Dirac Materials for Dark Matter Detection

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Deciphering the nature of Dark Matter is one of the most important challenges in modern cosmology. The candidate that collected the interest of most of the community is the Weakly interacting massive particle (WIMP), and most of the searches have been carried out looking for WIMPs in the mass range a few GeV/c^2 to tens. Models predicting low-mass WIMPs and more in general low-mass dark matter particles have been recently proposed as a viable and well-motivated option to the traditional WIMP paradigm. Such low-mass dark matter particles detection would require the use of small gap materials in sensors. We propose the use of informatics tools to rapidly assay materials band structures to search for small gap semiconductors and semimetals. Using recent estimates of the WIMP mass, we identify the relevant target space towards small band gap materials (100-10 meV). We use a large dataset search to identify candidate materials, rather than focusing on a few preselected compounds. Dirac materials, a class of small- or zero-gap materials, emerge as natural candidates for sensors for dark matter detection. As a specific example of the proposed search strategy, we use the organic materials database (omdb.diracmaterials.org) to identify few organic candidates for sensors. In this presentation I will introduce the dark matter puzzle, its proposed solutions and the experimental approaches. I will finally outline a novel approach to search for sensor materials where a rapid assay of materials using informatics tools yields more candidates and thus provides a useful tool to identify sensor materials for dark matter detection.

References:
[1] arXiv:1806.06040