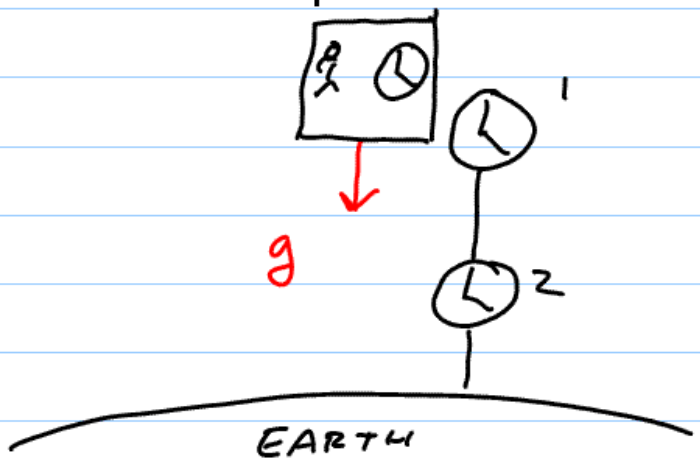
PHY132S Relativity
Class 6 - April 8 2009

1



SR: Clock 2 runs more slowly than Clock 1

Grav. time dilation: Clocks in gravitational fields run slowly

Example: GPS

2 Stellar Aberration

3 Newton! 1 planet Sun spherical

ellipse

Advance of Perihelion

Expts difficult

4 move q, $\vec{E}$ "kink" at c

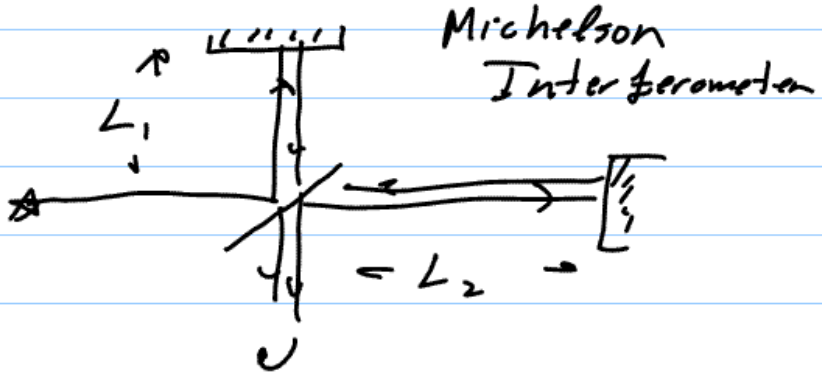
oscillate q: "kink" electro-magnetic radiation

