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SPACE EXPLORATION SYMPOSIUM (A3)
Moon Exploration – Part 2 (2B)

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LUNAR ENVIRONMENTAL ANALOG INVESTIGATIONS WITH THE IPG6-B TEST FACILITY: MINI-MAGNETOSPHERES, REGOLITH-PLASMA-SPACECRAFT INTERACTIONS

Abstract

In close collaboration between the Center for Astrophysics, Space Physics and Engineering Research (CASPER) at Baylor University, Texas, and the Institute of Space Systems (IRS) at the University of Stuttgart, Germany, two plasma facilities of similar type have been established using the Inductively heated Plasma Generator 6 (IPG6), which is based on proven IRS designs. A wide range of applications is currently under consideration for both test and research facilities. Basic investigations in the area of plasma radiation and catalysis, simulation of certain parameters of fusion divertors and space applications are planned. The facility at Baylor University (IPG6-B) will be qualified for the use with hydrogen in order to conduct research regarding fusion divertors and further the simulation of mini-magnetospheres on the Moon which are known to be connected to the appearance of swirls on the lunar surface. The solar wind is deflected by those local magnetospheres leading to a shielding of the subjacent lunar surface. As a result the ion flux of the solar wind is locally reduced and increased elsewhere. Thus patterns of lighter colored, less weathered, soil can be found on the lunar surface. The interaction of the solar wind with such mini-magnetospheres can be simulated in a plasma wind tunnel by observing the interaction between a hydrogen plasma jet and a permanent magnet. The density of a plasma jet in such a facility is of course several magnitudes higher than in the solar wind. However, this can be compensated by scaling other parameters of the experiment to make the simulation of mini-magnetospheres in the laboratory possible. Further it is planned to expose lunar simulant to the described conditions. Due to the high ion flux in the experiment the aging of the lunar surface could be simulated in timeframes that are feasible for laboratory experiment. Thus artificial lunar swirls could be created and compared to the lunar equivalents. Another lunar application can be the analysis of regolith charging effects in hydrogen plasma. CASPER already has expertise of dust charging in plasma. The hydrogen plasma environment of the IPG6-B test facility will provide the opportunity to analyze the charging and resulting levitation of lunar simulant dust particles in a laboratory experiment.