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Canada's Magnetic Confinement Fusion (MCF) Devices –MU Z-pinch and STOR-M tokamak

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While holding the promise of meeting the large energy demands of the future, a practical energy producing fusion reactor has eluded humanity since it's conception in the middle of the twentieth century. The difficulty can be partially attributed to the complicated behaviours of a plasma, the medium where fusion reactions take place. This talk will provide a theoretical framework and an overview of the concepts of magnetic confinement fusion (MCF) used in two Canadian MCF devices oriented towards fusion applications, the MU z-pinch (Quebec) and STOR-M tokamak (Saskatchewan).

The MU Z-pinch is part of a new class of z-pinch devices which demonstrate neutron production and plasma stability 1-2 orders of magnitude longer than theoretical Alfven transit time, representing both a theoretical and experimental breakthrough. Z-pinch systems have a simplistic geometry, offering the possibility for lower cost fusion reactors as compared to tokamaks or stellarators. While previous studies have correlated stabilization of the m=0 "sausage"mode to a radial sheared flow profile this does not explain the stabilization for the m=1 "kink"mode. Experimental magnetic data from several arrays of diagnostic bdot probes are analyzed via time-of-flight and spatial Fourier analysis methods to infer several plasma phenomena including stabilization of the m=1 "kink".

The STOR-M tokamak is a small experimental tokamak at the University of Saskatchewan operating since 1987. While the size and energy output of tokamaks continues to increase in the move towards breakeven/ignition, plasma disruptions may damage these large (and costly) tokamaks, relegating the study of plasma disruptions to either theory/simulations (for which there is not yet a comprehensive theory) or replicating conditions on smaller tokamaks. Rotating m=2 magnetic islands measured with an array of magnetic bdot probes have been found to precede minor plasma disruptions which are accompanied by a static m=1 mode in the STOR-M tokamak.

Keyword-1

z-pinch

Keyword-2

tokamak

Keyword-3

MCF

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