Jets downstream of collisionless shocks
Proposal to the International Space Science Institute
2015 Call for International Teams in Space Science
Team leader: Ferdinand Plaschke, Austria
Co-leader: Heli Hietala, United Kingdom

Summary
Magnetospheric processes are highly dependent on the solar wind input to the magnetosphere. More precisely, it is the magnetosheath plasma that is in direct contact with the outer magnetospheric boundary, the magnetopause. One of the geo-effective magnetosheath phenomena are localized transient enhancements in density and/or dynamic pressure (called, e.g., jets or plasmoids) that cannot be explained by direct solar wind driving. These jets shall be the subject of the proposed team effort. Their occurrence should not be restricted to the Earth’s magnetosheath. Instead, the phenomenon should be universal, downstream of collisionless shocks.

Recent statistical studies have shown that many of these transients occur downstream of the quasi-parallel bow shock, linking them to processes in the foreshock or at the shock itself. However, statistical findings also imply that different types of jets/plasmoids exist, which feature a range of characteristics and may be associated to a number of different source mechanisms proposed in many case studies. Yet these studies were based on differing definitions of transients, have used varying terminology, methodology, data sets/simulations, and yielded, not unexpectedly, differing results on origin and characteristics of jets. In any case, the jets/plasmoids appear to be plasma entities that flow through an ambient plasma of different characteristics. They share this fundamental property with magnetotail bursty bulk flows, to which they have not been compared to date.

So far, different groups studying jets/plasmoids (including source regions/mechanisms and jet impacts) have been largely disconnected from each other. Consequently, the findings in this field currently resemble pieces of a puzzle rather than a full picture. Our aim is to bring existing and new pieces together in order to construct that picture. We will do so: by compiling a comprehensive review article; by initiating teamwork between researchers familiar with data analysis and simulations, to reconcile findings from both approaches; and by launching interdisciplinary collaborations to significantly advance our understanding of the nature of jets/plasmoids and bursty bulk flows. In order to achieve these objectives, we bring together a strong team, composed by top tier researchers from 7 different countries. Our team’s combined expertise covers all areas relevant to the proposed research. The team is, hence, in a unique position to overcome present shortcomings of individual approaches to the jet/plasmoid phenomenon.

Scientific rationale, goals, and timeliness of the project
The Earth’s magnetosphere constitutes a highly coupled and dynamic system. The evolution of that system is strongly dependent on the upstream solar wind conditions, which magnetospheric processes are often related to. However, it is not the pristine solar wind that is in direct contact with the outer boundary of the magnetosphere, the magnetopause. Instead, the solar wind plasma is decelerated at the bow shock upstream of the magnetopause from super-magnetosonic to sub-magnetosonic speeds, and it flows around the magnetosphere within the magnetosheath region (e.g., Spreiter et al., 1966). That shocked, inhomogeneous magnetosheath plasma and the magnetic field embedded in it constitute the true inputs to the magnetospheric system. These inputs are highly dependent on the wealth of phenomena inherent to the foreshock, bow shock, and magnetosheath regions.

One class of such phenomena are (localized) transient enhancements in the density and/or dynamic pressure downstream of the shock that cannot be explained by direct solar wind driving (see Figure 1). Originally, these were given the name “transient flux enhancements” by Nemecek et al. (1998), but they are also often called “magnetosheath high-speed jets” (e.g., Hietala et al., 2009; Plaschke et al., 2013), “fast plasmoids” (e.g., Karlsson et al., 2012; Gunell et al., 2014), “super-magnetosonic streams” (Savin et al., 2012), or “high dynamic pressure/kinetic energy pulses” (e.g., Amata et al., 2011; Archer et al., 2012).
These jets/plasmoids shall be the subject of our proposed team effort. In the following paragraphs we will outline: why these jets are relevant; what we know about them; what the shortcomings of previous investigations were; and how ISSI can be most valuable in helping us overcome those and construct a comprehensive picture of jets/plasmoids downstream of collisionless shocks.

