

Double layers in a field-aligned current driven plasma

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Abstract. The solutions of small amplitude ion acoustic double layers in current-carrying plasma in the presence of the magnetic field have been presented. The electron beam along the magnetic field has only been considered and the drift velocity assumed to be less than the electron thermal velocity. The velocity, the width and the potential of such DLs are calculated.

Keywords. Ion acoustic double layers; electron beam; electron drift velocity.

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1. Introduction

Double layers (DLs) in a current-driven plasma in the presence of magnetic field have not been explored much, although DLs in unmagnetized plasma have been studied both theoretically and experimentally (Block 1972; Sato 1982; Schamel 1983; Sekar and Saxena 1984; Bujarbarua and Goswami 1985; Sutradhar and Bujarbarua 1987) extensively. Recently both weak ion acoustic DL and weak electron acoustic DL have been studied (Goswami and Bujarbarua 1985, 1987). Swift (1976) proposed a theory of laminar electrostatic shock, propagating obliquely to the magnetic field, supported by current-driven electrostatic ion cyclotron instability. Mozer *et al* (1977) observed large electric field in the auroral zone due to the ion cyclotron drift, which was of the order of electron thermal speed. Barnes *et al* (1985) showed in their simulation that weak DLs are formed in current-driven ion acoustic turbulence when the plasma is strongly magnetized and when the drift velocity is less than the electron thermal speed.

Recently Sutradhar Das and Bujarbarua (1988) studied the formation of weak ion acoustic DLs in an unmagnetized plasma, with electron drift velocity less than the electron thermal velocity. In the present study we have solved the small amplitude DLs in a plasma consisting of an electron beam in the presence of a magnetic field. However we have considered the magnetic field only along the direction of the beam as also the electron drift velocity less than the electron thermal velocity.

2. Basic equations

We consider a homogeneous and infinite plasma consisting of an electron beam in the presence of the magnetic field along the direction of the electron beam, and treat the