Extended Curriculum Vitae

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Education

Ph.D. in Planetary Science, University of Arizona, Tucson, AZ, 1988; advisors D.M. Hunten and R.A. Brown. Dissertation title: "Sodium in Io's Extended Atmosphere".

B.A. in Physics & Astronomy (with honors), Dartmouth College, Hanover, NH, 1979.

Employment History

2017-present: Professor, Astrophysical, Planetary and Atmospheric Sciences

1997-2017: Associate Professor, Astrophysical, Planetary and Atmospheric Sciences

1989-1997: Assistant Professor, Astrophysical, Planetary and Atmospheric Sciences, University of Colorado, Boulder, CO. Also Faculty Research Associate, Laboratory for Atmospheric & Space Physics.

1988-1989: Post-doc with D.E. Shemansky, concentrating on the application of atomic physics to the Io torus and in outer planet atmospheres, and analysis of Voyager UVS data.

Awards & Recognition

Presidential Young Investigator (National Science Foundation), 1991-1996.
Boulder Faculty Assembly *Award for Excellence in Teaching*, 2010
NASA *Group Achievement Awards* for MAVEN (three awards)
NASA *Exceptional Science Achievement Medal* (awarded to individuals), 2017
Asteroid 6365 Nickschneider, 2002

Research Overview

Planetary spectroscopy, origin & evolution of planetary atmospheres, planetary magnetospheres, extra-solar planets, scientific visualization, and instrument development. I am the Science Lead on the Imaging UV Spectrograph instrument on MAVEN, a NASA Mars Scout mission for the study of Mars atmospheric escape which arrived at Mars in 2014. Additional projects are focused on groundbased and spacebased observations of the Jupiter/Io system, especially imaging and spectroscopy of the Io neutral clouds and plasma torus. I am also a co-investigator two European Space Agency mission team: the SPICAM ultraviolet spectrograph team on Mars Express now orbiting Mars, and the JANUS imager on the JUICE mission to Jupiter under development.

Mission Participation

MAVEN: Co-investigator and Science Lead for the Imaging UV Spectrograph (IUVS)
ESA/Mars Express: Co-investigator on the SPICAM instrument
JAXA/Hisaki: Guest Investigator
JUICE: Co-investigator on the JANUS instrument (under development)

Education & Outreach Overview

Educational reform at the University of Colorado is a high priority, where I focus on advancing innovative teaching & learning practices in large science classes. I teach at the lower-division non-majors level, at the upper division majors level, and at the graduate level. I am a co-author of "The Cosmic Perspective", the most widely-used textbook series in college introductory astronomy courses. I am active in public outreach in planetary science, locally and nationally.

Research – Extended Summary

Overview

My research interests lie in the areas of the origin & evolution of planetary atmospheres, planetary spectroscopy, planetary magnetospheres, extra-solar planets, scientific visualization, and instrument development. My current primary focus is Mars and the evolution of its atmosphere. I serve as Instrument Lead on the Imaging UltraViolet Spectrograph on a NASA Mars Scout mission "MAVEN" (Mars Atmosphere and Volatile Evolution, Bruce Jakosky PI). This effort constituted a fundamental change in research direction after tenure. I do still maintain an active program focused on my pre-tenure research on planetary magnetospheres, particularly the interactions between planetary plasmas and the satellites of the outer planets. For work in this area on the Jupiter/Io system early in my career I was awarded the Presidential Young Investigator Award. I am a co-investigator or guest investigator on three operating missions (MAVEN, Mars Express/SPICAM, and Hisaki) and one planned mission (JUICE).

Mars Atmosphere & Planetary Evolution

I serve as Instrument Lead on the Imaging UltraViolet Spectrograph (IUVS) on the MAVEN, now in its second year of operation at Mars. Jointly with Bill McClintock (Instrument Scientist), I oversaw the design and development of this $22M instrument. Since launch it has been my sole responsibility to lead the science team with an annual budget of ~$2M. I directly supervise a group of 3-4 postdocs, 3-4 graduate students, a handful of undergraduates plus several scientific staff. Through subcontracts, co-investigatorships and science team membership, I oversee the research direction of another ~8 PhD's plus their students and staff.

