Joel Franklin

Physics Department, Reed College
3203 SE Woodstock Blvd.
Portland, OR
97202

Education

B.A. Physics, Reed College, 1997.

M.A. Physics, Brandeis University, 1999.

Ph.D. Computational Mathematics, Stanford University, 2003.

("Topics in macro-molecular dynamics integration" with Sebastian Doniach.)

Visiting Researcher, Structural Biology & Chemistry, Pasteur Institute, 2003.

Work Experience

Postdoctoral Associate, M.I.T., 2003-2005. Member, ΣΞ, M.I.T. Chapter.

Visiting Assistant Professor, Reed College, 2005–2007.

Assistant Professor, Reed College, 2007 – 2010.

Associate Professor, Reed College, 2010 – 2016

Professor, Reed College, 2016 –

Visiting Associate Professor, Stanford University, 2012.

Publications

Papers

1. S. Deser, J.S. Franklin, D. Seminara, "Graviton-Graviton Scattering, Bel-Robinson and Energy (Pseudo)-Tensors", Class. Quant. Grav. 16(9):2815-2821, 1999.

2. S. Deser, J. Franklin, B. Tekin, "Shortcuts to Spherically Symmetric Solutions: A Cautionary Note", Class. Quant. Grav. 21(22): 5295-5296, 2004.

3. S. Deser, J. Franklin, "Schwarzschild and Birkhoff a la Weyl", Am. J. Phys. 73(3):261-264, 2005.

4. S. Deser, J. Franklin, "Birkhoff for Lovelock Redux", Class. Quant. Grav. 22:L103-106, 2005.

5. S.A. Hughes, S. Drasco, E.E. Flanagan, J. Franklin, "Gravitational Radiation Reaction and Inspiral Waveforms in the Adiabatic Limit", Phys. Rev. Lett. 94, 221101, 2005.

6. J. Lipfert, J. Franklin, Fang Wu & Sebastian Doniach, "Protein Misfolding and Amyloid Formation for the Peptide GNNQQNY from Yeast Prion Protein Sup35: Simulation by Reaction Path Annealing", J. Mol. Biol. 349(3):648-58, 2005.

7. J. Franklin, S. Doniach, "Adaptive Time Stepping in Molecular Dynamics", J. Chem. Phys. 123, 124909, 2005. (selected for the Virtual Journal of Biological Physics Research).

8. J. Franklin, S. Doniach, "Dynamic Bond Constraints in Protein Langevin Dynamics", J. Chem. Phys. 124, 154901, 2006. (selected for the Virtual Journal of Biological Physics Research).

9. J. Franklin, P. T. Baker, "Linearized Kerr and Spinning Massive Bodies: An E&M Analogy", Am. J. Phys. 75(4):336–342, 2007.

10. J. Franklin, P. Koehl, S. Doniach & M. Delarue. "MinActionPath: Maximum Likelihood Trajectory for Large-Scale Structural Transitions in a Course-Grained Locally Harmonic Energy Landscape", Nucleic Acids Research, 35, W477-482, 2007.

11. S. Deser, J. Franklin, "Time-(In)Dependence in General Relativity", Am. J. Phys. 75(3):281–283, 2007.

12. S. Deser, J. Franklin, "Circular Symmetry in Topologically Massive Gravity", Class. Quant. Grav. **27**:1007002, 2010.

13. S. Deser, J. Franklin, "De/Re-Constructing the Kerr Metric", General Relativity and Gravitation, **42**, 11, 2657–2662, 2010.

14. J. Franklin, F. Morton-Park. "Charged Radial Infall for Spherical Central Bodies", Am. J. Phys. 78(12):1336, 2010.

15. S. Deser, J. Franklin. "Is BTZ a Separate Superselection Sector of CTMG?", Phys. Lett. B, **693**, 609–611, 2010.

16. S. Deser, J. Franklin, "Bel-Robinson for TMG", Class. Quant. Grav. **28**:032002, 2011.

17. J. Franklin, T. Garon, "Approximate Born-Infeld Effects on the Relativistic Hydrogen Spectrum", Phys. Lett. A, **375**, 1391–1395, 2011.

