Plasma Phys. Control. Fusion **50** (2008) 105005 (14pp) doi:10.1088/0741-3335/50/10/105005

Current and neutron scaling for megajoule plasma focus machines

S Lee

Institute for Plasma Focus Studies, 32 Oakpark Drive, Chadstone, VIC 3148, Australia
and
Nanyang Technological University, National Institute of Education, Singapore 637616, Singapore
and
INTI International University College, 71800 Nilai, Malaysia

E-mail: leesing@optusnet.com.au

Received 20 June 2008, in final form 22 July 2008
Published 21 August 2008
Online at stacks.iop.org/PPCF/50/105005

Abstract
In a 2007 paper Nukulin and Polukhin surmised from electrodynamical considerations that, for megajoule dense plasma focus devices, focus currents and neutron yield Y_n saturate as the capacitor energy E_0 is increased by increasing the capacitance C_0. In contrast, our numerical experiments show no saturation; both pinch currents and Y_n continue to rise with C_0 although at a slower rate than at lower energies. The difference in results is explained. The Nukulin and Polukhin assumption that the tube inductance and length are proportional to C_0 is contrary to laboratory as well as numerical experiments. Conditions to achieve Y_n of 10^{13} in a deuterium plasma focus are found from our numerical experiments, at a storage energy of 3 MJ with a circuit peak current of 7.6 MA and focus pinch current of 2.5 MA.

1. Introduction

In a 2007 paper Nukulin and Polukhin [1] surmised that the peak discharge current I_{peak} in a plasma focus reaches a limiting value when the storage energy of its capacitor bank is increased to the megajoule level by increasing the bank capacitance C_0 at a fixed charging voltage V_0. The crux of their argument is that for such large banks, increasing C_0 increases the discharge current risetime which then requires an increase in the length of the focus tube in order for the axial transit time to match the current risetime. According to their reasoning the axial tube inductance $L_a = 2 \times 10^{-7}\text{In}(b/a)z_0$ (their equation (5)) where b and a are the outer and inner radii, respectively, and the length of the coaxial section is $z_0 = (\pi/2)(L_aC_0)^{0.5}v_a$ (their equation (4)). We rewrite their equations in SI units throughout except where stated otherwise. Here v_a is the average axial speed in the rundown stage which in experimental situations is known to be best kept at a value around 10^5 (or 10 cm μs^{-1}). This argument leads

