GAMMA-DECAY CALCULATIONS WITHIN THE EXCITON MODEL: THE CASE OF $^{64}Zn+^{68}Zn$ AND $^{20}Ne+^{112}Sn$ REACTIONS

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The possibility of gamma emission has been incorporated into the pre-equilibrium exciton model nearly a decade ago [1]. Recently, the original idea has been modified [2] and extended from spin-independent formulation into a more realistic spin-dependent one [3]. Very recently, also a concept of the gamma emission based on the bremsstrahlung appeared [4,5]. Both the ways proved their usefullness: the former idea [1,2] served to explain observed gamma spectra at not too high energies ($\varepsilon_\gamma \lesssim 25$ MeV), and also the quantities related to the gamma-to-nucleon competition (like $\Gamma_\gamma/\Gamma_{tot}$, the differential gamma multiplicities, the exclusive nucleon spectra, etc.) in this energy domain, and the latter one [4,5] has been used only for calculations of high-energy gamma spectra ($20 \text{ MeV} \lesssim \varepsilon_\gamma \lesssim 100$ MeV) from heavy-ion reactions.

A rather important field of application has been suggested by the gamma spectra measurements by Kamanin et al. [6-8]. They measure gammas from various heavy-ion reactions up to the energy of about 20 MeV, and indicate generally some enhancement near the giant dipole resonance. Some of their experiments are more elaborated measurements, where the creation of specified composite nuclear system has been verified by the characteristic x-ray emission and/or by the detection of fission fragments. To make the data reliable, all possible care was taken in order to eliminate neutrons as false counts in the gamma detectors. Especially interesting is their measurement of gammas for couple of reactions leading to the same composite nucleus $^{132}Nd^*$ at nearly the same excitation energy, namely $^{64}Zn+^{68}Zn$ at 290 MeV, and $^{20}Ne+^{112}Sn$ at 110 MeV. Therein, some slight difference in the spectral shape is observable at $\varepsilon_\gamma > 8$ MeV (and probably only to $\varepsilon_\gamma < 16$ MeV).

We have tried to look at this problem via the exciton model picture [1,2]. The extension of the exciton model to the heavy-ion reactions is not straightforward, because of com-

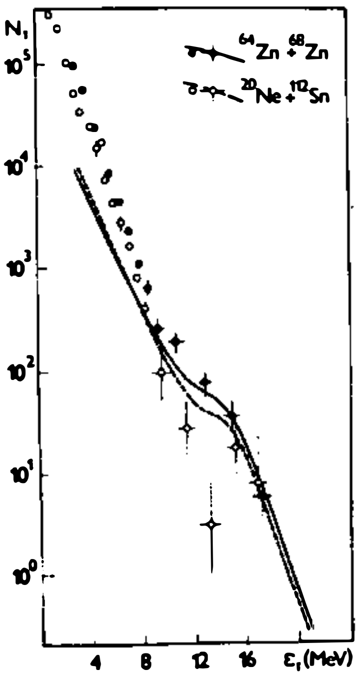

Fig. 1. Experimental and calculated gamma spectra from the decay of ^{132}Nd (and its daughter nuclei). For details, see the text.

plicated nature of the initial configuration. Though one should take a time-dependent initial configuration (see, e.g. [9,10]), effectively a single value (dependent on the energy above the Coulomb barrier) yields rather good results [11-13]. The systematics gave n_0=6 for Ne- and n_0=15 for Zn-induced reaction. Gamma emission in accord to [2] was incorporated into the PEQGM program [14]. This code enabled to calculate cascade of gammas, interspersed with nucleons as needed (up to 6 subsequent nucleons were used).

Resulting spectra for the two reactions are presented in Fig. 1. Possible switch to the former model [1] does not change the picture; also the changes of the matrix element manifest themselves only very weakly. In any case, the difference between these reactions is pronounced clearly in the calculated spectra in the energy range 10-15 MeV, though it seems less significant than in the experiment.

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