Muon-Catalyzed Fusion

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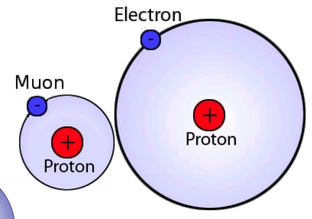
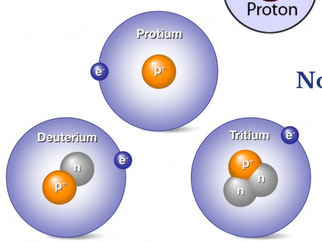
Why Muons?

By replacing the electron with a muon, we can bring nuclei closer together and facilitate fusion!

Muons and electrons only differ by mass.
Muons are around 200 times heavier.



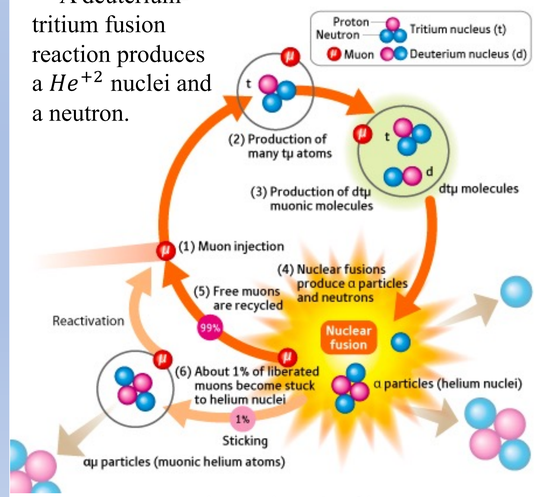
Normal vs. Muonic Hydrogen



Hydrogen Isotopes

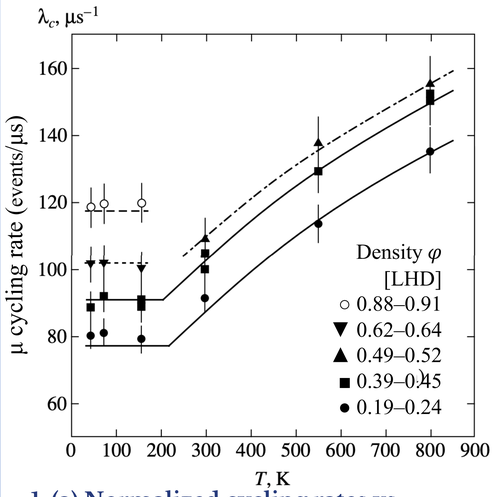
Fusion Process

A deuterium-tritium fusion reaction produces a He^{+2} nuclei and a neutron.

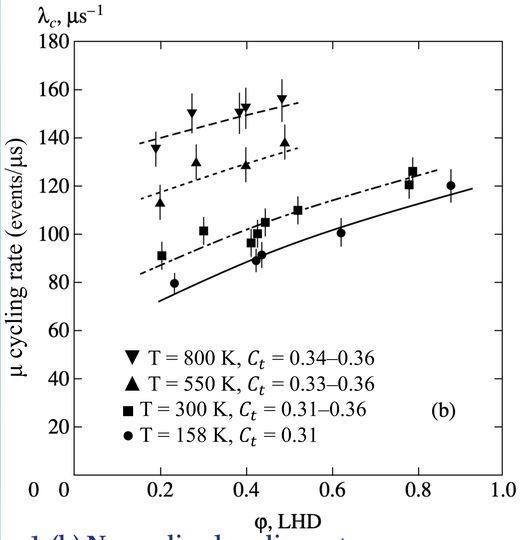


Muonic Fusion Outline

Previous Experimental Data



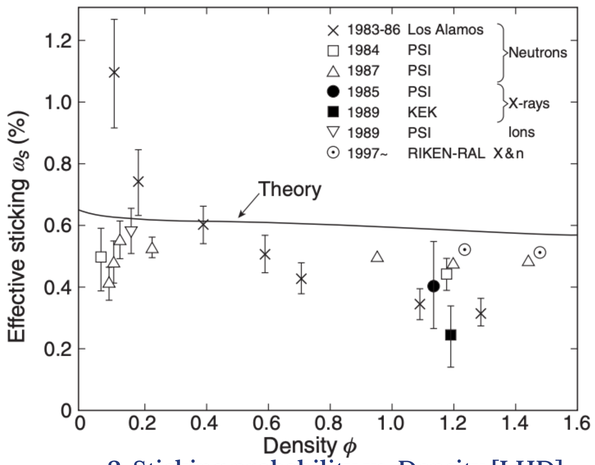
1. (a) Normalized cycling rates vs. temperature for gaseous D/T mixture at 33% Tritium Concentration (C_t) and different densities.



