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Doubly magic character of ^{78}Ni - complex studies of simple nuclei[1]

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The neutron-rich, doubly-magic nucleus ^{78}Ni and its neighbors are candidates for benchmarks that test nuclear structure models far from stability. According to shell-model calculations with effective interactions[e.g., 1], the large neutron excess in nuclei near ^{78}Ni is expected to modify single-particle energies, which may lead to the weakening or disappearance of traditional shell-gaps. Moreover, these nuclei lie in a region of interest for nuclear astrophysics, since r-process nucleosynthesis is supposed to be initiated close to ^{78}Ni [2]. Very little is known empirically about ^{78}Ni.

Several experimental studies on neutron-rich Z$\sim$28 and 40¡N¡50 nuclei based on fragmentation reactions have been performed [3-5] and a new theoretical description was recently developed [6]. These very sensitive measurements provided not only the first information on the lowest excited states of the semi-magic nickel isotopes from ^{70}Ni to ^{76}Ni, but also stimulated the development of a new shell-model description [6]. These studies also provided the first identification of beta-delayed neutron emission from $^{71-74}$Co [7], where larger than predicted branching ratios pointed to important nuclear structure effects. The latter phenomenon is of astrophysical interest since it provides information on the Gamow-Teller beta-strength distribution and on the branching ratios that are fundamental input parameters for calculations of the r-process network.

An overview of the experimental progress achieved in recent years will be presented and discussed in comparison with theoretical predictions.

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