ISSI International Research Team proposal on:

"Understanding the Role of Current Sheets in Solar Eruptive Events"

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Abstract

Current sheets (CSs) are a basic prerequisite for magnetic reconnection. The goal of the proposed research is to define current sheet properties in the solar atmosphere and their signatures in the interplanetary medium, and to understand their role in the development of solar eruptive events. The project was inspired by recently acquired ground and space based observations that reveal CSs signatures at the time of flares/CMEs (Coronal Mass Ejections), in the chromosphere, in the corona and in the interplanetary medium. At the same time, theoretical studies predict the formation of CSs in different models/configurations, but theories and observational results have not yet developed an interaction efficient enough to allow us to construct a unified scenario. This proposal aims at maximizing the synergy between observers/data analysts and theoreticians, so as to enable a significant advance in our understanding of current sheet behavior and properties. A further motivation for studying CSs is related to the expected electric fields in CSs that may well be the source of solar energetic particle (SEP) events that create a serious hazard for human beings and their machines. Hence, the refinement of CS models has a pragmatic benefit in helping forecast the production of energetic particles, an issue of growing importance for our present society. Our project also fits perfectly into the scope of the International Heliophysical Year (2007), an international program devoted to understanding the entire interconnected heliophysical system by fostering collaborations among scientists from different countries and specialties.

Scientific rationale of the project: background

Magnetic reconnection has been invoked as the process responsible for small and large–scale solar eruptive events. The presence on the Sun of ubiquitous magnetic fields, and their continual reconfiguration, makes this quite an appealing claim, although direct observational evidence of reconnection is elusive (but see the recent work of Lin et al., 2005). Over the last ten years, however, distinctive signatures of reconnection phenomena have been identified. At chromospheric and low coronal levels, both the observations of bidirectional plasma jets associated with small–scale explosive events (Innes et al., 1997) and, in Active Regions (ARs), of tangential magnetic field discontinuities identified as current sheets (Solanki et al., 2003), bear evidence of reconnection phenomena. At higher coronal levels the long-known presence of hot plasma at the top of newly reconnected loops has been complemented by observations, acquired in the aftermath of flares/coronal mass ejections, of hot plasma in CSs, in agreement with predictions from flare/CME models (Ciaravella et al., 2002, Ko et al., 2003). In the outer corona, thin, bright and narrow rays, visible in white light coronagraphic images in the wake of CMEs have been identified as CSs (Webb et al., 2003) and possible reconnection signatures which persist out to interplanetary distances have been recently pointed out both in Ulysses composition data (Poletto et al., 2004) and in brief intervals of accelerated/decelerated plasma flows in ACE (Advanced Coronal Explorer) data, which have been ascribed to reconnection exhausts (Gosling et al., 2005).

Understanding and fully characterizing reconnection signatures by inferring their physical parameters would be of tremendous help for comprehending the observed phenomena and for their modeling. The above phenomena are different facets of the process responsible for solar eruptive events. To put them in a unified scenario we need to recognize the phenomena as they evolve through the solar atmosphere to the Earth and beyond. We believe that understanding CSs is one of the most important aspects for comprehending the entire eruptive process. Hence, this project focuses on the identification of CS properties from the lower solar atmosphere to distances of the order of a few astronomical units. Taking advantage of the diverse but complementary expertise of the members of the team, our aim is to reach a coherent view of the role of CSs in solar eruptive phenomena and to gain a better understanding of CS physical properties.

The international team represents 5 european countries and the U.S. Its members are experts in observational solar physics (Poletto, Bemporad, Innes, Ciaravella, Webb), interplanetary physics (Von Steiger, Suess, Ko), spectroscopy (Raymond), solar radioastronomy (Aurass), numerical and theoretical modeling of solar events and reconnection processes (Lin, Poedts, Vrsnak, Büchner), with many members bridging over more than one specific field of competence. Establishing a collaboration among the components of the team implies strengthening the multidisciplinary aspects of the research we are proposing.

