ID de Contribution: **92** Type: **Invited presentation**

The contribution of nuclear physics to reactor antineutrinos

jeudi 28 septembre 2023 11:00 (25 minutes)

Reactor antineutrino energy spectra are the subject of active experimental researches nowadays, one of them being dedicated to nuclear physics measurements of the properties of the fission products. Some of these measurements were motivated by two observed anomalies in the antineutrino spectra. The reactor anomaly (RAA), first, was observed in 2011 as a deficit in the reactor antineutrino flux with respect to the conversion model which relies on measurements of integral beta spectra and a conversion approach to predict the antineutrino energy spectra. Then a distortion between 5 and 7 MeV of the measured antineutrino spectra with respect to the conversion model, called the shape anomaly, was observed and still remains unexplained up to now. In 2017, the Daya Bay experiment measured the evolution of the antineutrino flux with the fuel content of the reactor core. The collaboration observed that the deficit of the detected flux compared with the predictions of the conversion model was almost totally explained by the data arising from the fissions of 235U which called into question the measurements of its integral beta spectra.
Summation calculations, based on nuclear data of the fission products, are a unique alternative to the converted spectra. They have the advantage of being predictive for innovative fuels and also of giving access to the main nuclei contributing to the spectra in the various ranges of energy. However some of the beta decay data of interest suffer from the Pandemonium effect, a strong bias which can affect high resolution data coming from experiments with HPGe detectors. The TAGS measurements allow one to overcome this systematic error and thus to correct nuclear data from it as well as the predictions of antineutrino energy spectra. The TAGS collaboration has carried out three experimental campaigns during the last fifteen years at the JYFLTRAP of Jyväskylä (Finland) measuring a large set of data in order to improve the quality of the predictions of our summation method. The impact of these measurements on the predicted antineutrino energy spectrum and flux using our summation calculations will be presented and discussed as well as some on-going activity on studies dedicated to the shape of the antineutrino spectra.

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Classification de Session: Beta decay