Abstract Submitted
for the DAMOP11 Meeting of
The American Physical Society

**Interactions between ultra-cold ions and neutral atoms/Bose-Einstein condensates** DAVID A. ANDERSON, ANDREW T. CADOTTE, RACHEL E. SAPIRO, GEORG RAITHEL, University of Michigan — Recently, there has been growing theoretical and experimental interest in understanding interactions between ultra-cold, charged impurities and Bose-Einstein condensates (BEC). The phenomena one may expect to find include quantum charge diffusion [1] and the formation of mesoscopic molecular ions via recombination of BEC atoms by ion-induced polarization potentials [2]. Here, we present progress towards experimental studies of these phenomena using a $^{87}$Rb BEC setup. In these studies it is paramount that the ion have low kinetic energy and a sufficiently long dwell time in the ultra-cold neutral atom sample/BEC ($\sim$100 $\mu$s). These conditions are met by creating free ions via photoionization of $^{87}$Rb atoms into low values of the single atom energy continuum and by minimizing stray electric fields in the interaction region. We are capable of spatially imaging ion distributions, ion counting, and acquiring ion time-of-flight information. These are achieved by extracting the ions using an electric field from a small tip-like structure, guiding them through an ion-lens system and into a multichannel plate. Ion trajectories are modeled for our system to guide experimental imaging parameters. [1] R. Cote, Phys. Rev. Lett. **85** 5316 (2000); [2] R. Cote et al., Phys. Rev. Lett. **89** 093001 (2002). We acknowledge support by the AFOSR.

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Date submitted: 04 Feb 2011 Electronic form version 1.4