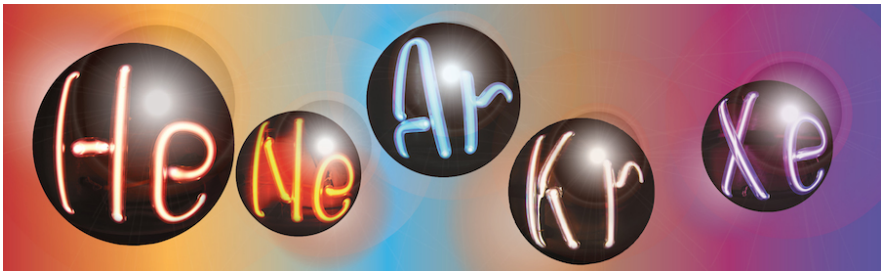

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A compact Optical Liquid Argon Facility at Roma Tre

Thursday, 23 October 2025 09:40 (20 minutes)

Liquid argon (LAr) has been used in neutrino and dark matter experiments as an active medium thanks to its excellent properties in charge yield and transport as well as its capacity as a scintillator. We will present the preparation of a compact test facility with a volume of 40 l LAr to fully characterise the response of LAr as a scintillation detector for the LEGEND-1000 experiment. To readout the optical photons, we use the vacuum ultraviolet silicon photomultipliers (VUV SiPM) from Hamamatsu [1], which are sensitive to the 128 nm photons from LAr. The SiPMs will be submerged in the LAr, with the photo-sensitive surfaces directly in contact with the LAr. We use a sealed gamma source to generate scintillation photons, whose timing is defined by the coincidence of three SiPMs placed close to the source. Another ten SiPMs will be placed at multiple distances from the source ranging from 15 cm to 80 cm to measure the attenuation length of the photons. A high intensity LED source will be placed close to the gamma source for calibrating the SiPMs. This configuration is an adaptation from the LLAMA detector [2] which is mounted inside the 64 m^3 LAr tank of LEGEND-200 experiment for monitoring the purity of the LAr. The direct optical contact between the LAr and the VUV SiPMs in the configuration is essential to eliminate the systematics from the wave length shift materials and other optical devices which have been used primarily for the read out of the LAr scintillation photons.
As the dedicated testbench for the R&D of the LEGEND-1000 LAr detector, the compact size of our facility is also important for a quick turnaround in implementing modifications. Impurities including nitrogen and oxygen in the argon can be measured so that we can also monitor the dependence of the LAr optical properties on the level of the impurities.

[1] T. Pershing, et al, "Performance of Hamamatsu VUV4 SiPMs for detecting liquid argon scintillation" , JINST 2022, 17, P04017.
[2] M. Schwarz, et al, "Liquid Argon Instrumentation and Monitoring in LEGEND-200" , EPJ Web of Conferences 2021, 253, 11014.

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