Ramin Abolfath, PhD

Assistant Professor | Clinical Medical Physicist | Data Scientist

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Howard University Profile | ORCID: 0000-0001-5722-2526

Academic Profile

Theoretical and computational physicist, clinical medical physicist, and data scientist working at the interface of radiation physics, radiobiology, oncology, complex systems, and scientific computing. Current research emphasizes multiscale mechanisms of conventional-dose-rate and FLASH ultra-high-dose-rate (UHDR) irradiation, particle therapy, micro-/nanodosimetry, radiation-induced chemical and biological damage, neural and retinal network models, anomalous transport in heterogeneous tissues, detector physics, and AI-enabled medical imaging.

Current research themes:

- Microdosimetry, nanodosimetry, proton/ion therapy, and biologically guided treatment optimization.
- Theoretical and computational modeling of FLASH-UHDR versus conventional-dose-rate irradiation.
- Thermoacoustic response, scintillation quenching, thermal spikes, shock waves, and collective track effects.
- Radiation chemistry and radiobiology, including DNA damage, lipid-membrane damage, reaction–diffusion kinetics, and oxygen effects.
- Neural-network, Hopfield/Ising, spin-glass, and percolation approaches to radiation-induced cognitive and retinal dysfunction.
- Complex systems, fractal and anomalous diffusion, tumor microenvironment transport, and immune-cell infiltration.
- Normal-tissue toxicity, tumor control, risk modeling, and multimodality treatment response.
- Data science, machine learning, and deep learning for CT/MRI/PET imaging, radiomics, post-irradiation toxicity, and molecular-scale simulations.

These principles have applications in UHDR radiation, detector physics, radiation biology, neural systems, cancer treatment, and radio-, chemo-, and immuno-therapy.

Current Academic Appointments

Assistant Professor — **Aug. 2024–Present**
Department of Physics and Astronomy, Medical Physics Graduate Program, Howard University — Washington, DC
Research and teaching in medical physics, radiation physics, radiobiology, computational modeling, and data science.

Adjunct Assistant Professor — **Jan. 2020–Present**
Departments of Radiation Physics and Oncology, The University of Texas MD Anderson Cancer Center — Houston, TX
Member of the FLASH-therapy consortium; development of theoretical and multiscale models for ultra-high-dose-rate radiotherapy.

Education and Professional Training

PhD, Topological Structures in Condensed Matter Physics — **1997**
Quantum Hall effects, superconductivity, and exotic states of materials. Work initiated at Sharif University of Technology and finalized at Indiana University, Bloomington. Advisors: Prof. Steve Girvin and Dr. Nasser Nafari.

MS, Theoretical Physics — **1992**
Sharif University of Technology; cosmology, string theory, and quantum field theory. — Iran

BS, Engineering — **1989**
Iran University of Science and Technology. — Iran

CAMPEP-Accredited Medical Physics Residency — **2015**
Department of Therapeutic Radiology, Yale University School of Medicine and Smilow Cancer Hospital. — New Haven, CT

CAMPEP-Accredited Medical Physics Certificate Program — **2016**
University of Florida. — Gainesville, FL

Professional Experience

Clinical Medical Physicist **Jan. 2019–Aug. 2024**

Department of Radiation Oncology, New Jersey Urology / Summit Health West Orange, NJ
New Jersey Certified Physicist; clinical radiation-therapy physics, treatment planning, quality assurance, and commissioning.

Research Fellow **Sept. 2018–Jan. 2019**

Department of Radiation Oncology, University of Pennsylvania Philadelphia, PA
Developed computational tools for clinical analysis of brain post-irradiation toxicity in proton therapy.

Research Fellow **Sept. 2018–Sept. 2019**

Department of Radiology, Yale University New Haven, CT
Developed 3D convolutional-neural-network methods for tumor/tissue toxicity recognition in MRI/PET/CT DICOM imaging.

Clinical Medical Physicist **Feb. 2017–July 2018**

Department of Radiation Oncology, St. Vincent's Medical Center Bridgeport, CT
Clinical medical physics support for external-beam radiotherapy and associated quality assurance.

Research Fellow **Sept. 2016–Feb. 2017**

Department of Radiation Oncology, Roberts Proton Therapy Center, Perelman School of Medicine, University of Pennsylvania Philadelphia, PA
Developed proton arc therapy methods for Varian technologies in a Varian-funded project.

Research Fellow **Sept. 2015–Sept. 2016**

Department of Radiation Physics, Division of Radiation Oncology, The University of Texas MD Anderson Cancer Center Houston, TX
Modeled radiobiological effects in particle therapy for clinical-trial applications.

Medical Physics Resident **July 2012–July 2015**

Department of Therapeutic Radiology, Yale University School of Medicine and Smilow Cancer Hospital New Haven, CT
CAMPEP-accredited residency in therapeutic medical physics.

Lecturer **Jan. 2008–July 2012**

Department of Physics, The University of Texas at Dallas Richardson, TX
Undergraduate and graduate physics instruction.

Assistant Instructor **July 2007–Dec. 2009**

Department of Radiation Oncology, The University of Texas Southwestern Medical Center Dallas, TX
Instruction and research activities in radiation oncology.

Research Associate **Jan. 2004–July 2007**

National Research Council of Canada, Institute for Microstructural Sciences Ottawa, Canada
Computational condensed-matter and nanostructure research.

Postdoctoral Research Scientist **Jan. 2003–Jan. 2004**

Albert Einstein Medical Center, Department of Biochemistry Bronx, NY
Computational biophysics and chemical-dynamics research.

Postdoctoral Research Scientist **Sept. 1999–Jan. 2003**

The University of Texas at Austin Austin, TX
Research in condensed-matter theory and correlated-electron systems.