Scientific rationale of the project: the approach

Observational approach: SOHO experiments and results have advanced the work, still far from being completed, on the remote identification and characterization of CSs, but the *in situ* analysis of the residue of the reconnection process that created the CS has not yet been satisfactorily developed. However, neither remote, nor *in situ* analyses can give *unique* answers unless they are merged and considered as part of the same phenomenon. Since this issue is central to our proposal, *in situ* measurements will be joined with remote observations to convey information on the still-to-be-defined *in situ* signatures of CSs, on the configuration of the region where CMEs originate, and on the mechanism that generates CMEs. The breakout model (see, e.g. Antiochos et al., 1999) predicts reconnection to occur above the flux-rope and, at later times, also below it, while, e.g., the Lin and Forbes (2000) catastrophe model predicts a long CS to extend from the flux rope towards the underlying growing arcade of loops: identification of hot CS plasma ahead of the flux rope in *in situ* data directly links to a CME model. Analysis of composition, ionization state, and energetic particle signatures in the context of the local magnetic field will be used to define the plasma - magnetic field context and to learn whether this is consistent with model predictions and properties of the ejecta inferred from remote observations. This will be done for specific well-observed events and in a statistical analysis of groups of events. Remotely acquired data sources will mainly be SOHO, the MLSO (Mauna Loa Solar Observatory) MK4 coronagraph, TRACE (Transition Region and Coronal Explorer), RHESSI (Reuven Ramaty High Energy Solar Spectroscopic Imager), SMEI (Solar Mass Ejection Imager) and various ground-based magnetographs and radio dynamic spectra and Nancay radioheliograph observations.

Modeling approach: there is specific synergy, as mentioned above, between the observational approach and models of CMEs. In particular, the so-called *a posteriori* approach (Chané, Poedts et al., 2005) aims to reproduce the characteristics of CMEs at the Sun, starting with their *in situ* properties. Simulations of the CSs themselves will be used to understand the observed heating and particle acceleration. Models of CME origins, as mentioned above, will be compared with the *in situ* and remote measurements to test consistency and learn how to use the in situ data to better identify various parts of the ejecta. Also, MHD and kinetic CS simulations will be developed as an independent complementary issue.

Expected outputs

In the following we list key questions that we will address in our project. These will be the focus of papers in refereed international journals and of presentations given at international conferences.

• CS evolution from the Sun into the interplanetary medium: We will consider CS signatures embedded in the solar wind and examine when and under what conditions they are present. Specifically; (i) Are CME reconnection jets identifiable *in situ*? Models of CME evolution from the Sun to 1 AU have shown that jetlike flows beneath a CME may be signatures of posteruptive reconnection below the flux rope (Riley et al., 2002). However, there is not a unique interpretation to the presence of these flows and they should be substantiated by further evidence; (ii) What are the *in situ* CME-related reconnection signatures? (iii) How is the reconnection reflected in the *in situ* ionization state structure within the magnetic field? We plan on using data from past SOHO-Sun-Ulysses quadratures – where the same plasma parcel remotely observed by SOHO is later sampled by *in situ* Ulysses experiments – as well as developing a statistical approach to examining classes of *in situ* and remote phenomena.

• Can we infer from *in situ* observations, CS properties in the corona and the CME production mechanism? Are there crucial observations that would help modelers choose among different CME models? What is the role of CSs in these; Can their behavior help in distinguishing between the flux rope vs. non-flux rope CME classes? The composition/ionization state signatures may help in answering these questions if we can identify the structure within which highly ionized plasma is sampled in the interplanetary medium. This issue links to the CME models because, e.g., the Lin & Forbes (2000) CME model suggests that the CME core should be devoid of highly ionized ions.

• We will ask several questions regarding the magnetic configuration that leads to an eruption: What is the role of pre-event, pre-eruption brightenings observed at transition region/lower corona levels (Büchner et al., 2004)? What leads to the eruption of the pre-CME field configuration? Can we model the evolution of a twisted flux rope, possibly to become a CME, from the time its ends are anchored in the photosphere and underlie an arcade to its eruption? What role does the CS play in the pre-eruption and post-eruption processes? Which is the relationship between the flare and the post-CME CS?

• Physics of CSs: The combined remote and *in situ* measurements, together with a modeling program, will address the following: By which process is the CS plasma heated? What do models suggest (Vrsnak & Skender, 2005)? Adiabatic heating seems to provide the required energy at a late stage of the CS development (Bemporad et al., 2006), but what can we say about earlier stages? Ohmic heating, slow mode shocks, dissipation of turbulence, can be invoked as contributing to the energy budget of the CS. Can we derive a complete energy budget for the CS, by comparing the power released in the flare, the CME kinetic energy, the kinetic energy of the outflow in the CS, and so on, or can we at least nail down a few terms?
Observations of type II radio bursts may provide further information on CSs: the radio signature of reconnection outflow shocks has been identified (Aurass & Mann, 2004). Other data sets can be explored to find further instances of such identification to help understand how radio data fit into the global scenario.

