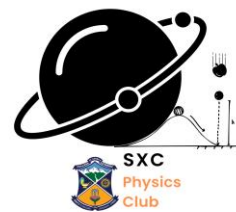




St.Xavier's College Physics Club
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Question Of the Month-December Series

A photon of frequency f possesses an effective inertial mass m determined by its energy. Assume that it has a gravitational mass equal to this inertial mass. Accordingly, a photon emitted at the surface of a star will lose energy when it escapes from the star's gravitational field.

Show that the frequency shift Δf of the photon when it escapes from surface the star to infinity is given by

$$\frac{\Delta f}{f} \simeq -\frac{GM}{Rc^2}$$

for $\Delta f \ll f$ where:

G = gravitational constant

R = radius of the star

c = velocity of light

M = mass of the star.

Thus, the red-shift of a known spectral line measured a long way from the star can be used to measure the ratio M/R . Knowledge of R will allow the mass of the star to be determined.