Thursday, April 9, 2009

Third Exam, Thursday, April 16. Neutron Stars and Black Holes

Astronomy in the News:

Pic of the Day - crescent Venus in the day time, between the Earth and Sun

International Year of Astronomy extra credit

Do some research on the IYA.

Write up a brief report. 1/2 to 1 page.

Information Loss??

Black holes have only three fundamental properties: mass, spin, and electrical charge (= 0 in practice)

Deep issue.

What happens to the ***information*** about all the stuff that fell into the black hole?

Quantum theory insists there must be no loss of information.

Maybe it is in the radiation (Hawking) or maybe it is still somehow in the singularity (string theory).

Does the singularity evaporate and disappear? Don't know in absence of a theory of ***Quantum Gravity.***

One Minute Exam

According to Stephen Hawking:

A) Black holes are totally black

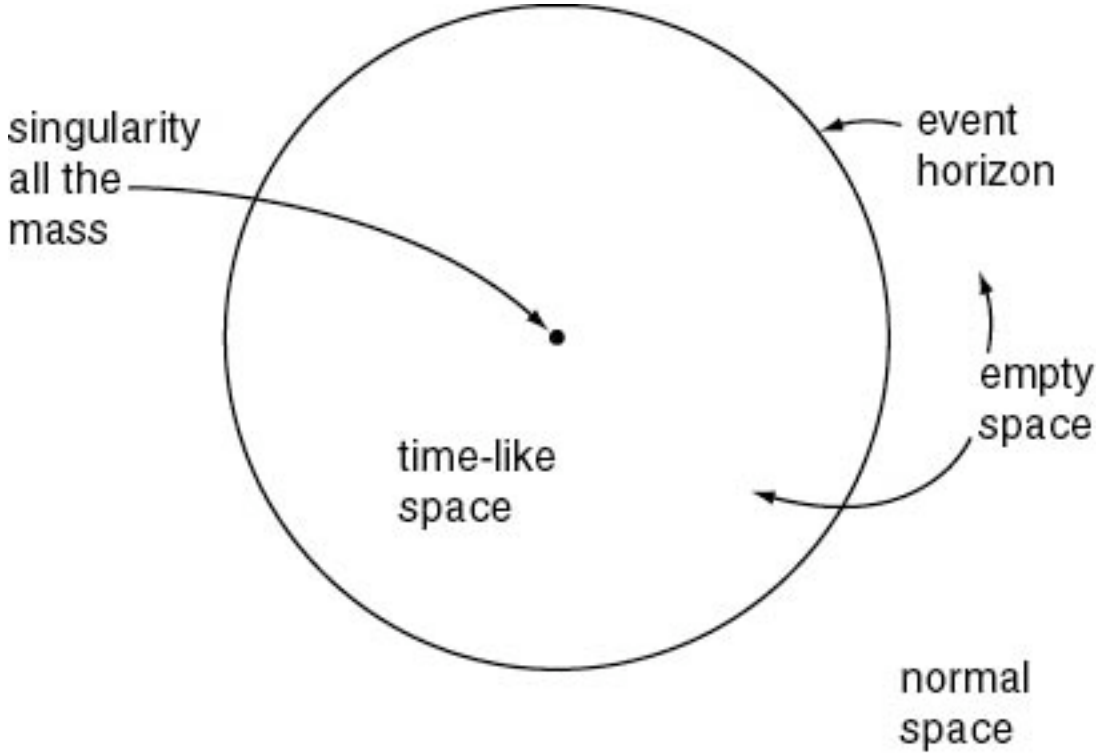
B) Combining a neutron star and an anti-neutron star will make a black hole

