FERMILAB-POSTER-23-158-STUDENT

Muon-Catalyzed Fusion

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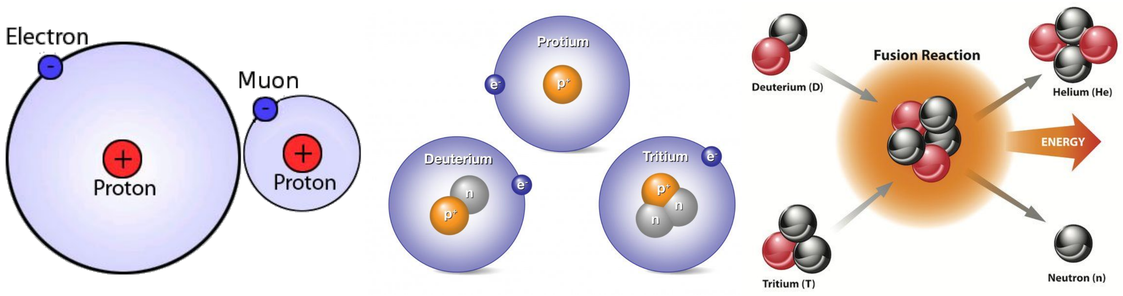
Muon-Catalyzed vs. Thermonuclear Fusion

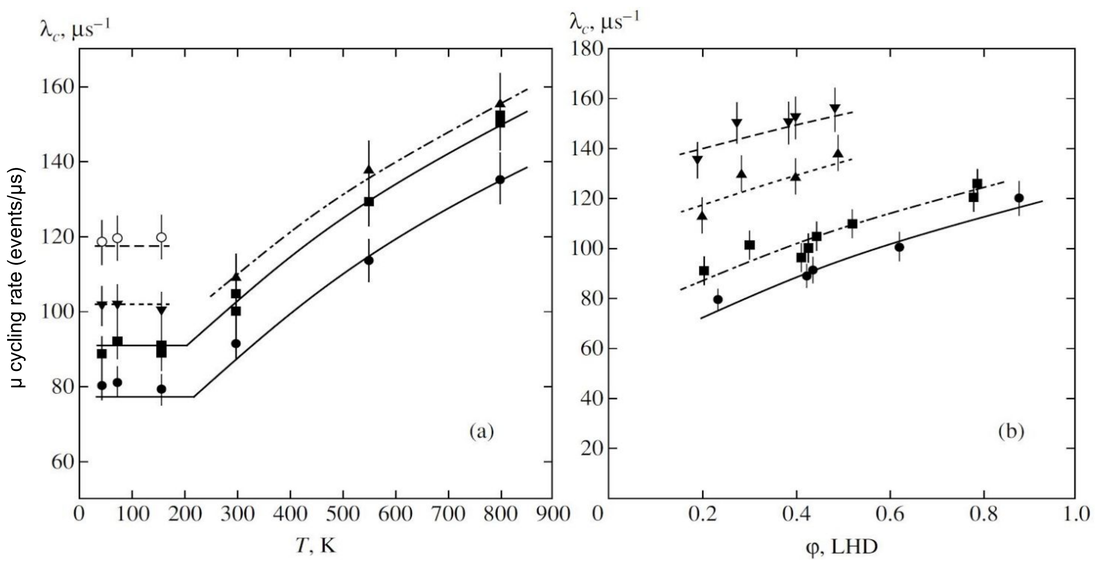
Advantages	Disadvantages
❖ Muon allows for smaller atomic orbitals ❖ Achieved at room temperature or lower (no need for plasma).	❖ Need muons (μ^-) ❖ Muon average lifetime is 2.2μs ❖ Muon sticks to alpha particle (He nuclei)



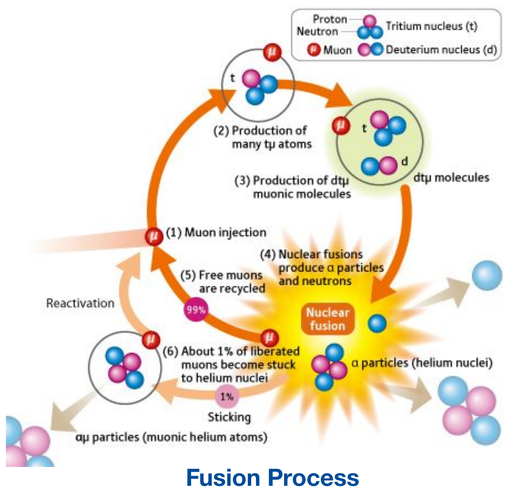
Reference of smaller Atomic Orbitals with Muons.