Relevance of jets
When jets/plasmoids impact the magnetopause, they may cause localized, large amplitude boundary indentations (e.g., Shue et al., 2009; Amata et al., 2011; Dmitriev and Suvorova, 2012). These may result in magnetopause surface waves and/or low-frequency, compressional waves within the dayside magnetosphere (Plaschke et al., 2009; Plaschke and Glassmeier, 2011; Archer et al., 2013), which can excite field-line resonances (Samson et al., 1971; Chen and Hasegawa, 1974; Southwood, 1974), modify drift paths of radiation belt electrons (e.g., Elkington, 2003), and even lead to rapid loss of these electrons via magnetopause shadowing (Loto'aniu et al., 2010; Turner et al., 2012). The impact of jets on the magnetopause may also trigger local reconnection and flux transfer events (Karimabadi et al., 2014), in agreement with enhanced high latitude convection reported by Hietala et al. (2012). Furthermore, the jets/plasmoids may directly end up within the magnetosphere, due to impulsive penetration (e.g., Karlsson et al., 2012).

Jets/plasmoids are conceptually interesting as they provide long-range correlations from foreshock and shock processes to downstream phenomena, at the magnetopause and in the magnetosphere (Savin et al., 2012). At Earth, they facilitate (localized) energy, mass, and momentum coupling between regions up- and downstream of the dayside magnetosheath, over considerable distances with respect to the overall size of the magnetosphere. Moreover, these jets should be universal, occurring downstream of collisionless planetary, helio-, and astrophysical shocks. For instance, Saturn’s bow shock can have ideal conditions for spontaneous jet formation (Masters et al., 2013), while the interaction of the heliospheric current sheet with the termination shock has been shown to create jets (Opher et al., 2003, 2004). The Earth’s magnetosheath, though, remains the only environment in which jets/plasmoids can be studied by in-situ multi-spacecraft observations.

Sources and characteristics
The only two major statistical studies on these jets (Archer and Horbury, 2013; Plaschke et al., 2013) have benefited from multi-spacecraft (THEMIS) magnetosheath observations. Both studies agree that steady radial interplanetary magnetic field conditions are most favorable for jet occurrence. Hence, a larger fraction of jets appears to originate from the quasi-parallel shock or the upstream foreshock region. One possibility for jet formation in agreement therewith is related to bow shock rippling: The quasi-parallel shock is believed to be dynamically formed and reformed by foreshock structures that steepen in front of the nominal shock position (e.g., Schwartz and Burgess, 1991; Lucek et al., 2008; Omidi et al., 2005; Blanco-Canó et al., 2009). Consequently, the shock is not uniform and even, but patchy or rippled. Solar wind plasma entering the magnetosheath through locally inclined shock surfaces (at the ripples) will be less thermalized, i.e., faster than the ambient plasma, constituting the jets seen in the magnetosheath (Hietala et al., 2009, 2012; Hietala and Plaschke, 2013).

Statistical findings, however, also show a range of jet properties, suggesting different generation mechanisms, evolution downstream of the shock, and varying impacts on the magnetopause and magnetosphere. For instance, a sizeable number of jets are observed behind the quasi-perpendicular shock. Similarly, some jets are associated to changes in IMF direction rather than the predominantly steady solar wind conditions jets are typically observed under. Thus, it seems likely that only a combination of different sources can explain the entirety of the observed jets.

Different sources of magnetosheath jets have indeed been proposed and discussed in a number of case studies. For instance, rotational discontinuities in the IMF may interact with the bow shock and/or with solar wind ions that are reflected back upstream from the bow shock (e.g., Omidi and Sibeck, 2007; Turner et al., 2013). As shown by simulations of Lin et al. (1996a, 1996b), such an interaction may produce enhancements in dynamic pressure in the magnetosheath, along the discontinuity plane (see, Archer et al., 2012; Dmitriev and Suvorova, 2012). Discontinuities in the IMF may also trigger hot flow anomalies in the foreshock (e.g., Schwartz et al., 2000; Omidi and Sibeck, 2007). As these may constitute obstacles to the solar wind flow, jets may be created as a response to their occurrence (Savin et al., 2012; Archer et al., 2014). Magnetosheath jets may also result from reconnection at the magnetopause (e.g., Eastwood et al., 2014).

All these case studies show how diverse reasons for transient enhancements in dynamic pressure/density may be. Unfortunately, the studies are hard to compare, as they are based on vastly differing data sets or simulations, and use different methodology and definitions of transients. Hence, not unexpectedly, the resulting interpretations on the origins and nature of jets/plasmoids also vastly differ.
Scale sizes and morphology

Similar challenges appear when studying scale sizes and morphology of jets/plasmoids. Typical estimates of the spatial sizes of the dynamic pressure or density enhancements are on the order of 1 Earth radius (e.g., Savin et al., 2008; Hietala et al., 2012; Archer et al., 2012; Karlsson et al., 2012; Plaschke et al., 2013), whereby the spread reported within studies and also from study to study is quite large (± an order of magnitude). Furthermore, multi-spacecraft analyses of Karlsson et al. (2012) and Gunell et al. (2014) seem to indicate that jets/plasmoids are pancake or cigar shaped plasma entities that traverse the magnetosheath flat side first (see Figure 2c).