C) A singularity is a point

D) Black holes can explode

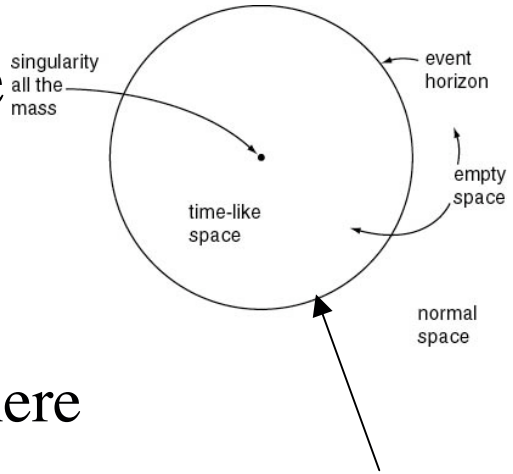
§ 8 Time-like Space

Figure 9.1



"Time-like" space forces motion in one direction. Space moves faster than the speed of light compared to a distant observer; the real reason black holes are black.

Non-rotating Schwarzschild Black Hole



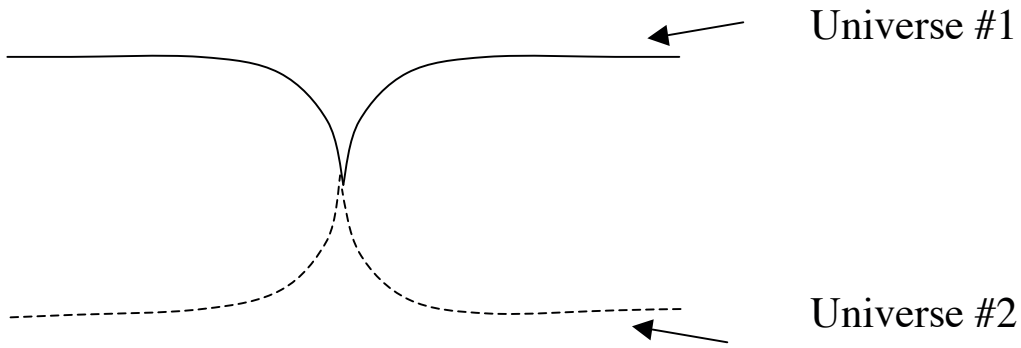
Mass, but no spin, no electrical charge

Assume all mass is in the singularity, no mass anywhere else (assumption necessary to solve equations)

Find two Universes, each of infinite space, connected at one instant by the singularity.

Cannot pass from one to the other if travel at less than the speed of light

Event horizon is also surface of infinite redshift

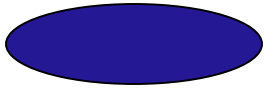


Rotating Kerr Black Hole

Mass and spin, but no electrical charge

Assume all mass is in the singularity, no mass anywhere else (assumption necessary to solve equations)

