First Electron-Scale Measurements of Magnetic Reconnection in Space
First Electron-Scale Measurements of Magnetic Reconnection in Space

*James L Burch[1]、Torbert Roy[1,2]、Phan Tai[3]、Chen Li-Jen[4]、Moore Thomas[5]、Ergun Robert[6]、Eastwood Jonathan[7]、Gershman Daniel[5]、Argall Matthew[2]、Wang Shan[4]、Hesse Michael[5]、Pollock Craig[15]、Giles Barbara[5]、Nakamura Rumi[8]、Mauk Barry[9]、Fuselier Stephen[1]、Russell Christopher[10]、Strangeway Robert[10]、Cassak Paul[11]、Drake James[4]、Shay Michael[12]、Khotyaintsev Yuri[13]、Lindqvist Per-Arne[14]、Wilder Frederick[6]、Oka Mitsuo[3]、Dorelli John[5]、Goldstein Jerry[1]、Baker Daniel[6]
*James L Burch[1], Roy B. Torbert[1,2], Tai D. Phan[3], Li-Jen Chen[4], Thomas E Moore[5], Robert E Ergun[6], Jonathan P Eastwood[7], Daniel J Gershman[5], Matthew R Argall[2], Shan Wang[4], Michael Hesse[5], Craig J Pollock[15], Barbara L Giles[5], Rumi Nakamura[8], Barry H Mauk[9], Stephen A Fuselier[1], Christopher T Russell[10], Robert J Strangeway[10], Paul A Cassak[11], James F Drake[4], Michael A Shay[12], Yuri Khotyaintsev[13], Per-Arne Lindqvist[14], Frederick D Wilder[6], Mitsuo Oka[3], John C Dorelli[5], Jerry Goldstein[1], Daniel N Baker[6]

1.Southwest Research Institute、2.University of New Hampshire、3.University of California, Berkeley、4.University of Maryland、5.NASA, Goddard Space Flight Center、6.University of Colorado LASP、7.Imperial College London、8.Space Research Institute, Austrian Academy of Sciences、9.Johns Hopkins University Applied Physics Laboratory、10.University of California, Los Angeles、11.West Virginia University、12.University of Delaware、13.Swedish Institute of Space Physics、14.Swedish Royal Institute of Technology、15.Denali Scientific
1.Southwest Research Institute, 2.University of New Hampshire, 3.University of California, Berkeley, 4.University of Maryland, 5.NASA, Goddard Space Flight Center, 6.University of Colorado LASP, 7.Imperial College London, 8.Space Research Institute, Austrian Academy of Sciences, 9.Johns Hopkins University Applied Physics Laboratory, 10.University of California, Los Angeles, 11.West Virginia University, 12.University of Delaware, 13.Swedish Institute of Space Physics, 14.Swedish Royal Institute of Technology, 15.Denali Scientific

Magnetic reconnection is a fundamental plasma physical process in which stored magnetic energy is explosively converted through the reconfiguration of a magnetic field into heat and kinetic energy of charged particles. Reconnection occurs in many astrophysical plasma environments as well as in laboratory plasma experiments and is responsible for solar flares and coronal mass ejections, x-ray flares in magnetars, magnetospheric storms and substorms, and sawtooth collapses in fusion devices. Although the effects of reconnection are easily observed, the electron-scale kinetic physics that allows plasmas to become demagnetized, with the resulting change in the topology of the magnetic field and the release of particle energy, has up to now eluded observation in both space and the laboratory. However, recent observations by NASA’s Magnetospheric Multiscale Mission (MMS), made with unprecedently high time resolution (100 times faster than previous missions for electrons and 30 times faster for ions), have provided the first detailed look at electron demagnetization and acceleration at sites along the sunward boundary of Earth’s magnetosphere where the interplanetary magnetic field encounters and reconnects with the terrestrial magnetic field. With these new measurements we have (1) observed the reduction of magnetic-field energy to near zero, (2) measured the reconnection electric field and the current that flows along it causing the dissipation of magnetic energy, and (3) identified the electron population that carries the current as a result of demagnetization and acceleration during their penetration of the reconnection dissipation region. The persistence of a characteristic crescent shape in the velocity-space distributions of these electrons suggests that the kinetic processes causing magnetic field line reconnection in this event were dominated by laminar electron physics rather than turbulence-induced dissipation.

