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Chiara P. Salemi

Research Interests

Experimental searches for **axion dark matter** using **quantum sensors**

Education

Massachusetts Institute of Technology
Ph.D., Department of Physics — *2022*

University of North Carolina Chapel Hill
B.S. Physics and Mathematics, Highest Honors, Highest Distinction — *2017*

Awards and Honors

Rising Stars in Physics
Workshop for outstanding young women physicists — *2023*

Martin and Beate Block Winter Award
For outstanding achievements by a promising young physicist, Aspen Center for Physics — *2023*

Porat Fellow
Kavli Institute for Particle Astrophysics and Cosmology (KIPAC), Stanford/SLAC — *2022*

Dr. Pliny A. and Margaret H. Price Prize
Ohio State University CCAPP — *2020*

NSF Graduate Research Fellow
2018–2021

MIT Presidential Fellow
2017–2018

Paul E. Shearin Outstanding Senior Award in Physics
UNC Chancellor's Award — *2017*

Senior Thesis Highest Honors
Magnet Simulations for ABRACADABRA — *2017*

Phi Beta Kappa
2016

Daniel C. Johnson Award
Award for outstanding junior in the UNC Physics and Astronomy Department — *2016*

Goldwater Scholar
National scholarship for students pursuing research careers in STEM — *2016*

Honors Carolina
2013–2017

Appointments

Postdoctoral fellow, axion dark matter and quantum sensing
KIPAC, Stanford University and SLAC — *2022–present*

Graduate researcher, axion dark matter
Winslow group, Laboratory for Nuclear Science, MIT — *2017–2022*

Undergraduate researcher, particle astrophysics
Henning group, UNC Chapel Hill — *2013–2017*

Undergraduate research intern, ADMX
Fermi National Accelerator Laboratory (Fermilab) *Summer 2016*

Undergraduate research intern, ATLAS
Organisation Européenne pour la Recherche Nucléaire (CERN) *Fall 2015*

Undergraduate research intern, MAJORANA Demonstrator
Lawrence Berkeley National Laboratory (LBNL) *Summer 2015*

Undergraduate researcher, radio astronomy
Reichart group, UNC Chapel Hill *2014–2015*

Research and Scientific Collaborations

DMRadio *2019-present*
- Leading calibration team
- Developing SQUID amplifier chain for m^3 experiment
- Optimized 50 L (1st generation) dark matter coupling
- Worked on alternatives analysis for m^3 detector geometry
- Led the proposal for a definitive, large-scale experiment for GUT-scale QCD axions

BREAD *2023-present*
- Developing qubit-based THz photon sensors
- Leading calculations and simulations for BREAD THz sensitivity determination

ABRACADABRA-10 cm *2016-present*
- Designed, constructed, and ran the experiment
- Wrote data processing software to FFT long time series datasets
- Led the upgrades for runs 2 and 3
- Led the run 2/3 data calibration and contributed to data analysis

ADMX-VERA *2023*
- Advising on the cryomechanical design of the cold experiment

ADMX *Summer 2016*
- Ran electromagnetic field simulations for multi-cavity designs
- Simulated and tested coplanar waveguide resonators to develop nonlinear dieletric tuning

ATLAS *Fall 2015*
- Analyzed the Higgs diphoton decay channel

MAJORANA Demonstrator *2014-2016*
- Designed and tested low-background front-end amplifiers
- Analyzed data to measure cosmogenic activation of tritium in germanium

Skynet Robotic Telescope Network and Green Bank Observatory *2014-2015*
- Wrote software for radio telescope mapping and statistical analyses

CALIOPE *2014-2015*
- Ran Geant4 Monte Carlo detector simulations for tests of CP and CPT violation

Publications

[14] S. Knirck et al. "First Results from a Broadband Search for Dark Photon Dark Matter in the 44 to 52μeV Range with a Coaxial Dish Antenna". In: *Phys. Rev. Lett.* 132 (13 Mar. 2024), p. 131004. DOI: 10.1103/PhysRevLett.132.131004. URL: https://link.aps.org/doi/10.1103/PhysRevLett.132.131004.