Isotopes of Hydrogen

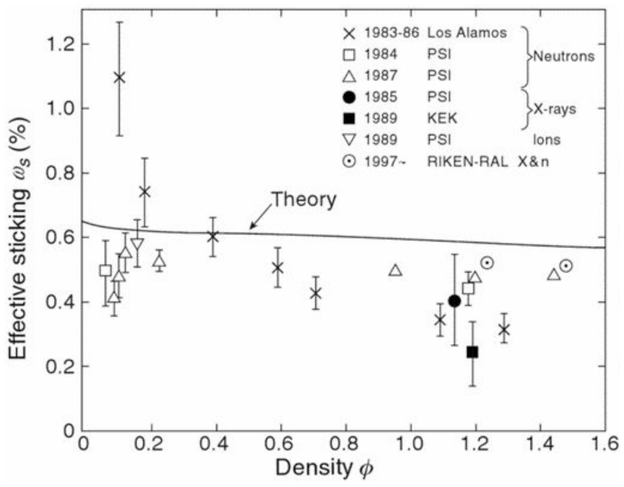
Fusion Particle Emission



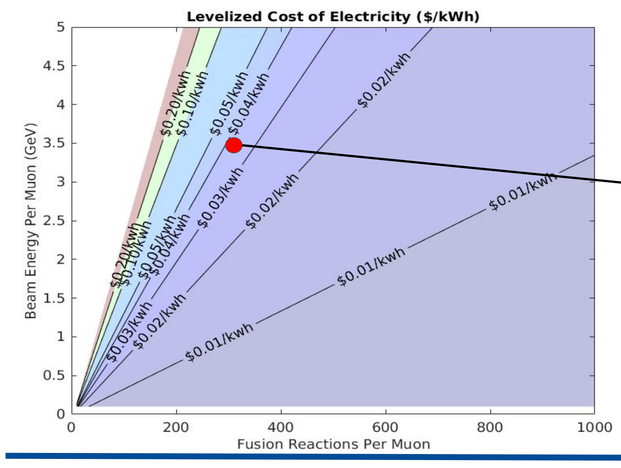
(a) Normalized cycling rates as a function of temperature for the gaseous D/T mixture at $C_t \approx 33\%$ and different densities φ = 0.88–0.91 (○), 0.62–0.64 (▼), 0.49–0.52 (▲), 0.39–0.45 (■), 0.19–0.24 (●) LHD. (b) Normalized cycling rates as a function of density for the gaseous D/T mixture at $C_t \approx 33\%$ and different temperatures T = 800 K, C_t = 0.34–0.36 (▼); T = 550 K, C_t = 0.33–0.36 (▲); T = 300 K, C_t = 0.31–0.36 (■); T = 158 K, C_t = 0.31 (●). The curves are obtained with optimum parameters.



Fusion Process



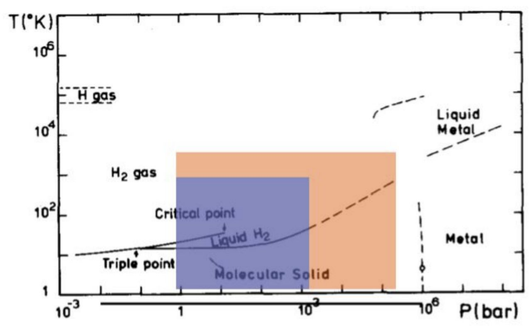
Discrepancies between Theory and Experimental Data



Target operating point for commercial fusion

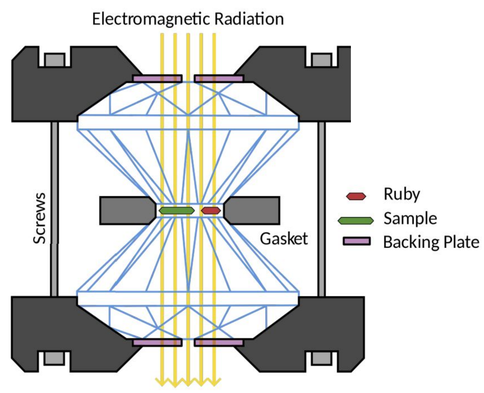
(Assumes superconducting accelerator, Brayton cycle balance-of-plant, exothermic tritium breeding, and revenue from heat sales.)

