

Jonah S. Peter

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🔗 [Google Scholar](#)

Research Interests

Theoretical quantum optics applied to atomic, molecular, optical (AMO), and **biophysical** systems. Primary focus on **open quantum systems**, superradiance, light-harvesting, chirality-induced spin selectivity, and topology.

Origins of life research on photophysics of organic molecules, prebiotic chemistry, and the habitability/astrobiology of ocean worlds.

Education

Ph.D.	Harvard University Biophysics Secondary Field in Origins of Life Research	Expected: May 2025
	• Advisors: Susanne Yelin, Dimitar Sasselov	
M.A.	Harvard University Physics	May 2021
B.A.	University of Pennsylvania Physics with Honors Summa cum laude (GPA: 3.97/4.00)	May 2018
	• Minors: Astrophysics, Computational Neuroscience	
	• Thesis: "An information-theoretic approach to mass spectra deconvolution for icy worlds."	

Research and Work Experience

Harvard University	Research Associate, Groups of Profs. Susanne Yelin and Dimitar Sasselov	2019 – Present
RIKEN Institute	Invited Visiting Research Scholar, Group of Prof. Franco Nori	Spring 2024
Massachusetts General Hospital	Research Associate, Radiation Oncology	2019 – 2020
	• Performed nano-scale computer modeling of galactic cosmic ray irradiation of the brain using Monte Carlo track structure codes.	
NASA Jet Propulsion Laboratory	Research Scientist, Group of Dr. Kevin Hand	2018 – 2019
	• Discovered HCN and oxidized organics in the Enceladus plume using statistical and information theory tools applied to Cassini mass spectra.	
	• Contributed to the Europa Lander mission concept development as member of Pre-Project Science Team.	
NASA Jet Propulsion Laboratory	Propulsion Engineer, Group of Dr. Rich Hofer	2018 – 2019
	• Designed and performed thermal vacuum quality assurance tests of spacecraft components.	
	• Developed electric propulsion technology for use on NASA's Deep Space Gateway.	
Hospital of the University of Pennsylvania	Group of Prof. Abass Alavi	2015 – 2018
	• Developed novel computational algorithms for lateralizing seizure foci in temporal lobe epilepsy patients using positron emission tomography.	
	• Explored role of beta-amyloid radiotracers at evaluating cognitive decline in patients with Alzheimer's disease and mild cognitive impairment.	
NASA Jet Propulsion Laboratory	Research Associate, Group of Dr. Kevin Hand	Summer 2017
	• Investigated laboratory mass spectra of radiolytically processed ices relevant to Enceladus and Europa	
NASA Ames Research Center	Space Life Sciences Training Program, Group of Dr. Josh Alwood	Summer 2016
	• Examined effects of simulated microgravity and galactic cosmic rays on cancellous bone microarchitecture using micro-computed tomography and computer imaging programs.	
	• Optimized automated tissue segmentation algorithm for 20x faster data collection and analysis.	

Publications

First Author Papers (8)

8. **J. S. Peter**, R. Holzinger, S. Ostermann, and S. F. Yelin, Examining the quantum signatures of optimal excitation energy transfer, *Phys. Rev. Res.* **6**, 033252 (2024). [🔗](#)

7. **J. S. Peter**, S. Ostermann, and S. F. Yelin, Chirality dependent photon transport and helical superradiance, *Phys. Rev. Res.* **6**, 023200 (2024). [↗](#)
6. **J. S. Peter**, S. Ostermann, and S. F. Yelin, Chirality-induced emergent spin-orbit coupling in topological atomic lattices, *Phys. Rev. A* **109**, 043525 (2024). [↗](#)
5. **J. S. Peter**, T. A. Nordheim, and K. P. Hand, Detection of HCN and diverse redox chemistry in the plume of Enceladus, *Nat. Astron.* **8**, 164 (2024). [↗](#)
4. **J. S. Peter**, J. Schuemann, K. D. Held, and A. L. McNamara, Nano-scale simulation of neuronal damage by galactic cosmic rays, *Phys. Med. Biol.* **67**, 235001 (2022). [↗](#)
3. **J. Peter**, M. Khosravi, T. J. Werner, and A. Alavi, Global temporal lobe asymmetry as a semi-quantitative imaging biomarker for temporal lobe epilepsy lateralization: A machine learning classification study, *Hell. J. Nucl. Med.* **21**, 95 (2018). [↗](#)
2. **J. Peter**, S. Houshmand, T. J. Werner, D. Rubello, and A. Alavi. Novel assessment of global metabolism by 18F-FDG-PET for localizing affected lobe in temporal lobe epilepsy, *Nucl. Med. Commun.* **37**, 882 (2016). [↗](#)
1. **J. Peter**, S. Houshmand, T. J. Werner, D. Rubello, and A. Alavi. Applications of global quantitative 18F-FDG-PET analysis in temporal lobe epilepsy, *Nucl. Med. Commun.* **37**, 223 (2016). [↗](#)