This assertion is in stark contrast with simulation results by Karimabadi et al. (2014) that allow for a global view on the generation, and evolution of jets in the magnetosheath (see Figures 2a and b). In their simulations, jets do not penetrate straight through the sheath, but are bent and deflected. Consequently, they should look more like serpentine fast flows, elongated in propagation direction, embedded in the ambient plasma. Simulation results, in general, and this picture, in particular, need to be reconciled with the observations.

Comparison to bursty bulk flows (BBFs)

The jets/plasmoids consistently appear to be plasma entities that flow through an ambient plasma of different characteristics. They share this fundamental property with magnetotail bursty bulk flows (BBFs, Baumjohann, 1993; Angelopoulos et al., 1994), to which they have not been compared to date. Jets and BBFs, both appear to push ambient plasma away on their passage (e.g., Panov et al., 2010). However, while jets are mainly characterized by their dynamic pressure, that quantity is of minor importance for tail BBFs, which are shaped by an interplay of magnetic and thermal pressure forces. In fact, BBFs are defined by a magnetic flux bundle, which accelerates the plasma earthward. Correspondingly, currents flow on the interface between the BBF and the ambient tail plasma (e.g., Liu et al., 2013). It remains to be studied if jets also feature a distinct magnetic field configuration and currents on their boundaries, and how significant magnetic forces (field line draping and plasma beta effects) are in shaping jets. Consequently, comparative studies of jets and BBFs should be quite fruitful in order to unravel the fundamental physics governing plasma jet propagation, evolution, and impacts in different parameter ranges.

Goals and proposed team effort

So far, different groups studying magnetosheath jets/plasmoids, including jet sources and impacts, have been largely disconnected from each other, even more so from groups working on BBFs. Consequently, findings in this field currently resemble pieces of a puzzle rather than a full picture. Our aim is to bring the existing and new pieces together in order to construct that comprehensive picture. Together, we will seek answers to the following science questions:

1) What types of jets/plasmoids exist in terms of characteristics and generation mechanisms?
2) How do they evolve? How do they interact with the ambient (magnetosheath) plasma, and with the magnetopause?
3) What are their similarities with and differences from bursty bulk flows? What can we learn from a comparative approach in terms of jet/plasmoid physics?

We will seek answers to these question in three steps: First, we propose to work on a review of the current knowledge, by compiling, discussing, and finally putting together the puzzle pieces that individual researchers
and groups can contribute to the team. Secondly, we propose to start collaborations between groups working on simulations and observation analysis. Thereby, we seek to reconcile findings obtained with these two approaches to obtain a global picture/understanding of jet creation, evolution, and impact. Thirdly, we propose to start building a bridge between the communities that study (magnetosheath) jets/plasmoids and magnetotail BBFs, for the mutual benefit to both communities, to enhance our understanding of the fundamental physics underlying both (distinct, but related) phenomena.

**Timeliness**

The timeliness of our proposal stems from the recent advances in simulation and observational studies that make possible an efficient and productive multi-disciplinary approach on the phenomenon. The statistical studies by Archer and Horbury (2013) and Plaschke et al. (2013) yield the basis for differentiating various types and source mechanisms of jets. Recent simulations by Karimabadi et al. (2014) have shown for the first time, how jets may look like on a global scale. The simulations provide new testable features that can now be compared to observations.

Furthermore, the set of in-situ magnetosheath observations will soon be complemented by multi-spacecraft measurements from the Magnetospheric Multi-Scale (MMS) mission, launched on March 12, 2015. The four MMS spacecraft will fly in a tetrahedral configuration, studying kinetic scale physics of magnetic reconnection. The first two winters of the primary mission focus on dayside magnetopause reconnection and MMS may observe jets impinging on the magnetopause. Thus it will be crucial to understand magnetosheath transients as a boundary condition. This period may also give us the first opportunity to contrast kinetic scale (e.g., PIC and Vlasov-hybrid) simulations of jets with state-of-the-art MMS measurements. The first dayside season during which the spacecraft actually traverse the magnetosheath (after reaching high apogees in 2017) is going to start after the project is completed. Hence, our results can be used to conceive optimal data retrieval strategies for this later science season.

