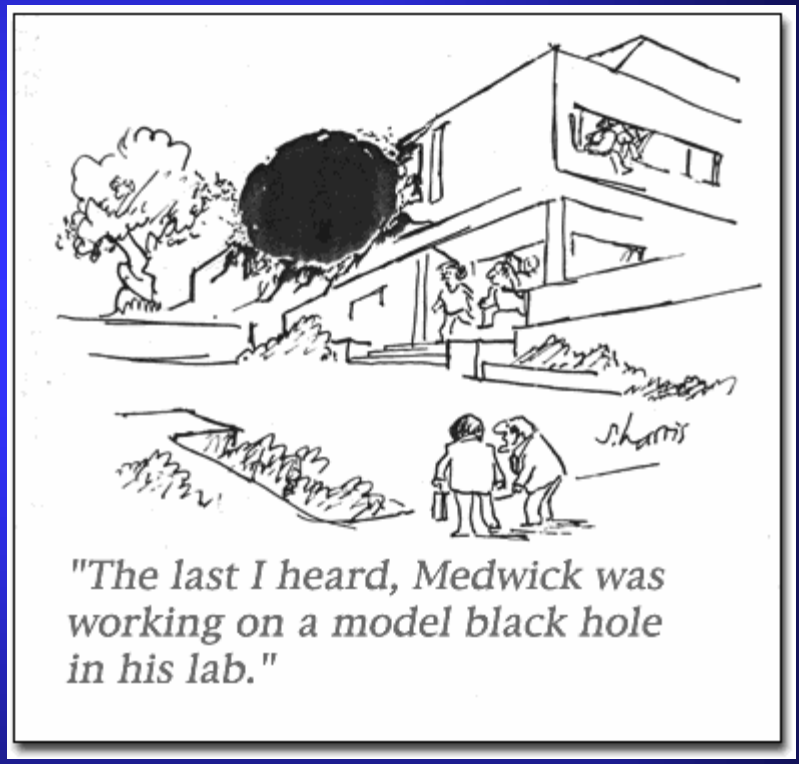
Weird Stuff


"WHAT IT COMES DOWN TO IS THE GOVERNMENT WANTS TO KNOW HOW $\frac{K}{4}\sqrt{3}^{n}-T$ WILL HELP AMERICA."


"The last I heard, Medwick was working on a model black hole in his lab."

Overview

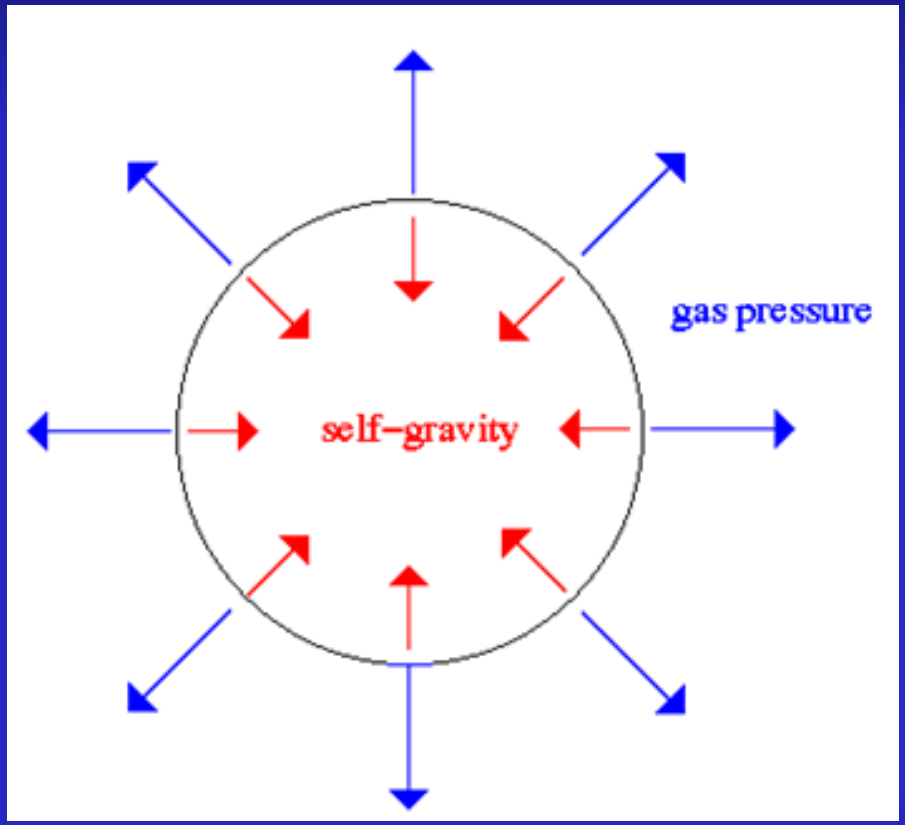
A. White Dwarf
   1. How do they form?
   2. What are they made of?
   3. What stops them from collapsing?
   4. How big are they?
   5. What's their size/mass relationship?
   6. What is a nova?
   7. What is a type I supernova?

Overview

B. Neutron Star
   1. Repeat questions A 1-4
   2. What is a Pulsar?
   3. How where pulsars discovered (and by whom?)

C. Black Holes
   1. What are they?
   2. What is Einstein's gravitation theory?
   3. Why are black holes "black"?
   4. Are black holes eating the universe?
   5. What if I fall into one?
   6. Do they REALLY exist?

Discussion Question



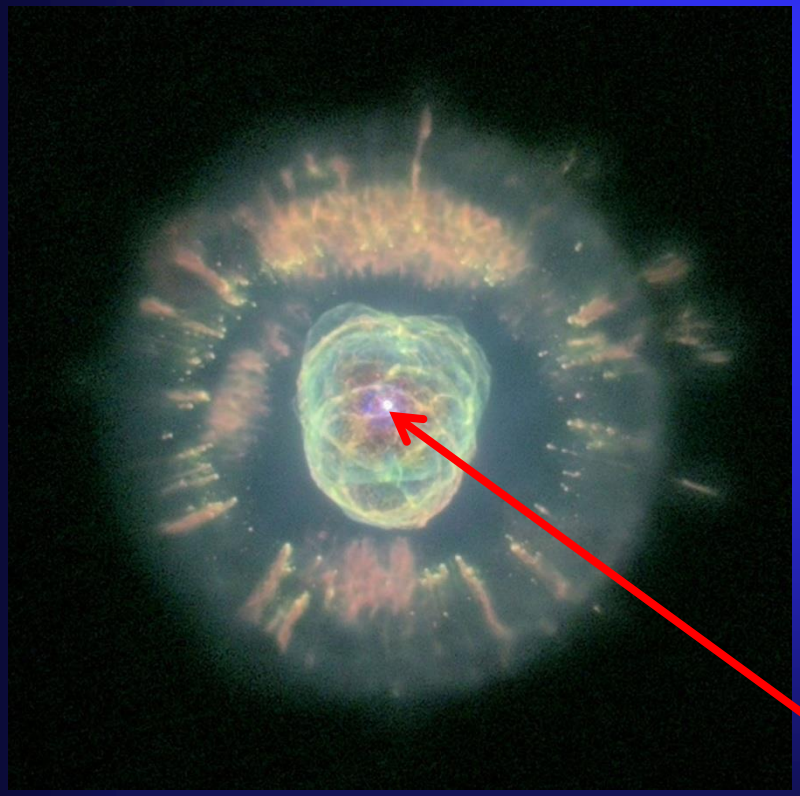
When gas pressure goes to zero… What happens?