The science goals of IUVS are remarkably broad: atmospheric escape, dayglow, nightglow, atmospheric composition, ionospheric physics, photochemistry, seasonal variability, clouds, dust, ozone, atmospheric tides, waves, global circulation, aurora and meteor showers. Actively participating in each and every investigation is truly a career highlight. I have taken the lead on the last two investigations above, meteor showers and aurora, and expect these to be very fruitful areas for publications into the future for me, my postdocs and my students.

Jupiter/Io/Enceladus

Prior to my Mars/MAVEN work, I focused my efforts on innovative groundbased observations of the Jupiter/Io system. My imaging work with Trauger remains the definitive description of the plasma torus structure after 20 years, and both imaging and spectroscopic work on Io's escaping atmosphere identified critical new pathways with implications for other planets and satellites. This work led to development of a Small Explorer mission concept "JMEX: the Jupiter Magnetospheric Explorer) which was twice selected for Phase A study but not selected for flight. The scientific motivation remained compelling, however, and formed the basis of the JAXA Hisaki mission. I was selected as a Guest Investigator on Hisaki and will continue to pursue JMEX objectives. I have also continued a groundbased program using the Keck Telescope, Apache Point Observatory and the Telescopio Nazionale Galileo, leading to further publications about Io and two publications about similar phenomena at Saturn's moon Enceladus.

Publications: Review Papers and Book Chapters

1. Strom, R.G. and N.M. Schneider, "Volcanic Eruption Plumes on Io", in Satellites of Jupiter, D. Morrison, Ed., Univ. of Arizona Press, Tucson, pp. 598-633, 1982.
2. Schneider, N.M., W.H. Smyth and M.A. McGrath, "Io's Atmosphere and Neutral Clouds", in *Time-Variable Phenomena in the Jovian System*, M.J.S. Belton et al., eds., *NASA SP-494*, pp. 75-99, 1989.
3. Spencer, J.R. and N.M. Schneider, "Io on the Eve of the Galileo Mission", *Ann. Rev. Earth Plan. Sci. 24*, 125-90, 1996.
4. Schneider, N.M. and F. Bagenal, "Io's Neutral Clouds, Plasma Torus and Magnetospheric Interaction", in *Io After Galileo*, R. Lopes, Ed., Springer/Praxis, pp. 265-286, 2007.
5. McClintock, W.E., N.M. Schneider, G.M. Holsclaw, J.T. Clarke, A.C. Hoskins, A.I.F. Stewart, F. Montmessin, R.V. Yelle, J. Deighan, "The Imaging Ultraviolet Spectrograph (IUVS) for the MAVEN Mission", Space Science Reviews, doi: 10.1007/s11214-014-0098-7, 2015.
6. R.J. Lillis, D. A. Brain, S. W. Bougher, F. Leblanc, J. G. Luhmann, B. M. Jakosky, R. Modolo, J. Fox, J. Deighan, X. Fang, Y.C. Wang, Y. Lee, C. Dong, Y. Ma, T. Cravens, L. Andersson, S.M. Curry, N. Schneider, M. Combi, I. Stewart, J. Clarke, J. Grebowsky, D. L. Mitchell, R. Yelle, A.F. Nagy, D. Baker, and R. P. Lin, "Characterizing atmospheric escape from Mars today and through time, with MAVEN Space Sci. Rev. (2015) 195: 357. doi:10.1007/s11214-015-0165-8.
7. Jakosky, B.M., R.P. Lin, J.M. Grebowsky, J.G. Luhmann, D.F. Mitchell, G. Beutelschies, T. Priser, M. Acuna, L. Andersson, D. Baird, D. Baker, R. Bartlett, M. Benna, S. Bougher, D. Brain, D. Carson, S. Cauffman, P. Chamberlin, J.-Y. Chaufray, O. Cheatom, J. Clarke, J. Connerney, T. Cravens, D. Curtis, G. Delory, S. Demcak, A. DeWolfe, F. Eparvier, R. Ergun, A. Eriksson, J. Espley, X. Fang, D. Folta, J. Fox, C. Gomez-Rosa, S. Habenicht, J. Halekas, G. Holsclaw, M. Houghton, R. Howard, M. Jarosz, N. Jedrich, M. Johnson, W. Kasprzak, M. Kelley, T. King, M. Lankton, D. Larson, F. Leblanc, F. Lefevre, R. Lillis, P. Mahaffy, C. Mazelle, W. McClintock, J. McFadden, D.L. Mitchell, F. Montmessin, J. Morrissey, W. Peterson, W. Possel1, J.-A. Sauvaud, N. Schneider, W. Sidney, S. Sparacino, A.I.F. Stewart, R. Tolson, D. Toublanc, C. Waters, T. Woods, R. Yelle, R. Zurek; The Mars Atmosphere and Volatile Evolution (MAVEN) Mission, *Space Sci. Rev.*,195, 3–48, DOI: 10.1007/s11214-015-0139-x, 2015.

