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Comment on "Observation of a Narrow Structure in $^1H(\gamma,K_S^0)X$ via Interference with ϕ-Meson Production"

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Comment on "Observation of a narrow structure in $^1H(\gamma,K^0_S)X$ via interference with ϕ-meson production"

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In Ref. [1], the authors claim to observe a narrow structure in the mass spectrum constructed from the (pK_L) system using data from the CLAS detector. The interpretation of this narrow structure given in Ref. [1] is as follows: "It may be due to the

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photoproduction of the Θ^+ pentaquark or some unknown Σ^* resonance." The authors go on to say that "it is unlikely for the observed structure to be due to a Σ^* resonance."

This analysis was reviewed by the CLAS Collaboration, following the established procedures for all CLAS papers, and did not receive approval. The purpose of this Comment is to explain the reasons why that analysis was not approved for publication.

An extensive review of the analysis in Ref. [1] was carried out by two separate committees of the Hadron Spectroscopy Physics Working Group in the CLAS Collaboration. In both cases, the committees came to the same conclusion: The physics claims of Ref. [1] could not be supported. The reasons for this conclusion are manyfold, but a primary concern is the lack of justification for the kinematic cuts used in that analysis.

The review committees reported that the narrow structure appears only within a specific range of values of the kinematic cuts. Here, the details are important (which cuts were varied and by how much) but this would require more space to document than a simple Comment will allow. We give only one example below but note that the CLAS committees conducted an extensive review of the sensitivity of the narrow structure to what they considered reasonable variations of the cuts [2].

As an example, the cut on the t_Θ variable (defined in Ref. [1]) was restricted to a small region of the total phase space ($-t_\Theta < 0.45$ GeV^2). Without this cut, the narrow structure is not statistically significant. By examining Fig. 8 of Ref. [1], one can see that the structure is not really visible in the top spectrum [Fig. 8(a)] and appears only in Fig. 8(c). When the cut value is increased by 20% ($-t_\Theta < 0.55$) as shown by Fig. 8(b), or decreased by 10% ($t_\Theta < 0.4$), as shown by Fig. 8(d), then the purported structure at a mass of 1.54 GeV is consistent in size with other fluctuations in those spectra.

While the authors of Ref. [1] make an argument about why the t_Θ cut was necessary, the CLAS Collaboration was not convinced. For example, it is possible that an interference between the narrow structure and the background is dependent on the t_Θ variable, but this assumption is difficult to prove. The analysis of Ref. [1] did not provide any evidence of interference phases.

It is not uncommon to use kinematic cuts to reduce background and, hence, improve the signal-to-background ratio for known particles, but other studies [3] have shown that one must be careful when applying kinematic cuts that can create spurious fluctuations. We could argue whether the kinematic cuts used in Ref. [1] are justified, but the fact remains that the CLAS Collaboration as a whole was not convinced that the narrow structure of Ref. [1] corresponds to a real physical entity.

In the end, the validity of the narrow structure claimed by Ref. [1] will be determined by future experiments. If it is a physical resonance, as suggested by Ref. [1], then it should be reproducible. The evidence presented in Ref. [1] was not sufficient to convince the CLAS Collaboration of the physics conclusions of that analysis.

[1] M. Amaryan *et al.*, Phys. Rev. C **85**, 035209 (2012).

[2] E. Smith *et al.*, Report of the committee to review the ODU analysis of meson-baryon interference, version 3, CLAS-NOTE 2011-021 [https://misportal.jlab.org/ul/Physics/Hall-B/clas/].

[3] J. Klein and A. Roodman, Ann. Rev. Nucl. Part. Sci. **55**, 141 (2005).