Degeneracy Pressure

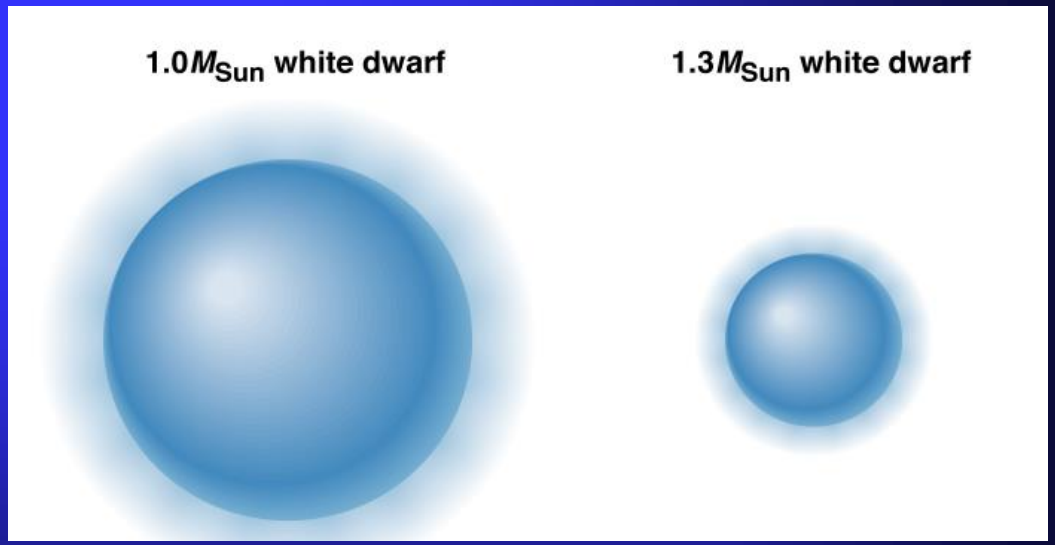
Pauli says everyone sits in their own chair

White Dwarfs

Carbon Core- held up by **electron degeneracy** pressure



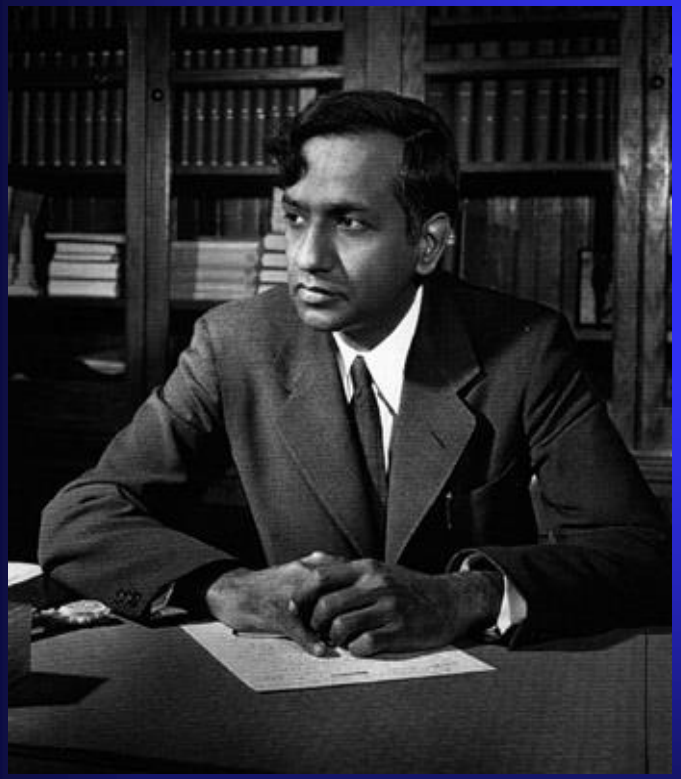
White Dwarf



A1,A2,A5

White Dwarf Limit

The Chandrasekhar Limit

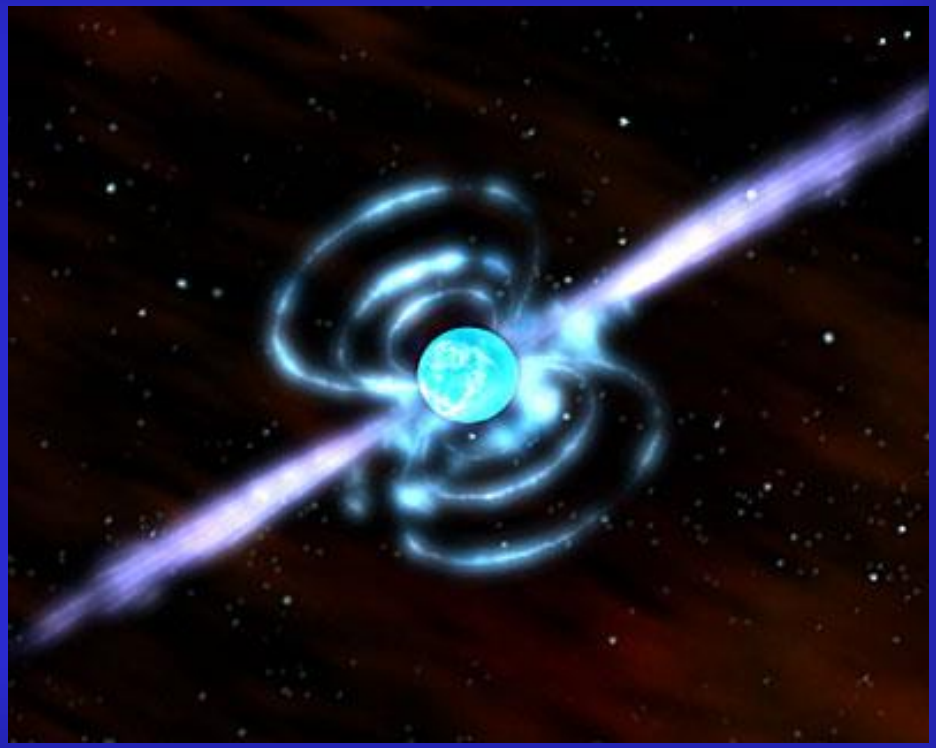


White dwarfs can be no more than 1.4 solar masses

Electron degeneracy pressure fails for more massive objects

Neutron Stars

The leftover core of a more massive star.



Held up by neutron degeneracy pressure

A GIANT ball of neutrons.

