VITA

NAME:	David J. Jeffery
Vita Update:	2015 August 6
Date and Place of Birth:	1958; Port Colborne, Ontario, Canada
Citizenship:	Canadian

ADDRESS:

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RESEARCH INTERESTS:

Theoretical Astrophysics, Supernovae, Radiative Transfer

PROFESSIONAL SOCIETY MEMBERSHIPS:

Canadian Astronomical Society / Société Canadienne d'Astronomie (CASCA)

EDUCATION:

1988	Ph.D. Physics	McMaster University, Hamilton, Ontario, Canada
1984	M.Sc. Physics	McMaster University, Hamilton, Ontario, Canada
1981	B.Sc. Physics	McMaster University, Hamilton, Ontario, Canada

PROFESSIONAL EXPERIENCE:

`2014aug01–present`	Assistant Professor-in-Residence, Department of Physics & Astronomy, University of Nevada, Las Vegas (UNLV), Las Vegas, Nevada, U.S.A.
`2012aug01–2014jun30`	Visiting Assistant Professor, Department of Physics & Astronomy, University of Nevada, Las Vegas (UNLV), Las Vegas, Nevada, U.S.A.
`2011aug01–2012may31`	Visiting Assistant Professor, Department of Physics, University of Evansville, 1800 Lincoln Avenue, Evansville, Indiana 47722, U.S.A.
`2010aug23–2011may13`	Instructor, Department of Physics & Astronomy, Northern Arizona University, NAU Box 6010, Flagstaff, Arizona 86011-6010, U.S.A.
`2008jun29–2010jun26`	Senior Instructor, Department of Physics, University of Idaho, PO Box 440903, Moscow, ID 83844-0903, U.S.A.
`2007aug12–2008jun28`	Temporary Lecturer, Department of Physics, University of Idaho, PO Box 440903, Moscow, ID 83844-0903, U.S.A.
`2005aug01–2007aug11`	Postdoctoral Research Associate, Homer L. Dodge Department of Physics & Astronomy, University of Oklahoma, Norman, Oklahoma 73019, U.S.A.
`2004aug–2005may`	Lecturer, Department of Physics & Astronomy, Washburn University, 1700 SW College Ave., Topeka, Kansas 66621, U.S.A.
`2003aug01–2004jun30`	Visiting Assistant Professor, Department of Physics, University of Nevada, Las Vegas (UNLV), Las Vegas, Nevada, U.S.A.
`2001aug16–2003may16`	Visiting Assistant Professor, Physics Department, New Mexico Tech, Socorro, New Mexico, U.S.A.
`2000aug14–2001may19`	Visiting Assistant Professor, Department of Physics & Health Physics, Idaho State University (ISU), Pocatello, Idaho, U.S.A.

1999aug01–2000may13	Visiting Assistant Professor, Department of Physics & Astronomy, Middle Tennessee State University (MTSU), Murfreesboro, Tennessee, U.S.A.
1998aug01–1999may18	Visiting Assistant Professor, Department of Physics, University of Nevada, Las Vegas (UNLV), Las Vegas, Nevada, U.S.A.
1996oct01–1998jul	Postdoctoral Research Associate, Oak Ridge National Laboratory, Oak Ridge, Tennessee, U.S.A.
1995aug–1996aug	Visiting Assistant Professor of Astronomy, Department of Physics & Astronomy, Vanderbilt University, Nashville, Tennessee, U.S.A.
1994apr–1995jun	Fellow (Becario) of the Spanish Ministerio de Educación y Ciencia, Dept. d'Astonomia i Meteorologia, Facultat de Física, Universitat de Barcelona, Barcelona, Spain
1993sep–1994apr	Visiting Researcher, Department of Physics & Astronomy, McMaster University, Hamilton, Ontario, Canada
1993feb01–1993jun30	Lecturer on Astronomy, Department of Astronomy, Harvard University, Cambridge, Massachusetts, U.S.A.
1991jun–1993aug31	Postdoctoral Research Associate, Harvard College Observatory (Harvard-Smithsonian Center for Astrophysics), Cambridge, Massachusetts, U.S.A.
1991jan–1991may	Visiting Instructor, Department of Physics & Astronomy, University of Oklahoma, Norman, Oklahoma, U.S.A.
1990oct–1990dec	Visiting Researcher, Department of Physics & Astronomy, University of Oklahoma, Norman, Oklahoma, U.S.A.
1988sep–1989jul	Visiting Researcher, Institut für Astronomie und Astrophysik Der Universität München, Munich, Germany
1988jan–1990jun	Postdoctoral Research Associate, Department of Physics & Astronomy, University of Oklahoma, Norman, Oklahoma, U.S.A.
1980may–1980aug	NSERC Summer Student, Department of Physics, McMaster University, Hamilton, Ontario, Canada
1979sep–1987apr	Teaching Assistant, Department of Physics, McMaster University, Hamilton, Ontario, Canada

COURSES TAUGHT:

Classical Mechanics, graduate level

1. New Mexico Tech; 2001 fall; Text: H. Goldstein et al. Classical Mechanics, 3rd Edition

Colloquium in Physics/Astronomy, faculty and student colloquia, senior and graduate level

2. ISU; 2001 spring, one credit hour
1. Vanderbilt Univ.; 1995 fall, one credit hour

Conceptual Physics, non-science students

1. Univ. of Evansville; 2011 fall, Text: Paul G Hewitt, *Conceptual Physics*

Energy in Physics and Society, one of three course modules of the Physics of Everyday Life: the concept of the energy, energy and power units, thermodynamics, heat engines and refrigerators, world energy resources and consumption

1. Univ. of Idaho; 2009 fall, 2008 fall, 2007 fall; Texts: formerly Louis A. Bloomfield, *How Things Work*, my own online lectures at URL
`http://www.nhn.ou.edu/~jeffery/course/c_energy/energy.html`
Co-taught with Profs. Chris Berven and Ruprecht Machleidt of the Univ. of Idaho in 2007–2008, Profs. David McIlroy and Jason Barnes in 2009

History of Astronomy

1. Vanderbilt Univ.; 1995 fall, 1996 spring, summer; Texts: Michael Zeilik, *Astronomy,* John North, *The Norton History of Astronomy and Cosmology*

Independent Study/Research in Physics

1. Univ. of Evansville: 2012 spring; advising a course of research for a single upper division student with written and oral reports; at UE, this is technically two courses with variable credit hours, but it is at least two credit hours altogether; advisee senior student Ryan Darwish

Introductory Astronomy for non-science students

8. Univ. of Nevada, Las Vegas; 2012 fall (2 sections stars and cosmology [SC]), 2013 spring (1 section planetary systems [PS]), 2013 summer (1 section PS), 2013 fall (2 sections SC), 2014 spring (2 sections SC), 2014 fall (2 sections PS), 2015 spring (2 sections SC), 2015 fall (2 sections PS), Text: my own online lectures at URL `http://www.nhn.ou.edu/~jeffery/astro/astlec/lecture.html`
7. Univ. of Evansville; 2011 fall (all astronomy), Text: my own online lectures
6. Northern Arizona Univ.; 2010 fall (all astronomy), 2011 spring (all astronomy); Text: my own online lectures
5. Univ. of Idaho; 2009 fall (all astronomy); Text: my own online lectures
4. Washburn Univ.; 2004 fall, 2005 spring (2 sections on Stars and Galaxies; 1 section on the Solar System); Text: Neil F. Comins & William J. Kaufmann *Discovering the Universe* plus my own online lectures
3. UNLV; 2003 fall (2 sections on Solar System), 2004 spring (2 sections on Solar System); Text: Iain Nicolson, *Unfolding the Universe* plus my own online lectures
2. UNLV; 1998 fall (2 sections on Solar System), 1999 spring (2 sections on Solar System); Text: Michael Seeds *Foundations of Astronomy* for 1998–1999
1. Harvard; 1993 spring; taught jointly with William Press and Abraham Loeb

Introductory Astronomy Laboratory for non-science students

1. Univ. of Nevada, Las Vegas; 2012 fall (1 section), 2013 spring (2 sections), 2013 summer (lab coordinator), 2013 fall (lab coordinator and 1 section), 2014 spring (lab coordinator), 2014 summer (lab coordinator), 2014 fall (lab coordinator and 1 section), 2015 spring (lab coordinator and 1 section), 2015 summer (lab coordinator), 2015 fall (lab coordinator and 1 to 2 sections)

Introductory Physics I, algebra-based, mechanics, fluids, waves, thermodynamics (sometimes)

4. Univ. of Nevada, Las Vegas: 2013 spring (1 lab section); Text: David H. Lloyd *Physics Laboratory Manual*
3. Univ. of Evansville: 2011 fall (1 lab section)
2. Univ. of Idaho: 2008 fall, 2007 fall; Text: John D. Cutnell & Kenneth W. Johnson, *Physics*
1. MTSU: 1999 fall (2 sections), 2000 spring (2 sections), 2000 summer; taught in laboratory mode (course developed by Victor Montemayor of MTSU); three credit hours

Introductory Physics II, algebra-based, electricity and magnetism optics, radiation (sometimes)

4. Univ. of Evansville: 2012 spring (1 lab section)
3. Northern Arizona Univ.: 2010 fall (1 lab section as instructor, 4 lab sections as supervisor, 2011 spring (several lab sections as supervisor); only a laboratory module
2. Univ. of Idaho: 2008 spring; Text: John D. Cutnell & Kenneth W. Johnson, *Physics*
1. MTSU: 2000 spring, 1999 fall (2 sections); one credit hour; only a laboratory course.