18. S. Deser, J. Franklin, "No Bel-Robinson Tensor for Quadratic Curvature Theories", Class. Quant. Grav., **28** 235016, 2011.

19. S. Deser, J. Franklin, "Canonical Analysis of Lanczos-Lovelock Gravity", Class. Quant. Grav., **29** 072001, 2012.

20. D. Clark, J. Franklin, N. Mann, "Relativistic Linear Restoring Force", Eur. J. Phys. **33**, 1041–1051, 2012.

21. S. Deser, J. Franklin, "Symmetrically Reduced Galileon Equations and Solutions", Phys. Rev. D. **86** 047701, 2012.

22. J. Franklin, C. LaMont, "The Motion of a Pair of Charged Particles", Braz. J. Phys. **43** 4, 2013.

23. J. Franklin, D. Griffiths, "The Fields of a Charged Particle in Hyperbolic Motion", Am. J. Phys. **82** 8, 2014.

24. J. Franklin, "Self-Consistent, Self-Coupled Scalar Gravity", Am. J. Phys. **83** 4, 2015.

25. J. Franklin, Y. Guo, A. McNutt & A. Morgan, "The Schrödinger-Newton System with Self-Field Coupling", Class. Quant. Grav., **35** 065010, 2015.

26. S. Deser, J. Franklin, "Bel-Robinson as Stress-tensor Gradients and their Extensions to Massive Matter", Gen. Rel. Grav., **47**, 68, 2015. (editor's choice).

27. J. Franklin, K. Cole Newton, "Classical and Quantum Mechanical Motion in Magnetic Fields", Am. J. Phys., **84**, 263, 2016 (editor's pick).

28. J. Franklin, Y. Guo, K. Cole Newton & M. Schlosshauer, "The Dynamics of the Schrödinger-Newton System with Self-Field Coupling", Class. Quant. Grav., **33** (7), 2016.

29. E. Banyas, J. Franklin, "The (Weak) Gravitational Field of a Dirac Monopole", Class. Quant. Grav., **34** 195004, 2017.

30. J. Franklin, A. Ryder, "Electromagnetic Field Visualization in Virtual Reality", Am. J. Phys., **87**, 2019.

31. J. Franklin, "Symmetric Criticality and Magnetic Monopoles in General Relativity", Symmetry (special issue on symmetry in special and general relativity), **11** (7), 2019.

32. J. Franklin, Gopal Goel, "Finite & Half-Infinite Solenoids and the Aharonov-Bohm Effect", Am. J. Phys., **87**, 2019 (an editor's pick).

33. A. Chambliss, J. Franklin, "A Magnetic Velocity Verlet Method", Am. J. Phys., **88**, 1075, 2020.

34. Joel Franklin, David J. Griffiths & Nelia Mann, "Motion of a Charged Particle in the Static Fields of an Infinite Straight Wire", Am. J. Phys., **90**, 513, 2022.

35. Joel Franklin, David Griffiths, & Darrell Schroeter, "A Taxonomy of Magnetostatic Field Lines", Am. J. Phys., **92**, 583, 2024.

Books

36. J. Franklin. *Advanced Mechanics and General Relativity*, Cambridge University Press, 2010.

37. J. Franklin. *Computational Methods for Physics*, Cambridge University Press, 2013.

38. J. Franklin. *Classical Field Theory*, Cambridge University Press, 2017.

39. J. Franklin. *Mathematical Methods for Oscillations and Waves*, Cambridge University Press, 2020.

40. J. Franklin. *Introduction to Gravity*, Cambridge University Press, 2024.

Talks and Presentations

1. "I Don't Know What Magnetic Field Lines Are", presentation to Reed College Physics Major Group, October, 2023.

2. "Particle Motion in a Magnetic Field", Portland State University, May, 2022.

3. "Sabbatical Potpourri", Reed College, November, 2019.

4. "The Gravitational Field of a Dirac Monopole", Stanford University (SITP theory seminar), March, 2018.

5. "The (weak) Gravitational Field of a Dirac Monopole", Lewis and Clark College, November, 2017.

