PS#5 due Thursday:

NOTE: orbital period = 8 hrs on prob 1

test after break

(test prep sheet upcoming review session 9:15pm night ~~before~~ before)

POST-NEWTONIAN EFFECTS of G.R.

1) precession of perihelion (Mercury's orbit)

periastron

periqalacticon

2) deflection of light

eclipse observations

→ gravitational lenses

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3) gravitational redshift

$$z = \frac{\Delta\lambda}{\lambda} = \frac{\Delta P_\theta}{P_\theta}$$

"redshift"

$$= \frac{1}{\sqrt{1 - R_s/r}} - 1$$

Schw. radius of some mass

distance of the light source from mass

how much redshift do you observe from infinite distance

$R_s/r \to 0$

If observer is not at infinity

$$z_{obs} = z_{source \to \infty} - z_{observer \to \infty}$$

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prob set #2

change in redsh.ft

D

4) gravitational waves

effect: orbital period decreases

NOT observed in solar system

LAB FOR G.R.

"Binary Pulsar"

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pulsars: discovered in late 1960s

observed: pulses of radio waves

pulsation happen every with period between milliseconds to tens of seconds

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rotating magnetized neutron stars

FABLE: Jocelyn Bell and discovery of pulsars

MORAL: grad students } never get women } the credit

: Thinking and doing are not the same

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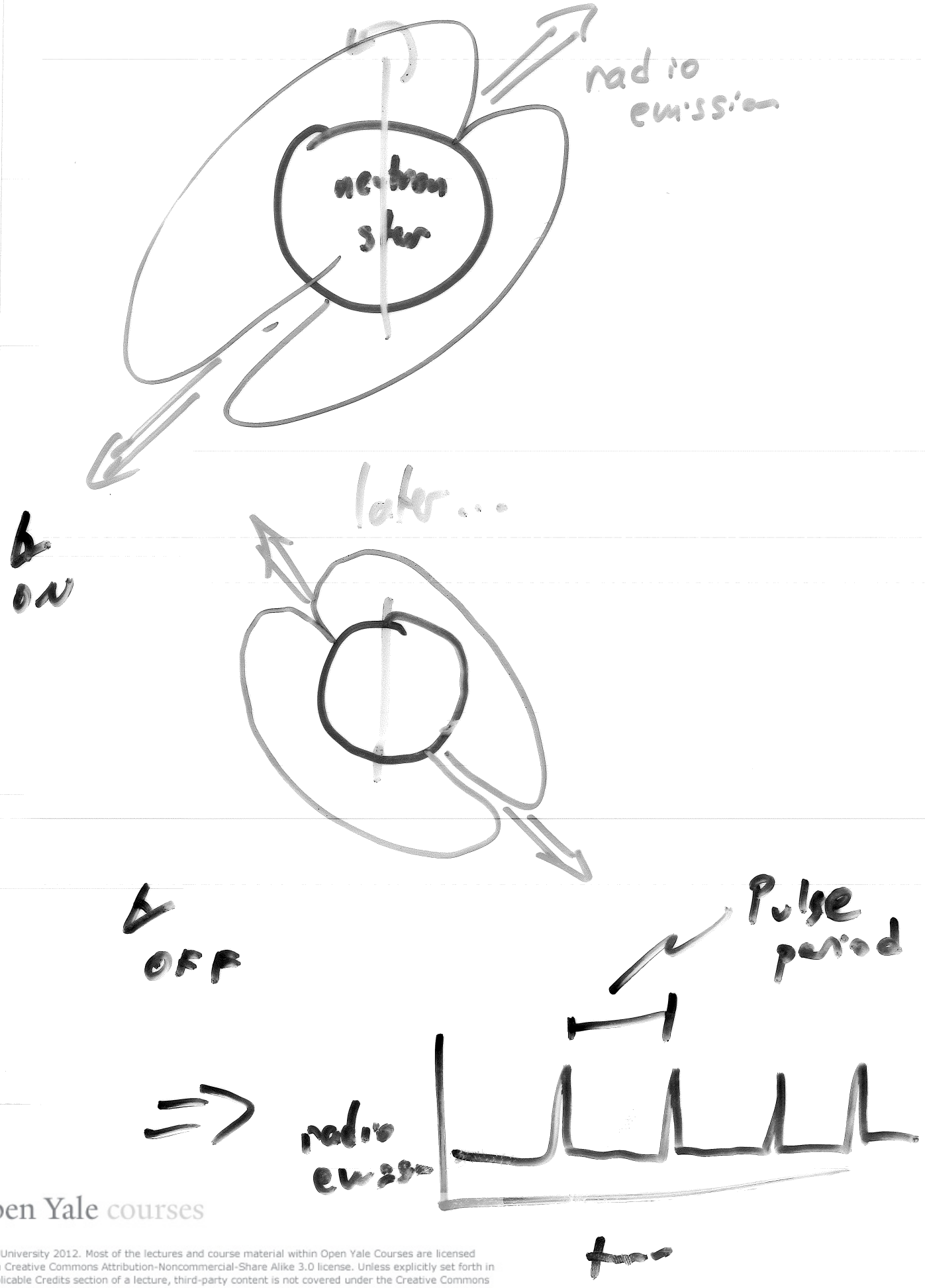

