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Uncertainty in the Reactor Neutrino Specrum and the Mass Hierarchy Determination

In the next years reactor neutrino experiments, like JUNO or RENO 50, will attempt to determine the mass hierarchy. There are many problems that need to be overcome to accomplish this task, one of them is the theoretical uncertainty in the spectrum. Indeed, as became clear a few years ago with the measurement of the "5 MeV bump", the theoretical models that predict the reactor neutrino spectrum do not fit very well with the experimental results; moreover the current experimental data was obtained with an energy resolution considerably lower than the one required to identify the mass hierarchy, so it is possible that an eventual fine structure of the spectrum could be present and undetected, even if it is large enough to affect the determination of the hierarchy. This is one of the reasons why, recently, it was proposed to add a near detector to the JUNO experiment. I will discuss a model-independent way to treat the spectrum uncertainty and the effect that it will have on the final result, as a function of the mass of the near detector. Another possible complication could arise from the fact that the near detector will receive neutrinos only from one reactor core, while the JUNO far detector will be able to see neutrinos coming from two different power plants (each one with several reactor cores); moreover the two complexes use different models of nuclear reactor, hence the chemical composition of the fuel used will be different: since the neutrino spectrum depends on the chemical composition of the fuel, the near and the far detector will probably see two different spectra. I will show that, taking into account the time evolution of the chemical composition of the fuel in the reactor core, it is possible to reconstruct the far detector spectrum from the near detector data; I will show how the sensitivity to the mass hierarchy can be affected by different methods of reconstructing the spectrum.

Primary author: Prof. CIUFFOLI, Emilio (IMP, CAS)

Presenter: Prof. CIUFFOLI, Emilio (IMP, CAS)

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