



# NEUTRON STARS

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# OVERVIEW

- Introduction
- Life of a star
- Formation of Neutron star
- pulsars
- Summary



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## Neutron star vs. Chicago



Mass =  $1.4 M_{\text{sun}}$ , Radius = 10 km

Spin rate up to 38,000 rpm

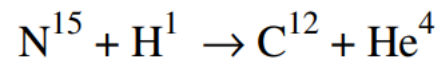
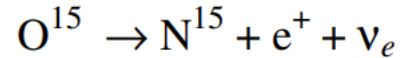
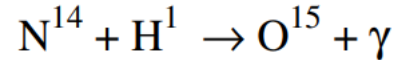
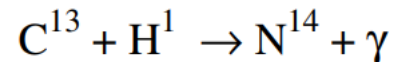
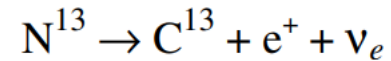
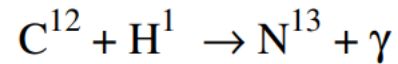
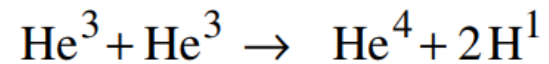
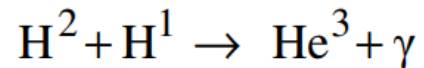
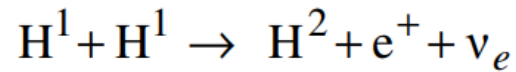
Density  $\sim 10^{14}$  g/cc, Magnetic field  $\sim 10^{12}$  Gauss

# Introduction

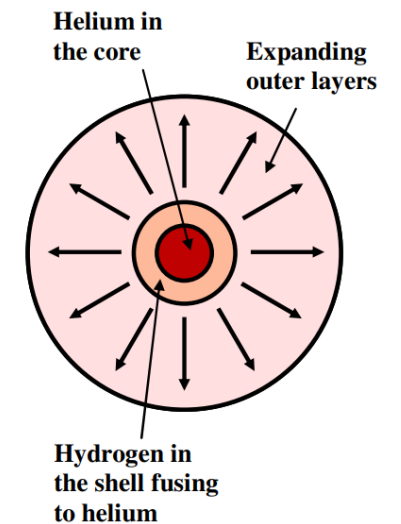
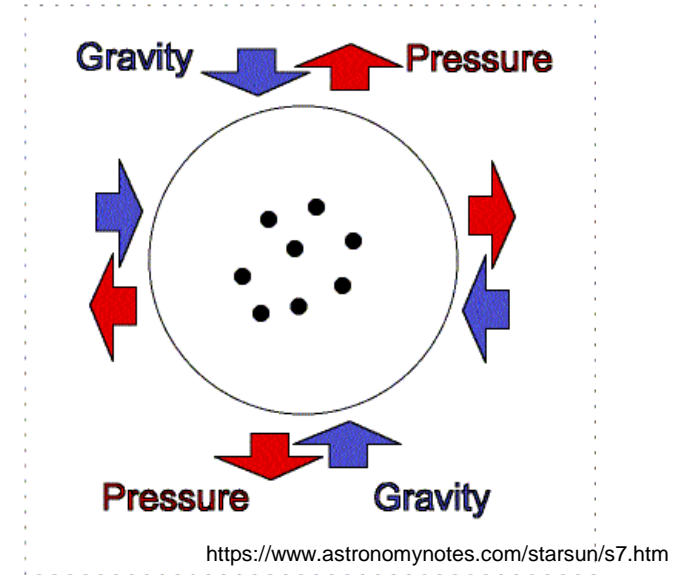
- Neutron stars are the collapsed cores of some massive stars.
- They are the most dense objects in the universe
- Theoretical prediction in 1934 by **Walter Baade and Fritz Zwicky**
- Discovered by **Jocelyn Bell** in 1967