Coauthored Papers (4)

4. R. Holzinger, **J. S. Peter**, S. Ostermann, H. Ritsch, and S. F. Yelin, Harnessing quantum emitter rings for efficient energy transport and trapping, *Opt. Quantum* **2**, 57 (2024). [↗](#)
3. C. Paige, D. Newman, and **J. Peter**, Advanced thermal, radiation, and dust protection for spacesuits and space systems, *International Conference on Environmental Systems. ICES-2020-327* (2020). [↗](#)
2. V. H. Chaplin, R. B. Lobbria, A. L. Ortega, I. G. Mikellides, P. J. Roberts, **J. S. Peter**, R. R. Hofer, J. E. Polk, and A. J. Friss, Spatiotemporally resolved ion velocity distribution measurements in the 12.5 kW HERMeS hall thruster, *International Electric Propulsion Conference. IEPC-2019-532* (2019).
1. M. Khosravi, **J. Peter**, N. A. Wintering, M. Serruya, S. P. Shamchi, T. J. Werner, A. Alavi, and A. B. Newberg, 18F-FDG is a superior indicator of cognitive performance compared to 18F-Florbetapir in Alzheimer's dementia and mild cognitive impairment evaluation: A global quantitative analysis, *J. Alzheimer's Dis.* **70**, 1197 (2019). [↗](#)

Presentations

Invited Talks

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| 8. Leverhulme Center for Life in the Universe Coffee Meeting
"Using high energy electrons to build the molecules of life on ocean worlds" | Cambridge, UK 2024 |
| 7. Harvard Origins of Life Initiative Chalk Talk
"Building the molecules of life on ocean worlds" | Cambridge, MA 2024 |
| 6. Harvard Biophysics Retreat
"Photons, electrons, and molecules: from quantum science to the origins of life" | York, ME 2024 |
| 5. Gordan Research Seminar: Quantum Science
"Biologically-inspired light-harvesting and the quantum-to-classical transition" | Easton, MA 2024 |
| 4. 113 th RIKEN Quantum Computing Seminar
"Examining the quantum signatures of optimal excitation energy transfer" | Saitama, Japan 2024 |
| 3. University of Innsbruck Theoretical Physics Seminar
"Examining the quantum signatures of optimal excitation energy transfer" | Innsbruck, Austria 2024 |
| 2. American Geophysical Union
"Detection of HCN and diverse redox chemistry in the plume of Enceladus" | San Francisco, CA 2023 |
| 1. Harvard-MIT Center for Ultracold Atoms Retreat
"Chirality dependent photon transport and helical superradiance" | Plymouth, NH 2023 |

Contributed Talks

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| 4. Astrobiology Science Conference
"Detection of HCN and diverse redox chemistry in the plume of Enceladus" | Providence, RI 2024 |
| 3. American Physical Society: Division of Atomic Molecular and Optical Physics
"Excitation transport in dipole-coupled photonic emitter arrays" | Orlando, FL 2022 |
| 2. Harvard Biophysics Retreat
"Modeling galactic cosmic ray irradiation of the brain at the cellular and molecular levels" | Cambridge, MA 2020 |
| 1. American Geophysical Union
"Quantitative chemical analysis of Enceladus' plume composition" | New Orleans, LA 2017 |

Contributed Posters

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| 12. Origins of Life Federation Meeting
"Building the molecules of life on ocean worlds" | Cambridge, UK 2024 |
| 11. Gordon Research Conference: Electron Donor-Acceptor Interactions
"Cooperative light-matter effects in biologically inspired designs" | Newport, RI 2024 |
| 10. Obergurgl Quantum Optics Conference
"Examining the quantum signatures of optimal excitation energy transfer" | Obergurgl, Austria 2024 |
| 9. Harvard-MIT Center for Ultracold Atoms Retreat
"Examining the quantum signatures of optimal excitation energy transfer" | Plymouth, NH 2024 |
| 8. KITP: Exploring Non-equilibrium Long-range Quantum Matter
"Chirality dependent photon transport and helical superradiance" | Santa Barbara, CA 2023 |
| 7. Okinawa School in Physics: Coherent Quantum Dynamics
"Chirality dependent photon transport and helical superradiance" | Okinawa, Japan 2023 |
| 6. Gordon Research Conference: Quantum Science
"Proximity sensing using non-Hermitian quantum emitters" | Easton, MA 2022 |
| 5. Society of Nuclear Medicine and Medical Imaging
"The case for global quantitative analysis in the assessment of temporal lobe epilepsy" | Denver, CO 2017 |
| 4. American Society for Gravitational and Space Research
"Short-term effects of simulated space radiation and microgravity on cancellous bone loss in mice tibiae" | Cleveland, OH 2016 |
| 3. American Society for Gravitational and Space Research
"Conceptual model of autonomous seed germination habitat for mars mission" | Cleveland, OH 2016 |
| 2. Society of Nuclear Medicine and Medical Imaging
"Novel global quantitative analysis of temporal lobe epilepsy using FDG-PET" | San Diego, CA 2016 |
| 1. Society of Nuclear Medicine and Medical Imaging
"Potential role of global quantitative FDG-PET image analysis in assessing temporal lobe epilepsy" | San Diego, CA 2016 |