Introductory Physics I, calculus-based, mechanics, fluids (sometimes), waves (sometimes), thermodynamics (sometimes)

4. Univ. of Evansville: 2012 spring (2 sections and 2 lab sections) Text: Jearl Walker *Halliday & Resnick: Fundamentals of Physics*
3. Univ. of Idaho: 2010 spring (2 sections), 2009 fall, 2009 spring, 2008 fall, 2008 spring; Text: Raymond A. Serway & John W. Jewett, Jr. *Physics for Scientists and Engineers* plus my own online lectures (still in early development) at URL `http://www.nhn.ou.edu/~jeffery/course/c_intro/intrc.html`
2. New Mexico Tech: 2001 fall, 2002 fall; Text: Halliday, Resnick, & Walker, *Fundamentals of Physics*
1. ISU: 2001 spring; Text: Halliday, Resnick, & Walker, *Fundamentals of Physics*

Introductory Physics II, calculus-based: electricity, magnetism, optics, special relativity (sometimes)

5. Northern Arizona Univ.: 2010 fall, 2011 spring; one credit hour; only a laboratory course
4. Univ. of Idaho: 2009 summer (also lab), 2009 spring, 2008 summer; Text: Raymond A. Serway & John W. Jewett, Jr. *Physics for Scientists and Engineers*
3. New Mexico Tech: 2002 summer; Text: Halliday, Resnick, & Walker, *Fundamentals of Physics*
2. ISU: 2000 fall; Text: Halliday, Resnick, & Walker, *Fundamentals of Physics*
1. Univ. of Oklahoma; 1991 spring; Text: Richard Wolfson & Jay M. Pasachoff, *Physics*

Mathematical Physics: various topics that can include vector analysis, curvilinear coordinates, tensors, infinite series, functions of complex variables, Sturm-Liouville theory, Legendre Polynomials and spherical harmonics, Fourier series, Fourier transforms

2. Northern Arizona Univ.; 2010 fall; Text: Hans J. Weber & George B. Arfken, *Essential Mathematical Methods for Physicists*
1. Univ. of Idaho; 2007 fall; Text: Hans J. Weber & George B. Arfken, *Essential Mathematical Methods for Physicists*

Modern Physics: some of quantum mechanics, quantum mechanics applications, special relativity

1. Univ. of Idaho; 2008 spring; Texts: Robert Eisberg & Robert Resnick, *Quantum Physics of Atoms, Molecules, Solids, Nuclei, and Particles;* Brian Greene, *The Fabric of the Cosmos*

Physical Science: introduction to physics, astronomy, chemistry, and geology for non-science students

2. Washburn Univ.; 2004 fall/2005 spring; Text: K.B. Krauskopf & A. Beiser, *The Physical Universe*; I taught physics and astronomy and co-instructor Sue Salem taught chemistry
1. MTSU; 2000 spring semester; Text: James T. Shipman et al., *An Introduction to Physical Science*; included an instructor-taught physics and chemistry laboratory

Quantum Mechanics I, graduate level

3. Northern Arizona Univ.; 2011 spring; Text: David J. Griffiths, *Introduction to Quantum Mechanics*; a graduate class, but essentially the same as undergraduate Quantum Mechanics II
2. New Mexico Tech: 2002 fall; Texts: Gordon Baym, *Lectures on Quantum Mechanics*, Walter A. Harrison, *Applied Quantum Mechanics*
1. ISU: 2000 fall; Text: Claude Cohen-Tannoudj et al. *Quantum Mechanics: Vol. I*

Quantum Mechanics II, graduate level

1. New Mexico Tech: 2003 spring; Texts: Gordon Baym, *Lectures on Quantum Mechanics*

Quantum Mechanics I, undergraduate level

3. Univ. of Idaho; 2009 spring; Text: David J. Griffiths, *Introduction to Quantum Mechanics*
2. New Mexico Tech: 2002 spring; Text: David J. Griffiths, *Introduction to Quantum Mechanics*
1. ISU: 2001 spring; Text: David J. Griffiths, *Introduction to Quantum Mechanics*

Quantum Mechanics II, undergraduate level

2. Univ. of Idaho; 2010 spring; Text: David J. Griffiths, *Introduction to Quantum Mechanics*; this was a special topics course that was 60 % Quantum Mechanics II and 40 % a follow-up course in classical mechanics
1. ISU: 2000 fall; Texts: M.A. Morrison, *Understanding Quantum Physics*, M.A. Morrison, T.L. Estle, and N.F. Lane, *Understanding More Quantum Physics*

Radiative Transfer

2. New Mexico Tech: 2002 spring; Text: Robert J. Rutten, *Radiative Transfer in Stellar Atmospheres* online at URL
   `http://www.phys.uu.nl/~rutten/Lecture_notes.html`
   three credit hours; senior undergraduate level taught as a special topic course
1. Vanderbilt Univ.; 1996 spring, astrophysical radiative transfer; Text: D. Mihalas & B.W. Mihalas, *Foundations of Radiation Hydrodynamics*; three credit hours; graduate level taught as a special topic course

Survey of Science for Teachers, Physics module: introductory physics, algebra-based

1. New Mexico Tech: 2002 summer; Text: none; A short survey course of the sciences for K-1–12 teachers without a science background (2 credit hours); taught jointly with Christa Hockensmith (chemistry) and Robert Cormack (psychology)

INVITED TALKS:

1. MARAC: 37th Annual Mid-American Regional Astrophysics Conference, 2007 April 13–14, University of Missouri, Kansas City, Kansas City, Missouri: *A Review of Supernova Atmosphere Modeling: Radiative Transfer and All That* (`http://www.nhn.ou.edu/~jeffery/aalib/052_marac/marac.html`), but the online version has never been completed.

PUBLICATIONS:

58. X. Wang, L. Wang, A.V. Filippenko, G. Aldering, P. Antilogus, D. Arnett, D. Baade, E. Baron, B.J. Barris, S. Benetti, P. Bouchet, A.S. Burrows, R. Canal, E. Cappellaro, R. Carlberg, E. di Carlo, P. Challis, A. Crotts, J.I. Danziger, M. Della Valle, D. Jack, M. Fink, R. Foley, C. Fransson, A. Gal-Yam, P. Garnavich, C.I. Gerardy, G. Goldhaber, M. Hamuy, W. Hillebrandt, P.A. Hoeflich, S.T. Holland, D. Holz, J.P. Hughes, D.J. Jeffery, S.W. Jha, D. Kasen, A.M. Khokhlov, R.P. Kirshner, R. Knop, C. Kosma, K. Krisciunas, M. Kromer, B.C. Lee, B. Leibundgut, E. Lentz, D.C. Leonard, W.H.G. Lewin, W. Li, M. Livio, P. Lundqvist, D. Maoz, T. Matheson, P. Mazzali, P. Meikle, G. Miknaitis, P. Milne, S. Mochnacki, K. Nomoto, P.E. Nugent, E. Oran, N. Panagia, F. Patat, S. Perlmutter, M.M. Phillips, P. Pinto, D. Poznanski, C.J. Pritchet, M. Reinecke, A. Riess, P. Ruiz-Lapuente, R. Scalzo, E.M. Schlegel, B. Schmidt, J. Siegrist, A.M. Soderberg, J. Sollerman, G. Sonneborn, A. Spadafora, J. Spyromilio, R.A. Sramek, S.G. Starrfield, L.G. Strolger, N.B. Suntzeff, R. Thomas, J.L. Tonry, A. Tornambe, J.W. Truran, M. Turatto, M. Turner, S.D. van Dyk, K. Weiler, J.C. Wheeler, M. Wood-Vasey, S. Woosley, H. Yamaoka, & T. Zhang, "Evidence for Type Ia Supernova Diversity from Ultraviolet Observations with the Hubble

Space Telescope," *Astrophysical Journal* (ApJ), 2012, 749, Issue 2, article id. 126, 17 pages, arXiv:1110.5809v3

57. D. Branch, D.J. Jeffery, J. Parrent, E. Baron, M.A. Troxel, V. Stanishev, M. Keithley, & C. Bruner, "Comparative Direct Analysis of Type Ia Supernova Spectra. IV. Postmaximum," *Publications of the Astronomical Society of the Pacific (PASP)*, 2008, 120, 135–149, arXiv:0712.2436v1

56. E. Baron, D.J. Jeffery, D. Branch, E. Bravo, D. García-Senz & P. H. Hauschildt, "Detailed Spectral Modeling of a 3-D Pulsating Reverse Detonation Model: Too Much Nickel," *Astrophysical Journal* (ApJ), 2008, 672, 1038-1042, arXiv:0709.4177v1

55. D. Branch, M.A. Troxel, D.J. Jeffery, K. Hatano, M. Musco, J. Parrent, E. Baron, L.C. Dang, D. Casebeer, N. Hall, & W. Ketchum, "Comparative Direct Analysis of Type Ia Supernova Spectra. III. Premaximum," *Publications of the Astronomical Society of the Pacific (PASP)*, 2007, 119, 709–721, arXiv:0706.0081

54. M. Parthasarathy, D. Branch, D.J. Jeffery, & E. Baron, "The Progenitors of Type Ia Supernovae: Binary Stars with White Dwarf Companions," *New Astronomy Reviews*, 2007, 51, 524–538, arXiv:astro-ph/0703415

53. D. Branch, J. Parrent, M.A. Troxel, D. Casebeer, D.J. Jeffery, E. Baron, W. Ketchum, & N. Hall, "Probing the Nature of Type I Supernovae with SYNOW" in *The Multicoloured Landscape of Compact Objects and their Explosive Origins, AIP Conf. Pro. 924, Week One, Cefalù, Sicily, 2006 June 11–24*, ed. L. A. Antonelli, G. L. Israel, L. Piersanti, & A. Tornambè (Melville, New York: American Institute of Physics), 2007, 342–349

52. J. Parrent, D. Branch, M.A. Troxel, D. Casebeer, D.J. Jeffery, W. Ketchum, E. Baron, F.J.D. Serduke, & A.V. Filippenko, "Direct Analysis of Spectra of the Unusual Type Ib Supernova 2005bf," *Publications of the Astronomical Society of the Pacific (PASP)*, 2007, 119, 135–142, arXiv:astro-ph/0701198

51. D.J. Jeffery & P.A. Mazzali, "Giant Steps in Cefalù" in *The Multicoloured Landscape of Compact Objects and their Explosive Origins, AIP Conf. Pro. 924, Week One, Cefalù, Sicily, 2006 June 11—24*, ed. L. A. Antonelli, G. L. Israel, L. Piersanti, & A. Tornambè (Melville, New York: American Institute of Physics), 2007, 401–406, arXiv:astro-ph/0611002

50. D.J. Jeffery, D. Branch, & E. Baron, "On SN 2003fg: The Probable Super-Chandrasekhar-Mass SN Ia," 2006, unpublished, arXiv:astro-ph/0609804

49. M. Parthasarathy, D. Branch, E. Baron, & D.J. Jeffery, "An Ultralow-Dispersion Spectrum of Sanduleak -69 202, the Progenitor of Supernova 1987A," *Bulletin of the Astronomical Society of India*, 2006, 34, 385–391, arXiv:stro-ph/0611033

