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Decorrelated behaviour of spin-orbit partners in neutron-rich copper isotopes

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In two (d,3He) transfer reactions with MUST2 at Ganil and the split-pole at Orsay, we have determined the position of the proton-hole states in the neutron-rich 71Cu and 69Cu isotopes (Z = 29, N = 42 and 40). We have found that in 71Cu the hole strength of the f7/2 orbital lies at higher excitation energies than expected. From β-decay, the f5/2 excited particle state in these isotopes was known to come down rapidly in energy when passing N = 40 [1] and even become the ground state in 75Cu (N = 46) [2]. This sudden energy shift has been explained in a number of theoretical works [3,4,5]. The prediction for the f7/2 spin-orbit partner was that it would lower in energy as well through a related effect. The present result, however, indicates a decorrelated behaviour between the spin- orbit partners. We remeasured the single-particle strength in 69Cu in the corresponding (d,3He) reaction in order to extend the existing data [6] and in particular to make sure that there is a consistent analysis of spectroscopic factors between both isotopes. Taking together the results from both reactions, we find that additional mechanisms may have to be included to understand the nuclear structure of the neutron-rich copper isotopes and constrain the weakening of the Z = 28 shell gap towards doubly magic 78Ni.

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