ϕ photo-production off nuclei at SPring-8/LEPS

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Modification of vector meson properties in nuclei is a subject of great interest. Some theoretical calculations predict a mass shift and a change of the decay width of ϕ meson in a nucleus [1]. In high-energy heavy-ion experiment one attempts to find for such an evidence. However, the ϕ-nucleon total cross section ($\sigma_{\phi N}$), the real-imaginary ratio of the ϕ-nucleon scattering amplitude ($\alpha_{\phi N}$), and the ϕ-nucleon coupling constant ($f_{\phi N}$), which are the fundamental parameters to describe ϕ-nucleon scattering, are not well determined. Detailed studies of the ϕN interaction will give new checks to various models.

ϕ photo-production off nuclei is the best way to determine these parameters because the nucleus is transparent to the photon probe, and the multi-step process is negligible. One measurement of the ϕ photo-production cross section off nuclei at high energies (6.4 ~ 9.0 GeV) was performed to determine the fundamental parameters mentioned above [2]. Since the coherent process is dominant at 6.4 ~ 9.0 GeV, an optical model for the coherent production was used [3]. To deduce $\sigma_{\phi N}$ from the target mass number dependence of the production cross section, the model for the coherent production requires three parameters — $\sigma_{\phi N}$, $\alpha_{\phi N}$, and $f_{\phi N}$. A unique solution for $\sigma_{\phi N}$ could not be determined due to the fact that there are a large number of parameters. However, just above the ϕ meson photo-production threshold, the coherent

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production is expected to be suppressed compared to the incoherent one since the minimum momentum transfer |*t*| is large. An optical model for the incoherent production can be used to deduce $\sigma_{\phi N}$ [3]. In the model for the incoherent production, only one parameter — $\sigma_{\phi N}$ — is related with the target mass number dependence of the production cross section. Thus $\sigma_{\phi N}$ can be determined with less ambiguities.

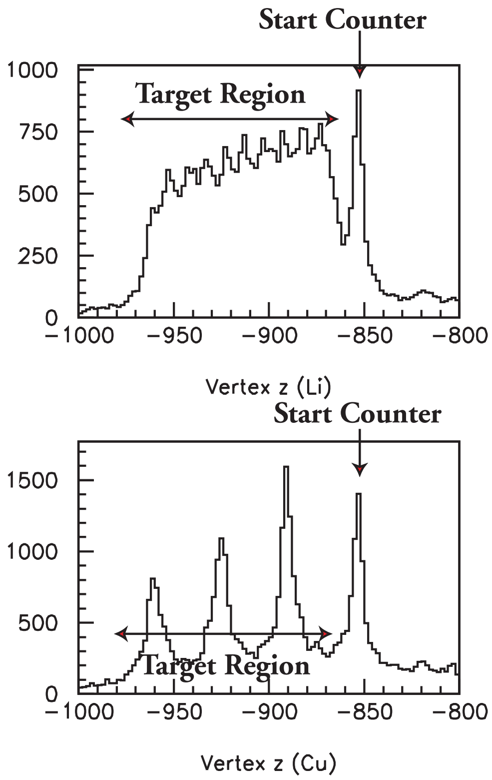

Figure 1: z-vertex coordinate for two track events

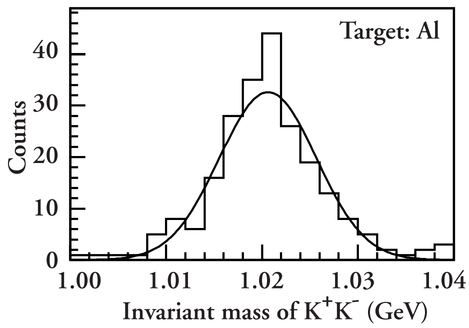

Figure 2: Invariant mass of K^+K^-

The cross sections of ϕ photo-production at E_γ=1.6~2.4 GeV were measured for four targets (^{6}Li, C, Al, and Cu) at SPring-8/LEPS. Incident photons were produced by the backward Compton scattering of ultra-violet laser photon (~350 nm) from 8 GeV electron in a storage ring. The tagged photon rate is 800 kcps. In order to reduce the systematic error for target mass number dependence of the production cross section, the following steps were taken. 1) The target positions and their standard deviations were set to the same values, respectively, to reduce the effect of the different acceptances due to the different target thickness. 2) Targets were replaced every one or two hours to avoid the long term change of beam conditions. Figure 1 shows a vertex distribution along the beam axis for two track events with ^{6}Li and Cu targets. The event originated in target and start counter for time of flight measurement can be seen. The ϕ meson events are identified by detecting K^+ and K^- mesons. Figure 2 shows the invariant mass of K^+K^- pairs measured with an Al target. The ϕ meson peaks (1.02 GeV) were observed for all the targets.

Detailed analysis for the target mass number dependence of ϕ photo-production cross sections, and $\sigma_{\phi N}$ is in progress.

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