Lecturer / Researcher / Staff Scientist **Jan. 1997–Jan. 1999**

Sharif University of Technology; Tehran University; Institute for Theoretical Physics and Mathematics (IPM); Atomic Energy Organization of Iran Tehran, Iran
Teaching and research in theoretical physics and related areas.

Research Program and Recent Radiation-Oncology Experience

- Multiscale and patient-data-driven modeling of cell/tissue toxicity in radiation therapy, linking nanometer-scale DNA damage and enzymatic repair/misrepair kinetics to cell survival, tumor control probability, and normal-tissue toxicity.
- Stochastic nanodosimetry, chromosome aberrations, Monte Carlo track-structure modeling, molecular dynamics, and high-performance computational methods for biologically driven radiotherapy.
- MRI/PET-informed and RBE/LET-guided optimization for proton and ion therapy, including multiobjective

treatment-planning strategies.
- Machine/deep-learning analysis of post-radiation imaging and radiation-therapy data.
- Modeling of combined radiation, chemotherapy, and immunotherapy in multimodality cancer treatment.

Research Support and Grant Activity

Awarded / Funded

- **Principal Investigator**, American Cancer Society Diversity in Cancer Research Institutional Development Grant (DICRIDG-21-074-01-DICRIDG), 2025; $40,000.
- **Consultant**, NIH/NCI R16 grant proposal, San Jose State University; awarded.
- **Consultant**, NIH/NCI R15 grant proposal, The University of Texas at Arlington; awarded.

Submitted / Collaborative / Planned

- NIH R01 collaborative submission with MD Anderson; under review.
- NIH R21 submission; under review.
- Development of a multiscale computational platform for biological response as a function of dose, LET, ionization density, and ion type, submitted for NIH/NCI R01 co-PI with MD Anderson, requested $500K for five years, and PI of R21, requested $250K for two years.
- **Co-PI**, Swiss National Science Foundation proposal, "Peroxidation reaction dynamics after FLASH irradiation: from liposomes containing amino acids and thiols to cells, normal brain, and glioblastoma-bearing mice" (2023), with P. Froidevaux and M.-C. Vozenin.
- Collaborative P01 activity on FLASH therapy at MD Anderson.

Selected Research Contributions and Recognition

- FLASH-radiotherapy research recognized by a radiation-oncology committee at MD Anderson as a highly ranked paper in the Jan./Feb. evaluation cycle reported in the source CV.
- Member of the MD Anderson FLASH-therapy consortium; development of a multiscale radiobiology computational platform.
- Proton-therapy work highlighted by *Europhysics News* and the *European Physical Journal D*.
- Nanodosimetric kinetic model and variable-RBE work selected as a "Best in Physics" abstract at the 2016 AAPM meeting.
- Coupled Geant4 Monte Carlo and large-scale molecular-dynamics modeling of radiation-induced DNA damage, published in *Physics in Medicine & Biology* (2013).
- Large-scale reactive molecular-dynamics studies of DNA damage and graphene oxide using ReaxFF.
- Contributions to optical control of DNA radiosensitivity, quantum Hall ferrimagnetism, and piezomagnetism in quantum dots.
- Most-cited paper listed in the source CV: "Theory of Magnetic Anisotropy in (III,Mn)V Ferromagnets," *Phys. Rev. B* 63, 054418 (2001), reported there as approximately 500 citations.

Current Data-Science / AI Projects

- **Ramin Abolfath** et al., tissue and tumor auto-segmentation and prediction of dose distributions in prostate-cancer patients using U-Net architectures and deep learning.
- **Ramin Abolfath** et al., reduction of metal artifacts in CT images and Eclipse treatment-planning workflows for radiotherapy patients with hip prostheses using convolutional neural networks and deep learning.

Manuscripts in Preparation

1. **Ramin Abolfath**, Marie-Catherine Vozenin, A radiochemistry-renormalized Markov birth–death model for delayed hippocampal neurogenesis recovery after FLASH whole-brain irradiation
2. **Ramin Abolfath**, Marie-Catherine Vozenin, A hippocampal-module Ising–percolation framework for radiation-induced cognitive reduction under conventional and FLASH irradiation: from mechanistic theory to experimental calibration and predictive validation
4. Babak Pornour Mehravani, Michael Dingfelder, **Ramin Abolfath**, A time-dependent Monte Carlo simulation framework for investigating the effect of intertrack coupling on Reactive Oxygen Species productions at Ultra-High Dose Rate

Manuscripts Under Review

3. **Ramin Abolfath**, Mohammad Rezaee, Causal Multiscale Modeling of Ocular FLASH Electroretinography: Model Development, Experimental Fitting, and Spin-Glass–Percolation Predictions, The International Journal of Radiation Oncology, Biology, Physics, the Red Journal.
5. **Ramin Abolfath**, Fractal transport barriers govern immune-cell infiltration into heterogeneous solid tumors, Physical Biology.
6. **Ramin Abolfath**, Microscopic Particle Bunching and Collective Stopping in Proton FLASH Ultra-High Dose Rate Radiotherapy, Phys. Med. Biol.
7. Niayesh Afshordi, Martin Radler, Julie Lascaud, Reza Taleei, **Ramin Abolfath**, A sound-lensing hypothesis for differential tissue response in FLASH radiotherapy, Phys. Med. Biol.
8. P. Ballesteros-Zebadua, J. Jansen, V. Grilj, J. Franco-Perez, M-C. Vozenin, **Ramin Abolfath**, FLASH Radiotherapy is faster than a heartbeat: A model to illustrate the interplay between tissue oxygen perfusion and ultra-high dose rates, Medical Physics
9. **Ramin Abolfath**, Cloe Giguere, Uwe Titt, Luc Beaulieu, Sam Beddar, Scintillation Quenching in Conventional and Ultra-High Dose Rate Proton Beams: I. Theoretical Quantum Electrodynamics Model, Phys. Med. Biol.
10. Cloe Giguere, Nassim Tavakoli, Uwe Titt, Luc Beaulieu, Sam Beddar, **Ramin Abolfath**, Scintillation Quenching in Conventional and Ultra-High Dose Rate Proton Beams: II. Experimental Validation, Phys. Med. Biol.

