GDR EMISSION IN $^{64}Ni+^{92}Zr \rightarrow ^{156}Er$ REACTION STUDIED WITH GASP*

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The Giant Dipole Resonance (GDR) from the decay of excited ^{156}Er nuclei has been studied with the GASP spectrometer. The correlations between the emission of energetic gamma rays, the fold k distribution and low energy discrete gamma lines have shown that standard statistical calculations can be used to describe not contaminated GDR gamma spectra.

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The search for non statistical or entrance channel effects in fusion-evaporation reactions is a topic of current interest in nuclear physics since ten years. In the first generation experiments, measurements of inclusive neutron [1] and gamma ray spectra [2, 3] were performed. The signature for dynamical effects was obtained by comparing reactions with different entrance channel (typically C- or O- and Ni-induced reactions), being the more symmetric channel the candidate for a non statistical behaviour. More recently, the impossibility of reproducing with statistical models the anomalous shape of energetic γ-ray spectra from the decay of the giant dipole resonance, detected in Ni-induced reactions, has been interpreted as evidence of dynamical effects in the entrance channel of fusion reactions [4].

The giant dipole resonance (GDR) from the decay of excited ^{156}Er nuclei has been studied in a new experiment performed at the Laboratori Nazionali di Legnaro, with the GASP spectrometer. 241 MeV ^{64}Ni beam was focussed onto a 0.5 $\mu g/cm^2$ ^{92}Zr target. Two Ge detectors of the GASP array have been replaced by two large BGO crystals ($4'' \times 4''$) to detect hard gamma rays (Hγ). A third Ge was dismounted allowing the use of a neutron

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detector (NE213 $5'' \times 2''$) inserted in a massive shielding at ~ 3 meter from the target. Correlations between the emission of Hγ, the fold k measured in the inner ball and the low energy γ-ray in the Ge detectors have been studied.

The Ge spectra (in coincidence with events in the GDR region) gated on different k cuts are shown in Fig. 1. It can be noted that for high fold ($k > 10$) the discrete γ lines from relevant Er isotopes produced in the fusion-evaporation reaction dominate. On the contrary, at low fold a very strong background is present, due to reactions with kinematics different from 241 MeV ^{64}Ni + ^{92}Zr fusion, probably the known strong deep inelastic channel. Reactions on light target contaminants are also possible.

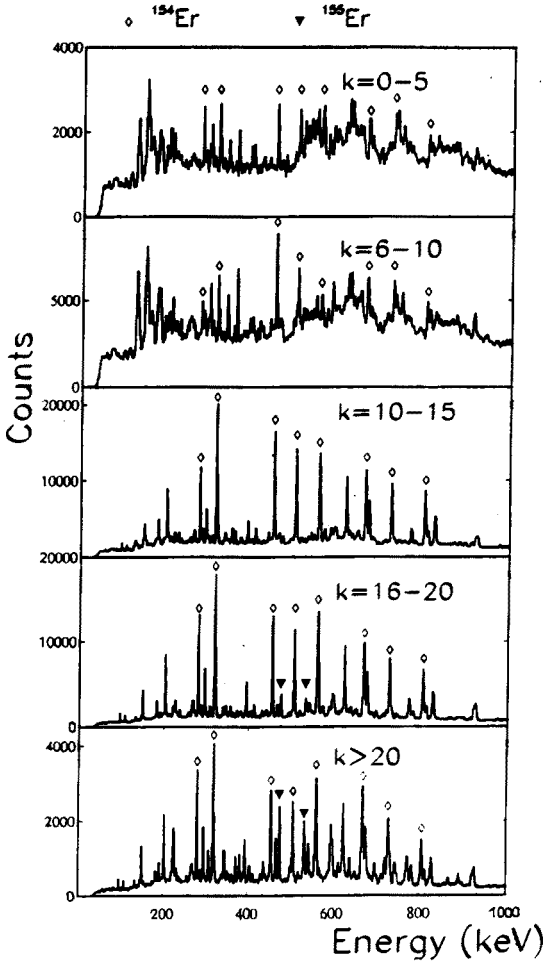

Fig. 1. Ge spectra in coincidence with hard γ-rays for different gates in measured fold.

