

Curriculum Vitae

Meers Maxwell Oppenheim

Born: 2 November 1962 at Bethesda, MD, U.S.A.
Nationality: U.S. Citizen
Address: Department of Astronomy, Boston University
725 Commonwealth Ave., Boston MA 02215
Phone: 617-353-6139; Fax: 617-353-5704
email: meerso@bu.edu

Present Positions: Professor of Astronomy, Boston University

Education

Ph.D.: Cornell University, May 1995, Electrical Engineering, Space Plasma Physics Group
Advisor: Prof. Neils Otani
M.Eng.: Cornell University, May 1990, School of Applied and Engineering Physics
B.S.: Cornell University, May 1984, School of Applied and Engineering Physics

Professional Experience

Professor of Astronomy, Boston University	<i>Sep. 2013 - present</i>
Associate Chairman of Astronomy, Boston University	<i>Sep. 2014 - Jul. 2017</i>
Associate Professor of Astronomy, Boston University	<i>Sep. 2004 - 2013</i>
Director of Graduate Studies, Astronomy Department	<i>Sep. 2006 - Aug. 2010</i>
	<i>Jan. 2012 - 2017</i>
Associate Chairman of Astronomy, Boston University	<i>Sep. 2002 - Sep. 2004</i>
Assistant Professor of Astronomy, Boston University	<i>Sep. 1998 - Sep. 2004</i>
Director of Undergraduate Studies:	<i>Sep. 2000 - Sep. 2004</i>
Research Associate: U. of Colorado, Boulder with Dr. M. Goldman	<i>May 1996 - Aug. 1998</i>
Max Planck Society Postdoctoral Scientist: with Dr. Tor Hagfors	<i>May 1995 - May 1996</i>
Research Assistant: Cornell University with Dr. Niels Otani	<i>Sep. 1988 - May 1995</i>
Computational Physics Consultant:	
Physics International Corporation, San Leandro, CA	<i>1986-1988</i>
HY-TECH Research Corporation, Radford, VA	<i>1990</i>
Staff Physicist: Physics International Corporation, San Leandro, CA	<i>1984-1986</i>
Programmer and Junior Analyst Jack Faucett Associates, Inc., Chevy Chase, MD	<i>1980-1982</i>

Teaching Experience

Fully responsible for the following classes:

<i>Class</i>	<i>Term(s)</i>	<i>Credits</i>	<i>Total No. Students</i>
<i>Undergraduate</i>			
AS202 Principles of Astro I	F99, F00, F01, F03, F05, F07, F08, F12, F13, F17	4	~240
AS202HP Prin. of Astro I, honors	F01, F03, F05, F07, F08	4	27
AS101 The Solar System	S00, S03, S10, S14	4	225
AS414 Solar and Space Physics	S06, S08	4	32
AS499 Directed Studies in Astro	F01, F03, F07	1	10
<i>Graduate</i>			
AS703 Intro to Space Physics	S04, F06, F07, F09, F14, F15	4	53
AS727 Cosmic Plasma Physics	F98, S01, F02, S07, S09, S11, S13, S15	4	90
AS783 Ionospheres	S12	4	8
AS699 Teaching College Astro.	F05-F14	2	18
AS865 Space Physics Seminar	F01, S02	2	25
AS793 Adv Topics in Space Phys	S02	2	4
AS911 Directed Studies in AS	Most terms	2 & 4	

Graduate Students Advised and Current Status

<i>Ph.D. Degree Recipients</i>			
<i>Name</i>	<i>Grad. Date</i>	<i>Role</i>	<i>Current Status or Project</i>
Lars Dyrud	2004	Advisor	Head of the Ionosphere Thermosphere Sect. John's Hopkins Univ., Applied Physics Lab.
Sigrid Close	2004	Advisor	Assistant Prof., Dept. of Aeronautics and Astronautics, Stanford University
Marcos Diaz	2010	ECE Co-Advisor and 2nd Reader	Assistant Prof., ECE, University of Chile
Hassan Akbari	2016	ECE Co-Advisor	Researcher at LASP, CU, Boulder
Elizabeth Bass	2012	Advisor	Researcher at Lincoln Labs.
Chad Madsen	2017	Advisor	Researcher at Center for Astrophysics
Carsten Schult	2018	External Examiner	U. of Rostock, Germany
Matthew Young	2018 (Expected)	Advisor	Studying ionospheric waves
William Longley	2019 (Expected)	Advisor	Studying Plasma and Radar Physics
Glenn Sugar	2019 (Expected)	Co-Advisor	Research on Meteor Plasma Physics
Nithin Sivadas	2020 (Expected)	ECE co-advisor,	studying magnetospheric particle acceleration
<i>MA/MS Degree Recipients</i>			
Stephen Hunt	2004	Advisor	Asst. section head at Lincoln Laboratory
Alex Macdonnell	2012	ECE Co-Advisor	Analyst at Raytheon

Activities, Affiliations and Honors

Visiting Scholar and Professor, Leibniz-Institut für Atmosphärenphysik, Kuhlungsborn, Germany, Aug. 3-15, 2018
CEDAR Prize Lecturer, 2016
Elected Vice-Chair, Union Radio Science International, International Commission H, 2011-2014 (Chair-Elect for 2014).
Elected member, CEDAR Science Steering Committee, 2008-2011
Elected Chair, Union Radio Science International, U.S.A Commission H, 2006-present
Member, American Physical Science, Division of Plasma Physics, program committee, 2003-2005
Elected Vice-Chair, Union Radio Science International (U.S.A Commission H), 2002-2005
Elected member, Union Radio Science International (Commissions G & H), 2001
National Research Council Fellowship 1996
Member of the American Geophysical Union (AGU)
Member of the American Physical Society (APS)
Member of the American Association for the Advancement of Science (AAAS)
Max Planck Society Fellowship for 1995-96
Outstanding Student Paper, spring 1994 AGU meeting
Honorable mention, 1994 CEDAR conference
Reily scholar, 1988-1989
Cornell Daily Sun's editorial news board 1983-1984
Cornell crew and Cornell men's volleyball team (Co-Captain 1983-1984)