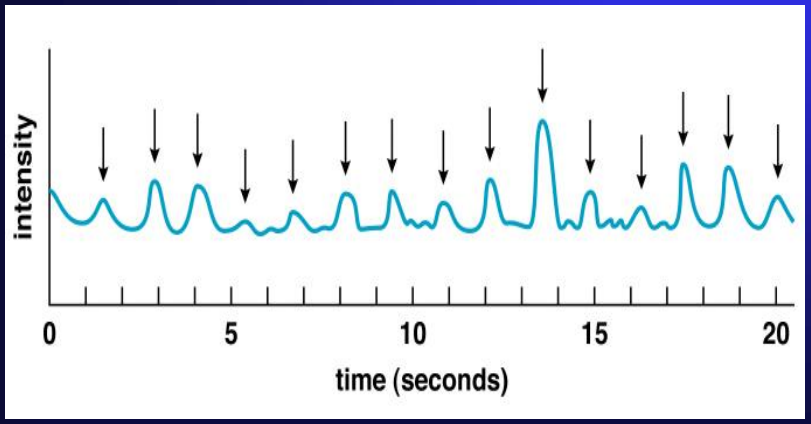
Little Green Men

Jocelyn Bell- 1967

A 4 ½ acre radio telescope designed to find quasars

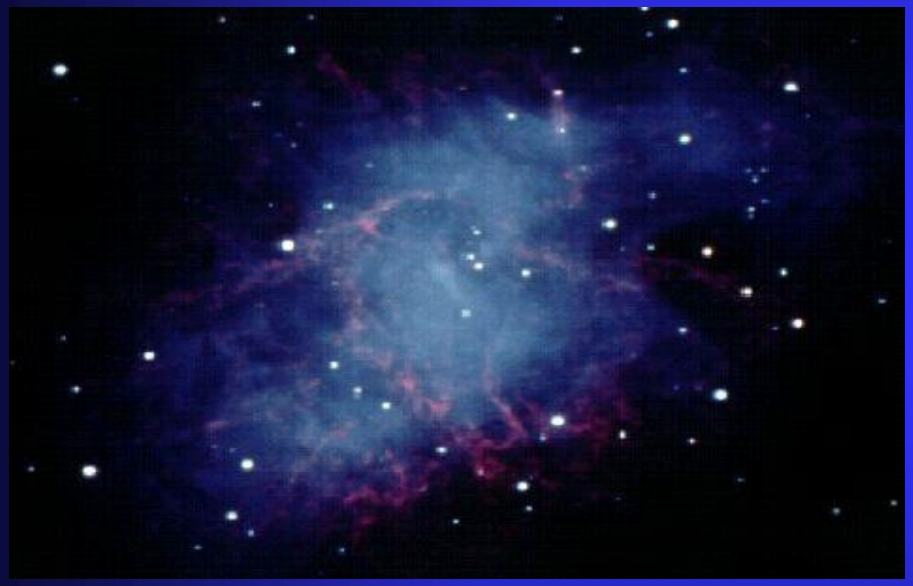
Found a very regular radio signal.