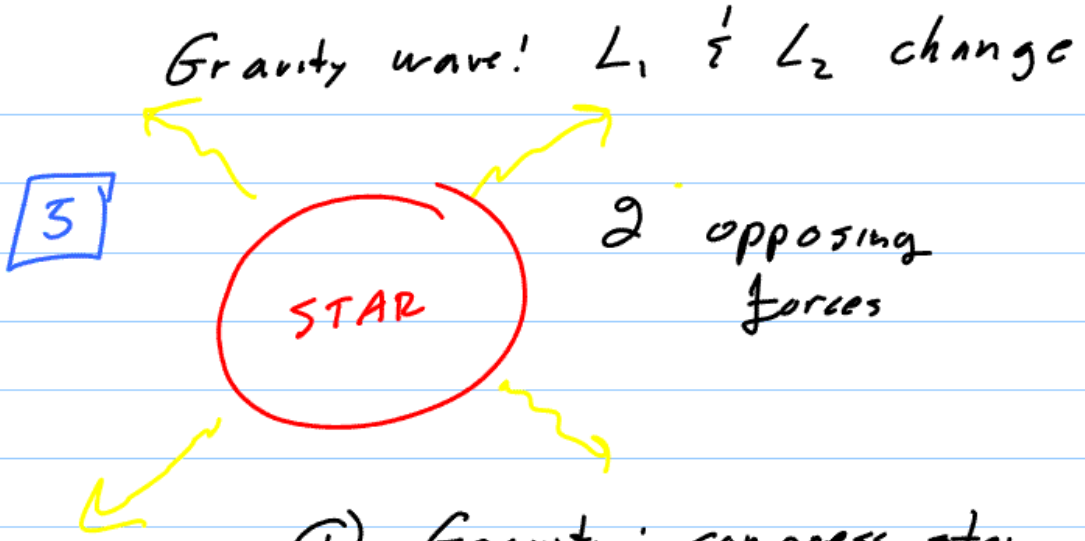
oscillate

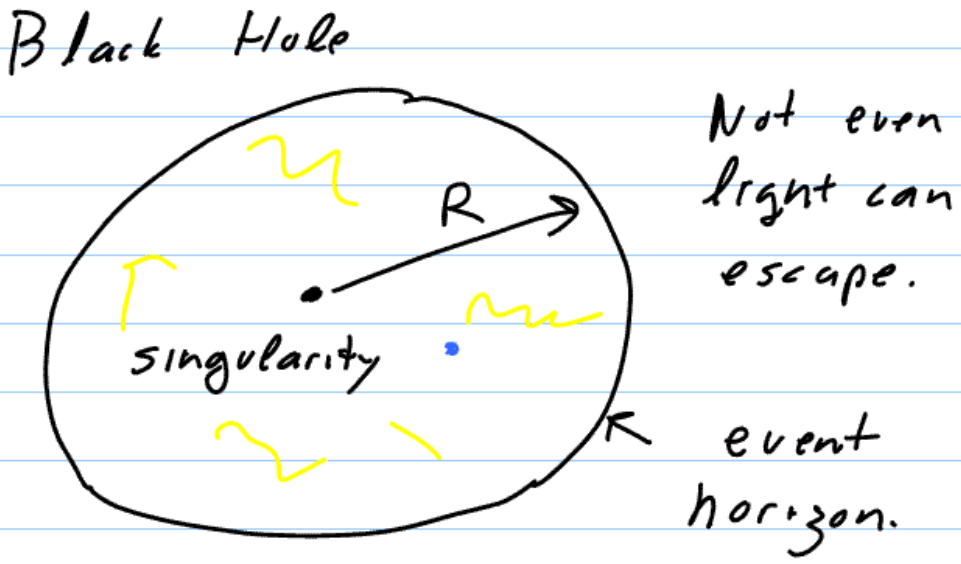
M

Gravity Wave

LIGO




Gravity wave! L_1 & L_2 change
3
STAR
2 opposing forces
(1) Gravity: compress star reduce radius
(2) radiation pressure! increase radius


Black Hole
R
singularity
Not even light can escape.
event horizon.

6

1916: GR predicts an expanding universe.

Einstein: NO!

Fudge factor, "cosmological constant" to force a static universe

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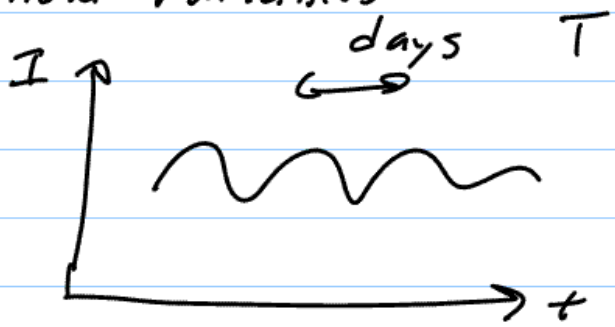
1926: HUBBLE

$I \propto \frac{1}{r^2}$

Know absolute brightness, determine r.

Cepheid Variables



Known relation between T and absolute brightness

Doppler shift: determine speed

Result: universe is expanding.

Run movie backwards

~15 billion years ago:

$r = 0$
$\rho = \infty$
$temp = \infty$

} BIG BANG

Expansion reverses! "Closed"

Expansion forever! "Open"

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15 years ago:

Problems! (1) Flatness

(2) Homogeneity

(3) Dark matter

1998 - Perlmutter et al.

Hubble-type xpt with supernovae

Rate of expansion of universe is increasing