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Two-dimensional Collisionless Weakly-ionized Plasma in Fluid Approximation VALERY GODYAK, Osram Sylvania, NATALIA STERNBERG, Clark University — A finite cylinder is a common plasma shape in many research experiments and plasma processing reactors. In the diffusion limit (the Schottky model), the two-dimensional plasma density profile for a finite cylinder of length $2L$ and diameter $2R$ is the product of the corresponding one-dimensional solutions, namely, $n(x,r)/n_0 = cos(\pi x/2L)J_0(2.4r/R)$. This representation of the plasma spatial distribution is commonly used at low gas pressures, even when the Schottky model is not applicable (such as in the cases of collisionless ions, or variable ion mobility). In this presentation, we will analyze, for a wide range of the aspect ratio L/R, the behavior of the ionization frequency, plasma densities at the radial and axial boundaries, the spatial plasma profile, the plasma flux to the wall, as well as the entering angle of ions at the plasma boundary. We will demonstrate that for cylindrical collisionless plasma, the spatial plasma profile cannot be represented by the product of the corresponding one-dimensional solutions. Moreover, in the limiting cases of small and large aspect ratios, the plasma distribution along the longer length (L or R) approaches the diffusion distribution, which corresponds to the highly collisional ion motion, although the ion motion in this direction is collisionless.

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