48. D.J. Jeffery, W. Ketchum, D. Branch, E. Baron, A. Elmhamdi, & I.J. Danziger, "Goodness-of-Fit Tests DIFF1 and DIFF2 for Locally Normalized Supernova Spectra," *Astrophysical Journal Supplement Series*, 2006, 171, 493–511, arXiv:astro-ph/0607084

47. D. Branch, D.J. Jeffery, T.R. Young, & E. Baron, "Hydrogen in Type Ic Supernovae?," *Publications of the Astronomical Society of the Pacific (PASP)*, 2006, 118, 791–796, arXiv:astro-ph/0604047

46. D. Branch, L.C. Dang, N. Hall, W. Ketchum, M. Melakyil, J. Parrent, M.A. Troxel, D. Casebeer, D.J. Jeffery, & E. Baron, "Comparative Direct Analysis of Type Ia Supernova Spectra. II. Maximum Light," *Publications of the Astronomical Society*

of the Pacific (PASP), 2006, 118, 560–571, arXiv:astro-ph/0601048

45. E. Baron, D. Branch, D.J. Jeffery, P. Nugent, R.C. Thomas, S. Bongard, P. Hauschildt, D. Kasen, & D. Mihalas, "Quantitative Spectroscopy of Supernovae for Dark Energy Studies," White paper submitted to the Dark Energy Task Force, 2005, unpublished, arXiv:astro-ph/0510166

44. J. Deng, K.S. Kawabata, Y. Ohyama, K. Nomoto, M. Iye, P.A. Mazzali, L. Wang, D.J. Jeffery, H. Tomita, & Y. Yoshii, "Late-Time Spectroscopy of the Interacting Type Ia SN 2002ic: Evidence of a H-rich, Asymmetric CSM," in *Annual Report of the National Astronomical Observatory of Japan, Vol. 6, Fiscal 2003,* ed. K. Tanikawa et al. (Tokyo: Astronomical Observatory of Japan), 2005, 16

43. K.S. Kawabata, J. Deng, P.A. Mazzali, K. Nomoto, K. Maeda, N. Tominaga, H. Umeda, N. Kobayashi, L. Wang, M. Iye, G. Kosugi, Y. Ohyama, T. Sasaki, K. Aoki, N. Kashikawa, T. Takata, W. Aoki, Y. Komiyama, Y. Mizumoto, J. Noumaru, R. Ogasawara, K. Sekiguchi, Y. Shirasaki, J. Watanabe, T. Yamada, Höflich, P., J.C. Wheeler, D.J. Jeffery, N. Kawal, T. Sakamoto, Y. Urata, A. Yoshida, T. Tamagawa, K. Torii, & T. Totani, "Subaru/FOCAS spectropolarimetry of Type Ic hypernova SN 2003dh/GRB 030329" in *Annual Report of the National Astronomical Observatory of Japan, Vol. 6, Fiscal 2003,* ed. K. Tanikawa et al. (Tokyo: Astronomical Observatory of Japan), 2005, 15

42. K.S. Kawabata, D.J. Jeffery, M. Iye, N. Kashikawa, Y. Saito, T. Misawa, T. Yamada, I. Tanaka, Y. Ohyama, G. Kosugi, T. Sasaki, K. Sekiguchi, K. Aoki, T. Takata, N. Ebizuka, K. Nomoto, P.A. Mazzali, J. Deng, K. Maeda, H. Umeda, K. Ota, M. Yoshida, M. Inata, K. Okita, Y. Shimizu, R. Asai, T. Ozawa, Y. Yadoumaru, H. Taguchi, F. Nakata, & T. Kodama, "Optical Spectropolarimetry of SN 2002ap with Subaru Telescope," in *Annual Report of the National Astronomical Observatory of Japan, Vol 5, Fiscal 2002,* ed. K. Tanikawa et al. (Tokyo: Astronomical Observatory of Japan), 2004, 22

41. D.J. Jeffery, "A Simple Bipolar Jet Model for the Polarization of Core-Collapse Supernovae," 2004, unpublished, arXiv:astro-ph/0406440

40. J. Deng, K.S. Kawabata, Y. Ohyama, K. Nomoto, P.A. Mazzali, L. Wang, D.J. Jeffery, M. Iye, H. Tomita, & Y. Yoshii, "Subaru Spectroscopy of the Interacting Type Ia Supernova SN 2002ic: Evidence of a Hydrogen-rich, Asymmetric Circumstellar Medium," *Astrophysical Journal (Letters)*, 2004, 605, L37–40, arXiv:astro-ph/0311590

39. K.S. Kawabata, J. Deng, L. Wang, P.A. Mazzali, K. Nomoto, K. Maeda, N. Tominaga, H. Umeda, M. Iye, G. Kosugi, Y. Ohyama, T. Sasaki, P. Höflich, J.C. Wheeler, D.J. Jeffery, K. Aoki, N. Kashikawa, T. Takata, N. Kawai, T. Sakamoto, Y. Urata, A. Yoshida, T. Tamagawa, K. Torii, W. Aoki, N. Kobayashi, Y. Komiyama, Y. Mizumoto, J. Noumaru, R. Ogasawara, K. Sekiguchi, Y. Shirasaki, T. Totani, J. Watanabe, & T. Yamada, "On the Spectrum and Spectropolarimetry of Type Ic Hypernova SN 2003dh/GRB 030329," *Astrophysical Journal Letters,* 2003, 593, L19–22, arXiv:astro-ph/0306155

38. D. Branch, E. Baron, & D.J. Jeffery, "Optical Spectra of Supernovae" in *Supernovae and Gamma-Ray Bursters,* ed. K.W. Weiler (Berlin: Springer-Verlag), 2003, 47–76, arXiv:astro-ph/0111573

37. K.S. Kawabata, D.J. Jeffery, M. Iye, Y. Ohyama, G. Kosugi, K. Kashikawa, N. Ebizuka, T. Sasaki, K. Sekiguchi, K. Nomoto, P.A. Mazzali, J. Deng, K. Maeda, K. Aoki, Y. Saito, T. Tanaka, M. Yoshida, R. Asai, M. Inata, K. Okita, K. Ota,

T. Ozawa, Y. Shimizu, H. Taguchi, Y. Yadoumaru, T. Misawa, F. Nakata, T. Yamada, I. Tanaka, & T. Kodama, "Optical Spectropolarimetry of SN 2002ap: A High Velocity Asymmetric Explosion" in *The Proceedings of the IAU 8th Asian-Pacific Regional Meeting, Volume II,* ed. S. Ikeuchi, J. Hearnshaw, & T. Hanawa (Japan: Astronomical Society of Japan), 2002, 333-334

36. K.S. Kawabata, D.J. Jeffery, M. Iye, Y. Ohyama, G. Kosugi, K. Kashikawa, N. Ebizuka, T. Sasaki, K. Sekiguchi, K. Nomoto, P.A. Mazzali, J. Deng, K. Maeda, H. Umeda, K. Aoki, Y. Saito, T. Tanaka, M. Yoshida, R. Asai, M. Inata, K. Okita, K. Ota, T. Ozawa, Y. Shimizu, H. Taguchi, Y. Yadoumaru, T. Misawa, F. Nakata, T. Yamada, I. Tanaka, & T. Kodama, "Optical Spectropolarimetry of SN 2002ap: A High Velocity Asymmetric Explosion," *Astrophysical Journal (Letters),* 2002, 580, L39–42, arXiv:astro-ph/0205414

35. D. Branch, S. Benetti, D. Kasen, E. Baron, D.J. Jeffery, K. Hatano, R.A. Stathakis, A.V. Filippenko, T. Matheson, A. Pastorello, G. Altavilla, E. Cappellaro, L. Rizzi, M. Turatto, Weidong Li, D.C. Leonard, & J.C. Shields, "Direct Analysis of Spectra of Type Ib Supernovae," *Astrophysical Journal,* 2002, 566, 1005–1017, arXiv:astro-ph/0106367

34. D. Kasen, D. Branch, E. Baron, & D.J. Jeffery, "A Complete Analytic Inversion of Supernova Lines in the Sobolev Approximation," *Astrophysical Journal,* 2002, 565, 380-384, arXiv:astro-ph/0108403

33. D. Branch, D.J. Jeffery, M. Blaylock, & K. Hatano, "Supernova Resonance-Scattering Profiles in the Presence of External Illumination," *Publications of the Astronomical Society of the Pacific (PASP),* 2000, 112, 217–223, arXiv:astro-ph/9911099

32. D.J. Jeffery, "Radioactive Decay Energy Deposition in Supernovae and the Exponential/Quasi-Exponential Behavior of Late-Time Supernova Light Curves," 1999, unpublished, arXiv:astro-ph/9907015

31. D.J. Jeffery, P.S. Krstić, W. Liu, D.R. Schultz, & P.C. Stancil, "Atomic and Molecular Physics and Data Activities for Astrophysics at Oak Ridge National Laboratory" in *Proceedings of the NASA Laboratory Space Science Workshop,* Harvard-Smithsonian Center for Astrophysics, 1998 April 1–3, Local Organizing Committee: W. H. Parkinson, Kate Kirby, & Peter L. Smith, 1998, p. 101

30. D.J. Jeffery, "A Grey Radiative Transfer Procedure for γ-ray Transfer in Supernovae," 1998, unpublished, arXiv:astro-ph/9811356

29. D.J. Jeffery, "A Grey γ-ray Transfer Procedure for Supernovae" in *Stellar Evolution, Stellar Explosions, and Galactic Chemical Evolution: Proceedings of the 2nd Oak Ridge Symposium on Atomic & Nuclear Astrophysics,* ed. A. Mezzacappa (Bristol: Institute of Physics Publishing), 1998, p. 687–691, arXiv:astro-ph/9802229

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RESEARCH INTERESTS AND RESEARCH PROJECTS FOR THE FUTURE AND FOR STUDENTS:

At the outset, I need to state that I have been largely research inactive since 2007 due, among other things, to heavy teaching loads, courseware projects, and employment changes. I can foresee returning to research when time and motivation allow.

The courseware projects have been my main creative work since circa 2007. These projects are detailed in my section **TEACHING EXPERIENCE AND INTERESTS**. However, I will comment here that I have devoted considerable time to developing online lectures (which are the equivalent of textbooks) for introductory astronomy,

`http://www.nhn.ou.edu/~jeffery/astro/astlec/lecture.html` , calculus-based introductory physics,

`http://www.nhn.ou.edu/~jeffery/course/c_intro/introl/000.html` ,

and introductory quantum mechanics,

`http://nhn.nhn.ou.edu/~jeffery/course/c_quantum/sqm/000_a.html` .

