Andrew James Steinmetz, Ph.D.

Curriculum Vitae

Email:	ajsteinmetz@arizona.edu	**Website:**	https://ajsteinmetz.github.io/
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Employment

Position	Department	Institution	Dates
Global Professor	Dept. of Physics	The University of Arizona	Nov. 2023–Present
Global Professor	Arizona College of Tech.	Hebei University of Technology	Feb. 2024–Present
Adjunct Faculty	Physics & Astronomy Dept.	Pima Community College	June 2020–Dec. 2023

Education

Degree	Field	Institution	Dates
Ph.D.	Physics	The University of Arizona	2023
B.S.	Physics	The University of Arizona	2014
B.S.	Chemical Engineering	The University of Arizona	2014

Research Interests

- **Relativistic Spin Dynamics:** Exploring non-minimal (and nonlinear) electromagnetism (EM) in quantum mechanics utilizing the Klein-Gordon-Pauli (KGP) equation, or classically via modifying the covariant Thomas-Bargman-Michel-Telegdi (TMBT) torque equation.
- **Neutrino Physics:** EM mixing of neutrino flavor through transition magnetic dipole moments as a possible probe of the hierarchy problem. Exploring possible EM-induced neutrino mass splitting.
- **Cosmic Magnetization:** Magnetized spin-polarized thermal plasmas during the electron-positron and quark-gluon-plasma (QGP) epochs as a possible origin of primordial magnetic fields (PMF).

Dissertation

Title: Modern Topics in Relativistic Spin Dynamics and Magnetism

Committee: Dr. Johann Rafelski (Chair), Dr. Shufang Su (Member), Dr. John Rutherfoord (Member), Dr. Stefan Meinel (Member), Dr. Sean Fleming (Member)

HDL: http://hdl.handle.net/10150/670301 **Presentation:** 10.13140/RG.2.2.24323.27689

Publications

Peer-Reviewed Journal Articles

1. **Steinmetz, A.**, Rafelski, J. "Short note on spin magnetization in QGP," *Eur. Phys. J. Spec. Top.* (2025), 10.1140/epjs/s11734-025-01625-9.
2. Birrell, J., Formanek, M., **Steinmetz, A.**, Yang, C. T., Rafelski, J. "Fermi-Dirac Integrals in Degenerate Regimes: Novel Asymptotic Expansion," *Int. J. Theor. Phys.* 63, 163 (2024), 10.1007/s10773-024-05695-8.
3. Rafelski, J., **Steinmetz, A.**, Yang, C. T. "Dynamic fermion flavor mixing through transition dipole moments," *Int. J. Mod. Phys. A* 38.31 (2023): 2350163, 10.1142/S0217751X23501634.
4. **Steinmetz, A.**, Yang, C. T., Rafelski, J. "Matter-antimatter origin of cosmic magnetism," *Phys. Rev. D* 108 (2023): 123522, 10.1103/PhysRevD.108.123522.
5. Formanek, M., **Steinmetz, A.**, Rafelski, J. "Motion of classical charged particles with magnetic moment in external plane-wave electromagnetic fields," *Phys. Rev. A* 103.5 (2021): 052218, 10.1103/PhysRevA.103.052218.

6. Formanek, M., **Steinmetz, A.**, Rafelski, J. "Radiation reaction friction: Resistive material medium," *Phys. Rev. D* 102.5 (2020): 056015, 10.1103/PhysRevD.102.056015.
7. Formanek, M., **Steinmetz, A.**, Rafelski, J. "Classical neutral point particle in linearly polarized EM plane wave field," *Plasma Phys. Control. Fusion* 61.8 (2019): 084006, 10.1088/1361-6587/ab242e.
8. **Steinmetz, A.**, Formanek, M., Rafelski, J. "Magnetic dipole moment in relativistic quantum mechanics," *Eur. Phys. J. A* 55, 40 (2019), 10.1140/epja/i2019-12715-5.
9. Formanek, M., Evans, S., Rafelski, J., **Steinmetz, A.**, Yang, C. T. "Strong fields and neutral particle magnetic moment dynamics," *Plasma Phys. Control. Fusion* 60.7 (2018), 10.1088/1361-6587/aac06a.
10. Rafelski, J., Formanek, M., **Steinmetz, A.** "Relativistic dynamics of point magnetic moment" *Eur. Phys. J. C* 78 (2018): 1–12, 10.1140/epjc/s10052-017-5493-2.