**Expected output and impacts**

Based on our discussions at ISSI, we expect to compile our views and current understanding of the generation mechanisms, evolution, and impact of magnetosheath jets/plasmoids into one comprehensive review paper. This paper will be written over the course of the project, and should be submitted to a major peer-reviewed journal during the last team meeting or shortly after. We envision all team members and young scientists of our team to be coauthors of this paper.

Secondly, we expect a number of papers to result from collaborations among individual team members. In particular, we expect major progress from simulations of magnetosheath jets, comparisons of different simulation methods to determine what key physics are involved, comparisons between simulations and observations and between jet and BBF physics. The team will also provide a venue to compare and benchmark, for the first time, state-of-the-art global kinetic simulations of the dayside magnetosphere.

Thirdly, we expect the understanding of the phenomenon of magnetosheath jets/plasmoids to be significantly advanced. In particular, we anticipate major progress in understanding how these structures, localized in time and/or space, contribute to mass, momentum, and energy transport from the foreshock, bow shock, and magnetosheath, to the magnetopause and into the inner magnetosphere. Correspondingly, our findings will directly contribute to the magnetospheric research community, studying magnetopause reconnection, ultra-low frequency waves (such as field-line resonances), drift paths of radiation belt electrons and/or radiation belt losses due to magnetopause shadowing.

Lastly, we expect to contribute to the data-analysis of the MMS mission and positively influence the planning of data retrieval strategies for its later dayside season. Therewith, we seek to lay the ground for the acquisition of kinetic scale multi-spacecraft measurements of jets for future studies.

**Added value from ISSI**

As stated above, individual researchers and groups have largely been working separately from each other, so far. The main purpose of our proposed project is to overcome this situation, in order to come up with a comprehensive picture of transients (jets/plasmoids) in the solar wind-magnetosphere interaction region. This purpose is optimally served by face-to-face meetings at ISSI of top tier researchers who work on observations, simulations, and theory, from both the jet and BBF communities. ISSI is able to provide us with a unique meeting place that allows us to focus entirely on: putting the comprehensive picture on sheath jets/plasmoids together; conducting comparative multi-disciplinary research; building new collaborations among team members and beyond.
Confirmed team members

In order to achieve our objectives, we bring together a strong, multi-disciplinary team comprised by the following 10 members and 1 confirmed young scientist from 7 countries:

<table>
<thead>
<tr>
<th>Name</th>
<th>Institute/University</th>
<th>Country</th>
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<tbody>
<tr>
<td>Ferdinand Plaschke</td>
<td>Space Research Institute</td>
<td>Austria</td>
</tr>
<tr>
<td>Heli Hietala</td>
<td>Imperial College,</td>
<td>UK</td>
</tr>
<tr>
<td>Xochitl Blanco-Cano</td>
<td>Universidad Nacional Autónoma de México,</td>
<td>Mexico</td>
</tr>
<tr>
<td>Primoz Kajdic</td>
<td>Universidad Nacional Autónoma de México,</td>
<td>Mexico</td>
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<tr>
<td>Tomas Karlsson</td>
<td>KTH Royal Institute of Technology,</td>
<td>Sweden</td>
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<tr>
<td>Nick Omidi</td>
<td>Solana Scientific Inc.,</td>
<td>USA</td>
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<tr>
<td>Minna Palmroth,</td>
<td>Finnish Meteorological Institute,</td>
<td>Finland</td>
</tr>
<tr>
<td>Vadim Roytershteyn,</td>
<td>Space Science Institute,</td>
<td>USA</td>
</tr>
<tr>
<td>Viktor Sergeev,</td>
<td>St. Petersburg State University,</td>
<td>Russia</td>
</tr>
<tr>
<td>David Sibeck</td>
<td>NASA Goddard Space Flight Center,</td>
<td>USA</td>
</tr>
<tr>
<td>Martin Archer (young scientist),</td>
<td>Imperial College,</td>
<td>UK</td>
</tr>
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Our combined expertise covers all the relevant areas: theory and multi-spacecraft observations of solar wind, foreshock, bow shock, magnetosheath, magnetopause, and magneto-sphere/magnetotail processes and interactions; multi-spacecraft analysis techniques; jet and BBF statistics; MHD, particle-in-cell (PIC), PIC-hybrid, and Vlasov-hybrid simulations, as well as their interpretation and comparison to observations. The pre-existing collaborations among some team members indicate that the working atmosphere will be productive and efficient in general, as well as during the face-to-face meetings at ISSI in particular. Our team is, hence, in a unique position to address the key scientific questions by following the three step approach detailed above.