• Models vs. observations: reconnection is a requisite of CME models, however, models of magnetic reconnection need to address the problem of the observational consequences they predict, if we want to check for consistency between models and observations. Specifically, modeling efforts will focus on predicting parameters such as the CS brightness at diffferent heliocentric distances and/or at different viewing angles, the plasma inflow (towards the CS) speed and the plasma outflow (from the reconnection region) speed.

Implementation of the project

Before meeting at ISSI, the members of the team will make a provisional selection of the topics they want to address and will begin identifying events that can be taken as case-instances for discussion and study. At this stage e-mail/phone contacts will be sufficient to reach an agreement.

We plan to have two one-week meetings, at ISSI, with the participation of the whole team, and to end the project within 18 months from its start.

More specifically:
First meeting: individual presentations; identification of specific observational/theoretical objectives and of benchmark data sets; formation of sub-groups with well-defined tasks. At this time, catalogs of events having both remote and *in situ* data will be developed and, separately, catalogs of both well-observed remote CS observations and of well-defined, *in situ* magnetic cloud/ICMEs (Interplanetary CMEs) at Ulysses/ACE/WIND will be developed. The analysis of the events in these three catalogs will be planned and tasks assigned to individual team members.
Second meeting: discussion of results and draft of papers from the project will be the main objective. Results will have been defined, listed and described by the time of the meeting. By the time the program terminates we expect to have papers submitted or published in international refereed journals and the results being presented at international conferences.

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Lin, J., Ko, Y.K., Sui, L. & al. 2005, ApJ 622, 1251

Poletto, G., Suess, S.T., Bemporad, A., & al., 2004, ApJL, 613, L173

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Solanki, S. K., Lagg, A., Woch, J., & al., 2003, Nature, 425, 692

Vrsnak, B. & Skender, M. 2005, SP, 226, 97

Webb, D. F., Burkepile, J., Forbes, T. G., & al. 2003, J. Geophys. Res. 108 (A12), 1440, doi:10.1029/2003JA009923

Reasons for choosing ISSI as implementation site

An obstacle to progress in this field is the geographical spread of scientists interested in the problem. ISSI represents an excellent common ground to bring the U.S. and European communities together and to have theorists interact with observers and share problems while sitting at the same table. Also, ISSI ideally provides for the possibility of analysing data acquired by different spacecraft (SOHO, Ulysses, ACE), enabling for cross-fertilization between interdisciplinary experts.

List of participants

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J. C. Raymond, Harvard-Smithsonian Center for Astrophysics, Cambridge, USA
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R. Von Steiger, ISSI, Bern, Switzerland
B. Vrsnak, Faculty of Geodesy, Zagreb, Croatia
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Schedule of the project

First meeting: October-November 2006 (after the August IAU GA and a number of solar meetings that are scheduled in September/first half of October 2006).
Second meeting: about 12 months after the first meeting.
Completion of the project: April/May 2008.

Facilities required

Computers for data and model handling; access to solar database; IDL language.

Financial situation and requirements from ISSI

Our team consists of 14 members, but no support is required for one participant (R. Von Steiger, ISSI Institute). Hence, ISSI would be required to provide living expenses for 13 team members, two times, for one week. Members from the U.S. are able to provide for their travel to ISSI, as well as members from European countries.

Appendix A: Addresses, telephone, fax, e-mail of all team members

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Appendix B: Brief CV of all team members

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1966 - 1970 Study of Applied Geophysics at Leipzig University
1971 - 1973 Research student, PHD in Geophysics
1973 - 1975 Institute of Solar-Terrestrial Physics of the Academy of Sciences of the GDR, Potsdam, Dept. of Magnetospheric and Solar Physics
1976 -1978 same institute, Solar Radio Observatory
1978 - 1991 Head of the Solar Radio Observatory.;
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1991 - now Senior research scientist in the Solar Radio Group of the (newly founded) Astrophysical Institute Potsdam
1995 Habilitation at Potsdam University
Research stays at other institutes (after 1989, only): several weeks/year at Paris-Meudon Observatory (France, 1990-1995), NASA GSFC and Naval Res. Lab. (USA, 1997, 98 and 99) ISAS and Mitaka Tokyo, Nobeyama Radio Obs. (Japan, 1998, 2000, 2002)
Languages Russian and English active; French passive
Selected publications:
Aurass, H., Rausche, G., Mann, G., Hofmann, A. 2005, "Fiber bursts as 3D coronal magnetic field probe in postflare loops", A&A 435, 1137
Aurass, H., Mann, G. 2004, "Radio observation of electron acceleration at solar flare reconnection outflow termination shocks", ApJ 615, 2004, 526
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Aurass, H., Vrsnak, B., Mann, G. : 2002, "Shock-excited radio bursts from reconnection outflow jet?", A&A 384, 273
Aurass, H., Shibasaki, K., Reiner, M., Karlicky, M.: 2002, "Microwave detection of shock and associated electron beam formation", ApJ 567, 610

