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The Visible Energy of the Double Chooz Experiment

Double Chooz (DC) is a neutrino experiment aiming to measure θ_{13} with high precision using both the deficit and the spectral distortion expected from the manifestation of neutrino oscillations. The cosmogenic backgrounds are expected to have the largest impact on the sensitivity of θ_{13} shape information in the final phase of the experiment, after multi-detector systematic cancellation. Those backgrounds can be measured in-situ without the use of energy spectral information, as well as via reactor-OFF data. However, when measuring θ_{13}, the combined rate and full background shape information can be used to further constrain background systematics leading to a significantly improvement of the overall precision of the result. Thus, the DC analysis requires an excellent control of the e^+ energy scale systematics, otherwise deteriorating both rate and shape information on θ_{13}.

The proposed poster aims to describe the definition of the reconstructed energy of DC, named "visible energy", which is based on the calorimetric sum of the charges as measured, upon reconstruction, from the PMT light pulses digitised by FADC electronics. The calorimetric measure of charge is then anchored to the PMT hit multiplicity providing a robust digital-like energy definition of the photo electron (PE) scale, including the correction of a PE non-linearity arising from digitisation artefacts. The PE scale is then anchored to the MeV scale using the 2.2 MeV gamma peak from the H-neutron capture, upon applying corrections on the uniformity, stability and linearity of response. Several artificial sources (^{252}Cf and γ-sources) as well as natural calibration sources such as spallation neutrons are used to cross-check the performance of the energy scale and estimate systematics. The artificial sources were deployed in all the active volumes by means of dedicated systems. Being still a one detector experiment, the energy systematics are evaluated as the specific bias of the calibrated data against the calibrated MC providing the un-oscillated energy spectrum reference. The calibrated MC has followed the same energy definition and calibration scheme, as if it was an independent detector. The overall normalisation and shape systematics due the energy definition are very small and, in addition, they are expected to further reduce upon the use of the near detector.

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