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THE IPG6-B AS A RESEARCH FACILITY TO SUPPORT FUTURE DEVELOPMENT OF ELECTRIC PROPULSION

Abstract

The inductively-heated plasma generator IPG6-B at Baylor University has been established and characterized in previous years for use as a flexible experimental research facility across multiple applications. The system uses a similar plasma generator design to its twin-facilities at the University of Stuttgart (IPG6-S) and the University of Kentucky (IPG6-UKY). At Baylor University, laboratory experiments in the areas of astrophysics, geophysics as well as fundamental research on complex (dusty) plasmas are planned. The study of fundamental processes in low-temperature plasmas connects directly to electric propulsion systems. Proper understanding of these processes is essential for further research and development in this area. Concerning our partner facilities, the IPG6-S is used as a test bed for atmosphere-breathing electric propulsion (ABEP) as part of a Horizon 2020 research program, while the IPG6-UKY is used as tool to study the gas-surface interaction of high enthalpy flows. The similarity between these three IPGs in Stuttgart, Lexington and at Baylor University offers the advantage to reproduce results and provides comparability to achieve cross-referencing and verification leading to a significantly increased level of confidence in the achieved results.

Characterization of the IPG6-B has been conducted using various plasma diagnostics, including a calorimeter, a pitot probe and electrostatic probes. Additionally, data has been compared to data collected at our twin facilities, allowing essential parameters of the plasma to be identified. Therefore, the application of the facility as a research tool for multiple disciplines in physics and engineering has been demonstrated. The most recent of these experiments include the study of dusty plasmas and astrophysical phenomena such as the aggregation of fine dust rims on chondrules in the solar nebulae. A secondary objective of the facility is to study the interaction of charged dust with electric and magnetic fields. In this case, dust can be used as a diagnostic for such fields and can reveal essential information of the magneto-hydrodynamics in low-temperature plasmas which is again relevant to electric propulsion. The investigation of magnetic field interactions with the plasma as it occurs in helicon thrusters and magnetic nozzles is of particular interest.

Although some of these goals require further advancement of the facility, it will be shown that several phenomena relevant to electric propulsion as well as to other fields of physics can be studied using the existing facility.