Peer-Reviewed Publications and Book Chapters

11. N. Valizadeh, R. Rahimi, **Ramin Abolfath**, Fractal geometry-governed oxygen diffusion: Tumors vs. Normal Tissues, Phys. Med. Biol. 2026, DOI 10.1088/1361-6560/aeabe7
12. Reza Taleei, Dario Rodrigues, Arlene Oei, Sunil Krishnan, Khadijeh Koushki, **Ramin Abolfath**, Michael Weinfeld, Innovative Strategies to Enhance Radiosensitivity: Hyperthermia, Nanoparticles, and DNA Repair Inhibition, Chapter 4, p. 55–77, In: Taghizadeh-Hesary, F., Ashique, S., Mishra, N., Behnam, B. (eds) From Radiobiology to Radiation Oncology. Springer, Cham. 2026, https://doi.org/10.1007/978-3-031-95724-6_4
13. Sedigheh Fardirad, Abbas Ghasemizad, **Ramin Abolfath**, Dosimetry and Chemical Yield Analysis of Metal Nanoparticles in FLASH Radiotherapy: A Monte Carlo Study, Phys. Med. Biol. 2025; 70 (24), 245012. DOI 10.1088/1361-6560/ae281d
14. **Ramin Abolfath**, Sedigheh Fardirad, Houda Kacem, Marie-Catherine Vozenin, Abbas Ghasemizad, A Monte Carlo simulation framework for investigating the effect of intertrack coupling on H_2O_2 productions at ultra-high dose rates, Med. Phys. 2025; 52: e17972. https://doi.org/10.1002/mp.17972
15. Martin Radler, Niayesh Afshordi, Reza Taleei, Radhe Mohan, **Ramin Abolfath**, Julie Lascaud, A semiclassical description of the immediate temperature and pressure distribution surrounding the track of heavy ions with therapeutic energies, Phys. Med. Biol. 70 (2025) 115010. https://doi.org/10.1088/1361-6560/add83b
16. **Ramin Abolfath**, Niayesh Afshordi, Sohrab Rahvar, Adri van Duin, Martin Radler, Julie Lascaud, Reza Taleei, Katia Parodi, Radhe Mohan, A molecular dynamics simulation framework for investigating ionizing radiation-induced nano-bubble interactions at ultra-high dose rates, Eur. Phys. J. D 78:141 (2024). https://doi.org/10.1140/epjd/s10053-024-00928-1
17. Alexander Baikalov, **Ramin Abolfath**, Radhe Mohan, Emil Schuler, Jan Wilkens, Stefan Bartzsch, Intertrack interaction at ultra-high dose rates and its role in the FLASH effect, Front. Phys. 11:1215422 (2023). DOI: 10.3389/fphy.2023.1215422
18. **Ramin Abolfath**, Alexander Baikalov, Stefan Bartzsch, Emil Schuler, Radhe Mohan, A stochastic reaction-diffusion modeling investigation of FLASH ultra-high dose rate response in different tissues, Special issue on Multidisciplinary Approaches to the FLASH radiotherapy in Medical Physics Section of Frontier in Physics, 11:1060910 (2023). DOI 10.3389/fphy.2023.1060910
19. Santosh KC, **Ramin Abolfath**, Towards the Ionizing Radiation Induced Bond Dissociation Mechanism in Oxygen, Water, Guanine and DNA Fragmentation: A Density Functional Theory Simulation, Scientific Reports 12, 19853 (2022), https://doi.org/10.1038/s41598-022-23727-3
20. **Ramin Abolfath**, Mitra Khalili, Alireza G. Senejani, Balachandran Kodery, Robert Ivker, The Dependence of Compensation Dose on Systematic and Random Interruption Treatment Time in Radiation Therapy, Onco 2, 264-281 (2022). DOI: https://doi.org/10.3390/onco2030015
21. **Ramin Abolfath**, Alexander Baikalov, Stefan Bartzsch, Niayesh Afshordi, Radhe Mohan, The effect of non-ionizing excitations on the diffusion of ion species and intertrack correlations in FLASH ultra-high dose rate radiotherapy, available on arXiv: 2201.07887 Phys. Med. Biol. 67 105005 (2022). DOI: https://doi.org/10.1088/1361-6560/ac69a6
22. A. Baikalov, R. Abolfath, R. Mohan, D. Grosshans, J. Wilkens, S. Bartzsch, Modeling the effects of inter-spur

interactions at FLASH dose rates, Physica Medica 94:S77 (2022), DOI: 10.1016/S1120-1797(22)01607-6.

