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Scientific Interests

auroral physics, auroral acceleration processes, wave-particle interactions, magnetosphere-ionosphere-thermosphere coupling, planetary magnetospheres, planetary atmospheres, computational science

Education

UNIVERSITY OF COLORADO, BOULDER CO, USA August 2010
 Ph.D. in Astrophysical and Planetary Sciences
 Dissertation: “The impact of field-aligned potentials on Jupiter’s auroral emission”
 Thesis Advisor: Fran Bagenal

UNIVERSITY OF COLORADO, BOULDER CO, USA May 2006
 M.S. in Astrophysical and Planetary Sciences
 Thesis: “Modelling the Io-related DAM Emission by Modifying the Beaming Angle”
 Thesis Advisor: Fran Bagenal

BOSTON UNIVERSITY, BOSTON MA, USA May 2003
 B.A. in Astronomy and Physics, Cum Laude

Research Experience

POST-DOCTORAL RESEARCH ASSOCIATE, MSSL/UCL August 2015 – Present
 Supervisor: Andrew Fazakerley
 Modeling the density and potential structure of auroral flux tubes at Earth with an aim to compare with Cluster data. Analysing Cluster data from Earth’s auroral acceleration region.

POST-DOCTORAL RESEARCH ASSOCIATE, UCL May 2014 – July 2014
 Supervisor: Nick Achilleos
 Modeling the effect of the cooling due to infrared H_3^+ emissions on the flows and dynamics of Jupiter’s upper atmosphere using a numerical model of the coupled magnetosphere-ionosphere-thermosphere system.

NSF INTERNATIONAL RESEARCH FELLOW, UCL April 2012 – April 2014
 Sponsor: Nick Achilleos
 Integrated a 1-D model of Jupiter’s magnetosphere-ionosphere coupling currents with an azimuthally symmetric general circulation model of the jovian upper atmosphere to investigate the affect of high-latitude field-aligned potentials on the atmospheric flows and energy balance.

POST-DOCTORAL RESEARCH ASSOCIATE, IC March 2011 – March 2012
 Supervisor: Marina Galand
 Described the plasma and potential structure of magnetic flux tubes in Saturn’s magnetosphere. Determined the energy intensity profiles of precipitating electron at Saturn’s ionosphere.

POST-DOCTORAL RESEARCH ASSOCIATE, U. COLORADO August 2010 – March 2011
 Supervisors: Fran Bagenal & Bob Ergun
 Modeled the effect of auroral electrons on the martian atmosphere. Further developed models of magnetosphere-ionosphere coupling at Jupiter and Saturn.

NASA EARTH SPACE SCIENCE FELLOW, U. COLORADO August 2007 – August 2010

Thesis Advisor: Fran Bagenal

Topic: “The impact of field-aligned potentials on Jupiter’s auroral emission” Doctoral research focused on describing Jupiter’s auroral currents system through: 1) the development of a model of magnetosphere-ionosphere coupling at Jupiter, which self-consistently included the effect of field-aligned potentials; 2) use of a kinetic Vlasov model to describe the plasma and potential structure along a magnetic flux tube in a rapidly rotating system.

GRADUATE STUDENT RESEARCHER, U. COLORADO

May 2004 – August 2007

Thesis Advisor: Fran Bagenal

Research topics included constructing a model of Io’s motion through Jupiter’s magnetosphere and the excitation of radio emission at high latitudes, using a kinetic hybrid model to describe Pluto’s interaction with the solar wind, and constructing a model of magnetosphere-ionosphere coupling at Jupiter.

UNDERGRADUATE RESEARCH ASSISTANT, BOSTON U.

May 2001 - August 2003

Supervisor: Meers Oppenheim

Constructed a model of meteor ablation in Earth’s E-region ionosphere.

Publications **L. C. Ray**, J. Gustin, D. Grodent (submitted), “The characteristics of Jupiter’s auroral acceleration region”, *Icarus*.

J. Gustin, D. Grodent, **L. C. Ray**, B. Bondfond, E. J. Bunce, J. D. Nichols (2016), “Characteristics of North Jovian aurora from STIS FUV spectral images”, *Icarus*, 268, doi:10.1016/j.icarus.2015.12.048.

C. G. A. Smith, **L. C. Ray**, and N. A. Achilleos (2016), “A planetary wave model for Saturn’s 10.7-hour periodicities”, *Icarus*, 268, doi:10.1016/j.icarus.2015.12.041.

L. C. Ray, N. A. Achilleos, and J. N. Yates (2015), “The effect of including field-aligned potentials in the coupling between Jupiter’s thermosphere, ionosphere, and magnetosphere”, *J. Geophys. Res.*, 120, doi:10.1002/2015JA021319.

