Neutron Stars

Neutron star - characteristics

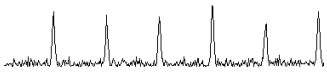
_____
_____
_____

Theory: _____

Can this theory be proven to be true?

Can this theory be supported?

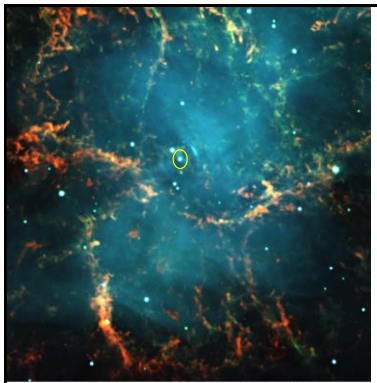
Jocelyn Bell



Pulsars!

What are they?

Rotating _____?



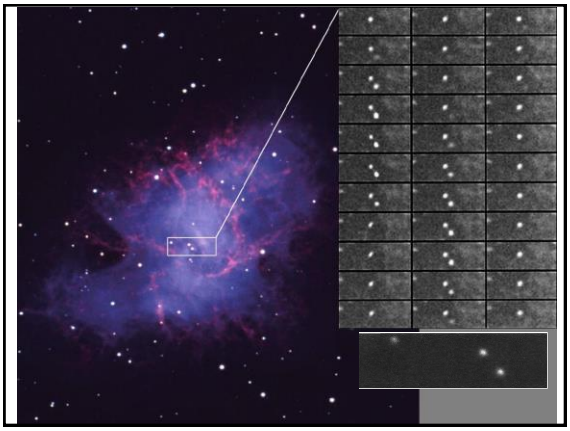
The Crab Nebula in Taurus (centre) (VLT KUEYEN + FORS2)

Crab Nebula - _____ Remnant

Located inside is a _____!

Other remnants with pulsars!

Pulsar are _____
_____



A typical pulsar

The Crab pulsar

Very fast pulsar

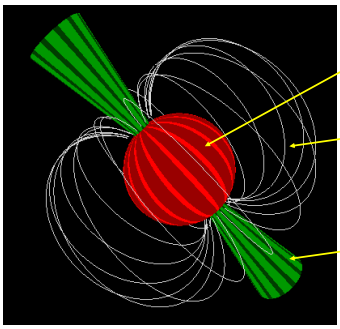
Why so fast?

Conservation of _____-

Rate of rotation ↔ Distribution of mass

What causes the pulses?

Strong _____ Field → _____ Radiation



Pulsar

_____ Field

_____
Radiation

Black Holes

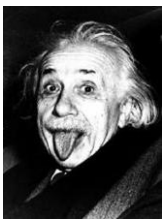
What if a core is too massive to be a neutron star?

It could become a black hole…..

What is a black hole?

What are its characteristics?

Need to take a detour into relativity



Special Theory of Relativity

Gives us $E=mc^2$

More importantly gives us the following rules -

1. The speed of light is _____
2. Nothing can _____

So what? What's the big deal?

How fast will the ball be moving?

_____ mph

How fast is the light moving?

V=_____

Side effects of travelling close to c

- Lengths measure _____
- Colors (red-blue)
- Masses measure _____
- Time measured _____

Really?

Has been observed in many experiments!

General Theory of Relativity

The "difficult" theory

Basic premise -

1. _____warps (distorts) space
2. Space influences how mass, or anything else in it, moves

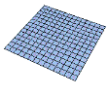
Warped space?

How is space warped?

3-dimensional space is warped into a 4th spatial dimension

Huh?

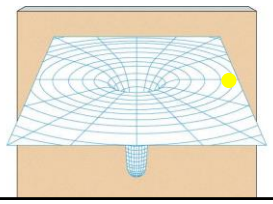
Use 2-dimensional analogies

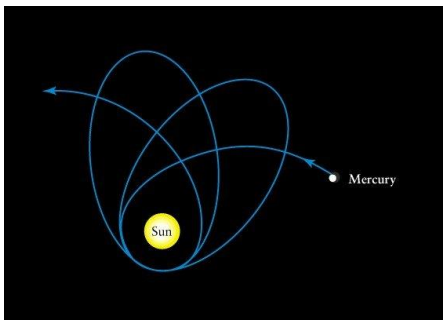


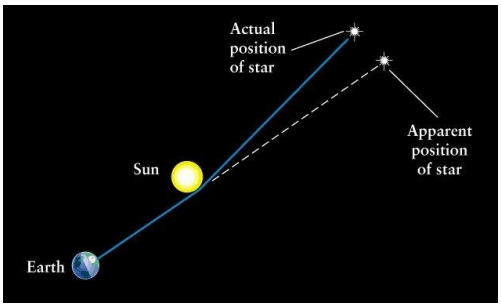
Flat uncurved space

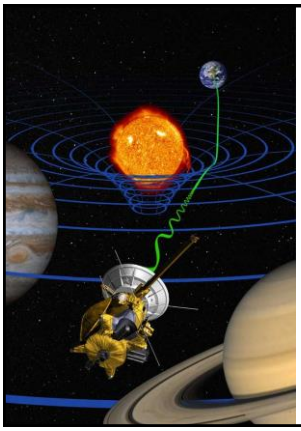
Curved space

Objects must follow the shape of the space









Spacecraft heading for Saturn tested Einstein's theory of General Relativity

Test results match prediction

Black Hole Characteristics

It has mass

Size =0

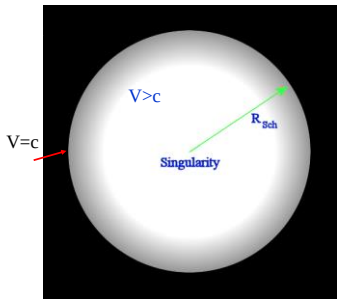
Size not defined - point = _____

What else?

How close can you get to the _____ and still escape?

_____**Radius** - "size" of a Black Hole

R_{sch} depends on the mass (1 solar mass = 3 km)



Journey into a Black Hole

Far from the black hole - everything's normal

Closer to the black hole, effects of relativity become obvious

How?

Let's send someone into the black hole!

Volunteers?


Ouch!

Will we see the astronaut ever go into the black hole?

What will the astronaut see?

Do black holes really exist?

Black holes are black (they don't give off any light)

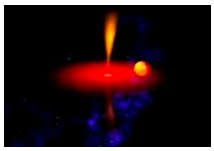
Space is black

How do you find one?

Look for its gravitational influence

How?

Look at x-ray binary star systems



Cygnus X-1