23. Huagang Yan, David J. Carlson, **Ramin Abolfath**, Wu Liu, Microdosimetric Investigation and a Novel Model of Radiosensitization in the Presence of Metallic Nanoparticles, Pharmaceutics, 13, 2191 (2021) https://doi.org/10.3390/pharmaceutics13122191
24. Alejandro Bertolet, **Ramin Abolfath**, David J. Carlson, Robert A. Lustig, Christine Hill-Kayser, Michelle Alonso-Basanta, Alejandro Carabe, Correlation of LET with MRI changes in brain and potential implications for normal tissue complication probability for meningioma patients treated with pencil beam scanning proton therapy, International Journal of Radiation Oncology, Biology, Physics (Red Journal), 112, pp. 237–246 (2022) https://doi.org/10.1016/j.ijrobp.2021.08.027.
25. **Ramin Abolfath**, David Grosshans, and Radhe Mohan, Oxygen depletion in FLASH ultra-high dose rates: A molecular dynamics simulation, Med. Phys. 47, 6551 (2020).
26. **Ramin Abolfath**, Yusuf Helo, David Carlson, Rob Stewart, David Grosshans, and Radhe Mohan, New Approach in Microdosimetry of Proton Beam, Med. Phys. Jul;47(7):3184–3190 (2020). DOI: 10.1002/mp.14165.
27. **Ramin Abolfath**, Chris Peeler, Dragan Mirkovic, David Grosshans, and Radhe Mohan, A DNA damage multi-scale model for NTCP in proton and hadron therapy, Med. Phys. Apr;47(4):2005-2012 (2020). DOI: 10.1002/mp.14034.
28. **Ramin Abolfath**, Yusuf Helo, Lawrence Bronk, Alejandro Carabe, David Grosshans, and Radhe Mohan, Renormalization of radiobiological response functions by energy loss fluctuations and complexities in chromosome aberration induction: from cell to tissue deactivation theory for proton therapy. Eur. J. Phys. D. 73, 64 (2019). DOI: 10.1140/epjd/e2019-90263-5 Selected as the Journal's Highlight: https://epjd.epj.org/epjd-news/1686-epjd-highlight-optimising-proton-beam-therapy-with-mathematical-models Highlighted in Europhys News: https://www.europhysicsnews.org/vol-50-no-3-highlights
29. **Ramin Abolfath**, Rob Stewart, Yusuf Helo, Alejandro Carabe, David Grosshans, and Radhe Mohan, New Approach in Microdosimetry of Proton Beam. Selected as SNAP Oral presentation in AAPM 2019, St. Antonio.
30. **Ramin Abolfath**, Chris R. Peeler, Mark Newpower, Lawrence Bronk, David Grosshans, and Radhe Mohan, A model for relative biological effectiveness of therapeutic proton beams based on a global fit of cell survival data, Sci. Rep. 7, 8340 (2017).
31. **Ramin M. Abolfath**, David Carlson, Zhe Chen, Ravinder Nath, A molecular dynamics simulation of DNA damage induction by ionizing radiation, Phys. Med. Biol. 58, 7143–7157 (2013).
32. **Ramin M. Abolfath**, Fanqing Guo, Zhe Chen, Ravinder Nath, First Principle Calculation of Quantum Yield in Photodynamic Therapy, Med. Phys. 41, 266 (2014).
33. Hassan Abbas, **Ramin M. Abolfath**, Zhe Chen, Ravinder Nath, Dosiemtric Impact of Patient Positioning Uncertainty in SBRT Treatments, Med. Phys. 41, 346 (2014).
34. **Ramin M. Abolfath**, Anna Trojnar, Bahman Roostaei, Thomas Brabec, Pawel Hawrylak, Dynamical magnetic and nuclear polarization in complex spin systems: semi-magnetic II–VI quantum dots, New J. Phys. 15, 063039 (2013).
35. **Ramin M. Abolfath**, Marek Korkusinski, Thomas Brabec, and Pawel Hawrylak, Spin Textures in Strongly Coupled Electron Spin and Magnetic or Nuclear Spin Systems in Quantum Dots, Phys. Rev. Lett. 108, 247203 (2012).
36. **Ramin M. Abolfath**, Adri van Duin, and Thomas Brabec, Reactive Molecular Dynamics study on the first steps of DNA-damage by free hydroxyl radicals, J. Phys. Chem. A 115, 11045 (2011). Animations and ppt presentations can be found at: http://qmsimulator.wordpress.com/
37. **Ramin M. Abolfath**, Optical control of DNA-base radio-sensitivity, J. Phys. Chem. B 113, 6938 (2009), preprint arXiv:0907.4721.
38. **Ramin M. Abolfath**, Thomas Brabec, Optical control of the initial OH radical induced DNA-backbone damage, Journal of Computational Chemistry 31, 2601 (2010).
39. **Ramin M. Abolfath**, Lech Papiez, Protection strategy of sensitive body organs in radiation therapy, Med. Phys. 36, 3013 (2009), preprint arXiv:0907.4943.
40. Lech Papiez, **Ramin M. Abolfath**, Variable Beam Dose Rate and DMLC-IMRT to moving body anatomy – algorithms and implications, Med. Phys. 35 4837 (2008).
41. R. M. Abolfath, L. Papiez, S. Stojadinovic, and T. Solberg, Optical Enhancement of DNA-Base Radio-Resistivity, Med. Phys. 36, 2634 (2009).
42. Michal Hammel, Yaping Yu, Brandi L. Mahaney, Brandon Cai, Ruiqiong Ye, Barry M. Phipps, Robert P. Rambo, Greg L. Hura, Martin Pelikan, Sairei So, **Ramin M. Abolfath**, David J. Chen, Susan P. Lees-Miller, and John A. Tainer, Ku and DNA dependent Protein Kinase Dynamic Conformations and Assembly Regulate DNA Binding and the Initial Non-homologous End Joining Complex, THE JOURNAL OF BIOLOGICAL CHEMISTRY,

VOL. 285, NO. 2, pp. 1414–1423 (2010).