Awards to mentored students:

Tenure at Stanford University starting Fall. 2016: Advisee Dr. Sigrid Close
Faculty Position at Stanford University starting Jan. 2010: Advisee Dr. Sigrid Close
Senior Scientist and Head of the Ionosphere Thermosphere Section at the John's Hopkins University Applied Physics Laboratory: Advisee Dr. Lars Dyrud
Winner of NASA graduate student research program fellowship: Lars Dyrud, 1999-2003
Winner of Outstanding Student Paper Award by L. Dyrud, AGU conference, May, 2000
Winner of Best Student Paper Award for conference: L. Dyrud, CEDAR meeting, May 2000
Winner of Best Student Paper Award: L. Dyrud, AGU Conference, May, 2001
Winner of Best Student Paper Award: Lars Dyrud, CEDAR conference, 2001
Winner of outstanding student paper award by S. Close at URSI, January 2002 (\$1000 prize)
Winner of Best Student Paper Award: Licia Ray, CEDAR conference, 2002

Professional Community Service

External Examiner: University of Rostock, Germany, Ph.D. Defense of Carsten Schult, Aug. 2018
Elected Vice-Chair: Union Radio Science International, International Commission H, 2011-2014 (Chair-Elect for 2014-2017: resigned 2014 due to family tragedy).
Elected member: CEDAR Science Steering Committee, 2008
Commentator: History Channel's *The Universe* first aired in 2007

Chair: H Commission, URSI National organization, 2006-
 Committee Member: Am. Physical Society, Div. of Plasma Physics, program committee, 2003-
 Vice-chair: H Commission, URSI National organization, 2002-2005
 Panels Served: N.A.S.A (ITM) 1999, N.S.F. (G.E.M.) 2003
 Committee Member: A.G.U. S.P.A. Student Awards committee, 1998-2002
 Committee Member: CEDAR, Student Awards committee, 1998-2002

Chairing and organizing sessions

Organized and chaired session on nonlinear plasma physics, for URSI International, 2011, Istanbul, Tukey
 Organized and chaired session on “Meteoroids and Their Atmospheric Effects” at Fall AGU, 2009
 Organized and chaired session on particle-wave interaction in space plasma physics, USNC URSI, 2008
 Organized and chaired session on particle-wave interaction in space plasma physics, USNC URSI, 2006
 Chaired session at Meteoroids 2004 conference on Interstellar Meteoroids And Extrasolar Dust, March 2004
 Chaired session at American Physical Society (APS), Div. of Plasma Physics meeting, 2003
 Chaired session at International Union of Geodesy and Geophysics (IUGG) in Sapporo, Japan, July, 2003
 Organized and chaired session on numerical methods in space physics, North American URSI, 2003
 Organized and chaired session on meteors in space physics, National URSI, 2002
 Chairperson at International Meteoroids 2001 Conference, Kiruna Sweden, August 2001
 Organized and chaired session on small scale plasma structures in space physics, National URSI, 2001
 Chaired Aeronomy section at the Spring AGU meeting, 2002
 Chaired Solar Heliospheric Poster Session, Spring Meeting, 1998

Boston University Service Record

<i>Dates</i>	<i>Service</i>
2017-2018	Member of the Natural Sciences Curriculum Committee College of Arts & Sciences
2014-2017	Associate Chair, Astronomy Department
2012-2014	Director of Graduate Studies, Astronomy Department
2012-	Member, Graduate Recruitment Committee, Astronomy Department
2006-2010	Director of Graduate Studies, Astronomy Department
2006-2008	CAS Writing Advisory Board
2005	Summer training of new teaching fellows
2003-2004	Advisor, College of Arts and Science, Undergraduate Advising Office
2002-2004	Member, Undergraduate Research Opportunities Program Committee
2002-2004	Associate Chairman for Undergraduate Studies, Department of Astronomy
2000-2002	Director of Undergraduate Studies, Department of Astronomy

1999-2002 Summer advising of incoming undergraduate students
 1998-2000 Member of the Natural Sciences Curriculum Committee College of Arts & Sciences
 1998-2002 Member of the Astronomy Department computer committee
 1998-2004 Member, Ph.D. Oral Qualifying Exam Committee (10 examinations)
 1998-2004 Member, Ph.D. Thesis committees (6 students, 4 completed)
 1998-2004 Advisor, Ph.D. Thesis students (3 students, 1 completed)

Grant Applications Approved

NASA/Heliophysics PI *Conductance Effects on Global Magnetosphere-Ionosphere Evolution during Storms and Superstorms*, 11/01/2018-10/01/2022, \$1,111,739.000

NSF/Aeronomy PI: *Collaborative Research: Exploring Low-Latitude Ionospheric Irregularities in the Upper E-Region Valley Using Observations, Theory, And Simulations*, 07/2018-06/2021, \$395,973

NSF/Aeronomy CO-PI: *Collaborative Proposal: Meteor Plasma Formation and Dynamics with Implication for Radar Measurements*, 08/2018-07/2021, \$382,708

NSF/Physics PI: *Collaborative Research: Heating the Solar Chromosphere through Plasma Turbulence*, 07/'15-07/'18, \$340,000

NASA/Heliophysics Grand Challenge Research PI: *Including Macroscopic Effects of Small-Scale E-Region Turbulence in Global Magnetosphere-Ionosphere-Thermosphere Models*, 8/15-7/19, \$1,173,461.00

