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Investigations of alpha clustering in ^{12}C using a TPC detector and gamma beams[1] ROBIN SMITH, Sheffield Hallam University, MOSHE GAI, SARAH R. STERN, DERAN K. SCHWEITZER, University of Connecticut, MOHAMMAD W. AHMED, TUNL and NC Central University, MARTIN FREER, University of Birmingham, HANS O. U. FYNBO, Aarhus University — The ^{12}C nucleus is well-described as an exotic three alpha particle structure. The low-energy portion of its excitation spectrum is accurately predicted using the algebraic cluster model **(ACM),** describing the rotation and vibration of alpha particles with D_{3h} point group symmetry. In addition to the already-established mixed parity ground state rotational band, a series of rotational levels built on the Hoyle state are predicted, which have not yet been observed. Additionally, the question of whether the Hoyle state can be described as an alpha particle condensate has reached its 20^{th} year, still without resolution. The nature of the Hoyle state has been examined by us, using gamma beams at HIγS at TUNL in conjunction with an Optical TPC detector (O-TPC). Sequential and apparent "direct" decays of the 2^+ excitation of the Hoyle state were unambiguously identified in the O-TPC and an upper limit on the direct decay branching ratio for the 2^+ state was obtained. A theoretical extrapolation allowed the direct decay branching ratio of the Hoyle state to be calculated using three body penetration factors. The deduced B.R. was found to be significantly lower than expected for an alpha particle condensate.

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