# Life of a star

- Stars are made up of hydrogen and helium.
- Initial stages : Hydrogen burning



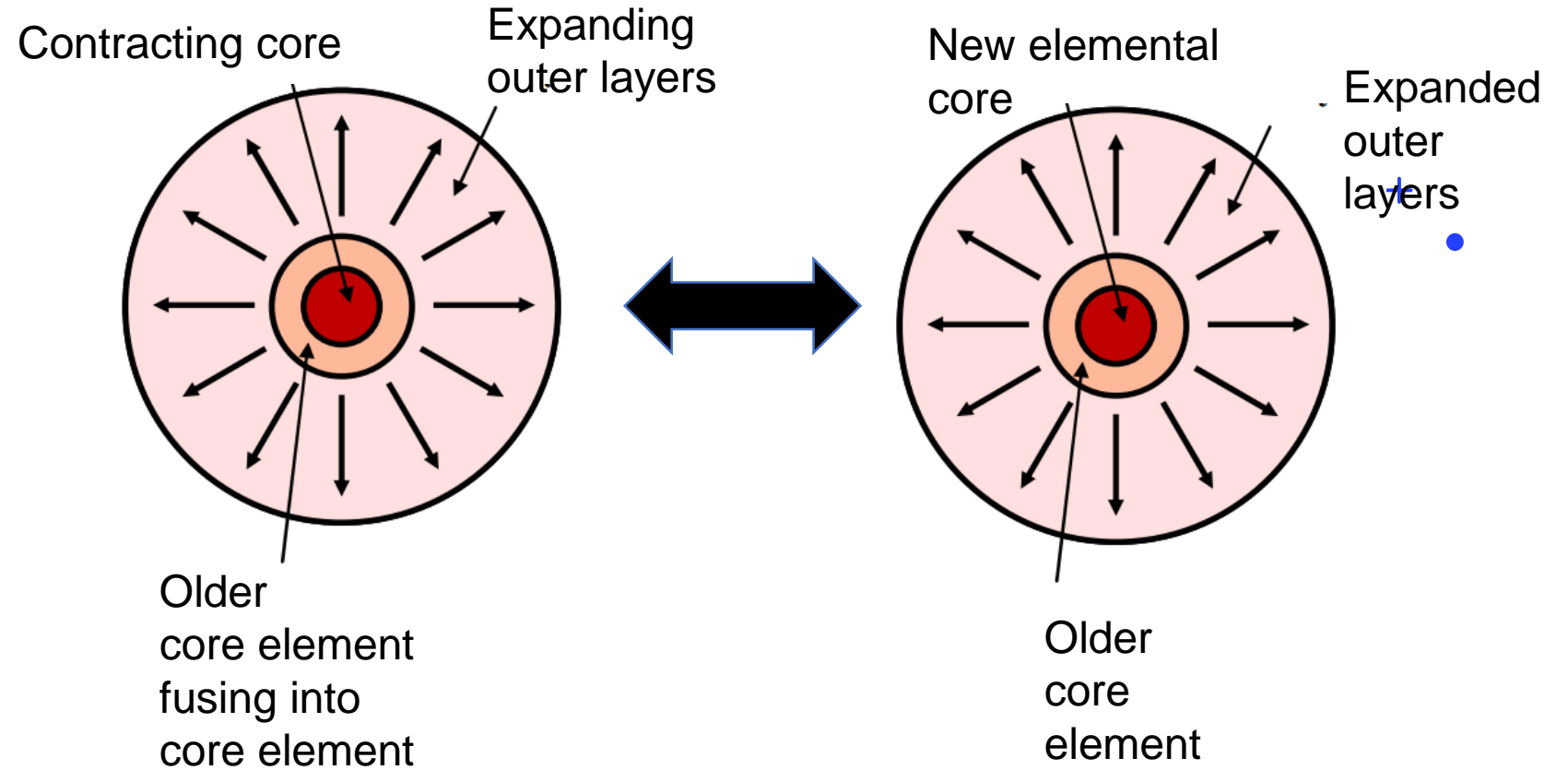
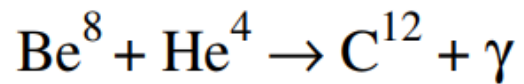
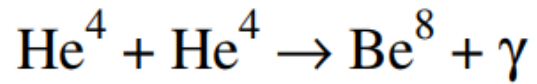
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<https://egyankosh.ac.in/bitstream/123456789/19475/1/Unit-10.pdf>

