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High Yield Muon Catalyzed Fusion

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Fusion holds great promise as a clean and abundant energy source. However, traditional thermonuclear fusion encounters significant challenges due to the extreme temperatures required to overcome the coulomb barrier for two nuclei to fuse. In contrast, muon-catalyzed fusion presents an alternative approach that can surmount this barrier at significantly lower temperatures. Muons, with properties resembling those of electrons but 200 times heavier, can effectively reduce the atomic orbital radius, enabling central nuclei to overcome the coulomb force through the strong force. By introducing muons into a mixture of deuterium and tritium (two hydrogen isotopes), fusion is facilitated, releasing a 3.5MeV alpha particle and a 14.1MeV neutron. In the majority of cases, the muon is liberated and can initiate further fusions. However, approximately 0.8% of the time, it adheres to the alpha particle and remains bound until it either decays or undergoes reactivation through collisional ionization. To maximize the number of fusions per muon, it is crucial to enhance the cycling rate and reactivation fraction. Theoretical predictions and experimental data both suggest that the sticking rate decreases with increasing density. However, there exists a discrepancy between experimental observations and theoretical estimations regarding the extent of this decrease. To address these disparities, this experiment aims to investigate the cycling rate and sticking fraction under higher temperatures and pressures than previously explored.

Additionally, search for Muonium (M ≡ μ+ e −, chemically a light isotope of hydrogen) to Antimonium conversions, antimatter gravity and M atomic spectrum measurements are in need of a reliable high-efficiency source of Muonium.

Both experiments can be supported at the MeV Test Area (MTA) experimental hall using the secondary production beamline. This beamline uses the 400 MeV Fermilab proton Linac beam and a tungsten target. I will be contributing to data analysis as well as simulations for this experiment.

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