キーワード：Magnetic Reconnection、Solar-Wind Magnetosphere Interactions、Charged Particle Acceleration
Keywords: Magnetic Reconnection, Solar-Wind Magnetosphere Interactions, Charged Particle Acceleration

MMSへの日本からの参加：現状とこれから
Japanese Participation to MMS: Current Status and Future Plan

*斎藤 義文[1]、横田 勝一郎[1]、北村 成寿[1]、長谷川 洋[1]
*Yoshifumi Saito[1], Shoichiro Yokota[1], Naritoshi Kitamura[1], Hiroshi Hasegawa[1]

1.宇宙航空研究開発機構・宇宙科学研究所・太陽系科学研究系
1.Solar System Science Division, Institute of Space and Astronautical Science, Japan Aerospace Exploration Agency

MMS was successfully launched on12 March 2015 and is continuing to produce highest quality data ever we had. Based on the results obtained by Geotail observations, Japanese researchers have been interested in the main target of MMS that is to understand the micro process of the magnetic reconnection. The same group that developed the low energy particle experiment (LEP) on Geotail has been participating to the development of one of the instruments on MMS that is FPI-DIS (Fast Plasma Investigation - Dual Ion Sensor). Design, fabrication, assembly, and the initial tests of the 16 Flight Model DIS sensors were made in Japan collaborating with U.S. and French colleagues. Currently, Japanese scientists are also participating to the initial analysis of the obtained data and evaluation of the performance of the 16 DIS sensors.
Since the time resolution of the FPI is high, the amount of the data is quite large. FPI data are delivered to Japan periodically using hard drives since it takes too long time to transfer all the data from the data center over the internet. ISAS is operating a data server for FPI data, that can be accessed by Japanese FPI team members.
The collaborative observation between MMS and Geotail is also making progress. After July 2015, the operation time of Geotail in Japan is increased in order to make collaborative observation with MMS. Since Geotail has unique orbit with apogee of 30Re and perigee of 9Re, Geotail - MMS pairs will realize multiple scale measurements of the key regions of the magnetic reconnection region. In some of the period, Geotail can be used as a solar wind monitor, that is closer to the magnetosphere than solar wind monitor at L1 point.
Since many Japanese researchers have great interest in the night side phenomena in the Earth's magnetotail, we are placing high expectations on the MMS Phase2 data that will be obtained in the near future. The time resolution of the Geotail low energy particle observation was 12 seconds. Therefore it was difficult to see the detailed structure of the the Earth's magnetotail. Although the sensitivity of the FPI sensors are not enough high for tenuous plasma measurements in the magnetotail, they can make observation much faster than 12sec. FPI- DIS will be able to measure low energy ions with more than an order higher time resolution than Geotail-LEP even taking into account the sensitivity. Many new discoveries are expected to be made also in the Earth's magnetotail in the near future.

キーワード：磁気リコネクション、衛星観測、プラズマ計測
Keywords: magnetic reconnection, satellite observation, plasma measurement

ジオスペース探査ERGプロジェクトと国際連携

Geospace Exploration Project ERG: Contribution to Heliosphere/Geospace (H/GSO) system observatory

*三好 由純[1]、篠原 育[2]、高島 健[2]、浅村 和史[2]、松本 晴久[2]、東尾 奈々[2]、三谷 烈史[2]、横田 勝一郎[2]、笠原 慧[2]、風間 洋一[3]、Wang Shaing-Yu[3]、平原 聖文[1]、笠原 禎也[4]、笠羽 康正[4]、八木谷 聡[4]、松岡 彩子[2]、小嶋 浩嗣[6]、藤本 正樹[2]、塩川 和夫[1]、関 華奈子[7]、加藤 雄人[5]、小野 高幸[5]

*Yoshizumi Miyoshi[1], Iku Shinohara[2], Takeshi Takashima[2], Kazushi Asamura[2], haruhisa matsumoto[2], Nana Higashio[2], Takefumi Mitani[2], Shoichiro Yokota[2], Satoshi Kasahara[2], Yoichi Kazama[3], Shaing-Yu Wang[3], Masafumi Hirahara[1], Yoshiya Kasahara[4], Yasumasa Kasaba[4], Satoshi Yagitani[4], Ayako Matsuoka[2], Hirotsugu Kojima[6], Masaki Fujimoto[2], Kazuo Shiokawa[1], Kanako Seki[7], Yuto Katoh[5], Takayuki Ono[5]