Work on these projects perhaps others will continue. At present, the work largely goes into abeyance when I am not actually teaching the courses they support. There are projects within the projects for undergraduate students.

The following subsections introduce my main research areas (§ 1), discuss projects for future research and for students (§ 2), and give a last word (§ 3).

1. *Research Areas*

My primary research interests are in the theoretical study of supernovae (SNe), particularly through radiative transfer analysis work and in the development of radiative transfer techniques mainly to support the aforesaid analysis work. Since almost all that we know about SNe (and all other extra-solar-system objects) must be determined from the electromagnetic radiation they emit, the importance of radiative transfer analysis and radiative transfer techniques is manifest.

A brief introduction to SNe is that they are the powerful explosions of stars and they are of considerable astrophysical importance. They are among the brightest astrophysical objects and, unlike most observable astrophysical objects, they evolve rapidly in time and this evolution can be detected over time scales as short as hours or, in the special case of neutrino emission, seconds. The physics of SN explosions is of intrinsic interest and is also of interest in understanding material properties under extreme conditions. All types of SNe eject into the interstellar medium heavy elements (carbon and above) synthesized in the explosion or from pre-explosion evolution. The element yield from SNe drives most of the heavy element evolution of the universe. Rocky planets, like Earth, and life as we know it would probably not be possible without the heavy elements from SNe. The impact of supernova ejecta on the interstellar medium is also important and, especially from core-collapse SNe, is important in the creation and dispersal of star-forming regions. Non-core-collapse SNe, Type Ia SNe or SNe Ia, are of great importance in the determination of the cosmological parameters.

2. *Research Projects for the Future and for Students*

I would like to return to active reseach in the future. A general direction would be in the development of radiative transfer techniques in particular in of Monte Carlo radiative transfer. Monte Carlo radiative transfer has been important ever since invented in the 1940s. However, it seems likely to become ever more important with the increasing power of massively parallel computers. Monte Carlo radiative transfer is effectively infinitely parallelizable because each photon packet (which represents a large number of photons, but transfers like a single one) can be treated in parallel with all the others. Monte Carlo radiative transfer can be done with great physical realism in radiation interaction processes and easily extends to multi-dimensional radiative transfer. It seems likely to me that Monte Carlo radiative transfer will become the dominant technique for radiative transfer in multi-dimensional systems in the future.

There would be many projects for students in the development and application of Monte Carlo radiative transfer codes. Given the importance of Monte Carlo techniques and computational methods in general, such work would very good for students interested that kind of work. The use or further development of open-source codes could also happen. Students could take the lead in particular projects as appropriate.

I do not at present envisage developing a large code for detailed state-of-art radiative transfer. Already existing codes such as difference-equation code PHOENIX (Hauschildt & Baron 1999, and references therein; Baron & Hauschildt 2004, and references therein) and the Monte Carlo code SEDONA (Kasen et al. 2006) have too great a lead to be challenged by me even with significant student assistance. I envisage developing small codes that can be used to test new Monte Carlo techniques and investigate particular problems in radiative transfer.

I have played around with toy Monte Carlo codes in the past. However, there would be a large learning curve for me to become proficient and generate publishable work.

A particular project which I plan to undertake at some time is to write a review of the formalism of the Sobolev method of radiative transfer (e.g., Rybicki & Hummer 1978; Mihalas 1978, p. 471ff). The Sobolev method is a radiative transfer technique that can be used in moving atmospheres with steep velocity gradients. It is an approximate technique and some of its limitations are probably not eradicable in any useful way. But on the other hand, it is a simple technique to code, it is quite accurate in some cases, and it gives great insight into how radiative transfer events actual happen and this insight is useful working with other radiative transfer methods. I have made contributions to Sobolev method technique (Jeffery 1988, 1989, 1990, 1993, 1995a, 1995b) and written a partial review of the formalism (Jeffery & Branch 1990) and believe I am well qualified to write a fuller review. It may be that no more significant extensions to the Sobolev method can be developed since other techniques (difference equation and Monte Carlo radiative transfer techniques) are probably already better for any extensions that can be imagined. On other hand, the Sobolev method is still very useful for certain applications. A review of general Sobolev method formalism may a good capstone for the history of its evolution.

For the Sobolev method review, it would be very useful to develop a new general Sobolev radiative transfer code. The code would provide demonstration calculations for a wide range of cases where the Sobolev method can be applied. The Sobolev code that I developed myself and used in past work (e.g., Jeffery et al. 1992; Kirshner et al. 1993) is designed only for supernovae in the photospheric epoch and is too inflexible and kludgy to generalize. The new Sobolev code I envisage would be useful for many kinds of moving atmospheres including the nebular epoch of supernovae and asymmetric atmospheres. The code will be written from scratch in fortran 95 (or a more advanced fortran version) and would be available for public distribution.

I believe that there are many projects for students in the development and use of the new Sobolev method code: e.g., writing subroutines, validating the code, running example calculations, and, perhaps, taking the lead in writing the code.

Aside from original research, I also have educational projects in which student participation would be useful. Students could help the continuing development of the online lectures I am working on (see the opening remarks above and other projects discussed in my **TEACHING EXPERIENCE AND INTERESTS** below). Student participation could include finding or creating images, researching aspects, and writing text, questions, and classroom activities.

The research plans outlined above would greatly benefit from student participation. I foresee many projects and sub-projects for students. In particular, since Monte Carlo codes have wide applications in astrophysics and other areas, student experience developing and using such codes should be very valuable. I expect students to produce reports and, perhaps, publishable papers.

3. *Last Word*

My long term plan is to continue working on courseware development and return to research in astrophysics if circumstances allow that. Besides supernovae and radiative transfer, I am interested in broadening my research into other areas of astrophysics and science.

RESEARCH EXPERIENCE:

I obtained my M.Sc. and Ph.D. degrees in theoretical astrophysics under the supervision of Peter G. Sutherland at McMaster University in the period 1981–1988. My M.Sc. thesis (Jeffery 1983) was on deflagrating white dwarfs as models for Type Ia supernovae (SNe Ia). (Supernovae [SNe] come in types Ia, Ib, Ic, Ic hypernova, II, and other types and subtypes.) Parameterized one-dimensional hydrodynamic calculations were done of deflagration wave propagation. The results were published in the paper of Jeffery & Sutherland (1985).

For my Ph.D. thesis (Jeffery 1988), I developed a procedure for analyzing polarimetric data obtained from supernovae. This procedure was specifically intended to be used for the study of supernova asymmetry. The novel ingredient in the analysis procedure is the use of the Sobolev-P method. The Sobolev-P method is a generalization of the Sobolev method of radiative transfer that I developed in order to treat polarized radiative transfer in both lines and continuum. The Sobolev-P method has been developed for general axisymmetric systems (Jeffery 1989) and for three-dimensional systems (Jeffery 1990). I have done several analyses of the SN 1987A polarimetric data using the Sobolev-P method (Jeffery 1987, 1988, 1989, 1991a, 1991b). As an aid for further analyses, I prepared a catalog of the SN 1987A polarimetric data corrected for interstellar polarization (Jeffery 1991c). The Sobolev-P method is now probably outdated by Monte Carlo polarized radiative transfer, but it was useful in the time it was developed.

While working at the University of Oklahoma in the period 1988–1991, at first as a postdoctoral research associate with David Branch and later in other capacities, I participated in several collaborative projects. David Branch, W. Drucker, and I wrote a small paper analyzing the Si II line velocities of SNe Ia (Branch, Drucker, & Jeffery 1988). David Branch and I wrote a paper on supernova spectrum analysis technique (using Sobolev method radiative transfer) that includes an analysis of the optical spectra of SN 1987A (Jeffery & Branch 1990). I participated in a collaboration headed by R.P. Kudritzki of the Institut für Astronomie und Astrophysik of the University of Munich and David Branch that applied NLTE radiative transfer techniques developed in Munich to the study of SNe Ia (Branch et al. 1991). For the period from 1988 September to 1989 July, I was a visiting researcher at University of Munich, where I developed a software package for updating the large files of atomic data needed for NLTE calculations. David Branch and I also collaborated with A.V. Filippenko and K. Nomoto on an analysis of a spectrum of SN 1987M, a Type Ic supernova (Jeffery et al. 1991).

From 1991 June to 1993 August, I was a postdoctoral research associate at the Harvard-Smithsonian Center for Astrophysics with Prof. R.P. Kirshner. There I primarily worked on parameterized LTE analyses of supernova spectra (Jeffery et al. 1992, 1994; Kirshner et al. 1993). I also collaborated on the NLTE analysis of the nebular spectra of the peculiar SN Ia SN 1991bg (Ruiz-Lapuente et al. 1993) and applied the relativistic Sobolev method of Hutsemékers & Surdej (1990) to homologously expanding atmospheres which include supernova atmospheres (Jeffery 1993).

In the period 1993 September to 1994 April, I was a visiting researcher with Peter G. Sutherland at McMaster University. While there, I worked principally on radiative transfer techniques. The major project was to develop an expansion opacity formalism for Sobolev method calculations (Jeffery 1995b). The second project was to improve the relativistic Sobolev method by including time-dependent effects in the optical depth formula (Jeffery 1995a). These projects were undertaken to improve supernova spectrum calculations, but the results should have a wider application in astrophysical radiative transfer.

From 1994 April to 1995 June, I held a fellowship from the Spanish Ministerio de Educación y Ciencia in the Dept. d'Astonomia i Meteorologia of the University of Barcelona. While in Barcelona, I completed the two projects I had begun at McMaster University.

From 1995 August to 1996 August, I was a visiting assistant professor of astronomy at Vanderbilt University. While there, I taught a history of astronomy course (in fall, spring, and summer semesters), worked on a set of written lectures on the history of astronomy, and aided one of the graduate students on a project to calculate the polarized emission from the dusty environment around young stellar objects using a Monte Carlo code.

