**Nonlinear Optics at the University of Maryland Electron Ring**

**Abstract:**

We present plans to demonstrate a nonlinear lattice at the University of Maryland Electron Ring (UMER). Theory predicts that a strongly nonlinear lattice should provide immunity against resonances without reducing dynamic aperture. Experimental plans and preliminary simulations will be discussed.

**Summary:**

Conventional thin lens sextupoles and octupoles are perturbative corrections to a linear lattice, which can lead to chaotic regions in phase space and loss of dynamic aperture. Theory predicts that lattices with one or two invariants and sufficiently strong nonlinear elements should suppress tune and envelope resonances without loss of stable phase space area [1]. We present plans to modify UMER to include nonlinear elements that meet the requirements for a singly invariant solution, which is well-suited to the current UMER framework. Preliminary simulations with the WARP PIC code demonstrate a linear lattice with a strong octupole channel that suppresses halo growth caused by beam mismatch, inspired by similar work in [2]. An analysis of lattice integrity in the presence of alignment errors and space charge is ongoing in preparation for experimental studies. Experimental plans include phase space mapping and observation of halo suppression. Required modifications include adjusting individually powered quadrupoles to provide a circular beam through the nonlinear channel, design and installation of printed circuit nonlinear magnets (octupole, sextupole or higher-order), generation/detection of low-current beams below typical UMER operating points, and improvements to ring alignment.

[1] V. Danilov, S. Nagaitsev, Phys. Rev. STAB 13, 084002 (2010)  
  
[2] Webb et. al, arxiv: 1205.7083