Level densities and radiative strength functions in rare earth nuclei

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The level density and radiative strength function are fundamental nuclear properties and important input parameters in large network calculations of the nucleosynthesis of heavy elements. The Oslo group has developed a technique to extract simultaneously the level density and radiative strength function from the same experiment. After finding the level density as a function of excitation energy, the entropy is known and we can explore thermodynamic properties of the nucleus such as the microcanonical temperature.
A pygmy resonance in the strength function has been observed at around 3 MeV in several deformed rare earth nuclei; the resonance vanishes for the spherical Sm nuclei, as expected, since the origin of this resonance is thought to be the scissors mode. In Dy isotopes the width of this resonance observed in Oslo experiments is about twice as wide as the width found by the Prague group when analyzing two-step cascades from neutron capture experiments. Further investigations into the possible spin dependence of the width are in progress. The strength function of ^{163}Dy and ^{164}Dy are best fitted by using two resonances, where the possible origin of the second resonance is not yet understood. Finally, an unexpected enhancement of the γ-strength below 4 MeV in the total radiative strength function of Fe, Mo, V and Sc isotopes has been observed. This enhancement is presently not understood and remains a challenge for theoretical models.

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