1.名古屋大学宇宙地球環境研究所、2.宇宙航空研究開発機構、3.Academia Sinica、4.金沢大学、5.東北大学、6.京都大学、7.東京大学

1.Institute for Space-Earth Environmental Research, Nagoya University, 2.JAXA, 3.Academia Sinica, Taiwan, 4.Kanazawa University, 5.Tohoku University, 6.Kyoto University, 7.The University of Tokyo

The ERG (Exploration of energization and Radiation in Geospace) isJapanese geospace exploration project. The project focuses on thegeospace dynamics and accelerations of radiation belt electrons in the context of the cross-energy coupling viawave-particle interactions. The project consists of the satelliteobservation team, the ground-based network observation team, andintegrated-data analysis/simulation team. The ERG satellite will belaunched in FY2016. Comprehensive instruments for plasma/particles, and eld/waves are installed in the ERG satellite to understand thecross-energy coupling system. In the ERG project, severalground-network teams join; magnetometer networks, radar networks,optical imager networks, etc, which provide a gloval view of geospace and complementary observation with the ERG satellite observation. Moreover, the modeling/simulations playan important role for the quantitative understanding. Besides research teams in the project, the science center has been operated. The science data from the project have been archived. Moreover, the science center has developed an integrated data analysis software that are a plug-in for SPEDAS in cooperation with the THEMIS mission. These data and softwares are available via the ERG-Science Webpage
(http://ergsc.stelab.nagoya-u.ac.jp). In thispresentation, we will talk about an overview of the ERG project and discuss the international collaborations with Van Allen Probes, MMS, THEMIS, Cluster, etc and ground network observations under the flame work of Heliosphere/Geospace (H/GSO) system observatory.

キーワード：ジオスペース探査、国際協力

Keywords: Geospace Exploration, International Collaboration

MMS High time resolution measurements of kinetic plasma turbulence in Earth's magnetosheath and upstream solar wind

MMS High time resolution measurements of kinetic plasma turbulence in Earth's magnetosheath and upstream solar wind

*Pollock Craig[1]、Giles Barbara[1]、斎藤 義文[2]、Matthaeus William [3]、Torbert Roy[4,5]
*Craig J. Pollock[1], Barbara L. Giles[1], Yoshifumi Saito[2], William Matthaeus [3], Roy Torbert[4,5]

1.NASA Goddard Space Center、2.宇宙航空研究開発機構・宇宙科学研究所・太陽系科学研究系、3.University of Delaware、4.University of New Hampshire、5.Southwest Research Institute
1.NASA Goddard Space Center, 2.Solar System Science Division, Institute of Space and Astronautical Science, Japan Aerospace Exploration Agency, 3.University of Delaware, 4.University of New Hampshire, 5.Southwest Research Institute

Kinetic plasma turbulence is known to be widespread in both solar wind and magnetosheath plasmas. The relationships between kinetic plasma turbulence and collisionless magnetic reconnection are likely myriad and complex. Plasma and magnetic field measurements are provided by MMS at unprecedented cadences, up to 133 Hz for sparsely sampled 3D electron distribution functions. Such fast measurements enable use of new windows into the kinetics of plasma turbulence in Earth's magnetosheath and the nearby solar wind. We will present examples of the turbulence signatures observed in the plasma and magnetic field observations on board MMS during the first Phase (1A) of the mission.

プラズマシートにおける磁気リコネクションと低域混成ドリフト不安定のもとでの磁気エネルギー散逸
Magnetic energy dissipation of plasma sheet under coupling of magnetic reconnection and lower hybrid drift instability

*星野 真弘[1]
*Masahiro Hoshino[1]

