Abstract:

This work, entitled “Properties of hot and fast rotating atomic nuclei studied by means of Giant Dipole Resonance in exclusive experiments”, is the *habilitation thesis* of dr. Adam Maj. It consists of the review (in Polish) of performed research and of attached reprints from 16 original publications (in English) which A. Maj is the main or one of the main authors. All the studies were performed in collaboration with the groups from Milano and Copenhagen, using the HECTOR array equipment (described in chapter V).

The Giant Dipole Resonance couples to the quadrupole degrees of freedom of the nucleus, and therefore constitutes a unique probe to test the shapes of atomic nuclei. In addition, the γ-decay of the GDR from highly excited nuclei is a very fast process, it can compete with other modes of nuclear decay, and therefore can provide the information on the initial stages of excited nuclei.

The presented investigations were concentrated on the following aspects: the shapes and thermal shape fluctuations, the origin of the behaviour of the GDR width, the properties of some exotic nuclei (Jacobi shapes, superdeformation, superheavy nuclei) and on “entrance channel” effects. The GDR γ-decay was measured for nuclei with very different masses: from light nuclei with $A \approx 45$, through $A \approx 110$, 145,170,190, up to superheavy nuclei with $A \approx 270$.

The shapes of hot nuclei are not fixed but fluctuate. The extent of these fluctuations and their influence on the measured quantities (GDR strength function, angular distribution and effective shape) is discussed in chapter VI.1.

The observed width of the GDR is found to arise from the interplay of two effects: the thermal shape fluctuations, which are controlled by the nuclear temperature, and the deformation effects, controlled by the angular momentum. The “*collisional damping*” effect, which should influence the intrinsic GDR width, was found to be negligible (chapter VI.2).

The GDR γ-decay from hot superheavy nucleus ^{272}Hs was possible to be observed for the first time. The studies have shown that the fission process is slow enough, that there is time for collective modes to be build-up. It was possible to extract the information on the lifetime of such hot superheavy system, and on its effective shape (chapter VI.3).

The predicted elongated Jacobi shapes were found for hot and rapidly rotating ^{46}Ti nucleus. The GDR strength function and angular distributions suggest the tri-axial shapes, with the axis ratio of 1.6 : 1.25 : 1 (chapter VI.4).

It was possible, for the first time, to observe the low energy component of the GDR built on the superdeformed discrete band in ^{143}Eu. From the intensity of this component it was concluded, that the superdeformation is the property of rather cold nuclei (chapter VI.5).

The influence of the entrance channel on the compound nucleus formation was investigated. The experimental results suggest a possibility of the pre-equilibrium emission of α-particles at high angular momenta in the case of symmetric reactions. Such an emission populates the compound nucleus at different excitation energy and angular momentum, as compared to the case of asymmetric reaction (chapter VI.6).