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Scientific Interest, Research activity:
Spectroscopy of coronal and solar wind plasma; diagnostic techniques; equilibrium vs. non-equilibrium plasma processes; correlation between coronal and "in situ" phenomena; cometary plasmas.
Publications:
"Current sheet evolution in the aftermath of a CME event", Bemporad A., Poletto G., Suess S.T., Ko Y.-K., Schwadron N.A., Elliott H.A., 2006, ApJ, 638, 1110
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Joerg Buechner

Joerg Buechner obtained his PhD from Moscow State University in 1980. He than moved to the Heinrich-Hertz Institute for Solar-Terrestrial Physics and in 1983 to the Astrophysical Institute in Potsdam. In 1990 he did his habilitation in Potsdam and became a visiting professor at the University of California in Los Angeles (UCLA - through 1991). After his return from the US in 1992 he started a space plasma simulation group at the Berlin department of the Max Planck Institute for Extraterrestrial Physics which he continued in 1997 at the Max Planck Institute for Solar System Research in Lindau. He teaches Space Plasma Physics and Numerical Simulation at the University of Göttingen, were he became a Privatdozent in 1999. He worked as guest professor at the UCLA and Nagoya University. JB has been involved as PI and Co-I in a number of space-based projects including INTERBALL, RELICT-2, EQUATOR-S and CLUSTER. He published about 160 papers, books, a textbook on Space Plasma Simulation. He gave more than 250 talks, including 70 invited on international scientific conferences. His scientific interests are space plasmas, magnetic reconnection and particle acceleration, current sheets, the origin of solar eruptions and geo-effective solar radiation, stellar-planetary interactions.

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“Elemental abundances and Post-CME Current Sheet in a Very Hot Active Region”, A. Ciaravella et al. 2002, ApJ,575, 1116
“Solar and Heliospheric Observatory Ultraviolet Coronagraph Spectrometer and Yohkoh Soft X-Ray Telescope Observations of the High-Temperature Corona above an Active Region Complex”, Y.-K. Ko et al., 2002, ApJ, 578, 979
“Ultraviolet Spectroscopy of the Narrow Coronal Mass Ejections”, D. Dobrzycka et al. 2003, ApJ , 588, 586
“Far Ultraviolet Spectra of Coronal Mass Ejections Associated with X-Class Flares”, J. C. Raymond et al. 2003, ApJL, 597, 1106
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“UV Properties of Halo CMEs: Doppler Shifts, Angles, Shocks and Bulk Morphology”, A. Ciaravella et al. 2005, ApJ, submitted

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Wang, T., Solanki, S.K., Innes, D.E., Curdt, W., 2005, ‘Initiation of hot coronal loop oscillations: Spectral features’, AA, 435, 753
Ning, Z.,Innes, D. E., Solanki, S. K., 2004, ‘Line profile characteristics of solar explosive event bursts’, AA, 419, 1141
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"Current Sheet Evolution in the Aftermath of a CME Event", Bemporad, A., Poletto, G., Suess, S. T., Ko, Y.-K., Schwadron, N. A., Elliott, H. A., Raymond, J. C., 2006, ApJ, 638, 1110
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"An Empirical Study of the Electron Temperature Profile and Heavy Ion Velocities in the South Polar Coronal Hole", Ko, Y.-K., Fisk, L. A., Geiss J., Gloeckler, G., Guhathakurta M., Solar Physics, 171, 345, 1997.

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Secondary Education:
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Higher Education, Qualifications and Research Experience:
Department of Physics and the Institute for the Study of Earth, Ocean, and Space, University of New Hampshire 1997-2001, PhD Physics, Thesis: Theoretical Mechanisms for Solar Eruptions. Advisor: Professor Terry G. Forbes
Department of Astronomy, Nanjing University (1981-1985): B.S. Astrophysics
1985-1988: M.S. Astrophysics
Research Assistant at Yunnan Observatory, Kunming, China (1988-1992)
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Ph. D. student, University of New Hampshire, advisor, dr. T. Forbes (1997-2001)
Astrophysicist, UVCS Team, Harvard-Smithsonian Center for Astrophysics, (from 2001)
Research Interests:
As a Research Astrophysicist at Harvard-Smithsonian Center for Astrophysics, I am studying solar eruptions, including solar flares, eruptive prominences, and coronal mass ejections, and transient disturbances in the interplanetary medium around the Earth (also known as Space Weather) and their effects on the Earth. My work covers both theory and observations. The Lin-Forbes model of solar eruptions is my first masterpiece in my professional career, it is now one of the few well-recognized models in the field.
Selected Publications:
Lin, J., & van Ballegooijen, A. A.: "Equilibrium and Evolution in the Multipolar Magnetic Configurations Resulting from Interactions among Active Regions", 2005, ApJ, 629, 582
Lin, J., Ko, Y.-K., Sui, L., Raymond, J. C., Stenborg, G. A., Jiang, Y., Zhao, S., & Mancuso, S.:"Direct Observations of Magnetic Reconnection Site of An Eruption on November 18, 2003", 2005, ApJ, 622, 1251
Lin, J., Raymond, J. C., and van Ballegooijen, A. A.: "The Role of Magnetic Reconnection in

