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Light vector bosons and the weak mixing angle in the light of new reactor-based CEνNS experiments

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After the first observation of coherent elastic neutrino-nucleus scattering (CEνNS), further experiments with different technologies have been established and the question arises how this signal can be further exploited for a variety of investigations in the future. In this context, nuclear reactors with their intense emission of low-energy antineutrinos in combination with high-purity germanium detectors have already shown their potential for CEνNS studies and represent a scalable technology for future precision experiments. Such measurements are of interest because deviations from the CEνNS prediction of the Standard Model could indicate the existence of new neutrino interactions, which in principle could also be associated with an existing dark sector. For example, a light vector boson may imply corrections to the Weinberg angle, so increasing the precision of this observable will help to probe additional U(1) extensions of the Standard Model. In this talk, we discuss the potential of future germanium-based reactor experiments for precision measurements of the weak mixing angle as well as for the search for a new light vector boson that may exist. Using a data-based reactor antineutrino prediction, we present the experimental sensitivity to the weak mixing angle and the parameters of generic light vector models. In addition, we highlight the impact of characteristic experimental parameters such as detector mass and energy threshold on the expected signal rate. In this way, we show where improvements in future experiment design could have the strongest impact on physics investigations.

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