



IL DOPPIO SENSO della SCIENZA

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Ricerca astronomica/fisica

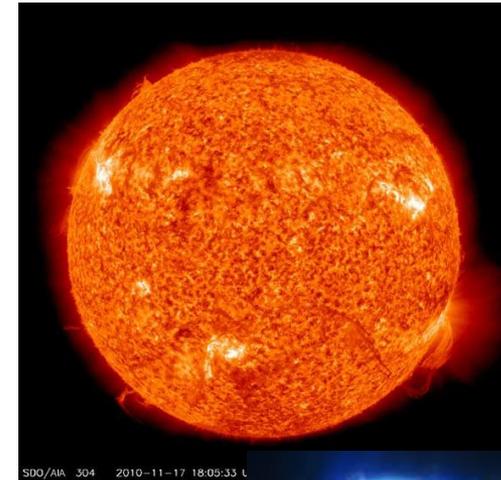
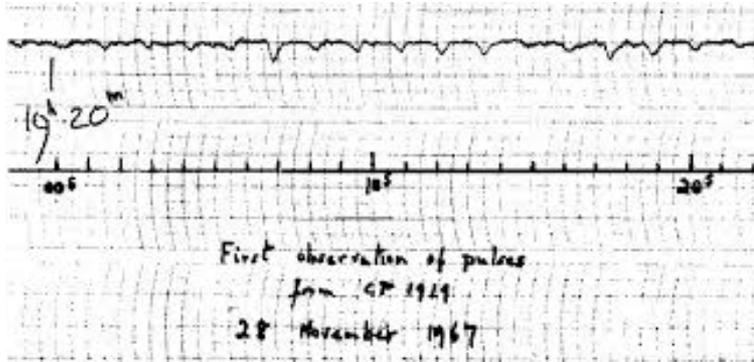
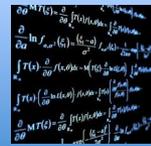


$$\frac{\partial}{\partial \theta} \ln f_{\sigma, \sigma^2}(\xi_i) = \frac{(\xi_i - \theta)}{\sigma^2} f_{\sigma, \sigma^2}(\xi_i) - \frac{1}{2\sigma^2}$$
$$\int T(x) \cdot \frac{\partial}{\partial \theta} f(x, \theta) dx = M\left(T(\xi) \cdot \frac{\partial}{\partial \theta} \ln f(x, \theta)\right)$$
$$\int T(x) \left(\frac{\partial}{\partial \theta} \ln f(x, \theta)\right) \cdot f(x, \theta) dx = \int T(x) \left(\frac{\partial}{\partial \theta} f(x, \theta)\right) dx$$
$$\frac{\partial}{\partial \theta} M T(\xi) = \frac{\partial}{\partial \theta} \int T(x) f(x, \theta) dx = \int T(x) \frac{\partial}{\partial \theta} f(x, \theta) dx$$
$$= \int T(x) \left(\frac{\partial}{\partial \theta} \ln f(x, \theta)\right) \cdot f(x, \theta) dx = \int T(x) \left(\frac{\partial}{\partial \theta} f(x, \theta)\right) dx$$





Little Green Men



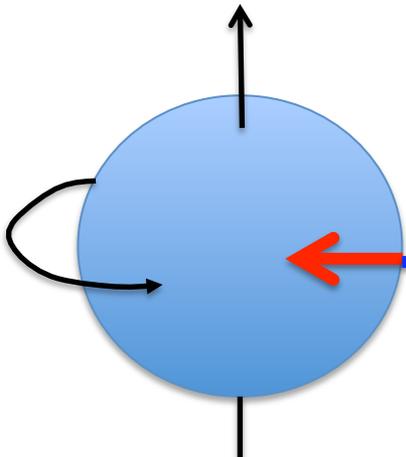
1.4 g cm⁻³
[130 g cm⁻³]



WD
1M_⊙
1000 Km



NS
1.5M_⊙
30 Km



$$\Omega^2 R < \frac{GM}{R^2}$$

$$\frac{4\pi^2 R}{P^2} < \frac{G}{R^2} \rho \frac{4}{3} \pi R^3$$

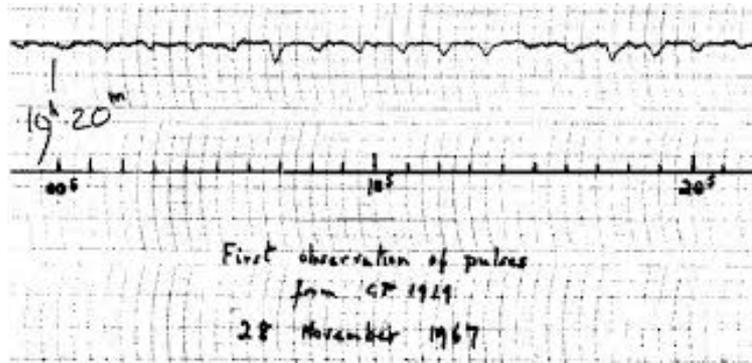
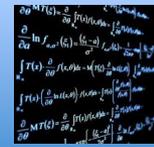
$$\rho > \frac{3\pi}{GP^2}$$

$$\rho > \frac{[P=1.3 \text{ sec}]}{10^8 - 10^{14} \text{ g cm}^{-3}}$$

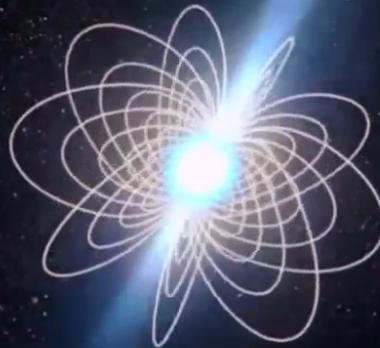
[P=10⁻⁴ sec]



Pulsar



Neutron Star
 $R=30 \text{ Km}$
 $M \sim 1.5$ Masse solari
 $B=10^{12}$ Gauss



Le pulsazioni
osservate ... oggetti
velocemente rotanti
che emettono un
fascio di luce
(orientato “di
sbieco”)



Pulsar: rotazione

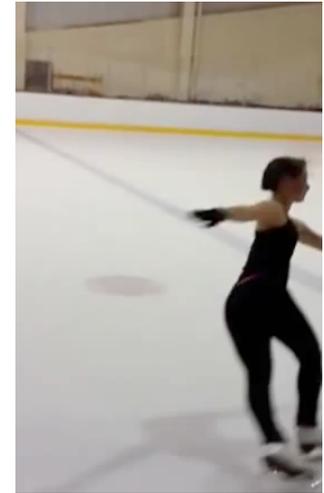


PERCHE' RUOTANO COSI' VELOCEMENTE?



