

Nicholas M. Rapidis

Curriculum Vitae

Email: rapidis@stanford.edu
Website: nicholas-rapidis.github.io

Phone: +1 (510) 847-1414
Nationalities: USA & EU (Greek)

Education

- 2019-present **Stanford University**
Ph.D. in Physics
Member of the *DMRadio* collaboration
Adviser: *Prof. Kent Irwin*
- 2018 **Institute for Quantum Computing, University of Waterloo**
Attended *Undergraduate School on Experimental Quantum Information Processing* in Summer 2018
- 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*
Adviser: *Prof. Karl van Bibber*
- 2011-2015 **Athens College High School, Psychiko, Greece**
Completed International Baccalaureate Diploma Program in May 2015

Research Experience

- 2020-present **Graduate Research Assistant**, Stanford University
Adviser: *Prof. Kent Irwin*
Member of Dark Matter Radio (DMRadio) collaboration. DMRadio is a series of experiments searching for ultra-light axions, with expected sensitivity to the QCD axion in the 30-200 MHz range. Responsible for designing and testing a novel quantum device, Radiofrequency Quantum Upconverters (RQUs), which will be implemented on DM radio 50L. Carrying out COMSOL simulations and analytic calculations for thermal and electromagnetic properties of DMRadio 50L and m^3 . In charge of cryogenic testing of Superconducting Quantum Interference Devices (SQUIDs) for cosmology projects, such as the BICEP Array, and training a rotating student in this area.
- 2019-2020 **Graduate Research Assistant**, Stanford Institute for Theoretical Physics
Adviser: *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-present **Mentor**, Polygence
 One-on-one mentoring of high school students who want to get involved in research projects in their pre-collegiate schooling. Working with a student on a project on dark matter halos.

Sp.-Fall 2020 **Teaching Assistant**, Stanford University
 Taught two discussion sections for Electricity and Magnetism (Physics 43 – Spring 2020) and two lab sections for Heat and Optics (Physics 46 – Fall 2020).

Summer 2017 **Reader (Grader)**, UC Berkeley
 Graded weekly problem sets for Quantum Mechanics I (Physics 137A – upper division).

Honors & Awards

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*

2014 Member of the Greek National Linguistics Team: Participated in 12th International Linguistics Olympiad in Beijing, China.

Publications & Talks

Journal Articles

[\[INSPIRE PROFILE\]](#) [\[GOOGLE SCHOLAR PROFILE\]](#)

A quantum-enhanced search for dark matter axions

K.M. Backes, D.A. Palken, S. Al Kenany, B.M. Brubaker, S.B. Cahn, A. Droster, G.C. Hilton, S. Ghosh, H. Jackson, S. K. Lamoreaux, A.F. Leder, K.W. Lehnert, S.M. Lewis, M. Malnou, R.H. Maruyama, N.M. Rapidis, M. Simanovskaia, S. Singh, D.H. Speller, I. Urdinarian, L.R. Vale, E.C. van Assendelft, K. van Bibber, and H. Wang, *Nature* **590**, 238-242 (2021) [[arXiv:2008.01853](#)] [[INSPIRE](#)]

Resonant Conversion of Dark Matter Oscillons in Pulsar Magnetospheres

A. Prabhu and N.M. Rapidis, *JCAP* **10**, (2020) 054 [[arXiv:2005.03700](#)][[INSPIRE](#)].

An improved analysis framework for axion dark matter searches

D.A. Palken, B.M. Brubaker, M. Malnou, S. Al Kenany, K.M. Backes, S.B. Cahn, Y.V. Gurevich, S.K.

Lamoreaux, S.M. Lewis, R.H. Maruyama, N.M. Rapidis, J.R. Root, M. Simanovskaia, T.M. Shokair, S. Singh, D.H. Speller, I. Urdinaran, K. van Bibber, L. Zhong, K.W. Lehnert, *Phys. Rev. D* **101**, 123011, (2020) [[arXiv:2003.08510](#)][[INSPIRE](#)].

Characterization of the HAYSTAC axion dark matter search cavity using microwave measurement and simulation techniques

N.M. Rapidis, S.M. Lewis, K.A. van Bibber, *Review of Scientific Instruments* **90**, 024706 (2019) [[arXiv:1809.02246](#)][[INSPIRE](#)].

Results from Phase 1 of the HAYSTAC microwave cavity axion experiment

L. Zhong, S. Al Kenany, K.M. Backes, B.M. Brubaker, S.B. Cahn, G. Carosi, Y.V. Gurevich, W.F. Kindel, S.K. Lamoreaux, K.W. Lehnert, S.M. Lewis, M. Malnou, R.H. Maruyama, D.A. Palken, N.M. Rapidis, J.R. Root, M. Simanovskaia, T.M. Shokair, D.H. Speller, I. Urdinaran, K.A. van Bibber, *Phys. Rev. D* **97**, 092001, (2018) [[arXiv:1803.03690](#)][[INSPIRE](#)].