NSF/Aeronomy Co-PI: *Theory and simulation of the formation and evolution of meteor plasmas*, 12/'13 - 12/'16, \$300,000

NASA/LWS PI; *Kinetic 2D and 3D Simulations and Theory of Low- to Mid-Latitude Ionospheric Irregularities*, 8/'11-8/'15, \$574,266

NSF/Aeronomy PI; *Simulations and Theory of Medium to Small Scale E-region Turbulence*, 5/'10-4/14, \$580,818.00

NSF/CEDAR PI; *CEDAR: Advancing Meteor Aeronomy, Observations, and Physics*, 1/11-1/14, \$308,230.00

AFOSR PI; *First Kinetic Simulations of Equatorial Spread-F: Analysis of Kilometer-to-Meter Scale Irregularities*, 7/01/09-6/30/12, \$390,000

NSF/Space Weather Co-PI; *NSF Space Weather: Improving quantitative modeling of high-latitude electrojet conductivities during magnetic storm and substorm time*, 7/01/08-6/30/11, \$242K

NSF/CEDAR PI; *CEDAR: Meteor Plasmas: Theory, Simultaions and Observations*; Award Dates: 3/1/07-2/28/10; Award Amount: \$160,000

NSF/DOE - plasma research award: PI; *Collaborative Research: Meteor Plasmas - Dynamics and Radio Wave Scattering*; Award Dates: 7/1/06-6/30/09; Award Amount: \$134,000

NSF - Aeronomy award: PI; *Simulations and Theory of Small-Scale E-region Turbulence*; Award Dates: 3/1/05-2/28/11; Award Amount: \$384,000

NSF - CEDAR award: Principal Investigator; *Aeronomy of Meteor Trails: Observations, Simulations, and Theory*; Award Dates: 2/1/04 – 1/31/07; Award Amount: \$240K

NSF - CEDAR Posdoctoral award: Principal Investigator; *Modeling Radar Observations of Meteor Trails*; Award Dates: 2/1/04 – 1/31/06; Award Amount: \$160K

NSF - Aeronomy award: Co-PI; *Plasma Instabilities and Turbulent Heating in Lower Ionosphere: Theory and Simulations*; PI: Yakov Dimant; Award Dates: 1/1/04-12/30/07; Award Amount: \$290,000

NSF - Integrative Graduate Education and Research Traineeship (IGERT): Contributing Scientist, *Multidisciplinary Approach to the Integration of High Performance Computing in Science Education*; PI: Claudio Rebbi; Approved Amount: ~ \$2,500,000 over 10 years

NSF Major Research Infrastructure: Contributing Scientist, *Acquisition of a Power4-based IBM SP and PC -based Scalable Display Wall for Multidisciplinary Computational Science Research*; PI: Claudio Rebbi; Award Dates: 10/1/01 – 9/30/04, Award Amount: \$938,315

Lincoln Laboratory Scholarship: PI, Fall 2002, \$14.25K for 1 term to support a graduate student doing research on Radar and Theoretical Studies of Meteors and Meteor Trails

Lincoln Laboratory Scholarship: PI, Fall 2001, \$13.3K for 1 term to support a graduate student doing research on Radar and Theoretical Studies of Meteors and Meteor Trails

NASA Graduate Student Research Program: PI 2000-2003, \$22K per year for three years to support graduate student research on kinetic theory of plasmas in the auroral ionosphere.

NSF/DOE: PI, 2001-2003, ~\$25K per year supplement for two years to support simulations and theory of plasmas in the auroral ionosphere.

NSF/DOE: PI 2000-2003, ~\$60K per year for three years to support simulations and theory of plasmas in the auroral ionosphere.

NSF Geosciences/Aeronomy: PI, 2000-2003, ~\$90K per year for three years to support simulations and theory research on turbulence in the E-region Ionosphere

NASA SR&T: PI, 1997-, \$75K per year for 3 years. Simulation and Theory of the Farley-Buneman Instability in the E-Region Ionosphere, (SR&T, ITM)

NSF magnetosphere: Co-PI, 1998-, ~\$85K per year for 3 years. Beam-Driven Waves and Turbulence in the Topside Auroral Ionosphere, Magnetospheric Physics Program

DOE Grant: Co-PI, 1998-, ~\$75K per year for 3 years. Basic Plasma Physics - study and simulate plasma turbulence as they occur in both laboratory experiments and space measurements.

PI for subcontract from the University of Iowa: , 1996, \$17K
For numerical modeling of the ionospheric Farley-Buneman instability

NASA Grant , 1995-1997, with Dr. N. Otani (PI), \$65K per year for 2 years.
For the continued study of the ionospheric Farley-Buneman Instability.

IGGP-LANL Grants: , 1992-1994, with Dr. R. Mason and Dr. N. Otani, \$22K per year. Simulations of the ionospheric Farley-Buneman instability.

Refereed Papers

Matthew A. Young, Meers M. Oppenheim and Yakov S. Dimant, *Simulations of Secondary Farley-Buneman Instability Driven by a Kilometer-Scale Primary Wave: Anomalous Transport and Formation of Flat-Topped Electric Fields*; J. of Geophysical Research; DOI: 10.1029/2018JA026072, 2018

Alex C. Fletcher, Yakov S. Dimant, Meers M. Oppenheim, and Juan Fontenla; *Effects of Ion Magnetization on the Farley-Buneman Instability in the Solar Chromosphere*; The Astrophysical Journal, doi: 10.3847/1538-4357/aab71a; 2018

William J. Longley Meers M. Oppenheim Alex C. Fletcher Yakov S. Dimant; *ISR Spectra Simulations With Electron-Ion Coulomb Collisions*, Journal of Geophysical Research: Space Physics; 123; doi: 10.1002/2017JA025015; 12 April 2018