$$\mathcal{L} = I \Omega$$

Momento angolare SI CONSERVA



Sfera di massa M e raggio R che ruota

$$\mathcal{L} = \frac{2}{5} M R^2 \Omega$$

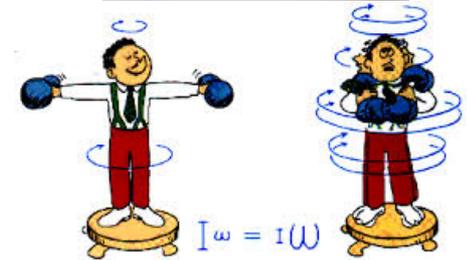
$$R_{\odot} = 7 \times 10^5 \text{ km}$$



$$R_{\odot} = 7 \text{ km}$$

$\Omega = 10$ miliardi di volte piu grande

... e per I



1999/09/27 15:46

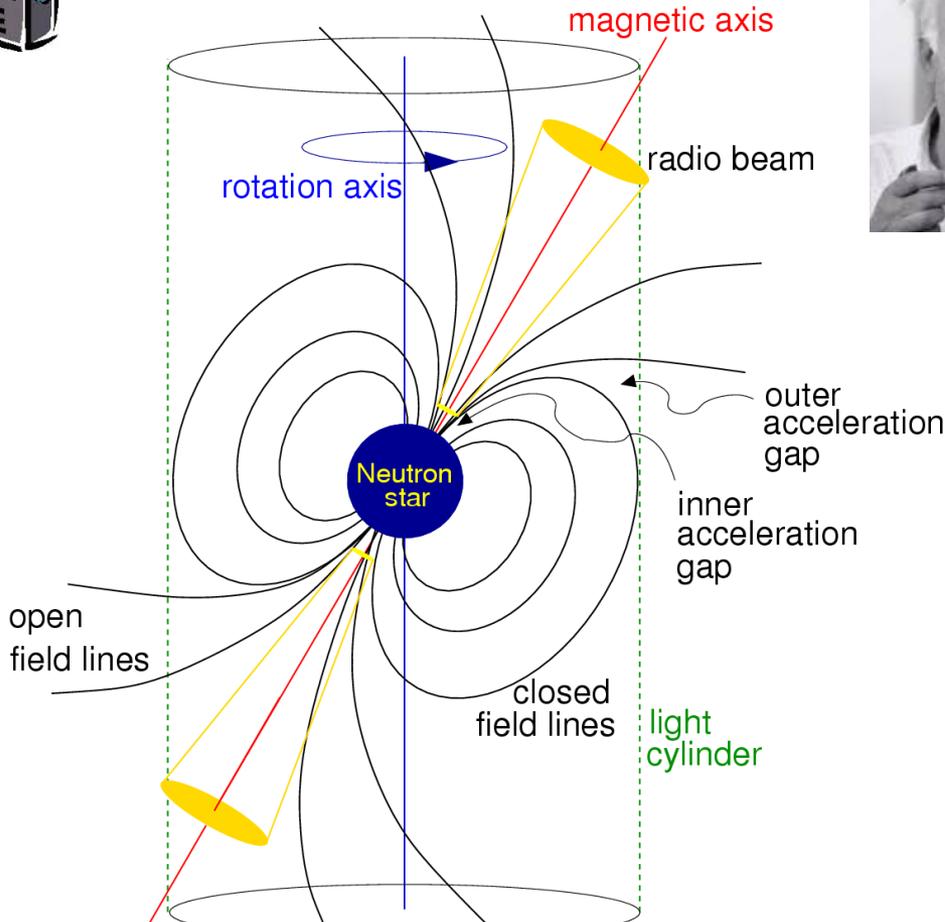


Pulsar: emissione (I)

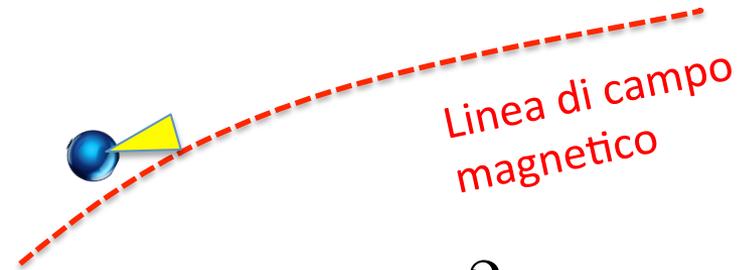


Che cosa produce la luce che vediamo?

CLASSE 1: Rotation Powered Pulsars



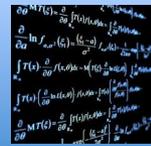
Una carica accelerata produce luce



$$L = \frac{2}{3} \frac{m_e r_e}{c} a^2$$



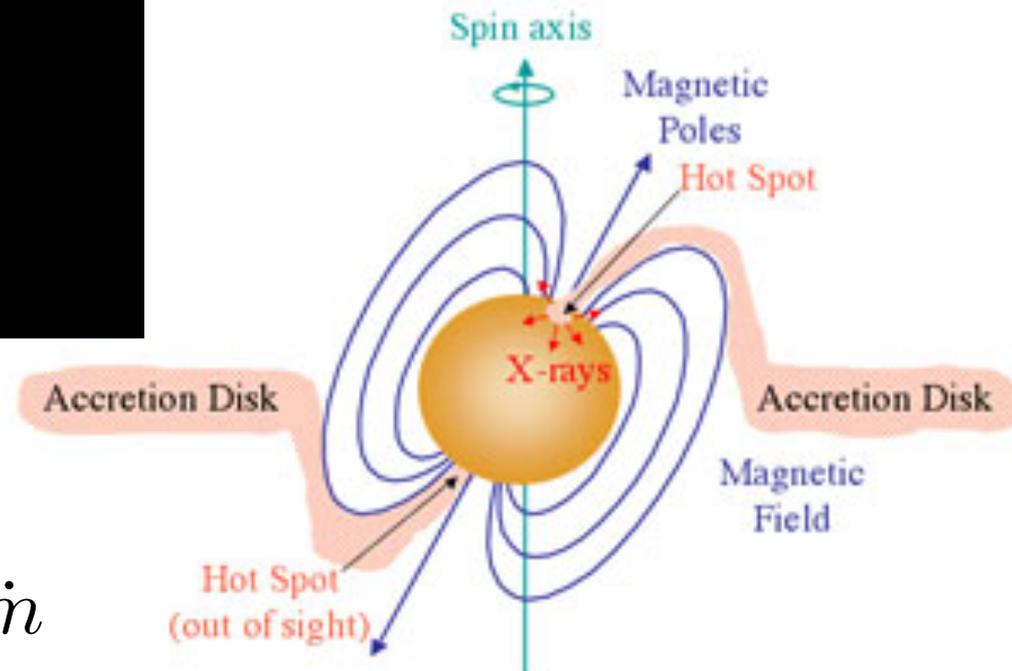
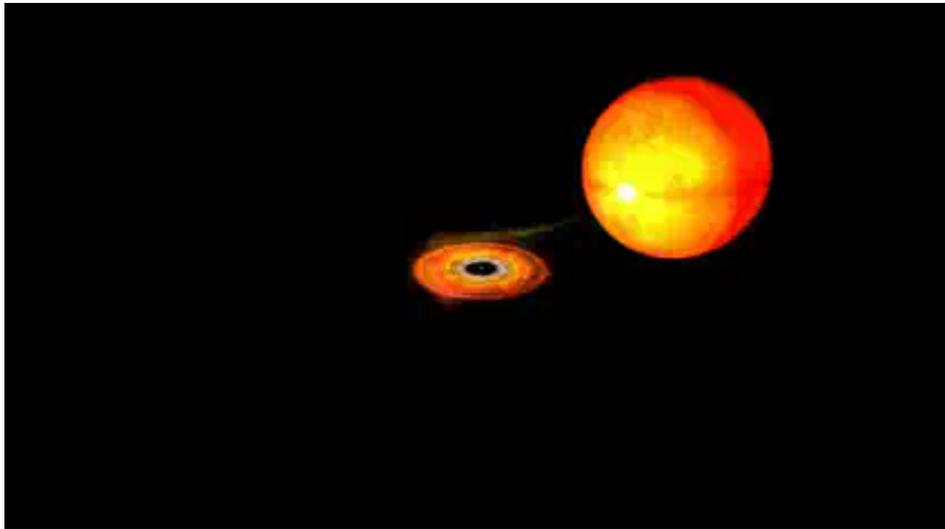
Pulsar: emissione (II)



