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Wave Probe - a new instrument for space research

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The study of wave activity in space plasmas is one of the principal directions of space research. As it is widely known, the wave processes in plasma are controlled by electric currents formed by flows of charged particles there. Till recently, the experimental study of wave activity was mainly made by measurements of electric and magnetic fields parameters. The electric currents values were mostly calculated using magnetometer data. Numerous attempts to measure directly the spatial current density were initiated as early as in the years 60-ties of the last century. Moreover, it was theoretically shown that, measuring simultaneously the spatial current density plus magnetic field intensity one can immediately find the value of wave vector. Also the possibility appears to separate spatial and temporal variations of wave activity in situ using only one satellite with correspondent set of electric and magnetic sensors. The attempts to create the sensor for the measurement of spatial current density were finally resulted in the creation of the new instrument called “wave probe” developed jointly by Space Research Institute and Lviv Centre of Institute of Space Research. This device consists of three operating in parallel sensors - split Langmuir probe, induction coil magnetometer and electric potential probe - incorporated in one body. The methodological experiment to prove the possibility to measure the space current was executed in frames of VARIANT project realized onboard Ukrainian remote sensing satellite “Sich-1M” (launched 24.12.2004). In spite of partial failure of the mission the reliable data of simultaneous measurements of the current component of the same wave process by three independent devices - Faraday Cup, Current Coil and Wave Probe - were received and similar measurement results were obtained. The Wave Probe construction and its main parameters are discussed and both tests results in plasma chamber and measurements results in space are presented. The authors highly appreciate the support of Dr. F. Dudkin and Dr. G. Lizunov in the theoretical substantiation and data processing. This work was supported by NSAU contract 1-02/03 (1274).