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Search for Toroids in Excited Nuclear Material

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Ground state nuclei usually have compact geometries. However, there have been theoretical predictions that excited nuclei can take on more extended shapes such as toroids or bubbles. There have been many attempts to identify signatures of such shapes in experimental data. One signature both predicted by theory and reported in experimental data is narrow resonances at high excitation energy in peripheral intermediate-energy heavy-ion collisions. This potential evidence for toroidal states was reported in the alpha particle disassembly of 28Si after collision with a 12C target at 35 MeV/nucleon. The prior work was limited by angular resolution and statistical uncertainties. The present work aims to measure the excitation energy distribution for these disassembly events with improved angular resolution and reduced statistical uncertainty using the Forward Array Using Silicon Technology (FAUST). FAUST is equipped with resistive dual-axis duo-lateral (DADL) position-sensitive silicon detectors capable of sub-millimeter position resolution. The measured excitation energy distributions α disassembly events showed no strong evidence for highly excited states at the cross section and widths suggested by previous experiment. A statistical likelihood analysis was performed to provide an upper limit to toroidal high-spin isomer cross section, as evidenced by this observable, as a function of the excitation energy and width of potential states.

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