Che cosa produce la luce che vediamo?



CLASSE 2: Accretion Powered Pulsars

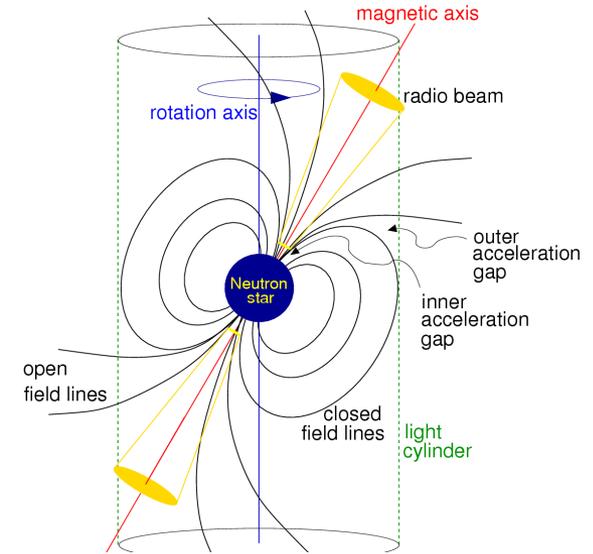
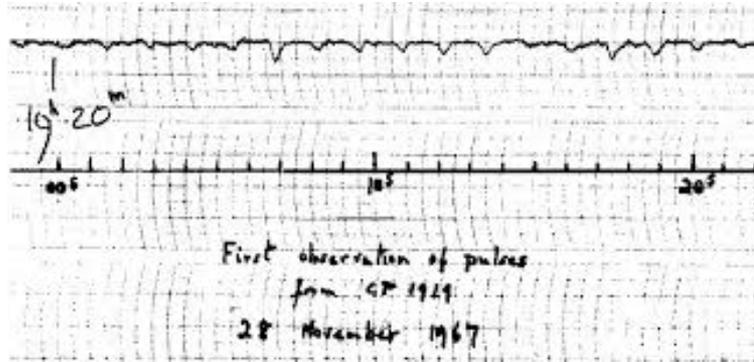
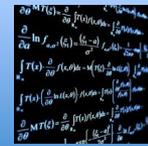


$$U = \frac{G M}{R} m$$

$$L = \frac{G M}{R} \dot{m}$$



Pulsar... come e' finita?



Observation of a Rapidly Pulsating Radio Source

A. HEWISH, S. J. BELL, J. D. H. PILKINGTON, P. F. SCOTT & R. A. COLLINS

Mullard Radio Astronomy Observatory, Cavendish Laboratory, University of Cambridge

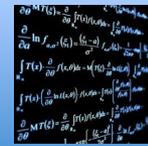
Unusual signals from pulsating radio sources have been recorded at the Mullard Radio Astronomy Observatory. The radiation seems to come from local objects within the galaxy, and may be associated with oscillations of white dwarf or neutron stars.



“... Finally, I am not myself upset about it - after all, I am in good company, am I not!”

