September 2023

Nicholas M. Rapidis

Curriculum Vitae

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Education

2019-present **Stanford University**
Ph.D. Candidate in Physics
Advisor: *Prof. Kent Irwin*
M.S. in Physics completed in July 2022

2015-2019 **University of California, Berkeley**
B.A. in Physics. Graduated with High Distinction in General Scholarship and Departmental Honors
Thesis Title: *Resonant Axion-Photon Scattering and Galactic Searches for Axions*
Advisor: *Prof. Karl van Bibber*

Research Experience

2020-present **Graduate Research Assistant**, Stanford University
Advisor: *Prof. Kent Irwin*

Member of the Dark Matter Radio (DMRadio) collaboration, a series of experiments searching for ultra-light axions, with sensitivity to QCD axions in the 10–200 MHz (41 neV–0.83 μeV) range. Responsibilities include leading the electromagnetic modeling and design of DMRadio-m^3 as well as carrying out first experimental tests for DMRadio-50L and contributing to construction of the experiment.

Formerly in charge of cryogenic testing of Superconducting Quantum Interference Devices (SQUIDs) for cosmology projects, such as the BICEP Array.

2019-2020 **Graduate Research Assistant**, Stanford Institute for Theoretical Physics
Advisor: *Prof. Savas Dimopoulos*

Studied the physics and phenomenology of dense dark matter axion clumps (oscillons) in the context of oscillon-neutron star collisions. Using current sensitivity of radio telescopes, set limits on the abundance of oscillons in galactic dark matter halos in terms of the axion mass and symmetry breaking scale.

2016-2019 **Undergraduate Research Assistant**, UC Berkeley

Advisor: *Prof. Karl van Bibber*

Member of the *Haloscope at Yale Sensitive to Axion Cold Dark Matter (HAYSTAC)* collaboration. HAYSTAC is an experiment designed to search for μeV mass axions. Designed and refurbished microwave cavities used in experimental runs. Co-lead on refurbishment and optimization for cavity used in first fundamental physics result to evade the standard quantum limit. Introduced extensive use of finite element simulation techniques for characterization of axion haloscopes.

Teaching Experience

2021-2022 **Mentor**, Polygence

One-on-one mentoring of high school students on research projects in their pre-collegiate schooling. Projects topics in dark matter physics and cosmology.

Head Teaching Assistant, Stanford University

Spr. 2022 Physics 25 – Modern Physics (Instructor: Kent Irwin).

Teaching Assistant, Stanford University

Fall 2020 Physics 46 – Heat and Optics (Instructor: Giorgio Gratta).

Spr. 2020 Physics 43 – Electricity and Magnetism (Instructor: Mark Kasevich).

Sum. 2017 **Reader (Grader)**, UC Berkeley

Physics 137A – Quantum Mechanics I

Honors & Awards

2022 *Young Scientist Award* at *Identification of Dark Matter 2022*: One of best three talks (out of 90) given by graduate students and postdocs at the conference.

2019 Member of ΦBK

2018-2019 *Haas Scholar*: Received $13,800 grant awarded to twenty UC Berkeley undergraduates across all disciplines to conduct research in their senior year.

2017-2018 *Berkeley Physics Undergraduate Research Scholar*

2016-2019 UC Berkeley *Dean's List*

Professional Activities

2023- Journal Referee for *Physical Review Letters*

Publications & Talks

Journal Articles

[INSPIRE PROFILE] [GOOGLE SCHOLAR PROFILE]

* (**) indicates principal (equal contribution principal) author paper

[14] **Measurements of DC SQUID Damping Effects on Superconducting Resonant Circuits**
E. C. van Assendelft *et al.* *IEEE Transactions on Applied Superconductivity* **33**, 5, (2023)

[13]* **Electromagnetic modeling and science reach of DMRadio-m^3**
A. AlShirawi *et al.* [arXiv:2302.14084][INSPIRE]

[12] **New Results from HAYSTAC's Phase II Operation with a Squeezed State Receiver**
M.J. Jewell *et al.* *Phys. Rev. D* **107**, 072007, (2023) [arXiv:2301.09721][INSPIRE]

[11] **Quantum metrology of low frequency electromagnetic modes with frequency upconverters**
S.E. Kuenstner *et al.* [arXiv:2210.05576][INSPIRE]

[10] **DMRadio-m^3: A Search for the QCD Axion Below 1 μeV**
L. Brouwer *et al.* *Phys. Rev. D* **106**, 103008, (2022) [arXiv:2204.13781][INSPIRE]

[9] **Introducing DMRadio-GUT, a search for GUT-scale QCD axions**
L. Brouwer *et al.* *Phys. Rev. D* **106**, 112003, (2022) [arXiv:2203.11246][INSPIRE]

[8] **A Model-Independent Radio Telescope Dark Matter Search**
A. Keller, *et al.* *Astrophys. J.* **927** (2022) 1, 71. [arXiv:2112.03439][INSPIRE]

[7] **A quantum-enhanced search for dark matter axions**
K.M. Backes *et al.* *Nature* **590**, 238-242 (2021) [arXiv:2008.01853][INSPIRE]

[6]** **Resonant Conversion of Dark Matter Oscillons in Pulsar Magnetospheres**
A. Prabhu and N.M. Rapidis, *JCAP* **10**, (2020) 054 [arXiv:2005.03700][INSPIRE].

