Comparative Study of Plasma Focus Machines

by

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ABSTRACT

The Lee Model code is a very powerful and convenient numerical experiment facility. This thesis analysed 44 Mather-type plasma focus (PF) machines operating in Deuterium, Neon and Argon; obtaining reasonably good fits for all machines so that realistic PF properties are computed and presented. Even the Speed-2 PF machine which uses a Marx bank is reasonably modelled and analysed. Also for Filippov-type PF machines, the computed current traces could be fitted to the measured only up to about half of the rising current trace.

For optimised low-inductance Type-1 machines (typically those in the region of or below 50 nH) the Lee Model 5-phase code is sufficient to fit the measured current traces. Those not properly time-matched may require the Lee Model 6-phase code to complete the fitting of the extended parts of the measured current dip. Type-2 high inductance machines (typically those above 100 nH) require the Lee Model 6-phase code even for optimised condition. The Lee Model 5-phase code is used to start the analysis of a machine, and when necessary proceeds to use the Lee Model 6-phase code to complete the fitting of any extended current dip. The code is found useful for testing whether machines are optimised or not. This has been the case of the India-Assam PF machine with electrodes designed to work in a different energy range. The code also assists in guiding the experimental process towards optimised operation as was the case for NX3. In analyzing radiation yields, it is found that the computed optimised neutron yield agrees with the measured maximum yield (difference between computed and measured being a factor about 3); the computed and available measured neon SXR yields agree in both optimised yields as well as yield versus pressure curves. Data from the machines studied was combined with that from existing machines to obtain neutron, Ne lines and Ar all-lines scaling laws.

One final observation is that, the Slow Focus Mode (SFM) is encountered at the highest pressure at which a pinch just occurs. This SFM produces a much larger pinch cross-section which may be a desirable property for deposition of advanced materials and nano-materials.

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