COLLECTIVE INSTABILITIES DRIVEN BY ANODE PLASMA IONS AND ELECTRONS IN A
NONRELATIVISTIC CYLINDRICAL DIODE WITH APPLIED MAGNETIC FIELD

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ABSTRACT

Use is made of the macroscopic cold-fluid-Poisson equations to investigate
the electrostatic stability properties of nonrelativistic, nonneutral electron
flow in a cylindrical diode with applied magnetic field $B_0 \hat{z}$. The cathode is
located at $r=a$ and the anode is located at $r=b$. Space-charge-limited flow with
$n_0^0(r=a)=0$ is assumed. Detailed stability properties are investigated analyti-
cally and numerically for electrostatic flute perturbations with $\beta/\beta_{te}=0$.
Particular emphasis is placed on the influence of neutral anode plasma on
stability behavior assuming uniform cathode electron density ($\hat{n}_b$) extending
from the cathode ($r=a$) to $r=r_b$, and uniform anode plasma density ($\hat{n}_a=Z_i \hat{n}_i$)
extending from $r=r_p$ to the anode ($r=b$). Depending on the cathode electron
density (as measured by $s_b=\hat{n}_b/a^2$), the anode plasma density (as measured by
$s=\hat{n}_a/a^2$), the diode aspect ratio, etc., it is found that there can be a
strong coupling of the anode plasma to the cathode electrons, and a concomitant
large influence on detailed stability behavior for both the high-frequency
(electron-driven) and low-frequency (ion-driven) branches. Detailed stability
properties are investigated over a wide range of cathode electron density, anode
plasma density, diode aspect ratio, etc.