2013-06-02

Alpha cluster structure in 16O.

International Nuclear Physics Conference, XXV, 2013, Firenze.
http://www.producao.usp.br/handle/BDPI/44528

International Nuclear Physics Conference INPC2013: 2-7 June 2013, Firenze, Italy

Alpha Cluster Structure in ^{16}O

M.R.D. Rodrigues[1], T. Borello-Lewin[1], H. Miyake[1], F. Cappuzzello[2,3], M. Cavallaro[3], J.L.M. Duarte[1], C.L. Rodrigues[1], M.A. Souza[1], L.B. Horodynski-Matsushigue[1], C. Agodi[3], M. Bondì[2,3], D. Carbone[2,3], A. Cunsolo[3], A. Foti[2,4], D. Nicolosi[2,3], S.Tropea[2,3], G.M. Ukita[5], P.N. de Faria[1]

[1] *Institute of Physics, Universidade de São Paulo, São Paulo − SP, Brazil*
[2] *Università di Catania, Catania, Italy*
[3] *I.N.F.N., Laboratori Nazionali del Sud, Catania,Italy*
[4] *I.N.F.N., Sezione di Catania, Catania,Italy*
[5] *Faculdade de Psicologia, Universidade de Santo Amaro, São Paulo − SP, Brazil*

Contact email: *marciadr@if.usp.br.*

The alpha cluster phenomenon in the light nuclei structure has been the subject of a longtime investigation since the proposal of the Ikeda diagrams [1], however the mechanism of the cluster formation is still not completely understood. In fact, if the clusters have a fairly rigid crystal-like or a gas-like structure remains an open question[2-3]. The interpretation of the Hoyle state as an α condensate brought a renewed interest to this subject, in particular to resonances analogous to the Hoyle state. In this context the study of the experimental evolution of the α-cluster phenomenon through (^{6}Li,d) transfer reactions has been performed in São Paulo [4]. Particularly important are the regions around the *n*α thresholds where the α-cluster structure states are predicted. The resonant states around the 4α threshold in the nucleus ^{16}O are the focus of the present contribution. The $^{12}C(^{6}Li,d)^{16}O$ reaction was measured at a bombarding energy of 25.5 MeV employing the São Paulo Pelletron-Enge-Spectrograph facility and the nuclear emulsion detection technique. Resonant states above the α threshold were measured and an energy resolution of 15-30 keV allows to define states previously unresolved. The angular distributions of the absolute cross sections were determined in a range of 4-40 degree in the center of mass system and up to 17 MeV excitation energy. The upper limit for the resonance widths in the crucial region of the 4α threshold was obtained. These values revealed to be at least a factor three smaller than the ones previously reported in the literature [5], indicating that the α cluster structure information on this region should be revised. Figure 1 shows an deuteron energy spectrum in order to illustrate the good resolution achieved and the narrow resonances observed in the present work.

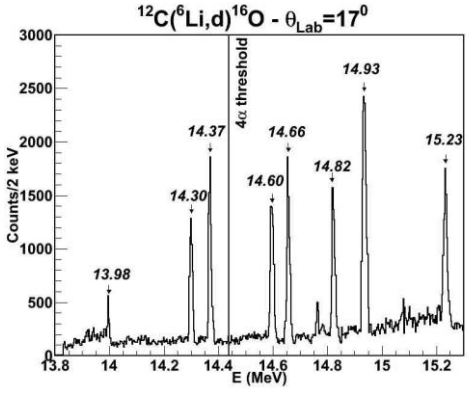

Figure 1: *Energy deuteron spectrum for θ_{lab} = 17° near the 4α threshold.*

[1]K. Ikeda, N. Takigawa, and H. Horiuchi, Prog. Theor. Phys. Suppl. E68, 464 (1968); H. Horiuchi, K. Ikeda, and Y. Suzuki, ibid. 44, 225 (1978).
[2] M. Itoh et al., Phys. Rev. C 84, 054308 (2011).
[3] T. Yamada et al. Phys. Rev. C 85, 034315 (2012)
[4] T. Borello-Lewin et al., Proceedings of13th Conference on Nuclear Reaction Mechanisms, Varenna, Italy, CERN Proceedings 2012-02,p. 167-170.
[5] C. Wheldon et al., Phys. Rev. C 83, 064324 (2011).