They called the source LGM-1

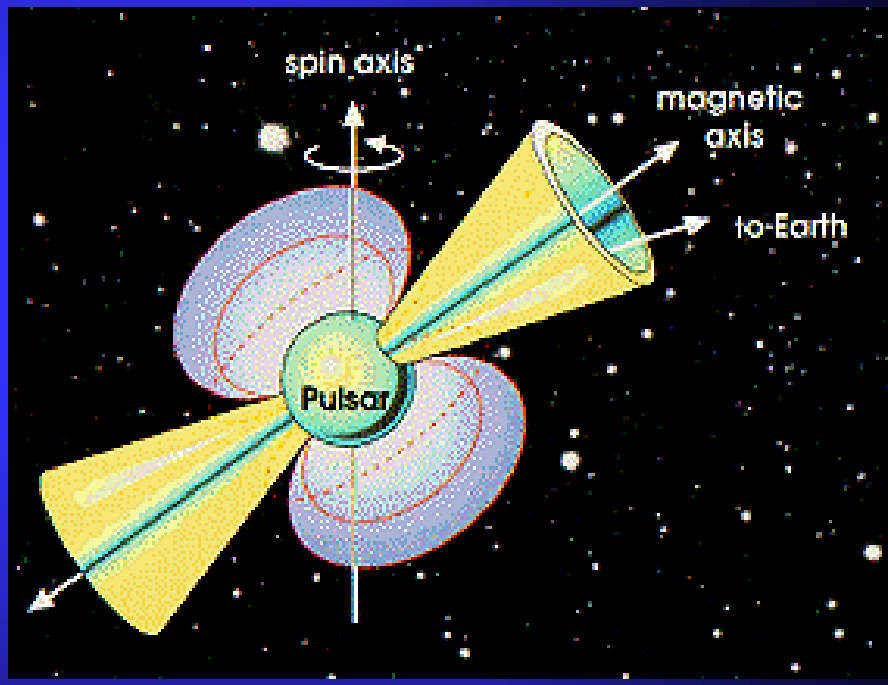


Pulsars

Spinning Neutron Stars



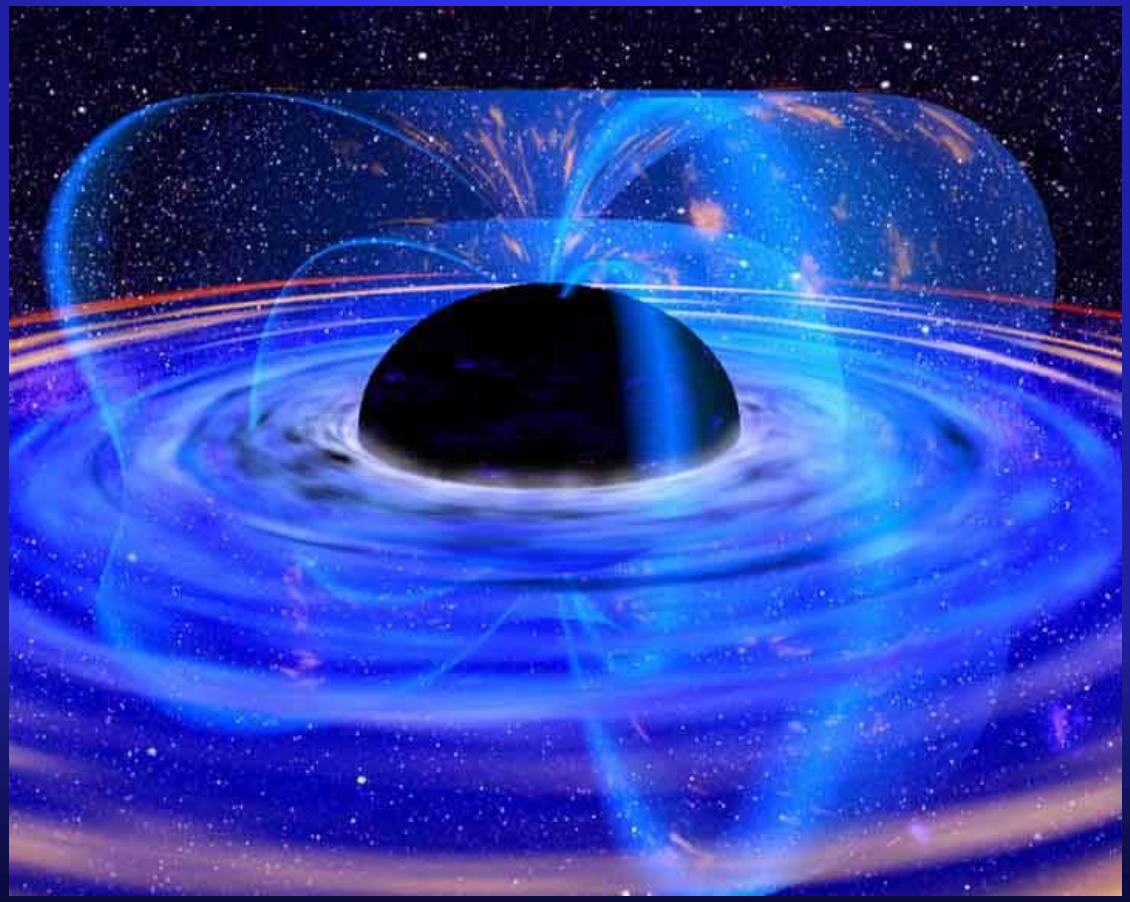
The Crab Nebula



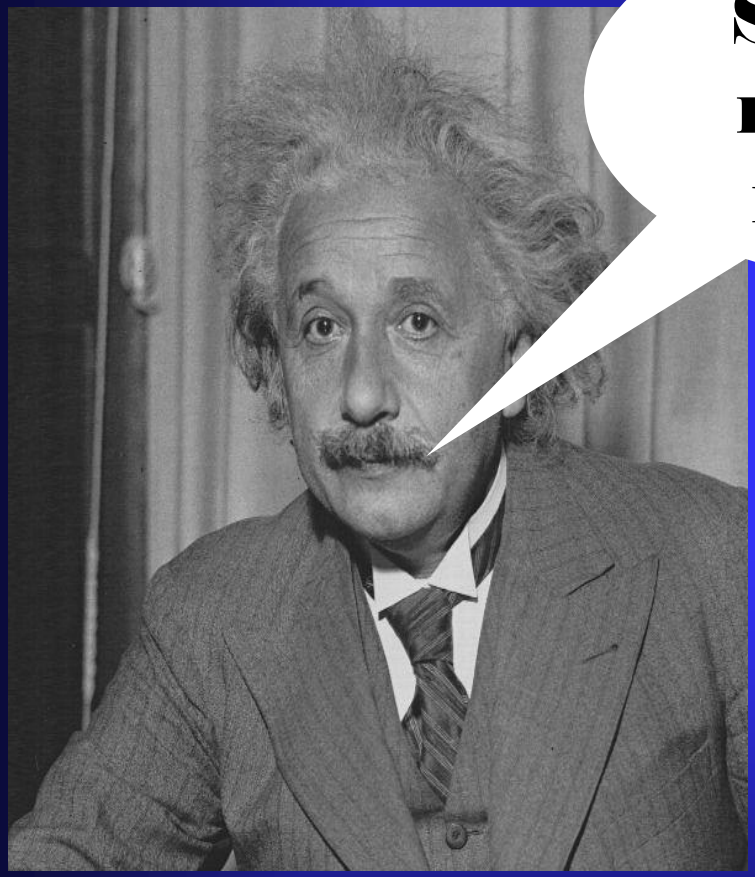
Spinning Neutron Stars

Black Holes

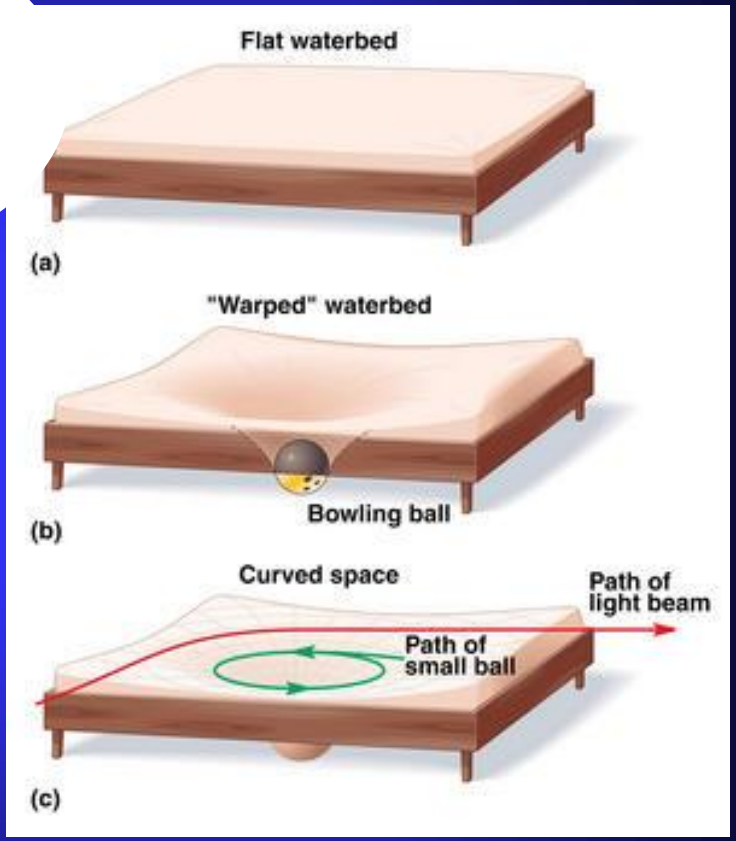
When even neutron degeneracy pressure fails



