Σ-Nucleus Interactions in Medium to Heavy Nuclei

H. Noumi[a] for the KEK-PS E438 collaboration

[a] *High Energy Accelerator Research Organization (KEK)*

We have studied the (π^-, K^+) reactions to investigate the Σ-nucleus potential. The inclusive (π^-, K^+) spectra on CH_2, Si, Ni, In, and Bi were measured at a beam momentum of 1.2 GeV/c with an energy resolution of 3.3$\sim$5.2 MeV (FWHM) by employing the superconducting kaon spectrometer (SKS) system at the KEK 12-GeV PS. Observed spectra show similar shape with increase of the magnitude as increase of the mass number. A notable feature is that the maximum of each spectrum occurs at the excitation energy larger than that predicted by the Fermi-gas model. Theoretical calculations based on DWIA have been done in order to extract information on the Σ-nucleus potentials, comparing with the observed spectra. Fig. 1 shows the measured spectrum on Si as a function of the Σ^--binding energy $(-B_{\Sigma^-})$. The calculated spectra for various values of the Σ-nucleus potential, assuming the Woods-Saxon type one-body potential, are fitted to the measured one. Two of the calculated spectra are shown in Fig. 1, for examples. It is demonstrated that a strongly repulsive Σ-nucleus potential of the central height V_0^Σ=+150 MeV with a finite size of the imaginary part of the central depth W_0^Σ=−15 MeV reproduces the observed spectrum (solid curve) in shape [1]. While, the weakly-attractive potential of V_0^Σ=−10 MeV with W_0^Σ=−10 MeV fails to reproduce (dashed curve). The repulsive Σ-nucleus potential should be taken into account on the hyperon constituents in dense nuclear matter, such as neutron stars [2].

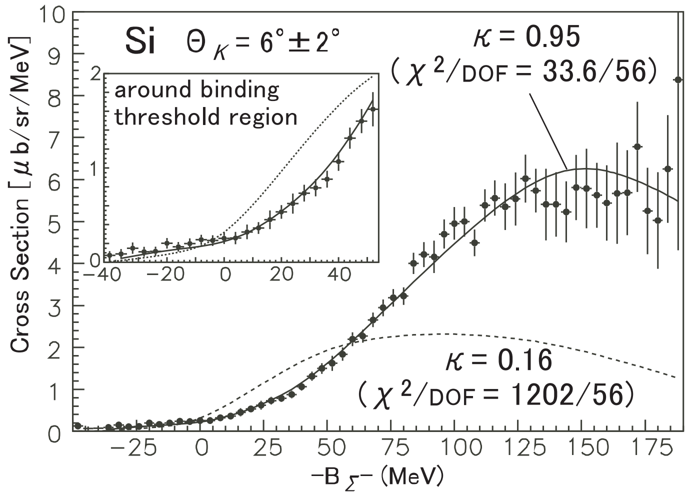

Figure 1: Inclusive (π^-, K^+) spectrum on Si at θ_K=6°±2°. The curves are the calculated spectra for the repulsive (solid) and weakly-attractive (dashed) Σ-nucleus potentials, fitted to the measured spectrum.

References

[1] H. Noumi *et al.*, submitted to Phys. Rev. Lett.
[2] S. Balberg and A. Gal, Nucl. Phys. **A625**, 435(1997).