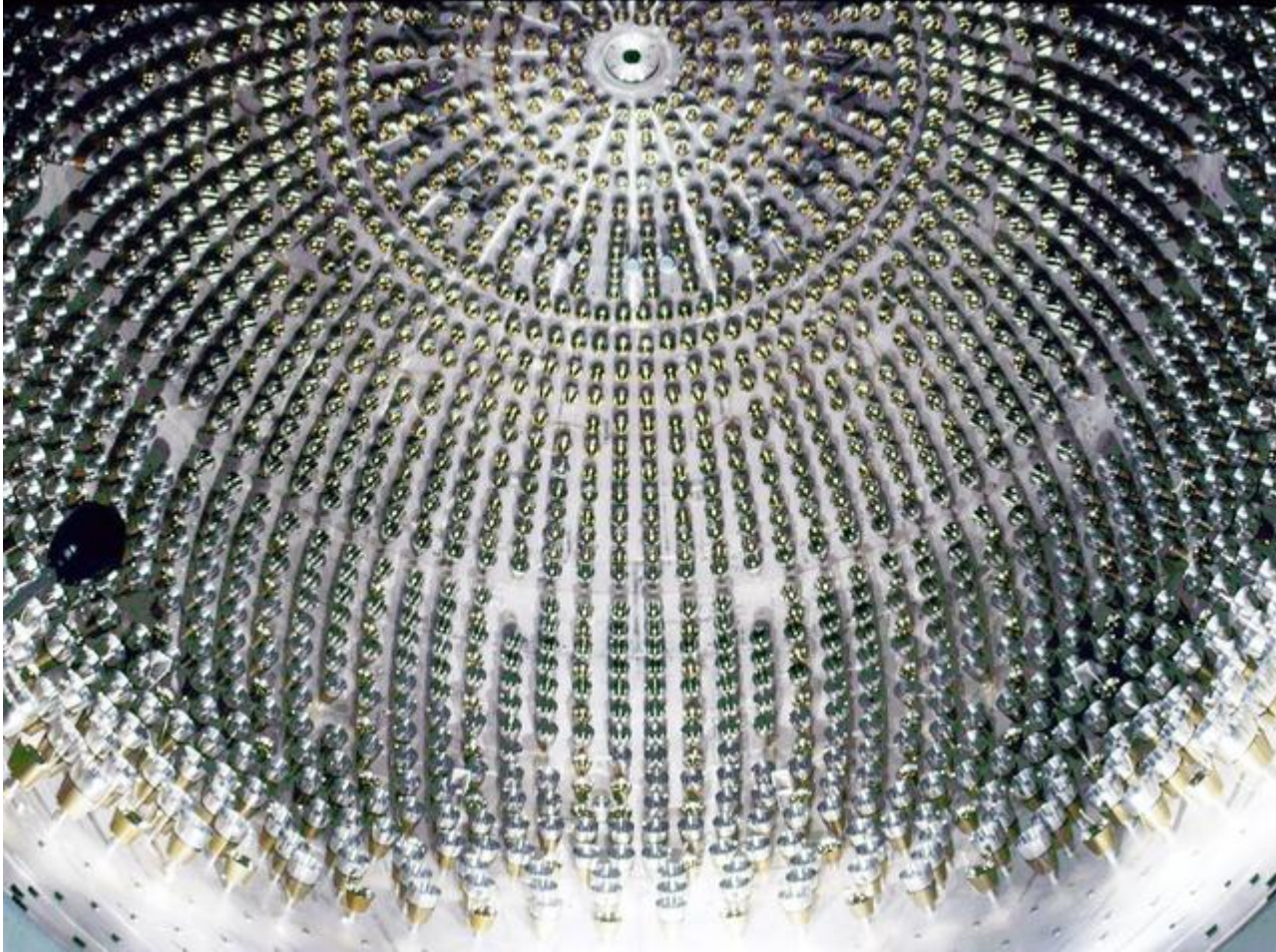
↓ GOING
UNDERGROUND



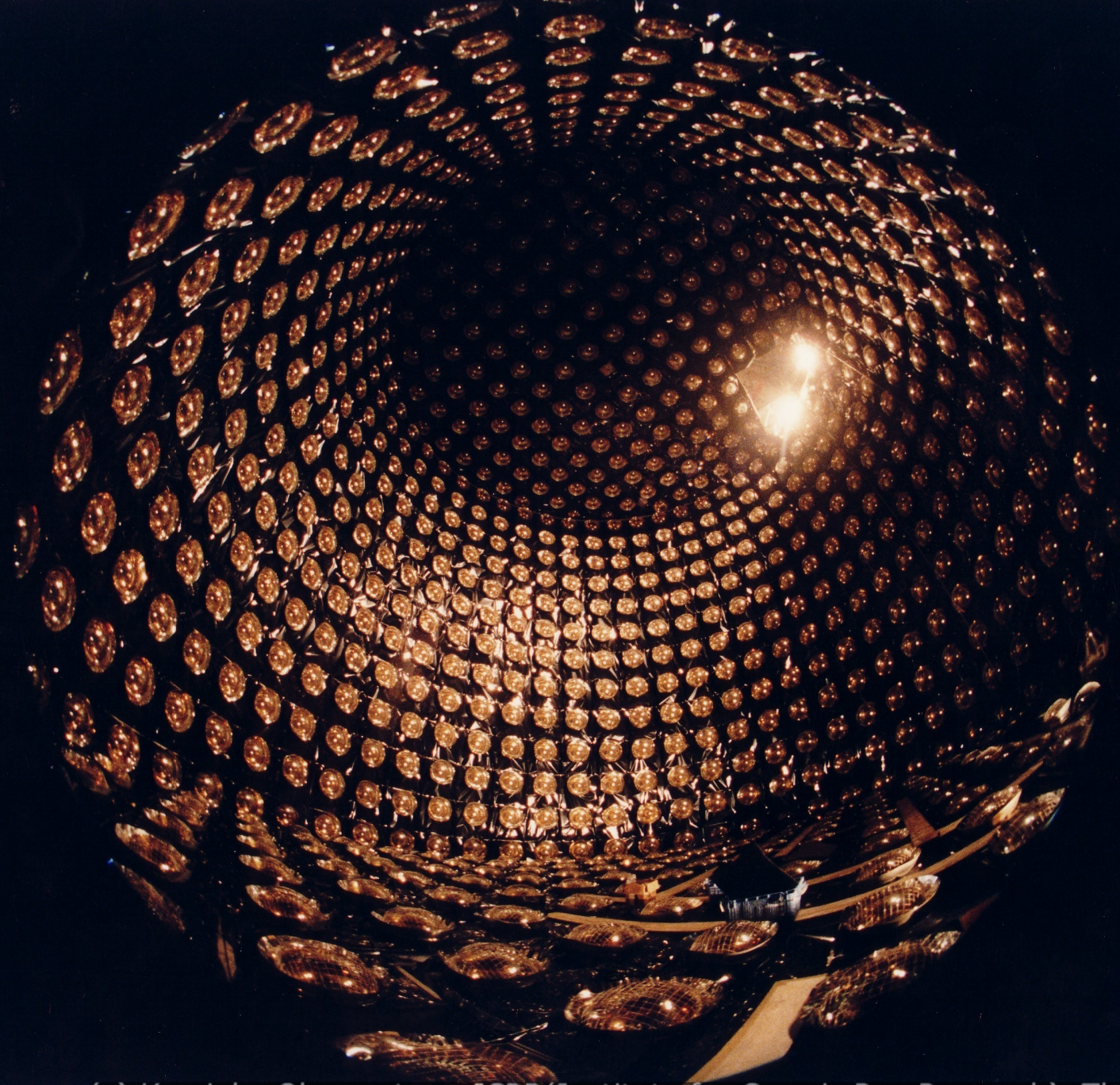
0.0002 Counts/s



