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Spin contents of Na isotopes towards driplines

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The structure evolution of neutron-rich isotopes provides with many intriguing facets. Recently, we presented [1] how such evolution occurs in F-Ne-Na-Mg isotopes up to their neutron driplines, by using an ab initio effective nucleon-nucleon (NN) interaction derived from the chiral Effective Field Theory of QCD [2]. In this presentation, we shall report some features of the spin contents obtained quite recently by extending this approach. These features are focused on because of the main interest of the conference. We thus discuss the magnetic moments of Na isotopes up to their dripline, in agreement with experimental values [3].
The wave functions used in this work can produce another nice agreement with experiment for the charge/matter radii and the quadrupole moments, as well as the ground-state energies [1]. The dripline is located at ^{39}Na, being most likely consistent with experiment [1,4].

One of the remarkable findings is that the magnetic moments of the ground states of Na isotopes up to ^{31}Na can be well described by free spin g-factors (g_s). On the other hand, it appears that the orbital g-factors (g_l) are changed from the free values by an isovector shift of 0.2. Such an isovector shift of the orbital g-factors is quite usual, and is ascribed to the meson effect which can be needed independently of the nuclear structure calculation. On the other side, the spin quenching has been considered to be due to the 2p2h excitations across the relevant magic gap (core polarization or configuration mixing), which are explicitly included, in our calculation, between the sd and pf shells thanks to the present ab initio effective NN interaction capable of describing such cross-shell excitations. We note that only the present interaction may have this capability among various ab initio interactions proposed so far, due to its derivation by the EKK method [5]. It is of interest to examine predicted values for Na isotopes beyond ^{31}Na.

The predicted magnetic moments of exotic Na isotopes indeed point to strongly deformed shapes, as expected in the scenario presented in Ref. [1]. The neutron spin contents of exotic Na isotopes are quite small up to the dripline nucleus. The proton spin contents are more sizable, but differ from those in the single-particle picture. Thus, the exotic Na isotopes are expected to be a very interesting domain in the nuclear chart, including their magnetic properties.

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