[13] C. Boutan et al. "Axions beyond Gen 2". In: *International Journal of Modern Physics A* 38.33n34 (2023), p. 2330012. DOI: 10.1142/S0217751X23300120. eprint: https://doi.org/10.1142/S0217751X23300120. URL: https://doi.org/10.1142/S0217751X23300120.

[12] ***** C. W. Fink et al. *The Superconducting Quasiparticle-Amplifying Transmon: A Qubit-Based Sensor for meV Scale Phonons and Single THz Photons*. 2023. arXiv: 2310.01345 [physics.ins-det].

[11] J. N. Benabou et al. "Lumped-element axion dark matter detection beyond the magnetoquasistatic limit". In: *Phys. Rev. D* 108 (3 Aug. 2023), p. 035009. DOI: 10.1103/PhysRevD.108.035009. URL: https://link.aps.org/doi/10.1103/PhysRevD.108.035009.

[10] A. AlShirawi et al. *Electromagnetic modeling and science reach of DMRadio-m^3*. 2023. DOI: 10.48550/ARXIV.2302.14084. URL: https://arxiv.org/abs/2302.14084.

[9] ***** L. Brouwer et al. "Proposal for a definitive search for GUT-scale QCD axions". In: *Phys. Rev. D* 106 (11 Dec. 2022), p. 112003. DOI: 10.1103/PhysRevD.106.112003. URL: https://link.aps.org/doi/10.1103/PhysRevD.106.112003.

[8] L. Brouwer et al. "Projected sensitivity of DMRadio-m^3: A search for the QCD axion below 1μeV". In: *Phys. Rev. D* 106 (10 Nov. 2022), p. 103008. DOI: 10.1103/PhysRevD.106.103008. URL: https://link.aps.org/doi/10.1103/PhysRevD.106.103008.

[7] C. B. Adams et al. *Axion Dark Matter* (*Snowmass 2021 White Paper*). 2023. arXiv: 2203.14923 [hep-ex].

[6] ***** C. P. Salemi et al. "Search for Low-Mass Axion Dark Matter with ABRACADABRA-10 cm". In: *Phys. Rev. Lett.* 127 (8 Aug. 2021), p. 081801. DOI: 10.1103/PhysRevLett.127.081801. URL: https://link.aps.org/doi/10.1103/PhysRevLett.127.081801.

[5] ***** C. P. Salemi. "First Results from ABRACADABRA-10 cm: A Search for Low-Mass Axion Dark Matter". In: *Proceedings of the 54th Rencontres de Moriond: Electroweak Interactions and Unified Theories*. Ed. by Étienne Augé, Jacques Dumarchez, and Jean Trân Thanh Vân. ARISF, 2019, pp. 229–234.

[4] J. L. Ouellet et al. "First Results from ABRACADABRA-10 cm: A Search for Sub-μeV Axion Dark Matter". In: *Phys. Rev. Lett.* 122 (12 Mar. 2019), p. 121802. DOI: 10.1103/PhysRevLett.122.121802. URL: https://link.aps.org/doi/10.1103/PhysRevLett.122.121802.

[3] J. L. Ouellet et al. "Design and implementation of the ABRACADABRA-10 cm axion dark matter search". In: *Phys. Rev. D* 99 (5 Mar. 2019), p. 052012. DOI: 10.1103/PhysRevD.99.052012. URL: https://link.aps.org/doi/10.1103/PhysRevD.99.052012.

[2] J. R. Martin et al. "Skynet Algorithm for Single-dish Radio Mapping. I. Contaminant-cleaning, Mapping, and Photometering Small-scale Structures". In: *The Astrophysical Journal Supplement Series* 240.1 (Jan. 2019), p. 12. DOI: 10.3847/1538-4365/aad7c1. URL: https://doi.org/10.3847%2F1538-4365%2Faad7c1.

[1] M. P. Maples et al. "Robust Chauvenet Outlier Rejection". In: *The Astrophysical Journal Supplement Series* 238.1 (Aug. 2018), p. 2. DOI: 10.3847/1538-4365/aad23d. URL: https://doi.org/10.3847%2F1538-4365%2Faad23d.

