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Average CsI neutron density distribution from COHERENT data

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The coherent neutrino scattering with nuclei provides a novel way to measure the distribution of neutrons in nuclei. This interaction has been theoretically predicted more than 40 years ago [1], but the difficulty of measuring the very small nuclear recoil made possible its experimental observation only in 2017 by the COHERENT experiment [2].

Using the COHERENT data, we are able to determine for the first time the average radius of the neutron distributions of the Caesium and Iodine nuclei [3], which turns out to be of about 5.5 millionths of a nanometer. It was also possible to evaluate the so called "neutron skin", which is the difference between the radii of the neutron and proton distributions. These quantities are crucial ingredients of the nuclear matter equation of state which plays an essential role in understanding several processes, like nuclei in laboratory experiments, heavy ion collisions, and the structure and evolution of astrophysical objects as neutron stars. Moreover, a better understanding of the neutrino-nucleus interaction process is of utmost importance in the direct dark matter searches field, in which this process contributes to an irreducible source of the background.

In this talk, the measurement of the neutron radius and the neutron skin from COHERENT data will be presented, and the implications in nuclear physics, astrophysics and the cosmology will be elaborated.

[1] D.Z. Freedman, Coherent neutrino nucleus scattering as a probe of the weak neutral current, Phys. Rev. D **9**, 1389 (1974).

[2] D.Akimov *et al.* [COHERENT Collaboration], Observation of Coherent Elastic Neutrino-Nucleus Scattering, Science **357**, 1123 (2017), [arXiv:1708.01294 [nucl-ex]].

[3] M.Cadeddu, C.Giunti, **Y.F. Li***and Y.Y. Zhang, Average CsI neutron density distribution from COHERENT data, Phys. Rev. Lett.120**, 072501 (2018),[arXiv:1710.02730 [hep-ph]].

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