1.東京大学大学院理学系研究科
1.Graduate School of Science, The University of Tokyo

Understanding of the magnetic energy dissipation process in a current sheet is an important problem in space plasma as well as in MMS science. So far the inertia resistivity by reconnection and the current driven instability such as the lower hybrid drift instability (LHDI) have been discussed as possible candidates for the origin of microscopic process of magnetic energy dissipation. It is well known that while the LHDI is mainly excited in the plasma sheet boundary, the inertia resistivity effectively works at the neutral sheet. Therefore, the role of the LHDI to the magnetic field dissipation is less important than the inertia resistivity involved in the magnetic reconnection. However, the activity of lower hybrid drift waves together with the electron heating is commonly observed in the plasma sheet boundary by modern satellite observations, and their impact on the magnetic field dissipation at the neutral sheet is not necessarily neglected. In addition, the nonlinear coupling between them is not theoretically understood yet. In this talk, we study the coupling of the collisionless reconnection and the LHDI by using a three-dimensional PIC simulation by paying a special attention to electron heating and the magnetic energy dissipation, and discuss the importance of the current driven instability during magnetic reconnection.

キーワード：磁気リコネクション、プラズマシート、プラズマ加熱、低域混成ドリフト不安定
Keywords: magnetic reconnection, plasma sheet, palsma heating, lower hybrid drift instability

The Electron Diffusion Region in Asymmetric Magnetic Reconnection with Guide Fields

*Michael Hesse[1], Yi-Hsin Liu[1], Li-Jen Chen[1], Naoki Bessho[1], James L. Burch[3], Joachim Birn[2]

1.NASA Goddard Space Flight Center, 2.Space Science Institute and Los Alamos National Lab, 3.Southwest Research Institute

The launch of the Magnetospheric Multiscale mission is leading to a revolution in our understanding of the way magnetic reconnection works. During the first orbit phases, MMS science focuses on asymmetric reconnection, as is commonly found at the Earth’s magnetopause. MMS observations have begun to support the view that reconnection operates primarily as a quasi-laminar process, supporting one class of theoretical predictions and a number of concurrent simulations. In this presentation, we present a detailed look at model predictions pertaining to asymmetric magnetic reconnection with a guide magnetic field, and we present a comparison to recent MMS observations.

Keywords: Magnetospheric Multiscale, Magnetic reconnection, Magnetopause

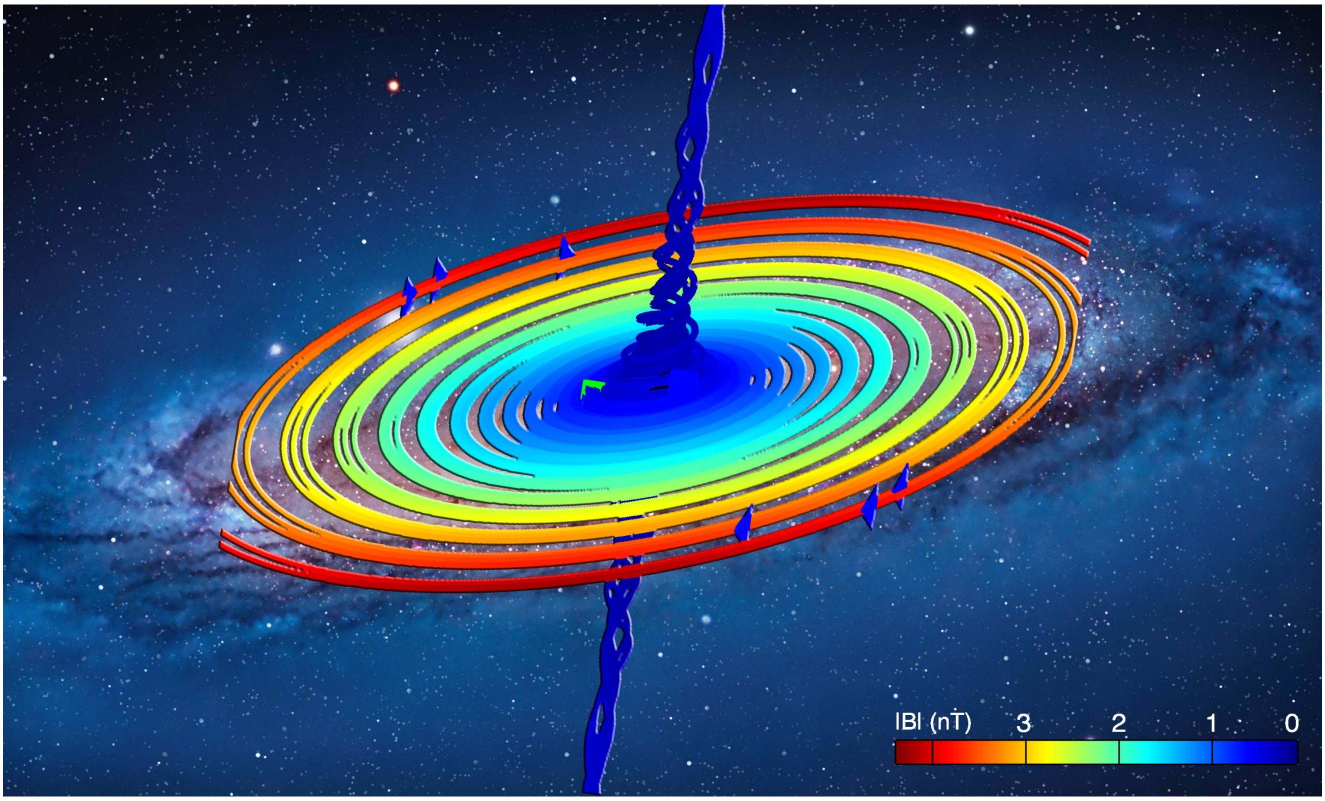
How to find magnetic nulls and reconstruct field topology with MMS data?

