



Contribution ID: 755

Type: Parallel talk

First Sub-Percent Exploration of PMNS Unitarity with LiquidO?

Thursday, 11 July 2019 12:05 (15 minutes)

The last decade has witnessed a remarkable progress in the knowledge of the Pontecorvo-Maki-Nakagawa-Sakata (PMNS) neutrino mixing matrix upon the first observation and today's precision ($\sim 3\%$) measurement of the θ_{13} mixing angle by the reactor experiments; i.e. Daya Bay (China), Double Chooz (France) and RENO (South Korea). However, only the JUNO experiment (China) will open, for the first time, the sub-percent precision era. The measurement of the ("solar") θ_{12} mixing angle is expected to reach $<1\%$ precision (today: $\sim 4\%$) soon upon data taking in 2022. The ("atmospheric") θ_{23} mixing angle ultimate knowledge depends on the DUNE (USA) and Hyper-Kamiokande (Japan) next generation beam experiments. The ultimate precision is expected to reach the $\sim 1\%$ level, despite the so called "octant" ambiguity. These same experiments are expected to provide the most precise knowledge on CP-Violation. Hence, sub-percent precision across the entire PMNS matrix is reachable within the forthcoming 2030 decade, only if a sub-percent θ_{13} measurement was possible. If so, the unprecedented opportunity for competitive unitarity exploration will open, including sensitivity to hypothetical evidence for physics beyond 3 neutrino families —a critical building block of the Standard Model. However, none of the running or proposed experiments can yield such a precision on θ_{13} . In this talk, we shall describe the necessary experimental steps needed to yield "the missing experiment" to reach the world best knowledge on PMNS unitarity. The new hypothetical experiment relies on a novel methodology and a new detection technique, called LiquidO, in active R&D demonstration. Both will be described as well as full systematics uncertainty feasibility for the first time. One of the most powerful sites is in Europe, which is to be highlighted too. A publication in preparation, this talk will be the first release.

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Session Classification: Neutrino Physics

Track Classification: Neutrino Physics