The Observable Features of Solar Eruptions", 2004, ApJ, 602, 422
Lin, J.: "CME-Flare Association Deduced from Catastrophic Model of CMEs", 2004, Solar Physics, 219, 169
Ko, Y.-K., Raymond, J. C., Lin, J., Lawrence, G., Li, J., Fludra, A., "Dynamical and Physical Properties of a Post-CME Current Sheet", 2003, ApJ, 594, 1068
Lin, J., van Ballegooijen, A. A., and Forbes, T. G.: "Evolution of A Semi-Circular Flux Rope with Two Ends Anchored in The Photosphere", 2002, JGR, 107(A12), 1438
Lin, J., and van Ballegooijen, A. A.: "Catastrophic and Noncatastrophic Mechanisms for Coronal Mass Ejections", 2002, ApJ, 576, 485
Lin, J. and Forbes, T. G.: "Effects of Reconnection on The Coronal Mass Ejection Process", 2000, JGR, 105(A2), 2375

Stefaan Poedts

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As Full Professor at the K.U.Leuven: teaching courses on
'Calculus', 'Linear algebra and analysis', 'Differential equations', 'Numerical methods for PDEs', and 'Solar plasma physics'
promotor of several scientific research projects, e.g.
"Multi-disciplinary Research on the Solar Astrophysics" (GOA project 2004-01)
"Multi-disciplinary Research on the Solar Drivers of Space Weather " (project OT-02-57);
"Space Weather: the role of coronal mass ejections", (FWO project G.0451.05);
"Solar Drivers of Space Weather" (ESA PRODEX 8 project);
"SWAP preparation to exploitation" (ESA PRODEX 8 project).
Publicationsi:
105 papers in international refereed journals + 5 in press
85 papers in proceedings of international conferences + 6 in press
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Giannina Poletto

G. Poletto got a PhD in astrophysics in 1971 and she has been working at the Arcetri Astrophysical Observatory, in Firenze, as an associate astronomer, since 1981. She has also been also occasionally associated with the University, giving courses of Astronomy, Astrophysics, Cosmic Magnetic Fields. She has been visiting scientist at the Harvard College Obs.; at Goddard Space Flight Center, Greenbelt, Md., at Lockheed Palo Alto Research Lab.; at the Space Research Laboratory, Utrecht, Holland; at Marshall Space Flight Center (now NSSTC), Huntsville, AL and at the Los Alamos National Laboratory. She has been Guest Investigator on the S054 experiment on Skylab and on the XRP experiment on SMM and Co-I on the UVCS experiment on SOHO. She is a member of the Organizing Committee of IAU Commission X, President of the European Solar Physics Division of the European Physical Society and member of the Editorial Board of Solar Physics (term ending 2006). She is the author of more than 150 scientific publications, of several popular papers and editor of 3 books. Her scientific interests include coronal heating mechanisms, solar wind origin and acceleration, relationship between solar and interplanetary phenomena. Her recent publications include:
"Current sheet evolution in the aftermath of a CME event", Bemporad, A., G. Poletto, S. T. Suess, Y.-K. Ko, N. A. Schwadron, H. A. Elliott, and J. C. Raymond, ApJ, 638, 1110
"The Sun and the Heliosphere as an Integrated System", Eds. G. Poletto & S.T. Suess, Kluwer,

