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Positron transport and thermalization - the plasma-gas interface

JOAN MARLER, University of Aarhus

Low energy positrons are now used in many fields including atomic physics, material science and medicine [1]. Plasma physics is providing new tools for this research, including Penning-Malmberg buffer-gas traps to accumulate positrons and the use of rotating electric fields (the "rotating wall" technique) to compress positrons radially and create tailored beams [1]. These devices (now available commercially), which rely in key instances on positron-neutral interactions, are a convenient way to create plasmas and beams for a variety of applications. A deeper understanding of the relevant cooling and loss mechanisms is required to take full advantage of this technology. This talk focuses on a recent study of positrons in such a tenuous gaseous environment in the presence of an applied electric field [2]. Energy-resolved collision cross sections and a Monte Carlo code modified to include positrionium (Ps) formation are used to obtain transport coefficients and the thermalization and Ps-formation rates. A markedly different type of negative differential conductivity is observed (i.e., not seen in electron systems), due to the non-conservative nature of the Ps-formation process. It is particularly prominent in gases with large, highly energy dependent Ps-formation cross sections. The relevance of these calculations to other positron applications will also be discussed, including a currently planned study of positrons in gaseous water. It is hoped that these calculations will inspire a new generation of positron transport experiments.

Work done in collaboration with Z.Lj. Petrović, A. Banković, M. Šuvakov, G. Malović, S. Dujko, S.J. Buckman.

1. C. M. Surko and R. G. Greaves, *Phys. Plasmas* **11**, 2333-2348 (2004).

2. A. Banković, J. P. Marler, M. Šuvakov, G. Malović, and Z. Lj. Petrović, *Nucl. Instrum. and Meth. in Phys. Res. B* **266**, 462-465 (2008).