Minimizing Plasma Temperature for Antimatter Mixing Experiments

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The ASACUSA collaboration produces a beam of antihydrogen atoms by mixing pure positron and antiproton plasmas in a strong magnetic field with a double cusp geometry. The positrons cool via cyclotron radiation inside the cryogenic trap. Low positron temperature is essential for increasing the fraction of antihydrogen atoms which reach the ground state prior to exiting the trap. Many experimental groups observe that such plasmas reach equilibrium at a temperature well above the temperature of the surrounding electrodes. This problem is typically attributed to electronic noise and plasma expansion, which heat the plasma. We recently observed another significant contribution, apparently due to the axially open trap geometry, which couples the plasma to the external (300 K) environment. We will discuss methods for reducing this coupling and the resulting reduction of plasma temperature.