# DENSE PLASMA FOCUS SOFT X-RAY CALIBRATION SOURCE*

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A Dense Plasma Focus (DPF) has been developed as a soft x-ray calibration tool. The DPF is a versatile discharge to create ~10-50ns pulses of soft x-rays in the 1-4keV range. When operated with Ne or Ar gas, K-shell spectra (923-1400eV for Ne, 3100-3300eV for Ar) are produced. When operated with $D_2$ gas, the DPF also serves as a useful calibration source of pulsed neutrons (2.5MeV)[1-2]. Kr may also be used to get the Kr L-shell spectrum from 1.6-2.3keV. A versatile excel macro written by S. Lee[3] was used to design optimized anodes for Ar and Ne pinches. This paper presents results of soft x-ray output from Ne and Ar pinches, as a function of anode radius and length, as motivated by the S. Lee code designs.

The DPF operates at a repetition rate of ~0.25Hz and can fire 1000s of shots/day, making it a useful tool for calibration purposes. A standard sensor may be cross-calibrated against an unknown sensor using signal averaging to enhance accuracy. For example, an inherent shot-shot variation in the DPF of±30% would be reduced to ±1% by simply averaging the data over 1000 pulses.

It is well known that there are electron and ion beams formed on the axis of DPF pinches. The electron beam impinges upon the anode rim and generates a hard x-ray (HXR) pulse. Step-wedge filters were used with various vacuum windows and a Digital Imaging Plate detector, to characterize the spectrum of the HXR pulse. Thus this DPF, originally intended as an SXR calibration source, also offers utility as an HXR source (in the 10-50keV range). HXR images of the source show that the HXR emission stems not only from the anode rim, but from the pinch itself in a narrow region near the pinch axis.

1. B. Bures, Y. Eshaq, and M. Krishnan "Control of Neutron Yield from a Small Dense Plasma Focus by using Deuterium-Inert Gas Mixtures" Proceedings of the 7th International Conference on Dense Z-Pinches. 2009 pp 195-198.
2. Rishi Verma, P. Lee, S. Lee, S.V. Springham, T.L. Tan, R.S. Rawat and M. Krishnan, "Order of magnitude enhancement in neutron emission with Deuterium-Krypton admixture operation in miniature plasma focus device" App. Phy. Lett. 93 2008.
3. Plasma Focus (Radiative) Computation Model and Code. S. Lee Website http://sci.nie.edu.sg/ckplee

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