Latest development of the combinatorial model of nuclear level densities

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The combinatorial model of nuclear level densities has now reached a level of accuracy comparable to that of the best global analytical expressions without suffering from the limits imposed by the statistical hypothesis on which the latter expressions rely. In particular, it provides naturally, non gaussian spin distribution as well as non equipartition of parities which are known to have a significant impact on cross section predictions at low energies [1,2]. Our first global model developed in Ref. [1] suffered from deficiencies, in particular in the way the collective effects - both vibrational and rotational - were treated. We have recently improved this treatment using simultaneously the single particle levels and collective properties predicted by a newly derived Gogny interaction [3], therefore enabling a microscopic description of energy-dependent shell, pairing and deformation effects. In addition for deformed nuclei, the transition to sphericity is coherently taken into account on the basis of a temperature-dependent Hartree-Fock calculation which provides at each temperature the structure properties needed to build the level densities. This new method is described and shown to give promising preliminary results with respect to available experimental data.

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