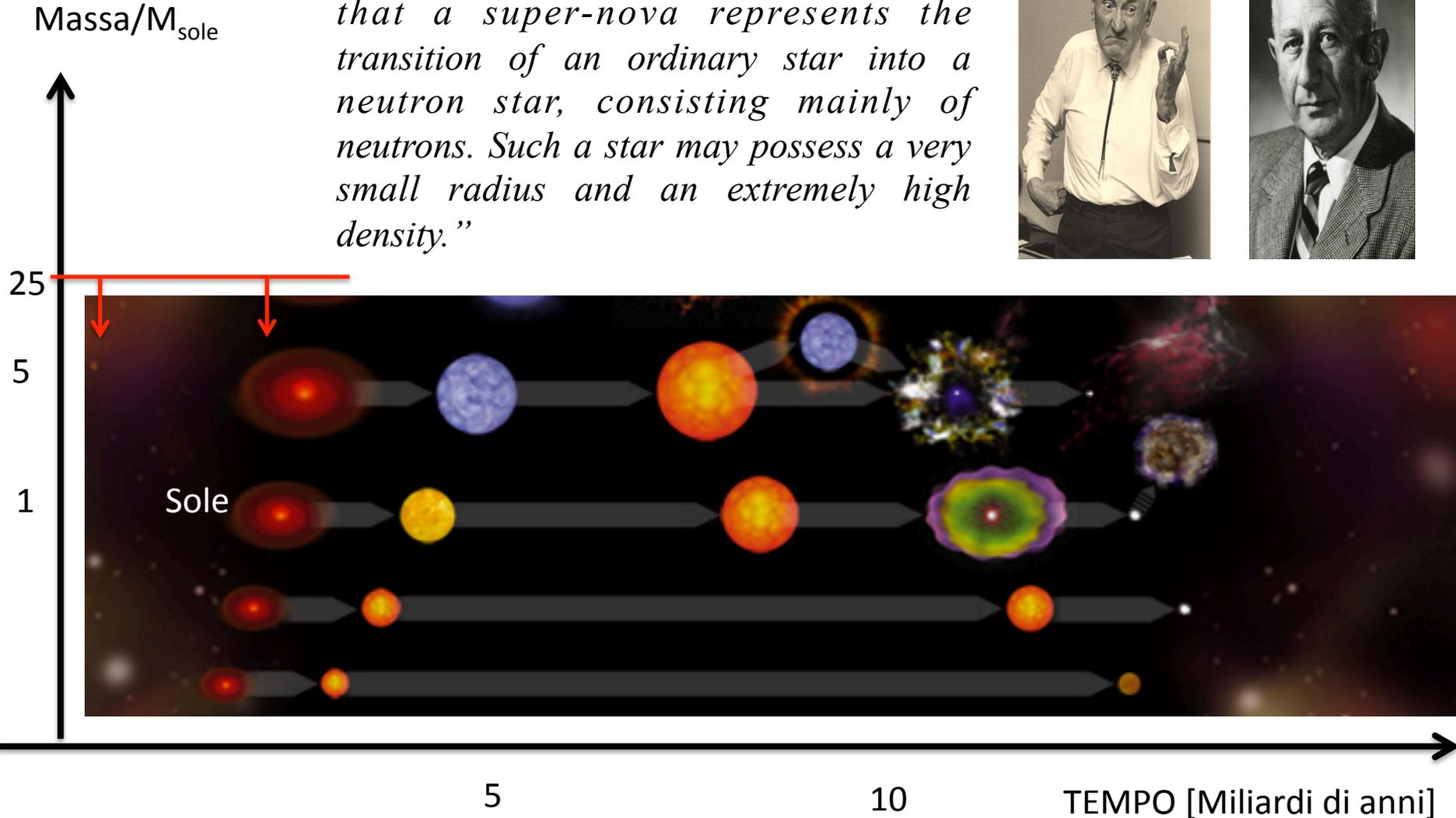


Quando finisce il carburante

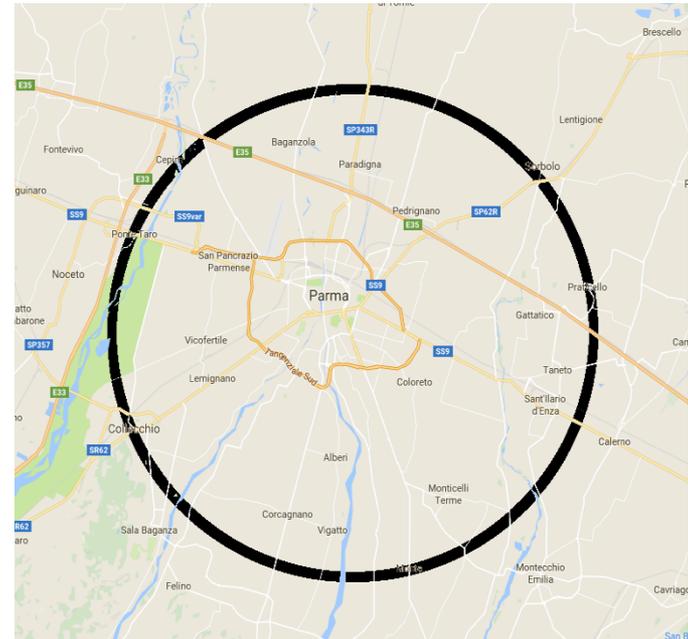
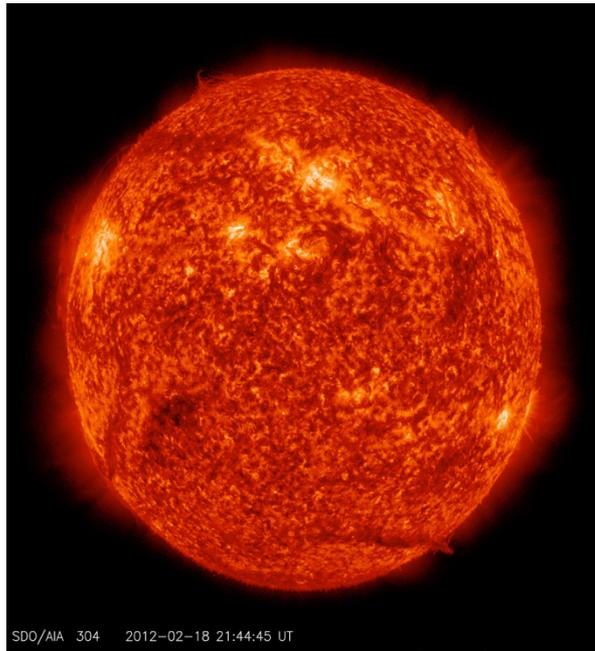


Baade W, Zwicky F (1934) On super-novae. *Proc Natl Acad Sci USA* **20**(5):254–259

“With all reserve we advance the view that a super-nova represents the transition of an ordinary star into a neutron star, consisting mainly of neutrons. Such a star may possess a very small radius and an extremely high density.”



Cosa sono le stelle di neutroni?



...ovviamente, di tanti neutroni: $\# \text{ neutroni} : \# \text{ protoni} = 9 : 1$

Densità della materia nelle NS: $\sim 4 \times 10^{14} \text{ g/cm}^3 >$ densità nuclei atomici

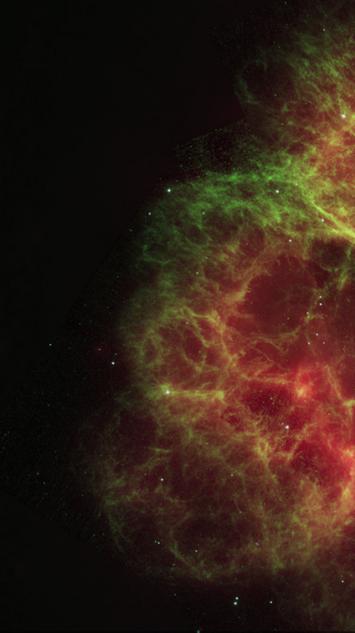
Stella di neutroni = gigantesco nucleo atomico con $A \sim 10^{57}$, regolato dall'interazione nucleare e della gravità



