Methods of Particle Beam Cooling

YIFAN FANG, Physics Department, Stony Brook University — Experiments in nuclear physics and elementary particle physics use accelerated beams of charged particles. Its important for these beams to be monochromatic and well collimated, which is guaranteed by a decreased 6-dimensional phase space volume[1] (or equivalently, an increased phase space density) of its generalized coordinates and conjugate momenta, especially for antiparticles or rare nuclei initially produced with low phase space density. For this purpose, it's necessary to introduce a dissipative force that act on individual particles that are dependent on their motion. In this talk, I'll first briefly review different cooling methods based on various processes, and then explain electron cooling method in more detail[2]. In the end, I'll present an example of electron cooling of high-energy antiprotons circulating in a storage ring at Fermi Lab[3]. References: [1] S. van der Meer, Rev. Mod. Phys. 57, 689 (1985). [2] G.I. Budker et al., Part. Accel. 7, 197 (1976). [3] Sergei Nagaitsev et al., PRL 96, 044801 (2006).