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Giant neutron halo in Ce isotopes near the neutron drip line

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Neutron halo is one of the most intriguing properties of nuclei with sufficient excess of neutrons. Neutron halo was first observed experimentally in ^{11}Li. The giant neutron halo of more than two neutrons was predicted also theoretically in medium and heavy mass nuclei near the neutron drip line, in particular in Ca, Zr, Ce. The halo and giant halo forms in $^{186-190}Ce$ and $^{192-198}Ce$ isotopes respectively according to the calculations within the relativistic HFB and RMFPC-CMR-BCS theories [1,2].
We investigated the neutron single-particle structure of Ce isotopes by the dispersive optical model (DOM) [3]. The method to construct dispersive optical model potential is given, for example, in [4]. The evolution of the neutron single-particle energies (see Fig.1) was calculated in the assumption that diffuseness parameter a_{HF} of the potential increased from 0.65 for ^{184}Ce to 0.8 fm for ^{198}Ce. The halo in Ce isotopes near the neutron drip line forms when neutrons occupy low-l states $4s_{1/2}$, $3d_{5/2}$ and $3d_{3/2}$. The calculated root mean square radii R_{rms} of these states are in the interval approx. from 10 to 12 fm, whereas the radii R_{rms} of the neighboring states equal to 6 - 7 fm. The total number of neutrons in halo states exceeds 2 for N > 134. The neutron density distributions of the ^{184}Ce with traditional magic neutron number N = 126 and ^{198}Ce with N = 140 are shown in Fig.2. For the latter isotope, the neutron density demonstrates the long tail, which can be attributed to the giant halo.

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