

Fake double layers in double plasma devices

S K MATTOO, Y C SAXENA, A N SEKAR
Physical Research Laboratory, Ahmedabad 380 009, India

MS received 11 August 1980

Abstract. The double layer like potential jumps have been observed in a double plasma device. They do not correspond to a switching of plasma potential from one metastable state to another but are caused by the ionisation of a very minute amount of the gas that inevitably leaks into the system during the probe movement.

Keywords. Double layer; double plasma device; ionisation.

1. Introduction

A double layer is a sharp discontinuity in plasma potential which results in electric fields that may accelerate charged particles to energies above the thermal energy. A widespread interest in the study of these layers has been stimulated by several recent experimental (Torvén 1965; Andersson *et al* 1969; Lutsenko *et al* 1975; Quon and Wong 1976; Hudson and Mozer 1978; Coakley *et al* 1978; Levine *et al* 1978; Leung *et al* 1980) and theoretical (Block 1972; Montgomery and Joyce 1969; Goertz and Joyce 1975; Knorr and Goertz 1974; Smith and Goertz 1978; DeGroot *et al* 1977; Singh 1979, 1980) studies dealing with their formation and stability. Most of these investigations have been summarised in review articles (Block 1972; Shawhan *et al* 1978; Raadu and Carlqvist 1979; Torvén 1979).

Double layers have been detected in numerous laboratory experiments. Detailed measurements of the structure of these layers can however be obtained only in the experiments at low plasma densities. Quon and Wong (1976) claim to have produced double layers at low plasma densities ($n \sim 10^{14} \text{ m}^{-3}$) in a filament discharge-type double-plasma device. However, Coakley and Hershkowitz (1979) detected strong double layers in their triple-plasma device but were unable to produce them in their double-plasma device. This has led to a controversy whether or not double layers can be produced in double-plasma devices. Although they were unable to achieve double layers in their double-plasma device, they could produce what they have called pseudo-double layers. It was found that as the axial position of a monitoring probe was changed in the target chamber, a point was reached at which the potential of the entire plasma changed. This observation has been attributed to the fact that the plasma in the target region of the double plasma device possesses two metastable states.

Although all our attempts so far have failed to produce a strong and stable double layer in the double plasma device, we have obtained results which can explain the observations of pseudo-double layers (Coakley and Hershkowitz 1979). These results are reported in the following.