

Software-type Wave-Particle Interaction Analyzer (SWPIA) by RPWI for JUICE: Science objectives and implementation

Software-type Wave-Particle Interaction Analyzer (SWPIA) by RPWI for JUICE: Science objectives and implementation

*加藤 雄人¹、小嶋 浩嗣²、浅村 和史³、笠羽 康正¹、土屋 史紀¹、笠原 禎也⁴、井町 智彦⁴、三澤 浩昭¹、熊本 篤志¹、八木谷 聡⁴、石坂 圭吾⁵、木村 智樹⁶、三好 由純⁷、小路 真史⁷、北原 理弘¹、Ondrej Santolik^{8,9}、Jan-Erik Wahlund¹⁰

*Yuto Katoh¹, Hirotsugu Kojima², Kazushi Asamura³, Yasumasa Kasaba¹, Fuminori Tsuchiya¹, Yoshiya Kasahara⁴, Tomohiko Imachi⁴, Hiroaki Misawa¹, Atsushi Kumamoto¹, Satoshi Yagitani⁴, Keigo Ishisaka⁵, Tomoki Kimura⁶, Yoshizumi Miyoshi⁷, Masafumi Shoji⁷, Masahiro Kitahara¹, Ondrej Santolik^{8,9}, Jan-Erik Wahlund¹⁰

1.東北大学大学院理学研究科、2.京都大学生存圏研究所、3.宇宙航空研究開発機構宇宙科学研究所、4.金沢大学、5.富山県立大学、6.理化学研究所、7.名古屋大学宇宙地球環境研究所、8.Institute of Atmospheric Physics、9.Faculty of Mathematics and Physics, Charles University、10.Swedish Institute of Space Physics, Uppsala

1.Graduate School of Science, Tohoku University, 2.Research Institute for Sustainable Humanosphere, Kyoto University, 3.ISAS/JAXA, 4.Univ. Kanazawa, 5.Toyama Pref. Univ., 6.RIKEN, 7.ISEE, Nagoya Univ., 8.Institute of Atmospheric Physics, 9.Faculty of Mathematics and Physics, Charles University, 10.Swedish Institute of Space Physics, Uppsala

We present science objectives of Software-type Wave-Particle Interaction Analyzer (SWPIA), which will be realized as a software function of Low-Frequency receiver (LF) running on the DPU of RPWI (Radio and Plasma Waves Investigation; PI: J.-E. Wahlund, IRF-Uppsala, Sweden) for the ESA JUICE mission. SWPIA conducts onboard computations of physical quantities indicating the energy exchange between plasma waves and energetic ions. Onboard inter-instruments communications are necessary to realize SWPIA, which will be implemented by efforts of RPWI, PEP (Particle Environment Package; PI: Stas Barabash, IR-Kiruna, Sweden) and J-MAG (JUICE Magnetometer; PI: M. Dougherty, ICL, UK). By providing the direct evidence of ion energization processes by plasma waves around Jovian satellites, SWPIA contributes scientific output of JUICE as much as possible with keeping its impact on the telemetry data size to a minimum.

SWPIA measures the energy transfer process between energetic particles and electromagnetic plasma waves [Fukuhara et al., EPS 2009; Katoh et al., AnGeo 2013]. SWPIA will be firstly realized in the ERG satellite mission of JAXA to measure interactions between relativistic electrons and whistler-mode chorus in the Earth's inner magnetosphere. We will apply SWPIA to ion-scale wave-particle interactions occurring in the Jovian magnetosphere. SWPIA clarifies where/when/how heavy ions are energized by waves in the region close to Ganymede and other Jovian satellites. In SWPIA of RPWI for JUICE, we focus on the interactions between energetic ions (a few to tens of keV) and ion cyclotron waves (typically less than 1 Hz). SWPIA uses wave electromagnetic field and ion velocity vectors provided by RPWI sensors and PEP, respectively, with referring three-components of the background magnetic field detected by J-MAG. SWPIA measures a relative phase angle between the velocity vector v_i of i -th particle of charge q_i and the wave electric field vector at the timing of particle's detection ($E(t_i)$) and computes an inner product of $W(t_i) = q_i E(t_i) \cdot v_i$, where $W(t_i)$ corresponds to the variation of the kinetic energy of the i -th energetic particle. We accumulate W for detected particles to obtain $W_{int} = \sum_i W(t_i)$, and we expect statistically significant values of W_{int} for the case of the measurement at the site of efficient wave-particle interactions. In this presentation, we discuss details of the implementation of SWPIA of RPWI and

inter-instruments communications among RPWI-PEP-J-MAG of JUICE.

キーワード：木星磁気圏、木星衛星、波動粒子相互作用

Keywords: Jovian magnetosphere, Jovian satellite, wave-particle interactions