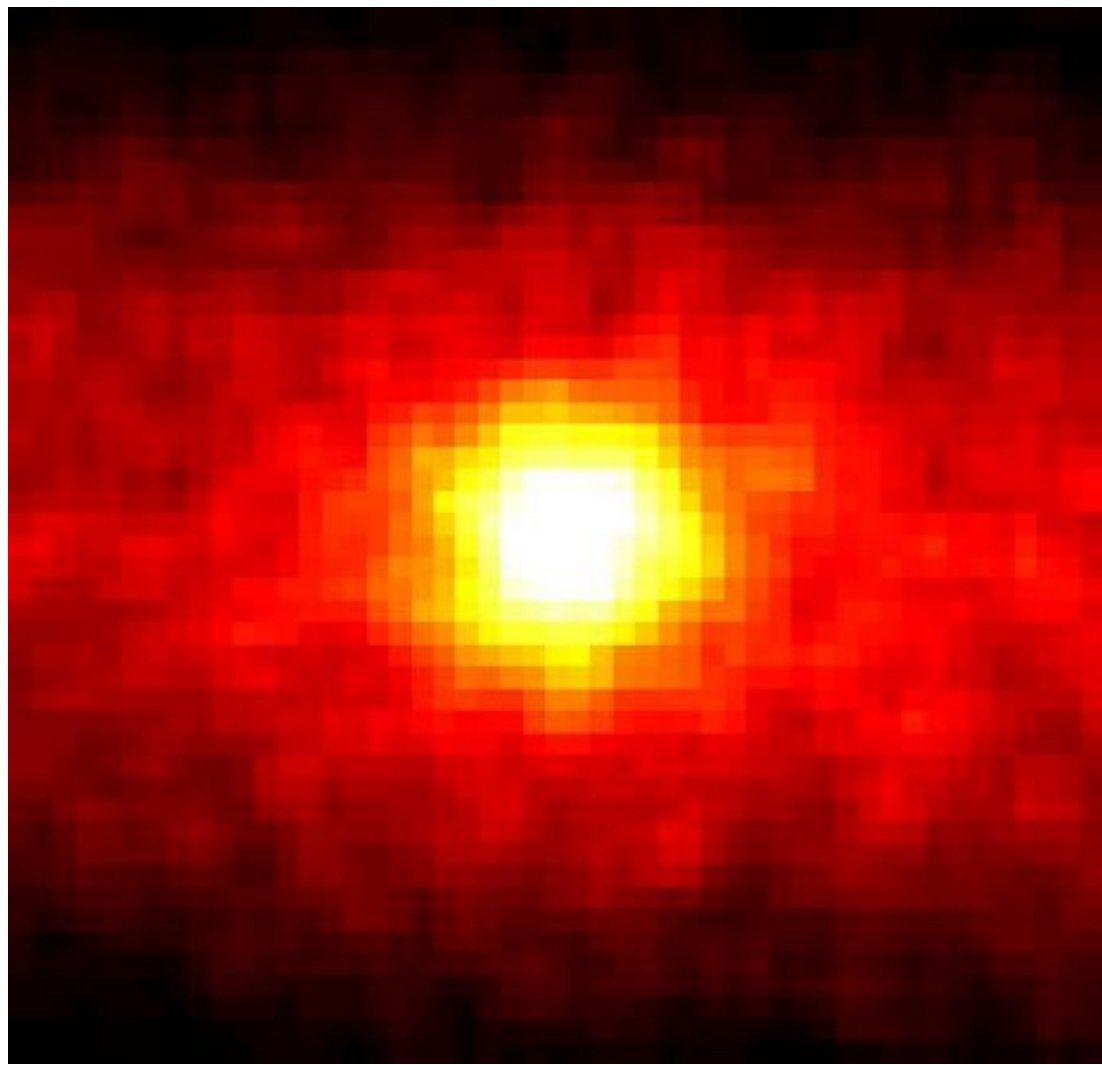
<http://borex.lngs.infn.it/pictures/Borexino/>



<http://borex.lngs.infn.it/pictures/Borexino/>



(c) Kamioka Observatory, ICRR(Institute for Cosmic Ray Research), The University of Tokyo



Alcuni esempi delle metodologie nucleari sviluppate nelle ricerca di base

