
Vetri Velan, PhD

Curriculum Vitae

Lawrence Berkeley
National Laboratory
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Summary of Qualifications

- Chamberlain Fellow at Lawrence Berkeley National Laboratory
 - Calibration Operations coordinator for the LUX-ZEPLIN experiment
 - PhD in experimental particle physics, with expertise in the use of liquid noble elements and calorimetry for dark matter direct detection
 - Author or co-author on 30+ publications, with 2 as lead or co-lead author
 - 16+ public research presentations given, including 5 seminars or invited talks
 - Expertise in data analysis; statistics for particle physics experiments, including limit-setting; Monte Carlo simulations; atomic-scale physics model building; data acquisition (DAQ) systems and controls; transition-edge sensor (TES) dynamics; dilution refrigeration
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Education

Doctor of Philosophy in Physics, August 2015 – August 2022

University of California, Berkeley; Berkeley, CA 94720

Ph.D. Dissertation: “*Discrimination in Liquid Xenon and Calorimetry in Superfluid Helium for the Direct Detection of Particle Dark Matter*” [[View on Proquest](#)]

Advisor: Daniel N. McKinsey

Master of Arts in Physics, May 2017

University of California, Berkeley; Berkeley, CA 94720

Bachelor of Science *Summa Cum Laude*, May 2015

Rutgers, the State University of New Jersey, New Brunswick, NJ 08901

Majors: Physics, Chemical Engineering GPA: 3.87 / 4.00

Minor: Mathematics

High Honors in Physics

Senior Honors Thesis in Physics: “*Search for $t \rightarrow cH$ with the Multilepton Signature in LHC Data*”

Senior Design Report in Chemical Engineering: “*Production of Dimethyl Ether from Biomass Feedstocks: A Feasibility Report for the Consolidated Chemical Company*”

Honors and Awards

Chamberlain Fellowship, Lawrence Berkeley National Laboratory	September 2022 - Present
Graduate Instrumentation Research Award	June 2018 – June 2020
Funded by U.S. Department of Energy, Office of High Energy Physics	
Administered by American Physical Society, Coordinating Panel on Advanced Detectors	
Winner of first annual APS Division of Particles & Fields “Grad Slam”	April 2019
Recognition in U.S. Congressional Record	January 2018
Outstanding Graduate Student Instructor 2015-16	May 2016
Marshall Scholarship 2015 Finalist	November 2014
Cap & Skull Senior Honor Society	April 2014 – Present
National Undergraduate Fellowship in Plasma Physics	June 2014 – August 2014
Robert L. Sells Scholarship, Rutgers Dept. of Physics & Astronomy	April 2013 – May 2014
RISE Scholarship, German Academic Exchange Service (DAAD)	June 2013 – August 2013
Rutgers Presidential Scholarship	September 2011 – May 2015
National Merit Scholar	September 2011 – May 2015
Rutgers School of Engineering Honors Program	September 2011 – May 2015

Research Affiliations and Collaborations

Postdoctoral

LUX-ZEPLIN Experiment	September 2022 – Present
Calibration Operations, Coordinator	January 2023 – Present
Neutron Calibration Analysis, Working Group Lead	January 2023 - Present
SPICE/HeRALD Collaboration	September 2022 – Present
Lawrence Berkeley National Laboratory Physics Division, Dark Matter Group	September 2022 – Present

Graduate

Large Underground Xenon (LUX) Experiment	December 2015 – August 2022
Detector Performance Working Group, Co-Coordinator	January 2018 – August 2022
Effective Field Theory Working Group	November 2019 – May 2020
Backgrounds Working Group	January 2018 – May 2019
Noble Element Simulation Technique (NEST) Collaboration	August 2017 – August 2022
University of California, Berkeley- Department of Physics Primary Investigator: Professor Daniel N. McKinsey	December 2015 – August 2022
Lawrence Berkeley National Laboratory Physics Division, Dark Matter Group	December 2015 – August 2022

Undergraduate

Rutgers University- Department of Physics & Astronomy Primary Investigator: Professor Sunil Somalwar	September 2013 – May 2015
Princeton Plasma Physics Laboratory	June 2014 – August 2014

Primary Investigator: Dr. Ahmed Diallo

Technische Universität Dortmund- Department of Physics
Primary Investigator: Professor Bernhard Spaan

June 2013 – August 2013

Rutgers Department of Chemical & Biochemical Engineering
Primary Investigator: Professor Nina Shapley

May 2012 – May 2013

Please also see **“Publications and Talks”** below.

