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Search for Tetraneutron States via Transfer Reaction on ^8He at TRIUMF

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Neutron stars represent the only known place in the universe where neutrons are held in close proximity. This unique scenario results from the extreme gravitational forces that compress them together in nearly pure neutron matter. However, the existence of an isolated multi-neutron system is still an open question.

Theoretical predictions have long suggested the existence of an exotic nuclear structure consisting of four neutrons, prompting a quest for experimental evidence that has persisted for over five decades. This elusive tetraneutron system could be observed in reactions that result in four neutrons as a possible exit channel. Numerous studies indicated a short-lived quasi-bound state of the tetraneutron, and recent advances in detection systems and experimental techniques have facilitated the measurement of a resonance-like structure associated with it. However, theoretical debate and controversy persist, fostering ongoing discussions within the scientific community.

Transfer reactions can provide a clean probe to assess the presence of a true resonance (or bound) state. A new measurement has been carried out at the IRIS facility at TRIUMF by using a transfer reaction from a post-accelerated ^8He beam.

This measurement utilizes the missing mass technique to determine the excitation spectrum. The presentation will describe the experiment and the observations from the present status of data analysis.

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