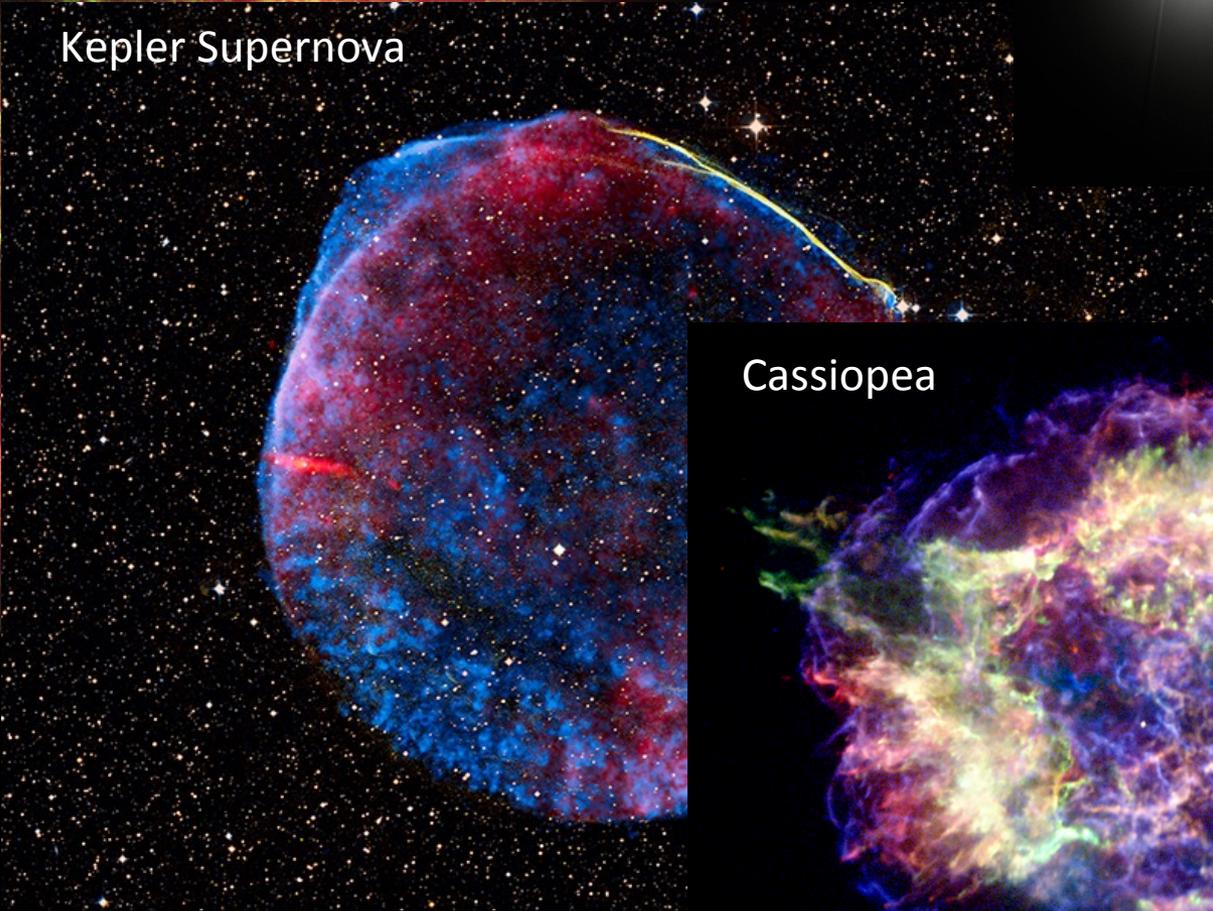
“Polvere” di stelle



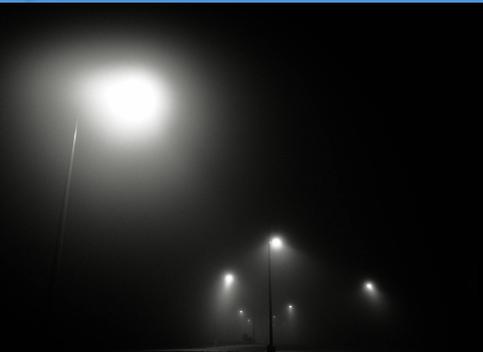
CRAB NEBULA



Kepler Supernova

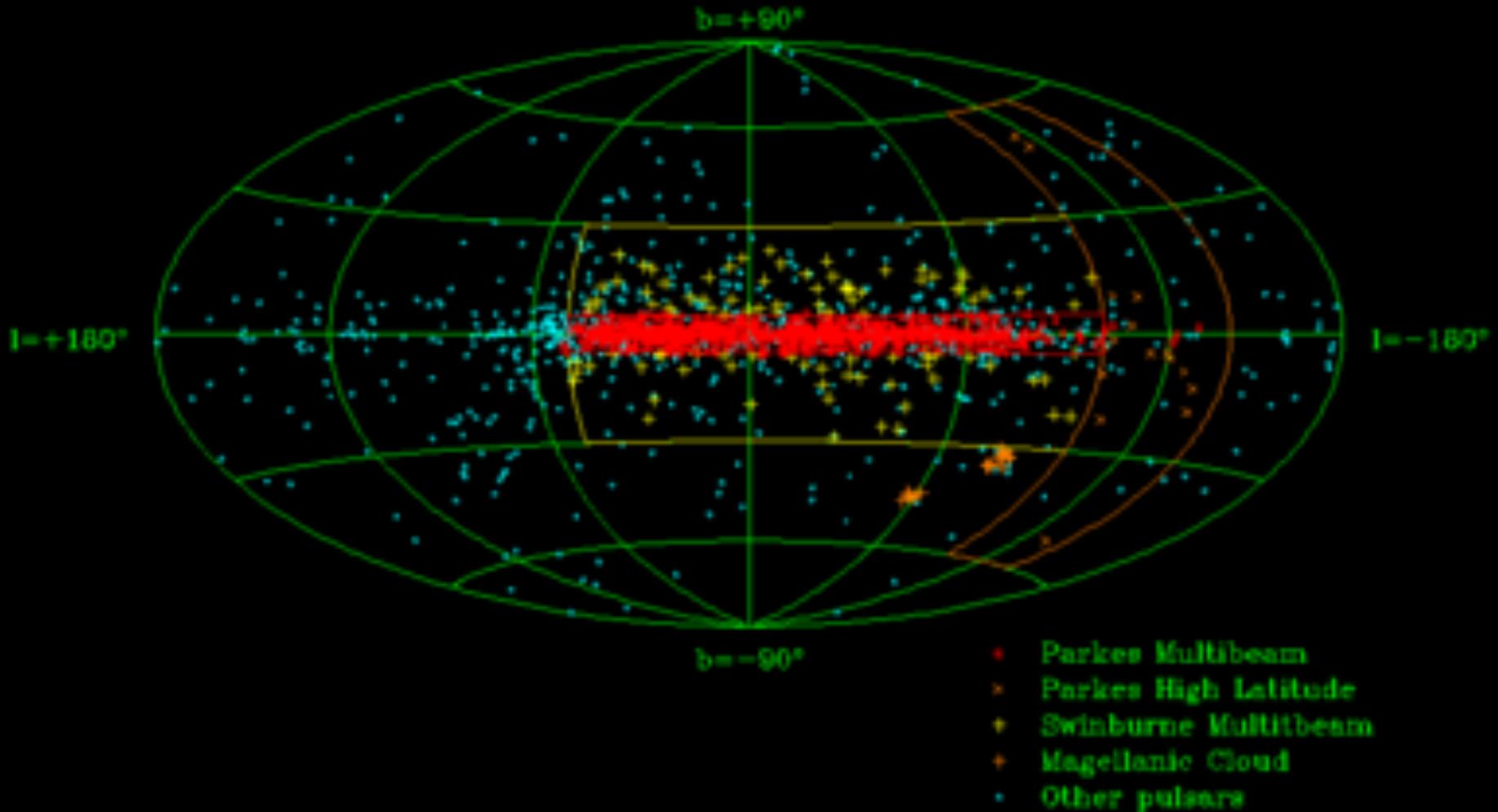
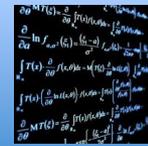


