

Pulsars and Quark Stars

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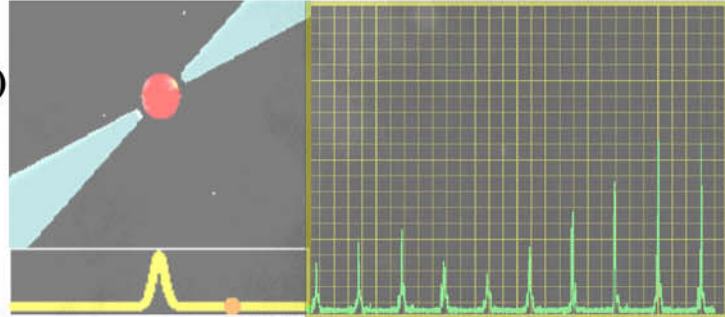
● What is a pulsar?

Pulsars, stars which radiate radio pulses, are actually *cosmological lighthouse* ...

Discovered by Hewish, Bell, et al. (1967)

Suggested to be neutron stars by Gold (1968)

Are pulsars really neutron stars?



● What is a neutron star?

Neutron stars are composed mostly of neutron matter (or nuclear matter) ...

Landau's idea (1932) about neutron stars:

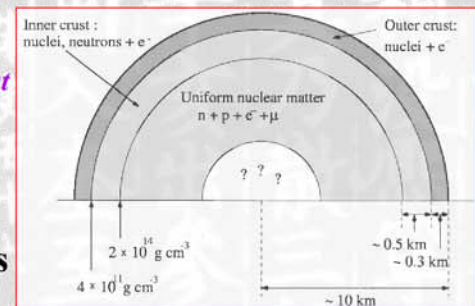
“ We expect that this must occur when the density of matter becomes *so great* that atomic *nuclei come in close contact*, forming one gigantic nucleus. ”

Baade-Zwicky (1934): supernovae produce neutron stars

Openheimer & Volkoff (1939): first model and mass-limit

Pacini (1967): as the energy source for supernova remnants

A neutron star = Atmosphere + Crust (outer & inner) + Neutron matter + Core



Heiselberg 2002

● What is a quark star?

Quark stars are composed mostly of *quark* matter (or quark-gluon plasma) ...

Leptons	Quarks	U up	C charm	T top
		D down	S strange	B bottom
	Neutrinos	ν _e e- Neutrino	ν _μ μ- Neutrino	ν _τ τ- Neutrino
	Electrons	E electron	μ muon	τ tau
		I	II	III
The Generations of Matter				

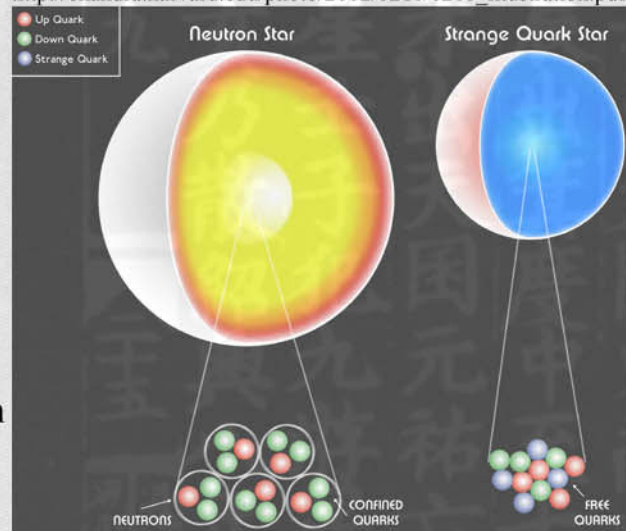
Quarks and leptons, interacted by gauge bosons between them, are world's *building blocks*.

Quantum Chromodynamics (QCD) is believed to be the underlying theory of the strong interaction. QCD is still developing; nevertheless, it has a nature of *asymptotic freedom*, proven in both experiment and theory in 1970s, at smaller scales (~0.1 fm).

The prediction of quark matter (and therefore quark stars) is a *direct consequence* of the asymptotic freedom.

Pulsars: Quark stars?

http://chandra.harvard.edu/photo/2002/0211/0211_illustration.pdf



● Why to do such a study?

- * To understand the final stage of evolved stars
- * To understand the supernova explosion
- * To find possible astrophysical quark matter
- * To understand low-temperature quark matter
- * To understand the elementary color interaction

And how to do ... ? see my page at:

<http://vega.bac.pku.edu.cn/rxxu/>