G. Sugar M. M. Oppenheim Y. S. Dimant S. Close; *Formation of plasma around a small meteoroid: Simulation and theory*; Journal of Geophysical Research: Space Physics; doi:10.1002/2018JA025265; 06 April 2018

Jing Liu Wenbin Wang Alan Burns Meers Oppenheim Yakov Dimant; *Faster Traveling Atmosphere Disturbances Caused by Polar Ionosphere Turbulence Heating*; Journal of Geophysical Research: Space Physics; 123, doi:10.1002/2017JA024746; 01 March 2018

Wiltberger, M.; Merkin, V.; Zhang, B.; Toffoletto, F.; Oppenheim, M.; Wang, W.; Lyon, J. G.; Liu, J.; Dimant, Y.; Sitnov, M. I.; Stephens, G. K.; *Effects of electrojet turbulence on a magnetosphere-ionosphere simulation of a geomagnetic storm*; *J. Geophys. Res.*; DOI: 10.1002/2016JA023700 (2017)

Young, M. A.; Oppenheim M.; and Dimant, Y. S.;. *Hybrid simulations of coupled Farley-Buneman/gradient drift instabilities in the equatorial E region ionosphere*; *J. Geophys. Res.*; DOI: 10.1002/2017JA024161 (2017)

Dimant, Y. S. and M. M. Oppenheim; *Formation of plasma around a small meteoroid: 1. Kinetic theory*; *J. Geophys. Res.*; **122**, doi:10.1002/2017JA023960 (2017).

- Dimant, Y. S. and M. M. Oppenheim; *Formation of plasma around a small meteoroid: 2. Implications for radar head echo*; *J. Geophys. Res.*; **122**, doi:10.1002/2017JA023963 (2017).
- Dimant, Y. S.; Oppenheim, M. M.; Fletcher, A. C. (2016); *Generation of electric fields and currents by neutral flows in weakly ionized plasmas through collisional dynamos*; *Physics of Plasmas*, V. 23, I. 8; doi:10.1063/1.4961085
- Oppenheim, M., Dimant, Y. S. (2016); *Photoelectron Induced Waves: A Likely Source of 150-km Radar Echoes and Enhanced Electron Modes*; *Geophys. Res. Lett.*; V. 43, I. 8, pp. 3637-3644; doi: 10.1002/2016GL068179 NOTE: This was reported in SCIENCE [Perkins, May 2016, DOI: 10.1126/science.aaf9863]. See <http://www.sciencemag.org/news/2016/05/mysterious-radar-echoes-sky-explained>
- Liu, J., W., Wang, M. Oppenheim, Y. Dimant, M. Wiltberger, V. Merkin (2016), *Anomalous electron heating effects on the E region ionosphere in TIEGCM*, *Geophys. Res. Lett.*, 43, doi:10.1002/2016GL068010.
- Oppenheim M. M., and Y. S. Dimant (2015), *First 3-D simulations of meteor plasma dynamics and turbulence*, *Geophys. Res. Lett.*, 42, doi:10.1002/2014GL062411.
- Madsen C., Y. S. Dimant,, M. Oppenheim, J. M. Fontenla; *The Multi-Species Farley–Buneman Instability in the Solar Chromosphere*; *The Astrophysical Journal*, 783:128 (6pp), 2014 March 10 doi:10.1088/0004-637X/783/2/128
- Chau, J. L., I. Strelnikova, C. Schult, M. M. Oppenheim, M. C. Kelley, G. Stober, and W. Singer (2014), *Nonspecular meteor trails from non-field-aligned irregularities: Can they be explained by presence of charged meteor dust?*, *Geophys. Res. Lett.*, 41, 3336–3343, doi:10.1002/2014GL059922
- Oppenheim, M. M., and Y. S. Dimant; *Kinetic simulations of 3-D Farley-Buneman turbulence and anomalous electron heating*, *J. Geophys. Res. Space Physics*, 118, 1306–1318, doi:10.1002/jgra.50196, 2014
- M. M. Oppenheim, S. Arredondo, and G. Sugar; *Intense Winds and Shears in the Equatorial Lower Thermosphere Measured by High Resolution Non-Specular Meteor Radar*, *J. Geophys. Res. Space Physics*, 119, doi:10.1002/2013JA019272, 2014
- Close, Sigrid; Volz, Ryan; Loveland, Rohan; Macdonell, Alex; Colestock, Patrick; Linscott, Ivan; Oppenheim, Meers; *Determining meteoroid bulk densities using a plasma scattering model with high-power large-aperture radar data*; *Icarus*, V. 221, I. 1, p. 300-309, 10.1016/j.icarus.2012.07.033
- Diaz, M. A.; Zettergren, M.; Semeter, J. L.; Oppenheim, M.; *Plasma parameter analysis of the Langmuir decay process via Particle-in-Cell simulations*; *Annales Geophysicae*, Volume 30, Issue 8, 2012, pp.1169-1183; 10.5194/angeo-30-1169-2012
- Dimant, Y., Oppenheim, M.; *Magnetosphere-ionosphere coupling through E region turbulence: 1. Energy budget*; *J. Geophys. Res.*, V. 116, A9, A09303, 2011
- Dimant, Y., Oppenheim, M.; *Magnetosphere-ionosphere coupling through E region turbulence:*