6. "Constellations: post-show Talkback", Portland Center Stage, June, 2017.

7. "Electromagnetic and Gravitational Radiation", Oregon Episcopal School, June, 2017.

8. "Magnetic Motion and Ehrenfest's Theorem", Willamette University, March, 2017.

9. "Seeing Light, Hearing Gravity" (a more technical version of below), University of Puget Sound, February, 2017.

10. "Seeing Light, Hearing Gravity", OMSI Science Pub, July, 2016.

11. "Rolling cylinders", talk given to kindergartners at Duniway Elementary School, May, 2016.

12. "Seeing Light", Digital Scholarship panel, Reed College, April, 2016.

13. "Motion in a Magnetic Field", University of Portland, November, 2015.

14. "Newtonian Gravity and Special Relativity", University of Portland, January, 2014.

15. "The Motion of Two Charged Particles", Reed College, January, 2014.

16. "Newtonian Gravity and Special Relativity", ORAAPT, October, 2013.

17. "A Pair of Charged Particles", University of Puget Sound, April 2013.

18. "Motion of Charged Particles", University of Portland, November, 2012.

19. "Lanczos-Lovelock Gravity and Other Modifications", Stanford University SPS faculty seminar, February 2012.

20. "Birkhoff's Theorem for Lovelock Forms" – presentation of research to the Kavli Institute for Theoretical Physics, undergraduate theory section, July 2007.

21. "Birkhoff's Theorem in Electricity & Magnetism, and General Relativity", Linfield College, May, 2007.

22. "Spinning Charged Bodies and the Linearized Kerr Metric" – paper for AAPT topical conference, "Teaching General Relativity to Undergraduates", 2006.

23. "Particles and Fields in General Relativity", Reed College Physics Seminar, December, 2004.

24. "Dynamic Bond Constraints for Stochastic Molecular Dynamics", SIAM Conference on the Life Sciences, July, 2004. (Session Chair)

25. "Adaptive Time Stepping for Langevin Dynamics of Macromolecules", Uppsala University, May, 2003, and Pasteur Institute, July, 2003.

26. "Molecular Dynamics and the Gravitational N-Body Problem" – 2nd annual SIGRAV meeting, Pisa Italy, June, 2003.

Summer Students

1. Kreicbergs, Toms. "Multipole moments in Curved Space: E&M and General Relativity", Sherman Fairchild summer research student, 2006.

2. Schlender, Amory. "Time Scales and Potentials for N-body Physics", 2007.

3. Rhines, Andrew. "Hookean Vibrating Strings", 2007.
4. Case, Steven. "Reed College Physics Computing Cluster Setup and Configuration", 2008.
5. Garon, Todd. "Relativistic Born-Infeld Corrections to the Hydrogen Spectrum", 2010.
6. Gopalaswamy, Varchas & Allison Morgan, Andrew McNutt, Carl Proepper. "The Schrödinger-Newton system with self-coupled gravitational sourcing", 2013.
7. Newton, Katherine. "Wave function localization in gravitational and continuous spontaneous collapse models", 2014.
8. Banyas, Ella. "Conical Singularities in Physics", 2017.
9. Ryder, Andrew. "Electromagnetic Field Visualization in Virtual Reality", 2017.
10. Cao, Jesse. "Numerical Solutions of the Nonlinear Schrödinger-Poisson Problem", 2021.

Thesis Students (present position, when known, appears in brackets)

1. Baker, Paul. "Electrodynamics and an Investigation of Weak Field Kerr Geometry", 2006. [physics faculty, SUNY Geneseo.]
2. Katz, David. "Surface Phenomena in Ferrohydrodynamics", 2006.
3. Kreicbergs, Toms. "Dynamics of Doubly Special Relativity", 2007. [broker, UBS Securities.]
4. Rhines, Andrew. "A Realistic Model of Elastic Vibrations", 2007. [postdoctoral fellow, University of Washington.]
5. Schlender, Amory. "On the Dynamics of Coupled Particle Systems with a Periodic Pair Potential", 2007. [senior software engineer, Coursera.]
6. Znameroski, David. "Normalizing the Most Likely Trajectory Connecting Local Minima", 2007. [actuary.]
7. Flashman, Michael. "Modified Electrodynamics: Fixing Relativistic Field Theories", 2008. [software engineer, Zymergen, Inc.]
8. Hougland, Juliet. "Separability of the Kerr Geodesic Hamilton-Jacobi Equation", 2008. [data platform engineer, StitchFix.]
9. Vergara, Verónica. "Laplacian Growth: How Mistaken are we by Calling it DLA?", 2008. [HPC support specialist/programmer, Oak Ridge National Laboratory.]

