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Current Developments for Electric Field Measurements by Probe Methods in Japan

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Accurate measurement of electric field is an essential request for studies of macroscopic plasma convection, microscopic waveparticleinteractions, violation of MHD approximation, etc. One of typical measurement techniques is Double Probe method, identical to that of a voltmeter: the potential difference between two top-hat probes [cf. Pedersen et al., 1998]. The potential of aconductive material in plasma is mainly determined by the balance of outflow photoelectrons (Iph) and inflow ambient electrons(Ie). In tenuous plasma, conductive materials are positively charged because number of outflow photoelectrons exceeds that ofinflow ambient electrons. Such potential is highly variable associated with density and temperature of ambient electrons. For thestabilization of the probe potential, the bias current (Ib) is fed to the probe. Double Probe method can measure electric field passively and continuously in all plasma conditions with high time resolution. However, accuracy, gain (effective length), and off-set are affected by a) the disturbance from ambient plasma and b) the disturbancefrom the spacecraft body. In this paper, we summarize the current development status for future electric field measurementin space by the probe system, toward BepiColombo, Scope, and ERG. I. Evaluation of the current systems: Quantitative evaluation of electric field data obtained by GeotailII. Surface materials: a) Measurement of photoelectron and 2nd electron yields, b) Evaluation of the spacecraft potential invarious plasma conditions, c) Precise determination of electron density by spacecraft potential, d) Excitation of Large amplitude electric fieldIII. Extensible sensor mechanics: a) Numerical simulations for space potentials around the spacecraft, b) Refinement of Ribbonantenna, c) Development of Boom antennaIV. Receivers: a) AC/DC unified preamps, b) Automatic gain control, c) Unification of digital unit, d) Langmuir probe