Publications: Refereed Papers

8. Brown, R.A. and N.M. Schneider, "Sodium Remote from Io", *Icarus 48*, 519-535, 1981.
9. Strom, R.G., N.M. Schneider, R.J. Terrile, A.F. Cook, C.J. Hansen, "Volcanic Eruptions on Io", *J. Geophys. Res. 86*, 8593-8620, 1981.
10. Schneider, N.M., D.M. Hunten. W.K. Wells and L.M. Trafton, "Eclipse Observations of Io's Sodium Atmosphere", *Science 238*, 55-58, 1987.
11. Broadfoot, A.L., and 21 others (including N.M. Schneider), "Ultraviolet spectrometer observations of Neptune and Triton", *Science*, 246, 1459-1466, 1989.
12. Melosh, H.J., N.M. Schneider, K.J. Zahnle and D. Latham, "Ignition of global wildfires at the Cretaceous/Tertiary boundary", *Nature* 343, 251-254, 1990.
13. Russell, C.T., J.J. Caldwell, I. de Pater, J. Goguen, M.J. Klein, B.L. Lutz, N.M. Schneider And R.A. West, "International Jupiter Watch; A program to study time-variability of the Jovian system", *Adv. Space Res. 10*, 1239-1242, 1990.
14. Hunten D.M., W.K. Wells, R.A. Brown, N.M. Schneider and R.L. Hilliard, "A Cassegrain Echelle Spectrograph", *Pub. Astr. Soc. Pacific 103*, 1187-1192, 1991.
15. Schneider, N.M., D.M. Hunten, W.K. Wells, A.B. Schultz, U. Fink, "The Structure of Io's Corona", *Astrophys. J. 368*, 298-315, 1991.