Professional Service

Snowmass Physics Education Topical Group Particle Physics Education White Paper, Co-Coordinator	June 2020 – July 2022
Faculty Search Committee	January – February 2018
Admitted Student Open House Committee	March – April 2016
Physics Graduate Student Association	September 2015 – April 2018

Professional Affiliations

American Physical Society	July 2014 – Present
National Science Policy Network	April 2019 - Present
Tau Beta Pi, Engineering Honor Society	December 2013 – Present
American Institute of Chemical Engineers	September 2011 – May 2015
Omega Chi Epsilon, Chemical Engineering Honor Society	December 2012 – May 2015

Teaching Experience

UC Berkeley- Department of Physics & Astronomy <i>Head Graduate Student Instructor</i>	August 2016 – December 2016
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Organized logistics for a 530-student introductory physics course, including course websites, exams, homework, labs, discussion sections, grading, academic misconduct, and office hours.

Managed 15 Graduate Student Instructors (GSIs, i.e. TAs).

Taught lectures with up to 200 students when the professors were unavailable.

UC Berkeley- Department of Physics & Astronomy <i>Graduate Student Instructor</i>	August 2015 – May 2016
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Led 2 discussion/lab sections per week, each meeting 4 hours/week and containing 20 students, for an introductory physics course covering the fundamentals of thermodynamics and electromagnetism.

Created lesson plans for each section, in which students solved physics problems in peer groups. These were designed to stimulate students’ analysis skills and reinforce concepts taught in lecture.

Received an Outstanding Graduate Student Instructor award.

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Publications and Talks

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Articles prepared for peer-reviewed journals or community reports

Lead or co-lead author

1. O. Bitter, E. V. Hansen, S. Kravitz, V. Velan, Y. You. “Transforming U.S. Particle Physics Education: A Snowmass 2021 Study.” [arXiv:2204.08983](https://arxiv.org/abs/2204.08983).
2. D. S. Akerib et al. (LUX Collaboration) “Discrimination of electronic recoils from nuclear recoils in two-phase xenon time projection chambers.” *Phys. Rev. D* **102**, 112002 (2020). (Preprint: [arXiv:2004.06304](https://arxiv.org/abs/2004.06304))

Substantial contribution

3. M. Szydagis et al. (NEST Collaboration). “A Review of NEST Models, and Their Application to Improvement of Particle Identification in Liquid Xenon Experiments.” [arXiv:2211.10726](https://arxiv.org/abs/2211.10726).
4. S. A. Hertel, A. Biekert, J. Lin, V. Velan, D. N. McKinsey. “A Path to the Direct Detection of sub-GeV Dark Matter Using Calorimetric Readout of a Superfluid ^4He Target.” *Phys.Rev.D* **100** (2019) **9**, 092007. (Preprint: [arXiv:1810.06283](https://arxiv.org/abs/1810.06283))

Co-author

5. A. Biekert et al. (SPICE/HeRALD Collaboration). “A portable and high intensity 24 keV neutron source based on ^{124}Sb - ^9Be photoneutrons and an iron filter.” [arXiv:2302.03869](https://arxiv.org/abs/2302.03869).
6. D. S. Akerib et al. (LUX Collaboration). “Improved Dark Matter Search Sensitivity Resulting from LUX Low-Energy Nuclear Recoil Calibration.” [arXiv:2210.05859](https://arxiv.org/abs/2210.05859).
7. R. Anthony-Petersen et al. (SPICE/HeRALD Collaboration). “A Stress Induced Source of Phonon Bursts and Quasiparticle Poisoning.” [arXiv:2208.02790](https://arxiv.org/abs/2208.02790).
8. A. Biekert et al. (SPICE/HeRALD Collaboration). “A backing detector for order-keV neutrons.” *Nucl. Instrum. Meth. A* **1039**, 166981 (2022). (Preprint: [arXiv:2203.04896](https://arxiv.org/abs/2203.04896))
9. J. Aalbers et al. “A Next-Generation Liquid Xenon Observatory for Dark Matter and Neutrino Physics.” *J. Phys. G: Nucl. Part. Phys.* **50**, 013001 (2023). (Preprint: [arXiv:2203.02309](https://arxiv.org/abs/2203.02309))
10. D. S. Akerib et al. (LUX Collaboration). “Fast and Flexible Analysis of Direct Dark Matter Search Data with Machine Learning.” [arXiv:2201.05734](https://arxiv.org/abs/2201.05734).
11. A. Biekert et al. (SPICE/HeRALD Collaboration). “Scintillation yield from electronic and nuclear recoils in superfluid ^4He .” *Phys. Rev. D* **105**, 092005 (2022). (Preprint: [arXiv:2108.02176](https://arxiv.org/abs/2108.02176))
12. D. S. Akerib et al. (LUX Collaboration) “Constraints on Effective Field Theory Couplings Using 311.2 days of LUX Data.” *Phys. Rev. D* **104**, 062005 (2021). (Preprint: [arXiv:2102.06998](https://arxiv.org/abs/2102.06998))

