

Curriculum Vitae

Name: Heidi Fearn

Birth Date: August 21, 1965, Nottinghamshire, England.

Webpage : <http://physics.fullerton.edu/~heidi>

Degrees:

BSc. (Hons) Theoretical Physics, University of Essex, Colchester, England, 1986.

PhD. Quantum Optics, supervisor Prof. R. Loudon (FRS), University of Essex, England, 1989.

Academic Positions:

Current Position: Full Professor of Physics, CSUF..

University of Essex; Grad laboratory demonstrator, 1986-89.

Max-Planck Institute; Postdoctoral Research Assistant, July-August, 1989.

University of New Mexico; Postdoctoral Research Assistant, 1989-91.

University of Arizona; Visiting Scholar, 1989-91.

California State University Fullerton, Lecturer in Physics, tenure track 1991. (Greencard 1992)

CSU Fullerton, Assistant Professor in Physics, 1992-1995.

CSU Fullerton, Associate Professor in Physics, 1995-2001

CSU Fullerton, Full Professor in Physics, 2001–present.

USAF academy Colorado Springs: Distinguished Visiting Professor of physics 1 Aug 2007 - 31 July 2009.

Courses Taught:

Graduate Level:

quantum mechanics 555A & 555B, mathematical methods 510, mechanics 520, electromagnetism 530A & 530B, special topics 560T (atomic theory), statistical mechanics 516

Upper Division:

quantum mechanics 455, optics 411, classical mechanics 320, electrodynamics 330A and B, and modern physics 340, advanced quantum mechanics (atomic theory) 476, statistical and thermodynamics 416 (can also teach 300, 310)

Lower Division:

optics with modern physics both theory 227 and lab 227L, electromagnetism 226, mechanics theory 225 (and stand in for lab 225L)

Citations in standard Text Books:

1. “Optics” 4th edition by Eugene Hecht (Addison Wesley 2002). Cited in the preface (page iv) for contributions and suggestions.
2. “Principles of Optics”, 7th edition (Cambridge University Press 1999). I am cited in the Author index.

3. “Quantum Mechanics”, 3rd edition by Eugene Merzbacher (Wiley 1998). I am mentioned in the preface (page ix) for checking a new chapter Dr. Merzbacher added to the text.
4. “Quantum Field Theory”, by Mark Srednicki (Cambridge University Press 2007). I am mentioned in the preface for proof reading 2/3 of the text whilst visiting Santa Barbara as a visiting KITP Scholar during 2003-05.

Awards: New 2012-2017 marked with (*)

Consultant Los Alamos National Laboratory 1994-2005.

CSUF Outstanding faculty recognition for scholarship that results in the highest quality peer reviewed journal articles, 2000-01.

Difference-In-Pay leave from Fullerton at LANL, paid for by LANL Spring semester 2001.

KITP Fellowship 2003-05 Santa Barbara CA.

Consultant CSU INTERTECH report summer 2003

CSUF, NSM service award; In recognition of outstanding service 2005–06.

Distinguished Professor of Physics (USAF) US Air Force academy Colorado Springs 2007–2009. Including at least one month summer salary, 2007 and 2008.

Sabbatical Leave with pay from CSU Fullerton, Fall 2011.

(*) Woodward Physics Faculty award for Research 2013. (This award has a time restriction, you can only win once every 4 years, so will be eligible again 2017.)

(*) Fellow of the Institute of Physics 2015-present

(*) Fellow of the British Interplanetary Society 2016-present

Professional Affiliations/Membership:

American Physical Society (APS), 1991-present.

Institute of Physics (IOP) , Fellow since 2013.

Space Studies Institute, senior member.

Optical Society of America (OSA), 2006-present.

The British Interplanetary Society, 2013-present

American Institute of Aeronautics and Astronautics (AIAA), 2013-present

American Association for the Advancement of Science (AAAS), 1998-present.

Biographical Directory Listings:

“APS speakers list” in physics 1991-present

“American Men and Women in Science”, vol 2. p1225 (1995).

“Who’s Who in Science and Engineering”, Marquis (1995).

“American Men and Women in Science”, vol 2. p1225 (1995-present).

“Who’s Who in Science and Engineering”, Marquis (1995-). “Who’s who in the West”, Marquis (1997-). “Who’s who in the world”, Marquis (1997-). “2000 Outstanding Intellectuals of the 20th century”, IBC (1999).

“2000 Outstanding scientists of the 20th century”, IBC (1999), Nominated as “International woman of the year”, 1999, 2004, 2005
“2001 Outstanding scientists of the 21st century”, IBC (2001).
others not listed.

