DOPPLER EFFECT - relative motion

Gravitational red shift :

This gives an idea about black hole

mass of moving photon $m = P/c$ →

$$m = \frac{h\nu}{c^2} \quad (\because P = E/c \text{ \& } P = h\nu/c) \rightarrow ①$$

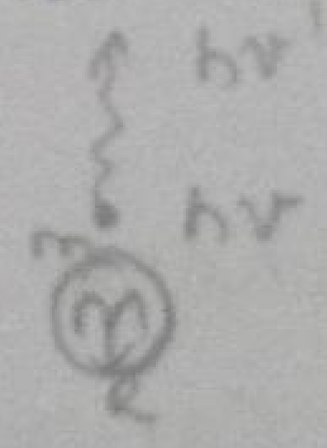
for mass m (particle / photon) & of mass M (planet or star)

$$PE = \frac{-GMm}{R} \rightarrow ②$$

substituting ① in ②

$$PE = \frac{-GMh\nu}{c^2 R} \rightarrow ③$$

Total energy (TE) of mass 'm' is



$$E = h\nu - \frac{GMh\nu}{c^2 R}$$

$$h\nu' = h\nu - \frac{GMh\nu}{c^2 R}$$

(ν' is frequency of light after emission) which comes out of planet

$$\nu' = \nu\left(1 - \frac{GM}{c^2 R}\right) \rightarrow ④$$

$\nu' < \nu$ (ν' = frequency after coming out of star by observer
ν = freq at source)

$\lambda' > \lambda \Rightarrow$ red shift

hence observer finds frequency to be decreased

If some planet, $\frac{GM}{c^2R} \geq 1$ then $\nu' = 0$

here the observer will not observe any light. This is the case of black hole

Taking 4^{th} eqn

$$\nu' = \nu\left(1 - \frac{GM}{c^2R}\right)$$

for $\theta = \pi$, we get max $\Delta\lambda$ in Compton effect

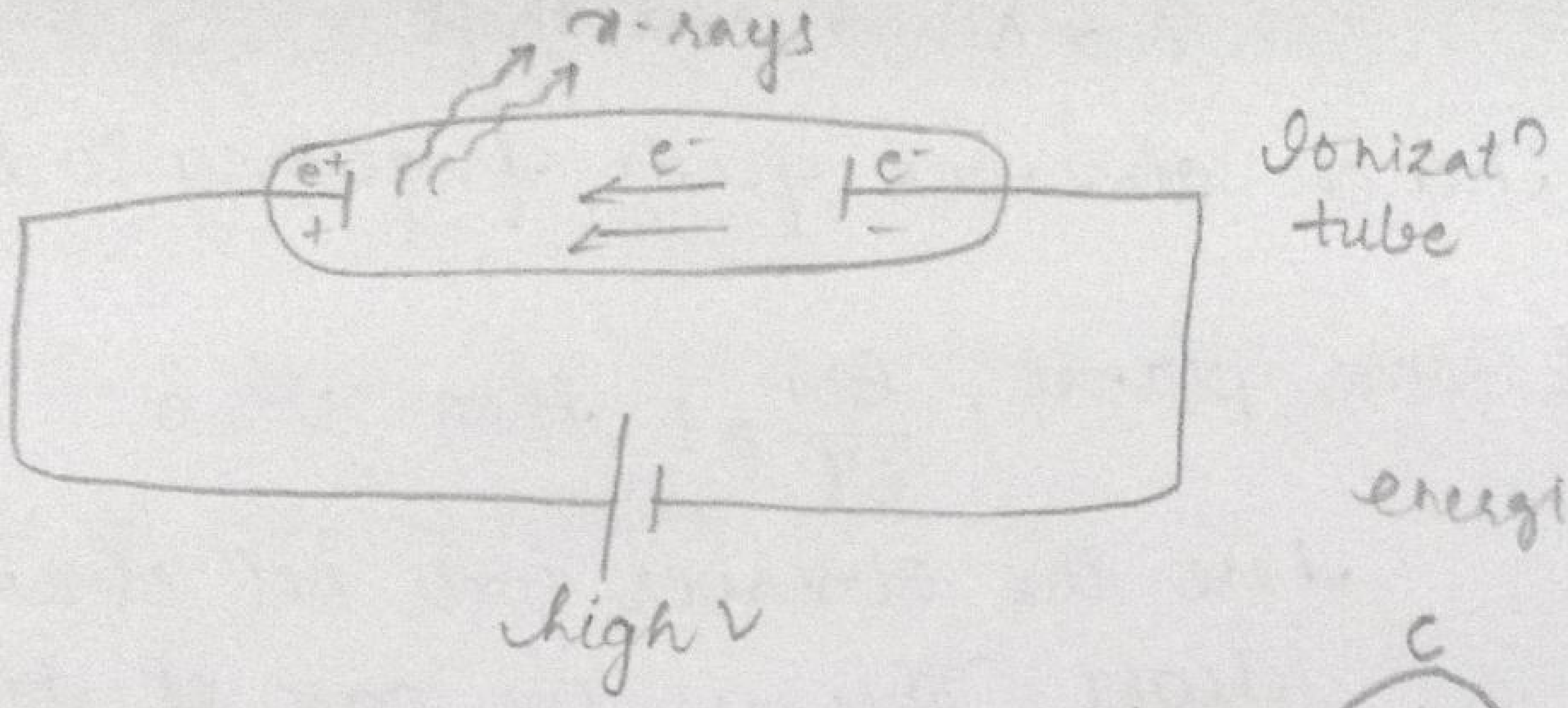
apparent $\leftarrow$ $\frac{\nu'}{\nu}$ $\rightarrow$ intrensic $= 1 - \frac{GM}{c^2R}$

