様式3

論　文　内　容　の　要　旨

氏　名	（　柳　善永　）
論文題名	Study of interference between φ and Λ(1520) near the photoproduction threshold （ファイ中間子とΛ(1520)の光生成における干渉効果の研究）

論文内容の要旨

The phi-meson production has the unique feature that the gluon dynamics dominates in the reaction process because the process is OZI suppressed due to the dominant ssbar structure of the phi-meson, assuming the strangeness component of the proton is small. Because there are no strange s- and u-channel resonances which could couple to the phi, only the t-channel exchanges with $J^{PC} = 0^{++}$ and I = 0 can contribute. Therefore, phi photoproduction is predicted to proceed by the exchange of color singlet gluonic objects such as the Pomeron trajectory which has the same quantum numbers as the vacuum.
The Pomeron is introduced in Regge theory for high-energy hadron scattering and is considered to be dominated by gluon dynamics. Extrapolation from the high-energy region predicts a smooth energy dependence of the cross section down to the threshold energy for the reaction. The LEPS recent observation has shown a strong indication of a bump structure at around E = 2 GeV. A theoretical explanation is proposed that it could be due to an excitation of missing nucleon resonances with a large ss content. However, the bump structure appears only at forward angles. CLAS data (for both K^+K^- and $K^0_L K^0_S$ channels) show that resonance interpretation looks unlikely.

Recent theoretical works relate this to a coupling between the phi p and $K^+\Lambda(1520)$ channels, since the bump structure appears very close to the threshold of Λ(1520) production. Therefore, the structure around 2.0 GeV has attracted much attention for the nature of phi photoproduction mechanism near threshold. We have measured phi photoproduction from protons at SPring-8. Compton backscattered photons were incident on a 150-mm thick liquid hydrogen target with linear polarization. A large-aperture dipole spectrometer (LEPS) reconstructed charged particles at forward angles. With the 2002/2003 and the 2006/2007 LH_2 data sets from the LEPS, a new analysis on phi-Λ(1520) photoproduction has been performed using kinematic fits and simultaneous fits on the K^+K^- and K^-p mass spectra with Monte-Carlo templates. This self-consistent analysis made it possible to investigate a possible interference between the phi and Λ(1520).

It should be emphasized that we have first measured phi-Λ(1520) interference in gamma p to K^+K^-p reaction near phi photoproduction threshold. We reconfirmed that forward differential cross sections for phi photoproduction show a clear bump structure at around photon energy E = 2 GeV. We have measured the relative phase angles by building an amplitude interference function from the Breit-Wigner lineshape for the phi and the Monte-Carlo template distributions for the

$\Lambda(1520)$ in the kinematic region which the two resonances appear.

We have observed a clear phi- $\Lambda(1520)$ interference in the energy ranges from 1.673 to 2.173 GeV. From the fit with the interference amplitude term, the relative phase measurement results suggest a strong constructive interference when K^+K^- pairs are observed at forward angles, while destructive interferences when protons emit at forward angles. There is a change in phase signs for the events with K^-p detected at forward angles.

様式 7

論文審査の結果の要旨及び担当者

氏　名	（　柳　善永　）	
	（職）	氏　名
論文審査担当者	主 査　教　授	中野　貴志
	副 査　教　授	青井　考
	副 査　教　授	岸本　忠史
	副 査　教　授	保坂　淳
	副 査　教　授	與曽井　優
	副 査　主任研究員	延與　秀人

論文審査の結果の要旨

1.5～2.4 GeV ガンマ線を用いた 液体水素標的からのファイ中間子光生成及びΛ(1520)光生成反応の研究を SPring-8/LEPS にて行った。終状態に正負の荷電 K 中間子と一つの陽子が現れる崩壊過程を同定し、両者が運動学的に区別できる領域と区別できない領域で収量と２個の K 中間子の不変質量分布を詳細に解析することにより、両者の振幅の干渉を世界で初めて観測した。

両者が干渉し得る系の全エネルギーが 2 GeV に近い領域では、両者ともに未だ理論的に解明されていない生成断面積のバンプ構造（盛り上がり構造）が確認されている。本研究の結果は、バンプ構造を説明するために提唱された様々な理論モデルに制限を与えるとともに、ポメロン交換で説明されてきたファイ中間子光生成の微視的理解に対する重要な知見をもたらすと期待される。

以上のことから、博士（理学）の学位論文として十分価値のあるものと認める。