Referee for following Journals: IOP, APS

- Physics Review A,D,E
- Reviews of Modern Physics
- Physical Review Letters
- American Journal of Physics
- Journal of Modern Optics
- Journal of Physics A,B
- Optics Letters
- European Journal of Physics
- Annals of Physics
- Foundation of Physics
- Others too numerous to list

Conferences/Invited Talks & Seminars for 2012-present:

- “Recent Results of an Investigation of Mach Effect Thrusters”, Physics dept, Oct 2012.
- “Recent Results of an Investigation of Mach Effect Thrusters”, Advanced Space Propulsion Workshop, (ASWP), Nov, Huntsville AL., 2012. <http://aspw.jpl.nasa.gov/proceedings-2012> (see also <http://www.centauri-dreams.org/?p=25752>)
- “Experimental tests of a Mach effect thruster”, IAC-13/C4/8/ paper 4. Presented at the *64th International Astronautical Congress.*, 23-27th September , Beijing China (2013). <http://www.iac2013.org>
- “Theory of a Mach effect thruster”, 50th AIAA Joint Propulsion Conference (JPC) , Cleveland Ohio 28-30th July (2014). <https://www.aiaa.org/EventDetail.aspx?id=18582>
- “Mach Effect Thruster Development”, 20th Advanced Space Propulsion Workshop (ASPW 2014). Cleveland Ohio, Nov 17-20th (2014). <http://aspw.jpl.nasa.gov/workshop-proceedings>
- Was invited to attend the local Chapman College CA, *Quantum Sensing and Metrology Conference*, Dec 10th 2014.
- Invited to attend a quantum workshop at Northrop Grumman Redondo Beach. This was to establish research objectives for their new quantum optics division. Jan 2015.

- "New Theoretical Results for the Mach Effect Thruster", 51st AIAA Joint Propulsion Conference (JPC), Hilton Orlando, Orlando Florida 27-29th July (2015). Dr Fearn was co-chair of the NFF-04 session nuclear and future flight propulsion systems. Proceedings of 2014 and 2015 can be found here: <http://arc.aiaa.org/> (Aerospace Research Council)... search for H. Fearn for the conference proceedings papers.
- Special Seminar presented at Woodland Hills Northrop Grumman. "Theory and Experiment of a Mach effect thruster", Sept 18th (2015). *Possible collaboration for quantum optics and gravitational propulsion.*
- I was co-organizer of a Workshop on Advanced Propulsion, Estes Park CO Sept 19-22, 2016. I am also co-editor of the proceedings (published by SSI) a free pdf proceedings and video links of the talks are available on the ssi.org website. I presented two talks at the meeting. *Gravitational Absorber theory and Mach's principle*, and *Conjectures on Mach's principle and Cosmology*. Both talks were written up as a 30 page paper in the proceedings. I also helped by ghost writing 2 papers for Paul March and George Hathaway, and converted several papers from word to latex.
- "The Mach effect gravity assist drive", paper presented at *Foundations of Interstellar Studies, Workshop on Interstellar flight*, City Tech, CUNY, New York June 13-15 (2017). To be published - by JBIS as part of the workshop proceedings.
- I was co-organizer of a Workshop on Advanced Propulsion, held at Aerospace Corporation, El Segundo, Nov 1-3, 2017. The videos are available online at the ssi.org website. The proceedings has been published as a special issue of JBIS vol 70, Oct-Nov 2017.
- I am currently organizing another Estes Park Advanced Propulsion workshop, to be held in Estes Park CO, 10-14 Sept 2018. This meeting is by invitation only. The proceedings will be published by ssi.

TEACHING

I have worked with a great many students on projects and theses. *I have both prepared and administered all of the graduate exams. These consisted of 3, two hour exams on mechanics, electromagnetism and mathematics and quantum mechanics and general physics. Few (if any) exams have been offered since 2007.*

Teaching at CSUF

My teaching usually consists of 3-4 courses, with a heavy emphasis on upper division and graduate courses. These are time consuming and involve much preparation of new materials. Graduate courses usually involve research level materials.

The last 3 semesters I have taken on a lighter teaching load of 2 courses with multiple research graduate students. One of these courses is a large double section of PHYS 227. I am trying to concentrate more on my research and obtaining grants/funding at the moment.

For more information or work over a longer time period see my webpage at:

<http://physics.fullerton.edu/~heidi>

Grants Written 2012- onwards

Intermural, Sr grants, 2013, 2014, 2015 & 2016 **all declined**.