2. *Anomalous conductivities and frictional heating*, J. Geophys. Res., V. 116, A9, A09304, 2011
- Diaz, M. A.; Oppenheim, M.; Semeter, J. L.; Zettergren, M.; *Particle-in-cell simulation of incoherent scatter radar spectral distortions related to beam-plasma interactions in the auroral ionosphere*; J. Geophys. Res., V. 116, A00K10, 2011
- Close, S.; Kelley, M.; Vertatschitsch, L.; Colestock, P.; Oppenheim, M.; Yee, J.; *Polarization and scattering of a long-duration meteor trail*; J. Geophys. Res., V. 116, A1, A01309, 10.1029/2010JA015968, 2011
- Loveland, R.; Macdonell, A.; Close, S.; Oppenheim, M.; Colestock, P.; *Comparison of methods of determining meteoroid range rates from linear frequency modulated chirped pulses*; Radio Science, V. 46, 2, RS2007, 10.1029/2010RS004479, 2011
- Diaz, M. A.; Semeter, J. L.; Oppenheim, M.; Zettergren, M., *Analysis of beam plasma instability effects on incoherent scatter spectra*, Annales Geophysicae, V. 28, I.12, 2010, pp. 2169-2175, 12/2010
- Dimant, Y. S.; Oppenheim, M. M., *Interaction of plasma cloud with external electric field in lower ionosphere*; Annales Geophysicae, V. 28, I. 3, 2010, pp.719-736, 10.5194/angeo-28-719-2010
- Sugar, G.; Oppenheim, M. M.; Bass, E.; Chau, J. L. ; *Nonspecular meteor trail altitude distributions and durations observed by a 50 MHz high-power radar*; J. Geophys. Res., Vol. 115, No. A12, A12334 10.1029/2010JA015705
- Oppenheim, Meers M., Sugar, G., Slowey, N. O.; Bass, E. ; Chau, J. L.; Close, S. , *Remote sensing lower thermosphere wind profiles using non-specular meteor echoes*; Geophysical Research Letters, V. 36, I. 9, CiteID L09817, 2009
- Dimant, Y. S., Oppenheim, M. ; Milikh, G. M., *Meteor plasma trails: effects of external electric field*; Annales Geophysicae, V. 27, I 1, 2009
- Dyrud, L., Krane, B., Oppenheim, M., Pécseli, H. L., Trulsen, J., Wernik, A. W., *Structure functions and intermittency in ionospheric plasma turbulence*, Nonlinear Processes in Geophysics, V. 15, I. 6, pp.847-862, 2008
- Bass, Elizabeth; Oppenheim, Meers; Chau, Jorge; Olmstead, Alice; *Improving the Accuracy of Meteoroid Mass Estimates from Head Echo Deceleration*, Earth, Moon, and Planets, Volume 102, Issue 1-4, pp. 379-382, 06/2008
- Close, S.; Hamlin, T.; Oppenheim, M.; Cox, L.; Colestock, P.; *Dependence of radar signal strength on frequency and aspect angle of nonspecular meteor trails*, J. Geophys. Res, V. 113, A6, A06203, 2008
- Oppenheim, Y. S. Dimant, and L. P. Dyrud (2008), *Large-scale simulations of 2D fully kinetic Farley-Buneman turbulence*; Annales Geophys., V. 26, I. 3, pp.543-553, 2008.
- Oppenheim, M. M., G. Sugar, E. Bass, Y. S. Dimant, and J. L. Chau, *Day to night variation in meteor trail measurements: Evidence for a new theory of plasma trail evolution*; Geophys. Res. Lett., doi:10.1029/2007GL032347, 2008

- Diaz, M.; Semeter, J.; Oppenheim, M.; Zettergren, M., *Particle-in-cell simulation of the incoherent scatter radar spectrum*; Radio Science, V. 43, 1, RS1007, 2008
- Dyrud, Lars P.; Kudeki, Erhan; Oppenheim, Meers, *Modeling long duration meteor trails*; J. Geophys. Res., V 112, DOI: 10.1029/2007JA012692, 2007
- Close, S.; Brown, P.; Campbell-Brown, M.; Oppenheim, M.; Colestock, P.; *Meteor head echo radar data: Mass velocity selection effects*; Icarus, V. 186, 2, p. 547-556.
- Dyrud, L.; Krane, B.; Oppenheim, M.; Pécseli, H. L.; Schlegel, K.; Trulsen, J.; Wernik, A. W.; *Low-frequency electrostatic waves in the ionospheric E-region: a comparison of rocket observations and numerical simulations*; Annales Geophysicae, Volume 24, Issue 11, 2006, pp.2959-2979
- Oppenheim, M. and Y. Dimant, *Meteor Induced Ridge and Trough Formation and the Structuring of the Nighttime E-Region Ionosphere*; Geophys. Res. Lett., 111, doi:10.1029/2006GL028267, 2006
- Close, S., P. Brown, M. Campbell-Brown, M. Oppenheim, P. Colestock, *Meteor head echo radar data: Mass-velocity selection effects*; Icarus, doi:10.1016/j.icarus.2006.09.007, 2006
- Dimant, Y. and Oppenheim, M., *Meteor trail diffusion: 1. Simulations*; J. Geophys. Res., V. 111, DOI:10.1029/2006JA011797, 2006
- Dimant, Y. and Oppenheim, M., *Meteor trail diffusion: 2. Analytical theory*; J. Geophys. Res., V. 111, DOI:10.1029/2006JA011798, 2006
- Dyrud, L. P., and M. M. Oppenheim, *Electron holes, ion waves, and anomalous resistivity in space plasmas*, J. Geophys. Res., 111, A01302, doi:10.1029/2004JA010482, 2006
- N. F. Otani and M. M. Oppenheim, *Saturation of the Farley-Buneman instability via three mode coupling*; J. Geophys. Res., V. 111, DOI:10.1029/2005JA011215, 2006
- S. Close; Oppenheim, M.; Durand, D.; Dyrud, L., *A new method for determining meteoroid mass from head echo data*; J. Geophys. Res., V. 110, A9, 10.1029/2004JA010950, Sep 2005
- Lars P. Dyrud.; Ray, Licia; Oppenheim, Meers; Close, Sigrid; Denney, Kelly, *Modelling high-power large-aperture radar meteor trails*, *J. Atmos. & Solar Terr. Phys.*, V. 67, 13, p. 1171-1177, Sep. 2005
- M. M. Oppenheim and Y. S. Dimant; *Ion Thermal Effects on E-Region Instabilities: 2-D Kinetic Simulations*; *J. Atmos. & Solar Terr. Phys.*, Vol 66, Issue 17, Nov. 2004, p. 1655-1668.
- Y. S. Dimant and M. M. Oppenheim. *Ion Thermal Effects On E-Region Instabilities: Linear Theory*; *J. Atmos. & Solar Terr. Phys.*, Vol 66, Issue 17, Nov. 2004, p. 1639-1654
- L. P. Dyrud, K. Denney, S. Close, M. Oppenheim, J. Chau, L. Ray, *Meteor velocity measurements with plasma physics*; Atmospheric Chemistry and Physics Discussions, Vol. 4, p. 1247, 2004
- S. Close, M. Oppenheim, S. M. Hunt, A. Coster, *A Technique for Calculating Meteor Plasma Density and Meteoroid Mass from Radar Head Echo Scattering*; Icarus, Vol. 168, p. 43-52, 2004
- S. M. Hunt, M. Oppenheim, S. Close, P. Brown, F. McKeen and M. Minardi, *Determination of the*

