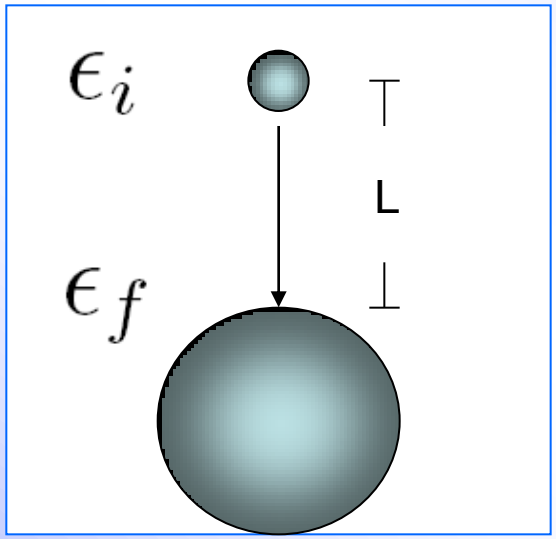
MASA INERCIAL DEL FOTÓN



Cambio de frecuencia por caída en un campo gravitacional

$$m = \frac{\epsilon}{c^2} = \frac{h\nu}{c^2}$$

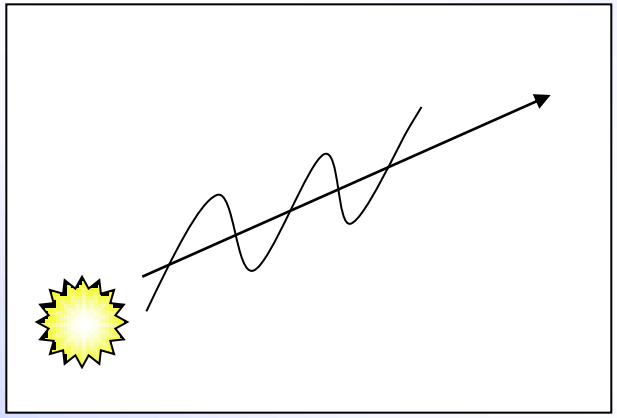
Masa inercial del fotón

$$\begin{aligned} \epsilon_i &= h\nu \\ \epsilon_f &= \epsilon_i + mgL \\ h\nu' &= h\nu + \frac{h\nu}{c^2} gL \end{aligned}$$

$$\frac{h\Delta\nu}{\nu} = \frac{hgL}{c^2}$$

$$\frac{\Delta\nu}{\nu} = \frac{gL}{c^2}$$

Luz saliendo de una estrella



$$\Delta\epsilon = \frac{GM_s m}{R_s}$$

$$\epsilon_i = \epsilon_f$$

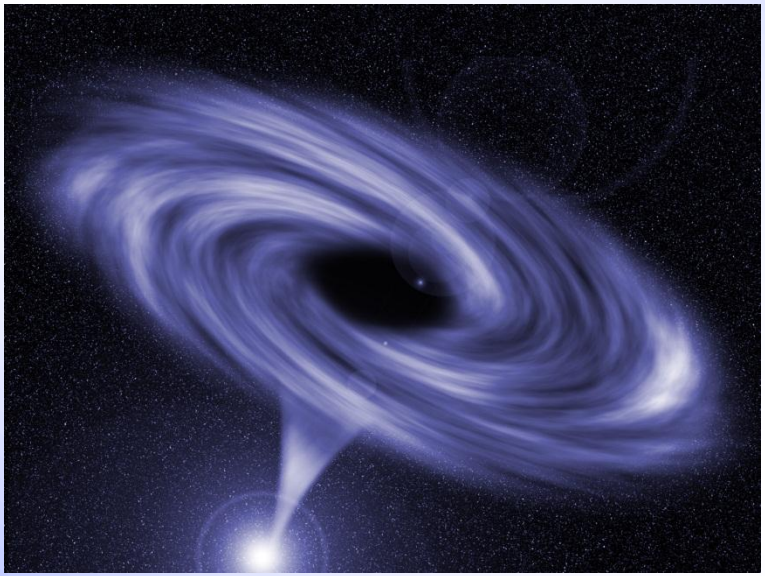
$$\epsilon_i = h\nu + \frac{GM_s m}{R_s}$$

$$\epsilon_f = h\nu' + 0$$

$$\frac{h(\nu' - \nu)}{\nu} = \frac{h}{c^2}\frac{GM_s}{R_s}$$

$$\frac{\Delta\nu}{\nu} = \frac{GM_s}{c^2 R_s}$$

AGUJEROS NEGROS



La luz no escapa del agujero

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

$$U_{atraccion} = G\frac{Mm}{R_s}$$

$$\nu' \to 0$$

$$\frac{GM_s}{R_s c^2} = 1$$

$$\varepsilon = h\nu \quad \text{si} \quad U \geq \varepsilon$$

$$\frac{GM_s}{R_s}\frac{h\nu}{c^2} \geq h\nu$$

$$\frac{GM_s}{R_s c^2} \geq 1$$