N. M. Pilkington, N. A. Achilleos, C. S. Arridge, P. Guio, A. Masters, **L. C. Ray**, N. Sergis, M. F. Thomsen, A. J. Coates, and M. K. Dougherty (2015), “Asymmetries observed in Saturn’s magnetopause geometry”, *Geophys. Res. Lett.*, 42, doi:10.1002/2015GL065477.

N. M. Pilkington, N. A. Achilleos, C. S. Arridge, P. Guio, A. Masters, **L. C. Ray**, N. Sergis, M. F. Thomsen, A. J. Coates, and M. K. Dougherty (2015), “Internally driven large scale changes in the size of Saturn’s magnetosphere”, *J. Geophys. Res.*, 120, doi:10.1002/2015JA021290.

A. Masters (+25 coauthors including **L. Ray**) (2014), “Neptune and Triton: Essential pieces of the Solar System puzzle”, *Planetary and Space Science*, doi:10.1016/j.pss.2014.05.008.

P. A. Delamere, F. Bagenal, C. Paranicas, A. Masters, A. Radioti, B. Bonfond, **L. Ray**, X. Jia, J. Nichols, C. Arridge (2014), “Solar wind and internally driven dynamics: influences on magnetodiscs and auroral responses”, *Space Science Reviews*, doi:10.1007/s11214-014-0075-1.

L. C. Ray, N. A. Achilleos, M. F. Vogt, and J. N. Yates (2014), “Local time variations in Jupiter’s magnetosphere-ionosphere coupling system”, *J. Geophys. Res.*, 119, doi:10.1002/2014JA019941.

L. C. Ray, M. Galand, P. A. Delamere, and B. L. Fleshman (2013), “Current-voltage relation for the saturnian system”, *J. Geophys. Res.*, 118, 3214-3222, doi:10.1002/jgra.50330.

L. C. Ray, M. Galand, L. E. Moore, and B. L. Fleshman (2012), “Characterising the limitations to the coupling between Saturn’s ionosphere and middle magnetosphere”, *J. Geophys. Res.*, 117, A07210, doi:10.1029/2012JA017735.

L. C. Ray and R. E. Ergun (2012), “Auroral Signatures of Magnetosphere-Ionosphere Coupling at Jupiter and Saturn”, *Auroral Phenomenology and Magnetospheric Processes: Earth and Other Planets*, pp. 205-214.

L. C. Ray, R. E. Ergun, P. A. Delamere, and F. Bagenal (2012), “Magnetosphere-Ionosphere Coupling at Jupiter: A parameter space study”, *J. Geophys. Res.*, 117, A01205, doi:10.1029/2011JA016899.

S. L. G. Hess, P. A. Delamere, V. Dols, **L. C. Ray** (2011), “Comparative study of the power transferred from satellite-magnetosphere interactions to auroral emissions”, *J. Geophys. Res.*, 116, A01202, doi:10.1029/2010JA015807.

L. C. Ray, R. E. Ergun, P. A. Delamere, and F. Bagenal (2010), “Magnetosphere-Ionosphere Coupling at Jupiter: Effect of field-aligned potentials on angular momentum transport”, *J. Geophys. Res.*, 115, A09211, doi:10.1029/2010JA015423.

L. C. Ray, Y.-J. Su, R. E. Ergun, P. A. Delamere, and F. Bagenal (2009), “Current-Voltage Relation of a Centrifugally Confined Plasma”, *J. Geophys. Res.*, 114, A04214, doi:10.1029/2008JA013969.

R. E. Ergun, **L. C. Ray**, P. A. Delamere, F. Bagenal, V. Dols, and Y.-J. Su (2009), “Generation of Parallel Electric Fields in the Jupiter-Io Torus”, *J. Geophys. Res.*, 114, A05201, doi:10.1029/2008JA013968.

L. C. Ray and S. Hess (2008), “Modelling the Io-related DAM Emission by Modifying the Beaming Angle”, *J. Geophys. Res.*, 113, A11218, doi:10.1029/2008JA013669.

P. A. Delamere, F. Bagenal, V. Dols, and **L. Ray** (2007), “Saturn’s neutral torus vs. Jupiter’s plasma torus”, *Geophys. Res. Lett.*, 34, L09105, doi:10.1029/2007GL029437.

L. P. Dyrud, **L. Ray**, M. Oppenheim, S. Close and K. Denney (2005), “Modelling high-power large-aperture radar meteor trails”, *J. of Atmos. and Solar-Terrestrial Phys.*, 67, 1171-1177.

L. P. Dyrud, K. Denney, S. Close, M. Oppenheim, **L. Ray**, and J. Chau (2004), “Meteor velocity determination with plasma physics”, *Atmos. Chem. and Phys.*, 4 (3) 817 - 824.