2004
"Evidence for the Same Hot Plasma after Coronal Mass Ejection Events, in Both Remote and In Situ Observations", Poletto, G.; Suess, Steven T.; Bemporad, A.; Schwadron, N. A.; Elliott, H. A.; Zurbuchen, Thomas H.; Ko, Y.-K., 2004, ApJ 613, L173
"A slow streamer blowout at the Sun and Ulysses", Suess, S. T.; Bemporad, A.; Poletto, G., 2004, GRL, 310, 5810
"The Nascent Solar Wind: Origin and Acceleration", Teriaca, L.; Poletto, G.; Romoli, M.; Biesecker, D. A., 2003, ApJ 588, 566, 2003
"Temporal Evolution of a Streamer Complex: Coronal and in Situ Plasma Parameters", Bemporad, A.; Poletto, G.; Suess, S. T.; Ko, Y. K.; Parenti, S.; Riley, P.; Romoli, M.; Zurbuchen, T. Z., 2003, ApJ, 593, 1146
"Low-latitude solar wind during the Fall 1998 SOHO-Ulysses quadrature", Poletto, G.; Suess, S. T.; Biesecker, D. A.; Esser, R.; Gloeckler, G.; Ko, Y.-K.; Zurbuchen, T. H., 2002, JGR, Volume 107, Issue A10, pp. SSH 9-1, CiteID 1300, DOI 10.1029/2001JA00027
"Two-dimensional Structure of a Polar Coronal Hole at Solar Minimum: New Semiempirical Methodology for Deriving Plasma Parameters", Zangrilli, L.; Poletto, G.; Nicolosi, P.; Noci, G.; Romoli, M., 2002, ApJ, 574, 477

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Positions held:
1991-1996 Associate director, Solar & Stellar Physics Division, Smithsonian Astrophysical Observatory
1982-1984 Harvard Summer School, Lecturer
1980 - Smithsonian Astrophysical Observatory, Physicist
1976-1980 Harvard College Observatory, Research Fellow
Selected Recent Publications
"Detection and Diagnostics of a Coronal Shock Wave Driven by a Partial-Halo CME on 2000 June 28", A. Ciaravella, J. C. Raymond, S.W. Kahler, A. Vourlidas, A. & J. Lin 2005, ApJ, 621, 1121
"Densities and Velocities in Fast Coronal Mass Ejections: Radiative Pumping of the O VI Doublet", J. C. Raymond and A. Ciaravella 2004, ApJ, 606, L159
"Active Region Streamer Diagnostics from 2001 September 14 to 16", M. Uzzo, Y.-K. Ko & J. C. Raymond 2004, ApJ, 603, 760
"Elemental abundances and Post-CME Current Sheet in a Very Hot Active Region", A. Ciaravella, J. C. Raymond et al. 2002, ApJ, 575, 1116
"Far UV Spectra of Fast Coronal Mass Ejections Associated with X-class Flares", J.C. Raymond, A. Ciaravella, D. Dobrzycka, L. Strachan, Y.-K. Ko, M. Uzzo, & N.E. Raouafi 2003, ApJ, 597, 1106
"Dynamical and Physical Properties of a post-CME current Sheet", Y.K. Ko, J.C. Raymond, J. Lin, G. Lawrence, J. Li & A. Fludra 2003, ApJ, 594, 1068
"UVCS-SOHO observations of a CME-driven shock: consequences on ion heating mechanisms behind a coronal shock", S. Mancuso et al., 2002, A&A, 383, 267
"The Dec 12, 1997 Helical Coronal Mass Ejection: Density and Energy Estimates", A. Ciaravella, J.C. Raymond, F. Reale, L. Strachan & G. Peres 2001, ApJ, 557, 351
"SOHO Observations of a Coronal Mass Ejection", A. Akmal, et al., 2001, ApJ, 557, 922
"SOHO and radio Observations of a Coronal Mass Ejection shock wave", J. C. Raymond, B. J.

