In Class Exercises (ICE) - 3/23/01

In this ICE, you will investigate how some of the ideas that we have used to approximate areas under curves translate into a more general setting. Your task is to estimate the amount of dough in a donut. Your answer should consist of:

- *A description of your plan for making the approximation.*
- *A sketch showing what your approximation will actually look like.*
- *The results of your measurements and/or calculations.*
- *An analysis of whether your result is an over-estimate of the amount of dough, or an under-estimate of the amount of dough.*

Just in case you thought that this is a silly calculation, note that this calculation lies at the heart of research into generating electrical power by means of nuclear fusion[1]. Figures 1 and 2 show the interiors of the "Tokamak" (located in Princeton, NJ) and "Joint European Tourus" (located in Abingdon, Oxfordshire, England). The volumes of these spaces had to be exquisitely accurately calculated, and they are shaped exactly like donuts.
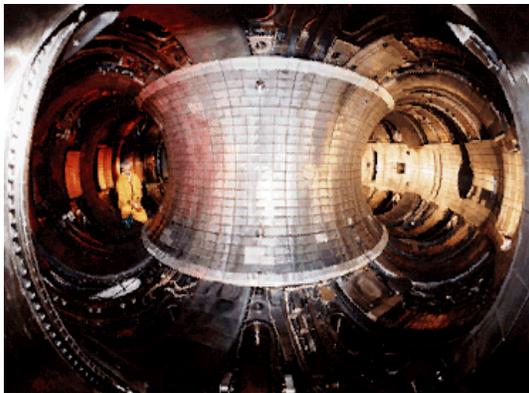

Figure 1: The interior of the Tokamak Fusion Test Reactor, Princeton Plasma Physics Laboratory.
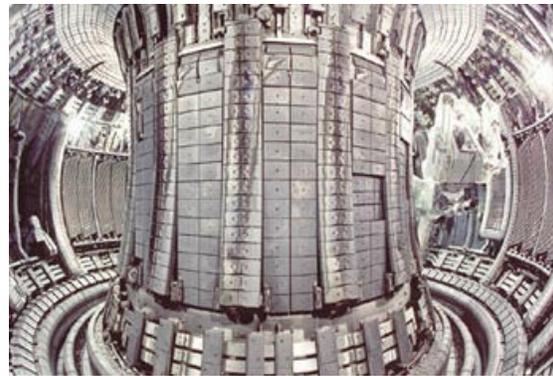

Figure 2: The interior of the Joint European Torus, the main research facility of the European Fusion Development Agreement.

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[1] At 7:44pm on Saturday 9 November 1991, the Joint European Torus (JET) generated power by means of a nuclear fusion reaction for the first time in human history. The JET generated between 1.5 and 2 megawatts of power. In order to do so, the researchers had to heat a mixture of deuterium and tritium gas to about 200 million degrees Celsius. This is about 10 times hotter than the interior of the Sun. Source: Joint European Torus Project Press Release, 1991.