PhD seminar - Cyprien Beaufort – ABSTRACT

**Searches for dark matter as WIMPs and Kaluza-Klein axions with the MIMAC detector**

While the gravitational evidence for the dark matter (DM) hypothesis is getting stronger, the nature of such matter remains unknown. The detection of a DM particle would deeply contribute to the understanding of the Universe and would shine light on new Physics. Gaseous detectors are of particular interest to search for DM since one can easily adapt the experimental conditions (target mass, spin, etc.) to the considered phenomenology. In this seminar we present MIMAC, a directional detector which measures simultaneously the energy of a particle and its 3D track in a adaptable energy range [150 eV , 30 MeV]. We will discuss searches for WIMPs and Kaluza-Klein axions.

The WIMP is the most studied DM candidate and it would induce nuclear recoils inside a detector. The largest projects searching for WIMPs will soon reach the “neutrino floor”, a boundary beyond which a WIMP signal cannot be distinguished from the irreducible background due to neutrinos. The only known principle to overpass this background is to measure the direction of the induced recoils, with a directional detector as MIMAC, and to correlate it with the expected incoming direction of the WIMPs (favored direction due to the solar system motion in a static WIMP halo).

In the low energy region, where there is a lack of experimental searches, measuring the directional information is challenging. To reach this energy region we need to increase the gain of the detector. However, we will see that non-linear effects appear at high gain and distort the measured signal. We used a homemade simulation toolkit to study possible explanations of the non-linearities. In the seminar, we will see how the large number of ions produced in the avalanche region of the detector could affect the measured signal and how one can recover the directional information.

Since the nature of DM is unknown, it is interesting to search for several candidates at the same time. We will discuss the case of Kaluza-Klein (KK) axions, which are axions propagating in extra spatial dimensions. At first glance, considering additional dimensions can seem uselessly complex, but we will see that this model is theoretically motivated and one can use KK axions as a probe for extra dimensions. KK axions would be produced in the Sun, part of them getting trapped in the solar gravitational field and would then accumulate over the Sun history. A couple of detectors are searching for trapped KK axions but the model is based on a single theoretical paper. We have produced the entire revision of the model, deriving analytical expressions and updating the astrophysical constraints with recent measurements. In the seminar we will present the main results of our model revision, showing that the event rate in a detector has been significantly overestimated. This model revision represents a key step in the search for KK axions.