Thompson, O.C. St. Cyr et al., 2000, GRL, 27, 1493

Steven T. Suess

Dr. Suess received his Ph.D. in planetary & space physics (geophysical fluid dynamics) from the University of California at Los Angeles and his A.B. in geophysics from the University of California at Berkeley. He has been a research physicist with the Space Environment Laboratory of NOAA/ERL, an adjunct professor at the University of Colorado in Boulder, an occasional adjunct professor at the University of Alabama in Huntsville, and a member of the National Space Science & Technology Center at Marshall Space Flight Center. He has been a visiting scientist at the Max Planck Institut fr Aeronomie, a visiting scholar at Stanford University/Wilcox Solar Observatory, and a visiting scientist at the Osservatorio Astrofisico di Arcetri, Florence, Italy. He is Co-Investigator on both the solar wind plasma experiment on Ulysses (SWOOPS - D.J. McComas, PI) and on the SOHO Ultraviolet Coronagraph Spectrometer (UVCS - J. Kohl, PI) and is also Associate Project Scientist for the Ulysses Mission. He has extensive experience in analytical and numerical modeling of the solar corona and interplanetary medium. His recent work has focused on global coronal structure, fine structure in coronal holes, streamer structure, and on analysis of SOHO-Ulysses quadrature data.
Positions Held:
1983 - Physicist, NASA Marshall Space Flight Center (NSSTC, 2001 - present)
1983 - Occasional Adjunct Professor, University of Alabama in Huntsville
1969 - 1983 Physicist, Space Environment Lab, NOAA/ERL, Boulder, Colorado
1972 - 1983 Adjunct Professor, University of Colorado in Boulder
Recent Awards and Professional Activities:
2006-2008 Member of the NASA Earth-Sun Systems Subcommittee.
2004-2007 Chairman, NASA Solar-Heliospheric Management Operations Working Group.
2004-2005 Member of the NASA Sun-Earth Connections Advisory Subcommittee (SECAS).
2003 Principal writer for the Ulysses 2003 Senior Review Proposal
2004 Editor (w/ G. Poletto) of Kluwer book "The Sun and the Heliosphere as an Integrated System"
2004-2006 Member of Visions Mission Study (P. Liewer, PI) on the Solar Polar Imager.
2003 Organized (w/ G. Poletto) Joint Discussion on "The Sun and the Heliosphere as an Integrated System" at the IAU Gen. Assembly., Sydney.
2002-2003 SEC Roadmap Team member.
2001-2004 Solar-Heliospheric MOWG Member
2005 Visiting scientist, Institute for Astrophysics, Florence, Italy (also 1991, 1993, 1996, 1999, 2001, 2003, 2004)
1999 - Member, NASA Interstellar Probe Science and Technology Definition Team
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A.B. Univ. of California at Berkeley, Geophysics, 1964.
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Recent Bibliography (since 2003):
Nerney, S. F., and S. T. Suess, Stagnation flow in thin streamer boundaries, Astrophys. J., May 2006.
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Rudolph Von Steiger

Rudolph Von Steiger: no need for his Vita for an ISSI proposal: here it will suffice to say that he is willing to participate in the proposal and, if the proposal is selected, will contribute to the team's work as a regular team member.

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- M.Sc.: 1983, Astrohysics, Univ. Zagreb
- PhD: 1987, Astrophysics, Solar Phys, Univ. Zagreb
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- member: International Astronomical Union, European Astronomical Society, Committee on Space Research, Joint Organization for Solar Observation (JOSO), Community of European Solar Radio Astronomers (CESRA), Croatian Astronomical Soc., Croatian Physical Soc.
- published: 163 sci. papers (65 in C.C. journals.), 2 text-books & 3 hand-books, and 40 sci.-pop. papers;
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Selected Publications:

Veronig, A., Karlicky M., Vrnak, B., Temmer, M., Magdaleni, J., Dennis, B., Otruba, W., & Potzi, W., X-ray Sources and Magnetic Reconnection in the X3.9 Flare of 2003 November 3, A&A 446, 675-690, 2006

Vrsnak, B. & Skender, M., 2.5-Dimensional Reconnection Model and Energy Release in Solar Flares, Solar Phys. 226, 97-119, 2005

Vrsnak, B., Sudar, D. & Ruzdjak, D., The CME-flare Relationship: Are there Really Two Types of CMEs?, A&A 435, 1149-1157, 2005

Maricic, D., Vrsnak, B., Stanger, A. & Veronig, A., Coronal Mass Ejection of 15 May 2001: I. Evolution of Morphological Features of the Eruption, Solar Phys. 225, 337-353, 2004

Vrsnak, B., Maricic, D., Stanger, A. & Veronig, A., Coronal Mass Ejection of 15 May 2001: II. Coupling of the CME Acceleration and the Flare Energy Release, Solar Phys. 225, 355-378, 2004

Vrsnak, Bojan; Ruzdjak, D., Sudar, D., & Gopalswamy, N.: Kinematics of Coronal Mass Ejections Between 2 and 30 Solar Radii : What can be Learned about Forces Governing the Eruption?, A&A 423, 717-728, 2004

Skender, M., Vrsnak, B., & Martinis, M.: Solutions of Complete Jump Relations at Discontinuities in a Two-and-Half-Dimensional Reconnection Model, Physical Review E. 68, 046405, 2003

Vrsnak, B., Klein, K.-L., Warmuth, A., Otruba, W., & Skender, M.: Vertical Dynamics of the Energy Release Process in a Simple Two-Ribbon Flare, Solar Phys. 214, 325-338, 2003