2015-16 NSF # 7577483, Physics AMO Experimental: Attempted to get funding for an undergraduate optics laboratory for quantum optics equipment. NSF replied, no equipment grants available **declined**.

2015-16 NSF # 7577546, Physics gravitational theory: Attempted to get funds to investigate “Mach’s principle and gravitational theory”, to prove EM drive can work, but only using Mach effects like the MEGA drive (Mach effect gravitational assist drive). **Also declined**, reason the gravitational group do not support propulsion physics.

2016 NIAC grant Phase I, **NASA granted March 2016**.

2017 NIAC grant Phase II: **NASA granted May-June 2018**.

Publications

1. “Quantum theory of a lossless beamsplitter”, H. Fearn and R. Loudon, *Opt. Commun.* **64**, 485 (1987).
2. “Representation of squeezed states with thermal noise”, H. Fearn and M. J. Collett, *J. Mod. Opt.* **35**, 553 (1988).
3. “Theory of two-photon interference”, H. Fearn and R. Loudon, *J. Opt. Soc. Am.* **B6**, 917 (1989).
4. “Theory of two-photon correlations and Bell’s inequality”, H. Fearn, *J. Opt. Soc. Am.* **B6**, 2420 (1989).
5. “Two-photon interference”, H. Fearn, *NATO Advanced workshop on QED and quantum optics*, Istanbul, Turkey (1989).
7. “Coherence and correlations in quantum optics: I Theory”, M. O. Scully, H. Fearn and B. W. Atherton, *NATO Advanced workshop on QED and quantum optics*, Istanbul, Turkey (1989). Invited paper.
8. “Coherence and correlations in quantum optics: II Applications”, M. O. Scully, H. Fearn and B. W. Atherton, *NATO Advanced workshop on QED and quantum optics*, Istanbul, Turkey (1989). Invited paper.
9. “Lasing without inversion”, H. Fearn, *Proceedings of the 9th international workshop on laser interaction and related plasma phenomena*, Monterey, California, 6-10 Nov. (1989). Invited paper.
10. “Linear amplifiers and attenuators”, H. Fearn, *Quantum Optics*, **2**, 103 (1990).

11. "Correction to the golden rule", H. Fearn and W. E. Lamb Jr., Phys. Rev. **A43**, 2124 (1991).
12. "Comment on the theory of lasers without inversion", S. Y. Zhu, J. Cresser and H. Fearn, Phys. Rev., **A43**, 5170 (1991).
13. "The effect of atomic decay on micromasers", S. Y. Zhu, L. Z. Wang and H. Fearn, Phys. Rev., **A44**, 737 (1991).
14. "Opportunity knocks for atomic interferometers", H. Fearn and M. O. Scully, Physics World, **4**, 23 (1991). Invited paper.
15. "Theory of noise minimization in direct and phase-sensitive photodetection", H. Fearn, R. Loudon and T. J. Shepherd, J. Opt. Soc. Am. **B8**, 2218 (1991).
16. "Lasing without inversion: I. Initial atomic coherence", M. O. Scully, S. Y. Zhu and H. Fearn, Zeit. fur Physik **D22**, 471, (1992).
17. "Lasing without inversion: II. Raman process created atomic coherence", S. Y. Zhu, M. O. Scully, H. Fearn and L. Narducci, Zeit. fur Physik **D22**, 483, (1992).
18. "Lasing without inversion: III. Nonlinear theory of a three-level laser with microwave coupling", H. Fearn, M. O. Scully and S. Y. Zhu, Zeit. fur Physik **D22**, 495 (1992).
19. "Lasing without inversion in a simple model of a three-level laser with microwave coupling", Optics Commun. **87**, 323, (1992).
20. "Gain and threshold in noninversion lasers", Optics Commun. **88**, 240, (1992).
21. "Computational approach to the quantum Zeno effect: Position measurements", Phys. Rev. **A46**, 1199 (1992).
22. "Reply to the Comment by Home and Whitaker on the quantum Zeno effect", Phys. Rev. **A48**, 2505 (1993).
23. "The micromaser welcher-weg detector revisited", invited paper at the Trieste conference on Quantum Interferometry, (Eds. F. De Martini, G. Denardo and A. Zeilinger) (World Scientific, Singapore 1994).
24. "Comments on the Quantum Zeno Effect", invited paper Nathiagali Summer School, Pakistan July 9-14 1994, published in, Quantum Semiclass. Opt. **7**, 211 (1995).
25. "The Aharanov-Bohm Effect Revisited", invited paper Nathiagali Summer School, Pakistan 9-14 1994, published in, Quantum Semiclass. Opt. **7**, 205 (1995).
26. "Fizeau's Experiment and the Aharanov-Bohm Effect", published in the Amer. Jour. of Phys., **63**, 705 (1995).
27. "Sudden Replacement of a Mirror by a Detector in Cavity QED: Are Photons Counted Immediately?", Phys. Rev. Letts., **74**, 1327, (1995).