Book Chapters & Review Articles

1. Rafelski, J., Birrell, J., Grayson, C., **Steinmetz, A.**, Yang, C. T. "Quarks to Cosmos: Particles and Plasma in Cosmological evolution," *Eur. Phys. J. Spec. Top.* (in press, 2025), arXiv:2409.19031.
2. Rafelski, J., **Steinmetz, A.**, Yang, C. T. "Dynamic Flavor Mixing Through Transition Moments," *Harald Fritzsch Memorial Volume*, pp. 269–284 (2024), 10.1142/9789811292279_0015.
3. Rafelski, J., Birrell, J., **Steinmetz, A.**, Yang, C.T. "A Short Survey of Matter-Antimatter Evolution in the Primordial Universe," *Universe* 9.7 (2023): 309, 10.3390/universe9070309.

Works in Progress

1. **Steinmetz, A.**, Evans, S., Formanek, M., Grayson, C., Labun, L., Price, W., Rafelski, J. "Strong fields in classical and quantum physics," (in preparation, 2025).
2. **Steinmetz, A.**, Rafelski, J. "Magnetized primordial heavy-quark plasma," (in preparation, 2025).
3. **Steinmetz, A.**, Yang, C. T., Rafelski, J. "Electromagnetic field forcing of dynamic CP-violation in lepton sector," (in preparation, 2025).
4. Evans, S., **Steinmetz, A.** "Anomalous magnetic moment in the QCD vacuum," (in preparation, 2025).

Public Outreach

1. **Steinmetz, A.** (2024, November 7). Proving that SU(2) is compact (and other group theory bits). https://ajsteinmetz.github.io/mathematics/2024/11/07/su2-compactness.html
2. **Steinmetz, A.** (2024, October 17). Einstein's mass-energy and kinetic energy. https://ajsteinmetz.github.io/physics/2024/10/17/kinetic-energy-coefficient.html
3. **Steinmetz, A.** (2024, October 16). Can we ever detect the graviton? https://ajsteinmetz.github.io/physics/2024/10/16/graviton-detector.html

Conference Presentations & Talks

1. Rafelski, J., Birrell, J., Grayson, C., **Steinmetz, A.**, Yang, C. T., Foster, S. "Quarks to Cosmos: Particles and Plasma in Cosmological Evolution." *16th Conference on Quark Confinement and the Hadron Spectrum (QCHSC 2024)*, The University of Adelaide, Cairns, Australia, August 9, 2024. 10.13140/RG.2.2.19642.30407.
2. Rafelski, J., Yang, C. T., Birrell, J., Grayson, C., Foster, S., **Steinmetz, A.** "Particles & Plasmas in the First Hour of the Universe." *Physics Particles & Plasmas Symposium*, HUN-REN Wigner Research Centre for Physics, Budapest, Hungary, June 11, 2024. 10.13140/RG.2.2.22997.74727.
3. **Steinmetz, A.**, Yang, C. T., Rafelski, J. "Primordial Cosmic Magnetism." *SMT 30th Anniversary Steward Observatory Symposium*, The University of Arizona, Tucson, Arizona, September 22, 2023. 10.13140/RG.2.2.19213.24806.
4. **Steinmetz, A.**, Yang, C. T., Rafelski, J. "Magnetism in the Cosmic Plasma Epoch." *ELI-Beamlines Strong Fields Frontiers*, The Extreme Light Infrastructure ERIC, Prague, Czech Republic, June 13, 2023. 10.13140/RG.2.2.32635.02087.
5. **Steinmetz, A.**, Yang, C. T., Rafelski, J. "Magnetism in the Cosmic Plasma Epoch." *Margaret Island Symposium on Particles and Plasmas*, HUN-REN Wigner Research Centre for Physics, Budapest, Hungary, June 8, 2023. 10.13140/RG.2.2.29279.57762.
6. Rafelski, J., **Steinmetz, A.** "Space-time, Acceleration and Matter." *The Extreme Light Infrastructure ERIC*, Prague, Czech Republic, December 2022. 10.13140/RG.2.2.25933.76001.

7. Rafelski, J., Yang, C. T., Birrell, J., Grayson, C., **Steinmetz, A.** "Particles and Plasmas in the Universe." *22nd Zimanyi School Winter Workshop on Heavy Ion Physics*, HUN-REN Wigner Research Centre for Physics, Budapest, Hungary, December 2022. 10.13140/RG.2.2.27611.48160.
8. **Steinmetz, A.** "Relativistic Two-Body Quantum Mechanics." *Physics Department Grad Talk*, The University of Arizona, Tucson, Arizona, March 2017.

* Presenter.

In addition, I have closely collaborated on producing research and academic talks delivered by Prof. Johann Rafelski at the following venues: HUN-REN Wigner Research Centre for Physics Particles & Plasmas Symposium (2023), 21st Zimanyi School Winter Workshop on Heavy Ion Physics, XI International Conference on New Frontiers in Physics (ICNFP 2022), Hungarian Academy of Sciences, Institute of Theoretical Physics Uniwersytet Wroclawski, 4th LeCosPA Symposium.