Cassiopea



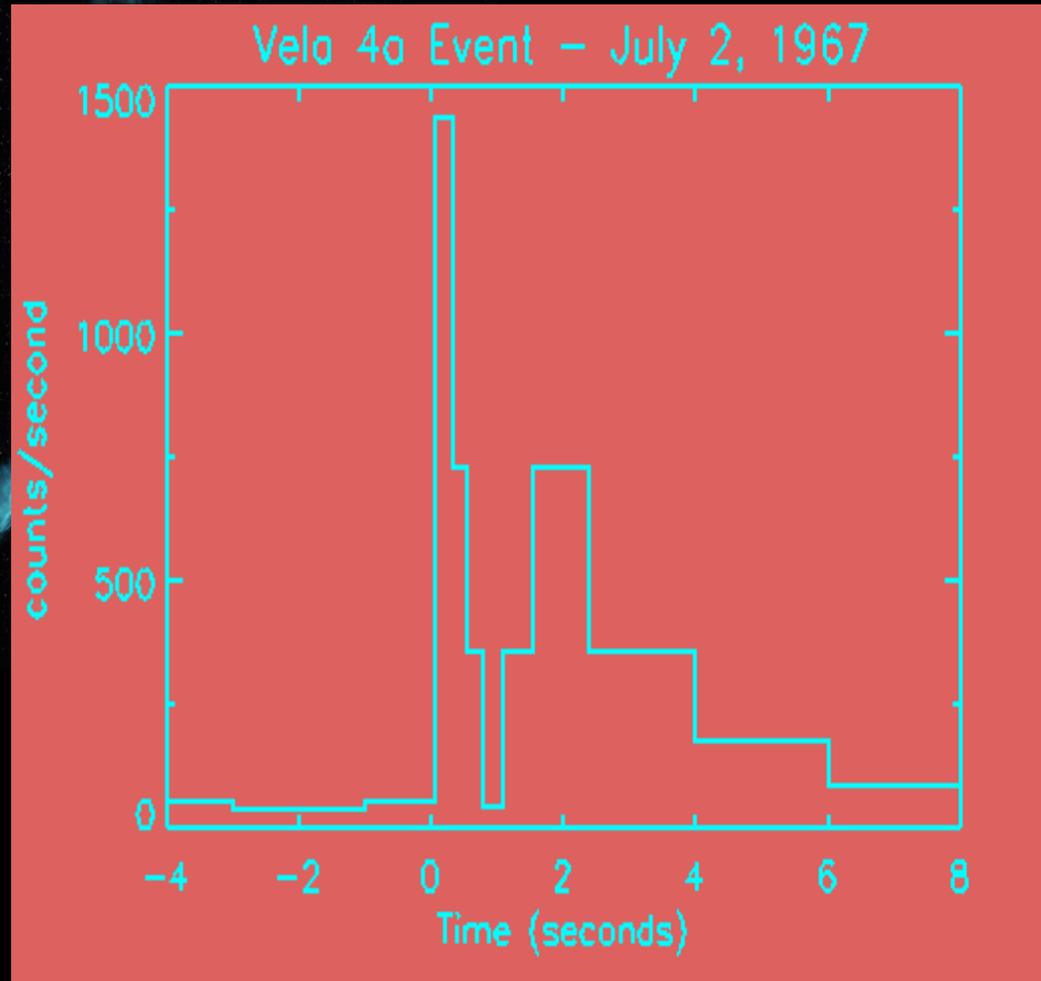
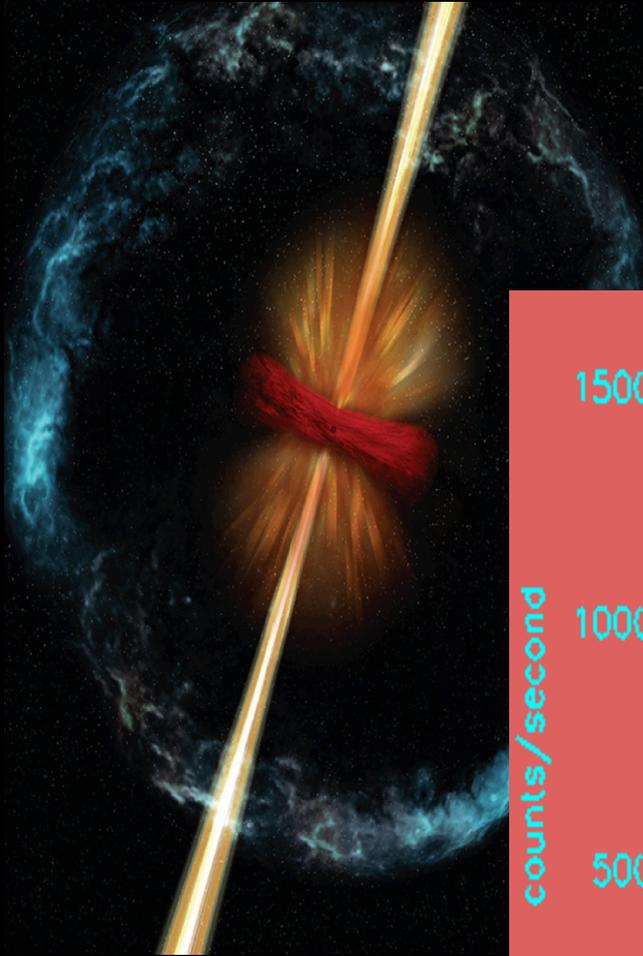


Pulsar (quante e dove)



Un altro esempio ??

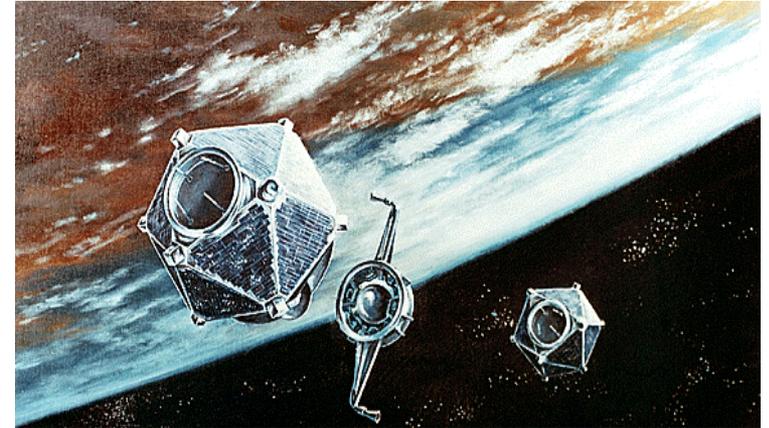
Lampi di raggi gamma (Gamma Ray Bursts = GRB)