43. **Ramin M. Abolfath** and Kyeongjae Cho, Computational studies for reduced graphene oxide in hydrogen-rich environment, J. Phys. Chem. A 116, 1820 (2012); MD movies: http://qmsimulatorGOJPC.wordpress.com/
44. Cheng Gong, Muge Acik, **Ramin M. Abolfath**, Yves Chabal, and Kyeongjae Cho, Graphitization of Graphene Oxide with Ethanol during Thermal Reduction, J. Phys. Chem. C. 116, 9969 (2012).
45. **Ramin M. Abolfath**; P. K. Biswas, R. Rajnarayanam, Thomas Brabec, Reinhard Kodym; Lech Papiez, Multi-scale QM/MM Molecular Dynamics Study on the First Steps of Guanine-Damage by Free Hydroxyl Radicals in Solution J. of Phys. Chem. A 116, 3940 (2012).
46. **Ramin M. Abolfath**, Thomas Brabec, Performance engineering of semiconductor spin qubit systems, Phys. Rev. B 82, 075311 (2010), preprint arXiv:1001.2313. Selected for the August 2010 issue of Virtual Journal of Quantum Information, and August 23, 2010 issue of Virtual Journal of Nanoscale Science and Technology.
47. **Ramin M. Abolfath**, Para-ortho transition of artificial H2 molecule in lateral quantum dots doped with magnetic impurities, Phys. Rev. B, 80, 165332 (2009); preprint arXiv:0907.4726.
48. **Ramin M. Abolfath**, Thomas Brabec, Pawel Hawrylak, Closed-Shell Semi-magnetic Quantum Dots, Phys. Rev. Lett. (in press).
49. **Ramin M. Abolfath**, Anna Trojnar, Bahman Roostaei, Thomas Brabec, Pawel Hawrylak, Dynamical Magnetic Polarization in Semi-magnetic II-VI Quantum Dots, submitted to Phys. Rev. B. arXiv:1202.5352
50. **Ramin M. Abolfath**, Chang-Yu Hsieh, Pawel Hawrylak, Performance engineering in semiconductor triple quantum dot spin coded-qubit systems, submitted to Phys. Rev. Lett.
51. **Ramin M. Abolfath**, Andre Petukhov, Igor Zutic, Piezomagnetic Quantum Dots, Phys. Rev. Lett. 101, 207202 (2008), arXiv:0707.2805.
52. R. Abolfath, R. Timmerman, T. Solberg, D. Saha, M. Story, P. Derose, and H. Hamidian, Computational Analysis of the Dose and Dose-Rate Dependence of DNA Double-Strand Break Repairs, Med. Phys. 35, 2818 (2008).
53. L. Papiez and R. Abolfath, Variable Beam Dose Rate and DMLC IMRT to Moving Body Anatomy, Med. Phys. 35, 2746 (2008).
54. R. Abolfath and L. Papiez, Genetic Optimizers and Control of DMLC IMRT Delivery to Moving Body Anatomy, Med. Phys. 35, 2750 (2008).
55. **Ramin M. Abolfath**, Pawel Hawrylak, and Igor Zutic, Tailoring Magnetism in Quantum Dots, Phys. Rev. Lett. 98, 207203 (2007), cond-mat/0612489.
56. **Ramin M. Abolfath**, and Pawel Hawrylak, Quantum Hall Ferrimagnetism in lateral quantum dot molecules, Phys. Rev. Lett. 97, 186802 (2006), cond-mat/0607638. Selected for the Nov. 31, 2006 issue of Virtual Journal of Nanoscale Science and Technology.
57. Carlos F. Destefani, Chris McDonald, **Ramin M. Abolfath**, Pawel Hawrylak, Thomas Brabec, Nonadiabatic coherent control of electron spin based coded qubit, Phys. Rev. B 78, 165331 (2008).
58. **Ramin M. Abolfath**, Pawel Hawrylak, and Igor Zutic, Electronic states of magnetic quantum dots, New Journal of Physics 9, 353 (2007); Part of Focus on Spintronics in Reduced Dimensions.
59. **Ramin M. Abolfath**, and Pawel Hawrylak, Spin transitions induced by a magnetic field in quantum dot molecules, Phys. Rev. B 77, 165430 (2008), cond-mat/0612529. Selected for the May 12, 2008 issue of Virtual Journal of Nanoscale Science and Technology.
60. **Ramin M. Abolfath**, and Pawel Hawrylak, Real Space Hartree-Fock Configuration Interaction Method For Complex Lateral Quantum Dot Molecules, J. Chem. Phys. 125, 034707 (2006), cond-mat/0511741. Selected for the July 31, 2006 issue of Virtual Journal of Nanoscale Science and Technology.
61. **Ramin M. Abolfath**, W. Dybalski, Pawel Hawrylak, Theory of a two-level artificial molecule in laterally coupled quantum Hall droplets, Phys. Rev. B 73, 075314 (2006),cond-mat/0509585.
62. **Ramin M. Abolfath**, Pawel Hawrylak, Michel Pioro-Ladriere, and Andy Sachrajda, Quantum Hall Droplets in Coupled Lateral Quantum Dots, Physica E 34, 636 (2006).
63. M. Pioro-Ladriere, A. S. Sachrajda, P. Hawrylak, R. Abolfath, J. Lapointe, P. Zawadzki, S. Studinikin, Quantum Molecule in Low Electron Limit, Physica E 34, 437 (2006).
64. M. Pioro-Ladriere, R. Abolfath, P. Zawadzki, J. Lapointe, S. Studinikin, A. S. Sachrajda, and P. Hawrylak, Charge Sensing of an Artificial H2 Molecule, Phys. Rev. B 72, 125307 (2005), cond-mat/0504009. Selected for the September 19, 2005 issue of Virtual Journal of Nanoscale Science and Technology.
65. Dimitri Antoniou, **Ramin Abolfath**, and Steven D. Schwartz, Transition Path Sampling Study of Classical Rate Promoting Vibrations, J. Chem. Phys. 121, 6442 (2004).
66. Alvaro S. Nunez, J. Fernndez-Rossier, M. Abolfath, and A. H. MacDonald, Optical Control of the Magnetization Damping in Ferromagnetic Semiconductors, J. Magn. Magn. Mater. 272, 1913 (2004).
67. M. Abolfath, R. Khomeriki, and K. Mullen, Theory of the tunneling resonances of the bilayer electron systems in

strong magnetic field, Phys. Rev. B 69, 165321 (2004), cond-mat/0208236.