Schedule of the project

We propose to meet three times at the ISSI facilities in Bern. The meetings would take place in fall 2015 (one week), spring 2016 (three days), and lastly, in fall 2016 (three days). The goals for the meetings are the following:

- **2015 fall meeting (one week):**
  - Inspection of older and recent simulations and observations, definition of the structure of the review paper, determination of the leading authors and contributing collaborators for the various paper sections/topics.
  - Initiation of inter-disciplinary collaborations between team members to work on specific topics: e.g., identification of features in simulations to contrast with observations, development of new simulation set-ups and analysis tools to address specific questions originating from observational studies, contrasting of theory/observations of jets and BBFs.

- **2016 spring meeting (three days):**
  - Discussion of progress on inter-disciplinary efforts, rough drafting of corresponding papers.
  - Assessment of the review paper status, update of its content in light of discussions and new results.

- **2016 fall meeting (three days):**
  - Presentation and discussion of work on multi-disciplinary topics.
  - Final input to research papers. Final touch-up and submission of review paper.
  - Discussion of future collaborations and input to MMS dayside season data acquisition planning.

Between meetings, we will hold regular teleconferences to monitor and discuss the work progress.

Facilities required

We will require access to a wireless network and the internet. We expect most participants to bring a laptop. For students and unexpected needs we would like to have access to one computer/laptop. We will also need access to a printer and a meeting room for about 15 people. The room should be equipped with projection facilities and a white board. ISSI staff will be welcome to participate in our meetings. We may also use teleconferencing/skype, in case team members may not be able to attend one meeting.

Financial support requested

For our proposal, we just require the standard financial support package for international teams, which shall cover the travel costs of the team leader (approx. 250 €), plus hotel costs and per diem for all team members for the three meetings (lasting 1x one week and 2x three days). The hotel and per diem costs for the young scientists (Martin Archer and further young scientists to be identified once the proposal is selected) shall not exceed 20% of the financial means allotted to the team members.
Addresses of participants

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References


8
Ferdinand Plaschke

Professional preparation
2007  Diploma, Physics, Technische Universität (TU) Braunschweig, Germany
2011  Doctorate, Natural Sciences, TU Braunschweig, Germany

Appointments
2007 – 2011  Researcher and doctoral student, TU Braunschweig, Germany
2007 – 2011  Member IMPRS, Max-Planck-Institute for Solar System Research, Germany
2011 – 2012  Assistant Researcher, University of California Los Angeles, USA
2013 – 2013  External Lecturer, Univ. of Applied Sciences Wiener Neustadt, Austria
2013 – 2013  External Lecturer, TU Graz, Austria

Mission involvements, honors and awards
JUICE MAG team science Co-investigator
THEMIS flux-gate magnetometer (FGM) in-flight calibration and data processing activities, FGM team, 2008-
MMS magnetometer and electron drift instrument cross-calibration activities, digital flux-gate (DFG) magnetometer team, 2013-
Walter-Kertz-Studienpreis, TU Braunschweig, 2011
Heinrich-Büssing-Award, TU Braunschweig, 2012

Participation in ISSI activities
2008: team on multi-scale electrodynamics of magnetosphere-ionosphere interactions at high latitudes, lead by A. V. Streltsov

Relevant publications (from a total of 27 publications)
Heli Hietala

Professional preparation
2007 MSc, Theoretical Physics, University of Helsinki, Finland
2012 PhD, Theoretical Physics, University of Helsinki, Finland

Appointments
2007 – 2012 Researcher (doctoral student), University of Helsinki, Finland
2012 – Research Associate, Imperial College London, UK

Mission and Committee Involvements, Honors and Awards
Vlasiator, kinetic global simulation, Co-investigator
Outstanding Student Paper Award, Space Physics and Aeronomy Section, AGU 2011
Outstanding Student Poster Award, Solar-Terrestrial Sciences Division, EGU 2011

Participation in ISSI activities
2013: ISSI Workshop on Multi-Scale Structure Formation and Dynamics in Cosmic Plasmas
2013-2015: team on Ion and Electron Bulk Heating by Magnetic Reconnection, funded by ISSI, lead by Tai Phan

