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M. Anghinolfi

Angela Biselli

Fairfield University, abiselli@fairfield.edu

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Comment on “Observation of a narrow structure in $^1\text{H}(\gamma, K_S^0)X$ via interference with ϕ -meson production”

M. Anghinolfi,¹⁸ J. Ball,⁸ N. A. Baltzell,^{1,29} M. Battaglieri,¹⁸ I. Bedlinskiy,²⁰ M. Bellis,^{6,25} A. S. Biselli,¹¹ C. Bookwalter,¹³ S. Boiarinov,^{20,30} P. Bosted,³⁰ V. D. Burkert,³⁰ D. S. Carman,³⁰ A. Celentano,¹⁸ S. Chandavar,²⁴ P. L. Cole,^{16,30} V. Crede,¹³ R. De Vita,¹⁸ E. De Sanctis,¹⁷ B. Dey,⁶ R. Dickson,⁶ D. Doughty,^{9,30} M. Dugger,² R. Dupre,¹ H. Egiyan,^{30,35} A. El Alaoui,¹ L. El Fassi,¹ L. Elouadrhiri,³⁰ P. Eugenio,¹³ G. Fedotov,²⁹ M. Y. Gabrielyan,¹² M. Garcon,⁸ G. P. Gilfoyle,²⁷ K. L. Giovanetti,²¹ F. X. Girod,³⁰ J. T. Goetz,³ E. Golovatch,²⁸ M. Guidal,¹⁹ L. Guo,^{12,30} K. Hafidi,¹ H. Hakobyan,³² D. Heddle,^{9,30} K. Hicks,²⁴ M. Holtrop,²³ D. G. Ireland,³³ B. S. Ishkhanov,²⁸ E. L. Isupov,²⁸ H. S. Jo,¹⁹ P. Khetarpal,¹² A. Kim,²² W. Kim,²² V. Kubarovsky,³⁰ S. V. Kuleshov,^{20,32} H. Y. Lu,⁶ I. J. D. MacGregor,³³ N. Markov,¹⁰ M. E. McCracken,^{6,34} B. McKinnon,³³ M. D. Mestayer,³⁰ C. A. Meyer,⁶ M. Mirazita,¹⁷ V. Mokeev,^{28,30} K. Moriya,^{6,*} B. Morrison,² A. Ni,²² S. Niccolai,¹⁹ G. Niculescu,^{21,24} I. Niculescu,^{15,21,30} M. Osipenko,¹⁸ A. I. Ostrovidov,¹³ K. Park,^{22,30} S. Park,¹³ S. Anefalos Pereira,¹⁷ S. Pisano,¹⁷ O. Pogorelko,²⁰ S. Pozdniakov,²⁰ J. W. Price,⁴ G. Ricco,¹⁴ M. Ripani,¹⁸ B. G. Ritchie,² P. Rossi,¹⁷ D. Schott,¹² R. A. Schumacher,⁶ E. Seder,¹⁰ Y. G. Sharabian,³⁰ E. S. Smith,³⁰ D. I. Sober,⁷ S. S. Stepanyan,²² P. Stoler,²⁶ W. Tang,²⁴ M. Ungaro,^{10,26,30} B. Vernarsky,⁶ M. F. Vineyard,^{27,31} D. P. Weygand,³⁰ M. H. Wood,^{5,29} N. Zachariou,¹⁵ and B. Zhao³⁵

¹Argonne National Laboratory, Argonne, Illinois 60439, USA

²Arizona State University, Tempe, Arizona 85287-1504, USA

³University of California at Los Angeles, Los Angeles, California 90095-1547, USA

⁴California State University, Dominguez Hills, Carson, California 90747, USA

⁵Canisius College, Buffalo, New York, USA

⁶Carnegie Mellon University, Pittsburgh, Pennsylvania 15213, USA

⁷Catholic University of America, Washington, D.C. 20064, USA

⁸CEA, Centre de Saclay, Irfu/Service de Physique Nucléaire, 91191 Gif-sur-Yvette, France

⁹Christopher Newport University, Newport News, Virginia 23606, USA

¹⁰University of Connecticut, Storrs, Connecticut 06269, USA

¹¹Fairfield University, Fairfield, Connecticut 06824, USA

¹²Florida International University, Miami, Florida 33199, USA

¹³Florida State University, Tallahassee, Florida 32306, USA

¹⁴Università di Genova, 16146 Genova, Italy

¹⁵The George Washington University, Washington, D.C. 20052, USA

¹⁶Idaho State University, Pocatello, Idaho 83209, USA

¹⁷INFN, Laboratori Nazionali di Frascati, 00044 Frascati, Italy

¹⁸INFN, Sezione di Genova, 16146 Genova, Italy

¹⁹Institut de Physique Nucléaire ORSAY, Orsay, France

²⁰Institute of Theoretical and Experimental Physics, Moscow, 117259, Russia

²¹James Madison University, Harrisonburg, Virginia 22807, USA

²²Kyungpook National University, Daegu 702-701, Republic of Korea

²³University of New Hampshire, Durham, New Hampshire 03824-3568, USA

²⁴Ohio University, Athens, Ohio 45701, USA

²⁵Northern Illinois University, Dekalb, Illinois 60115, USA

²⁶Rensselaer Polytechnic Institute, Troy, New York 12180-3590, USA

²⁷University of Richmond, Richmond, Virginia 23173, USA

²⁸Skobeltsyn Nuclear Physics Institute at Moscow State University, 119899 Moscow, Russia

²⁹University of South Carolina, Columbia, South Carolina 29208, USA

³⁰Thomas Jefferson National Accelerator Facility, Newport News, Virginia 23606, USA

³¹Union College, Schenectady, New York 12308, USA

³²Universidad Técnica Federico Santa María, Casilla 110-V Valparaíso, Chile

³³University of Glasgow, Glasgow G12 8QQ, United Kingdom

³⁴Washington & Jefferson College, Washington, Pennsylvania 15301, USA

³⁵College of William and Mary, Williamsburg, Virginia 23187-8795, USA

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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

* Current address: Indiana University, Bloomington, IN 47405.

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 manifold, 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 ($-t_\Theta < 0.45 \text{ GeV}^2$). 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. Amarian *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).