[5] **An improved analysis framework for axion dark matter searches**
D.A. Palken *et al.* *Phys. Rev. D* **101**, 123011, (2020) [arXiv:2003.08510][INSPIRE].

[4]* **Characterization of the HAYSTAC axion dark matter search cavity using microwave measurement and simulation techniques**
N.M. Rapidis *et al.* *Review of Scientific Instruments* **90**, 024706 (2019) [arXiv:1809.02246][INSPIRE].

[3] **Results from Phase 1 of the HAYSTAC microwave cavity axion experiment**
L. Zhong *et al.* *Phys. Rev. D* **97**, 092001, (2018) [arXiv:1803.03690][INSPIRE].

[2] **Design and Operational Experience of a Microwave Cavity Axion Detector for the 20-100 μeV Range**
S. Al Kenany *et al.* *Nuclear Instruments and Methods in Physics Research A* **854** (2017) 11–24. [arXiv:1611.07123] [INSPIRE].

[1] **First Results from a Microwave Cavity Axion Search at 24 μeV**
B.M. Brubaker *et al.* *Phys. Rev. Lett.* **118**, 061302 (2017) [arXiv:1610.02580][INSPIRE].

Talks

* indicates invited talk

[8] **Science reach and electromagnetic modeling of DMRadio-m^3**
Topics in Astroparticle and Underground Physics, Aug 28-Sep 1, 2023, Vienna, Austria

[7]* **Status of the DMRadio Program**
YOUNGST@RS - Shoot for the Stars, Aim for the Axions, October 4-7, 2022, Virtual.

[6] **Status of DMRadio 50L and m^3**
Identification of Dark Matter, July 18-22, 2022, Vienna, Austria

[5] **Modeling and optimizing DMRadio using an equivalent circuit formalism**
APS April Meeting 2021, April 17-20, 2021, Virtual

[4] **Electromagnetic sensing below the Standard Quantum Limit: 3 kHz to 300 MHz**
APS March Meeting 2021, March 15-19, 2021, Virtual

[3] **Characterization of the HAYSTAC dark matter detector cavity: microwave measurement and simulation**
APS April Meeting 2019, April 13-16, 2019, Denver, CO

[2] **Completion of Phase I and Preparation for Phase II of the HAYSTAC Experiment**
14th Patras Workshop on Axions, WIMPs, and WISPs, June 18-22, 2018, DESY, Hamburg, Germany

[1] **Application of the Bead Perturbation Technique to a Study of a Tunable 5 GHz Annular Cavity**
2nd Workshop on Microwave Cavities and Detectors for Axion Research, January 10-13, 2017, LLNL, Livermore, CA

Conference Proceedings

[9] **Status of DMRadio-50L and DMRadio-m^3**
N. M. Rapidis. Contributed to *Identification of Dark Matter 2022*. *SciPost Phys. Proc. 12, 036 (2023)* [arXiv:2210.07215][INSPIRE]

[8] **Axion Dark Matter**
C.B. Adams, *et al.*, *Snowmass 2021 – Whitepaper* [arXiv:2203.14923][INSPIRE]

[7] **New Horizons: Scalar and Vector Ultralight Dark Matter**
D. Antypas, *et al.*, *Snowmass 2021 – Whitepaper* [arXiv:2203.14915][INSPIRE]

[6] **A Model-Independent Radio Telescope Dark Matter Search**
A. Keller, S. O'Brien, A. Kamdar, N.M. Rapidis, A.F. Leder, K. van Bibber. Contributed to TAUP-2021. *J. Phys.: Conf. Ser.* **2156** 012026 [INSPIRE]

[5] **Probing the QCD Axion with DMRadio-m^3**
J.L. Ouellet *et al.* *Snowmass2021 – Letter of Interest*

[4] **DMRadio-GUT: Probing GUT-scale QCD Axion Dark Matter**
S. Chaudhuri *et al.* *Snowmass2021 – Letter of Interest*

[3] **HAYSTAC – Pioneering the Quantum Frontier**
S. Al Kenany *et al.* *Snowmass2021 – Letter of Interest*

[2] **Completion of Phase I and Preparation for Phase II of the HAYSTAC Experiment**
N.M. Rapidis, Contributed to the 14th Patras Workshop on Axions, WIMPs and WISPs, DESY in Hamburg, June 18 to 22, 2018. [arXiv:1809.05913][INSPIRE]

[1] **Application of the Bead Perturbation Technique to a Study of a Tuneable 5 GHz Annular Cavity**
N.M. Rapidis (2018), In: Carosi G., Rybka G., van Bibber K. (eds) Microwave Cavities and Detectors for Axion Research. *Springer Proceedings in Physics*, vol 211. Springer, Cham [arXiv:1708.04276] [INSPIRE].

Skills

Programming & Software

Languages:*Mathematica, Python, Matlab, LabVIEW*
Software: *COMSOL (AC/DC, RF, Heat Transfer), Fusion 360, CST Microwave Studio, KiCad*
Other: LaTeX, HTML

Languages

English (native), Greek (native), German (advanced proficiency)

Experimental Tools

Operating and calibrating electromagnetic devices using network analyzers and lock-in amplifiers, dips in liquid cryogens, operating dilution refrigerators, testing of quantum devices (e.g. SQUIDs), basic machine shop skills (operating mills, lathes, and drill presses for work on metallic parts)