BLACK HOLES AND THE LARGE HADRON COLLIDER

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Reference: Moore, Thomas A., *A General Relativity Workbook*, University Science Books (2013) - Chapter 16; Problem P16.3.

The Large Hadron Collider (LHC) has given rise to a number of scare stories about the various, presumably dangerous, things it might produce. Probably the most press coverage was given to the possibility of microscopic black holes that would swallow up the Earth. Like so many scare stories (don't get me started), this fear is unfounded. The lifetime of a black hole is

$$\Delta t = 2.0903 \times 10^{67} \left(\frac{M}{M_s} \right)^3 \text{ years} \tag{1}$$

where M_s is the solar mass. Because of the huge constant in this equation, it might seem that even a tiny black hole would last a long time; perhaps long enough to suck in surrounding matter. However, the black holes that might be created within the LHC are expected to have a mass of around $1 \text{ TeV} = 10^{12}$ eV. The mass equivalent of 1 eV is 1.783×10^{-36} kg so this black hole would have a mass of

$$M = 1.783 \times 10^{-24} \text{ kg} \tag{2}$$

The mass of the sun is

$$M_s = 1.989 \times 10^{30} \text{ kg} \tag{3}$$

so the expected lifetime of the microscopic black hole is

$$\begin{aligned} \Delta t &= 1.506 \times 10^{-95} \text{ years} && (4) \\ &= 4.75 \times 10^{-88} \text{ sec} && (5) \end{aligned}$$

All of this assumes that the theory is valid on a microscopic scale (after all, we might need a quantum theory of gravity for this), but even if we're out by an enormous number of magnitudes, it seems we're pretty safe.