PLS HAND IN PS #5

answers to be posted Tuesday

handed back in section after break

review session 9:15pm Mon after break

Tues after break: test. Test prep to be posted soon

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1) "supermassive" B.H.
very massive black holes
in centers of galaxies

2) gravitational waves
directly detected
(hasn't been done yet)

"Laser Interferometer Gravity Observatory"
LIGO

STRONG RELATIVITY

plan: 1) find a black hole
2) find out whether it behaves as G.R. predict
e.g. event horizon not a surface

X-ray astronomy

1960s: very strong X-ray sources
THOUSANDS of times solar radiation
all of it in X-rays

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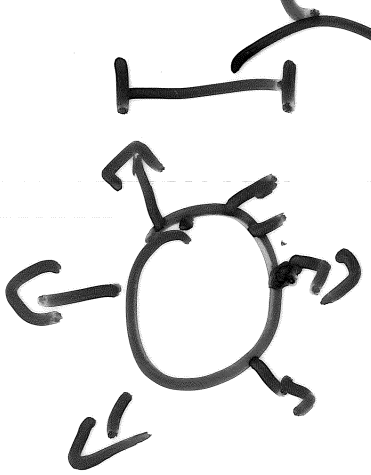
energetic photons:
require high T ($\sim 10^6$ degrees)
Sun has a surface T 6000 degrees

combining T and luminosity

→ emitting region is SMALL, much smaller than a star

ALSO brightness varies quickly

(~~hours~~ 0.01s timescales)



< 0.01 of a light second

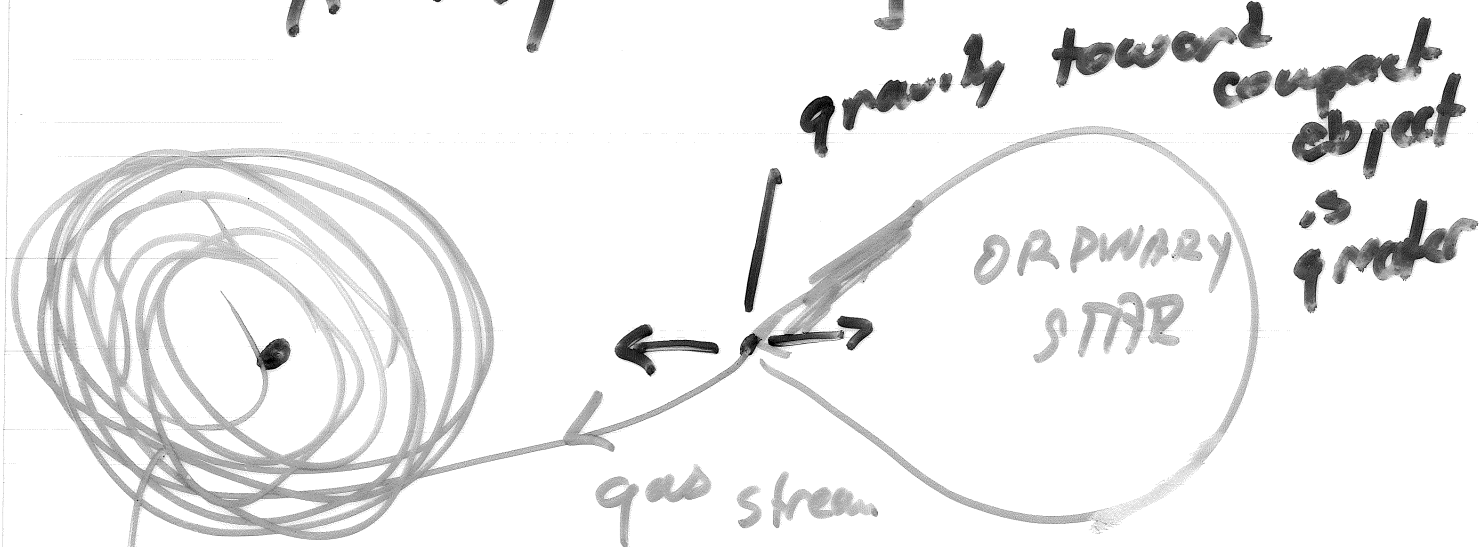
$c = 3 \times 10^8$ m/s

size $< 3 \times 10^6$ m

< 3000 km

⇒ NEUTRON STAR

X-ray Binary Stars



"compact object"
e.g. neutron star

accretion disk

inner orbits go faster than outer orbits

gas generates friction

→ heats gas up

→ extracts energy from orbit

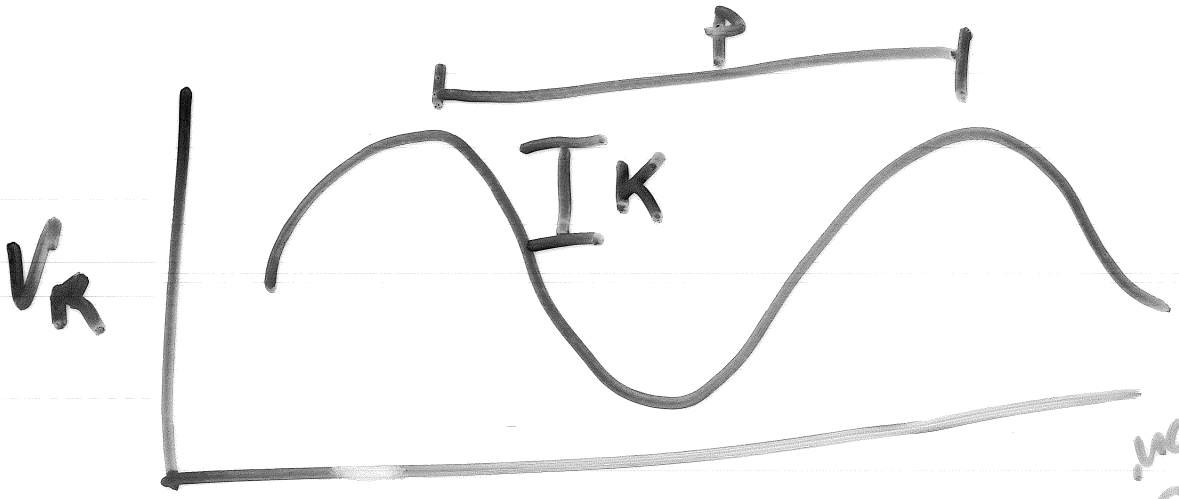
→ gas spirals in

inner accretion disk
→ millions of degrees
→ emit X-rays

$$v^2 = \frac{GM}{a}$$

$$M_{ns} < 3M_\odot$$

observe orbit of companion
determine mass of compact object



inclination

$$\frac{P K^3}{2\pi G} = \frac{M_{compact} \cdot \sin^3 i}{(1 + M_*/M_{comp})^2}$$

"mass function" observed from velocity curve only

$\frac{M_{comp}}{(>1)} = (<1)$

$\hookrightarrow$ < $M_{compact\ object}$

so if mass fnctn > 3 $M_\odot$ compact object > 3 $M_\odot$

hard to observed

accretion disk outshines star

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many objects have intermittent accretion

FINDING A B.H.

1) new source of X-rays
2) WAIT ....
3) X-rays turn off
4) measure mass function

IF $> 3 M_\odot$

you win.