Contribution ID: **209** Type: **Poster**

Light readout system tests and simulations on the way towards light - augmented calorimteric reconstruction and PID in LArIAT.

With the ongoing construction, commissioning and proposals of new detectors as well as R&D efforts, it is evident, that liquid argon Time Projection Chambers (TPCs) are starting to become a crucial technology in the US neutrino program. Their scope of use in the near and more distant future covers such urgent problems in weak interaction physics as the search for sterile neutrinos, the neutrino mass hierarchy or CP violation in the neutrino sector. For these to be resolved, there is a pressing need for precise measurements. To make them possible, the technology has to be thoroughly understood e.g by calibration in a controlled environment. To achieve this goal, the LArIAT test beam experiment will operate the former ArgoNeuT LAr TPC in the Fermilab Testbeam Facility (FTBF). The detection capabilities of the chamber will be enhanced by a photomultiplier - based light readout system (LRS), composed of standard and high quantum efficiency PMTs, as well as SIPMs together with wavelength shifter (TPB) covered walls. This is a novel approach to the light detection in LArTPCs as it will aim to implement a Dark Matter search-like system in order to use the scintillation light to augment the particle identification algorithms and a calorimetric reconstruction. To optimize its performance, detailed studies of light collection were performed using the improved version of the LArSOFT software package. The results of these simulation, including among others the necessary coverage of the TPB wavelength shifter on the full chamber walls as well as the light yield uniformity study will be presented. To assure the proper hardware functioning, before commissioning of the full detector, the PMT setup was tested in a small chamber at the University of Chicago. The results of these tests, also presented in this poster, were then used to validate and refine simulations of the full detector.

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Track Classification: Short Baseline Oscillations / Sterile Neutrinos / Non-standard Oscillations