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Linear field model of stacked washer Einzel lens systems

by

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The Heavy Ion Fusion Science Virtual National Laboratory (HIFS-VNL) is advancing towards the second phase of the Neutralized Drift Compression Experiment (NDCX). The NDCX is an intense ion beam accelerator at Lawrence Berkeley National Laboratory (LBNL) designed to explore Warm Dense Matter (WDM). Studies with the NDCX facility will help target design for accelerator driven Inertial Fusion Energy (IFE). Einzel lens systems are electrostatic transverse focusing elements composed of azimuthally symmetric biased conductors. Einzel lenses have frequently been used to focus low energy ion beams and are being applied in the NDCX facilities, specifically stacked washer Einzel lens systems are being studied to optimize beam focusing. Part of this study involves developing linear field models for the Einzel lens systems using both analytical analysis and numerical field simulations. The field simulations were made with the WARP code, a multidimensional intense beam simulation program being developed and used by the HIFS-VNL. Parametric data from WARP numerical simulations was applied to develop optimized reduced field models for Einzel lens systems with both unipolar and bipolar potential biases. Field solution data was exported from the WARP code and imported into a Mathematica script written to optimize a fit between a reduced analytical form for the field and the full numerical solution. This fitting procedure involved extracting Fourier harmonics from the data and then fitting the parametric variations in the Fourier harmonics to simple analytical forms using least squares fitting. The resulting reduced analytical form solutions with numerical fit parameters are simple and accurate over a wide range of geometric parameters. These reduced field descriptions are being applied in full beam dynamics models of Einzel lens systems. Results will be applied to improve the NDCX systems.