Relevant publications (from a total of 16 publications)

Xochitl Guillermina Blanco-Cano

PERSONAL DATA
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CHRONOLOGY OF EDUCATION:
- Bachelor of Science (Physics), Science School, UNAM, México, 1985 - 1990.
- PhD in Astrophysics, Queen Mary and Westfield College, University of London, UK, 1991-1995, Thesis: “Waves and particles upstream of the Earth's Bow Shock”

CHRONOLOGY OF EMPLOYMENT:
- April 1996-August 2001, Space Physics Associate Researcher, Instituto de Geofísica, UNAM, México City, México.
- August 2001-January 2005, Space Physics Researcher, Level A, Departamento de Física Espacial, Instituto de Geofísica, UNAM, México City, México.
- February 2005-February 2010., Space Physics Researcher, Level B, Departamento de Física Espacial, Instituto de Geofísica, UNAM, México City, México.
- March 2010-to present time, Full Professor (Investigador Titular C de tiempo completo), Departamento de Ciencias Espaciales, Instituto de Geofísica, UNAM, México City, México.

APPOINTMENTS

HONORS AND AWARDS:
- Juana de Asbaje Award, UNAM, México, 2005.

PARTICIPATIONS IN ISSI ACTIVITIES

Relevant publications
Primož Kajdič

Education
2002 - Diploma, Faculty of mathematics and physics, University in Ljubljana, Slovenia
2005 - Master, Faculty of Sciences, Institute for Astronomy, Universidad Nacional Autónoma de México, México
2008 - PhD, Faculty of Sciences, Institute for Astronomy, Universidad Nacional Autónoma de México, México

Postdocs and fellowships
- Fellowship position at European Space Research and Technology Centre (ESTEC), European Space Agency, Noordwijk, Holland, December 2013 – December 2015.
- Postdoctoral position at Institut de Recherche en Astrophysique et Planétologie (IRAP) from May 2012 to August 2013 with the STEREO SWEA team.
- Postdoctoral scholarship funded by the research proyect of Conacyt at the Instituto de Geofísica, UNAM, from March 2011 to April 2012.
- Postdoctoral scholarship awarded by the DGAPA in the Instituto de Geofísica, UNAM, during the period March 2009 – February 2011.
- Postdoctoral scholarship awarded by the Conacyt during the period from March 2008 to February 2009 at the Posgrado de Ciencias de la Tierra at the Instituto de Geofísica, UNAM.

Current affiliation
Tenure track, Instituto de Geofísica, Universidad Nacional Autónoma de México, México

Relevant publications (from a total of 21)

Invited talks
'Interplanetary shocks during the solar cycle 24', presentado en IAGA 2013, The XIIth Scientific Assembly, Mérida, México, August 29, 2013

Sessions organized
'Multipoint Measurements in the Solar Wind', AGU, Meeting of Americas, Cancún, México, May 14-17, 2013

Prizes and acknowledgements
First place in the regional contest for the best diploma, 2003.
Graduated with honors, PhD, 2008.
Curriculum Vitae

Tomas Karlsson
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Date of birth: May 15, 1964

Present employment

Educational History
- PhD, Royal Institute of Technology, June, ’02
- Studies at the Institute for Theoretical Physics, Lund University, January ‘91 – December ’91
- BSc, Lund University, May ‘91

Mission involvements, honors and awards
- Teaching Award, ‘En fjäder i hatten’, awarded by the students at the Engineering Science Programme, KTH, 2008.
- Co-I on the Solar Orbiter mission.
- Lead Co-I for the MEFISTO instrument on BepiColombo/ MMO.

Selection of scientific papers
Curriculum Vitae N. Omidi

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Education:
University of Iowa, IA  Industrial & Management Engineering  B. S.  (1979)
University of Iowa, IA  Physics  Ph.D. (1984)
University of Maryland  Postdoctoral Research  1984-1985

Appointments:
Senior Scientist, Solana Scientific Inc., 2005-present
Senior Scientist, SciberNet Inc., 1996-2005
Research Scientist and Lecturer, UCSD, 1993-2005
Associate Research Scientist and Lecturer, UCSD, 1989-1993
Associate Research Scientist, UCLA, 1988-1989
Assistant Research Scientist, UCLA, 1985-1988

Research Activities:
Dr. Omidi is an expert in kinetic plasma simulations and their applications to space physics. He has developed and refined a number of electrostatic and electromagnetic codes. He has extensive experience in numerical modeling of solar wind interaction with magnetized planets and asteroids, as well as, out-gassing comets and active experiments in space. He is internationally known for his use of hybrid simulations to study space plasma phenomena and was an instructor at the Fourth International School for Space Simulation. He has published over 100 articles in refereed journals and scientific books on linear and nonlinear properties of ULF and VLF waves, physics of collisionless shocks and plasma discontinuities, magnetic reconnection, FTEs at the magnetopause, cometary plasma processes and plasma-neutral gas-dust interactions at Enceladus.

