Research Proposal E161 to the
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Investigation of the isovector spin monopole resonance in ^{208}Bi and ^{90}Nb via the ^{208}Pb,^{90}Zr(^{3}He,t+p) reactions.

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Abstract

The existence of the isovector $2\hbar\omega$ giant monopole resonances is a long-standing problem. They are of fundamental interest as collective phenomena at high excitation energies and their observation provides a crucial test for microscopic models. Until recently, only in the $\Delta T_z = +1$ channel studied through the (π^-,π^0) and (^{7}Li,^{7}Be) reactions, strength was found that could unambiguously be attributed to the isovector giant monopole resonance (IVGMR, $\Delta L = 0$, $\Delta S = 0$). This is mainly due to the fact that the investigation is seriously hampered by the presence of a large, non-resonant, continuum background. However, a recent study of the Pb(^{3}He,t)Bi* reaction at E(^{3}He)=177 MeV and subsequent decay by proton emission at KVI Groningen, a large fraction of the continuum background could be removed and isovector monopole strength due to the IVGMR and its spin-flip partner, the isovector spin monopole resonance (IVSMR, $\Delta L = 0$,$\Delta S = 1$) was identified.

The proposed experiment is a continuation of the experiment at KVI, making advantage of the much higher bombarding energy (E(^{3}He)=450 MeV) available at RCNP. This leads to three major advantages. Firstly, the IVSMR is much more strongly excited than the IVGMR at E(^{3}He)=450 MeV (the ratio is 10:1 compared to 3:1 at E(^{3}He)=177 MeV) making interpretation of the data much more straightforward. Secondly, because of purely kinematic reasons, the background due to quasifree reactions is much more suppressed by requiring coincidences between tritons at forward angles and protons at backward angles. And, finally, absolute cross sections are expected to be larger at a higher bombarding energy, due to the decrease of momentum transfer (ΔL=0 resonances peak at q=0) and as a result of the strong increase of the distortion factor as a function of bombarding energy.

The combination of these factors indicate that results of better quality can be expected at E(^{3}He)=450 MeV compared to E(^{3}He)=177 MeV. It should be possible to determine width and location of the IVSMR with a good precision and by studying the decay protons, insight can be gained into the microscopic structure of the IVSMR. The latter was not possible from the results obtained at KVI, because of an ambiguity in the determination of the energy of the decay protons, but for the proposed experiment is intended to employ the $\Delta E/E$ measuring technique for the protons and this ambiguity will be lifted. Results can then be compared directly with recently performed theoretical predictions.