

# WHAT'S A... NEUTRON STAR

A NEUTRON STAR  
is the dead core of a  
massive star

## PROPERTIES

600,000K ~6,000K



100 times hotter  
than the Sun

1.1 to 2.1 solar masses



600,000 times  
heavier than earth

Neutron Star

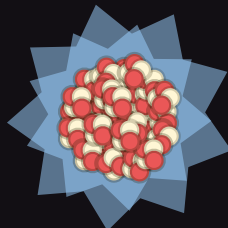
+  
Fast rotation  
+  
Magnetic Field  
=  
Pulsar!



~600 times smaller  
than earth



Density  $\sim 10^{17}$  kg/m<sup>3</sup>



Density of an  
atomic nucleus

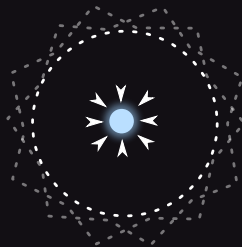
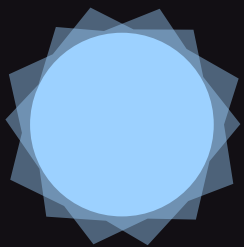
Neutron Star  
Mergers



Release Gravitational Waves  
and make Gold!

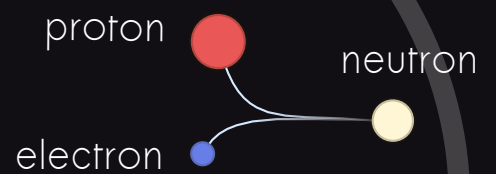
## NEUTRON STAR FORMATION

Take a massive Star  
> 8 solar masses



At the end of its life, the  
core runs out of fuel  
and collapses under its  
own weight.

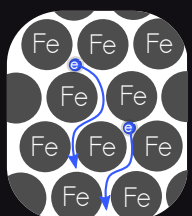
The pressure is such that  
protons and electrons  
are squashed together  
to make neutrons!



And the outer layers  
are ejected in a  
Supernova explosion

The collapsed core  
thus turns into a  
Neutron star

## NEUTRON STAR STRUCTURE



Lattice of iron nuclei with electrons free  
flowing in between. It's incredibly smooth!  
With a depth ~500 meters, bumps cannot  
be greater than 5mm.



The immense pressure that caused protons and  
electrons to merge and form neutrons helps stabilize  
large nuclei with an excess of neutron that would  
never exist on Earth!



In the outer core, the pressure is such that most  
nuclei have dissolved and only neutrons remain. They  
form a special phase of matter called "Nuclear Pasta"



No-one knows what is truly at the center of a Neutron  
Star! The neutrons might dissolve, leaving only quarks. Or  
could it even harbour Strange Matter?!

Outer  
Crust

Inner

Crust

Outer

Core

Inner

Core



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