

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

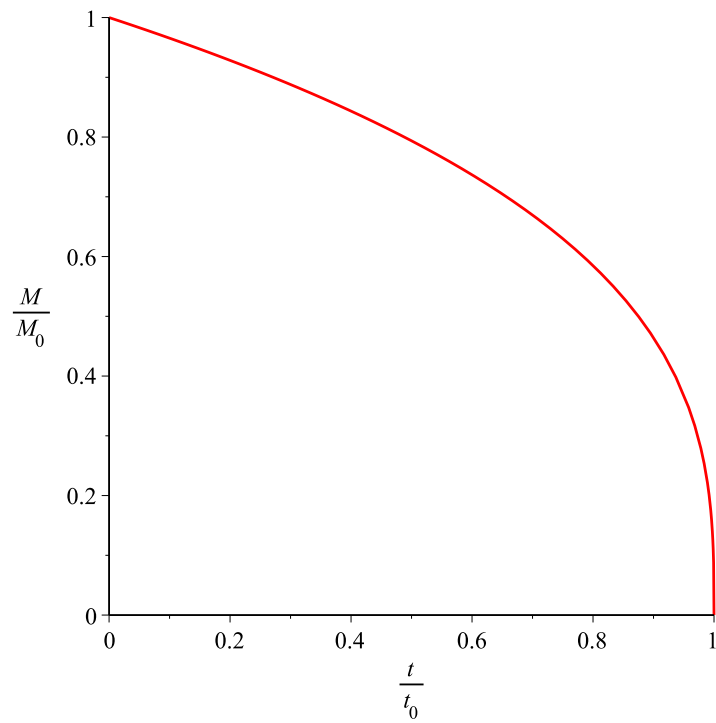
$$(1) \quad M_0^3 = \frac{3\sigma\hbar^4}{256\pi^3k_B^4G^2}t_0$$

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

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

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

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.