First observation of the $\beta 3\alpha$p decay of ^{13}O via β-delayed charged-particle spectroscopy

J. Bishop[1], G.V. Rogachev[1,2,3], S. Ahn[4], M. Barbui[1], S.M. Cha[4], E. Harris[1,2], C. Hunt[1,2], C.H. Kim[5], D. Kim[4], S.H. Kim[6], E. Koshchiy[1], Z. Luo[1,2], C. Park[4], C.E. Parker[1], E.C. Pollacco[7], B.T. Roeder[1], M. Roosa[1,2], A. Saastamoinen[1], and D.P. Scriven[1,2]

[1] *Cyclotron Institute, Texas A&M University, College Station, TX 77843, USA*
[2] *Department of Physics & Astronomy, Texas A&M University, College Station, TX 77843, USA*
[3] *Nuclear Solutions Institute, Texas A&M University, College Station, TX 77843, USA*
[4] *Center for Exotic Nuclear Studies, Institute for Basic Science, 34126 Daejeon, Republic of Korea*
[5] *IRFU, CEA, Université Paris-Saclay, Gif-Sur-Yvette, France*
[6] *Department of Physics, Sungkyunkwan University, Suwon 16419, Republic of Korea and*
[7] *Department of Physics, Sungkyunkwan University (SKKU), Republic of Korea*

The β-delayed proton-decay of ^{13}O has previously been studied [1], but the direct observation of β-delayed 3αp decay has not been reported. In this way, rare 3αp events from the decay of excited states in ^{13}N* provide a sensitive probe of cluster configurations in ^{13}N. To measure the low-energy products following β-delayed 3αp-decay, the TexAT Time Projection Chamber [2] was employed using the one-at-a-time β-delayed charged-particle spectroscopy technique at the Cyclotron Institute, Texas A&M University. A total of 1.9×10^5 ^{13}O implantations were made inside the TexAT Time Projection Chamber. 149 3αp events were observed yielding a β-delayed 3αp branching ratio of 0.078(6)%. Four previously unknown α-decaying excited states were observed in ^{13}N at 11.3 MeV, 12.4 MeV, 13.1 MeV and 13.7 MeV and the decay modes for these states were established. We demonstrate that clustering must dominate the structure of these states to exhibit the observed decay branching ratios.

[1] H. H. Knudsen *et al.* Phys. Rev. C **72** (2005) 044312.
[2] E. Koshchiy *et al.* NIM A, Volume **957**,(2020) 163398.