LABORATORY SIMULATION OF SPACE PLASMA PHYSICS*

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Throughout the past 40+ years of *in situ* research in near-Earth space plasmas, a rich variety of phenomena has been observed. Improvements in the temporal resolution of each successive generation of spacecraft have revealed that the space plasma environment is more rich and complicated than first thought. With the increasing sophistication of each successive generation of ground-based experiment, sounding rocket or satellite, the resulting measurements have indicated more and more about space plasma behavior. Large scale, long time duration processes are generally well known, but as the temporal and spatial resolution of the space measurements have increased, new phenomena have frequently been found at even the smallest scales. Nonetheless, there are several underlying difficulties with the data obtained from the space measurements. The data obtained are often single point measurements, causing frequent space-time ambiguities to arise, even if the measurements are made with the highest spatial resolution. Typically, the data are either snapshots in time or statistical compilations from many satellite passes which are subject to varying plasma conditions. Recently, missions such as Cluster have begun to address these issues by making multipoint measurements in space. However, given the operational realities of the environment and the expense of multipoint missions, further insight into the details of the processes can often be obtained through laboratory simulation of space plasma phenomena.

Laboratory experiments can compliment *in situ* space experimentation in several important ways. The main advantage offered by laboratory experiments is the ability to create controlled, *reproducible* conditions in which the important space plasma parameters can be scaled and maintained. By producing properly scaled space-like conditions, diagnosis of the physics involved in these processes can be performed with a level of detail that is not possible in space. In addition to studies of fundamental plasma processes, laboratory devices that can reproduce space-like conditions are excellent testing grounds for development of improved *in situ* diagnostics. This is particularly important since space physics has progressed to the point where the ability to make accurate, quantitative measurements in space is required [1].

A number of different facilities are currently being used to perform space-related laboratory experiments. Plasmas are created in these laboratory devices by several distinct methods. In this talk, the ways in which laboratory plasmas are created, the range of characteristics that these plasmas have and their scaling to space plasmas will be reviewed, along with a brief overview of the standard types of diagnostics available to the laboratory plasma experimentalist.

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[1] L. R. O. Storey, *Measurement Techniques in Space Plasmas: Particles*, Geophys. Monograph **102**, Amer. Geophys. Union, p. 17, 1998.