Einstein's Gravity

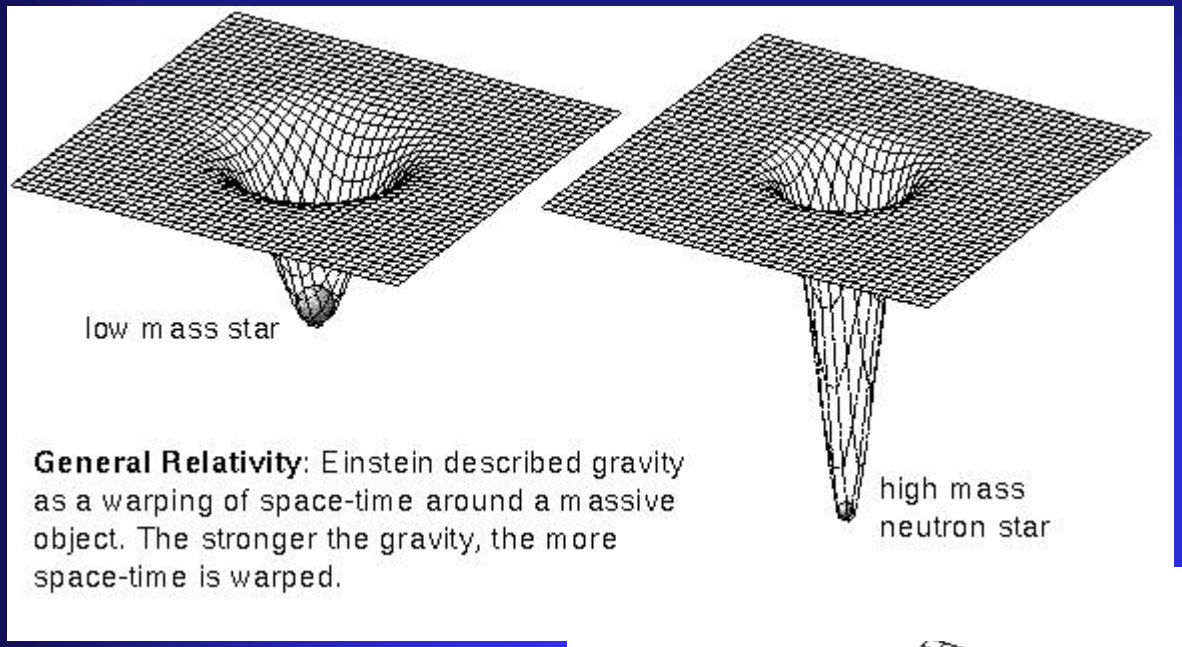


Space is made of rubber

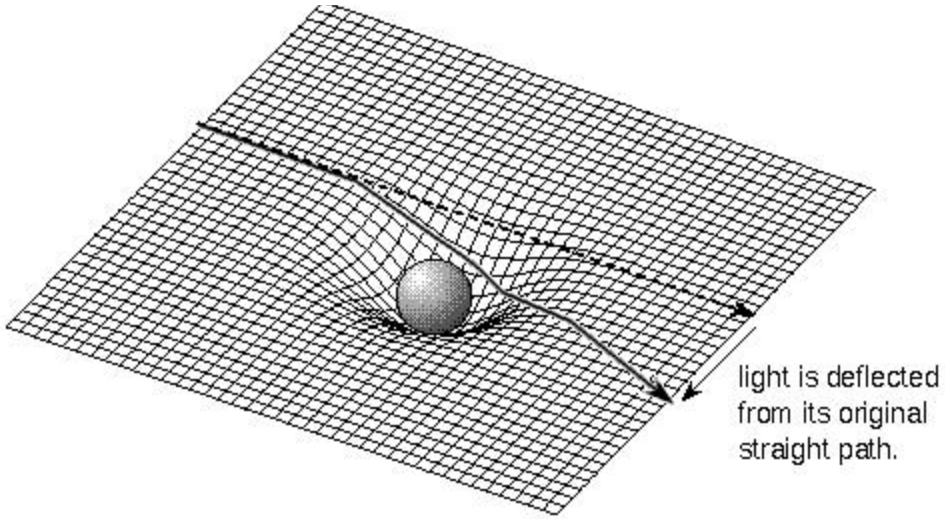


Gravity is really curved spacetime

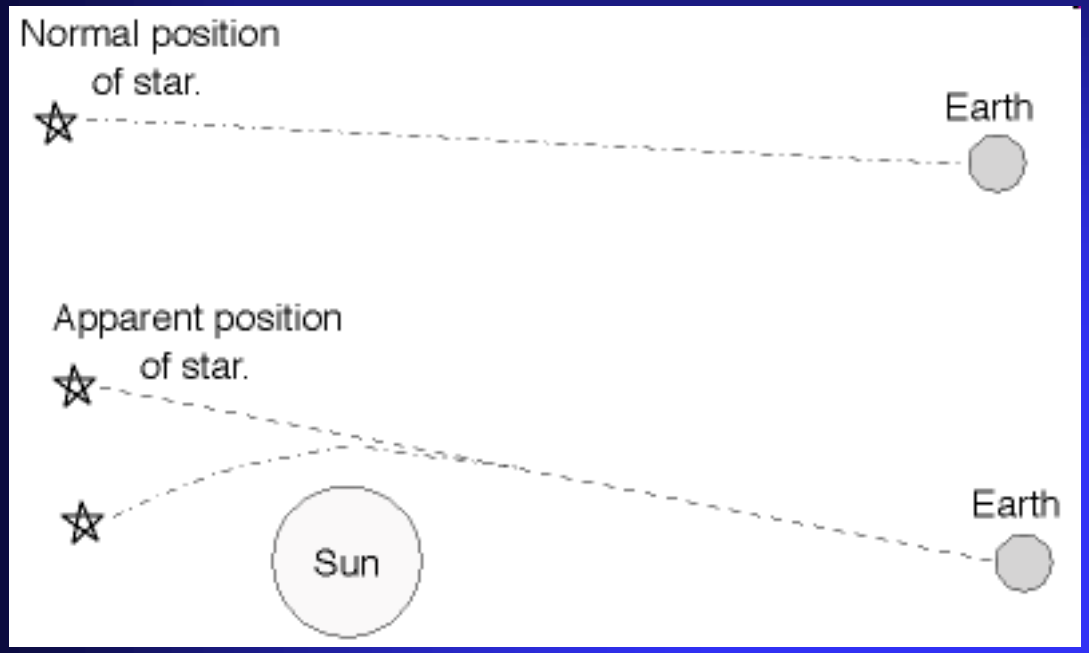
Rubber Space

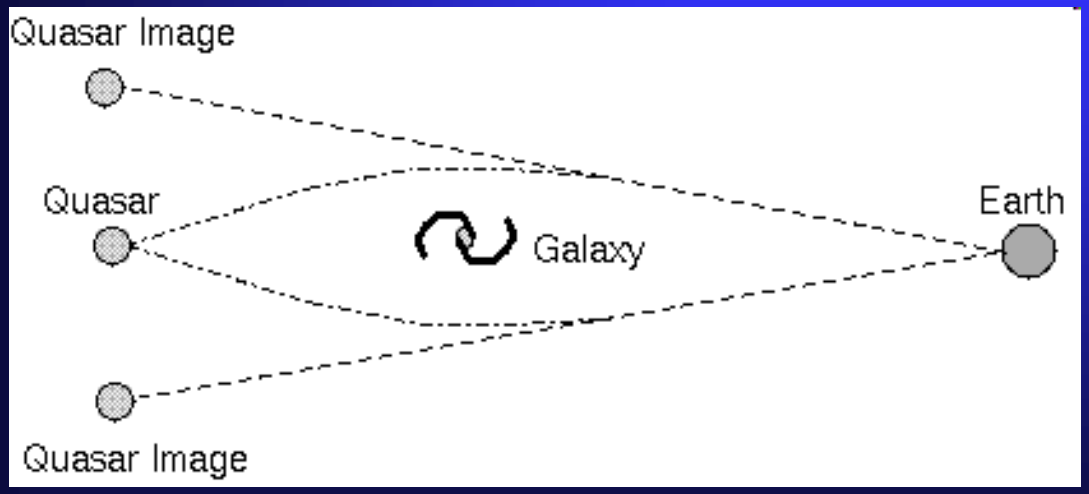


General Relativity: Einstein described gravity as a warping of space-time around a massive object. The stronger the gravity, the more space-time is warped.