Selected Publications:


Minna M. E. Palmroth

Professional preparation
1999  MSc, Physics, University of Helsinki, Finland
2003  PhD, Physics, University of Helsinki, Finland

Appointments
1999 – 2011  Researcher, Finnish Meteorological Institute (FMI), Finland
2004 – 2004  Visiting Scientist, High Altitude Observatory, NCAR Boulder, USA
2005 – 2008  Academy of Finland postdoctoral scientist, FMI, Finland
2008 – 2013  Academy Research Fellow, FMI, Finland
2011 –  Unit head, Earth Observation, FMI, Finland
2013 –  Research professor, FMI, Finland

Mission and Committee Involvements, Honors and awards
Vlasiator, kinetic global simulation, Principal investigator
GUMICS, global MHD simulation, Co-investigator
European Research Council Starting grant 2007, 200141-QuESpace
Partnership for advanced computing (PRACE Europe) Tier-0 awardee 2015
Partnership for advanced computing (PRACE Europe) Tier-0 awardee 2012
European Commission Space programme, Scientific Advisory Group member, 2013-
Cooperation forum member to advise in scientific computing in Finland, representing
Finnish government research institutes, 2013-2015

Participation in ISSI activities
2007-2009: team on GeoSpace at the system level, funded by ISSI, lead by Mark Lester

Relevant publications (from a total of 59 publications)
Von Alfthan, S., Pokhotelov, D., Kempf, Y., Hoilijoki, S., Honkonen, I., Sandroos, A., and
Palmroth, M., Vlasiator: First kinetic global hybrid-Vlasov simulation code for
Wave dispersion in the hybrid-Vlasov model: verification of Vlasiator, Phys. Plasmas,
Palmroth, M., Honkonen, I., Sandroos, A., Kempf, Y., von Alfthan, S., and Pokhotelov, D.,
Preliminary testing of global hybrid-Vlasov simulation: Magnetosheath and cusps
under northward interplanetary magnetic field, J. Atm. Solar Terr. Phys., 99, 41-46,
Palmroth, M., Laitinen, T. V., Anekallu, C. R., Pulkkinen, T. I., Dunlop, M., Lucek, E. A., and
Dandouras, I., Spatial dependence of magnetopause energy transfer: Cluster
Palmroth, M., Koskinen, H. E. J., Pulkkinen, T. I., Toivanen, P. K., Janhunen, P., Milan, S. E.,
and Lester, M., Magnetospheric feedback in solar wind energy transfer, J. Geophys. Res,
Palmroth, M., Partamies, N., Polvi, J., Pulkkinen, T.I., McComas, D. J., Barnes, R. J.,
coupling efficiency for solar wind pressure impulses, Geophys. Res. Lett., 34,
Palmroth, M., Pulkkinen, T.I., Janhunen, P., and Wu, C.-C., Stormtime energy transfer in
Vadim Roytershteyn

Professional preparation
1998 M.S., Applied Physics, State Technical University, St. Petersburg, Russia
2007 Ph.D., Physics, Massachusetts Institute of Technology, USA

Appointments
2006 – 2008 Postdoctoral Research Scholar, University of Iowa, USA
2008 – 2011 Postdoctoral Research Associate, Los Alamos National Laboratory, USA
2011 – 2012 Assistant Project Scientist, University of California, San Diego, USA
2012 – 2014 Research Scientist, SciberQuest, Inc, USA
2014 – Research Scientist, Space Science Institute, USA

Participation in ISSI activities
2014: team on kinetic turbulence and heating in the solar wind, lead by F. Sahraoui & D. Sundkvist