68. J. Fernndez-Rossier, Alvaro S. Nunez, M. Abolfath, and A. H. MacDonald, Optical spin transfer in ferromagnetic semiconductors, cond-mat/0304492.
69. M. Abolfath, A. H. MacDonald, and Leo Radzihovsky, Microscopic theory of critical currents in quantum Hall superfluids, Phys. Rev. B 68, 155318 (2003), cond-mat/0305295.
70. T. Jungwirth, M. Abolfath, Jairo Sinova, J. Kucera, A.H. MacDonald, Boltzmann theory of engineered anisotropic magnetoresistance in (Ga,Mn)As, Appl. Phys. Lett. 81, 4029 (2002), cond-mat/0206416.
71. M. Abolfath, Leo Radzihovsky and A. H. MacDonald, Global Phase Diagram for Bilayer Quantum Hall Ferromagnets, Phys. Rev. B 65, 233306 (2002), cond-mat/0110049. Selected for the June 10, 2002 issue of Virtual Journal of Nanoscale Science and Technology.
72. R. Khomeriki, M. Abolfath, and K. Mullen, Solitons in Polarized Double-layer Quantum Hall Systems, Phys. Rev. B 65, R121310 (2002), cond-mat/0112177.
73. M. Abolfath and A. Langari, Quantum Ferrimagnets in Magnetic Field, Phys. Rev. B 63, 144414 (2001), cond-mat/0101194.
74. M. Abolfath, T. Jungwirth, and A.H. MacDonald, Mean-field Theory of Magnetic Properties of Mn(III)V Semiconductors, Physica E, 10, 161 (2001), cond-mat/0103341.
75. M. Abolfath, Kieran Mullen, and H.T.C. Stoof, Massive Skyrmions in Quantum Hall Ferromagnets, Phys. Rev. B 63, 075315 (2001), cond-mat/0005195.
76. M. Abolfath, T. Jungwirth, J. Brum, and A.H. MacDonald, Theory of Magnetic Anisotropy in (III,Mn)V Ferromagnets, Phys. Rev. B 63, 054418 (2001), cond-mat/0006093.
77. M. Abolfath, H. Hamidian, and A. Langari, Quantum Ferrimagnets, cond-mat/9901063.
78. M. Abolfath, Ramin Golestanian, and T. Jungwirth, Finite Temperature Behavior of the nu=1 Quantum Hall Effect in Bilayer Electron Systems, Phys. Rev. B 61, 4762 (2000), cond-mat/9906374.
79. A. Langari, M. Abolfath, and M. A. Martin-Delgado, Phase Diagram of Ferrimagnetic Ladders with Bond-alternation, Phys. Rev. B 61, 343 (2000), cond-mat/9910103.
80. M. Abolfath and M.R. Ejtehadi, Field Theory of the Skyrme Lattice in Quantum Hall Ferromagnets, Phys. Rev. B 58, 10665 (1998), cond-mat/9807236.
81. M. Abolfath, Quantum Fluctuations of Classical Skyrmions in Quantum Hall Ferromagnets, Phys. Rev. B 58, 2013 (1998), cond-mat/9712260.
82. M. Abolfath, J..J. Palacios, H.A. Fertig, S.M. Girvin, A.H. MacDonald, A Critical Comparison of Field Theory and Microscopic Wavefunctions for Skyrmions in Quantum Hall Ferromagnets, Phys. Rev. B 56, 6795 (1997), cond-mat/9705125.
83. M. Abolfath, L. Belkhir, and N. Nafari, Quantum Hall Effect in Single Wide Quantum Wells, Phys. Rev. B 55, 10643 (1997), cond-mat/9608072.

Honors and Awards

- Junior Associate, Abdus Salam International Centre for Theoretical Physics (ICTP), Trieste, Italy, 1998.
- French Government award for a visiting-scientist stay at Université Paul Sabatier, Toulouse, France, 1999.
- Travel award supporting one year of PhD research as an exchange student at Indiana University, 1995–1996.
- Travel award, Landau Institute, Chernogolovka, Russia, summer 1994.
- Travel award, ICTP, Trieste, Italy, 1993.
- Five national awards for first-place rankings in physics competitions during education in Iran, as listed in the source CV.

Teaching and Course Development

Howard University

- **Current teaching:** Radiation Dosimetry and Measurement; Health Physics and Protection; Radiobiology.
- **Courses under development:** Radiation Transport, Monte Carlo and Molecular Simulations; Optimization Techniques by Quantum Computing Algorithms; Neural Networks and Modeling Human Cognition.

Selected Prior Teaching

- Undergraduate Quantum Mechanics I–II, PHYS 4301–4302, The University of Texas at Dallas.
- Graduate Electrodynamics II, PHYS 5322, The University of Texas at Dallas.
- Graduate Quantum Mechanics I–II, PHYS 6300–6301, The University of Texas at Dallas.
- Graduate Many-Body Physics I–II, University of Ottawa.
- Calculus-based and algebra-based General Physics, Richland College.

- Fundamental Physics, Mathematical Physics, Thermodynamics, Classical Mechanics, Electromagnetism, Solid-State Physics, Many-Body Systems, and Statistical Physics at Sharif University of Technology and Tehran University.

