Spin density matrix elements for radiative decays of the omega meson in photoproduction at 5 GeV

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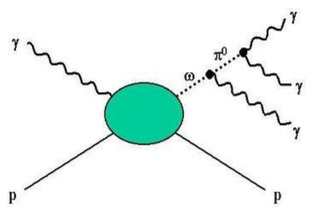
Abstract

The photoproduction of ω(782) meson on the nucleon at high energies is well described by a sum of t-channel exchanges. In the high energy limit of diffractive scattering, where Pomeron exchange dominates the total cross section, the helicity of the incident photon is transferred directly to the vector meson. At intermediate energies, other Regge exchanges compete with the Pomeron, leading to a complex energy dependence in the spin density matrix for vector mesons like the omega.

Introduction

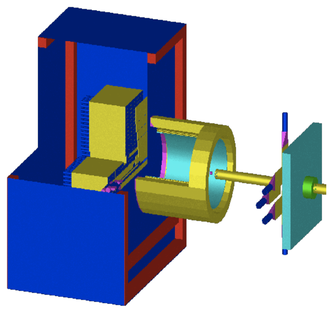
- At high energies and forward scattering process is dominated by t- channel exchanges



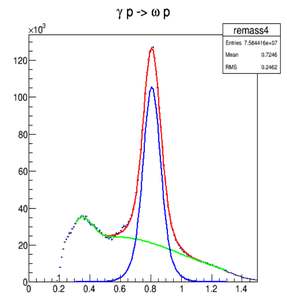
- Spin density matrix elemnts (SDME) are used to describe polarization of photoproduced vector meson
- For unpolarized incident photon beam the decay angular distribution in ω rest frame is given by:

$$W^0(\cos\theta,\phi)=\frac{3}{4\pi}\{\sin^2\theta\rho^0_{00}+(1+\cos^2\theta)\rho^0_{11}+\sin^2\theta\cos2\phi\rho^0_{1-1}+\sqrt{2}\sin2\theta\cos\phi\mathrm{Re}\rho^0_{10}\}$$

The Experiment



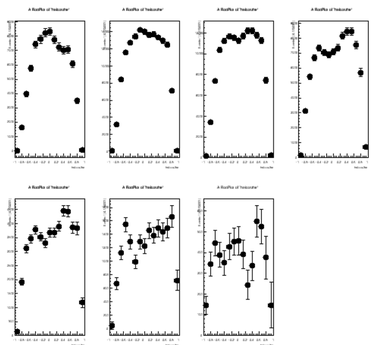
Radphi experiment designed to trigger all neutral final states



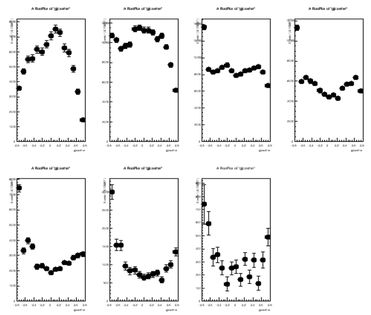
3Y invariant mass sample from Radphi detector.

Angular Distributions

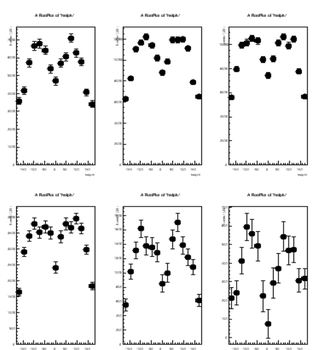
Angular distributions of omega meson decay products measured in the omega rest frame binned in |t|.



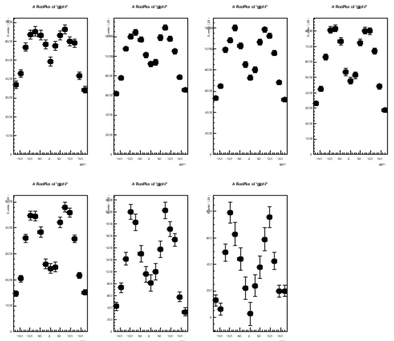
Cosθ distribution in helicty frame .



Cosθ distribution in GJ frame



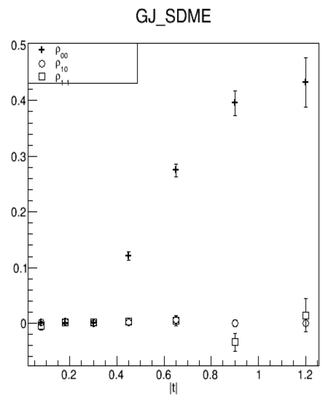
Helicity frame Φ distributions

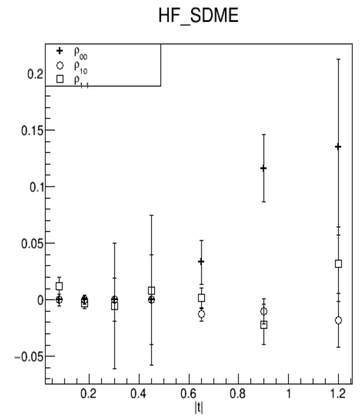


GJ frame Φ distributions

Spin Density Matrix Elements

Perform unbinned extended maximum likelihood fits to the angular distributions to extract the SDME





Spin density matrix elements measured in two reference frame

Conclusion and Future work

- Early indication of Helicity conservation in s-channel
- Early indication of violation of t-channel helicity conservation
- Next extract SDME in different energy

References

1. Schilling, K., Seyboth, P., & Wolf, G. (1970). On the analysis of vector-meson production by polarized photons. Nuclear Physics B, 15(2), 397-412.

2. Bauer, T., Spital, R., Yennie, D., & Pipkin, F. (1978). The hadronic properties of the photon in high-energy interactions. Reviews of Modern Physics, 50(2), 261.