From 1996 October to 1998 July, I was a postdoctoral research associate at Oak Ridge National Laboratory (ORNL) where I was part of the ORNL Program in Atomic and Molecular Astrophysics. In the first year of this appointment, I worked primarily on the analysis of nebular SN Ia spectra in collaboration with Weihong Liu and my supervisor David Schultz (director of the Controlled Fusion Atomic Data Center and group leader of Atomic Physics Theory). The work was published in the papers of Liu et al. (1997a,b,c, 1998). In this work we attempted to use the then best available evaluated atomic data. Sub-Chandrasekhar mass white dwarf explosion models for SNe Ia were favored by our analysis. Currently, Chandrasekhar mass white dwarf explosion models are strongly favored. In the second year of my appointment, I developed a simple γ-ray transport procedure for supernovae (Jeffery 1998a,b). I also worked on on relativistic radiative transfer theory and a catalog of SN Ia spectra. The first of these projects was never completed. The second eventually evolved into my supernova spectrum database SUSPEND:

`http://www.nhn.ou.edu/~jeffery/astro/sne/spectra/spectra.html` .

Further development of SUSPEND was undertaken at the University of Oklahoma in 2005–2007 (see below).

In the period 1998 August to 1999 June, I was a visiting assistant professor in the Physics & Astronomy Department of the University of Nevada, Las Vegas. While there, I completed an unpublished paper presenting in detail a simple analytical theory of radioactive decay energy deposition and its connection to the exponential/quasi-exponential behavior of late-time supernova light curves (Jeffery 1999). The theory is not original to me—it had been known to the experts in the field for 20 or so years. But being not aware of any detailed presentation anywhere, I thought it useful to provide one. The paper has turned out to be modestly useful and has collected 17 citations (12 in refereed publications) through 2013.

From 1999 August to 2000 May, I was a visiting assistant professor in the Department of Physics & Astronomy of Middle Tennessee State University in Murfreesboro. While there, I collaborated on a paper giving a simple theory of line formation in a supernova atmosphere illuminated from above by radiation from circumstellar interaction (Branch et al. 2000).

After a year as visiting professor in the Department of Physics at the Idaho State University (2000 August–2001 May) (where no research work was done), I spent a month as a visitor at the University of Oklahoma in the summer of 2001 (June 17–July 14). There I began work on a bipolar jet model for supernova polarization and was a minor collaborator on the analysis of SN Ib spectra (Branch et al. 2002) and on a paper on the analytic inversion of supernova lines in the Sobolev approximation (Kasen et al. 2002).

In the 2001 fall, I became a visiting assistant professor in the Physics Department of New Mexico Tech (NMT) in Socorro, New Mexico. At this institution I collaborated on a review paper on supernova spectra (Branch et al. 2003) and continued to develop the bipolar jet model. The bipolar jet model in a limited sense was used in the analysis of the peculiar SN Ic hypernova SN 2002ap (Kawabata, Jeffery et al. 2002, 2003b). I helped out on the analysis of spectra and spectropolarimetery of SN Ic hypernova SN 2003dh (Kawabata et al. 2003a) which was an extremely important supernova in that established unequivocally the connection of gamma-ray bursts and supernovae (e.g., Matheson et al. 2003). Also, at NMT I worked on started working on Monte Carlo radiative transfer.

From 2003 August to 2004 May, I was a visiting assistant professor at University of Nevada, Las Vegas for the second time. While there I continued to work on the bipolar jet model and completed an unpublished paper on it (Jeffery 2004). I had no money for page charges, and so the paper was never submitted to a journal. The bipolar jet model has not attracted much interest: there has been only one citation through 2013. I also aided on the analysis of the peculiar SN Ia SN 2002ic which showed an interaction with a hydrogen-rich wind (Deng et al. 2004).

From 2004 August to 2005 May, I was a lecturer in physics and astronomy at

Washburn University in Topeka, Kansas. My teaching duties and the further development of my online lectures on introductory astronomy (see the section **TEACHING EXPERIENCE AND INTERESTS**, subsection *Introductory Astronomy*) precluded any significant research during my time at Washburn.

For the period 2005 August to 2007 May, I was at the University of Oklahoma (OU) working as postdoctoral research associate with Professors Eddie Baron and David Branch. During this time I worked on various projects. The main projects in which I took the lead were on Monte Carlo radiative transfer techniques, local normalization and DIFF techniques, development of my supernova spectrum database SUSPEND

(see `http://www.nhn.ou.edu/~jeffery/astro/sne/spectra/spectra.html`),

and a project on the analysis of the peculiar SN Ia SN 2003fg.

The main Monte Carlo work was the development of an accelerated Monte Carlo radiative transfer method that I called giant steps. Giant steps was being developed in collaboration with Poalo Mazzali and Eddie Baron (Jeffery & Mazzali 2007). The giant steps work was interrupted by learning that a similar accelerated Monte Carlo method had been developed long ago by Fleck & Canfield (1984). The method of Fleck & Canfield seems to have been relatively unknown in astrophysical radiative transfer until circa 2009 (e.g., Min et al. 2009). Whether giant steps will ever be further developed depends on whether it offers some advantage over the method of Fleck & Canfield. In fact, even before learning of the method of Fleck & Canfield, I had already grown dissatisfied with giant steps. It seemed that there is no useful way to generalize it beyond static atmospheres. Since my own radiative transfer interests are in moving atmospheres, this limitation is severe for me. I became interested in the idea of solving radiative transfer by Monte Carlo in cells and then combining the cell solutions for a global solution. This cell idea seems to be valid for general atmospheres. However, I have not returned to the cell idea since circa 2007. If I return to research on Monte Carlo radiative tranfer, I would like to see if the cell idea can be developed.

Other Monte Carlo work was on energy deposition estimators in Monte Carlo radiative transfer and, in collaboration with Eddie Baron, on the solution of the NLTE rate equations using a Monte Carlo method. A good deal of the former project was completed and I may finish it someday. The latter project turned out to be rather unprofitable and may never be completed.

The work on local normalization, DIFF techniques, and SUSPEND was intended to lead to a statistical study of supernova spectra both observed and synthetic. The local normalization procedure essentially removes the continuum behavior by flattening the spectra. The DIFF techniques are goodness-of-fit tests for comparing locally normalized spectra. This work is reported on by Jeffery et al. (2007). A DIFF package containing programs for local normalization and the DIFF was under development, but perhaps will not be completed. The original and locally normalized spectra for many well observed SNe Ia and hydrogen-deficient supernovae (SNe IIb, Ib, Ic, and Ic hypernova) have been archived in SUSPEND.

The analysis of the peculiar SN Ia SN 2003fg is reported in Jeffery, Branch, & Baron (2006). This SN Ia, first observed and analyzed by Howell et al. (2006), was the intrinsically brightest SN Ia observed up to that time and was probably the most massive up to that time as well. (Brighter and more massive ones not recognized as such at least with confidence may have been observed before, of course.) The analysis done by Jeffery et al. confirmed the result of Howell et al. that SN 2003fg was probably the most massive SN Ia observed at that time and that its mass may have been about 2 solar masses. Most SNe Ia probably have masses of about 1.4 solar masses which is called the Chandrasekhar mass: larger SNe Ia are super-Chandrasekhar. SN 2003fg was first SN Ia with strong evidence that it was super-Chandrasekhar. The large mass of SN 2003fg is a challenge to the modeling of SN Ia progenitors and explosions. It may be that SN 2003fg will be a key to understanding SNe Ia. On the other hand, it may be just an extremely odd SN Ia with few implications for SN Ia studies. Further work will have to tell. The paper of Jeffery et al. was eventually rejected for publication, but the authors believe that there is nothing wrong with the paper. It is a paper whose major interest lies in its details rather than its conclusions. It have been cited for details by later papers (e.g., Maeda & Iwamoto 2009; Scalzo et al. 2010) and 14 citations (12 in refereed publications) through 2013.

While at OU, I also helped out with projects with David Branch on supernova spectrum analysis (Branch et al. 2006a,b, 2007a,b, 2008; Parrent 2007) using the code SYNOW (e.g., Fisher 2000; Branch et al. 2005). With Eddie Baron, I have helped out on a paper (Baron et al. 2008) that reports synthetic spectra for a three-dimensional SN Ia explosion model calculated by Eduardo Bravo and Domingo García-Senz. The radiative transfer calculations (which were done by Eddie Baron) were done using PHOENIX

(see `http://www.hs.uni-hamburg.de/EN/For/ThA/phoenix/index.html`)

developed by Peter Hauschildt et al. (e.g., Hauschildt & Baron 1999, and references therein; Baron & Hauschildt 2004, and references therein). PHOENIX is a state-of-the-art non-local-thermodynamic-equilibrium (NLTE) code. I also helped out on papers with M. Parthasarathy: one on on SN 1987A (Parthasarathy et al. 2006) and another a review of possible SN Ia progenitors (Parthasarathy et al. 2007).

In the period 2007 August to 2010 June, I was at the University of Idaho in a senior instructor position. My teaching duties (5 and 1/3 courses per academic year and summer courses and summer labs) and courseware projects left no energy for research.

From 2010 August to 2011 May, I was an instructor in the Department of Physics & Astronomy of Northern Arizona University. I had little time to devote to research while there. I was a coauthor of Wang et al. (2012) to which I made some editorial and very minor content contributions.

From 2011 August to 2012 May, I was a visiting assistant professor in the Physics Department of the University of Evansville. While there I had little time for research. My only effort was reviewing again the paper by Wang et al. (2012) just before submission to the *Astrophysical Journal.*

From 2012 August to 2014 June, I was a visiting assistant professor for the third time in the Physics & Astronomy Department of the University of Nevada, Las Vegas (UNLV). Since 2015 August, I have been a assistant professor-in-residence (a continuing, non-tenure-track teaching faculty position) at UNLV. While at UNLV, I have had little time for research. But I am participating in astronomy group meetings and updating myself in the fields of interest to myself and my colleagues.

TEACHING EXPERIENCE AND INTERESTS:

In the following subsections, I detail my teaching history (subsection 1), describe my online setup for courses and online courseware (subsection 2), and then give short outlines of my past approaches and/or goals for some of the courses I have taught or would very much like to teach (subsection 3 on). The outlines are for conceptual physics (section 3), cosmology (section 4), energy in physics and society (section 5), history of astronomy/cosmology (section 6), introductory astronomy (section 7), introductory astronomy laboratory (section 8), introductory physics (section 9), mathematical physics (section 10), modern physics (section 11), and quantum mechanics (section 12). For a complete listing of the courses I have taught and when and where I taught them, see my section **COURSES TAUGHT** above.