- Meteoroid Velocity Distribution Using High Gain Radar*, Icarus, Vol. 168, p. 34-42, 2004
- M. M. Oppenheim, L. P. Dyrud, A. vom Endt, *Plasma Instabilities in Meteor Trails: 2-D Simulation Studies*; J. Geophys. Res., 108(A2), 10.1029/2002JA009549, 2003
- M. M. Oppenheim, L. P. Dyrud, L. Ray, *Plasma Instabilities in Meteor Trails: Linear Theory*; J. Geophys. Res., 108(A2), 10.1029/2002JA009549, 2003
- Lars P. Dyrud, Meers M. Oppenheim, Sigrid Close and Stephen Hunt; *Interpretation of Non-Specular Radar Meteor Trails*; Geophys. Res. Lett., 29(21), 8-1, 10.1029/2002GL015953, 2002
- S. Close, M. M. Oppenheim, S. Hunt and L. P. Dyrud, , *Scattering characteristics of high-resolution meteor head echoes detected at multiple frequencies*; J. Geophys. Res., 107(A10), 9-1, 10.1029/2002JA009253, 2002
- L. P. Dyrud, M. M. Oppenheim and A. F. vom Endt.; *The anomalous diffusion of meteor trails*; Geophys. Res. Lett., Vol. 28,p. 2775, 2001.
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- M. M. Oppenheim, A. F. vom Endt and L. P. Dyrud. , *Electrodynamics of meteor trail evolution in the equatorial E-region ionosphere*; Geophys. Res. Lett., Vol. 27, No. 19, 3173, 2000.
- M. V. Goldman, D. Newman, F. Crary, and M. M. Oppenheim; *Turbulence Driven by Two-Stream Instability in a Magnetized Plasma*, Physics of Plasmas, Vol. 7, No. 5, 1732, 2000
- M. V. Goldman, D. L. Newman, K. D. Kang, F. Crary and M. M. Oppenheim; *Theory and simulations of electron beam-driven localized wave structures*; Physics Scripta, Vol. T84,34, 2000
- M. Oppenheim, M. Goldman and D. Newman; *Nonlinear two-stream Evolution of Electron Phase-Space Holes in a 2-D Magnetized Plasma*; Physical Rev. Let., 2344, Sept. 22, 1999
- M. Goldman, M. Oppenheim and D. Newman. *Theory of localized bipolar wave-structures and nonthermal particle distributions in the auroral ionosphere*; Nonlinear Processes in Geophysics, Vol. 6, No. 3, 221-228, 1999
- M. Goldman, M. Oppenheim and D. Newman. *Nonlinear two-stream instabilities as an explanation for auroral bipolar wave structures*; Geophys. Res. Let., Vol. 26, 1821, 1999
- M. Goldman, M. Oppenheim and D. Newman. *PIC Simulations of Bipolar Wave Structures Driven by Dense Beams in the Auroral Ionosphere*; Physics of Space Plasmas, No. 15, 1998
- N. Otani and M. Oppenheim. *A saturation mechanism for the Farley-Buneman Instability*; Geophys. Res. Let., Vol. 25, No. 11, 1833, 1998
- M. Goldman, D. Newman, and M. Oppenheim. *New Insights into how beam-excited instabilities*

saturate; Physica Scripta, Vol. T75, 52-57, 1998

M. Oppenheim. *Evidence and effects of a wave-driven nonlinear current in the equatorial electrojet*; Ann. Geophysicae 15, 899, 1997

M. Oppenheim. *A wave-driven nonlinear current in the E-region ionosphere*, Geophys. Res. Let., Vol. 23, No. 23, 3333, 1996

M. Oppenheim, N. Otani and C. Ronchi. *Saturation of the Farley-Buneman instability via nonlinear electron $\vec{E} \times \vec{B}$ drifts*; J. Geophys. Res., Vol. 101, No. A8, 17,273, 1996

M. Oppenheim and N. Otani; *Spectral characteristics of the Farley-Buneman instability: simulations vs. observations*; J. Geophys. Res., Vol. 101, No. A11, 24573, 1996

M. Oppenheim, N. Otani and C. Ronchi. *Hybrid Simulations of the Saturated Farley-Buneman Instability in the Ionosphere*; Geophys. Res. Let., 22, 353, 1995.

