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Investigation of Nonlinear Collective Dynamics and Excitations in Intense Charged Particle Beams and Development of Laser-Induced-Fluorescence (LIF) Diagnostic Using the Paul Trap Simulator Experiment[1] HUA WANG, ERIK GILSON, RONALD DAVIDSON, PHILIP EFTHIMION, RICHARD MAJESKI, Princeton Plasma Physics Laboraroty — The Paul Trap Simulator Experiment (PTSX) is a compact Paul trap that simulates the nonlinear transverse dynamics of an intense charged particle beam propagating through an equivalent kilometers-long magnetic alternating-gradient (AG) focusing system. Understanding of the collective behavior and mechanisms of collective instabilities of intense charged particle beams is of critical importance to a wide range of accelerator applications. Collective modes can occur naturally or be excited by external perturbations in an intense charged particle beam. In the experiments presented here, different external perturbations including quadrupolar and dipolar perturbations are employed to excite the collective modes. The comparison between experimental results using different external perturbations is shown to describe the characteristics of each driving scheme. Finally, a laser-induced-fluorescence (LIF) technique is being developed to provide *in situ* measurements of the radial density profile and, ultimately, the velocity distribution function of the intense charged particle beam. The new laser system and the new barium source will be described, and initial experimental results of the LIF technique will be presented.

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