# One-loop corrections to $\omega$ photoproduction near threshold

Yongseok Oh[a] and T.-S. H. Lee[b]

[a] *Institute of Physics and Applied Physics, Yonsei University, Seoul 120-749, Korea*
[b] *Physics Division, Argonne National Laboratory, Argonne, Illinois 60439*

The study of vector meson photoproduction near threshold is expected to be useful to resolve the so-called "missing-resonance" problem and rapid accumulation of experimental data in this field is being made. In order to extract more reliable nucleon resonances parameters from the forthcoming data, which can also test the existing models on baryon structure, it is necessary to understand the non-resonant background production amplitudes. In previous studies on the nucleon resonances in $\omega$ photoproduction [1,2], the non-resonant amplitudes are calculated from the tree diagrams of an effective Lagrangian. This is obviously not satisfactory for the following reasons. First, the tree-diagram models are not unitary. We have lessons, e.g., from pion photoproduction [3] that unitarity is crucial to analyze the data before one compares the physical quantities from the data with theoretical predictions, such as quark models, on the hadron structure. Second, the energy region of vector meson production allows several meson-nucleon channels whose effects should be taken into account.

In this work, we investigate the coupled-channel effects on $\omega$ photoproduction near threshold, i.e., at the resonance region, in a model that all relevant transition amplitudes are calculated from the tree diagrams of effective Lagrangians [4]. This is the first attempt to investigate this problem by extending the method developed by Ref. [3] since the coupled-channel effect studies in 1960's [5]. We compute the coupled-channel effects due to the intermediate $\pi N$ and $\rho N$ states with the parameters constrained by the data of $\gamma N \to \pi N$, $\gamma N \to \rho N$, and $\pi N \to \omega N$ reactions. We then discuss how the coupled-channel effects can significantly change the differential cross sections and spin observables in $\omega$ photoproduction. Our results show that the coupled-channel effects are as large as the role of the nucleon resonances studied earlier in Refs. [1,2] and hence strongly suggest that the coupled-channel effects should be taken into account in extracting reliable resonance parameters from the forthcoming data for vector meson photoproduction in the resonance region, e.g., from Jefferson Lab., LEPS of SPring-8, and GRAAL. We also discuss a possible way to improve the model.

## References

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