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Gaseous positronics: collisions and transport of positrons in gases

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While it may still be too early to call for a Gaseous Positronics Conference, as a result of the increased activity in the field of positron induced atomic and molecular physics, cross section sets that are sufficiently complete to model low energy positron transport in gases could be developed for a number of gases including Ar, N2, H2 and CF4. Calculations of the transport coefficients of low energy positrons (<10 eV) in gases have shown some of the standard features similar to electrons, but also some new kinetic phenomena that were not observed for electrons. These include the negative differential conductivity (NDC) for the bulk component of the drift velocity, while there is not even a favourable situation for the NDC for the flux component. A similar effect is observed as a large anisotropy of the bulk diffusion. Most recently, in the studies of positron transport in ExB fields, it was found that direction of drift may be quite different, by as much as 70 degrees, between the flux and the bulk components. In all cases it was found that the non-conservative nature of positronium (Ps) formation leads to all those processes. The recently developed positron trap at ANU in Canberra, Australia, has been used to cover the cross section data for a large number of gases, and our main interest has been focused on water vapour and other organic molecules that would provide the physical basis for modeling positron interaction with living organisms. Such data now exist, together with the corresponding transport data that show all the features induced by the Ps formation cross section. Finally, our improved ability to model collisions of positrons in gases has made it possible to model a gas-filled Surko trap and show how distributions of positrons develop from the initial beam like distributions and how positrons are thermalized. In collaboration with S.J. Buckman, J.Sullivan, C.Makochekanwa, A. Bankovic, S.Dujko, R. White, G. Malovic, M. Suvakov and S. Marjanovic