I will state here that I am interested in teaching a broad range of introductory and undergraduate courses. Courses of particular interest to me are introductory physics, introductory astronomy, quantum mechanics, mathematical physics, cosmology (never taught), history of astronomy/cosmology, energy and society, computational physics (never taught), thermodynamics and statistical mechanics (never taught), hydrodynamics (never taught), and modern physics. I am already experienced in teaching some of these courses: see following subsections and the section **COURSES TAUGHT** above. At the more advanced or graduate level, I would like to teach courses in cosmology (never taught), stellar structure (never taught), stellar atmospheres and radiative transfer, and supernovae (never taught).

As well as lecture courses, I have considerable experience from my teaching assistant years at McMaster University and my time at Middle Tennessee University, University of Idaho, Northern Arizona University, and the University of Evansville in teaching introductory physics laboratories. At the University of Nevada, Las Vegas in 2012–2014, I acquired some experience in teaching introductory astronomy laboratories with small telescopes for non-science majors and acting as astronomy lab coordinator for all such labs.

1. *Teaching History*

I was employed for eight years (1979–1987) as a teaching assistant at McMaster University. During this employment, I demonstrated first year undergraduate physics laboratories for some years and for some years marked undergraduate physics courses in quantum mechanics and introductory astronomy for science students. For one semester (1991 spring), I was a visiting instructor at the University of Oklahoma, where I taught the calculus-based introductory physics course in electricity, magnetism, and optics, and also led a honors college recitation group for the calculus-based introductory physics course in mechanics. During the spring semester of 1993, I was a co-instructor (with William Press and Abraham Loeb) at Harvard University for a course in introductory astronomy for non-science students.

At Vanderbilt University (1995–1996), I taught a one-semester history of astronomy course for general undergraduate students during the fall, spring, and summer semesters. The history of astronomy course was one of a special set of courses in Vanderbilt's Arts and Science College called Science and the World Courses. All Arts and Science undergraduate students were required to take one such course at some time in their undergraduate years. The course as I taught it covered the essentials of naked-eye astronomy, prehistoric astronomy, ancient Mesopotamian astronomy, Greek astronomy, Islamic astronomy, and astronomy from the Renaissance to modern times. The emphasis was on theories, the role of the scientific method, and connections of astronomy to other sciences and society. For further information about this course, see subsection *History of Astronomy/Cosmology* below.

While at Vanderbilt, I was also instructor in the 1995 fall semester for the undergraduate seminar course in astrophysics (a one-credit-hour course) and in the 1996 spring semester for a special topics three-credit-hour course for graduate students in astrophysical radiative transfer. I also participated in the Vanderbilt Dyer Observatory public nights which were held monthly. I recall giving at least one public talk.

In the period 1998–1999, I taught a course in introductory astronomy focused on the solar system at the University of Nevada, Las Vegas (UNLV). This course was an elective for non-science students and counted as a science course for fulfilling the UNLV undergraduate general education core requirements. I taught two sections per semester with over 200 students in the 1998 fall semester and over 150 in the 1999 spring semester. In 1999 spring, John Kilburg (the UNLV physics computer staff person) and I developed on online home work procedure with automated marking. This tool is now, of course, out of date.

From 1999 August to 2000 July, I taught at Middle Tennessee State University (MTSU) in Murfreesboro, Tennessee. In the fall, spring, and summer semesters, I taught the algebra-based introductory physics course in mechanics and thermodynamics: two sections in fall and spring; one section in summer. This course was a three-credit-hour course. The course was taught according to a group-learning, problems-laboratory syllabus created by MTSU professor Victor Montemayor. All MTSU first-semester algebra-based introductory physics courses were taught using this syllabus at that time. The students in the course studied lecture material individually from an website (created by Prof. Montemayor). The current version of this website is at URL

`http://www.mtsu.edu/~phys2010/` .

The students reported to a classroom/laboratory twice a week for 2.5 hours where they worked through problems on computer spreadsheets and completed laboratory exercises in groups. They were graded on the laboratory reports, quizzes, two experimental group projects, three in-class tests, and a comprehensive final.

Also at MTSU, I taught two sections in the 1999 fall semester of the algebra-based introductory physics laboratory course in electrical circuits, optics, and radiation. This was a one-credit-hour course.

In 2000 spring, I taught a triple section of a general physical science course to introduce non-science students to physics, chemistry, astronomy, and geology. This was a four-credit-hour course. The course included a weekly two-hour laboratory. There were 12 labs in total: they included both physics and chemistry labs. I taught two sections of the laboratory part of the course.

In 2000 fall, I went to Idaho State University in Pocatello, Idaho as a visiting professor. I taught 3 courses in the 2000 fall semester: second semester calculus-based introductory physics (engineering physics), second semester undergraduate quantum mechanics, and first semester graduate quantum mechanics. In the 2001 spring semester, I taught the first semester calculus-based introductory physics (engineering physics), first semester undergraduate quantum mechanics, and the colloquium in physics course for senior and graduate students.

In period 2001 August to 2003 May, I was at New Mexico Tech in Socorro, New Mexico as a visiting professor. In the 2001 fall semester, I taught first semester calculus-based introductory physics and graduate classical mechanics. For the graduate class, Goldstein's *Classical Mechanics*, 3rd Edition was used. Although a classic text, I feel that Goldstein (even its revised 3rd edition) is probably not the best that can be done for modern students. A computationally oriented course would I believe introduce students to advanced concepts and at the same time allow a greater connection to application. I also have come to feel that physics students today do not get enough computational experience.

In 2002 spring, I taught introductory quantum mechanics for 3rd year students and the 4th year astrophysics course. The latter had no set material, and so I taught astrophysical radiative transfer which is one of my specialties. In this course, I introduced some computational exercises and added a journal club feature. In 2002 summer, I taught second semester calculus-based introductory physics and also the physics part of a survey of science course for Tech's masters degree in science teaching: a degree for K-1–12 teachers.

In 2002 fall, I again taught first semester calculus-based introductory physics and first semester graduate quantum mechanics. For the latter course, I chose Walter A. Harrison's *Applied Quantum Mechanics* as the course text. Although a good book in certian respects, I found it too sketchy on formalism for physics students. In 2003 spring, I taught second semester graduate quantum mechanics using *Lectures on Quantum Mechanics* by Gordon Baym. For the graduate quantum mechanics courses, I also added a journal club feature. I feel it is important for graduate students to look at the current literature in any course that they are taking.

From 2003 August to 2004 May, I at the University of Nevada, Las Vegas (UNLV) for the second time teaching the introductory astronomy course on the solar system that I taught there in 1998–1999.

From 2004 August to 2005 May, I was at Washburn University where I taught introductory astronomy courses on the solar system and on stars and cosmology, and a course in physical sciences (with Sue Salem) in the 2004 fall and 2005 spring semesters. For the physical sciences course, I taught the physics and astronomy parts and Sue Salem taught the chemistry part. Also at Washburn, I served as the Physics Department's representative on the University Library Committee: the committee members report on library activity to the departments and direct book orders from the department to the library collection personnel.

From 2005 August to 2007 July, I was at the University of Oklahoma (OU) in a nonteaching postdoctoral position. I did, however, interact with undergraduate students who were working on projects with my supervisors David Branch and Eddie Baron and who were coauthors on some of the papers of these projects (Branch et al. 2006b, 2007a,b, 2008; Parrent 2007). I also gave several talks to the supernova research group which includes all the undergraduates working with David Branch and Eddie Baron. As an example, the following is the online version of the talk I gave on my experiences interviewing for a job at the University of Texas Pan-American:

`http://www.nhn.ou.edu/~jeffery/aalib/057_panam/panam.html` .

From 2007 August to 2010 June, I was at the University of Idaho (UI) in Moscow, Idaho. For 2007–2008 as a temporary lecturer and after as a senior instructor. At UI, I taught introductory physics both algebra-based and calculus-based (for large sections), mathematical physics, modern physics, undergraduate quantum mechanics, introductory astronomy, and a special topics course in classical mechanics and quantum mechanics. I also taught one of the three modules of the core science course *The Physics of Everyday Life*. My module was entitled *Energy in Physics and Society*. Some details of these courses are given in the subsections below.

In addition to my teaching duties, I served on the UI physics department recruitment and retention committee (2008 fall) and the UI parking committee (2009 August to 2010 June). I have no recollection of any work I may have done for the recruitment and retention committee. The parking committee primarily acted as an appeal board for parking violations.

From 2010 August to 2011 May, I worked as an instructor in the Department of Physics and Astronomy at Northern Arizona University (NAU). In 2010 fall, I taught introductory astronomy to a large section of 180 students, mathematical physics, and a calculus-based, 1-credit-hour laboratory course on electricity and magnetism. I also taught a section of an algebra-based laboratory module on electricity and magnetism and supervised the 4 other sections taught by teaching assistants. These labs were part of an algebra-based course on electricity and magnetism of which I was not the instructor. In 2011 spring, I taught introductory astronomy again, a graduate course in quantum mechanics (though the material is essentially that of second semester undergraduate quantum mechanics), and the calculus-based, 1-credit-hour laboratory course on electricity and magnetism again. I also supervised the teaching assistants for several sections of the algebra-based laboratory module on electricity and magnetism.

In addition to my teaching duties at NAU, I was one of the faculty advisors for the NAU chapter of the Society of Physics Students (SPS). The other advisor was William Delinger. Acting as an advisor was not very difficult since the NAU SPS students were self-starters. However, I did attend SPS meetings and kept myself up to date with their activities and gave a talk to them on my life in astronomy.

From 2011 August to 2012 May, I was a visiting assistant professor in the Physics Department of the University of Evansville. In 2011 fall, I taught introductory astronomy and conceptual physics and was lab instructor for 3 sections of introductory physics labs. In 2012 spring, I taught 2 sections of first-semester, calculus-based introductory physics and was the instructor for 3 sections of introductory physics labs. I also acted as the advisor for student, Ryan Darwish, doing an individual study project. The product of this project was written and oral reports on decoherence theory in quantum mechanics.

From 2012 August to 2014 June, I was a visiting assistant professor for the third time in the Physics & Astronomy Department of the University of Nevada, Las Vegas (UNLV). Since 2015 August, I have been a assistant professor-in-residence (a continuing, non-tenure-track teaching faculty position) at UNLV. While at UNLV, I have been teaching introductory astronomy for a stars and cosmology course and a planetary systems course. I have also been teaching introductory astronomy laboratory sections and have taught one physics laboratory section (2013 spring). It is actually the first time that I taught intro astronomy labs and I gained useful experience including how to use small telescopes. Celestron C8 telescopes were used for the labs. In the 2013 summer, I took over as lab coordinator for the intro astronomy laboratories. This job includes setting up the lab course website and syllabus, setting the semester schedule of labs, assigning and overseeing the lab section instructors, and generally helping out with the labs.