16. Schneider, N.M., J.T. Trauger, J.K. Wilson, D.I. Brown, R.W. Evans, D.E. Shemansky, "Molecular Origin of Io's Fast Sodium", *Science 253*, 1394-1397, 1991.
17. Clarke, J.T., J.A. Ajello, J. Luhmann, N.M. Schneider, I. Kanik, "HST Observations of Io's Atmosphere Passing into Eclipse", *J. Geophys. Res. Planets 99*, 8387-8402, 1994.
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19. Wilson, J.K., N.M. Schneider, "Io's Fast Sodium: Implications for Molecular and Atomic Escape", *Icarus 111*, 31-44, 1994.
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21. Schneider, N.M., J.T. Trauger, "The Structure of the Io Torus", *Astrophys. J*. 450, 450-462, 1995.
22. Taylor, M.H., N.M. Schneider, F. Bagenal, B.R. Sandel, D.E. Shemansky, P.L. Matheson and D.T. Hall, "A comparison of the Voyager 1 ultraviolet spectrometer and plasma science measurements of the Io Plasma Torus", *J. Geophys. Res. 100*, 19541-50, 1995.
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24. Bagenal, F., F. J. Crary, A. I. F. Stewart, N.M. Schneider, D. A. Gurnett, W. S. Kurth, L. A. Frank, Paterson, W. R., Galileo measurements of plasma density in the Io torus, *Geophys. Res. Lett*., 24, 2119, 1997.
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27. Wilson, J.K. and N.M. Schneider, "Io's Sodium Directional Feature: Evidence for Ionospheric Escape", *J. Geophys. Res.*, 104, 16567-16583, 1999.
28. Burger, M.H. and N.M Schneider, "Galileo's Close-up View of Io's Sodium Jet*", Geophys. Res. Lett.,* 26, 3333-3336, 1999.
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34. Herbert F, Schneider NM, Hendrix AR, et al., "Hubble Space Telescope observations of sulfur ions in the Io plasma torus: New constraints on the plasma distribution", *J. Geophys. Res.* 108, 1-14, 2003.
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100. Chaufray, J.Y, *et al.* (2019). Effect of the 2018 Martian global dust storm on the CO_2 density in the lower nightside thermosphere observed from MAVEN/IUVS Lyman-alpha absorption.

Publications: Educational Works

J. Bennett, M. Donahue, N. Schneider, M. Voit, *The Cosmic Perspective,* a two-semester introductory astronomy textbook. First edition published 1998, 9th edition copyright 2020 (Pearson).

J. Bennett, M. Donahue, N. Schneider, M. Voit, *The Essential Cosmic Perspective,* a one-semester introductory astronomy textbook first published 1999, 8th edition copyright 2018. (Pearson).

J. Bennett, M. Donahue, N. Schneider, M. Voit, *Fundamentals of the Cosmic Perspective,* a one-quarter introductory astronomy textbook first published 2010, 3rd edition copyright 2020. (Pearson).

Teaching – Extended Summary

Overview

My teaching interests span all three levels taught at the University of Colorado: non-majors introductory astronomy, majors' classes in planetary science, and graduate level teaching of astronomical methods and planetary science. I am active in efforts to improve the quality of teaching at CU and nationally. I have co-written the most widely used introductory astronomy textbooks in the country, *The Cosmic Perspective* series. I received the Boulder Faculty Assembly Teaching Excellence Award in 2010. I served as Education and Outreach officer for the Division for Planetary Sciences for six years and implemented several new programs of use to the educational community.

Classroom Teaching

The bulk of my teaching has been at the undergraduate level, due to the high demand for our courses in planetary science and the small pool of instructors with content expertise. I remain enthusiastic about our introductory astronomy classes for non-majors; we teach a full-year course in which the first half is primarily planetary science. I therefore frequently teach ASTR 1000 and ASTR 1010 (the version with an integral lab component). My expertise is in particular demand in majors courses, ASTR 3710 (Solar System Formation and Dynamics, a course I created), ASTR/ATOC 3720 (Planets and Their Atmospheres) and ASTR 3750 (Planets, Moons and Rings). These courses have seen tremendous growth over my career, starting at class sizes of ~20 students to 60-70 students today. The growth is due in part to the ASTR major, but also is in great demand for students in Aerospace Engineering and other engineering departments. Over the years my courses have received very positive feedback from students via FCQ's and from departmental peer evaluations. I also teach at the graduate level; courses have included planetary science, statistics and observations, and graduate seminars.

I continue to serve as a departmental resource for faculty engaged in "interactive engagement" teaching methods such as clickers, on-line homework, and "Just-In-Time-Teaching" methods, providing materials, advice, and solutions. These methods have significant effect on student "learning gains". I also mentor graduate students on teaching methods, and informally mentor new faculty and honorarium faculty.