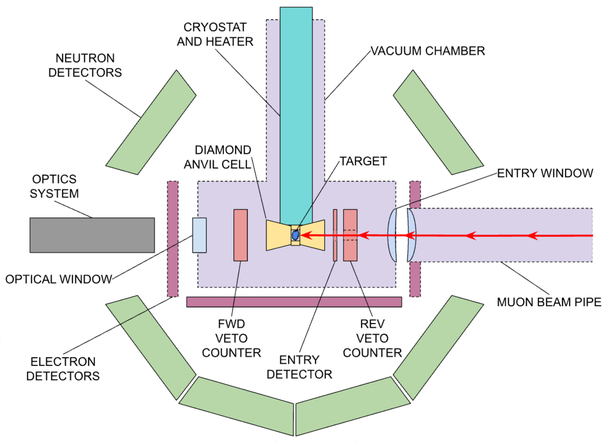
1. (b) Normalized cycling rates vs. density for gaseous D/T mixture at $C_t \approx$ 33% and different temperatures.

Muonic vs. Thermonuclear Fusion

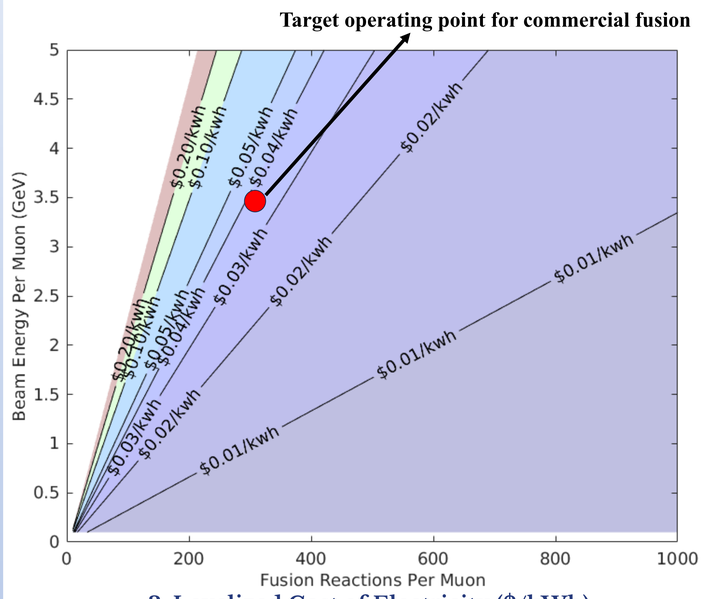
Advantages	Disadvantages
Smaller atomic radius	Need muons
Can be achieved at room temperature or lower	Short average muon lifetime (2.2μs)
No need for plasma	Loss of muons due to sticking factor



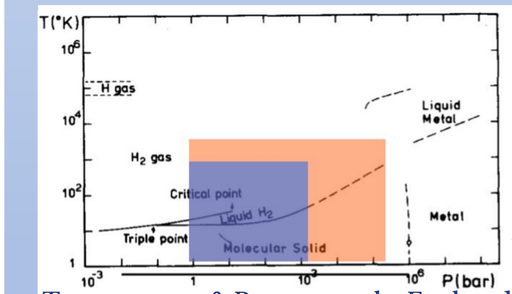
2. Sticking probability vs. Density [LHD]



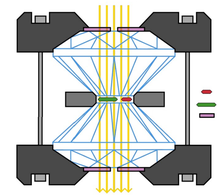
3. Experimental Layout



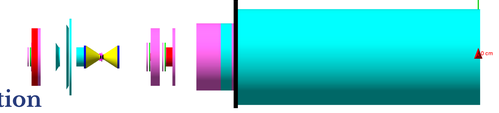
3. Levelized Cost of Electricity ($/kWh)



Temperatures & Pressures to be Explored



Diamond Anvil Cell



Beamline Simulation

References

1. Bom, V.R., Demin, A.M., Demin, D.L. et al. (2005). *Experimental investigation of muon-catalyzed dt fusion in wide ranges of D/T mixture conditions*.
2. Nagamine K. *Introductory Muon Science*. Cambridge University Press; 2003.
3. A. Knaian, *Diamond Anvil Measurement of Muon Catalyzed Fusion Kinetics*, Open CHRISP User Meeting BVR 55, January 2024, Villigen, Switzerland