



Wave-Particle Interaction Analyzer for the direct measurement of the energy exchange through wave-particle interactions in the magnetosphere

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Wave-Particle Interaction Analyzer (WPIA) is a new type of instrumentation recently proposed by Fukuhara et al. [1] for direct and quantitative measurements of wave-particle interactions. WPIA computes an inner product $W(t_i) = q\mathbf{E}(t_i) \cdot \mathbf{v}_i$, where t_i is the detection timing of the i -th particle, $\mathbf{E}(t_i)$ is the wave electric field vector at t_i , and q and \mathbf{v}_i is the charge and the velocity vector of the i -th particle, respectively. Since $W(t_i)$ is the gain or the loss of the kinetic energy of the i -th particle, by accumulating W for detected particles, we obtain the net amount of the energy exchange in the region of interest [2]. WPIA also has the capability to detect the pitch angle scattering of energetic particles by waves by measuring the Lorentz force acting on each particle [3].

The method of WPIA has been applied to results of *in situ* measurements by THEMIS [4] and MMS [5] for interactions between electromagnetic ion cyclotron waves and energetic ions. The presence of ion hole in the velocity phase space and the amount of energy exchange between waves and particles have been revealed directly and quantitatively. The Software-type WPIA (S-WPIA) has been installed on the ERG (Arase) satellite to measure the energy exchange between whistler-mode chorus emissions and energetic/relativistic electrons in the outer radiation belt [6]. S-WPIA on board the ERG satellite uses electromagnetic field waveform measured by Waveform Capture (WFC) of Plasma Wave Experiment (PWE) and velocity vectors detected by Medium-Energy Particle Experiments - Electron Analyzer (MEP-e), High-Energy Electron Experiments (HEP), and Extremely High-Energy Electron Experiment (XEP). A dedicated system has been developed in the ERG satellite in order to realize the required time resolution for the inter-instruments communications. We show the summary of the recent observation/simulation works related to WPIA and report the current status of S-WPIA on board the ERG satellite.

References

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