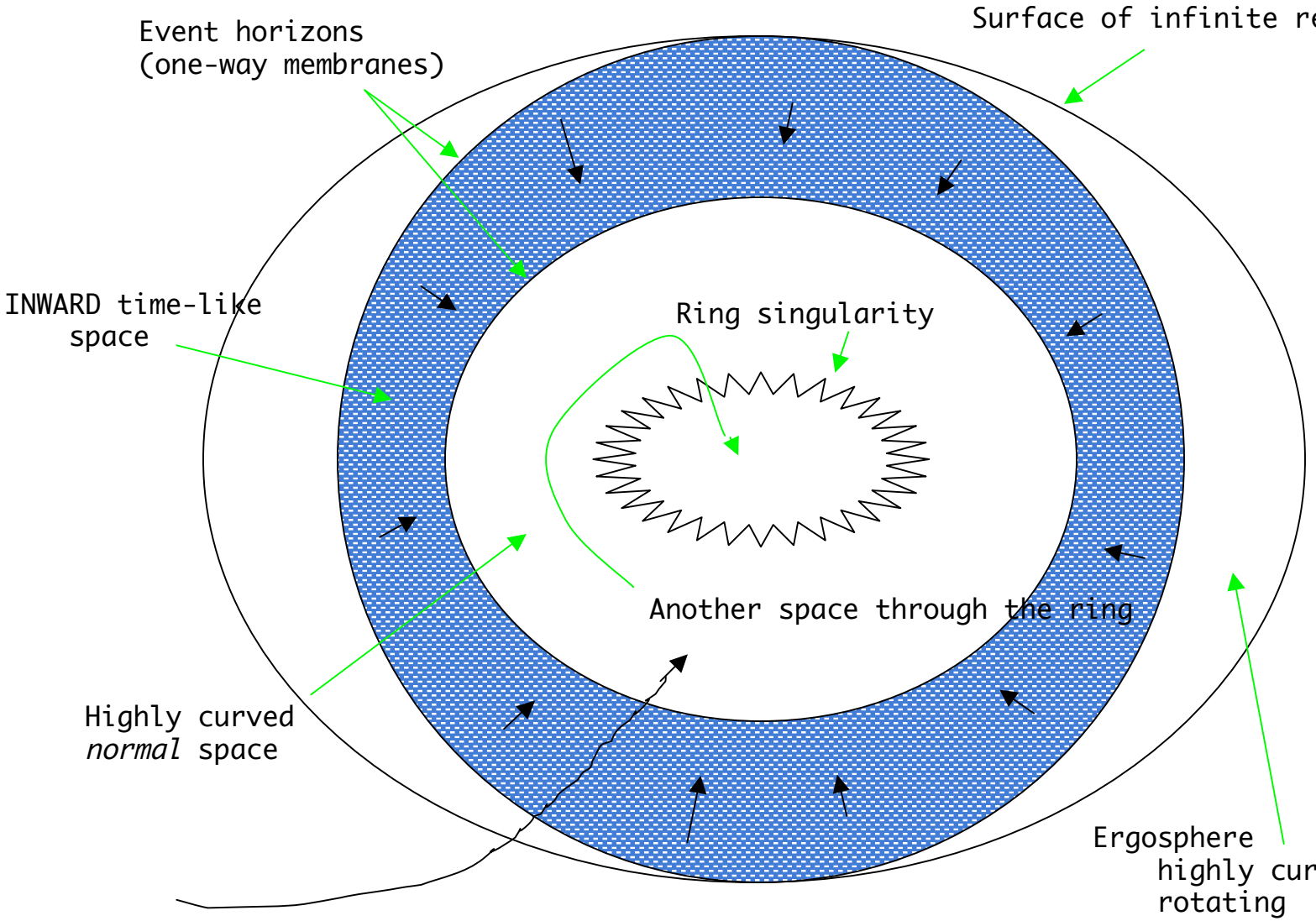
Find ***singularity is a ring*** (not a point)