*Huishan Fu[1], Andris Vaivads[2], Yuri Khotyaintsev[2], Vyacheslav Olshevsky[3], Mats André[2], Jinbin Cao[1], Shiyong Huang[4], Alessandro Retino[5]

1.Beihang University, 2.Swedish Institute of Space Physics, 3.KU Leuven, 4.Wuhan University, 5.Laboratoire de Physique des Plasmas, CNRS

In this study, we apply a new method—the first-order Taylor expansion (FOTE)—to find magnetic nulls and reconstruct magnetic field topology, in order to use it with the data from the forth-coming MMS mission. We compare this method with the previously used Poincare index (PI), and find that they are generally consistent, except that the PI method can only find a null inside the spacecraft (SC) tetrahedron, while the FOTE method can find a null both inside and outside the tetrahedron and also deduce its drift velocity. In addition, the FOTE method can (1) avoid limitations of the PI method such as data resolution, instrument uncertainty (Bz offset), and SC separation; (2) identify 3D null types (A, B, As, and Bs) and determine whether these types can degenerate into 2D (X and O); (3) reconstruct the magnetic field topology. We quantitively test the accuracy of FOTE in positioning magnetic nulls and reconstructing field topology, by using the data from 3D kinetic simulations. The influences of SC separation (0.05~1 d_i) and null-SC distance (0~1 d_i) on the accuracy are both considered. We find that: (1) for an isolated null, the method is accurate when the SC separation is smaller than 1 d_i, and the null-SC distance is smaller than 0.25~0.5 d_i; (2) for a null pair, the accuracy is same as in the isolated-null situation, except at the separator line, where the field is nonlinear. We define a parameter in terms of the eigenvalues of the null to quantify the quality of our method—the smaller this parameter the better the results. Comparing to the previously used one, this parameter is more relevant for null identification. Using the new method, we reconstruct the magnetic field topology around a radial-type null and a spiral-type null, and find that the topologies are well consistent with those predicted in theory. We therefore suggest using this method to find magnetic nulls and reconstruct field topology with four-point measurements, particularly from Cluster and the forth-coming MMS mission. For the MMS mission, this null-finding algorithm can be used to trigger its burst-mode measurements.

Keywords: Magnetic null, MMS mission, Magnetic reconnection, Topology , Reconstruction


IBI (nT)
3
2
1
0

広範囲にわたって持続する磁気リコネクション時の磁気圏界面の構造：GeotailとMMSの共同観測
Structure of the magnetopause during quasi-continuous spatially-extended magnetic reconnection: Geotail and MMS conjunction on 2015-10-02

*長谷川 洋[1]、北村 成寿[1]、斎藤 義文[1]、篠原 育[1]、横田 勝一郎[1]、長井 嗣信[2]、銭谷 誠司[3]、The MMS team
*Hiroshi Hasegawa[1], Naritoshi Kitamura[1], Yoshifumi Saito[1], Iku Shinohara[1], Shoichiro Yokota[1], Tsugunobu Nagai[2], Seiji Zenitani[3], The MMS team