Design and Operational Experience of a Microwave Cavity Axion Detector for the 20-100 μeV Range

S. Al Kenany, M.A. Anil, K.M. Backes, B.M. Brubaker, S.B. Cahn, G. Carosi, Y.V. Gurevich, W.F. Kindel, S.K. Lamoreaux, K.W. Lehnert, S.M. Lewis, M. Malnou, D.A. Palken, N.M. Rapidis, J.R. Root, M. Simanovskaia, T.M. Shokair, I. Urdinaran, K.A. van Bibber, L. Zhong. *Nuclear Instruments and Methods in Physics Research A* **854** (2017) 11–24. [[arXiv:1611.07123](#)] [[INSPIRE](#)].

First Results from a Microwave Cavity Axion Search at 24 μeV

B.M. Brubaker, L. Zhong, Y.V. Gurevich, S.B. Cahn, S.K. Lamoreaux, M. Simanovskaia, J.R. Root, S.M. Lewis, S. Al Kenany, K.M. Backes, I. Urdinaran, N.M. Rapidis, T.M. Shokair, K.A. van Bibber, D.A. Palken, M. Malnou, W.F. Kindel, M.A. Anil, K.W. Lehnert, G. Carosi, *Phys. Rev. Lett.* **118**, 061302 (2017) [[arXiv:1610.02580](#)][[INSPIRE](#)].

Conference Proceedings

Probing the QCD Axion with DMRadio-m³

J.L. Ouellet, L. Brouwer, S. Chaudhuri, H.-M. Cho, C. S. Dawson, A. Droster, A. Gavin, P. W. Graham, R. Henning, S. P. Ho, K. D. Irwin, F. Kadribasic, Y. Kahn, A. Keller, R. Kolevator, S. Kuentner, A. F. Leder, D. Li, J. L. Ouellet, K. Pappas, A. Phipps, S. Rajendran, N. M. Rapidis, B. R. Safdi, C. Salemi, M. Simanovskaia, J. Singh, E. C. van Assendelft, K. van Bibber, K. Wells, L. Winslow, B. A. Young, *Snowmass2021 – Letter of Interest*

DMRadio-GUT: Probing GUT-scale QCD Axion Dark Matter

S. Chaudhuri, L. Brouwer, H.-M. Cho, C. S. Dawson, A. Droster, A. Gavin, P. W. Graham, R. Henning, S. P. Ho, K. D. Irwin, F. Kadribasic, Y. Kahn, A. Keller, R. Kolevator, S. Kuentner, A. F. Leder, D. Li, J. L. Ouellet, K. Pappas, A. Phipps, S. Rajendran, N. M. Rapidis, B. R. Safdi, C. Salemi, M. Simanovskaia, J. Singh, E. C. van Assendelft, K. van Bibber, K. Wells, L. Winslow, B. A. Young, *Snowmass2021 – Letter of Interest*

HAYSTAC – Pioneering the Quantum Frontier

S. Al Kenany, K. M. Backes, B. M. Brubaker, S. B. Cahn, A. Droster, G. C. Hilton, S. Ghosh, H. Jackson, S. K. Lamoreaux, A. F. Leder, K. W. Lehnert, S. M. Lewis, M. Malnou, R. H. Maruyama, D. A. Palken, N. M. Rapidis, M. Simanovskaia, S. Singh, D. H. Speller, I. Urdinaran, L. R. Vale, E. C. van Assendelft, K. van Bibber, H. Wang, *Snowmass2021 – Letter of Interest*

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](#)]

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](#)].

Talks

Modeling and optimizing DMRadio using an equivalent circuit formalism

APS April Meeting 2021, April 17-20, 2021, Virtual

Electromagnetic sensing below the Standard Quantum Limit: 3 kHz to 300 MHz

APS March Meeting 2021, March 15-19, 2021, Virtual

Characterization of the HAYSTAC dark matter detector cavity: microwave measurement and simulation

APS April Meeting 2019, April 13-16, 2019, Denver, CO

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

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

Skills

Programming & Software

Advanced: *Mathematica*, *COMSOL (AC/DC & RF)*, *CST Microwave Studio*, *L^AT_EX*

Intermediate: *Python*, *LabVIEW*, *Matlab*

Basic: *HTML*

Languages

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

Experimental Tools

Basic machine shop skills (operating mills, lathes, and drill presses for work on metallic parts), Operating and calibrating network analyzers for studies of electromagnetic devices, Cryogenic dips and testing of quantum devices (e.g. SQUIDS)