

PHYSICS OF THE HELIOSPHERE: A 10 YEAR RETROSPECTIVE

Proceedings of the 10th Annual International
Astrophysics Conference

Maui, Hawaii 13 – 18 March 2011

EDITORS

Jacob Heerikhuisen
Gang Li
Nikolai Pogorelov
Gary Zank

University of Alabama, Huntsville, AL

All papers have been peer reviewed.

SPONSORING ORGANIZATION

Center for Space Plasma and Aeronomic Research (CSPAR)



Melville, New York, 2012
AIP | CONFERENCE PROCEEDINGS ■ 1436

Editors

Jacob Heerikhuisen
Gang Li
Nikolai Pogorelov
Gary Zank

CSPAR
Department of Physics
320 Sparkman Drive
Huntsville, AL 35899

E-mail: jacob.heerikhuisen@uah.edu
gang.li@uah.edu

Authorization to photocopy items for internal or personal use, beyond the free copying permitted under the 1978 U.S. Copyright Law (see statement below), is granted by the American Institute of Physics for users registered with the Copyright Clearance Center (CCC) Transactional Reporting Service, provided that the base fee of \$30.00 per copy is paid directly to CCC, 222 Rosewood Drive, Danvers, MA 01923, USA: <http://www.copyright.com>. For those organizations that have been granted a photocopy license by CCC, a separate system of payment has been arranged. The fee code for users of the Transactional Reporting Services is: 978-0-7354-1026-8/12/\$30.00

© 2012 American Institute of Physics

No claim is made to original U.S. Government works.

Permission is granted to quote from the AIP Conference Proceedings with the customary acknowledgment of the source. Republication of an article or portions thereof (e.g., extensive excerpts, figures, tables, etc.) in original form or in translation, as well as other types of reuse (e.g., in course packs) require formal permission from AIP and may be subject to fees. As a courtesy, the author of the original proceedings article should be informed of any request for republication/reuse. Permission may be obtained online using RightsLink. Locate the article online at <http://proceedings.aip.org>, then simply click on the RightsLink icon/“Permissions/Reprints” link found in the article abstract. You may also address requests to: AIP Office of Rights and Permissions, Suite 1NO1, 2 Huntington Quadrangle, Melville, NY 11747-4502, USA; Fax: 516-576-2450; Tel.: 516-576-2268; E-mail: rights@aip.org.

L.C. Catalog Card No. 2012930211
ISBN 978-0-7354-1026-8 (Original Print)
ISSN 0094-243X
Printed in the United States of America

AIP Conference Proceedings, Volume 1436
Physics of the Heliosphere: A 10 year Retrospective
Proceedings of the 10th Annual International Astrophysics
Conference

Table of Contents

Preface: Physics of the Heliosphere: A 10 Year Retrospective J. Heerikhuisen	1
 TURBULENCE AND PLASMA PROCESSES 	
Solitons in two-fluid plasma X. Ao, R. Burrows, G. P. Zank, and G. M. Webb	5
Parametric decay of large-amplitude Alfvén waves: MHD and hybrid simulations L. Del Zanna, L. Matteini, S. Landi, and M. Velli	12
Residual energy in MHD turbulence and in the solar wind Stanislav Boldyrev, Jean Carlos Perez, and Vladimir Zhdankin	18
Current sheets in the heliosheath: Voyager 1, 2009 L. F. Burlaga and N. F. Ness	24
Injection and acceleration of charged nano-dust particles from sungrazing comets Wing-Huen Ip and Tai-Hao Yan	30
Toward a self-consistent kinetic model of pickup ion isotropization Philip A. Isenberg and Bernard J. Vasquez	36
Velocities of density structures in the solar wind Paul J. Kellogg and Forrest S. Mozer	42
Numerical modeling of the solar wind turbulence I.A. Kryukov, N.V. Pogorelov, G.P. Zank, and S.N. Borovikov	48

Electrostatic structures in space plasmas: Stability of two-dimensional magnetic bernstein-green-kruskal modes	
C. S. Ng, S. J. Soundararajan, and E. Yasin	55
Effects of suprathermal particles in space plasmas	
Pierrard Viviane	61
Stability of the strahl and solar burst electron distribution function and its dynamics	
V. Shevchenko and V. Galinsky	67
Double Alfveén waves	
G. M. Webb, Q. Hu, J. A. le Roux, B. Dasgupta, and G. P. Zank	74
Solar wind electrons and Langmuir turbulence	
P. H. Yoon, R. P. Lin, D. E. Larson, and S. D. Bale	80
PARTICLE ACCELERATION AND TRANSPORT	
Ion pickup and acceleration: Measurements from planetary missions	
Andrew J. Coates	89
Observations of the longitudinal spread of solar energetic particle events in solar cycle 24	
C.M.S. Cohen, G.M. Mason, M.E. Wiedenbeck, D.K. Haggerty, R. Gomez-Herrero, E. R. Christian, A.C. Cummings, A. Korth, A. W. Labrador, R.A. Leske, U. Mall, R.A. Mewaldt, E.C. Stone, and T.T. Von Rosenvinge	103
Ion acceleration near CME-driven interplanetary shocks	
Mihir Desai, Maher Dayeh, Charles Smith, Glenn Mason, and Martin Lee	110
Energetic particle acceleration in the heliosphere	
L. A. Fisk and G. Gloeckler	116
The heliospheric current sheet and cosmic-ray transport in the heliosheath	
V. Florinski	124
Suprathermal ions associated with strong interplanetary shocks	
J. Giacalone and J. R. Jokipii	130