Gravitational Lensing





Gravitational Lensing

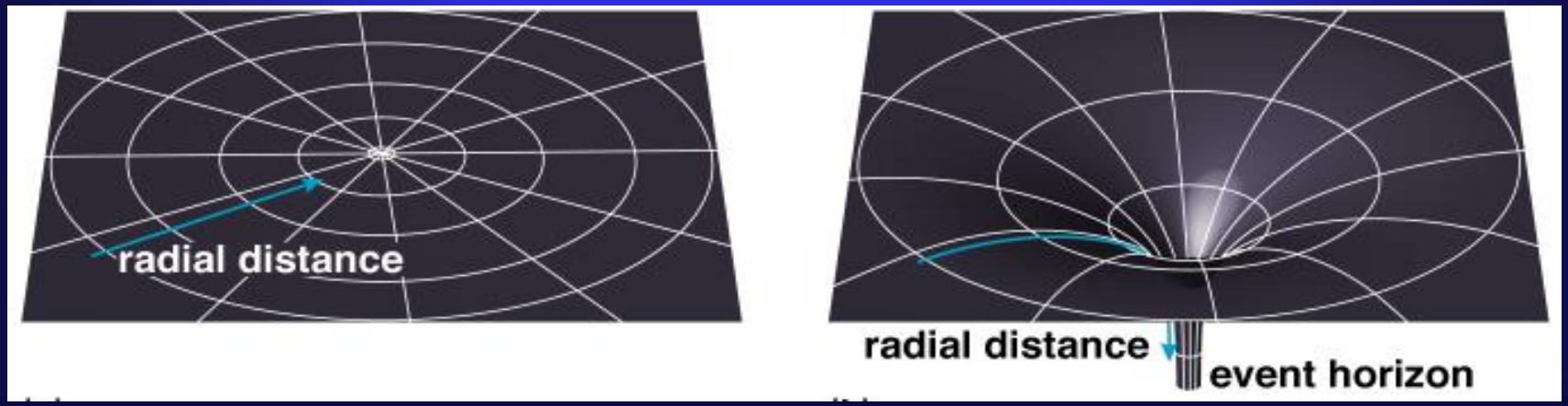
Gravitational Lens HST • WFPC2
Galaxy Cluster 0024+1654
PRC96-10 · ST ScI OPO · April 24, 1996
W.N. Colley (Princeton University), E. Turner (Princeton University),
J.A. Tyson (AT&T Bell Labs) and NASA

Why is it 'Black'?

Event Horizon

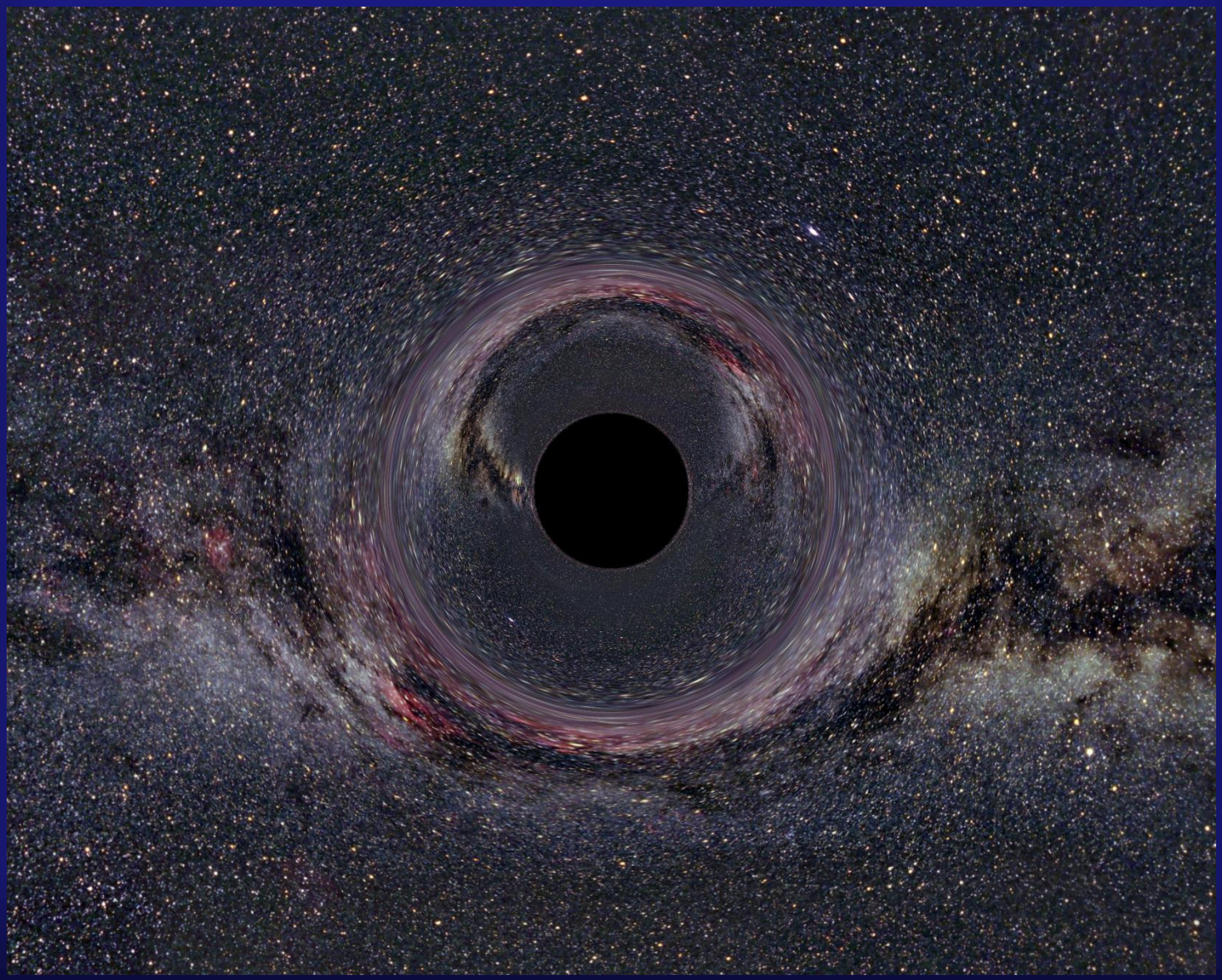
When the escape velocity exceeds the speed of light, nothing can escape.

Anything that falls in is gone forever



C3

Gravity Lens



Black Holes

The force of gravity 1 AU from a 10 Solar Mass black hole is:

A. The same as the force gravity from a 10 solar mass star .
B. Greater than the force of gravity from a 10 solar mass star
C. Less than the force of gravity from a 10 solar mass star.
D. Infinite

