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Non-Neutral Plasma Innovations for Antihydrogen Production[1]
CELESTE CARRUTH, JOEL FAJANS, University of California-Berkeley, ALPHA COLLABORATION — In the ALPHA collaboration in 2016, we succeeded in major improvements in the non-neutral plasma manipulations involved in creating antihydrogen. ALPHA uses plasmas of antiprotons, positrons, and electrons in Penning-Malmberg traps at cryogenic temperatures and 1-3T magnetic fields. the first development was SDREVC, a combination of the strong drive regime with EVC which stabilizes particle numbers and densities allowing us to have repeatable and tunable plasma conditions. After establishing SDREVC, we took advantage of our new stability and changed our antihydrogen mixing procedure from autoresonance excitation of antiprotons to "smerge," where we slowly lower the potential barrier between the antiproton and positron plasmas. Using smerge, we achieved a ten-fold increase in the average trapping rate. With a higher trapping rate, we then proceeded to develop a method to send electron and positron plasmas through trapped antihydrogen atoms in order to trap additional sets of antihydrogen atoms which allowed us to trap dozens of antiatoms. With these plasma developments that lead to much higher numbers of antihydrogen atoms, we are able to do some measurements more efficiently and additional measurements previously impossible.

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