M. M. Oppenheim, L. P. Dyrud, and **L. C. Ray** (2003), “Plasma instabilities in meteor trails: Linear theory”, *J. Geophys. Res.*, 108, 1063, doi:10.1029/2002JA009548, A2.

Recent Presentations

Auroral acceleration at Jupiter, *Seminar, University of Southampton*, Southampton, UK, December 2015

Jupiter’s thermospheric winds and energy budget, *Magnetospheres of the Outer Planets - poster*, Atlanta, CA, June 2015

Characteristics of Jupiter’s auroral acceleration region, *Magnetospheres of the Outer Planets - poster*, Atlanta, CA, June 2015

Modeling Jupiter’s coupled thermosphere-ionosphere-magnetosphere system, *International Space Science Institute Workshop*, Bern, CH, January 2015

Local time variations in Jupiter's magnetosphere-ionosphere coupling, *Seminar, Imperial College*, London, UK, May 2014

Breaking the azimuthal symmetry in Jupiter's M-I-T coupling system, *ISAS Workshop of Magnetospheric Plasmas*, Tokyo, JP, November 2013

Influence of azimuthal variations in the jovian magnetospheric field on global thermospheric energy inputs, *European Planetary Science Congress - Poster*, London, UK, September 2013

Models of magnetosphere-ionosphere-thermosphere coupling at Jupiter *Magnetospheres of the Outer Planets invited*, Athens, GR, July 2013

Thermosphere - Ionosphere - Magnetosphere Coupling at Jupiter, *International Space Science Institute Workshop*, Bern, CH, July 2013

Magnetosphere-Ionosphere-Thermosphere coupling at Jupiter: Impact of field-aligned potentials, *Seminar, Univ. of Cologne*, Cologne, DE, May 2013

Including field-aligned potentials in thermosphere-ionosphere-magnetosphere coupling at Jupiter: first results, *Seminar, Univ. of Leicester*, Leicester, UK, February 2013

Thermosphere - Ionosphere - Magnetosphere coupling at Jupiter, *American Geophysical Union - Poster*, San Francisco, CA, December 2012

Magnetosphere - Ionosphere Coupling at Jupiter and Saturn, *Giant Planet Magnetodiscs and Aurorae Workshop*, Bern, CH, September 2012

Magnetosphere - Ionosphere Coupling at Jupiter and Saturn, *Seminar, Université Liège*, Liège, Belgium, November 2012

Magnetosphere - Ionosphere Coupling at Saturn and Jupiter, *European Planetary Science Congress invited*, Madrid, ES, September 2012

Thermosphere - Ionosphere - Magnetosphere Coupling at Saturn, *International Space Science Institute Workshop*, Bern, CH, September 2012

Limitations to the transfer of angular momentum in Saturn's magnetosphere, *Seminar, Mullard Space Science Laboratory*, Dorking, UK, March 2012

Magnetosphere - Ionosphere Coupling in Saturn's inner and middle magnetosphere, *American Geophysical Union Fall Meeting invited*, San Francisco, CA, December 2011

Forty-one total presentations. Details available upon request.

Academic Appointments

INSTRUCTOR, UNIVERSITY COLLEGE LONDON (UCL) September 2014 - Present
Teach second year Certificate in Astronomy course, *Exoplanets and the Search for Life*, for mature students. Topics include habitability zones, planetary system formation, detection methods for exoplanets, planetary atmospheres. Prepare lectures, in-class demonstrations, quizzes and examinations. Grade coursework and exams. Create and maintain class web page to enhance communication with students. Class size: 15 - 30 students.

INSTRUCTOR OF RECORD, U. COLORADO Summer 2007
Teach introductory astronomy course, *Introduction to the Solar System*, for non-science majors. Topics include planetary atmospheres, planetary geology, light, telescopes, solar system formation. Prepare lectures, in-class demonstrations, quizzes and examinations. Grade coursework and exams. Create and maintain class web page to enhance communication with students. Class size: 35 - 50 students.