LIFE OF STAR

Helium Burning :  
triple- $\alpha$  reaction

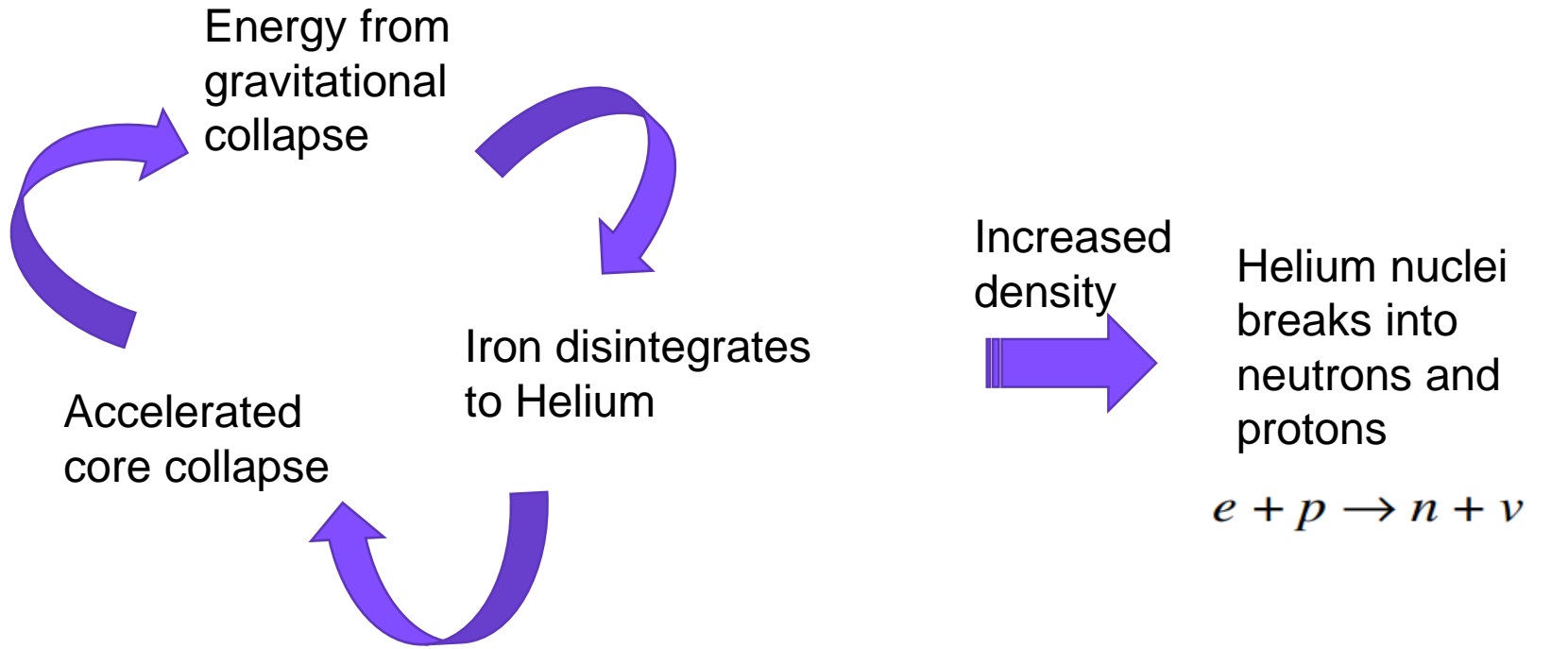


- This process Continues until the core is made of iron.

# Formation of Neutron stars

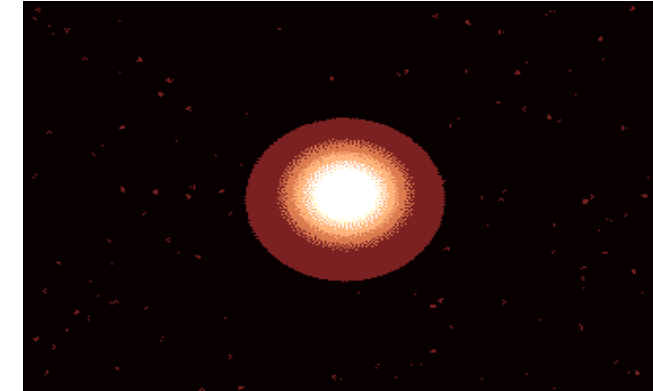
Iron has the high binding energy.

When mass of the star is between  $8M_{\odot}$ -  $12M_{\odot}$ .