Analysis of suprathermal tails using hourly-averaged proton velocity distributions at 1 AU	
G. Gloeckler, L. A. Fisk, G. M. Mason, E. C. Roelof, and E. C. Stone	136
Acceleration of energetic charged particles: Shocks, reconnection or turbulence?	
J. R. Jokipii	144
Anomalous cosmic rays in the heliosheath	
J. Kóta	157
Magnetic reconnection as the cause of cosmic ray excess from the heliospheric tail	
P. Desiati and A. Lazarian	163
The pre-heating and injection of bulk solar wind and suprathermal protons into first order Fermi acceleration at a fast traveling shock	
J. A. le Roux and G. M. Webb	171
Diffusive shock acceleration in large SEP events	
G. Li, X. Ao, O. Verkhoglyadova, G. P. Zank, and L. Ding	178
Angular distribution of energetic particles scattered by strongly anisotropic MHD turbulence: Understanding Milagro/IceCube results	
M. A. Malkov, P. H. Diamond, L. O'C. Drury, and R. Z. Sagdeev	190
Particle acceleration above the pick-up energy at comet 1P/Halley	
Susan McKenna-Lawlor	199
Evolution of suprathermal seed particle and solar energetic particle abundances	
R. A. Mewaldt, G. M. Mason, C. M. S. Cohen, R. Gómez-Herrero, D. K. Haggerty, R. A. Leske, and M. E. Wiedenbeck	206
Solar energetic particles: Shock acceleration and transport through self-amplified waves	
Chee K. Ng, Donald V. Reames, and Allan J. Tylka	212

INTERSTELLAR AND ENERGETIC NEUTRAL ATOMS

Modeling energetic neutral atoms and the IBEX spectrum	
Jacob Heerikhuisen, Nikolai Pogorelov, and Gary Zank	221

Potential sources for energetic neutrals from the heliosphere and beyond M. Hilchenbach, R. Kallenbach, K.C. Hsieh, and A. Czechowski	227
Primary neutral helium in the heliosphere Hans-Reinhard Müller and Jill H. Cohen	233
Cassini ENA images of the heliosheath and Voyager “ground truth”: Thickness of the heliosheath E. C. Roelof, S. M. Krimigis, D. G. Mitchell, R. B. Decker, and K. Dialynas	239
 CORONAL MASS EJECTIONS AND SHOCKS 	
Factors affecting the intensity of solar energetic particle events Nat Gopalswamy	247
Relationship between solar energetic oxygen flux and MHD shock mach number K. Liou, C. -C. Wu, M. Dryer, S. T. Wu, D. B. Berdichevsky, S. Plunkett, R. A. Mewaldt, and G. M. Mason	253
Magnetic field connection and large scale coronal disturbances in the context of gradual SEP events Nariaki V. Nitta	259
Statistical analysis of sparse data: Space plasma measurements Edmond C. Roelof	265
Power-law spatial profile in an upstream region of CME-driven interplanetary shock Tooru Sugiyama and Daikou Shiota	273
A decade of coronagraphic and spectroscopic studies of CME-driven shocks Angelos Vourlidas and Alessandro Bemporad	279
Heliospheric three-dimensional global simulation of multiple interacting coronal mass ejections during the Halloween 2003 epoch C. -C. Wu, K. Liou, S. T. Wu, M. Dryer, C. D. Fry, and S. Plunkett	285

THE LARGE SCALE HELIOSPHERE

How local is the local interstellar magnetic field? Priscilla C. Frisch	295
Simulations of magnetic minimum variance evolution in the solar wind S. Ghosh and D.A. Roberts	302
The MHD simulation of the inner heliosphere over 9 years using the observation-based time-varying boundary data Keiji Hayashi, H. Washimi, and M. Tokumaru	308
Insights gained using HHMS-PI from the Sun to Voyager 2 Devrie S. Intriligator, Thomas Detman, Murray Dryer, James Intriligator, Wei Sun, William R. Webber, and Charles Deehr	314
Numerical modeling of transient phenomena in the distant solar wind and in the heliosheath N. V. Pogorelov, S. N. Borovikov, L. F. Burlaga, R. W. Ebert, J. Heerikhuisen, Q. Hu, I. A. Kryukov, S. T. Suess, and G. P. Zank	321
Plasma variability in the heliosheath John D. Richardson	331
Modeling the global structure of the heliosphere during the recent solar minimum: Model improvements and unipolar streamers Pete Riley, Michael Stevens, Jon A. Linker, Roberto Lionello, Zoran Mikic, and Janet G. Luhmann	337
Magnetohydrodynamic modeling of the solar wind in the outer heliosphere A. V. Usmanov, M. L. Goldstein, and W. H. Matthaeus	344
A preliminary analysis of dynamic and realistic heliosphere using interplanetary scintillation and photospheric magnetic data Haruichi Washimi, Keiji Hayashi, Munetoshi Tokumaru, Gary P. Zank, Qiang Hu, Takashi Tanaka, Vladimir Florinski, James Adams, and Yuki Kubo	350
Exploration of the heliosphere and astrospheres with HST Brian E. Wood, Vladislav V. Izmodenov, and Dmitry Alexashov	356
Author Index	