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Review

Numerical Experiments Providing New Insights into Plasma Focus Fusion Devices

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Abstract: Recent extensive and systematic numerical experiments have uncovered new insights into plasma focus fusion devices including the following: (1) a plasma current limitation effect, as device static inductance is reduced towards very small values; (2) scaling laws of neutron yield and soft x-ray yield as functions of storage energies and currents; (3) a global scaling law for neutron yield as a function of storage energy combining experimental and numerical data showing that scaling deterioration has probably been interpreted as neutron 'saturation'; and (4) a fundamental cause of neutron 'saturation'. The ground-breaking insights thus gained may completely change the directions of plasma focus fusion research.

Keywords: plasma focus; numerical experiments; scaling laws; neutron saturation

1. Introduction

The Lee model code couples the electrical circuit with plasma focus dynamics, thermodynamics, and radiation, enabling a realistic simulation of all gross focus properties. The basic model, described in 1984 [1], was successfully used to assist several projects [2–4]. Radiation-coupled dynamics was included in the five-phase code, leading to numerical experiments on radiation cooling [5]. The vital role of a finite small disturbance speed discussed by Potter in a *Z*-pinch situation [6] was incorporated together with real gas thermodynamics and radiation-yield terms. This version of the code assisted other research projects [7–12] and was web published in 2000 [13] and 2005 [14]. Plasma