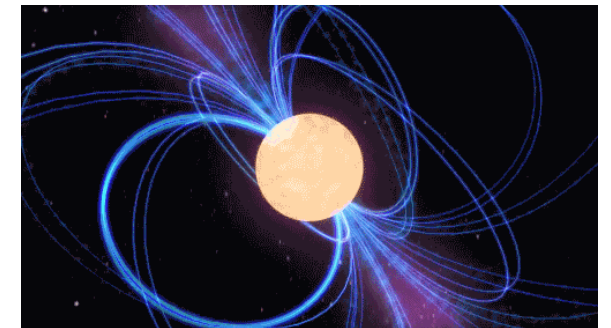


During this process large amount of energy transfer to envelope .

Nuclear reactions resulting into elements all the way to Iron and explodes to **supernova**



<https://asapscience.tumblr.com/post/74949397176/supernovae-as-frequent-as-almost-every-2-seconds>

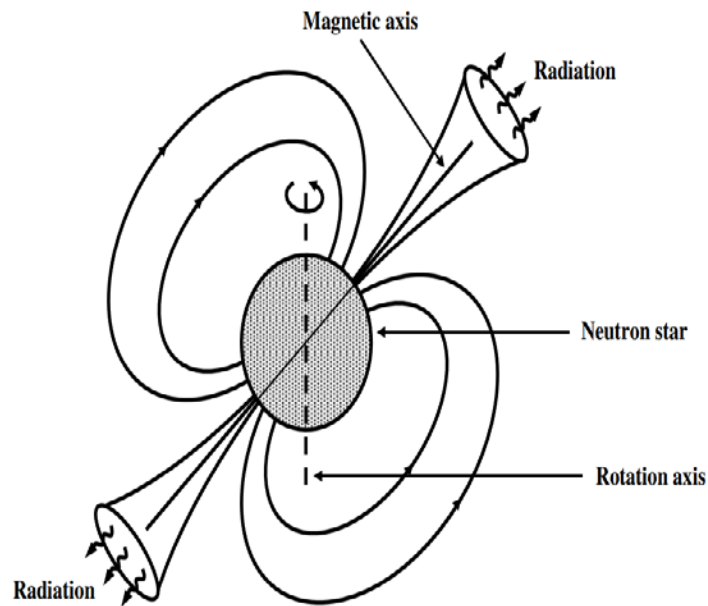


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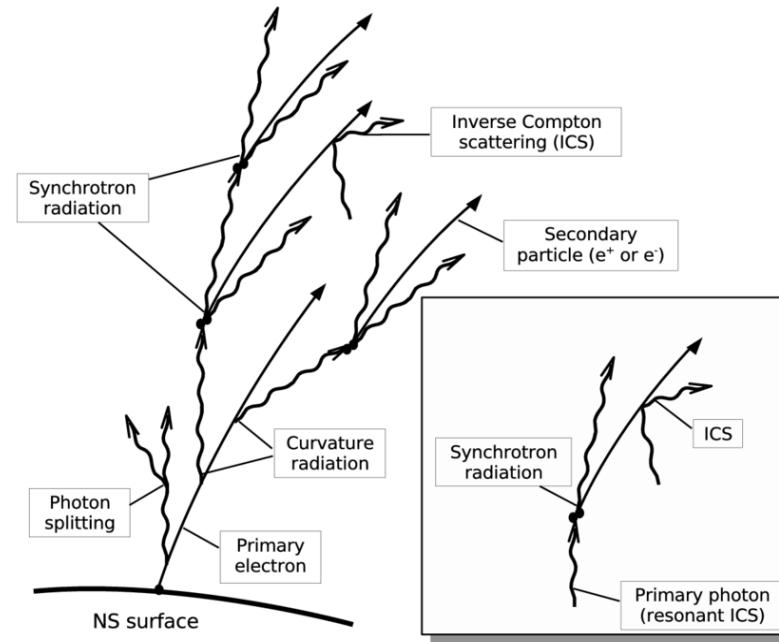


# Pulsars

Highly rotating neutron stars.  
synchrotron radiation.



<https://egyankosh.ac.in/bitstream/123456789/19475/1/Unit-10.pdf>



## Electron positron cascade

[https://www.researchgate.net/figure/A-schematic-diagram-showing-the-magnetosphere-pair-cascade-from-initiation-by-a\\_fig8\\_231149982](https://www.researchgate.net/figure/A-schematic-diagram-showing-the-magnetosphere-pair-cascade-from-initiation-by-a_fig8_231149982)



# summary

- Neutron stars are the end product of stellar evolution.
- Gravitational collapse is the main cause for the formation of Neutron stars.
- Pulsars emit pulses due to synchrotron radiation



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THANK YOU