Contribution ID: **98** Type: **Poster**

Dark Matter Subhalo Abundance in the Solar Neighborhood and Its Effect on Direct Detections

Wednesday, 10 July 2024 17:10 (20 minutes)

Lambda cold dark matter (ΛCDM) is widely considered as the standard model of the Big Bang cosmology that contains a postulated new particle called dark matter (DM), which makes up for 85% of the matter of the universe. However, DM has yet to be detected non gravitationally. One of the major ways of probing it is through direct detection experiments measuring the cross section of dark matter particles scattering off nuclei. Additionally, under ΛCDM, DM clumps up into halos and subhalos, potentially affecting our direct detection measurements if they happen to fly past the solar system and temporarily boost the local dark matter density. In this talk, I will give an estimation of the local abundance of low mass subhalos in the solar neighborhood and discuss the effect of their existence on direct detection. I will first introduce the local differential number density of subhalos, focusing on the dark low mass subhalos.I will then define the encounter cross section and further introduce the differential encounter rate for a subhalo to scatter off the Earth gravitationally that allows us to give an expected total number of yearly encounter events. Finally, I will discuss how such events are expected to affect the direct detection experiments. Although the rate is found to be quite small for the lifetime of direct detection experiments, this study inspires us to look for new ways to study the low mass subhalos, potentially through effects that can accumulate through years such as paleo detectors, and thus enable us to explore the lower end of the mass spectrum where the particle nature of DM plays a more important role.

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Session Classification: Poster session

Track Classification: Poster session: Direct detection