Honors And Awards

Selected Publicity

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| • The New York Times "Poison Gas Hints at Potential for Life on an Ocean Moon of Saturn" ↗ | 2023 |
| • Scientific American , "New Evidence Discovered That Saturn's Moon Could Support Life" ↗ | 2023 |
| • NASA Press Release , "NASA Study Finds Life-Sparking Energy Source and Molecule at Enceladus" ↗ | 2023 |
| • New Scientist , "Cyanide in the ocean of Saturn's moon Enceladus could be good for life" ↗ | 2023 |
| • Astronomy Magazine , "New clues emerge toward possible life on Enceladus" ↗ | 2023 |
| • The Harvard Gazette , "Harvard-NASA study finds key ingredient for biological building blocks" ↗ | 2023 |
| • Physics World , "How could galactic cosmic rays affect astronauts travelling to Mars?" ↗ | 2022 |

Fellowships

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| • Molecular Biophysics Training Grant , National Institutes of Health | 2019 – 2022 |
| • Jet Propulsion Laboratory Summer Internship Program , NASA-JPL/Caltech | 2017 |
| • Space Life Sciences Training Program , NASA Ames Research Center | 2016 |
| • Meor Maimonides Leaders Fellowship , UPenn | 2016 |

Awards

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| • Student Poster Award (3rd place) , Astrobiology Science Conference | 2024 |
| • Student Travel Award , NASA Astrobiology Institute | 2024 |
| • Graduate Research Fellowship Program (Honorable Mention) , National Science Foundation | 2021 |
| • Harvard Integrated Life Sciences Student-Organized Event Award , Harvard | 2020 |
| • UPenn William E. Stephen's Memorial Prize : "Awarded annually to the graduating physics major who has demonstrated, during the course of his or her undergraduate course work, the most promise for a successful career as a scientist based on overall performance in all aspects of the undergraduate program as judged by members of the physics faculty." | 2018 |

- **Phi Beta Kappa**, UPenn 2018
- **Dean's List**, UPenn 2015 – 2018
- **Chaptership Award for Best Advocacy**, Foundation for International Medical Relief of Children 2015

Teaching and Professional Service

Harvard Quantum Science and Society Student Group | Cofounder, Treasurer 2023 – Present

- Organizes seminars to promote interdisciplinary dialogue between departments on societal implications of quantum science and technology research.

Graduate Advanced Quantum Mechanics I | Teaching Fellow Fall 2020

- Graded exams, advised students, and taught a 90 minute weekly section.

Harvard Space Life Sciences Seminar Series | Lead Organizer, Host Fall 2020

- Conceived and established the Harvard Integrated Life Sciences (HILS) Space Life Sciences Seminar Series on topics ranging from astrobiology, human space exploration, and diversity, equity, and inclusion.
- Organized a series of interdisciplinary seminars to promote virtual collaboration between universities during the COVID-19 pandemic shutdown.

Outreach Activities

Harvard-MIT EngageCUA | Board Member 2024 – Present

- Organizes semi-annual Center for Ultracold Atoms open house to engage local community with quantum science.
- Invited to speak to middle school students at Cape Cod Academy to promote scientific research.

American Society for Gravitational and Space Research | Political Action Chair, Student Board 2016 – 2017

- Cofounded Political Action Committee and met with congressional staffers in Washington D.C. to advocate for increased utilization of International Space Station for physical science research.

Foundation for International Medical Relief of Children | Director of Awareness, UPenn Chapter 2014 – 2015

- Organized biweekly science outreach meetings to promote global health awareness on topics such as diabetes epidemiology and women's health.
- Created mental health awareness initiative and hosted semiannual "FIMRC Awareness Week" with public events such as yoga classes, mural paintings, and educational seminars.

Technical Skills

Programming Languages: Python, Mathematica, Matlab

Libraries and Tools: Qutip, Scikit-learn, Emcee, Itertools, Numpy, Scipy, Pandas

Particle Transport Codes: Geant4, Geant4-dna, TOPAS, TOPAS-nBio

CAD Software: Solidworks