Thesis and Other Publications

M. Oppenheim. Nonlinear simulations and theory of the Farley-Buneman instability in the E-region ionosphere, *Ph.D. Thesis*, Cornell University, 1995

Oppenheim, L. Dyrud and vom Endt, *Electrodynamics of Meteor Trail Evolution in the Equatorial E-Region*. International Symposium on Equatorial Aeronomy, Antalya Turkey talk, May 2000

S. Close, S. Hunt, M. Oppenheim, and F. Mckeen, *Simultaneous Dual-Frequency Observations of Meteor Head echoes Using ALTAIR*, Proc. Third European Conference on Space Debris, ESA SP-473, Oct, 2001

M. M. Oppenheim, L. P. Dyrud, S. Close and S. Hunt, *Theory and Simulations of Field-Aligned Irregularities in Meteor Trails*, Proc. of the Meteoroids 2001 Conference, ESA SP-495, Noordwijk: ESA Publications Division, ISBN 92-9092-805-0, 2001, p. 361 - 366

L. P. Dyrud, M. Oppenheim, S. Close and S. Hunt, *Interpretation of Non-Specular Radar Meteor Trails*, Proc. of the Meteoroids 2001 Conference, ESA Pub. Division, ISBN 92-9092-805-0, 2001, p. 465 - 468

S. Hunt, S. Close, M. M. Oppenheim, and L. P. Dyrud, *Two-frequency Meteor Observations Using the Advanced Research Project Agency Long Range Tracking and Instrumentation Radar (ALTAIR)*, Proc. of the Meteoroids 2001 Conference, ESA SP-495, ESA Pub. Div., ISBN 92-9092-805-0, 2001, p. 451 - 455

S. Close, M. Oppenheim, S. Hunt, F. McKeen, and A. Coster, *Meteoroid Mass Determination Using Head Echoes Detected at Multiple Frequencies*, Asteroids Conference, Germany, ESA Publications Division, ISBN 92-9092-810-7, 2002, p. 153 - 156

M. Oppenheim, N. Otani and C. Ronchi. *Nonlinear simulations and theory of the Farley-Buneman instability in the equatorial E-region ionosphere*, Proc. of the Ninth Inter. Symp. on Equatorial Aeronomy, A3-1, 1995

M. Oppenheim. *FEMTO - A comprehensive tool for solving static electromagnetic problems*, Proc. of the 1987 Pulsed Power Conf.

M. Oppenheim. *FEMTO - A User's Guide*, a 150 page manual describing a scientific computer program and its capabilities.

M. Oppenheim and J. Hammond. *Tuning complex pulse forming networks*, Proc. of the 1986 Power Modulator Symp.

Invited Talks

“Echoes from the Sky: Radar Observations and The Plasma Physics of Meteors ”, Leibniz-Institut für Atmosphärenphysik, Kuhlungsborn, Germany, Aug., 2018

“Studying Meteor Plasma Physics with Massively Parallel Particle-in-Cell Simulations,” Tromso University of the Arctic, Tromso Norway, Aug. 2018

“Evolution of Meteor Trails”, International Space Science Institute, Bern Switzerland, Aug. 2018

“Simulating the Ionosphere, One Electron at a Time.”, Physics Colloquium, U. Massachusetts, Lowell, May 2017

“Simulating the Ionosphere, One Electron at a Time.”, Physics Colloquium, U. Massachusetts, Lowell, Oct. 2016

“Simulating the Ionosphere, One Electron at a Time”, CEDAR Prize Lecture, CEDAR Workshop, Santa Fe, NM, June, 2016

“Evolution of Meteor Plasma and Radar Implications,” Small Meteor and Meteoroid Environment Workshop, Stanford University, June, 2015

“Echoes from the edge of space: Meteoroids, Meteors, and Meteor Winds,” Invited colloquium speaker, High Altitude Observatory, NCAR, Boulder Colorado, March 2015.

“The Giving Thesis: Collisional Plasma Turbulence in Space and Its Offshoots,” Physics and Astronomy Space Plasma Seminar, Dartmouth College, Sept. 30, 2014

“The Giving Thesis: An exploration of collisional plasma turbulence in space,” Center for Space Physics Seminar, Boston Univ., Sept. 4, 2014

“The Giving Thesis: Collisional Plasma Turbulence in Space and Its Offshoots,” Physics and Astronomy Space Plasma Seminar, U. Mass., Lowell, Nov., 2014

“ Including Macroscopic Effects of Small-Scale E-Region Turbulence in Global Magnetosphere-Ionosphere-Thermosphere Models,” CEDAR Workshop, June, 2014

“The Plasma Environment at 100 km at the CEDAR workshop,” June 2013, in Boulder CO.

“The Plasma Environment at 100 km” at the April 2013 Suborbital Workshop in Annapolis, MD.

“Simulations of solitary waves in space plasma” by Meers Oppenheim at The 11th International

School for Space Simulations, Taiwan, R.O.C., July 2013 (unable to attend)

“Simulations of kinetic Ionospheric physics,” International Equatorial Aeronomy Workshop, March, 2012

“Echoes from the Sky: Radar Observations and Plasma Physics of Meteors,” University of New Hampshire Physics Colloquium, Oct. 3, 2011

“Massively parallel kinetic simulations of meteor plasma: 3D meteor plasma diffusion and evolution” by Meers Oppenheim, Yakov Dimant, Lars Dyrud; invited speaker at the International Workshop on Meteoroids 2010, Breckenridge, CO

”Meteor Impacts: from a steady rain to showers,” by Meers Oppenheim, Invited colloquium speaker, Max Planck Institute for Sun and Solar System, July 16, 2009

”Meteor Impacts: from a steady rain to showers,” by Meers Oppenheim, Invited colloquium speaker, Max Planck Institute for Sun and Solar System, July 16, 2009

“Basic Particle-in-Cell Simulation Methods” by Meers Oppenheim at The 9th International School for Space Simulations, Paris, France, July 2009

