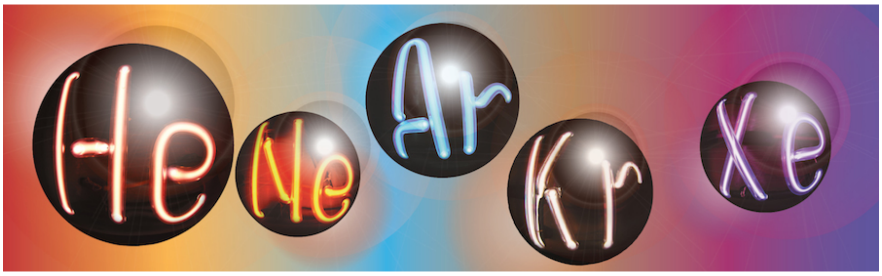

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First underground run of ArDM and measurement of the attenuation lenght of the argon scintillation light

Friday, 22 September 2017 09:45 (15 minutes)

With an active target mass of 850 kg, ArDM represents an important milestone towards developments for large LAr Dark Matter detectors. In this talk we introduce the experimental apparatus currently installed underground at the Laboratorio Subterráneo de Canfranc (LSC), Spain, presenting the results of the analysis of the first underground run. A relatively low value close to 0.5 m was found for the attenuation length of the liquid argon bulk to its own scintillation light. We interpret this result as a presence of optically active impurities in the liquid argon which are not filtered by the installed purification systems. We also present analyses of the argon gas employed for the filling and discuss cross sections in the vacuum ultraviolet of various molecules in respect to purity requirements in the context of large liquid argon installations. Finally, the status and the plans of the project will be presented.

Summary

We investigated the influence of impurities on the VUV light yield in a tonne scale LAr target. In particular the following two processes are considered, the non-radiative destruction of excimers states, often referred-to as (impurity) quenching, and
secondly and more important the absorption of produced VUV scintillation light during its
propagation through the LAr bulk. By first principles both effects trace back to the presence of impurities in the argon.
The study of the VUV light yield in the tonne scale LAr detector ArDM resulted in a lower
than expected value of 0.5 m for the attenuation length of the liquid argon bulk to its own scintillation light. The result was found by means of a Bayesian variation technique and yielded systematic uncertainties on the order of 20%. We interpret this result with the presence of optically-active trace impurities in the LAr which are not filtered by the installed purification systems primarily designed to target O2 and H2O molecules.
This allowed us to conduct a combined analysis of our result with respect to the involved
photoabsorption cross sections, the lifetime of the slow scintillation component, as well as mass spectra taken on argon gas samples.
The results of the work presented here has pointed out that other trace elements than
the usually targeted water and oxygen molecules might affect the overall performance of a
liquid argon TPC. This observation will likely have some implications on the design and optimisation of light detection systems and/or on the liquid argon purification systems of future large LAr detectors, where scintillation light attenuation length in excess of meters will be desirable.

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