MMS衛星観測データを用いた外部磁気圏Pc5波動内におけるプロトンからEMIC波動へのエネルギー輸送の直接計測

北村 成寿 [1]; 小路 真史 [2]; 北原 理弘 [3]; 三好 由純 [2]; 長谷川 洋 [4]; 中村 紗都子 [5]; 加藤 雄人 [3]; 齋藤 義文 [6]; 天野 孝伸 [7]; 寺本 万里子 [8]; 野村 麗子 [9]; Gershman Daniel J.[10]; Vinas Adolfo F.[11]; 横田 勝一郎 [6]; Giles Barbara L.[11]; Moore Thomas E.[12]; Paterson William R.[11]; Pollock Craig J.[13]; Russell Christopher[14]; Strangeway Robert J.[15]; Fuselier Stephen[16]; Burch James L.[17]
[1] JAXA 宇宙研; [2] 名大 ISEE; [3] 東北大・理・地球物理; [4] JAXA・宇宙研; [5] 京大生存研; [6] 宇宙研; [7] 東大・理; [8] 名大・宇地研; [9] JAXA; [10] NASA/GSFC, メリーランド大学; [11] NASA/GSFC; [12] ＮＡＳＡ・ゴダード宇宙センター; [13] Denali Scientific; [14] UCLA・IGPP; [15] Inst. of Geophys. and Planet. Phys.,UCLA; [16] Space Science & Engineering Div, SwRI; [17] Southwest Research Institute

Direct measurements of energy transfer from hot protons to EMIC waves observed by MMS during Pc5 waves in the outer magnetosphere

Naritoshi Kitamura[1]; Masafumi Shoji[2]; Masahiro Kitahara[3]; Yoshizumi Miyoshi[2]; Hiroshi Hasegawa[4]; Satoko Nakamura[5]; Yuto Katoh[3]; Yoshifumi Saito[6]; Takanobu Amano[7]; Mariko Teramoto[8]; Reiko Nomura[9]; Daniel J. Gershman[10]; Adolfo F. Vinas[11]; Shoichiro Yokota[6]; Barbara L. Giles[11]; Thomas E. Moore[12]; William R. Paterson[11]; Craig J. Pollock[13]; Christopher Russell[14]; Robert J. Strangeway[15]; Stephen Fuselier[16]; James L. Burch[17]
[1] ISAS/JAXA; [2] ISEE, Nagoya Univ.; [3] Dept. Geophys., Grad. Sch. Sci., Tohoku Univ.; [4] ISAS/JAXA; [5] RISH, Kyoto Univ.; [6] ISAS; [7] University of Tokyo; [8] ISEE, Nagoya University; [9] JAXA; [10] NASA/GSFC, Univ. of Maryland; [11] NASA/GSFC; [12] NASA, GSFC; [13] Denali Scientific; [14] IGPP, UCLA; [15] Inst. of Geophys. and Planet. Phys., Univ. of California, Los Angeles; [16] Space Science and Engineering Division, SwRI
; [17] Southwest Research Institute

Wave-particle interactions have been suggested to play a crucial role in energy transfer in collisionless space plasmas in which the motion of charged particles is controlled by electromagnetic fields. We report the temporal variation of energy transfer from hot anisotropic protons to electromagnetic ion cyclotron (EMIC) waves during a compressional ULF wave event using the data obtained by the four MMS (Magnetospheric Multiscale) spacecraft traversing the duskside outer magnetosphere. For the ULF wave, the period was about 2-5 minutes (Pc5 frequency range), and the magnetic and ion pressures were in antiphase, such that the total pressure remained almost constant. They were likely mirror mode type structures. The burst ion data from Fast Plasma Investigation Dual Ion Spectrometer (FPI-DIS) with a time resolution of 150 ms are available for two of the EMIC wave events during the ULF wave. Electric field data from the double probes were not usable to analyze the wave electric field due to the fluctuation with a frequency of ~0.1 Hz likely caused by ion beams from Active Spacecraft Potential Control (ASPOC) neutralizers. However, perpendicular electric fields were estimated using the cross product of the cold ion velocity and the magnetic field. To directly detect energy transfer from hot protons to EMIC waves, we apply the Wave-Particle Interaction Analyzer (WPIA) method [*Fukuhara et al.*, 2009; *Katoh et al.*, 2013] to the data. The energy transfer rate by cyclotron resonance was calculated as the wave component of the perpendicular electric fields and ion current perpendicular to the magnetic field around the resonance velocity which is called the resonant current. The energy transfer rate peaked at the local minima of magnetic field intensity, which corresponds to the maxima of the ion pressure in the compressional ULF wave. This result indicates that the spontaneous EMIC wave generation is affected by ULF waves, and preferential locations for the cyclotron resonant energy transfer are magnetic field intensity dips. In these dips, both of the relatively low resonance velocity due to small magnetic field intensity and the enhanced hot proton flux can contribute to the enhanced energy transfer from hot protons to the EMIC waves by cyclotron resonance.