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| More Teaching Experience | REGULAR GUEST LECTURER, UCL | 2012 - present |
| | Teach 3 classes each term on informal science communication for the <i>Effective Science Communication</i> course. Learning goals include identifying what a non-scientist might know about a topic (e.g. lunar eclipses, global warming, etc), what the key points that you would want them to understand are, and how to communicate those points effectively. | |
| | YEAR 3 PHYSICS TUTOR, IMPERIAL COLLEGE LONDON (IC) | 2011 - 2012 |
| | Lead tutorial sessions for Year 3 Physics students (final year of B.S. program) to prepare them for their comprehensive exams. Group sizes were 5 students. Topics cover the entirety of the physics degree course, including E&M, mechanics, solid state physics, and quantum mechanics. Prepare problem set solutions, guide students solving at the board, evaluate students each term. | |
| | TEACHING ASSISTANT, U. COLORADO | Spring 2004, Fall 2003 |
| | Assisted instructors of large (250+) general solar system and astronomy lecture courses. Responsibilities include running night observing labs, regular office hours, book keeping, lecture cover | |
| | TEACHING ASSISTANT, BOSTON UNIVERSITY | Summer 2002 |
| | Assisted instructors in introductory astronomy classes for non-science majors. Responsibilities include writing homework solutions, grading exams, and running night observing labs. | |
| Professional Service | CO-LEADER, INTERNATIONAL SPACE SCIENCE INSTITUTE (ISSI) TEAM | 2014–2015 |
| | Co-lead international team Coordinated Numerical Modeling of the Global Jovian and Saturnian Systems at ISSI in Bern, CH. Team goals include creating a unified model to described the solar wind-magnetosphere-ionosphere-thermosphere systems of Jupiter and Saturn, and improving communication of science results to broader community. | |
| | PROPOSAL REVIEWER FOR NASA | 2013 – present |
| | Panel member and external reviewer for NASA Programs | |
| | SESSION CO-CONVENOR | 2012 – present |
| | Propose, organize, and co-convene sessions on giant planet atmospheres and magnetospheres at international meetings such as the American Geophysical Union Fall meeting, European Planetary Science Congress, and Magnetospheres of the Outer Planets meeting. | |
| | MEMBER, ISSI TEAM AND WORKSHOP | 2012 – present |
| | Member of ISSI team on Comparative Jovian Aeronomy and ISSI workshop on Giant Planet Magnetodiscs and Aurorae | |
| | JOURNAL REFEREE | 2011 – present |
| | Regular referee for high-impact journals: Journal of Geophysical Research - Space Physics, Planetary & Space Science, Space Science Reviews, Icarus, and Geophysical Research Letters | |
| Professional Societies | Royal Astronomical Society, Member | 2011–present |
| | American Geophysical Union, Member | 2003–present |
| Educational Outreach | STEM AMBASSADOR | 2015-present |
| | Provide outreach talks in greater London area, mentor sixth form students for CREST Gold Award | |
| | UCL’S YOUR UNIVERSE FESTIVAL, LONDON, UK | 2015 |
| | Co-coordinated the UCL Astronomy festival. Responsibilities include advertising, volunteer coordination, exhibit set-up & tear-down, managing school groups. | |

UNIVERSITY OF LONDON OBSERVATORY, LONDON, UK 2012-2015
 Guide for Friday night tours of campus observatory. Responsibilities include a tour of ULO's three telescope domes, star tours, telescope operations, and explaining astronomy, with focus on spectroscopy, doppler shift, parallax, and telescopes to the community.

ASSORTED PUBLIC TALKS, LONDON, UK & COLORADO, US 2007 -present
 Provide public talks on planetary auroral processes for local astronomy clubs, Science Nights at the Natural History Museum, science fiction book clubs, UCL Science Centre

SOMMERS-BAUSCH OBSERVATORY, BOULDER, CO 2003-2010
 Volunteer host and operator for Friday night open house at campus observatory. Responsibilities include telescope operation, tours of night sky, and explaining astronomy to the community. Participated in public Observatory events, such as Astronomy Day and Mars' Closest Approach.

JUDSON B. COIT OBSERVATORY, BOSTON, MA 2002-2003
 Operated Boston University Astronomy Departments telescopes for students and general public.

Academic Service UCL ASTROPHYSICS PHD ADMISSIONS 2015
 Assisted academics by coordinating applicant interviews.

APS DEPARTMENTAL COMMITTEES, U. COLORADO 2004-2007
 Student representative in departmental faculty meetings (2007-2008), Graduate Admissions (2004-2006), and Comprehensive Exams Committee (2006)

Technical Skills Computer Platforms: Apple, Unix, Linux
 Operating Systems: OS X
 Programming: IDL, Matlab, F77, shell scripting

Honors NSF International Research Fellow April 2012 – April 2014
 NASA Earth Space Science Fellowship August 2007 – August 2010
 American Geophysical Union Outstanding Student Poster Award 2006, 2009
 Returning Graduate Student Supplemental Fellowship, APS, U. Colorado 2004 – 2005
 Teaching Assistant Award, APS, U. Colorado 2004
 The Center for Space Physics Award for Excellence in Space Physics,
 Boston University Astronomy Department 2003
 Outstanding Student Poster Award,
 Coupling, Energetics and Dynamics of Atmospheric Regions (CEDAR) June 2002