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$$\frac{\Delta P_r}{\Delta P_s} = \sqrt{\frac{1 + v_R/c}{1 - v_R/c}} - 1$$

$$\approx \frac{v_R}{c} \quad \text{Newtonian approx}$$

Discovery of binary pulsar

$P_{ORBITAL} \sim 8$ hrs

measure pulse period to high accuracy

elliptical orbit

precession of periastron

4°/year

(Mercury: 43"/century)

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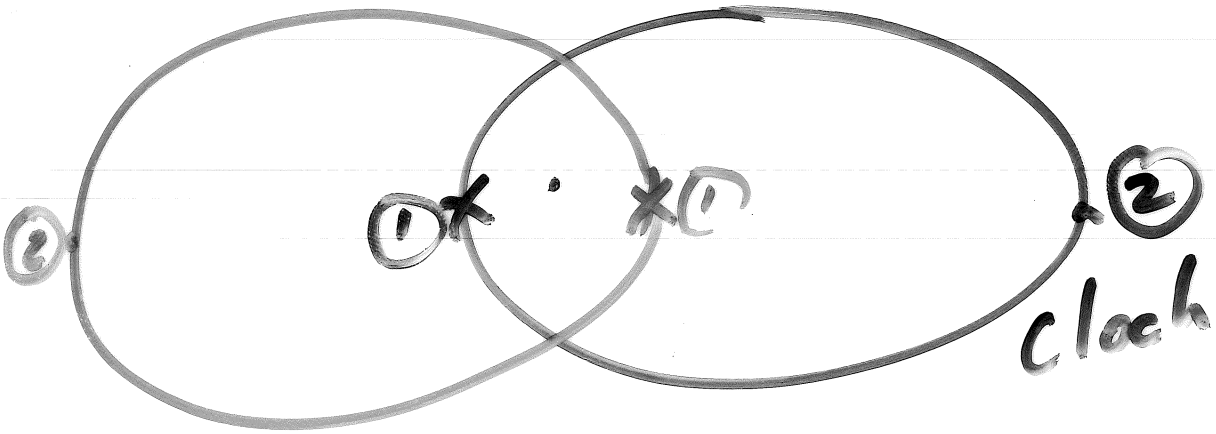
also: grav. redsh.ft

seeing effect of the companion object (also neutron star)



at position ① object's close redsh.ft caused by other object is large

at position ② distance is greater → redsh.ft is less

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ALSO: orbital period decreases due to grav. waves

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only Newtonian measurements

→ determine M_{TOT} if you know inclination

measure precession of periastron also depends on M_1, M_2, and i

SOLVE for inclination

know M_{TOT} but not each individual mass

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grav. redshift:
depends on M_1, M_2, i
now: solve for
M_1 (also M_2)

know M_1, M_2, inclination

PREDICT what the
period change should
be
Measure this effect
→ prediction correct
to measurement error

CLEAR that G.R. is
"correct" in post-Newtonian
approximation

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BUT imagine a theory which is like Newton (1st term) like G.R. (2nd term "post-Newt...")

but different at very strong grav. fields

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so ! it would be good to test STRONG FIELD effect

$R_s/r \to$ close to 1

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