Curriculum Development

I have placed a high priority on the development of departmental and interdepartmental curriculum, with a focus on courses in planetary science. In the '90's, the maturation of the field of planetary science and the growth in grad student population necessitated an expansion from a single graduate course offered irregularly to a two-year rotation of four courses (ASTR 5800 Planetary Surfaces and Interiors, 5810 Planetary Atmospheres, 5820 Solar System Formation, 5830 Special Topics in Planetary Science), plus a seminar 5835. I led the effort to create these courses, crosslist across with GEOL and ATOC and integrate them into the overall graduate curriculum. The resulting course sequence has had a profound impact on the coherence of our interdepartmental program. I also led the creation of ASTR2040 "The Search for Life in the Universe" and ASTR 3710 "Solar System Formation and Dynamics".

Graduate Student Advising, Postdoctoral Researcher Supervision, Undergraduate Researcher Supervision

I have graduated four students with Ph.D.'s in Astrophysical & Planetary Sciences, one with a master's degree, and am currently supervising two more.

- Linda Sauter, 1993 M. Sc.
- Jody Wilson, 1996 Ph.D., research scientist at the University of New Hampshire
- Martin Taylor, 1997 Ph.D., originally a consultant at STX; current position not known
- Matt Burger, 2003 Ph.D., research scientist at the Goddard Space Flight Center
- Jessica Lovering, 2010 M. Sc., Director of Energy at the Breakthrough Institute (think tank)
- Mike Chaffin, 2015 Ph.D., postdoc at LASP
- Matteo Crismani, 2018, NASA Postdoctoral Program fellow, Goddard Space Flight Ctr.
- Kyle Connour, expected graduation 2020

I have also served on thesis committees of students overseas, either by advising them on parts of their theses or serving on their examination committees. There include Cesare Grava (U. Padova, Italy, Ph. D., 2013), Arnaud Stiepen (U. Liege, Belgium, Ph. D. 2014), Alice Luchetti (U. Padova, Ph. D., 2016). Grava is now a Research Scientist at SouthWest Research Institute in San Antonio, while Stiepen and Luchetti have obtained excellent postdoctoral fellowship positions at their home institutions.

Postdoctoral Researcher Supervision

For my Jupiter/Io research, I employed two postdocs. Michael Kueppers, who now holds a position in ESA's Science Operations Department, and Cesare Grava, now at SwRI (see above). For MAVEN/IUVS I currently employ three postdocs: Justin Deighan, Sonal Jain and Mike Chaffin (all now promoted to Research Scientist II). I previously supervised postdocs Michael Aye, Arnaud Stiepen, now at U. Liege (see above) and Matteo Crismani (now at GSFC).

Undergraduate Researcher Supervision

I have supervised about fifteen undergraduate students on research projects, though on MAVEN the average is currently about two students at a time. Past & current students include Michael Leverington, Jeff Chu, Rob Morris, Seth Wilson, Albert Park, Robert Sturm, Steve Sutton, Natalie Bremer, Katie Fitzgerald, John Lothringer, Jeremy Emmett, Sam Stuver, Alyssa Derks, Cami Nasr, Zac Milby, and Ally Leffler.