Relevant publications (from a total of 30+ publications)
Karimabadi, H., V. Roytersheyn, H.X. Vu, Y.A. Omelchenko et al. (2014), The link between shocks, turbulence, and magnetic reconnection in collisionless plasmas, Phys. Plasmas 21(6), 062308,
W. Daughton, V. Roytershteyn, H. Karimabadi, L. Yin, B. J. Albright, B. Bergen & K. J. Bowers, “Role of electron physics in the development of turbulent magnetic reconnection in collisionless plasmas”, Nature Physics, 7, 539 (2011)
Curriculum Vitae

Viktor Andreevich SERGEEV

Date and place of birth: December 17, 1947, Leningrad (now St. Petersburg), USSR
Nationality: Russian Citizenship: Russia
Home address: Voykova str. 48A, Petrodvoretz, St. Petersburg 198 504, Russia
Affiliation and official address: St. Petersburg State University, Ulyanovskaya 1, St. Petersburg 198504, Russia

Education and degrees
1966(9)-1972(1): Leningrad State University (geophysics)
1971(12): M.S. in geophysics, Dept. of Physics in the Leningrad State University
1975(01): Ph.D. (Cand. of Science) in geophysics from Leningrad State University
1990(02): Doctor of Science degree in geophysics from Leningrad State University

Scientific career and full-time employment:
1974-till present: research in the Laboratory of Magnetospheric Physics, at the Institute of Physics and Physical Faculty, Leningrad State University:
  1974 - 1979 Junior Scientist
  1979 - 1990 Senior Scientist
  1990 - 1997 Leading Scientist
  1997 - present Professor, St. Petersburg State University

Speciality: Space Physics, Magnetospheric Physics with emphasize on physics of Substorms, and Magnetotail Physics

International awards:
2004 and 2008 - citations for excellence in refereeing from American Geophysical Union
2008 - Julius Bartels medal of European Geoscience Union for research in solar-terrestrial sciences

Participation in International Projects and activities:
- Coordinator of Ground-Based Observation working group and member of Scientific Committee of INTERBALL project (1985-2001)
- Member of CLUSTER Ground-Based Observation Working Group
- Co-Investigator in THEMIS project
- Associate editor, Journal Geophysical Research Space Physics (2006-2012)

Participation in ISSI activities:
2001: team on Auroral Physics (lead by G. Paschmann);
2006: team on Magnetotail transients (lead by S. Sharma);
2010: team on Substorm Current Wedge revisited (lead by L. Kepko);
2012: team on Magnetotail transients (lead by A. Retino).

Relevant recent publications (from a total of 250 papers).
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NASA/GSFC Positions Held:  

2004-2006  LWS TR&T Project Scientist  
2007-present  LWS Geospace Mission Scientist  
2004-2007  LWS Geospace Project Scientist  
2003-present  THEMIS Project Scientist  

Professional Activities:  

2014-present  President AGU SPA Section  
2011-2013  Chair, NSF GEM steering committee  
2004-2007  Associate Editor, GRL  
2004-2010  Editorial Advisory Board, EOS  
2005-2010  Guest Editor, Advances in Space Research  

Meetings Organized:  

1993  Organizer, IAGA Session on Magnetosheath  
1999  Organizer, IAGA Session on Shock, Sheath, and Magnetopause  
2000  Co-Organizer, NATO Magnetosheath Meeting, Antalya, Turkey  
2003  Co-Organizer, IAGA Magnetopause Session, Sapporo, Japan  

Awards  

1992 AGU Macelwane Award  

Publications: 292 refereed publications (74 first-authored).  

Martin Archer

Education & Qualifications
2010-2014 PhD Space Plasma Physics, Imperial College London, UK
2002-2006 MSci Physics with Theoretical Physics, Imperial College London, UK

Experience
2014 - Visiting Researcher, Imperial College London, UK
2014 - Outreach Officer, Queen Mary University of London, UK
2010 - Freelance Science Writer/Presenter
2014 Research Associate, Imperial College London, UK

Mission involvements, honors and awards
Solar Orbiter MAG calibration activities, Imperial College London, 2014
CINEMA MAGIC instrument in-flight calibration, attitude determination and science capability determination, Imperial College London, 2012-2014
Best Use of Online Video: BBC How to Put a Human on Mars, World Digital Media Awards 2014
Best Use of Online Video: BBC How to Put a Human on Mars, European Digital Media Awards 2014
Outstanding Student Paper Award, Space Physics & Aeronomy, AGU Fall Meeting 2012
STFC Science in Society Small Award: “DJ Physics”, 2011
Calendal Prize 2006, Imperial College London
Royal College of Science Association Prize 2005

Relevant publications (from a total of 11 publications)