# Study of the pygmy dipole resonance of $^{132}$Sn and $^{128}$Sn in inelastic $\alpha$-scattering

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In neutron-rich nuclei, the pygmy dipole resonance can be visualized as a vibration of excess neutrons against an isospin symmetric core in the nucleus, which corresponds to a dipole mode. Ongoing to the nature of the resonance, the phenomenon should be a function of the neutron-skin thickness and neutron excess. As the experimental data for this dipole mode are rare, even for stable nuclei[1], interesting open questions remain. One of them is the isospin character of the low-lying dipole strength. In an experiment with stable $^{124}$Sn[2], it has been realized that a large fraction of the pygmy strength is of isoscalar character. However, significant differences in the strength distribution with photo-excitation have been observed.

In November 2014, an experiment to investigate the isoscalar character of the pygmy dipole resonance in $^{128}$Sn and $^{132}$Sn was performed with inelastic $\alpha$-scattering at RIKEN. The isotopes were produced with a high-intensity primary $^{238}$U beam at 345 MeV/u impinging on a beryllium target. The secondary beam of approximately 200 MeV/u was directed towards the liquid helium target, with a thickness of approximately 300 mg/cm$^2$. At the target position, the emitted $\gamma$-rays were measured by 8 large-volume 3.5" $\times$ 8"$LaBr_3$:Ce crystals from the HECTOR-array at INFN Milano[3] and 95 large-volume NaI DALI2[4] crystals.

The particle identification involved a combination of energy loss, magnetic rigidity, and time-of-flight measurements using the BigRIPS and the ZeroDegree spectrometer[5]. The registered hits in the $\gamma$-array are selected within a time window to suppress noise stemming from particle hits and the background. As a result, the preliminary energy plot for the $\gamma$-rays measured with the crystals from the HECTOR-array, emitted by the excited $^{132}$Sn ions, is shown in Fig. 1. The peak at about 4 MeV corresponds to the $2^+$ state, which is the lowest excited state in the isotope..

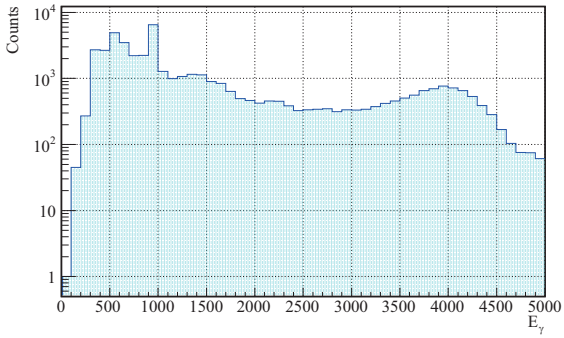


Fig. 1. Doppler-corrected $\gamma$-energy spectra measured using crystals from the HECTOR-array, gated on incoming and outgoing $^{132}$Sn ions. The $2^+$ state at 4 MeV can be identified.

With further investigation of the $\gamma$-energy spectra, the strength of the (isoscalar) pygmy dipole resonances can be determined. In addition, the obtained information will allow the isovector and isoscalar parts of the pygmy dipole resonance to be separated in data of experiments already performed at GSI Darmstadt with the R$^3$B setup.

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