BLACK HOLE RADIATION: MASS AS A FUNCTION OF TIME

Link to: physicspages home page.

To leave a comment or report an error, please use the auxiliary blog.

Reference: Moore, Thomas A., *A General Relativity Workbook*, University Science Books (2013) - Chapter 16; Problem P16.6.

We can get an expression for the mass of a black hole as a function of time, taking into account its evaporation through radiation. The total lifetime t_0 of the black hole of initial mass M_0 is given by

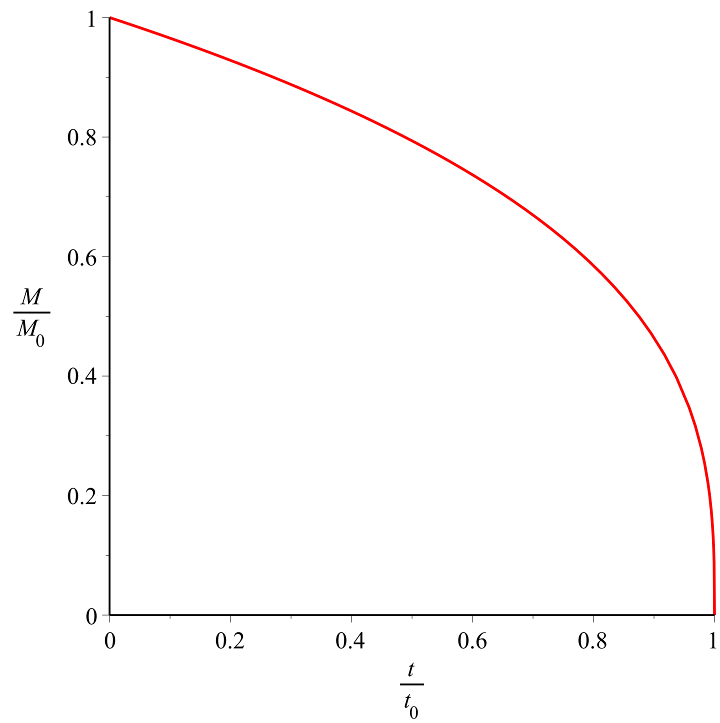
$$M_0^3 = \frac{3\sigma\hbar^4}{256\pi^3 k_B^4 G^2} t_0 \tag{0.1}$$

From the equation we derived earlier (eqn. 11 in this post, with variables renamed to match what we're doing here), the mass M at time t is

$$M(t) = \left[M_0^3 - \frac{3\sigma\hbar^4}{256\pi^3 k_B^4 G^2} t\right]^{1/3} \tag{0.2}$$

$$= M_0 \left(1 - \frac{t}{t_0}\right)^{1/3} \tag{0.3}$$

A plot of M/M_0 versus t/t_0 looks like this:



The rate of mass loss increases towards the end of the black hole's life.