GRB ... una scoperta casuale



1954 – 1958



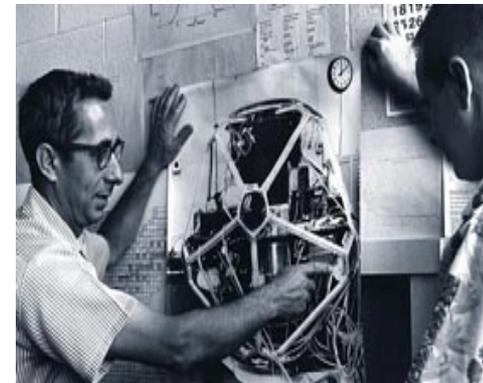
1963

THE ASTROPHYSICAL JOURNAL, 182:1395-1406, 1973 June 1
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OBSERVATIONS OF GAMMA-RAY BURSTS OF COSMIC ORIGIN

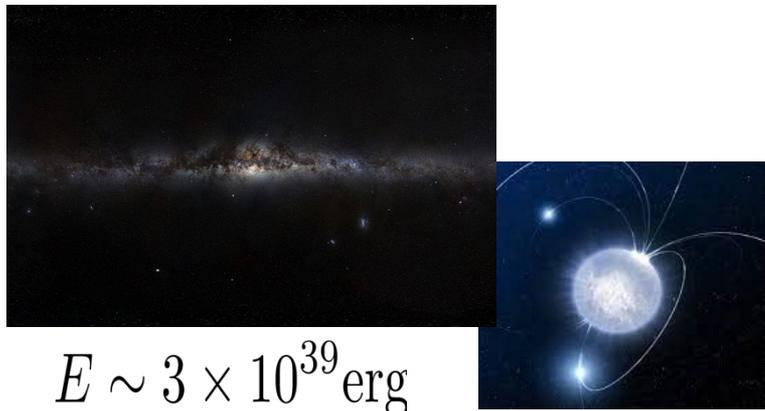
RAY W. KLEEBADDEL, IAN B. STRONG, AND ROY A. OLSON

University of California, Los Alamos Scientific Laboratory, Los Alamos, New Mexico
Received 1973 March 16; revised 1973 April 2

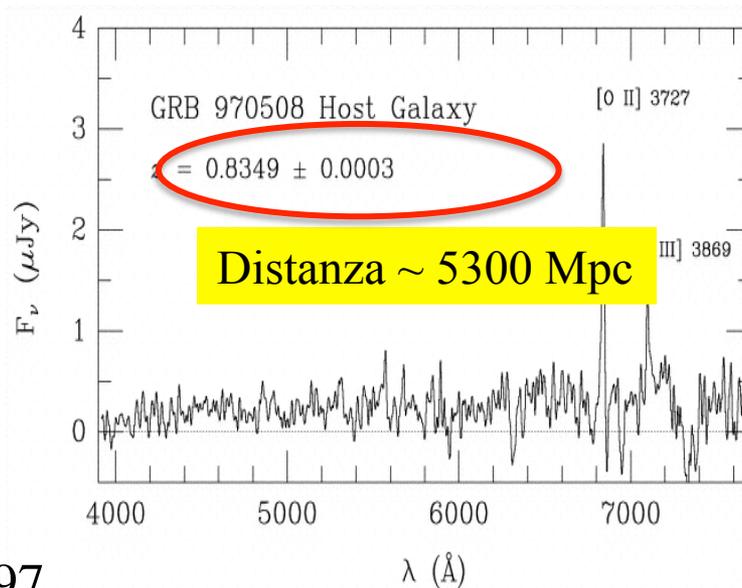
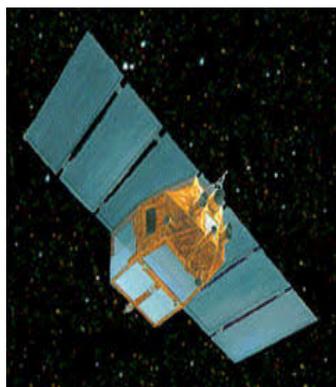


Da dove?

“Galattofili”



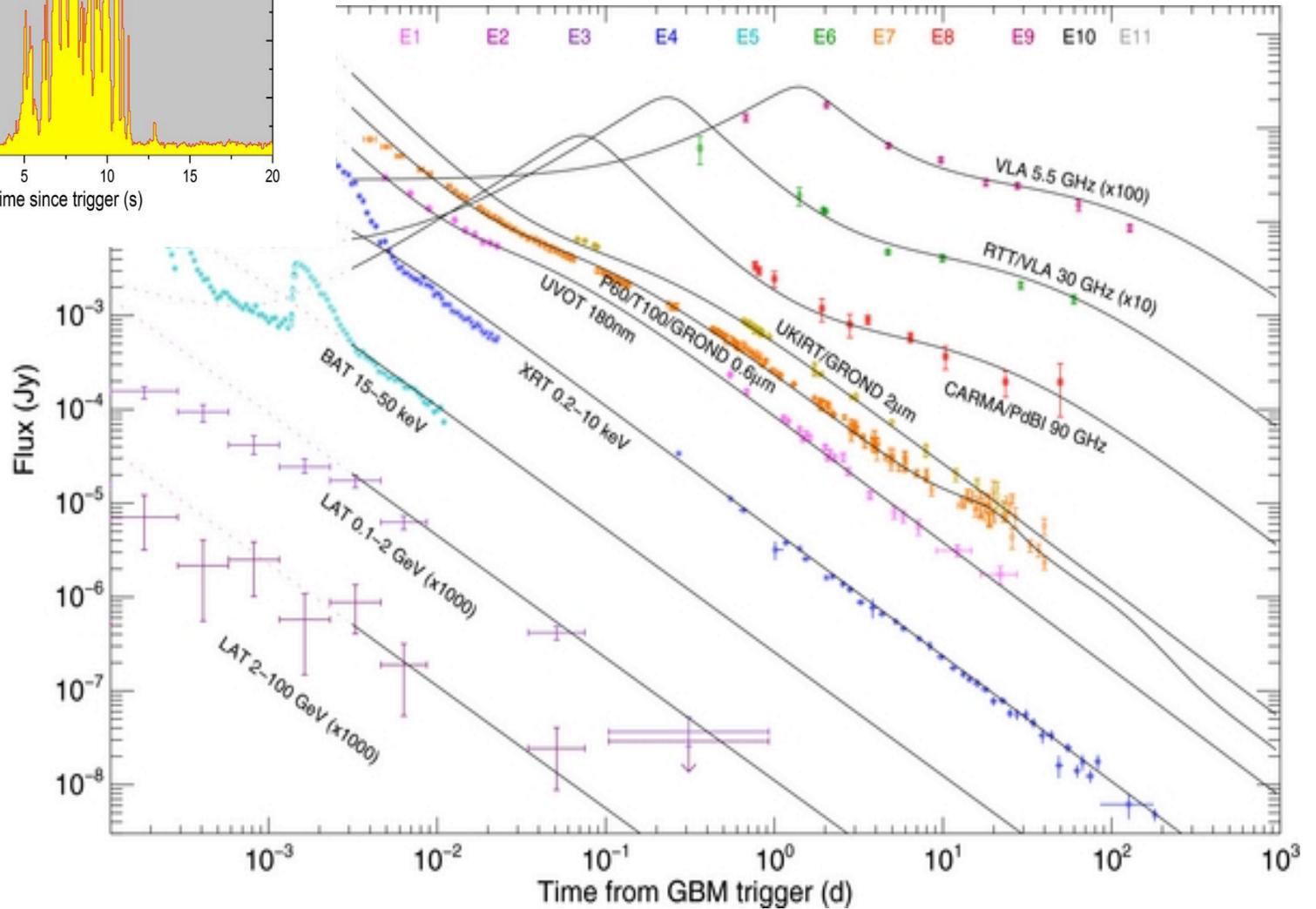
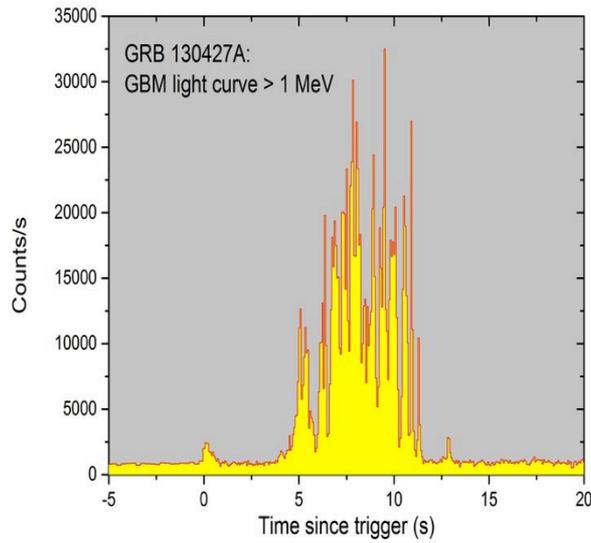
“Cosmofili”