28. “Photodetection and Causality in QED”, in collaboration with P. W. Milonni and D. James, Phys. Rev. **A52** , 1525 (1995).
29. “Theory of Two-Photon Down-Conversion in the Presence of Mirrors” in collaboration with P. W. Milonni Los Alamos, A. Zeilinger, Phys. Rev. **A53**, 4556, (1996).
30. “Classical Theory of Measurement: Towards a quantum theory”, with W. E. Lamb, published in “Amazing Light: A Volume Dedicated to Charles Hard Townes on his 80th Birthday”, edited by R. Y. Chiao, (Springer Verlag, New York, 1996).
31. “Comment on Superluminality, Parelectricity and Earnshaw’s theorem in Media with Inverted Populations”, by R. Y. Chiao & J. Boyce”, by P. W. Milonni, D. F. V. James and H. Fearn, Phys. Rev. Letts. **75**, 3194 (1995).
32. “Microscopic Approach to Reflection, Transmission, and the Ewald–Oseen Extinction theorem”, with P. W. Milonni and D. F. V. James, Am. J. of Phys. **64**, 986 (1996).
33. “Lasers look through opaque solids”, H. Fearn and Hua Huang, Physics World, p25 October 1997.
34. “Rotation matrices in quantum mechanics”, H. Fearn and J. B. Santiago, p92, Proceedings of the International conference on Quantum Optics and Laser Physics: *Frontiers of Quantum Optics and Laser Physics*, Hong Kong BAPTISTS University 3-6 Jan (1997). Ed’s. S. Y. Zhu, M. S. Zubairy and M. O. Scully.
35. “Seeing clearly through the atmosphere”, H. Fearn and A. M. Arroyo, Contemp. Phys. **39** (1) pp49-66 (1998).
36. “Theory of continuous wave excitation of the sodium beacon”, H. Fearn, P. W. Milonni, J. M. Telle and R. Q. Fugate, Opt. Soc. Am. **A16**, (10) p2555-2566 (1999).
37. “Of Some theoretical significance: Implications of Casimir Effects”, G. J. Maclay, H. Fearn and P. W. Milonni, Eur. J. Phys. **22**, pp463-469 (2001)
38. “Dispersion Relations and Causality: Does Relativistic Causality require $n(\omega) \rightarrow 1$ as $\omega \rightarrow \infty$.” Journal of Modern Optics, **53**, Nos. 16-17, pp2569–2581,(2006).
39. Russian Conference proceedings paper CCFP’06 “Can signals travel faster-than-c in non-trivial vacua in flat space-time? Relativistic Causality II.” Laser Physics **17**, No. 5 pp 1–5 (2007).

Papers after 2012

40. “Recent Results of an Investigation of Mach Effect Thrusters”, H. Fearn and J. Woodward, 48th Joint Propulsion Conference, Atlanta Georgia, 29 July- 1st August 2012. (Published by American Inst. of Aeronautics and Astronautics AIAA).
41. “Experimental tests of the Mach Effect Thruster”, H. Fearn, J. Woodward and K. Wanser, IAC-13-C4.8.4, Paper and talk presented (by HF) at the 64th International Astronautical

Congress, Beijing China Sept 2013. arXiv Oct 2013. J. of Space Exploration, Vol. 3 (3) 197-205 (2014)

42. “Experimental Null test of a Mach Effect Thruster”, H. Fearn and J. Woodward, published Journal of Space Exploration, Vol. 2. (2) pp98-105 (2013). arXiv:1301.6178.
<http://www.mehtapress.com/mehtapress/Journals/Journal-of-Space-Exploration/Volume-2-Issue-2/Experimental-null-test-of-a-Mach-effect-thruster.html>

43. H. Fearn, A. Zachar, J. F. Woodward and K. Wanser, “Theory of a Mach Effect Thruster, AIAA Joint Propulsion conference, Propulsion and Energy Forum: Nuclear and Future Flight Propulsion. Cleveland, Ohio, July 2014. Published in online conference proceedings.