10. Chartrand, Tom. "Numerical Solutions to Bohmian Quantum Mechanics", 2009. [graduate student, applied math, UC Davis.]

11. Vaccaro, Kristen. "Teaching Computers Prejudice", 2009. [graduate student, computer science, UIUC.]

12. Lazarus, Reuven. "Measuring Boltzmann's Constant Through Automated Video Tracking of Brownian Motion", 2010. [Google.]

13. Morton-Park, Frank. "On the Neutralization of Charged Black Holes", 2010. [technology specialist, McCoy Russell.]

14. Rodriguez, Carl. "Accretion Disk Geodesics in Extreme Kerr Geometries", 2010. [Pappalardo Postdoctoral Fellow, MIT.]

15. LaMont, Colin. "Relativistic Direct Interaction Electrodynamics: Theory and Computation", 2011. [graduate student, University of Washington.]

16. Silver, Jeremy. "Parkour: A Study of Efficient Human Movement", 2011.

17. Warren, MacKenzie. "An Introduction to Stellar Gravitohydrodynamics", 2011. [postdoctoral research associate, Michigan State University.]

18. Maxwell Gurewitz. "Multilayer Perceptrons", 2013. [software engineer, OpenTable.]

19. Lucas Howard. "A Numerical Investigation of Water Waves", 2013. [graduate student, University of Vermont.]

20. Carolynn Polancheck. "Composing Cavities and Stringing 19 Tones into One Octave", 2013.

21. Eliot Vrijmoet. "Numerically Levitating Objects with Rockets", 2013. [graduate student, astronomy, Georgia State University.]

22. Prakher Bajpai, "Attraction Between Two Charged Conducting Circles", 2014.

23. Gregory Kohler, "Bound States in Singular Potentials", 2014.

24. Allison Morgan, "Relativistic Strings and Ehrenfest's Paradox", 2014. [graduate student, computer science, CU Boulder.]

25. Jay Collins, "Using the Photon Wave Function to Compute the Behavior of Single Photon Wave Packets Travelling Through Linear Material Interfaces", 2015. [graduate student, University of Oregon.]

26. Dan Guo, "Scalar Gravity with Self-Field Coupling", 2015. [graduate student, Stanford University.]

27. Alex Emerman, "A Geometric Approach to k_T Clustering", 2015. [graduate student, Columbia University.]

28. Katherine Newton, "Bohmian Mechanics and the Aharonov-Bohm Effect: A Computational Approach", 2015. [graduate student, University of Wisconsin, Madison.]

29. Julia Selker, "Electrospray Plume Evolution", 2015.

30. Aaron Cholden-Brown, "Issues with First Quantization Quantum Mechanics on Curved Space-Times", 2016. [observatory duty scientist, NASA Swift Explorer.]

31. Timoteo Delgado-Esbenshade, "Bound Orbits in Classical Electrodynamics", 2016.

32. William Holdhusen, "First Quantization of the Radiation Reaction Force", 2016. [graduate student, physics, University of Indiana.]

33. Ella Banyas, "The Gravitational Signature of a Dirac Monopole", 2017. [graduate student, physics, University of California, Berkeley.]

34. Muldrow Etheredge, "Electrodynamics on Manifolds", 2017. [graduate student, physics, University of Massachusetts, Amherst.]

35. Kevin Freymiller, "Numerical Modeling of Waves and Wave Breaking", 2017.

36. Ian Fries, "Massless, Charged Scalar Fields," 2018. [SLAC researcher.]

37. Andrew Simler, "Solutions to the Klein-Gordon Wave Equation at the Event Horizon," 2018.

38. Daniel Timbie, "Modeling the Solar Dynamo with Finite Difference Approximations," 2018. [graduate student, Northwestern University.]