2. *Online Setup for Courses and Online Courseware*

Websites for the courses I have taught, am teaching, or have plans to teach are linked from URL

`http://www.nhn.ou.edu/~jeffery/#Courses` .

The course websites either are or are linked to the course syllabi. From the websites, students can access the course schedule (if one exists), their marks (listed at their request only and only by confidential aliases, but not when university policy forbids), and, in some cases, homeworks and answers to past homeworks and exams. The course websites are usually only updated when I am teaching or preparing to teach a course.

For many courses I have taught, I have developed problem books: some quite complete and others very incomplete. When sufficiently developed, the problem books are available to other instructors on request in electronic book form as free courseware. Currently, I have problem books for classical mechanics at the Goldstein level, conceptual physics, energy in physics and society, history of astronomy/cosmology (not yet ready for online access), introductory astronomy for non-science students, introductory physics, mathematical physics, modern physics, and quantum mechanics. Most of these problem books can be downloaded in pdf format at URL

`http://www.nhn.ou.edu/~jeffery/course/c_problem/problem.html` .

Only the introductory astronomy and introductory physics problem books are really sufficient for a full course at present. All the problems have complete solutions, but solutions are not available in the online problem books.

3. *Conceptual Physics*

Conceptual physics is a course for non-science students. A large realm of physics is covered, but with relatively low mathematics content. I have taught this course once (University of Evansville, 2011 fall). On that occasion I used the well known textbook *Conceptual Physics* by Paul G. Hewitt. It is an excellent book and I will probably use it again. However, eventually I intend to replace the textbook with online lectures similar to those that I have developed for introductory astronomy (see below subsection *Introductory Astronomy*). I have developed a problem book for conceptual physics that will accompany the online lectures: see

`http://www.nhn.ou.edu/~jeffery/course/c_concep/problem.pdf` .

The problem book is not extensive enough at present for an entire conceptual physics course.

4. *Cosmology*

I have not taught a course in cosmology yet. However, I would very much like to. There would be a learning curve for me in teaching it. In preparing to teach cosmology, I have developed a resource website with specified lecture topics:

`http://www.nhn.ou.edu/~jeffery/course/c_cosmos/cosmos.php` .

I prepared this page while sitting-in on the cosmology course taught by my University of Nevada, Las Vegas (UNLV) colleague, Ken Nagamine in 2012 fall.

5. *Energy in Physics and Society*

The *Energy in Physics and Society* course module (taught 2007 fall, 2008 fall, 2009 fall) is one of three modules making up the course *The Physics of Everyday Life* taught at the University of Idaho. This course was aimed at non-science students and was one of the University of Idaho's core science courses. For the course, I rely heavily on other sources including Wikipedia articles and *Energy at the Crossroads* by Vaclav Smil. I have prepared online lectures for this module which are at URL

`http://www.nhn.ou.edu/~jeffery/course/c_energy/energy.html` .

These lectures are still in development. An example of a useful online lecture (which is not finalized and is now in need of updateing) is

`http://www.nhn.ou.edu/~jeffery/course/c_energy/energyl/world_en.html`

which is on world energy resources and consumption. The problem book for the module is at

`http://www.nhn.ou.edu/~jeffery/course/c_energy/problem.pdf` .

I would very much like to expand the *Energy in Physics and Society* module into an entire course for non-science students on energy and society. This course would introduce the physics notion of energy and some formulae and then would go into society's uses and needs for energy and the world's energy problems. Such a course I think would be immensely relevant and interesting for students.

I would also like to develop more advanced courses on commercial energy that would be of interest to science, engineering, economics, and society policy students. An example textbook for such a course would be *Renewable and Efficient Electric Power Systems* by Gilbert Masters.

6. *History of Astronomy/Cosmology*

At Vanderbilt University (1995–1996), I taught a one-semester history of astronomy course for general undergraduate students during the fall, spring, and summer semesters.

As mentioned above in the subsection *Teaching History*, the course as I taught it covered the essentials of naked-eye astronomy, prehistoric astronomy, ancient Mesopotamian astronomy, Greek astronomy, Islamic astronomy, and astronomy from the Renaissance to modern times. The emphasis was on theories, the role of the scientific method, and connections of astronomy to other sciences and society.

As a resource for a history of astronomy course, I was developing a manuscript, *Lectures on the History of Astronomy*, in the form of TEX files which reached about 30 % completion.

I have now a decreased interest in developing a pure history of astronomy course. A pure history of astronomy course for non-science students involves some topics that I think would be of little interest to them. Also a one-semester course is too short to do all of astronomy from prehistory to today, except in a rather superficial way.

I would now prefer to develop a history of cosmology course. A one-semester course focusing on this narrower topic can adequately cover from the beginning of scientific cosmology to today I believe. Also and most importantly, cosmology is one of the two most interesting fields of astronomy both for laymen and professionals. The other most interesting field is the search for extraterrestrial life and intelligence.

My history of cosmology course as I envision it would be on philosophical and scientific cosmologies. Mythical cosmologies would only briefly be mentioned. The course breaks naturally into two parts: from the Greek Pre-Socratic philosophers to just before Newton and from Newton until today. The first part I believe I am already sufficiently knowledgeable on for a 1.0 version. The second part would take some more learning on my part.

For my online introductory astronomy lectures (see below subsection *Introductory Astronomy*), I have developed a lecture on the history of astronomy to Newton: see URL

`http://www.nhn.ou.edu/~jeffery/astro/astlec/lec004.html` .

This lecture is the seed from which I would develop a history of cosmology course. I would also probably cannibalize the incomplete manuscript *Lectures on the History of Astronomy* that I began developing at Vanderbilt University.

Wikipedia is a great resource for developing a history of cosmology course. It has useful articles that can be used as first sources and more importantly a vast store of images. A history of cosmology course for non-science students must depend heavily on images for classroom lectures.

I am interested in involving undergraduates as assistants in developing the history of cosmology course. They could help developing the resource base and the understanding needed to complete the course. They could also help by creating diagrams and images.

7. *Introductory Astronomy*

I have taught introductory astronomy courses many times. These courses focussed on stars and cosmology, planetary systems (mainly the solar system), and all-astronomy.

I did this teaching at Harvard University, the University of Nevada, Las Vegas, Washburn University, the University of Idaho, Northern Arizona University, and Evansville University.

My website for the introductory astronomy course is

`http://www.nhn.ou.edu/~jeffery/course/c_astint/ast.php`

and my problem book for the course is at

`http://www.nhn.ou.edu/~jeffery/course/c_astint/problem.pdf` .

For introductory astronomy courses, I have been developing a set of online lectures that are used as a lecturing tool and for individual study by students. The set is called Introductory Astronomy Lectures (IAL). IAL began at the University of Nevada, Las Vegas in 2003 and has continued to the present. IAL obviates the need for students to take notes or buy a textbook since IAL is the course notes and textbook. Making IAL the lecturing tool, course notes, and course textbook unifies the source material for the class. IAL is also my own complete notes for the class. Many spectacular and informative astronomical images are integrated into IAL and are updated as needed. The IAL website is

`http://www.nhn.ou.edu/~jeffery/astro/astlec/lecture.html` .

The IAL lectures are actually projected on a screen to large lecture sections. The lectures do form a complete narrative, but absolutely, positively they are **NOT** read in class. I concentrate on explaining images and graphs, and occasionally tables. Often I will stop on keywords to explain something. Questions for the class to be answered by vote are inserted the text. Typically, I just scroll through much of the narrative, paraphrasing and simplifying it in my lecturing. The students quickly adjust to not reading most of the words on the screen. The complete narrative is there for their private study. Since the lectures are given in a darkened room in order to see the images, student notetaking is not easily done and is not needed since, as mentioned above, the online lectures are the course notes.

I find the online lectures work well. The defects of the large lecture format are still present. Student attention can fatigue and concepts forgotten quickly. But the students have complete web access to the online lectures, and so can make up anything missed. In long 75-minute lectures, I typically take a break from lecturing and give the students a group activity for a few minutes while I wander the classroom interacting with them.

I need to state that IAL developed to suit my own lecturing style which in turn has been modified to suit IAL. It is not known that any other instructors would care to adopt IAL. However, I have given blanket permission for use of IAL for non-commercial and/or educational purposes.

The lectures for planetary systems are about 90 % complete and for stars and cosmology are about 70 % complete. Even uncomplete they are adequate for all the intro astronomy courses that I teach. IAL requires continual updating, of course.

Examples of fairly well-developed IAL lectures are *The Earth* which can be viewed at

`http://www.nhn.ou.edu/~jeffery/astro/astlec/lec011.php` and *Cosmology* which can be viewed at

`http://www.nhn.ou.edu/~jeffery/astro/astlec/lec031.html` .

The images for IAL not of my own creation are public domain or drawn from sources that permit educational use with credit: e.g., NASA, the National Optical Astronomical Observatories, and Wikipedia.

8. *Introductory Astronomy Laboratory*

I taught introductory astronomy laboratories for the first time in the 2012 fall semester at UNLV. Since then I have gained significant experience and I took over as the astro lab coordinator at UNLV in 2013 summer and will continue in this roll until 2014 June. The lab coordinator manages the course website, sets the syllabus and lab schedule for the semester, assigns and oversees the lab section intructors, and generally helps out with the labs.

The course website that I have developed for UNLV is at

`http://www.nhn.ou.edu/~jeffery/course/c_astlab/ast.php` .

The website requires updating every semester. The website contains the syllabus, the lab schedule, and links to ancillary pages. The ancillary pages include a catalog of the UNLV astro labs with links to ancillary materials for each lab, a description of telescope operation and tricks for the telescope, intructions for the lab instructors, for scheduled labs a lab preparation for instructors and students, and other items.

For lab exercises themselves at UNLV, we use Diane Pyper Smith's *A Guide to Astronomy*. One of my goals it to develop a comparable set of online lab exercises that will be free for the students and will be easily updated. I have made a start on this project, but considerable more research on ideas for labs is needed.

9. *Introductory Physics*

I have taught introductory physics courses many times. The courses included both calculus-based and algebra-based courses.

My website for the introductory physics calculus-based course is

`http://www.nhn.ou.edu/~jeffery/course/c_intro/intrc.html`

and for the algebra-based introductory physics course is

`http://www.nhn.ou.edu/~jeffery/course/c_intro/intra.html` .