***** paper for which I am a corresponding author

Invited Talks

Santa Clara University (colloquium) — **Santa Clara, CA**
Seeing the Invisible: The Search for Low-Mass Axion Dark Matter with DMRadio — *May 2024*

Physics Colloquium

KIPAC, Stanford University **Stanford, CA**
Searching for axion dark matter with qubit-based sensors *Mar 2024*
KIPAC Tea

Texas A&M (seminar) **College Station, TX**
Seeing the Invisible: The Search for Low-Mass Axion Dark Matter *Nov 2023*
HEPEC Seminar

Caltech (seminar) **Pasadena, CA**
Qubit-based sensing for axion dark matter *Oct 2023*
HEP Seminar

IBS/CAPP (seminar) **Daejeon, South Korea**
DMRadio: Searching for Low-Mass Axion Dark Matter *July 2023*
Center for Axion and Precision Physics Research

Fermilab (seminar) **Batavia, IL**
Seeing the Invisible: The Search for Low-Mass Axion Dark Matter *May 2023*
Cosmic Physics Center Seminar

Prospecting for New Physics through Flavor, Dark Matter, and Machine Learning **Aspen, CO**
Seeing the Invisible: The Search for Low-Mass Axion Dark Matter *Mar 2023*
Aspen Center for Physics Conference

King's College London (seminar) **Virtual**
Seeing the Invisible: The Search for Low-Mass Axion Dark Matter *Dec 2022*
EPAP Seminar

FISICA Workshop **Virtual**
Lumped element detection for low-mass axions: ABRACADABRA and DMRadio *Mar 2022*

Lawrence Berkeley National Laboratory (seminar) **Virtual**
Seeing the Invisible: The Search for Low-Mass Axion Dark Matter *Dec 2021*
Institute for Nuclear and Particle Astrophysics Seminar

Kavli Institute for Particle Astrophysics and Cosmology, Stanford **Virtual**
Seeing the Invisible: The Search for Low-Mass Axion Dark Matter *Dec 2021*
KIPAC Tea

Yale (seminar) **Virtual**
Seeing the Invisible: The Search for Low-Mass Axion Dark Matter *Dec 2021*
Mossman Seminar

Laboratory for Nuclear Science, MIT (seminar) **Cambridge, MA**
Seeing the Invisible: The Search for Low-Mass Axion Dark Matter *Nov 2021*
Lunchtime Seminar

Johns Hopkins University (seminar) **Virtual**
Seeing the Invisible: The Search for Low-Mass Axion Dark Matter *May 2021*
Experimental HEP Seminar

Rutgers University (seminar) **Virtual**
Seeing the Invisible: The Search for Low-Mass Axion Dark Matter *Apr 2021*
High Energy Experiment Seminar

Project 8 collaboration meeting (seminar) **Virtual**
The Search for Low-Mass Axion Dark Matter *Mar 2021*
External Speaker

CENPA, University of Washington (mini-seminar) **Virtual**
Seeing the Invisible: The Search for Low-Mass Axion Dark Matter *Mar 2021*

CENPA Monday Meeting

Axions Beyond Gen 2 Workshop **Virtual**
Lumped Element Searches for Low-Mass Axion Dark Matter *Jan 2021*

Boston University (seminar) **Virtual**
The Search for Low-Mass Axion Dark Matter *Dec 2020*
Student Seminar

University of Illinois Urbana-Champaign (seminar) **Virtual**
The Search for Low-Mass Axion Dark Matter *Nov 2020*
HEP/MEP Seminar

CCAPP, Ohio State University (seminar) **Virtual**
The Search for Low-Mass Axion Dark Matter *Sep 2020*
Price Prize Seminar

Rencontres de Moriond **La Thuile, Italy**
First Results from ABRACADABRA-10 cm *Mar 2019*

Purdue University (seminar) **West Lafayette, IN**
First Results from ABRACADABRA-10 cm *Nov 2018*
Particle Physics Seminar

Wright Laboratory, Yale (seminar) **New Haven, CT**
ABRACADABRA: A Search for Low-Mass Axion Dark Matter *May 2018*
Weak Interactions Discussion Group Seminar