Teaching Experience

Faculty Courses at UA/ACT (as Instructor-of-Record)*:

Course #	Title	Sections	Students	Semester
PHYS 371	Quantum Theory	1	75	Spring 2025
PHYS 381	Methods in Exp. Physics I	2	67	Spring 2025
PHYS 321	Theoretical Mechanics	2	139	Fall 2024
PHYS 382	Methods in Exp. Physics II**	2	46	Fall 2024
ENGR 498A	Senior Design/Capstone**	1	43	Fall 2024
PHYS 240	Intro. Electricity & Magnetism	3	203	Spring 2024
PHYS 381	Methods in Exp. Physics I**	2	50	Spring 2024

* Full teaching record and recent student course evaluations available upon request.
** First time offered at this institution. Designed, developed, and delivered curriculum.

- **Adjunct Courses at PCC (Physics & Astronomy Dept., as Instructor-of-Record):** Intro. Physics I/II (2020, 2021, 2023), The Solar System (2020–2023), Intro. Electricity & Magnetism (2022)
- **TA Courses at UA (Dept. of Physics, Dept. of Chemistry & Biochemistry):** Intro. to Scientific Computing (2017), Intro. Electricity & Magnetism (2017), Methods in Exp. Physics I/II (2018, 2019), Intro. Mechanics I/II Lab (2020), Intro. Physics I/II Lab (2020), General Chemistry I(Honors)/II Lab (2019, 2021–2023)
- **Key:** UA (The University of Arizona), ACT (Arizona College of Tech., Hebei University of Technology), PCC (Pima Community College)

Academic Service

- Organizer, Undergraduate Journal Club, Hebei University of Technology, (2025).
- Member, Department of Physics, University of Arizona, Faculty Search Committee, (2025, 2024).
- Reviewer for *Physical Review D*, *Physical Review Research*, *Modern Physics Letters A*, *International Journal of Modern Physics A*, *MDPI Universe*, and *ICPMS 2025*.

Press

1. World Scientific Publishing. (2025, January 9). *World Scientific Publishing on LinkedIn: The International Journal of Modern Physics A (IJMPA) celebrates 40 Years...* LinkedIn. https://www.linkedin.com/embed/feed/update/urn:li:share:7282593891487293440
2. Kong, X. (2024, March 20). Prof. Andrew Steinmetz of the University of Arizona Visited the Physics Demonstration and Exploration Lab. *Physics Experiments at HEBUT, Hebei University of Technology.*
3. The University of Arizona, Department of Physics. (2024, January 26). *Announcing Department of Physics new Faculty Member Prof. Andrew Steinmetz.* UA Science Physics. https://w3.physics.arizona.edu/news/announcing-department-physics-new-faculty-member-prof-andrew-steinmetz
4. The University of Arizona, Department of Physics. (2023, July 25). *International Symposium on "Par-*

ticles and Plasmas" and "Strong Fields." UA Science Physics.
https://w3.physics.arizona.edu/news/international-symposium-particles-and-plasmas-and-strong-fields

5. Springer. (2018, January 29). Relativity matters: Two opposing views of the magnetic force reconciled. *Phys.org*. https://phys.org/news/2018-01-relativity-opposing-views-magnetic.html

   Also published in: EPJ C Highlight, Springer Press, ScienceDaily, EuroPhysicsNews, EurekAlert!, Science Newsline, Sky Nightly, Space Daily.

Additional Links & Websites

Inspire-HEP: https://inspirehep.net/authors/1796313
Google Scholar: https://scholar.google.com/citations?user=fJBK1GIAAAAJ
GitHub: https://github.com/ajsteinmetz/
Faculty Page: https://w3.physics.arizona.edu/person/andrew-steinmetz
arXiv: https://arxiv.org/a/steinmetz_a_1.html
BlueSky: https://bsky.app/profile/ajsteinmetz.com
AstroBin: https://www.astrobin.com/users/djinn/
LinkedIn: https://www.linkedin.com/in/ajsteinmetz/

My Erdős Number is 5. (Source)

Professional References

1. **Dr. Johann Rafelski** – Professor of Physics, University of Arizona.
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2. **Dr. Shufang Su** – Department Head, Professor of Physics, University of Arizona
   Email: shufang@arizona.edu Phone: (520) 621-5540
3. **Dr. Srin Manne** – Associate Professor of Physics, University of Arizona
   Email: smanne@physics.arizona.edu Phone: (520) 626-5305
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6. **Dr. Sagar Samtani** – Associate Professor, Director of DSAIL, Indiana University
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