1.宇宙航空研究開発機構宇宙科学研究所、2.東京工業大学、3.国立天文台
1.Institute of Space and Astronautical Science, Japan Aerospace Exploration Agency, 2.Tokyo Institute of Technology, 3.National Astronomical Observatory of Japan

We present observations on 2 October 2015 when Geotail, near the Earth’s equatorial plane, and Magnetospheric Multiscale (MMS), at mid-southern latitudes, simultaneously traversed the Earth’s postnoon magnetopause and detected southward magnetic reconnection jets under southward interplanetary magnetic field (IMF) conditions. Such fortuitous observations allow us to estimate the length of the reconnection site, and to reveal spatial evolution of the jets along the magnetopause. Our observations show that the primary reconnection X-line under modest solar wind Alfven Mach number condition can be extended over a wide range of local time and remain active for hours. During a due southward IMF interval when anti-parallel reconnection was occurring, MMS encountered a localized ion-scale current sheet within the jet far downstream (>300 ion inertial lengths) of the primary reconnection site. The current sheet contained super-Alfvenic perpendicular electron flow, perpendicular electric current of order 500 nA/m^2, electron flow reversal, and both Hall current and Hall magnetic field signatures. The observations are consistent with the occurrence of secondary reconnection within the jets of quasi-continuous spatially-extended reconnection. It appears that the primary site of magnetopause reconnection under favorable conditions is two-dimensional, but the resulting reconnection jets and secondary reconnection are three-dimensional.

キーワード：磁気リコネクション、磁気圏界面、イオン拡散領域
Keywords: magnetic reconnection, magnetopause, ion diffusion region

Shift of the magnetopause reconnection line to the winter hemisphere under southward IMF conditions: Geotail and MMS observations

Shift of the magnetopause reconnection line to the winter hemisphere under southward IMF conditions: Geotail and MMS observations

*北村 成寿[1]、長谷川 洋[1]、斎藤 義文[1]、篠原 育[1]、横田 勝一郎[1]、長井 嗣信[2]、Pollock Craig[3,4]、Giles Barbara[3]、Moore Thomas[3]、Torbert Roy[5]、Russell Christopher[6]、Strangeway Robert[6]、Burch James[7]
*Naritoshi Kitamura[1], Hiroshi Hasegawa[1], Yoshifumi Saito[1], Iku Shinohara[1], Shoichiro Yokota[1], Tsugunobu Nagai[2], Craig J Pollock[3,4], Barbara L Giles[3], Thomas E Moore[3], Roy B Torbert[5], Christopher T Russell[6], Robert J Strangeway[6], James L Burch[7]

1.宇宙航空研究開発機構 宇宙科学研究所、2.東京工業大学、3.NASA ゴダード宇宙センター、4.Denali Scientific、5.ニューハンプシャー大学、6.カリフォルニア大学ロサンゼルス校、7.サウスウエスト研究所
1.Institute of Space and Astronautical Science, Japan Aerospace Exploration Agency, 2.Tokyo Institute of Technology, 3.NASA Goddard Space Flight Center, 4.Denali Scientific, 5.University of New Hampshire, 6.University of California, Los Angeles, 7.Southwest Research Institute

Recent global modeling studies and remote observations have indicated that the location of the dayside magnetopause reconnection line under southward interplanetary magnetic field (IMF) conditions tend to shift toward the winter hemisphere from the subsolar point owing to the effect of geomagnetic dipole tilt. We examined this idea using the data obtained by the Geotail and MMS (Magnetospheric Multi Scale mission) spacecraft near the GSM Z = 0 plane under southward IMF conditions. Around 0213 UT on 18 November 2015, the MMS spacecraft observed southward reconnection jets at the subsolar magnetopause (GSM Z = -0.33 R_E) under southward and dawnward IMF conditions. We estimated the plane of the magnetopause current sheet using the minimum variance analysis of current densities that were derived by the curlometer technique. The N axis of the LMN coordinates was defined as the normal to this plane. The L axis was defined as the nearest direction in this plane from the maximum variance direction of magnetic fields. Using the ratio between the N and L components of the magnetic field, the reconnection rate was estimated to be 0.03. The distance between the ion edge and the center of the current sheet (weakest magnitude of the magnetic field) was estimated as ~540 km, using the N component of the deHoffmann-Teller velocity and the time period between the two. On the basis of the estimated distance and reconnection rate, the reconnection line was ~2.8 R_E northward from the MMS. This corresponds to GSM Z ~ 2.5 R_E. About 30 minutes later, the Geotail spacecraft also observed southward reconnection jets at the dawnside magnetopause even though Geotail was in the northern hemisphere (GSM Z = 1.3 R_E). The effect of IMF B_y was very small around this time, since the MMS spacecraft observed purely southward directed magnetic fields in the magnetosheath. These observations are consistent with the idea that the dayside magnetopause reconnection line shifts toward the winter hemisphere under southward IMF conditions.

