Positron bunches & electron plasmas in supported & levitated dipole traps

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Intense gamma radiation can produce electron–positron pairs at sufficient density and scale to form a plasma [1]. The mass symmetry that defines a *"pair plasma"* is thought to suppress many of the instabilities that are common to conventional ion–electron plasmas [2]. Testing this hypothesis is one of the main objectives of APEX (A Positron Electron eXperiment) [3]. The aim is to create an electron–positron plasma and confine it over timescales pertinent to stability. Low-energy neutral plasmas will be created by combining non-neutral plasmas of electrons and positrons. The challenges associated with this task include (i) the construction of a trap that can simultaneously hold the oppositely charged leptons, and (ii) the accumulation and injection of sufficiently many positrons to produce a plasma. A compact, HTS (high-temperature superconductor) levitating dipole trap (LDT) has been built for the confinement of electron–positron plasmas, and so far long levitation (> 2 hr) and stable trapping of electron plasmas (> 2 s) have been achieved. In parallel to the LDT development, a lossless $E\times B$-drift technique was recently adapted to inject bunches of positrons—accumulated in a buffer-gas trap—into a supported dipole trap [4-6]. The pulsed beam was used to study transport in the inhomogeneous magnetic field and to trial schemes for merging collections of electrons and positrons.

References

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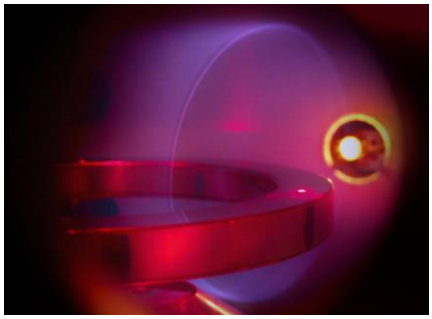

Figure 1. Helium glow discharge in the APEX LDT.