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High Energy Physics - Phenomenology

On the determination of anti-neutrino spectra from nuclear reactors

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In this paper we study the effect of, well-known, higher order corrections to the allowed beta decay spectrum on the determination of anti-neutrino spectra resulting from the decays of fission fragments. In particular, we try to estimate the associated theory errors and find that induced currents like weak magnetism may ultimately limit our ability to improve the current accuracy and under certain circumstance could even largely increase the theoretical errors. We also perform a critical evaluation of the errors associated with our method to extract the anti-neutrino spectrum using synthetic beta spectra. It turns out, that a fit using only virtual beta branches with a judicious choice of the effective nuclear charge provides results with a minimal bias. We apply this method to actual data for U235, Pu239 and Pu241 and confirm, within errors, recent results, which indicate a net 3% upward shift in energy averaged anti-neutrino fluxes. However, we also find significant shape differences which can in principle be tested by high statistics anti-neutrino data samples.

Comments:	20 pages, 5 figures, 9 tables, added references, version accepted for publication in Phys. Rev. C. Corrected errors in tab. 1 and eqs. 18 and 19. Results and conclusion unchanged
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