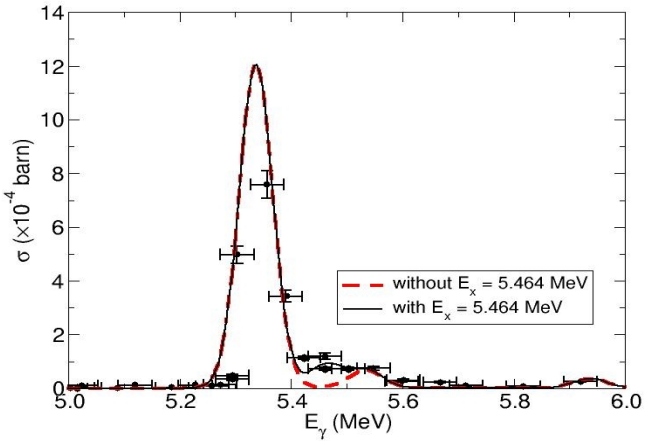
Joint Institute for Nuclear Astrophysics

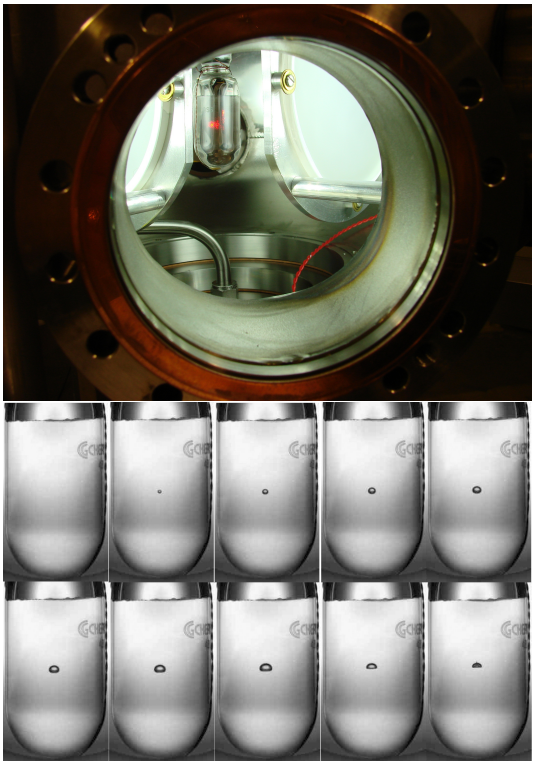
Measurement of (γ,α) reactions with the STAR bubble chamber: a proof of principle

We have devised a technique for measuring the (γ,α) reactions with a considerable improvement in sensitivity from previous experiments. Adopting ideas from dark matter search experiments with bubble chambers, we have found that superheated liquids would be sensitive to α-particle and heavy recoils produced from a γ-ray beam impinging on nuclei. The main advantage of the new target-detector system is a density as high as a factor of 10000 over conventional jet gas targets. Also, the detector would be virtually insensitive to the γ-ray beam itself, thus allowing us to detect only the products of the nuclear reaction of interest.

We studied the $^{19}F(\gamma,\alpha)^{15}N$ reaction as a proof of principle of the operation of the bubble chamber. The liquid chosen was C_4F_{10} for its low superheat temperature properties. This makes the device construction and operation relatively simple from the engineering point of view.



Cross section data determined from the bubble chamber count rate compared to a Breit-Wigner model of the $^{19}F(\gamma,\alpha)^{15}N$ reaction with parameters from Wilmes et al. (2002).



Bubble chamber and sequence of pictures depicting the evolution of a bubble produced from the photodisintegration of fluorine. Frames were acquired every 10 ms. Events do not leave tracks of bubbles as in classical bubble chambers. Only one bubble is observed for each event.

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