0 thickness, ∞ density, still uncertainty problem

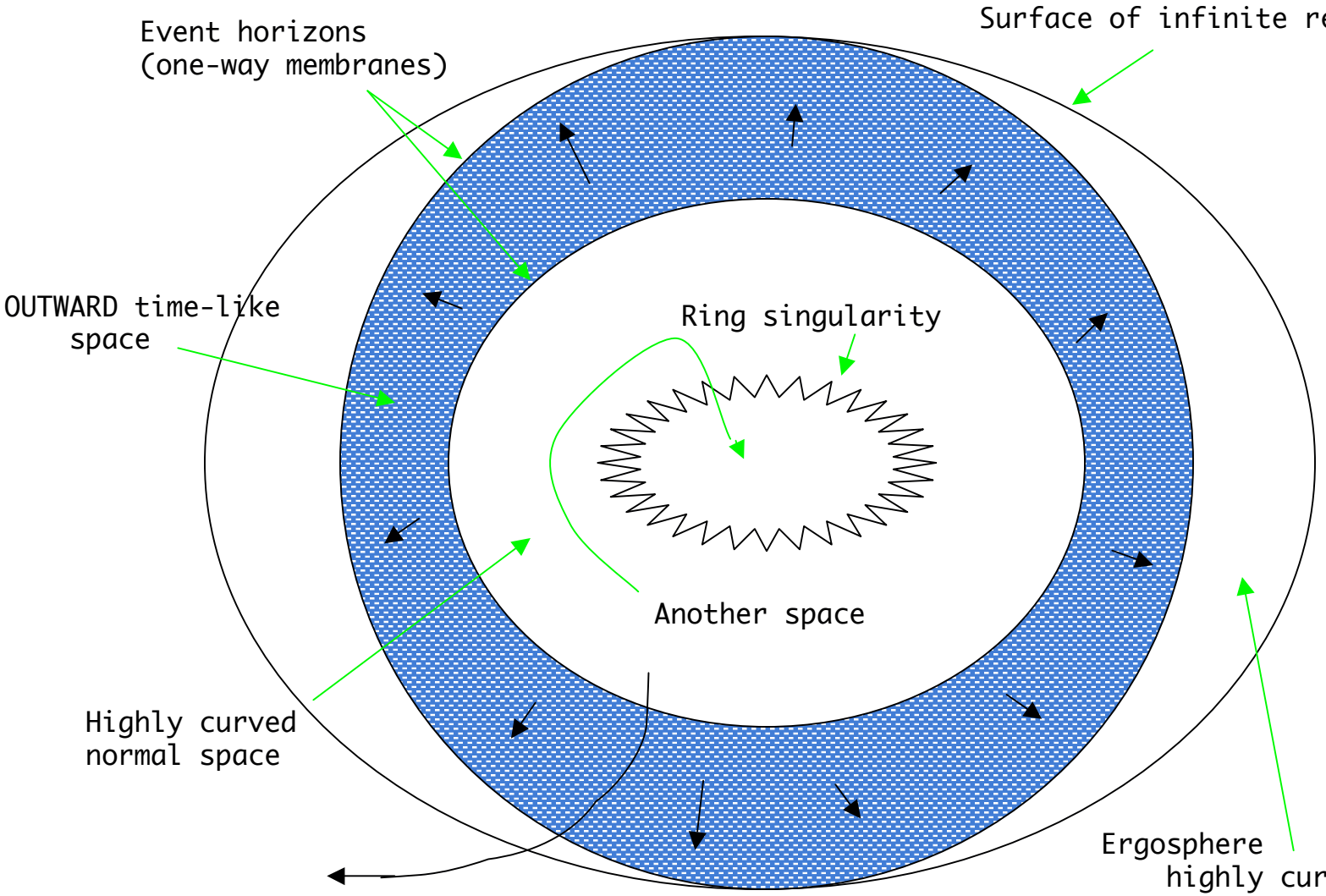
Infinite Universes!

Cross-sectional view of rotating Kerr black hole



Fly in, never to return

In future



Access to Universe different
than original one

Are Different Universes Real?

In Real Universe:

Light falls into the black hole

Photons are Doppler blue shifted, accelerated to higher energy, compacted into a thin shell: ***Bluesheet***

the blue sheet warps the space

changes the mathematical, hence the physical solution

So, probably not in this case, but stay tuned…

One Minute Exam

In the mathematical solution for a rotating black hole:

A) The surface of infinite redshift is identical to the event horizon.

B) You can escape the black hole back to the universe from which you entered.

C) There are exactly two universes.

D) The space entered through the ring singularity is different than the space surrounding the singularity.

Chapter 10 - Finding Black Holes for Real

There may be 1 - 100 million black holes in the Galaxy made by collapsing stars over the history of the Galaxy. How do we find them?

Black holes made from stars are really black! (Negligible Hawking radiation).

Those alone in space not impossible to find, but very tough.

Look for binary systems, where mass accretion occurs.

Will not see the black hole, cannot yet “see” a black spot.

Can detect the ***halo of X-rays*** from orbiting matter, the accretion disk, near the event horizon that will reveal the presence and nature of the black hole. ***Look in accreting binary systems!***