Proton Induced Coherent Pion Production

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The short range correlation of the Δ-Δ interaction in the nuclear medium is investigated by determining the spin longitudinal response function and the Landau-Migdal parameter $g'_{\Delta\Delta}$ with a Coherent Pion Production (CPP) experiment. The experimental information on the $g'_{\Delta\Delta}$ is poor, although it is important for the study of a high density nuclear matter since it is sensitive to the critical density of the pion condensation. The CPP ($p+A \rightarrow n+\pi^{+}+A$) can be interpreted as the emission of a virtual pion from the projectile, followed by the elastic scattering of this off-shell pion, till it becomes a real pion with the nucleus left in the ground state. It can access the kinematical region different from a real pion scattering, where the longitudinal response becomes maximum due to the attractive pion exchange. Theoretical works show the magnitude and the peak (E) of the cross section at zero degree are sensitive to the $g'_{\Delta\Delta}$, which can be written by $\Delta E \sim \Delta g'_{\Delta\Delta}(hcf_{\pi N\Delta}/2\pi m_{\pi}^{2})\rho_0$, where ρ_0 is the nuclear density.

The experiment is performed at the neutron time of flight facility (NTOF) at RCNP with the reaction $^{12}C(p,n\pi^{+})^{12}C$ at 392 MeV. The scattered neutrons are detected by the counter consisting of liquid and plastic scintillators, which is set at 70m downstream the target. The positive pions are momentum analyzed by the swinger magnet, and detected by the tracking detector installed inside the magnet. The tracking detector based on a Gas Electron Multiplier technology was constructed newly. It has a high position resolution of ~ 100 um which is sufficient to identify the ground state of the residual ^{12}C to get an accurate signature of the CPP. The enhancement can be observed in the region of the CPP as shown in the figure 1, which is distributed in the 200~300 MeV, after the event cuts with charged particle energy and TOF. The red line is the theoretical predication by E.Oset group, assuming the appropriate detector efficiencies. The present status of the CPP experiment at RCNP will be reported.

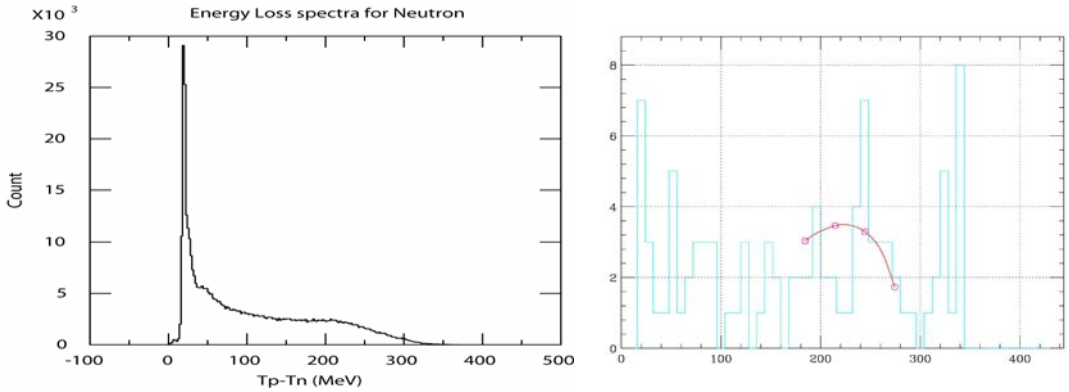

FIGURE 1. The neutron energy loss spectrum. The right is the events after the energy and TOF cuts. .