C4

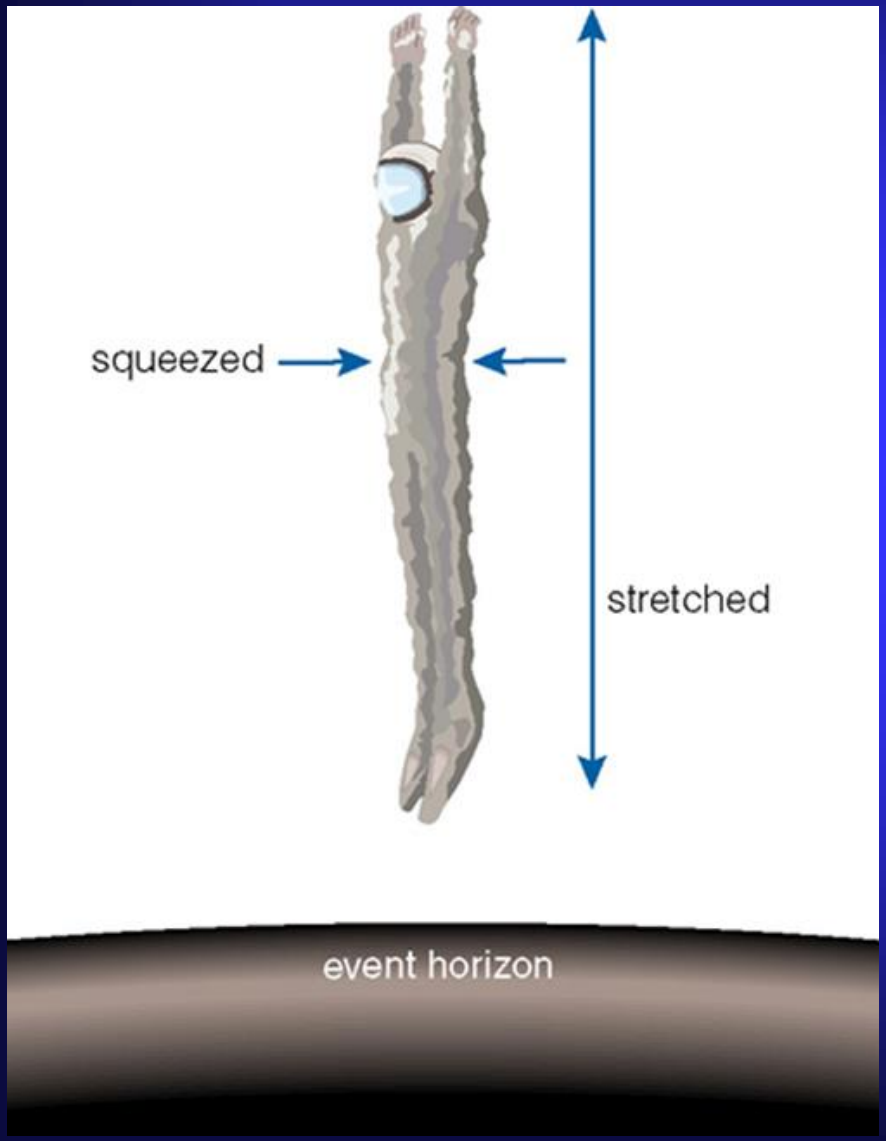
Black Holes

If the Sun were replaced by a 1 Solar Mass black hole:

A. The Earth and all the planets would be sucked in.
B. We would get very cold but our orbit would be unaffected.
C. The inner planets would get sucked in.
D. Everything would be exactly the same as now.

B: Because black holes ***don't suck***!

Tidal Forces are CRAZY



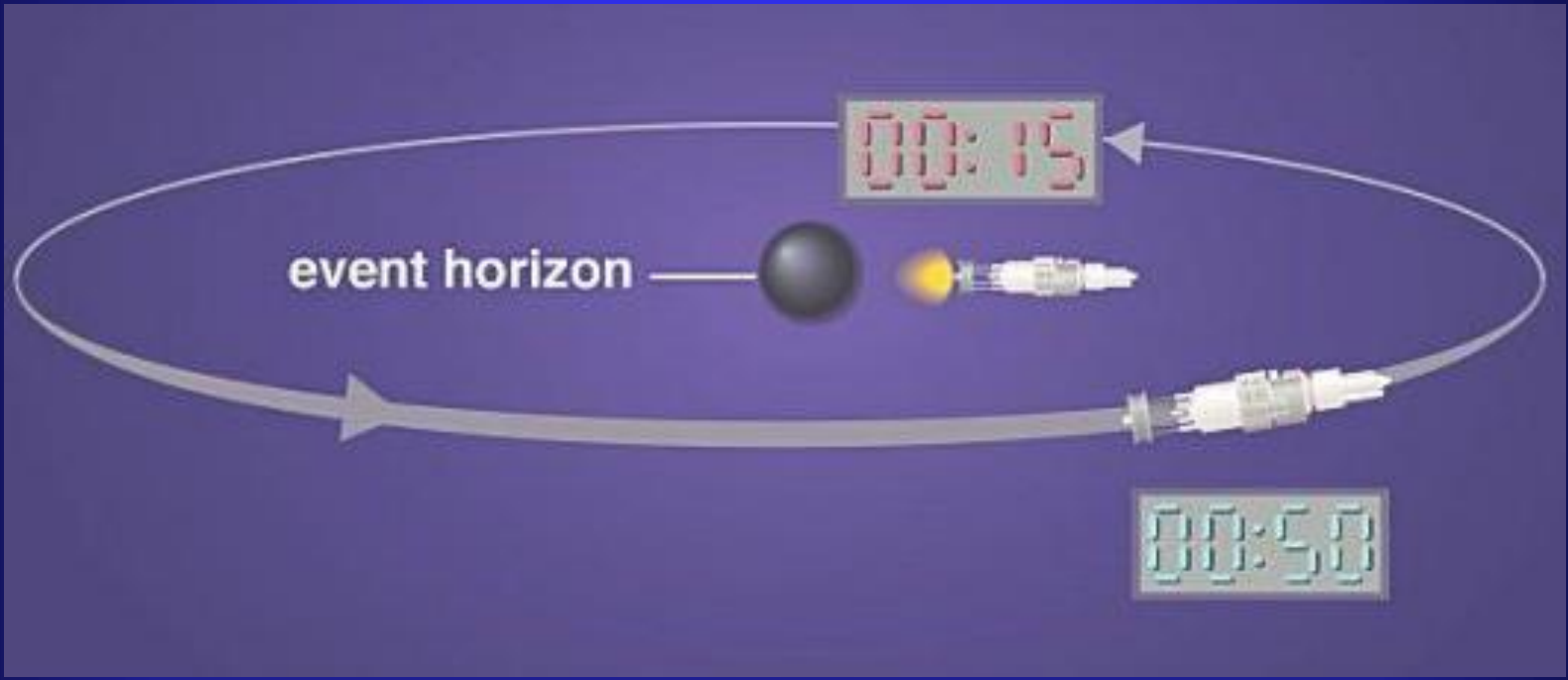
The gravitational force at your head

Is MUCH less than that at your feet

So you get stretched into spaghetti

Gravitational Time Dilation

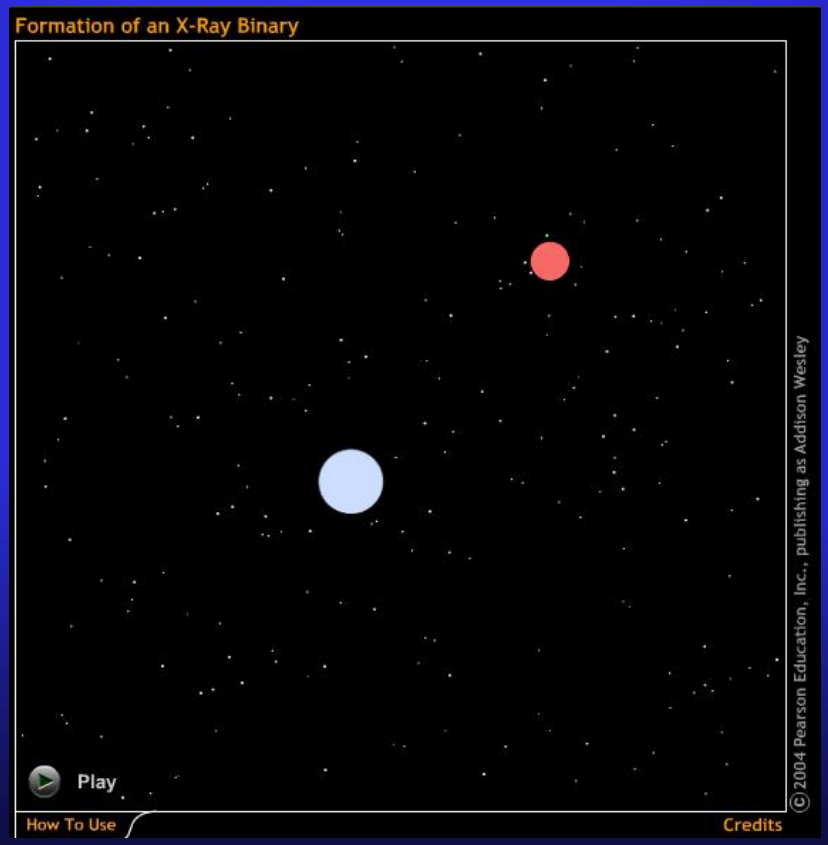
Time slows down on approaching the event horizon



