P1.017 Occulting light concentrators in liquid scintillator neutrino detectors

M Buizza-Avanzini[1], A Cabrera[2], S Dusini[3], M Grassi[4], M He[4] and W Wu[4]

[1]LLR Laboratory Palaiseau, France, [2]IN2P3/CNRS – APC and LNCA Laboratories, France, [3]Padova-INFN, Italy, [4]Institute of High Energy Physics, China

The experimental efforts characterizing the era of precision neutrino physics revolve around collecting high-statistics neutrino samples and attaining an excellent energy and position resolution. To achieve these goals, next generation liquid-based neutrino detectors, such as JUNO, HyperKamiokande, etc, share the use of a large target mass, and the need to push light collection to the edge for maximal calorimetric information. Achieving high light collection has considerable cost implications, especially when considering detector masses of several ktonnes. Thus, the question of how to maximize the effective photo-coverage with the minimum number of PMTs is to be addressed. A traditional strategy relies on Light Concentrators (LC), such as Winston Cones.

In this poster, the authors will introduce a novel concept called Occulting Light Concentrators (OLC), whereby a traditional LC gets tailored to a conventional PMT, by taking into account its single-photoelectron collection efficiency (CE) profile and thus occulting the worst performing portion of the photocathode. Indeed, the dispersive effects induced by a non-homogeneous CE affect the total number of collected photoelectrons. Moreover, the PMT-to-PMT differences contribute to worsen this irreducible PE detection dispersion, hence spoiling the energy resolution. The OLC shape optimization not only accounts for the optical interface of the PMT, but also for the maximization of the PMT detection performances. The light collection uniformity across the detector is another advantage of the OLC system. The adoption of OLC is expected to allow important and almost inexpensive improvements of the optical light collection of any detector. We will use the case of JUNO, which relies on the best energy resolution ever achieved in liquid scintillator detectors, to show OLC capabilities in terms of light collection and energy resolution as compared to conventional LCs. These results are expected to be shown for the first time in a conference and are being prepared for publication.