1st ICTP-Trieste/ICTP-SAIFR School on Particle Physics: Dark Matter and Particle Physics – Some exercises

Patrick J. Fox*

June 24, 2018

Below are a list of questions, some simple, some involved, that will help illustrate some of the points raised in lectures. The questions approximately follow the order of topics in the lectures, but you should feel free to approach them in any order you wish.

1 Lecture I

Question 1. *The Milky Way* The Milky Way is approximately made up of a disk of stars, a central bulge, and a spherical Dark Matter halo. What are the approximate sizes of each of these components? Consider a galaxy made of a uniform disk of stars of constant density ρ, and size R and thickness h. Determine the orbital speed of objects in the plane of the disk, as a function of r. Compare this to the observations of Vera Rubin, and others, determine the radial distribution of the Dark Matter, assuming it is spherically distributed and constant density.

Question 2. *Star collisions* What is the mean free path of a star in a galaxy?

Question 3. *DM Flux* If Dark Matter is a 100 GeV WIMP approximately how many Dark Matter particles pass through your hand every second? Compare this to the number of solar neutrinos.

*pjfox@fnal.gov