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Update of the summation calculations for reactor antineutrino spectra

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For the (NA)²STARS collaboration

The accurate determination of reactor antineutrino spectra remains a very actual research topic for which interrogations have emerged in the past decade. Indeed, after the "reactor anomaly"(RAA) [1] –a deficit of measured antineutrinos at short baseline reactor experiments with respect to spectral predictions –the three international reactor neutrino experiments Double Chooz, Daya Bay and Reno have evidenced spectral distortions in their measurements w.r.t the same spectral predictions (Shape Anomaly)[2]. This puzzle is called the "shape anomaly". The latter predictions were obtained through the conversion of integral beta energy spectra obtained at the ILL research reactor[3]. Several studies have shown that the underlying nuclear physics required for the conversion of these spectra into antineutrino spectra is not totally under control[4]. The unique alternative to converted spectra is a complementary approach consisting in determining the antineutrino spectrum through nuclear data[5,6]. In the past years, the reactor neutrino experiments such as Prospect [7], STEREO [8] and Daya Bay [9] have published in 2023 their analysis with the complete statistics of the measured data. The outcome of these analyses, combined with the work carried out in experimental nuclear physics with the Total Absorption Gamma-ray Spectroscopy measurements in particular [10, 11, 12], is that the sterile neutrino hypothesis is strongly disfavored to explain the RAA, but that further efforts remain to be made both theoretically and experimentally to fully understand the origin of RAA and shape anomaly, and that accurate predictions of antineutrino fluxes and spectra are still needed for future discoveries. Indeed the Daya Bay collaboration provided the first measurement of the high energy part of the reactor antineutrino spectrum above 8 MeV. In addition, the Juno-Tao [13] experiment will perform a measurement of reactor antineutrino spectra with unprecedented energy resolution that will allow to tackle the contribution of specific fission products and constrain potentially nuclear data with the measured antineutrinos. The summation method based on the nuclear data will be the privileged tool to interpret these measurements. At this conference, we propose to present an update of our summation calculations with a focus on the impact of the most recent TAGS results and in the context of the afore mentioned reactor neutrino experiments.
The European TAGS collaboration is aiming to build a Total Absorption Spectrometer (TAS) of the next generation. We will also present this new instrument, called STARS (Segmented Total Absorption with higher Resolution Spectrometer), that will ally efficiency with a higher segmentation and energy resolution than the existing TAS spectrometers thanks to the addition of 16 LaBr3 crystals. The two segmented TAS that exist in Europe that will benefit from this upgrade are DTAS detector (18 NaI crystals [14]) and the Rocinante detector (12 BaF2 crystals [15]). The scientific advances that will be made possible will concern nuclear structure, nuclear astrophysics, neutrino and reactor physics, topics to which the TAGS technique has proven to bring significant advances [11].

[1] G. Mention et al., Phys. Rev. D 83, 073006 (2011)

[2] Double Chooz and Reno Collaborations in Proceedings of the Neutrino 2014 Conference, http://neutrino2014.bu.edu/;
Daya Bay Collaboration in Proceedings of the ICHEP 2014 Conference, http://ichep2014.es/.

[3] P. Huber, Phys. Rev. C 84, 024617 (2011).

[4] A. C. Hayes et al., Phys. Rev. Lett. 112, 202501 (2014).

[5] M. Fallot et al., Phys. Rev. Lett. 109, 202504 (2012).

[6] A A. Sonzogni et al., Phys. Rev. C 91, 011301 (R) (2015).

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