IN-FLIGHT INSTABILITIES OF DOUBLE PROBE ELECTRIC FIELD INSTRUMENTS: A SURVEY OF OBSERVATIONS AND ANALYSES

John W. Bonnell[(1)]
(1) Space Sciences Laboratory, Univ. of California, Berkeley.

The design and implementation of double probe electric field sensors for space plasma applications has a long and successful history spanning well over 40 years. Existing and future designs for the E-field sensor elements and surrounding surfaces (guards, stubs, ushers, etc.) include options for current- and voltage biasing of those surfaces. This is done in order to optimize the DC and AC coupling of the sensors to potential fluctuations in the ambient plasma and to reduce the systematic errors in the E-field measurement due to stray and imbalanced currents to one or the other of the probes used for a given measurement. In general, this approach has resulted in high-quality DC and AC E-field and potential measurements over broad ranges of plasma parameters, from the cool dense plasmas of LEO and the Plasmasphere to the hot tenuous plasmas of the magnetosphere. However, in certain plasma regimes and with certain electrical and mechanical designs, instabilities have occurred that have had significant effects on both DC and AC E-field measurements, in some cases completely swamping the geophysical signals.

Here, we will survey a set of such instabilities that occurred on the Polar-EFI, DEMETER-ICE, C/NOFS-VEFI, and RBSP-EFW E-field instruments, discussing the electromechanical design of the antenna elements and driving electronics, as well as the current state of discussion and analysis of the root cause of the instabilities. Given recent laboratory work on the estimation of self- and mutual impedance of E-field antenna elements, we also propose a possible series of laboratory experiments that would serve to verify existing models of the antenna instabilities and determine useful design rules to prevent such instabilities in the future while still allowing for optimization of DC and AC sensor operation.