1997

... poi a seguire GRB 971214 @ $z=3.4$!!

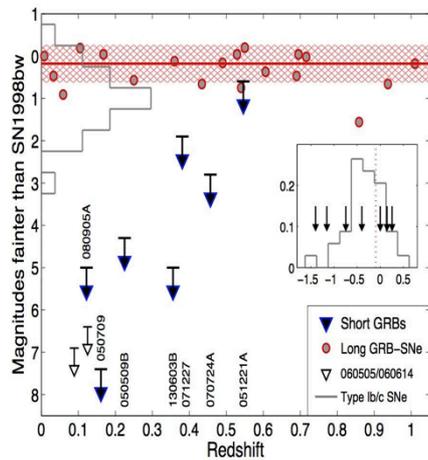
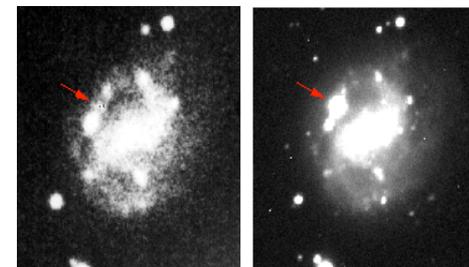
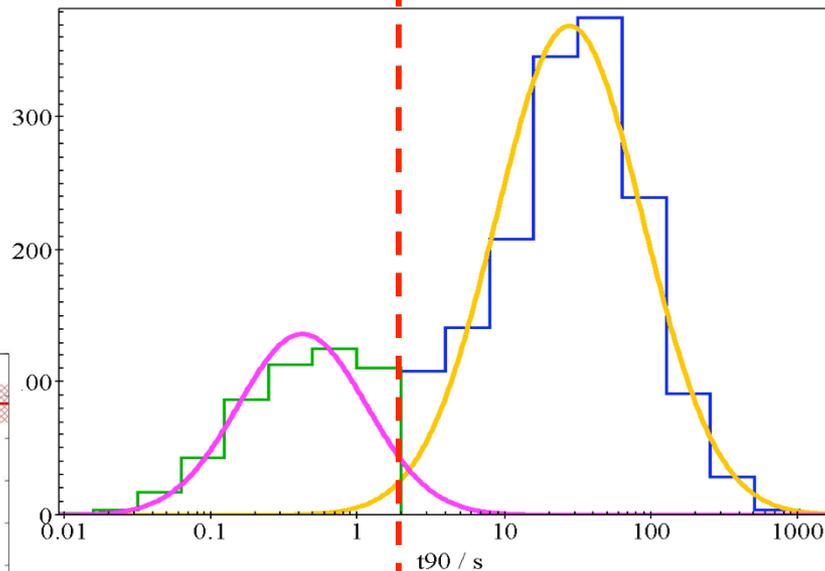
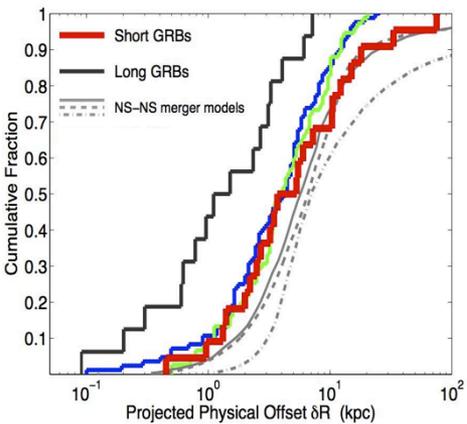
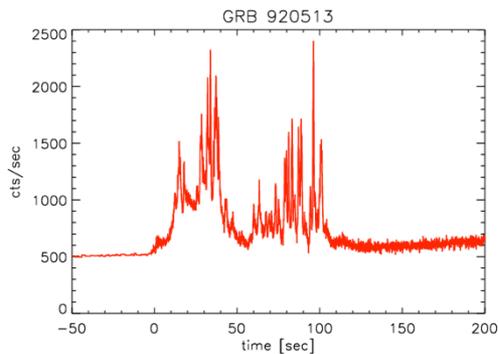
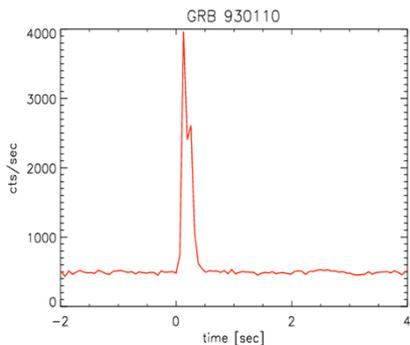
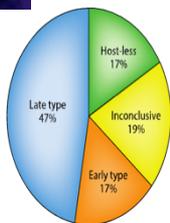
GRB: cosa vediamo



Gamma Ray Bursts

CORTI

LUNGI



DURATA

