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Harvesting the data from the COHERENT experiment

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The experimental observation of the coherent elastic neutrino-nucleus scattering (CEνNS) opened up a new window to explore different sectors from nuclear to neutrino physics, passing through electroweak parameters determination. Indeed, from the analysis of the data provided by COHERENT experiment, we determined for the first time the average neutron rms radius of ^{133}Cs and ^{127}I, obtaining the practically model-independent value $R_n = 5.5^{+0.9}_{-1.1}$ fm. Moreover, CEνNS represents a powerful probe of neutrino properties, allowing in particular to set bounds on the neutrino charge radii. We show that the time information of the COHERENT data permits to restrict the allowed ranges of the neutrino charge radii, especially that of ν_μ. We also obtained for the first time bounds on the neutrino transition charge radii, which would be a sign of physics beyond the Standard Model (SM). Finally, I will show that using the previous mentioned average neutron rms radius of ^{133}Cs and ^{127}I, we are able to remove the long-standing $1.5\,\sigma$ tension between the SM prediction and the weak mixing angle measurement from the atomic parity violation (APV) in caesium. The updated APV result becomes $\sin^2\vartheta_{\rm W} = 0.239^{+0.006}_{-0.007}$, to be compared with the SM prediction at low momentum transfer, $\sin^2\vartheta_{\rm W}^{\rm SM} = 0.23857(5)$. Moreover, from a combination of APV and COHERENT measurements a meaningful value of the caesium neutron skin, the difference between the neutron and proton distribution radii, is obtained $\Delta R_{np} = 0.62 \pm 0.31$ fm, showing for the first time a $2\,\sigma$ deviation from zero.

Collaboration name

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