

# **Survey of Collective Instabilities and Beam-Plasma Interactions in Intense Heavy Ion Beams\***

Ronald C. Davidson, Igor Kaganovich, Hong Qin and Edward A. Startsev  
Princeton Plasma Physics Laboratory, Princeton, New Jersey, USA

Dale R. Welch and David V. Rose  
Mission Research Corporation, Albuquerque, New Mexico, USA

Han S. Uhm  
Ajou University, Suwon, Korea

This paper presents a survey of the present theoretical understanding of collective processes and beam-plasma interactions affecting intense heavy ion beam propagation in heavy ion fusion systems. In the acceleration and beam transport regions, the topics covered include: discussion of the conditions for quiescent beam propagation over long distances; the electrostatic Harris-type instability and the transverse electromagnetic Weibel-type instability in strongly anisotropic, one-component nonneutral ion beams; and the dipole-mode, electron-ion two-stream instability driven by an (unwanted) component of background electrons. In the plasma plug and target chamber regions, collective processes associated with the interaction of the intense ion beam with a charge-neutralizing background plasma are described, including: the electrostatic electron-ion two-stream instability, the electromagnetic Weibel instability, electron plasma oscillation excitations, and the resistive hose, sausage, and hollowing instabilities. Particular emphasis is placed on identifying operating regimes where the possible deleterious effects of collective processes on beam quality are minimized.

\* Research supported by the U. S. Department of Energy.