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Temperature analysis in the shock waves regime for gas-filled plasma capillaries in plasma-based accelerators

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Plasma confinement represents a crucial point for plasma-based accelerators. For this reason, since each plasma parameter, such as the degree of ionization, the plasma temperature and the electron density, can affect the electron beam parameters, an accurate measurement of the plasma properties must be performed. In this paper, we introduce a novel method to detect the plasma temperature inside gas-filled capillaries in use at the SPARC\LAB test facility. The proposed method is based on the shock waves produced at the ends of the capillary during the gas discharge and the subsequent plasma formation inside it. By measuring the supersonic speed of the plasma outflow, the temperature is obtained both outside and inside the capillary. A plasma temperature between 0.3 and 2 eV has been measured, depending on the geometric properties and the operating conditions of the capillary.

Summary

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