44. H. Fearn, “Mach effect thruster development, 20th Advanced Space Propulsion Workshop (ASPW 2014) Cleveland Ohio, Nov 17th through 20th 2014. Online talk. <http://aspw.jpl.nasa.gov/>

45. H. Fearn ”Mach’s Principle, Action at a distance and Cosmology”, J. Of Modern Physics, **6** (3) 260-272 (2015). Available for online download, DOI: 10.4236/jmp.2015.63031, <http://dx.doi.org/10.4236/jmp.2015.63031>

46. H. Fearn A. Zachar, K. Wanser and J. Woodward, ”Theory of a Mach Effect Thruster I”, J. Mod. Phys. **6** 1510-1525 (2015). DOI: 10.4236/jmp.2015.611155 . <http://dx.doi.org/10.4236/jmp.2015.611155>

47. H. Fearn, Nolan van Rossum, K. Wanser and J. F. Woodward, ”Theory of a Mach effect Thruster II”, J. Mod. Phys. **6** pp1868-1880 (2015)

48. H. Fearn, “A delayed choice quantum eraser explained by the transactional interpretation of quantum mechanics”, H. Fearn, arXiv: 1501.00970, Foundations of Physics, (FOOP) **46** (1) pp44-69 (2016).

49. H. Fearn and J. F. Woodward, “Breakthrough Propulsion I: The Quantum Vacuum”, Journal. of the British Interplanetary Soc. (JBIS) **69** (5) pp.155-162 (2016) May.

50. H. Fearn and J. F. Woodward, “Breakthrough Propulsion II: A mass change experiment”, Journal. of the British Interplanetary Soc. (JBIS) **69** pp.263-270 (2016)

51. H. Fearn, “The Mach effect gravity assist drive”, paper presented at Foundations of Interstellar Studies, Workshop on Interstellar flight, City Tech, CUNY, New York June 13-15 (2017). To be published by JBIS as part of the workshop proceedings.

52. H. Fearn and J. F. Woodward, “Voltage power law scaling of the force for a Mach Effect Gravity Assist Drive”, special double issue: Oct-Nov, Advanced propulsion concepts JBIS. Jour. of the British Interplanetary Society 70, Nos. 10,11 pp. 365-372 (2017). This is the proceedings of the workshop held at Aerospace Corporation El Segundo CA (by invitation only) on Nov 1-3 (2017). This workshop was organized by H. Fearn, J. F. Woodward and G. Meholic at Aerospace Corp.

Papers on the arXiv.org:

1. “On the flight of the American football” H. Fearn and Curtis Horn. arXiv:0706.0366
2. “On radiation reaction and the $[x,p]$ commutator for an accelerating charge”, H. Fearn,

arXiv: 1301.7051

3. “Experimental Null test of a Mach Effect Thruster”, H. Fearn and J. Woodward, Jan 2013. arXiv:1301.6178.
4. “Radiation Reaction Force on a Particle”, H. Fearn and J. Bengtsson arXiv:1212.4469. (updated with Bengtsson originally sole author)
5. “Derivation of the Aharonov Bohm phase shift using classical forces ”, H. Fearn and Khai Nguyen, 2012. arXiv:1104.1449.
6. “Dispersion Relations and Relativistic Causality,” H. Fearn and R. H. Gibb, arXiv:quant-ph/0310059.
7. H. Fearn, “Mach’s Principle, Action at a Distance and Cosmolgy”, arxiv:1412.5426
8. H. Fearn, “A Delayed Choice quantum eraser explained by the transactional interpretation of quantum mechanics”, arXiv:1501.00970
9. H. Fearn, “Can Light Signals Travel Faster than c in Nontrivial Vacuua in Flat space-time? Relativistic Causality II ”, arXiv:0706.0553
10. H. Fearn, G. Jordan Maclay , Peter W. Milonni, “Of Some Theoretical Significance: Implications of Casimir Effects ”, arXiv:quant-ph/0105002

Articles in Books:

1. Invited article on “Pauli’s Exclusion Principle”, with P. W. Milonni, for Macmillan Encyclopedia of Physics, published (1996).
2. Invited article on “Surface Tension”, for Macmillan Encyclopedia of Physics, published (1996).
3. Invited article on “Eddy Currents”, for Macmillan Encyclopedia of Physics, published (1996).
4. Invited article on “Levitation: Electromagnetic”, for Macmillan Encyclopedia of Physics, published (1996).

Books Written or Edited

1. Proceedings for the Estes Park Advanced Propulsion Workshop. Workshop was held at Estes Park CO Sept 20-23, 2016. The workshop was sponsored by the Space Studies Institute (SSI) and the book will be published by Konfluence Press (Konfluene.org .. scientific research organization).

All papers were refereed unless otherwise stated.

Some articles are available for download on <http://www.ResearchGate.net>