The study of the $N = 28$ shell closure : a way to probe nuclear forces.

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The study of the evolution of the $N = 28$ magic shell has been started about 15 years ago. A lot of experimental studies aimed at determining whether the $N = 28$ shell closure is eroded in very neutron-rich nuclei through complementary methods. The very first hints of the vanishing of the $N = 28$ gap were obtained by β-decay [1], mass measurements [2] and Coulomb-excitation [3,4] experiments. Theoretical studies came progressively to the conclusion that the erosion of the $N = 28$ shell gap should lead to shape coexistence in ^{44}S and deformation in ^{42}Si (e.g.). For this latter, it was however not clear whether spherical shape would be preferred to deformation. Recent experimental campaigns were carried out worldwide to study atomic masses [5], β-decay [6], nuclear spectroscopy [7,8,9,10,11,12], neutron single-particle energies [13] to probe the onset of collectivity along the N=28 isotones. With these pieces of information in hand and new unpublished results, the progressive collapse of the $N = 28$ shell closure is now established. Interestingly this study is also ideal for probing the nuclear forces such as the spin-orbit and tensor forces in nuclei. Experimental highlights will be shown at the $N = 28$ shell closure, in connection with the state of the art theoretical descriptions. More generally, the shell-breaking mechanism discovered at N=28 should apply to other shell closures, such as the $N = 14$, $N = 50$ and $N = 82$ ones, in which the same spin orbit forces are at play. However they seem to have various consequences with respect to shell erosion...

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