Other Talks

Topics in Astroparticle and Underground Physics (TAUP) **Vienna, Austria**
The Search for Low-Mass Axion Dark Matter with DMRadio *Aug 2023*

Rising Stars in Physics Workshop **Berkeley, CA**
Seeing the Invisible: the Search for Axion Dark Matter *May 2023*

APS April Meeting **Virtual**
Recent results from the ABRACADABRA-10 cm search for low-mass axion dark matter *Apr 2021*

Laboratory for Nuclear Science, MIT (seminar) **Virtual**
Axion Cosmology *Apr 2020*
Student Lunch Seminar

APS Division of Particles and Fields Meeting **Boston, MA**
The Search for Low-Mass Axions with ABRACADABRA-10 cm: Preparations for Run 2 *July 2019*

APS April Meeting **Denver, CO**
COMSOL Simulations for ABRACADABRA *Apr 2019*

Laboratory for Nuclear Science, MIT (seminar) **Cambridge, MA**
ABRACADABRA: A Search for Low-Mass Axion Dark Matter *Apr 2018*
Student Lunch Seminar

Posters

Low-Temperature Detectors (LTD20) Conference **Daejeon, South Korea**
Qubit-Based Sensing of THz Photons and Phonons for Dark Matter Detection *July 2023*

Quantum Information and Systems for Fundamental Physics Conference **Aspen, CO**
ABRACADABRA: Searching for Low-Mass Axion Dark Matter *Feb 2020*

Dept of Physics, MIT **Cambridge, MA**
First Results from ABRACADABRA-10 cm, A Search for Low-Mass Axion Dark Matter *Apr 2018*
Won second prize at open house poster session

UCLA Dark Matter **Los Angeles, CA**
ABRACADABRA: A Search for Low-Mass Axion Dark Matter *Feb 2018*

Division of Nuclear Physics (DNP) Fall Meeting **Vancouver, Canada**
Microwave cavity tuning with nonlinear dielectric films for axion searches *Oct 2016*
Awarded funding by the Conference Experience for Undergraduates (CEU)

38th International Conference on High Energy Physics (ICHEP) **Chicago, IL**
Tuning microwave cavities with biased nonlinear dielectrics for axion searches *Aug 2016*

Division of Nuclear Physics (DNP) Annual Fall Meeting **Santa Fe, NM**
Testing new designs for the Majorana Demonstrator's low-mass front-end board *Oct 2015*
Awarded maximum funding by the Conference Experience for Undergraduates (CEU)

Teaching

Lecturer, one class
Stanford Physics 59 *Fall 2023*

Teaching Assistant
MIT graduate particle physics, 8.811 *Fall 2019, 2020, 2021*

Physics and math tutor
UNC Physics Tutorial Center *Spring 2016*

Service and Outreach

Journal Referee
Physical Review D, Nature Communications

Talks to AP Physics students: Shining Light on Dark Matter
San Mateo High School *May 2024*

Cosmology and dark matter lecture
SPINWIP program for high school girls, KIPAC, Stanford University *July 2023*

Public lecture–Shining light on dark matter
KIPAC Community Day, Stanford University *April 2023*

Booth volunteer (WIMP dark matter)
KIPAC Community Day, Stanford University *April 2023*

Faculty hiring pre-search committee member
MIT Laboratory for Nuclear Science *Spring & Fall 2021*

Application reviewer for MIT Summer Research Program (MSRP)
MIT *2021*
University-wide internship program for under-represented minority undergraduates

Mentor in Undergraduate Mentoring Program
MIT Physics Department *Fall 2020*

Mentor in Graduate Student Buddy Program
MIT Physics Department *2018–2020*

Founded and organized neutrinos and dark matter journal club
MIT Laboratory for Nuclear Science *2018–2020*

Mentor in Graduate/Undergraduate Women in Physics Buddy Program
MIT Physics Department *Fall 2019*

Girl's Day activity leader
MIT Museum *2017*

On-campus outreach director
Carolina Women in Physics (WiP) *2016-2017*

Tour co-leader for two elementary school programs
Morehead Observatory, UNC *2016*