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Single particle motion and gravitational measurements in magnetostatic antihydrogen traps[1] ANDREY ZHMOGINOV, JONATHAN WURTELE, JOEL FAJANS, ANDREW CHARMAN, Department of Physics, UC Berkeley — Recent progress in antihydrogen trapping [1-3] marks the beginning of physics measurements on neutral antimatter. One of the goals of such experiments is the observation of gravitational interaction of antimatter with matter. New methods for such measurements have been proposed, based on the statistical analysis of the temporal and spatial pattern of antihydrogen annihilations during slow (compared to bounce times) shutdowns of the mirror and octupole magnets that comprise the magnetic trap. These techniques require a thorough understanding of nonlinear dynamics of antihydrogen in magnetic traps. We apply a Hamiltonian perturbation theory to this system, analyze phase space dynamics and classify single particle orbits. The role of the stochasticity, and the Arnold diffusion accompanying it, on the accuracy of gravitational measurements is discussed. The analytical results are verified numerically, different approaches to slow particle release are compared, and implications for laser-cooling are discussed.

[1] G. B. Andresen and ALPHA Collaboration, *Nature* **468**, 673 (2010).
[2] G. B. Andresen and ALPHA Collaboration, *Nature Physics* **7**, 558 (2011).
[3] C. Amole and ALPHA Collaboration, *Nature* **483**, 439 (2012).

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