ID de Contribution: **9** Type: **Regular talk (YP)**

Study of the ^{12}C Hoyle state produced by fragmentation

mercredi 24 novembre 2021 17:40 (25 minutes)

The second 0^+ excited state of ^{12}C, also known as the Hoyle state, has a key role in the synthesis of the elements. It is also believed to possess a rather unusual structure where the dominant degrees of freedom are those of α clusters rather than nucleons [1]. Whereas the understanding of the properties of this state has been the focus of a major experimental activity, its non-radiative decay mode is still debated (i.e. direct decay into three α particles or sequential decay with formation of an intermediate ^{8}Be). Many direct-reaction experiments report a 3α direct decay branching ratio compatible with zero [1-5]. On the other hand, Raduta et al. [6] published in 2011 a large value of 17% for 3α direct decay. In this latter case, excited ^{12}C were produced in the ^{40}Ca+ ^{12}C at 25 MeV/A fragmentation reaction.

In this talk, I will present a new measurement of the direct decay branching ratio of the ^{12}C Hoyle state produced during fragmentation reactions (^{20}Ne+^{12}C at 25 MeV/A). Experimental data were acquired during the FAZIACOR experiment performed at LNS Catania. Excited ^{12}C have been reconstructed using the invariant mass method while the observable proposed in [5] was used to discriminate the different decay modes. The background was evaluated using the ponderated "event mixing" method. The direct decay branching ratio was finally obtained by comparing the experimental reconstructions with a complete simulation of the different decay modes, taking carefully into account the detector response.

We finally obtain a direct decay branching ratio compatible with zero, which is consistent with most of the previous results [1-5] but seems to invalidate the 17% direct decay obtained in [6].

[1] M. Freer and H. Fynbo, "The Hoyle state in 12 C,"Progress in Particle and Nuclear Physics, vol. 78, pp. 1–23, Sept. 2014.
[2] M. Freer, et al., "Limits for the 3α branching ratio of the decay of the 7.65 MeV 0_2^+ state in ^{12}C"Phys. Rev. C, vol. 49, pp. R1751–R1754, Apr 1994.
[3] O. S. Kirsebom, et al., "Improved limit on direct α decay of the hoyle state" Phys. Rev. Lett., vol. 108, p. 202501, May 2012.
[4] J. Manfredi, et al., "α decay of the excited states in ^{12}C at 7.65 and 9.64 MeV"Phys. Rev. C, vol. 85, p. 037603, Mar 2012.
[5] D. Dell'Aquila et al., "High precision probe of the fully sequential decay width of the Hoyle state in ^{12}C"Phys. Rev. Lett., vol. 119, no. 13, p. 132501, 2017.
[6] A. Raduta, et al., "Evidence for α-particle condensation in nuclei from the hoyle state deexcitation"Physics Letters B, vol. 705, p. 65–70, Nov 2011.

Auteurs principaux: REBILLARD-SOULIÉ, Alex (LPC Caen, France); Dr GRUYER, Diego (LPC Caen); VERDE, Giuseppe (L2I Toulouse, CNRS/IN2P3)

Orateur: REBILLARD-SOULIÉ, Alex (LPC Caen, France)

Classification de Session: Clustering phenomena and multi-particle decay

Classification de thématique: Clustering phenomena and multi-particle decay: Study of the ^{12}C Hoyle state produced by fragmentation