“Measuring MLT Winds by Tracking Meteor Trails with Incoherent Scatter Radar; A New Method Observes Rapidly Changing Winds Exceeding 500km/Hr” by Meers Oppenheim, CEDAR 2009 Highlight talk to the Plenary session, Santa Fe, NM

Invited Panelist, Meteor Workshop at the CEDAR Meeting, Santa Fe, NM, 2009

“Spectral Studies of E-Region Farley-Buneman Waves from massively parallel PIC simulations,” by Meers Oppenheim, Lars Dyrud, and Yakov Dimant, CEDAR Workshop 2006, Santa Fe, NM

“Turbulence in the E-region Ionosphere: Simulations and Theory,” RF Ionospheric Interactions Workshop, April 2006, Santa Fe, NM

“High Resolution Meteor Observations Using the 50MHz Jicamarca Radar,” Meers M. Oppenheim, Jorge L. Chau , Elizabeth N. Bass, 2006 National Radio Science Meeting, Boulder, CO

“Meteor Induced Ridge and Trough Formation and the Structuring of the Nighttime E-Region Ionosphere,” Dartmouth College Plasma Physics Seminar, Oct. 2005

“The Plasma Physics of Meteors: from Ionization to Turbulence to Dissipation,” MIT Plasma Colloquium, Oct. 2005

“Spectral studies of Type 1 E-region instabilities using a new generation of high-resolution simulations,” URSI International Conference, New Delhi, India, Oct., 2006

“High-Power, Large-Aperture, Radar Observations of Meteors,” U. of Adelaide, Physics Department Colloquium, Adelaide, Australia, Feb., 2005

“High-Power, Large-Aperture, Radar Observations of Meteors,” U. of Canterbury, Christchurch, New Zealand, Jan., 2005

“Simulations of Space Plasma Physics Using Almost a Billion Particles,” U. of Illinois, Electromagnetics and Remote Sensing Seminar, U. of Illinois, Oct. 26, 2004

“Simulations of Space Plasma Physics Using Almost a Billion Particles,” George Mason University, Physics Dept. Seminar, Nov 5, 2004

“The Physics and Aeronomy of High-Power, Large-Aperture, Radar Observations of Meteors,” SRI International Geospace Seminar. Sept. 17, 2004

“Observations and Plasma Physics of Meteors Trails,” Naval Research Laboratories Seminar, Washington, DC, June 2004

“E-region thermal instabilities,” CEDAR Workshop 2004, SanteFe, NM, June, 2004

“Ion Thermal Effects on *E*-Region Instabilities,” at IUGG international, July 2003

“Simulating ionospheric plasma physics using millions and millions of particles,” tutorial by M. Oppenheim at CEDAR, Longmont, CO, June, 2003

“Fully kinetic simulations and linear theory of E-region instabilities” by M. Oppenheim and Y. Dimant at CEDAR, Longmont, CO, June, 2003

“The Linear Plasma Theory of Meteor Trails and Implications for Radar Measurements” at the North American URSI meeting, Jun 2002

“Echoes from the Sky: The Plasma Physics of Meteors Trails” by Meers Oppenheim, American Physical Society, Div. of Plasma Physics annual meeting, St. Petersburg, FL, Nov, 2002

“Fully Kinetic 2-D and 3-D Simulations of the Farley-Buneman Instability: First Results,” Jicamarca 40th anniversary workshop, Lima, Peru, 20-23 May, 2002

“Meteor Induced Plasma Irregularities and Radar Signatures,” EGS meeting, Nice, France, April 2002

“Ablation and Ionization Modeling: Implications for Trail Instabilities and Head Echoes”, invited to present at the Radar Meteor Workshop, Arecibo, Puerto Rico, March 2003

“The plasma physics of meteors”, invited 30 min. talk APS / Div. of Plasma Physics, Orlando FL, Nov. 2002

“Echoes from the Sky: Meteors trails in the Earth’s Upper Atmosphere”, invited talk Dartmouth College Physics Colloquium, Nov. 2002

“Electrodynamics of Meteor Trail Evolution in the Ionosphere,” invited lunchtime talk, MIT Haystack Observatory, Jul. 2000

“Small Scale Plasma Waves in the E-region Ionosphere: Simulations, Movies, and a Little Theory,” invited talk, MIT Millstone Hill Observatory, Aug. 2000

“3-D Simulations of Electron Phase-Space Holes”, National Radio Science Meeting, Boulder, CO, Jan. 2000,

“Electron Phase-Space Tornadoes: Observations in Space, Simulations, and Animations,” presented at the Dartmouth College, Space Physics Seminar, November 1999.

“Nonlinear physics of small-scale E-region waves: simulations and theory,” presented at the 1997 IAGA meeting in Uppsala, Sweden

“Two-stream waves in the E-region ionosphere nonlinearly drive large-scale D.C. currents,” presented at the 1997 URSI meeting in Montreal, Canada

“Nonlinear wave-driven currents in the E-region ionosphere: simulations, movie and theories,” presented at: *Laboratory of Plasma Physics Colloquium, Cornell University*, November, 1996; *Department of Physics, Clemson University*, December 1996; and *Department of Physics, Utah State University*, March, 1997

Outreach and Miscellaneous

Science, *Mysterious radar echoes in the sky explained?* May 2016, DOI: 10.1126/science.aaf9863

Fox News, Discover Magazine, Der Spiegel, Daily Mail, and others reported on-line about the *Photoelectron Induced Waves* article, 2016

Physics Today article: “Meteor trails track upper atmospheric winds” by Mark Wilson, *Physics Today*, 2009, vol. 62, issue 6, p. 16

History Channel appearance on “The Universe,” 2007, ep. 7, discussing atmospheric electricity.