39. Sarah Racz, "Vector Cosmic Strings," 2018. [graduate student, University of Texas, Austin.]

40. Amelia Chambliss, "Plasma Particle Containment in Magnetic Confinement Fusion Devices: the Magnetic Mirror Machine and a Toroidal Confinement Field," 2020. [graduate student, Columbia University.]

41. Miles Cohen, "Single Particle Quantum Mechanics with the Schrödinger-Poisson Equation," 2020. [graduate student, UC Riverside.]

42. Saba Goodarzi, "Build-A-Bell-Workshop: Numerical Solutions to the von Kármán Equations for Arbitrary Shapes," 2020. [graduate student, UCLA.]

43. Ryen Burris, "Modelling Vibration of Membranes Under Non-Uniform Tension," 2021. [graduate student, University of Maryland.]

44. Matthew Hwang, "The Whole World and You: Toying With Physics on a Flat Earth," 2021.

45. Viola Lum, "Reinventing the Wheel: Rotational Rigidity under Relativity," 2021. [graduate student, University of Oregon.]

46. Rodger Zhang, "Model of length contraction," 2021.

47. Samantha Hordyk, "Multiphase Modeling of Glacial Lake Outburst Floods: A Review of Savage-Hutter Avalanche Theory and Debris Flow Models", 2022. [graduate student, Stanford University.]

48. Pratik Kafle, "On Schrödinger-Newton equation: A Numerical Study", 2022. [graduate student, Michigan State University.]

49. Deven Misra, "Multipole Moments of the Weyl-Lewis-Papapetrou Metric for an Axisymmetric Ring", 2022. [SULI researcher at Pacific Northwest National Laboratory.]

50. Hima Aramona, "Geodesics in Color Space", 2023. [junior software engineer, Anza Renewables.]

51. Rayn Samson, "Relativistic Ehrenfest Relations for Klein-Gordon Fields", 2023. [computational physics post-bac, Grinnell College.]

52. Regis Zhou, "A Non-Field-Theoretic Evaluation to the Point Charge Electrodynamics in Compact Extra Dimension: Potential, Bound States and Self-Forcing", 2023. [MSPQC student, University of Wisconsin, Madison.]

53. Olive Ross, "An Examination of Hinterleitner Doubly Special Relativity", 2024.

54. Devinder O'Dell Sagoo, "Charged Particle Dynamics in Uniform Magnetic Fields", 2024.

55. Guangyi Zhang, "A Geodesic Journey into the Wormholes", 2024. [graduate student, Caltech.]

Service

I have performed the usual academic duties at a small liberal arts college, serving on the following committees at various times: accreditation, radiation safety, drug and alcohol policy, community affairs, honor council, Reed Union, and the Committee on Academic Policy and Planning. I have served on various search committees in math/cs, and physics. I have been the faculty clerk, and chair of my department.

Academic service beyond Reed: I am a reviewer for the American Journal of Physics, European Journal of Physics, Classical and Quantum Gravity, General Relativity and Gravitation, European Physics Letters, European Physical Journal, Foundations of Physics and the Journal of Geometry and Physics. I also perform referee functions for the Oxford University Press, and the Cambridge

University Press. I was a member of the Apker Selection Committee of the APS (2016–2018). I have served as an external honors examiner at Swarthmore College (2016). I served on the external review team for the Kenyon College Physics Department (2017), and chaired the external review of the Macalester College Physics Department (2019).

Summary of Previous Research

- Numerical solutions of 1.5 dimensional magnetohydrodynamics equations for cylindrical geometry, including work on shock-capturing and total variation diminishing methods
- $\alpha - \Omega$ dynamo models of solar magnetic fields. Spherical solutions of Maxwell's (dynamo) equations to model the 11-year cycle of poloidal/toroidal magnetic fields inside the sun (poster presentations at SOHO-9 and SOHO-10 meetings).
- Numerical approximations for solving stochastic differential equations (Ph.D. research).