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Probing the Shape of Hot ^{194}Hg with the GDR Decay in Selected Cascades

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High energy γ-rays emitted in the decay of the hot compound nucleus ^{194}Hg , formed in the reaction 142 MeV ^{30}Si on ^{164}Dy, have been measured in coincidence with the low-energy, discrete γ transitions in the residual nuclei. The excitation energy of the compound ^{194}Hg nucleus was 60 MeV, and the maximum angular momentum ≈ 41 ħ. The experiment was performed at the Niels Bohr Institute, using a combination of Nordball and HECTOR arrays.

In the upper left panel of Fig. 1 the low-energy Ge spectra from Nordball are shown for 2 different conditions on the high energy γ-rays from HECTOR. One (lower spectrum) is in coincidence with high energy γ-rays with E_γ > 3 MeV, while the other (upper one) - with E_γ > 10 MeV. One readily sees that the relative intensity of the low spin transition of the populated residual nuclei ^{190}Hg (4n channel), ^{189}Hg (5n channel) and ^{191}Hg (3n channel) depends on the energy of the gating transitions. This can also be seen in the bottom panel of Fig. 1, where the relative cross-sections of the particular decay channel, deduced from the discrete line intensities, as a function of the lower limit of the gate on high-energy γ-rays are shown. A gate with E_γ > 10 MeV enhances the 3n channel, since the GDR γ-ray replaces a neutron in the decay sequence. Reversing the argumentation, the spectrum associated with the 3n channel is the most interesting in the GDR studies, because in this spectrum the contribution of the statistical gamma rays (4-8 MeV), that constitutes a background, is significantly reduced. Indeed, as one can see in the right panel of Fig. 1, the GDR bump is much more pronounced in the spectrum gated by the discrete lines in ^{191}Hg (3n channel) as compared to the total spectrum.

The results were analysed within the framework of the Monte-Carlo version of the statistical model CASCADE. The relative residues cross-section dependence on the energy of the gating γ-ray (bottom left panel) is reproduced relatively well, giving confidence in the statistical model parameters used. Moreover, the calculated GDR spectra, total and gated by 3n channel, agree very well with the experimental data (right panel of Fig. 1). The GDR parameters, fitting the best the spectra, were S = 1, E_{GDR} = 14 and Γ = 6.5 MeV.

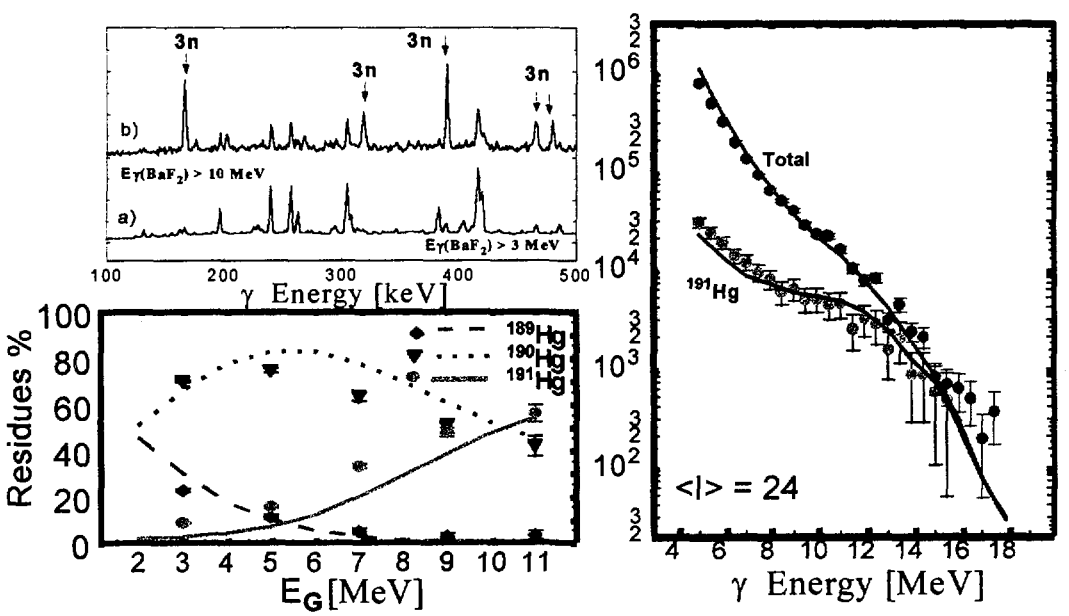

Fig. 1: Ge spectra with different gating conditions on high energy γ-rays (upper left panel); relative evaporation residue cross-section vs. energy of the gating transitions (bottom left); high energy γ-ray spectra: total and gated by discrete lines in ^{191}Hg (right). The lines represent the statistical model calculation results.