At the event horizon, time stops

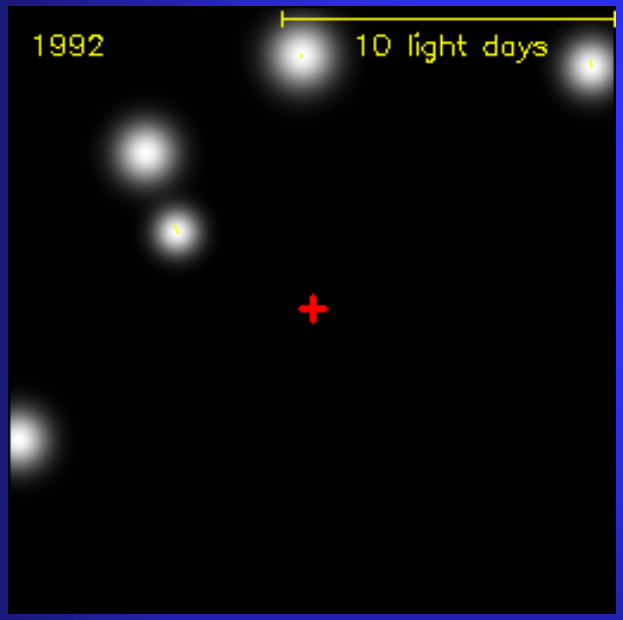
Finding Black Holes

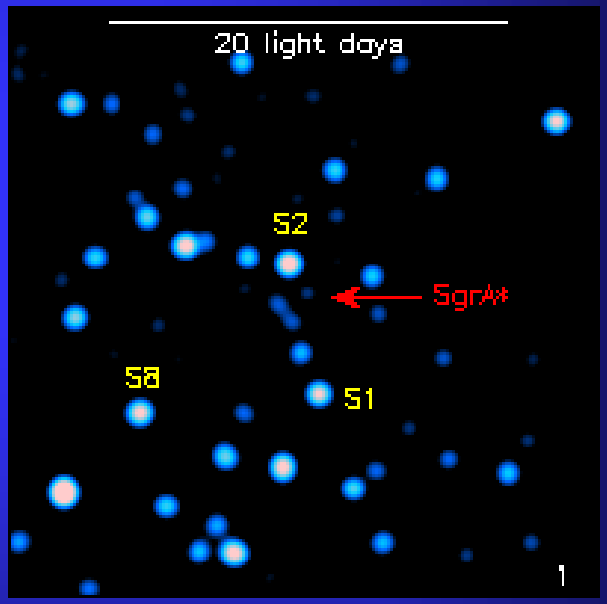
Since we can't see them, we have to look for their effects



Our Galactic Black Hole

Does a Black Hole exist at the center of the Milky Way?

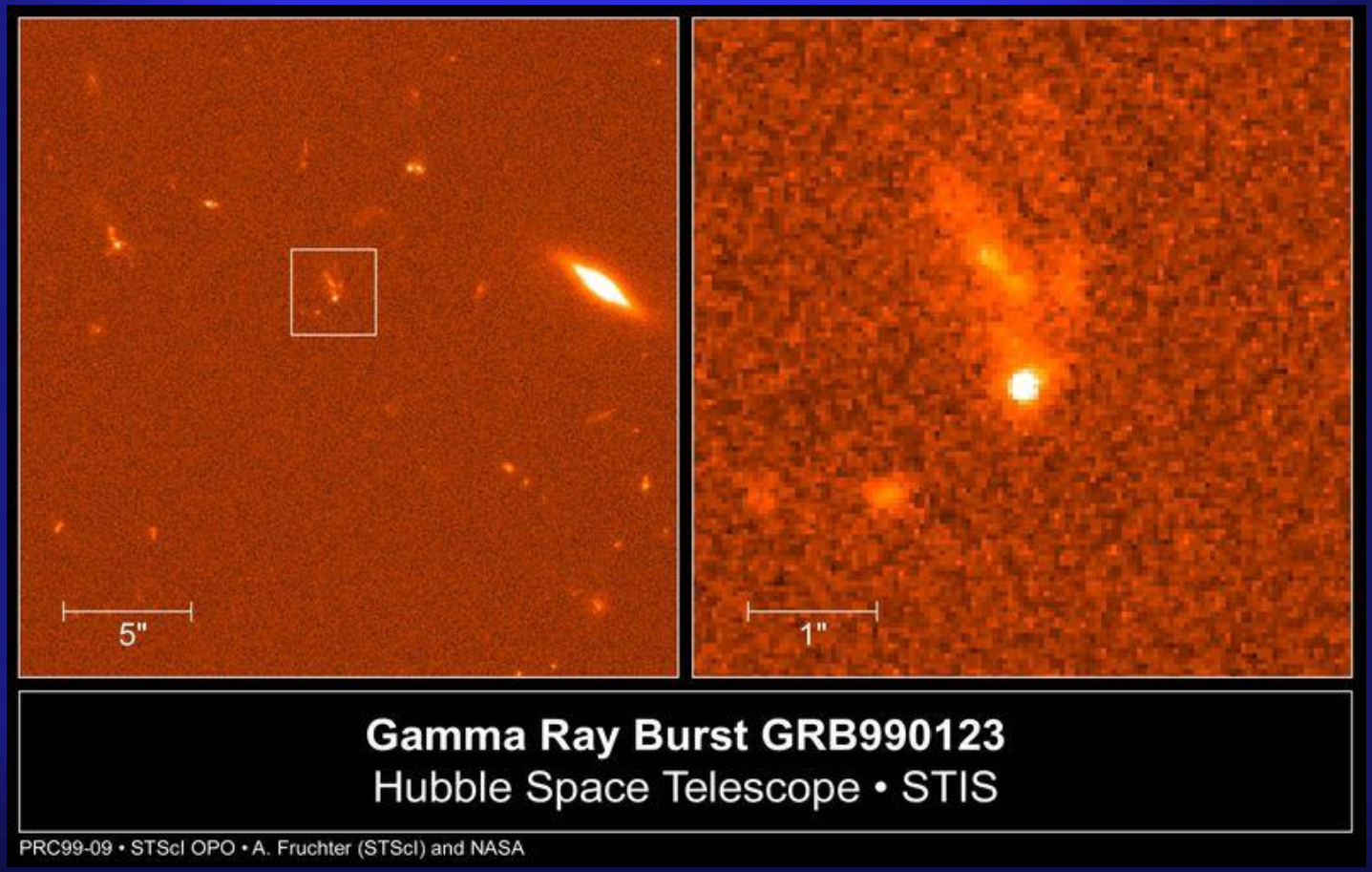




Chances are good, but evidence is inconclusive so far

Gamma Ray Bursts

Extremely bright explosions



What are They?

A hypernova explosion