Hard γ-ray spectra have been derived for the same cuts in fold and analyzed with the help of CASCADE statistical model calculations performed for the corresponding spin window as reported in Fig. 2. For lower fold ($k < 10$) unrealistically low strength values are obtained, demonstrating that the statistical tail of the gamma spectrum is heavily poisoned by the cotaminant reactions. As a results the spectrum is distorted and can not be satisfactorily described by standard parameters (or calculations).

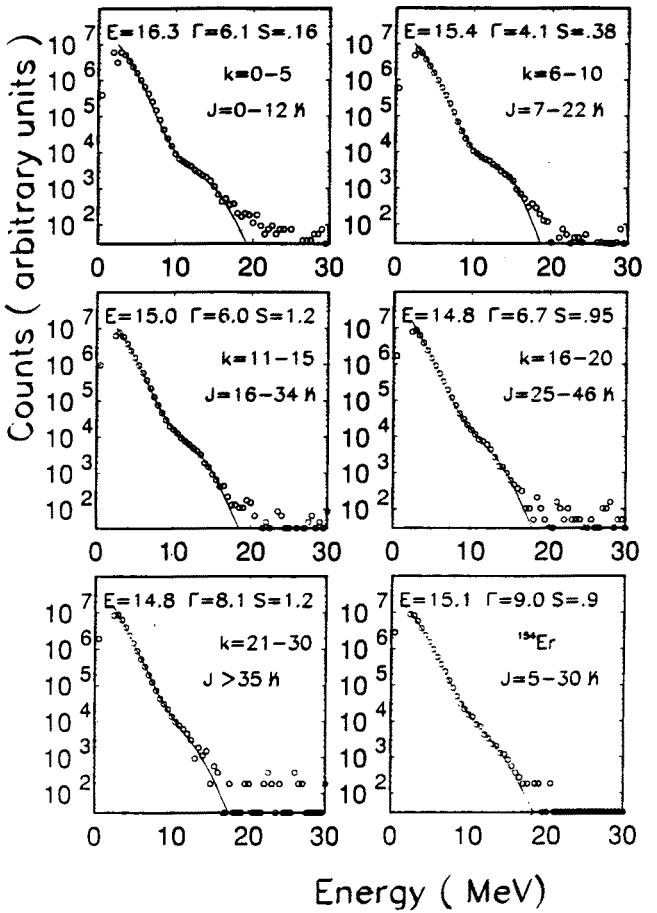

Fig. 2. Hard γ-rays spectra for different gates in measured fold. Solid lines are results of CASCADE statistical calculations. Tha last spectrum is in coincidence with discrete lines of the ^{154}Er.

The determined GDR parameters for fold $k > 10$ are: strength $S \sim 1$, energy $E \sim 15$ MeV and width $\Gamma = 6 - 8$ MeV increasing with the spin. Those parameters fit well with the systematics mainly obtained with lighter

beams and the spin dependence of the GDR width is well in agreement with the predictions from an adiabatic approach [5].

Futhermore the hard γ-ray spectrum in coincidence with discrete lines of the ^{154}Er nucleus ($2n$ evaporation) has been derived (last spectrum in Fig. 2). This spectrum is reproduced by standard CASCADE calculations yielding parameters reasonably in agreement with inclusive spectra, with the exception of the width. It has to be stressed that in this kind of calculations small contributions from other Er isotopes can not be avoided. A Monte Carlo statistical code will be needed to analyze the GDR in coincidence with single evaporation residue.

GDR spectra for single decay chain are supposed to be an important tool to verify the dependence of the GDR parameters on temperature and angular momentum of the compound nucleus as previously determined from inclusive measurements, being free from possible contaminations (as those in the present experiment).

The present experiment has shown that in Ni-induced reactions standard statistical calculations can satisfactorily describe not contaminated GDR γ-ray spectra, *i.e.* spectra corresponding to high fold ($k > 10$). The spin determination achievable with GASP inner ball together with the use of external detectors for energetic γ-ray offers a great possibility of addressing several important questions on the GDR in hot system, some of them completly new.

The data reported here have been obtained in a joint experiment between the GASP group and the HRN (Bari, Firenze, Milano, Padova and LNL) collaboration.

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