キーワード：MMS衛星群、磁気リコネクション、磁気圏界面、Geotail衛星
Keywords: MMS spacecraft, magnetic reconnection, magnetopause, Geotail spacecraft

Locations of Magnetopause Magnetic Reconnection: The Role of Magnetosheath Plasma Pressure

*Hui Zhang[1], Zuyin Pu[2], Jianyong Lu[3], Suiyan Fu[2], Changbo Zhu[1], Chongjing Yuan[1], Zhaodi Zhou[1], Weixing Wan[1], Libo Liu[1], Yiding Chen[1], Huijun Le[1]

1.Institute of Geology and Geophysics, Chinese Academy of Sciences, 2.School of Earth and Space Sciences, Peking University, 3.College of Math & Statistics, Institute of Space Weather, Nanjing University of Information Science and Technology

Question of where magnetic reconnection (MR) occurs or equivalently what mechanisms control the initiation of MR on the dayside magnetopause is intensively studied but not fully understood. Here, a novel statistic study reveals that magnetosheath thermal pressure maximizes near the subsolar point, its location, however, is modified by the dipole tilt angle in a manner the same as MR locations are. The maximum sheath thermal pressure, cooccurring with the enhanced magnetic pressure immediately inside the magnetopause, is though to be linked to a maximum magnetopause current density, where tearing mode instabilities tend to develop and MR initiates. The high pressure region shifts from the subsolar region due to magnetopause reshaping when the dipole tilt angle varies. The sheath flow stagnation point, however, remains unchanged at the subsolar point, and Xlines thus are embedded within sub Alfvenic sheath flows and are convected toward high latitudes. The successive Xlines may thus generate flux ropes.

Keywords: Magnetopuse, Magnetic Reconnection, Pressure

MMS衛星観測に基づく磁気圏界面構造とケルビン-ヘルムホルツ不安定性に与える影響の研究
Structure of the magnetopause observed by MMS and its effects on the Kelvin-Helmholtz instability

*関 華奈子[1]、松本 洋介[2]、北村 成寿[3]、斎藤 義文[3]、横田 勝一郎[3]、星野 真弘[1]、Pollock Craig J.[4,5]、Giles Barbara L.[5]、Moore Thomas E.[5]、Torbert Roy B.[6]、Russell Christopher T.[7]、Burch James L.[8]
*Kanako Seki[1], Yosuke Matsumoto[2], Naritoshi Kitamura[3], Yoshifumi Saito[3], Shoichiro Yokota[3], Masahiro Hoshino[1], Craig J. Pollock[4,5], Barbara L. Giles[5], Thomas E. Moore[5], Roy B. Torbert[6], Christopher T. Russell[7], James L. Burch[8]

1.東京大学大学院理学系研究科、2.千葉大学大学院理学研究科、3.JAXA宇宙科学研究所、4.Denali Scientific、5.NASA Goddard Space Flight Center、6.University of New Hampshire、7.University of California, Los Angeles、8.Southwest Research Institute
1.Graduate School of Science, University of Tokyo, 2.Graduate School of Science, Chiba University, 3.ISAS, JAXA, 4.Denali Scientific, 5.NASA Goddard Space Flight Center, 6.University of New Hampshire, 7.University of California, Los Angeles, 8.Southwest Research Institute