My problem book for introductory physics is at

`http://www.nhn.ou.edu/~jeffery/course/c_intro/problem.pdf` .

I am moving in the direction of activity-based introductory physics courses. There is a lot of evidence that the activity-based method is the superior teaching method. A full activity-based course integrates lectures, demonstrations, private work, groupwork, and laboratories. However, full activity-based courses are probably more than a visiting instructor can develop on his own. Such a course probably takes the collective agreement and effort of a department. Perhaps, it can never be fully implemented for very large sections consisting of a hundred or more students.

From my time in 1999–2000 at Middle Tennessee State University, I have some experience teaching an activity-based course, the one designed by Victor Montemayor. It worked well in my view.

I am doing what I can by myself to implement activity-based learning in the intro physics courses I teach. I made a first attempt at a partial activity-based course in 2010 spring at the University of Idaho. The course as implemented has to rank as a qualified failure. Student achievement went up modestly as measured by examinations insofar as I could judge, but student evaluations of me and the course were low. I will not be repeating many features of the 2010 spring course.

What I envision for future intro physics courses is a mixture of groupwork and lecturing in class with a lot encouragement for readings and problem solving alone and in groups outside of class. For the groupwork, I would like groups of typically 3 or 4 students to work together to solve problems. Among others things that students can do in groupwork is to try the problems alone and then mark each other (i.e., give each other peer review) and argue their way to an optimum solution. The lecture part would be mainly the derivations and concepts, the groupwork mainly the examples. I certainly want to get the students to argue concepts too in groupwork. In the groupwork time, I would circle in TA mode. Working a New Mexico Tech in 2001–2003, I set up groupwork like this informally in recitation periods. It worked well in my recollection.

For the calculus-based intro physics course, I am developing a set of lectures in pdf format. I certainly will **NOT** project these lectures on a screen. In physics courses, presentations that are too smooth are not effective in my experience. The act of writing words, derivations, and formulae on the board with all of the hesitations and occasional mistakes seems necessary to hold student interest. But the lectures are intended to be my script in lecturing and complete notes for students. The students should probably still take some notes in class, but mainly for the attention and learning effect.

The lectures are still in development. Those that at least partially exist can be found at

`http://www.nhn.ou.edu/~jeffery/course/c_intro/introl/000.html` .

An example of a complete lecture is the one on energy: see

`http://www.nhn.ou.edu/~jeffery/course/c_intro/introl/007_en.pdf` .

The first aim of the lectures are to give me a set of lectures fine-tuned to my own understanding of the material. I believe that many of the standard textbooks, although excellent in many respects, often gloss over some of the fine points of introductory physics including points of physics reasoning. One notices this very strikingly when preparing and giving lectures. To give a simple example, the ideal normal force used in introductory physics has no force law formula although one knows that it is never attractive and that it is a contact force. It is a constraint force known by its effect. Lack of a normal force law formula means that the normal force value can only be determined using Newton's 2nd or 3rd laws. But I have never seen this point (i.e., that the ideal normal force can only evaluated from 2nd and 3rd laws) explicitly stated in a textbook. The point is obvious, but even obvious points are not obvious to intro physics students.

Getting across to students some of the fine points I am thinking of is a challenge. But I think it is one that must be undertaken if the students are to really "get" physics.

Completing the lectures will take some years. At present, I have about 80 % of the first semester of intro physics covered by the lectures, but little of the second semester. I hope that eventually I will be able to dispense with textbooks altogether. This will save students money. The lectures are freely available for noncommercial and educational use.

10. *Mathematical Physics*

The mathematical physics course (taught 2007 fall, 2010 fall) is aimed at the junior level for physics and mathematics majors.

My website for the mathematical physics course is

`http://www.nhn.ou.edu/~jeffery/course/c_math/math.html`

and my problem book for this course is at

`http://www.nhn.ou.edu/~jeffery/course/c_math/problem.pdf` .

The textbook for 2007 fall and 2010 fall was *Essential Mathematical Methods for Physicists* by Hans J. Weber & George B. Arfken. A complete coverage of the textbook would take three semesters, and I have only covered a third or less of the textbook in times I have taught the course. The selection of topics, however, can vary from semester to semester.

Although Weber & Arfken is a good textbook, if I ever teach mathematical physics again, I think I would like to prepare my own online lectures for the course text. These would save students money and would closely correspond to my spoken lectures.

11. *Modern Physics*

The modern physics course (taught 2008 spring) is, of course, essentially the physics of the first half of the 20th century.

My website for the modern physics course is

`http://www.nhn.ou.edu/~jeffery/course/c_modern/modern.html` .

I am using primarily my quantum mechanics problem book for this course: see

`http://www.nhn.ou.edu/~jeffery/course/c_quantum/problem.pdf` .

For the modern physics course for 2008, I selected as textbooks *Quantum Physics of Atoms, Molecules, Solids, Nuclei, and Particles* by Robert Eisberg and Robert Resnick and *The Fabric of the Cosmos* by Brian Greene. The first is a rather more advanced textbook than traditional for modern physics courses. Although I think that it worked out well in some respects, I will probably not use it again for this course since it required rather too much adaptation on my part and it is also dated in some respects. The Eisberg-Resnick book, however, is very good at explaining many of the details and it gives a coverage of almost all the topics traditionally brought up in a modern physics course. The second textbook is, I believe, an excellent popular book on contemporary fundamental physics. It is intended to give the students a painless introduction to its subjects. Both textbooks were required to be read in their entirety according to scheduled readings. Marks were given for completed readings. Some of the student reading would be superficial, but I still think it is a good idea for students read books cover-to-cover so that they at least get a notion what all is there. I only lectured on parts of the Eisberg-Resnick book.

I decided to emphasize breadth and description rather than depth and math in modern physics courses—which is, of course, the usual procedure. I do not make a heavy emphasis on difficult mathematical derivations and developments. There are some derivations, of course.

12. *Quantum Mechanics*

I have now taught introductory quantum mechanics at the undergraduate and graduate several times and have achieved some degree of comfort with the material.

My website for the undergraduate quantum mechanics course is

`http://www.nhn.ou.edu/~jeffery/course/c_quantum/qm.html`

and my problem book for this course is at

`http://www.nhn.ou.edu/~jeffery/course/c_quantum/problem.pdf` .

For the 2nd semester, I have posted some of my handwritten notes: see the links from URL

`http://www.nhn.ou.edu/~jeffery/course/c_quantum/qm.html#Semester 2`.

I am beginning to develop a set of online pdf lectures for introductory quantum mechanics entitled *Speakable Quantum Mechanics* (SQM)—the title indicating aspiration rather than achievement. SQM would replace a course textbook eventually. The beginnings of SQM are at

`http://www.nhn.ou.edu/~jeffery/course/c_quantum/sqm/000_a.html` .

Developing SQM will improve my own understanding of quantum mechanics and when sufficiently complete would save students some money. I also think that SQM will be better for my own teaching than any undergraduate quantum mechanics textbook I am familiar with. The one I am most familiar with is Griffiths. In many ways it is an excellent book, but familiarity breeds quibbles. There are mysteries and inelegances in my view that I could cure.

At present, SQM has barely been started. I hope to make progress in the 2014. However, I expect that it will take several semesters of teaching both semesters of introductory quantum mechanics to complete SQM. I do not anticipate that SQM will develop into a publishable book.

TEACHING PHILOSOPHY:

Learning is life.

We do it from the beginning to the end—as individuals, as humankind. We learn alone, we learn together. Much of learning comes from the world in general, society in general. But there must be schools and universities for advanced learning. Places where it is safe to be a student—where there are teachers from all levels of the hierarchy—fellow students, official teachers, advisors, administrators. Places where learning is the focus and where there is a community of learning. Very few persons can master the advanced subjects of modern society alone—there arn't the resources, there isn't the community of support. Books alone were never enough, the Web alone will never be enough.

So what's a teacher? One who presents the subjects. The official ones are the ones who have mastered significant parts of subjects and have, at least, a broad view that allows them to present subjects in specific courses and in whole curriculums.

The teacher keeps the material coming. I have this mental image—parent bird, baby bird—the worms have to be kept coming. Neither students nor teachers would ever get through a semester of courses without the rigor of being yoked together in lectures, assignments, tests, finals.

But not just worms. The teacher has to guide students over material quickly that great minds took centuries to fathom. So the teacher doesn't recreate the subject in its total history. The teacher tries to help the student to recreate the subject as it is in the student's mind. That recreation will be incomplete compared to current understanding—usually vastly incomplete—but it should be open-ended in the direction of completion—which is a direction the student may never follow—but he/she should know where to begin.

Teaching methods? I apologize for quoting Feynman, but when asked what methods he used, he said he used all methods. Well one can't quite do that. One should be open to all methods. A teacher's own experience and experiments should always be growing. A teacher's colleagues are an essential resource. I'm always running to my colleagues. Then there is the vast field of pedagogy research to consult which alas I've little consulted—but my travels have shown I'm not alone in that regard. I have, however, taken note of what I've heard at seminars on pedagogy and am trying more and more to implement modern pedagogy strategies as discussed below. But all pedagogy comes down to getting the students to think about the subject in its whole, but definitely day to day in the bits that are being covered.

Lecturing is the standard teaching method and has its well known flaws—inattention, instant forgetting. But those arn't fatal flaws at all. A lot can be learnt in lecturing. Especially lecturing enlivened by the enthusiasm of the teacher, demonstrations, and give and take with the students. A steady course of lectures keeps the subject going forward. And lectures complemented by readings, assignments, and tests completes a reasonable course.

But like many others I think the activity-based method that integrates lectures, individual work, groupwork, demonstrations, and laboratories is the superior method for most students in large introductory courses. I also, however, believe activity-based courses have to be well organized and done well to achieve superiority. I think it takes the collective agreement and effort of a department faculty to do full activity-based courses well.

Nevertheless, I am implementing elements of the activity-based method in introductory physics courses and other introductory courses. The activity-based method probably less useful for upper division courses where students are more practiced at doing activities on their own.

In my own subject physics, I believe in a tough, thorough program of studies. It is what the students in the service courses need and what physics majors want. The deficiency I see in the current undergraduate physics program is the lack of an integrated computational component. I think physics majors should learn a programming language at the start of their undergraduate program and make use of it throughout that program.

To be a good teacher, one has to like students and be ready to help with their needs—those they know about and those they don't.

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