Study of particle and gamma decays of high-lying resonance states by inelastic scattering of 200 MeV protons

Adam Maj[1], Silvia Leoni[2] et al.

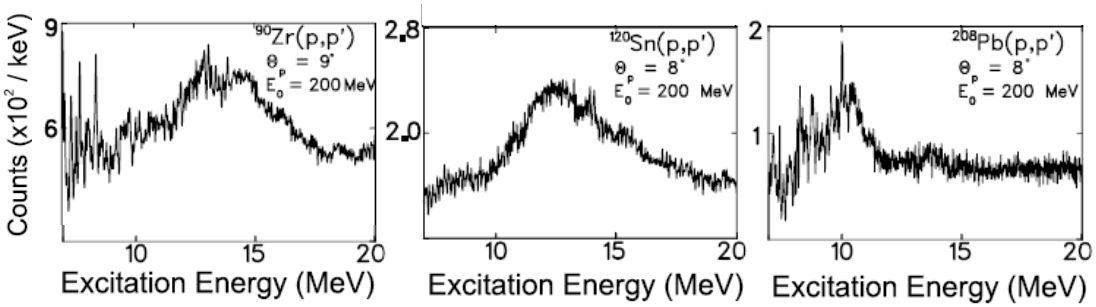
[1] *Institute of Nuclear Physics Polish Academy of Sciences, Kraków*
[2] *Milano University and INFN, Milano*

Giant Resonances are fundamental high frequency modes of excitation of nuclei, providing basic information on nuclear structure and on the effective nucleon-nucleon interaction. They can be excited employing different probes (protons, alphas, photons and heavy ions) and can decay directly by emission of particles and γ's.

Inelastic scattering of protons at 200 MeV has been shown to successfully populate the Giant Quadrupole Resonance in a number of stable targets, as for example ^{208}Pb, ^{56}Ni, ^{90}Zr and ^{124}Sn. This is illustrated in the figure below, showing high resolution proton spectra detected in a magnetic spectrometer [1]. Besides the pronounced resonance structure of quadrupole nature (in the 10-15 MeV region), the proton spectra give evidence for a number of lower-lying states of dipole nature (below particle threshold), which have been associated to the so called "pygmy" dipole resonance, arising from the oscillation of the neutron excess with respect to the proton-neutron inert core [2].

The previous observations call for additional investigation of these resonance states. In particular, their particle and gamma decay has never been investigated in details, although it would provide additional/basic information on the microscopic structure of such states and on the damping mechanisms into more complex degrees of freedom.

We therefore propose to measure particle and gamma decays of giant resonances produced by inelastic scattering of protons at 200 MeV. The experimental setup will consist of an array of 8 large volume BaF_2 detectors (HECTOR array) for the measurements of high-energy γ-rays, while the scattered protons will be detected by a system of E-ΔE Si telescopes, which will also allow to detect particles emitted by the resonance states of interest.



[1] A. Shevchenko et al., Phys . Rev. Lett. **93**, 122501-1 (2004).
[2] J. Endres et al., Phys. Rev. Lett. **105**, 212503 (2010).