Advising and Mentoring

- Sedigheh Fardirad – PhD student, U. Gellan, 2024–2025: H_2O_2 in FLASH and nanoparticles; completed PhD.
- Nassim Tavakili – Master's student, Columbia University, summer 2025: scintillation quenching in FLASH.
- Esha Sharma – Master's student, University of Connecticut, summer 2025: radiation-induced cognitive reduction.
- Rojan Paneru – Master's student, Howard University, summer 2025: neural-network and cognitive models.
- Neda Valizadeh – Postdoctoral researcher, Moghadas Ardebili University, 2025: fractal diffusion, tumors versus normal tissues, and FLASH radiotherapy.
- Hamed Farahani – PhD student, University of Cincinnati, summer 2025: quantum computing and optimization in radiotherapy.
- Babak Pornour Mehravani – PhD student, East Carolina University; co-PhD advisor.

Editorial, Professional, and University Service

- **Guest Editor**, *Cancers* (MDPI), Special Issue "Medical Physics in Oncology: Recent Progress," 2026.
  - Journal metrics listed in the source CV: 2025 Impact Factor 4.8; five-year Impact Factor 5.1; CiteScore 9.0; JCR Q2 in Oncology; CiteScore Q1 in Oncology and Cancer Research.
  - Special Issue scope includes radiotherapy physics, FLASH-UHDR, SFRT, particle therapy, Monte Carlo transport, micro-/nanodosimetry, image-guided/adaptive therapy, imaging and radiomics, AI/ML, quantum information/sensing/optimization, mathematical and multiscale modeling, tumor microenvironment and oxygenation, radiation–immune interactions, detector instrumentation, and physics-informed combined radio-, chemo-, and immuno-therapy.
- Howard University Physics Department seminars and colloquium activities.
- Howard University Physics Department amenities and awards activities.
- American Physical Society, GMED (Medical Physics), member at large.

Professional Memberships

- American Physical Society (APS).
- American Chemical Society (ACS).
- American Association of Physicists in Medicine (AAPM).
- Radiation Research Society.

Invited Talks and Presentations

- 6th Flash Radiotherapy and Particle Therapy Conference (FRPT 2026), 3–6 December 2026 in Lisbon, Portugal.
- 4th FLASH Workshop, July 1–3, 2026, Trento, Italy
- 5th Flash Radiotherapy and Particle Therapy Conference (FRPT 2025), 10–12 December 2025 in Prague, Czech Republic.
- 26th IUPAP Conference of Computational Physics, A Fractal Diffusion–Reaction Approach for Modeling Transport and Reactivity in Disordered and Biological Systems, Nov. 4, 2025
- Howard University Colloquium, Physics Department, Advances in micro- and nano-scale radiation interactions and dosimetry at FLASH-UHDR: challenges and opportunities, Oct 29, 2025
- University of Maryland, Dept. Radiation Oncology, Proton Center, Advances in micro- and nano-scale radiation interactions and dosimetry at FLASH-UHDR: challenges and opportunities, Oct 23, 2025, Baltimore, MD.
- Yale School of Medicine, Dept. Radiation Oncology, Advances in micro- and nano-scale radiation interactions and dosimetry at FLASH-UHDR: challenges and opportunities, Sept 16, 2025, New Haven, CT.
- National Institute of Standards & Technology (NIST), Advances in micro- and nano-scale radiation interactions and dosimetry at FLASH-UHDR: challenges and opportunities, Sept 3, 2025, Gaithersburg, MD.
- FLASH Workshop 2025 from July 1-3 2025, Heidelberg, the German Cancer Research Center (DKFZ).
- Workshop on Programmable Quantum Simulators based on 2D Materials (PQS2D) & Quantum Theory of Materials, Nanostructures and Devices (QTMND), FLASH Radiotherapy. June 18–20, 2025, the Fairmont Le Château Montebello, Canada
- Cancer Research: Howard University Guppy Talk Highlights Student and Early Faculty Projects, FLASH Radiotherapy, April 2025
- Howard University, DC, Multi-scale Modeling of FLASH radiotherapy (June 1, 2023).