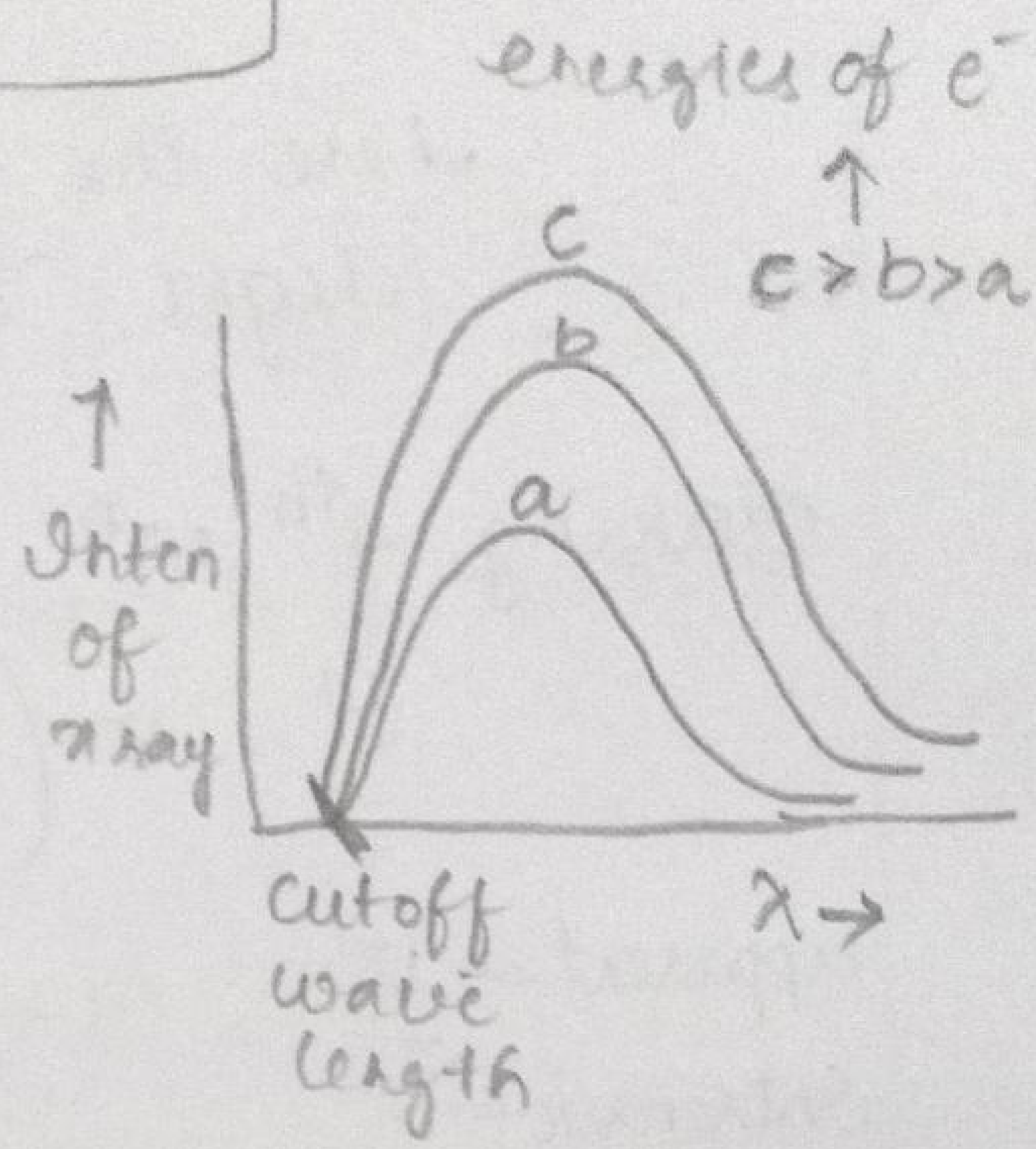
Black hole $\Rightarrow \frac{GM}{c^2R} \geq 1$

X- RAYS

Discovered by WK Coentgen (1895) and got nobel prize in 1902 which was first noble prize in physics.

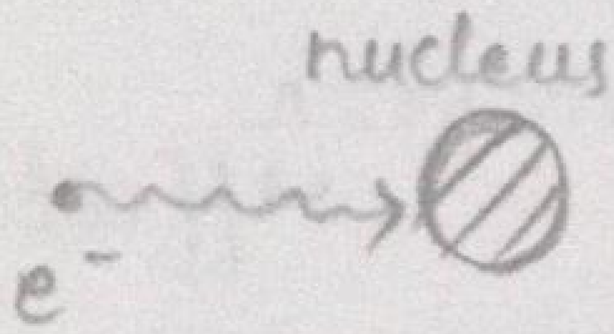
- → It is also called as inverse of photoelectric effect.
- → here the vaccum tube is used to ~~reduce~~ increase the mean free path of e^-





Duane & Hunt gave an eq?

$$\lambda_{min} = \frac{1.24 \times 10^{-6}}{V}$$



$$eV = h\nu_{max}$$
$$= hc/\lambda_{min}$$

There is a vacancy in K shell. If the e^- jump from L, M or N shell to K shell then there is a emission of characteristics of x-rays