

Conventional Point Cusp Theories Applied to the Polywell

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The magnetic field structure of the Polywell has been studied using conventional magnetic confinement ideas from the study of point and line cusps. Analytical expressions are presented for the magnetic field in the point and line cusps as a function of device parameters such as coil spacing and coil current. It is found that at small coil spacings it is possible for the point cusp losses to dominate over the line cusp losses, leading to longer overall electron confinement [1]. This effect may make the polywell field geometry superior to other open magnetic field geometries.

The types of single particle trajectories that can occur are analysed in the context of the magnetic field structure which results in the ability to define two general classes of trajectories, separated by a critical flux surface. Additionally, an expression for the single particle confinement time is proposed and subsequently compared with simulation. It is expected that the Polywell can further improve its confinement through other mechanisms such as space charge plugging of the cusps and improved recirculation. Some of these ideas will be discussed in the context of the point cusp model.

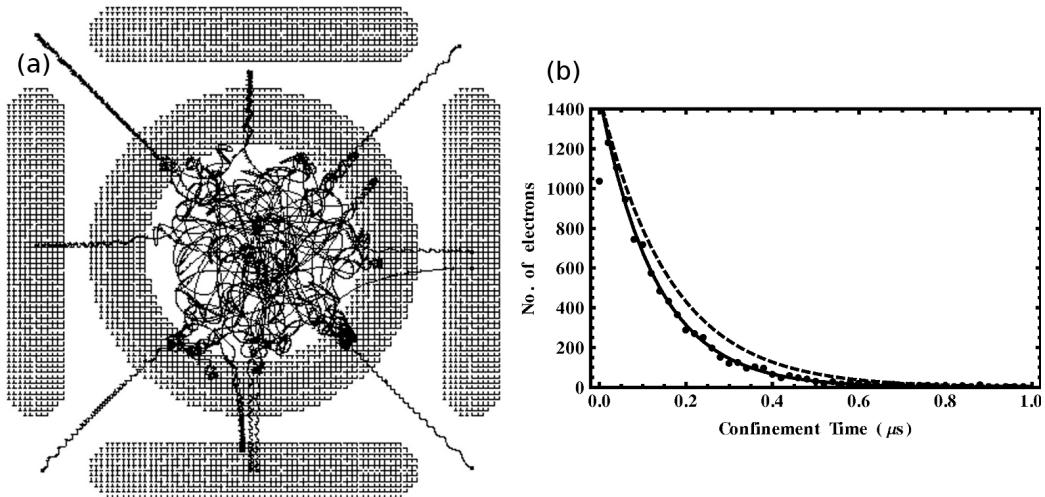


Figure 1: (a) A superposition of 10 different electron trajectories, each with a starting energy of 100eV and random initial velocity. The trajectories are plotted until they escape the Polywell. (b) The distribution of confinement times for 10,000 electrons with the same starting conditions as in (a). The data has been fitted for the mean confinement time and compared with a point cusp model.

[1] M. Carr, D. Gummersall, S. Cornish and J. Khachan. “Low beta confinement in a Polywell modelled with conventional point cusp theories”. *Physics of Plasmas* **18** (2011), p. 112501