Vrsnak, B., Warmuth, A., Maricic, D., Otruba, W., & Ruzdjak, V.: Interaction of an Erupting Filament with the Ambient Magnetoplasma and Escape of Electron Beams: Solar Phys. 217, 187-198, 2003

Aurass, H., Vrsnak, B., & Mann G.: Shock-Excited Radio Burst from Reconnection Outflow Jet?, A&A 384, 273-281 (2002)

Vrsnak, B. & Gopalswamy, N.: Influence of the Aerodynamic Drag on the Motion of Interplanetary Ejecta.: J. Geophys. Res. 107, SSH2 1-6, 2002

Vrsnak, B.: Dynamics of solar coronal eruptions.: J. Geophys. Res. 106, 25249-25260, 2001

Vrsnak, B.: Deceleration of Coronal Mass Ejections. Sol. Phys. 202, 173, 2001

Vrsnak, B.: Soft x-ray Emission from a Hot Turbulent Current Sheet and the Precursor Phase of Solar Flares: Solar Phys. 120, 79-92, 1989

David F. Webb

Webb is a research physicist employed at the Institute for Scientific Research at Boston College studying solar coronal mass ejections (CMEs) and transient disturbances in the interplanetary medium and their effects at Earth. He is also associated with the Air Force Research Lab, Center of Excellence in Space Weather at Hanscom AFB, MA. From 1968-1989 Webb worked in the Solar Physics Group at American Science and Engineering where he became a Senior Scientist. He has been a Visiting Scientist at the High Altitude Observatory/NCAR in Boulder, CO, studying coronal dynamics. Currently he is a Co-I on the current Solar Mass Ejection Imager (SMEI) and future STEREO mission programs. He has used data from the SMM and SOHO spaceborne coronagraphs, the Helios spacecraft, the Yohkoh SXT and SOHO EIT imagers and the Wind and ACE spacecraft to study the solar sources and heliospheric propagation of CMEs and shocks and their geophysical consequences. He has published over 100 scientific papers. Webb has led research studies establishing the link between halo CMEs and geomagnetic disturbances. He was on the steering committees for SHINE, the Intl. Solar Cycle Study, and the SHINE-GEM-CEDAR and S-RAMP Sept. 1999 Space Weather storm campaigns, and the SHINE Campaign events studies. Thus, he is at the forefront of Sun to Earth connection event studies. Webb is a member of the American Astronomical Society and its Solar Physics Division, the American Physical Society, the American Geophysical Union, and the International Astronomical Union. He is currently President of IAU Division II, which includes all solar and heliospheric aspects, and also President of Commission 49, Interplanetary Plasma and Heliosphere.

Recent related publications:

Reiner, M. J.; Jackson, B. V.; Webb, D. F.; Mizuno, D. R.; Kaiser, M. L.; Bougeret, J.-L. "Coronal mass ejection kinematics deduced from white light (Solar Mass Ejection Imager) and radio (Wind/WAVES) observations", 2005, JGRA,11009S14

Tappin, S.J., A.J. Buffington, M.P. Cooke, C.J. Eyles, P.P. Hick, P.E. Holladay, B.V. Jackson, J.C. Johnston, T. Kuchar, D. Mizuno, J.B. Mozer, S. Price, R.R. Radick, G.M. Simnett, D. Sinclair, N.R. Waltham, and D.F. Webb, "Tracking a Major Interplanetary Disturbance with SMEI", GRL, 31,
L02802, doi:10.1029/2003GL018766, 2004.

Webb, D.F., J.C. Johnston, R.R. Radick, and the SMEI Team, "The Solar Mass Ejection Imager (SMEI): A new tool for space weather", EOS, Trans. AGU, 83, pp. 33, 38-39 (2002).

Webb, D.F.,"CMEs and the Solar Cycle Variation in their Geoeffectiveness", in Proceedings of the SOHO-11 Symposium: From Solar Min to Max, SP-508, ESA, ESTEC, Noordwijk, The Netherlands, p. 409, 2002.

Zhao, X.P. and D.F. Webb, "The source regions and storm-effectiveness of front side full halo coronal mass ejections", JGR, 108, No. A6, 1234, 10.1029/2002JA009606, 2003.

Webb, D.F., J. Burkepile, T.G. Forbes, and P. Riley,"Observational evidence of new current sheets trailing CMEs", J. Geophys. Res. Vol. 108, No. A12, 1440, 10.1029/2003JA009923, 2003.

Webb, D.F. et al., "Relationship of halo coronal mass ejections, magnetic clouds, and magnetic storms", JGR, 105, 7491, 2000.