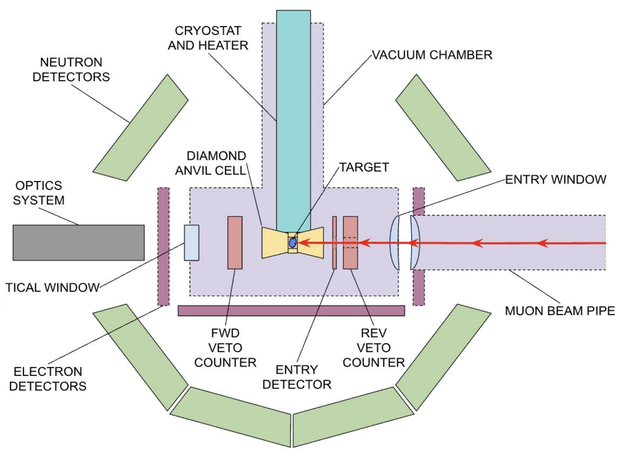
NK Labs Experiment



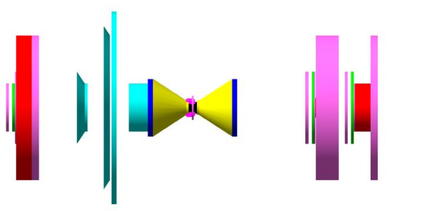
Experiment aims to explore new areas of temperature and pressure using a diamond anvil cell and resistance heating.

New Areas of Temperature & Pressure that will be Explored

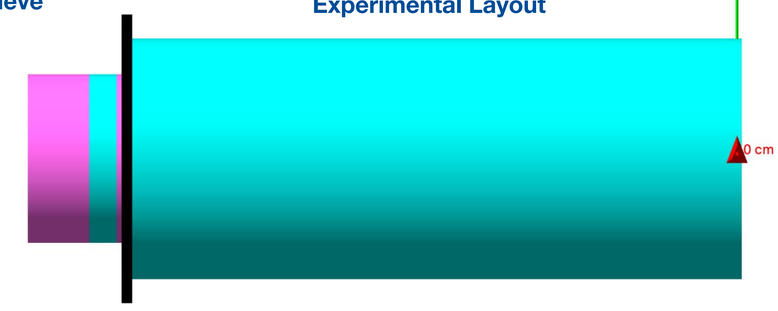




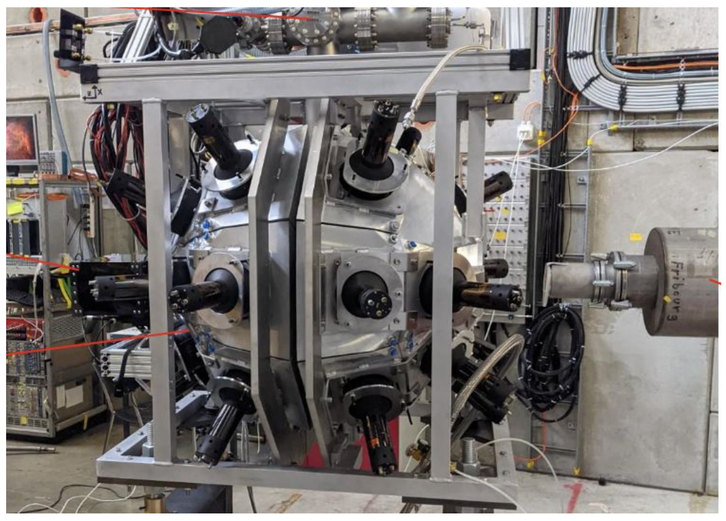
Diamond Anvil Cell - Used to Achieve High Pressures



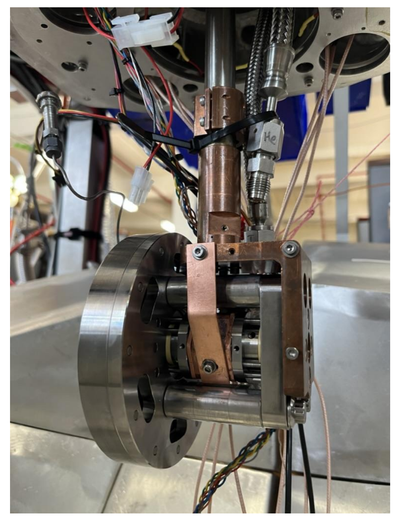
Experimental Layout



Simulation of NK Labs Particle Trajectory

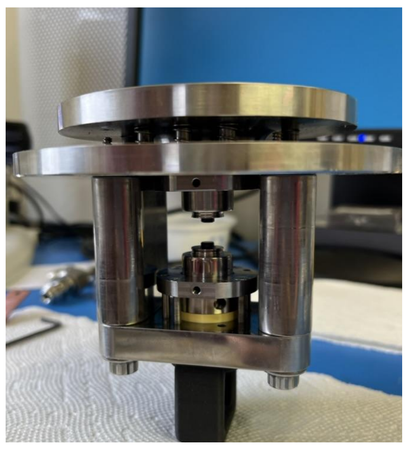


Equipment at PSI, Villigen, Switzerland



Diamond Anvil Cell in Placement

Secondary Beamline at Fermilab



Diamond Anvil Cell

Acknowledgements:

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