- Waterloo University, Theoretical Modeling of FLASH-UHDR (March 23, 2023).
- Indiana University, FLASH Radiotherapy (June 15, 2022).
- New York Proton Center, A Multiscale Model for FLASH UHDR effects: Implementation of molecular dynamics with Monte Carlo track-structure (Feb. 15, 2021).
- Washington University, A Multiscale Model for FLASH UHDR effects: Implementation of molecular dynamics with Monte Carlo track-structure (Feb. 23, 2021).
- University of Delhi - Ramjas College, A Path to Computational Nanodosimetry in Radiation Physics (March 4, 2021).
- Technical University of Munich and the Helmholtz Centre Munich, Germany, A Multiscale Model for FLASH UHDR effects: Implementation of molecular dynamics with Monte Carlo track-structure (Dec. 15, 2020).
- U. Texas at Arlington, Physics Colloquium, Toward Modeling Biological Responses at FLASH Ultra-High-Dose Radio-Therapy (Oct. 14, 2020).
- St. Jude Research Children Hospital, Memphis, Multi-scale cell deactivation modeling in proton Therapy (07-05-2018).
- New England Chapter of AAPM, UMass Lowell, Radio biological modeling in particle therapy (11-2-2018).
- National Institute of Standard (NIST), Washington DC, Recent Topics in Proton Therapy (12-5-2017).
- University of Washington, Seattle, Biological Modeling of Particle Therapy (11-11-2016).
- Massachusetts general hospital (MGH) & Harvard Medical School: Towards First Principle Modeling of Biological Responses of Ionizing Radiation (05-27-2015).
- MD-Anderson: Towards First Principle Modeling of Biological Responses of Ionizing Radiation (06-02-2015).
- University of Houston: Biological Responses of Therapeutic Ionizing Radiation (02-12-2016).
- University of Texas Southwestern Medical Center (UTSW): Biological Responses of Therapeutic Ionizing Radiation (11-09-2015).
- University of Texas at Austin – physics colloquium: Biological Responses of Therapeutic Ionizing Radiation (10-14-2015).
- New England Chapter of AAPM (EAAPM) Young Investigators' Symposium at Dana-Farber Cancer Institute, Harvard Medical School, Boston, MA (04-24-2015).
- British Columbia Cancer Agency and University of Victoria, Canada: Towards First Principle Modeling of Biological Responses of Ionizing Radiation (03-31-2015).
- New England Chapter of AAPM (EAAPM) Young Investigators' Symposium at Dana-Farber Cancer Institute, Harvard Medical School, Boston, MA (05-02-2014).
- Yale Radiation Oncology seminars at Smilow Cancer Hospital: Radiation Measurements for Radiation Therapy (11-11-2013).
- Yale Radiobiology & Radiotherapy seminars: Biophysical Modeling and Computational Approaches in Simulation of DNA Damage-Repair Mechanism, (10-09-2013).
- Molecular Modeling of Radiation interaction with biological systems: Radio-biological effects and DNA damage by ionizing radiation, Dept. Phys., Sothern Connecticut State University, New Haven (April, 2013).
- Molecular Modeling of Radiation interaction with biological systems: Radio-biological effects and DNA damage by ionizing radiation, Dept. Radiation Oncology, Yale University, New Haven (March 2, 2012).
- Molecular Simulations of Chemical Reactions, Young State University, Ohio (April 2012).
- Molecular simulations of radio-biological effects: DNA damage by ionizing radiation, Center for Mathematical Medicine, Fields Institute, U. Toronto (Dec. 2011).
- Computational modeling of magnetic materials, GE corporation (Sept. 2011).
- Computational modeling of DNA-damage and spin control of radio-sensitivity, San Diego State University (May 2011).
- Magnetic Quantum Dots, University of Texas at Dallas (Feb. 2009).
- Application of computer simulation and optimizing treatment planning in radiation oncology, University of Texas at Dallas (April 2008).
- Piezomagnetic Quantum Dots, Jackson State University, Jackson (June 2007).
- Correlations in coupled quantum dots, University of Ottawa, Ottawa (Feb. 2006).
- Theory of Artificial Molecules in Laterally Coupled Quantum Hall Droplets, Cornell University, Ithaca (Nov. 2005).
- Real Space Hartree-Fock Configuration Interaction Method For Complex Lateral Quantum Dot Molecules, Purdue University, West Lafayette, Indiana (Nov. 2005).
- Real Space Hartree-Fock Configuration Interaction Method For Complex Lateral Quantum Dot Molecules, State University of New York at Buffalo, Buffalo, New York (Nov. 2005).

- Correlated Electrons in Quantum Hall Bilayers and Quantum Dot Molecules, Queens University, Kingston (Oct. 2005).
- Quantum Dot Molecules, Ottawa University, Ottawa (Dec. 2005).
- Understanding Transition Path Sampling, Columbia University, New York (Sept. 2003).
- Recent Developments in Transition Path Sampling, and Optical Spin Transfer in Ferromagnetic Semiconductors, NEC, Princeton (Sept. 2003).
- Ferromagnetic Semiconductors, Rice University, Houston (April 2003).
- Anisotropic Magnetoresistance in (III,Mn)V Ferromagnets, University of Arkansas, Fayetteville (March 2001).
- Skyrmions: Topological Order in Quantum Hall Ferromagnets, Washington University, St. Louis (Nov. 2000).
- Finite Temperature Behavior of the nu=1 Quantum Hall Effect in Bilayer Electron Systems, The University of Oklahoma, Norman (June 1999).

Clinical Medical Physics Experience

Quality assurance and dosimetry:

- Patient-specific IMRT/VMAT (RapidArc) QA using film/ion chamber measurements, portal dosimetry, MapCHECK, ArcCHECK, and Delta4.
- In-vivo dosimetry for TBI and other clinical cases using diode detectors, OSLDs, and TLDs.
- Daily, monthly, and annual therapy-equipment QA under AAPM TG-142; X-ray/electron calibration under AAPM TG-51.
- CT simulator QA and HDR brachytherapy QA.

Treatment planning and clinical systems:

- 3DCRT, IMRT, RapidArc/VMAT, SRS/SBRT, iPlan, and brachytherapy.
- Treatment-planning systems: Eclipse, ADAC Pinnacle, iPlan (Brainlab), and BrachyVision.
- Record-and-verify systems: MOSAIQ and ARIA.

Commissioning and special procedures:

- End-to-end acceptance testing and commissioning of linear accelerators.
- Commissioning of a Varian Trilogy machine (Jan.–Feb. 2013) and Varian Miami applicator set for HDR.
- Experience with SRS/SBRT, Gamma Knife, TBI, TSET, and HDR (GammaMed/Nucletron; machine QA, Oncentra planning, and source changes).

Technical and Computational Expertise

- **Machine learning / AI:** deep learning, convolutional neural networks, U-Net methods, radiomics, 2D/3D medical-image classification, and DICOM imaging workflows.
- **Statistics and stochastic modeling:** stochastic processes, Monte Carlo simulation, Markov chains, Bayesian inference, multivariate nonlinear regression, and biostatistics.
- **Optimization and mathematical modeling:** conjugate-gradient methods, simulated annealing, genetic algorithms, decision trees, percolation, random graphs/networks, fractal geometry, finite differences, and finite elements.
- **Radiation and molecular simulation:** Geant4, Geant4-DNA, MCNP, TOPAS, micro-/nanodosimetry, MKM, MCDS-RMF, large-scale and ab-initio molecular dynamics, chemical reactions, and protein-folding simulations.
- **Programming:** Python, R, SQL, C/C++/C#, Java, Fortran, MATLAB, SAS, shell scripting, OpenMP/MPI, Windows, and Linux.
- **Clinical/data systems:** DICOM analysis and fusion, PET/CT/MRI quality control, Eclipse, Varian technologies, Origin, and Microsoft Office.