

BLACK HOLE RADIATION: MASS AS A FUNCTION OF TIME

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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

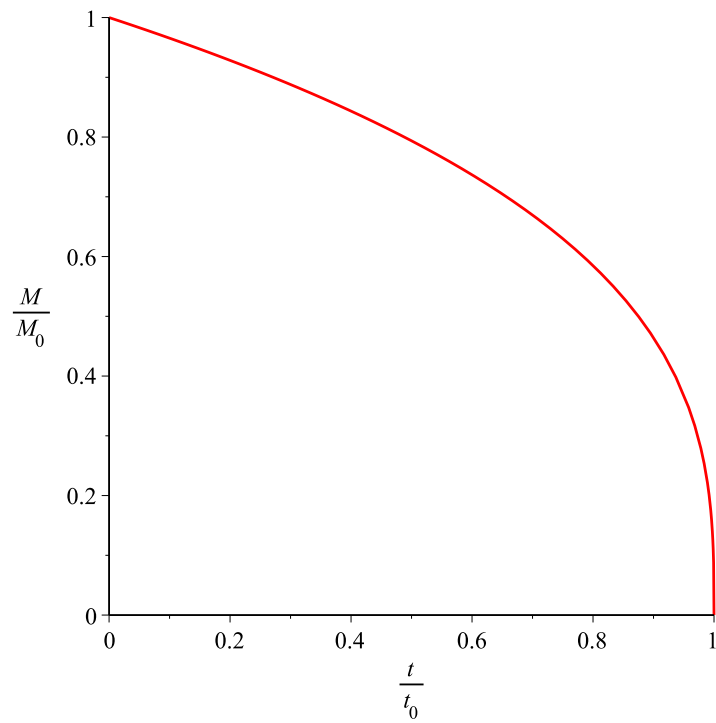
$$M_0^3 = \frac{3\sigma\hbar^4}{256\pi^3k_B^4G^2}t_0 \quad (1)$$

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

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

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

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.