"The Cosmic Perspective" Textbooks

Early in my career, I set a goal of changing that way planetary science is taught at the "Astro 101" level. The bone of contention was the traditional "March of the Planets" approach of every textbook at the time, with chapters on Mercury, Venus, Mars, etc. To meet my goal, I partnered

with Jeff Bennett, Megan Donahue and Mark Voit to co-author *The Cosmic Perspective* textbooks. The books are published by Pearson, with the latest in its 9th edition. I write the planetary science chapters which comprise roughly a quarter of the books. We were the first to use a comparative planetology approach, with chapters on Planetary Atmospheres and Planetary Geology, emphasizing concepts over factoids. This modern approach is one of the primary reasons instructors switched over to our textbook. Another key point is the online homework system *MasteringAstronomy*, developed in an integrated sense by the authors and not by contractors as is typical. The "*Cosmic Perspective*" series books are now well above ~600,000 copies sold, with each subsequent edition outselling the previous. Different versions are suitable for use in 1-yr, 1-semester or 1-quarter courses. Although firm numbers are difficult to establish, our publisher considers the Cosmic Perspective series as market leader overall in introductory astronomy. These texts are therefore helping me meet my original goal, as more and more students learn planetary science through comparative planetology.

Educational Outreach and Service

As Education & Outreach Officer of the AAS/DPS from 2008-2014, I initiated several programs at the national level. First, with David Kassen (Rowan U.), the DPS developed the first clearinghouse for graduate programs in planetary science (https://dps.aas.org/education/graduate-schools). It's the top google hit for anyone searching on planetary science graduate programs, and students I mentor or meet during recruiting invariably say they have used the site. Second, with David Brain (U. Colorado) I developed a series of lecture powerpoints based on "discoveries too new for the textbooks". They are still among the DPS' most popular webpages (https://dps.aas.org/education/dpsdisc), which will probably increase when the current officers follow through on extending the series. Third, with Sarah Horst (Hopkins) I established a series of Teacher Training workshops (led by Sarah Horst with other scientists) at the annual DPS meetings. This not only impacted teachers and their students, but also a set of DPS members then able to participate and lead other such workshops. Given NASA's retreat from offering these workshops directly, a community effort may be the most effective approach. Finally, at the DPS and ASP Conferences, I have made presentations and held workshops on "How to Teach Planetary Science", and made available digital copies of a collection of "Planetary Tips and Tools" with videos, unique demonstration how-to's, clicker questions and the lecture powerpoints mentioned above. Where possible, these resources have been made available through educational clearinghouses offered by NASA and other groups.

Service – Extended Summary

Overview

Service activities span from the local to national level. The common theme among my priorities is education. At the departmental level I have been very active in guiding the academic major tracks in our department, from curriculum development to student mentoring. At the national level I have served my professional organization as Education & Outreach Officer leading a number of significant initiatives. Below I highlight my primary efforts and accomplishments, not enumerating all the "good citizen" service roles on departmental committees, NASA/NSF review panels, national committees, organizing committees, etc.

Service Activities: Partial Listing

National/Professional

- 1993 (inception) - 2001: Newsletter Editor, Division for Planetary Sciences of the American Astronomical Society
- 1992-1995: Division for Planetary Sciences Committee (governing body), American Astronomical Society
- 2008-2014: Education & Public Outreach Officer, Division for Planetary Sciences of the American Astronomical Society (see activities under Teaching)
- 2005-present: Shapley Lecturer, American Astronomical Society
- 2016: NASA – Indian Space Research Organization Mars Data Workshop
- Regularly: journal reviewer and/or proposal reviewer for NASA, NSF or Hubble Space Telescope.
- Occasionally: NASA or NSF proposal review member or lead; NASA Senior Review for mission extensions, other NASA advisory groups.
- Occasionally: scientific community organizer, e.g. "International Jupiter Watch"

University/Department/Local

- All years: Undergraduate mentor (occasionally Lead Mentor)
- Regularly: Undergraduate Curriculum Committee (and occasionally Chair)
- 2010-2013,2014-2017: Lead Course Scheduler
- All years: Outreach activities in area schools, events; public lectures
- All years: Masters, PhD, Honors thesis committee member/chair
- Regularly: one or more of the following:
    - Colloquium, Examinations, Admissions, Dept. Governance, Awards
    - Self-Study author or external program reviewer
    - Conference organizer
    - Faculty Search Committee, Reappointment & Promotion Committees