How to cause plasma mixing across different plasma regimes has been one of the fundamental problems in the collisionless plasma physics. At a plasma boundary where different plasma regimes are in contact, there often exists a velocity shear and a density gradient. The Kelvin-Helmholtz instability (KHI) has been studied as a promising mechanism to cause the plasma mixing. Although the importance of the density gradient in the plasma transport acress the Earth’s magnetopause has previously been pointed out, the detailed structure of the boundary remains unknown due to lack of high-cadence observations across the magnetopause. Based on high time-resolution observations of ions and electrons as well as simultaneous magnetic field by MMS, we investigated the relations between the density gradient and velocity shear at the magnetopause. Based on the observed structure, we implemented a new initial condition for KHI simulations, and effects of the boundary structure on KHI excitation and subsequent plasma mixing is discussed.

キーワード：磁気圏界面、境界層、ケルビン-ヘルムホルツ不安定性、プラズマ混合、密度勾配、MMS
Keywords: magnetopause, boundary layer, Kelvin-Helmholtz Instability, plasma mixing, density gradient, MMS

MMS衛星とEISCATレイダーによる昼側高速流の観測
MMS satellites and EISCAT radar observations of dayside flow bursts.

*家田 章正[1]、小川 泰信[2]、大山 伸一郎[1]、北村 成寿[3]、斎藤 義文[3]、横田 勝一郎[3]、長谷川 洋[3]、田口 聡[4]、細川 敬祐[5]、町田 忍[1]、内野 宏俊[4]、堀 智昭[1]、Pollock C.[6]、Giles B.[6]、Moore T.[6]、Russell C.[7]、Strangeway R.[7]、中村 るみ[8]、Burch J.[9]
*Akimasa Ieda[1], Yasunobu Ogawa[2], Shin-ichiro Oyama[1], Naritoshi Kitamura[3], Yoshifumi Saito[3], Shoichiro Yokota[3], Hiroshi Hasegawa[3], Satoshi Taguchi[4], Keisuke Hosokawa[5], Shinobu Machida[1], Hirotoshi Uchino[4], Tomoaki Hori[1], C. J. Pollock[6], B. L. Giles[6], T. E. Moore[6], C. T. Russell[7], R. J. Strangeway[7], Rumi Nakamura[8], J. L. Burch[9]

1.名古屋大学 宇宙地球環境研究所、2.国立極地研究所、3.宇宙科学研究所、4.京都大学、5.電気通信大学、6.NASA Goddard Space Flight Center、7.University of California, Los Angeles、8.Space Research Institute, Austrian Academy of Sciences、9.Southwest Research Institute
1.Institute for Space-Earth Environmental Research, Nagoya University, 2.National Institute of Polar Research, 3.Institute of Space and Astronautical Science, 4.Kyoto University, 5.University of Electro-Communication, 6.NASA Goddard Space Flight Center, 7.University of California, Los Angeles, 8.Space Research Institute, Austrian Academy of Sciences, 9.Southwest Research Institute

A magnetic flux transfer event (FTE) was compared with ground radar observations of ionospheric ion flow bursts. Magnetospheric multiscale (MMS) satellites were located near the subsolar magnetopause at approximately 1049 UT on 15 December 2015. MMS satellites observed a southward turning of the interplanetary magnetic field (IMF), followed by a FTE 20 minutes later, and MMS entered the magnetosphere a further 10 minutes later. The European incoherent scatter (EISCAT) VHF radar at Tromso (Norway) was pointed to geographic north, with an elevation angle of 30 degrees, and was monitoring the ionospheric F region between 68 and 72 MLAT at 13 MLT. The Tromso radar did not observe an ionospheric flow burst at the time of the IMF southward turning but instead at the time of the FTE. A 630 nm all-sky imager at Longyearbean (74 MLAT, Norway) observed several poleward moving auroral forms (PMAFs) originating near 74 MLAT but none below 73 MLAT. The most significant PMAF accelerated and became enhanced approximately 3 minutes before the observation of the FTE. FTEs are usually associated with ionospheric flow bursts near the cusp and higher latitudes. In this particular case, it is suggested that the FTE is also associated with an ionospheric flow burst in subauroral latitudes. Such a subauroral flow burst may indicate a rarefaction inflow into the cusp and may occur when significant magnetic flux is removed by a FTE.

キーワード：リコネクション、MMS、EISCAT
Keywords: reconnection, MMS, EISCAT

