Contribution ID: **133** Type: **Poster**

Lithium-containing crystals for light dark matter search experiments in underground laboratories

Thursday, 25 July 2019 18:45 (15 minutes)

In the current direct dark matter search landscape, the leading experiments in the sub-GeV mass region mostly rely on cryogenic experiments which employ crystalline targets. One attractive type of crystals for these experiments are those containing lithium, such as LiF, Li_2MoO_4, and $LiAlO_2$. This is due to the fact that ^{6}Li can absorb neutrons, a challenging background for dark matter experiments, through a distinctive signature which allows the monitoring of neutron flux on site, while ^{7}Li is the ideal candidate to study spin-dependent dark matter interactions in the sub-GeV region for solid-state experiments.

The measurement of the neutron flux is a significant piece of information for the construction of the background model of an experiment. The adoption of crystals containing lithium would largely improve the current knowledge on the neutron flux in the specific setup. A measurement with a cryogenic detector employing a 373 g $LiAlO_2$ crystal has been performed in the first months of 2019 at Laboratori Nazionali del Gran Sasso to assess the feasibility of such a neutron detector.

Additionally, lithium is mostly composed by ^{7}Li (92.5% natural abundance), an isotope which can be used to probe spin-dependent dark matter interactions alongside the classic spin-independent interactions. First tests designed around this goal were performed in 2018 at Max Planck Institute for Physics in Munich in an above-ground laboratory. The results obtained are extremely promising and support further technological developments headed to explore the dark matter parameter space at low masses.

Less than 5 years of experience since completion of Ph.D

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Student (Ph.D., M.Sc. or B.Sc.)

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Presenter: BERTOLDO, Elia

Session Classification: Poster session

Track Classification: Low Temperature Detector Applications