13. E. Bodnia, E. P. Bernard, A. Biekert, E. M. Boulton, S. B. Cahn, N. Destefano, B. N. V. Edwards, M. Gai, M. Horn, N.A. Larsen, Q. Riffard, B. Tennyson, V. Velan, C. Wahl, D. N. McKinsey. “The Electric Field Dependence of Single Electron Emission in the PIXeY Two-Phase Xenon Detector.” [JINST 16 P12015 \(2021\)](#). (Preprint: [arXiv:2101.03686](#))
14. D. S. Akerib et al. (LUX Collaboration) “Improving sensitivity to low-mass dark matter in LUX using a novel electrode background mitigation technique.” [Phys. Rev. D 104, 012011 \(2021\)](#). (Preprint: [arXiv:2011.09602](#))
15. D. S. Akerib et al. (LUX Collaboration) “Investigation of background electron emission in the LUX detector.” [Phys.Rev.D 102 \(2020\) 9, 092004](#). (Preprint: [arXiv:2004.07791](#))
16. D. S. Akerib et al. (LUX Collaboration) “An Effective Field Theory Analysis of the First LUX Dark Matter Search.” [Phys. Rev. D 103, 122005 \(2021\)](#). (Preprint: [arXiv:2003.11141](#))
17. D. S. Akerib et al. (LUX Collaboration) “Search for two neutrino double electron capture of ^{124}Xe and ^{126}Xe in the full exposure of the LUX detector.” [J.Phys.G 47 \(2020\) 10, 105105](#). (Preprint: [arXiv:1912.02742](#))
18. A. G. Singh, A. Biekert, E. Bernard, E. M. Boulton, S. B. Cahn, N. Destefano, B. N. V. Edwards, M. Gai, M. Horn, N. Larsen, B. Tennyson, Q. Riffard, V. Velan, C. Wahl, D. N. McKinsey. “Analysis of 83mKr Prompt Scintillation Signals in the PIXeY Detector.” [JINST 15 \(2020\) 01, P01023](#). (Preprint: [arXiv:1911.03999](#))
19. D. S. Akerib et al. (LUX Collaboration) “Improved Modeling of β Electronic Recoils in Liquid Xenon Using LUX Calibration Data.” [JINST 15 \(2020\) 02, T02007](#). (Preprint: [arXiv:1910.04211](#))
20. D. S. Akerib et al. (LUX Collaboration) “First direct detection constraint on mirror dark matter kinetic mixing using LUX 2013 data.” [Phys.Rev.D 101 \(2020\) 1, 012003](#). (Preprint: [arXiv:1908.03479](#))
21. D. S. Akerib et al. (LUX Collaboration) “Extending light WIMP searches to single scintillation photons in LUX.” [Phys.Rev.D 101 \(2020\) 4, 042001](#). (Preprint: [arXiv:1907.06272](#))
22. A. Biekert, S. A. Hertel, E. Huebler, J. Lin, H. D. Pinckney, R. K. Romani, A. Serafin, V. Velan, D. N. McKinsey. “Nuclear Recoil Scintillation Linearity of a High Pressure ^4He Gas Detector.” [JINST 14 \(2019\) 10, P10028](#). (Preprint: [arXiv:1907.03985](#))
23. D. S. Akerib et al. (LUX Collaboration) “Improved Measurements of the β -Decay Response of Liquid Xenon with the LUX Detector.” [Phys.Rev.D 100 \(2019\) 2, 022002](#). (Preprint: [arXiv:1903.12372](#))
24. D. S. Akerib et al. (LUX Collaboration) “Results of a Search for Sub-GeV Dark Matter Using 2013 LUX Data.” [Phys.Rev.Lett. 122 \(2019\) 13, 131301](#). (Preprint: [arXiv:1811.11241](#))
25. D. S. Akerib et al. (LUX Collaboration) “Search for annual and diurnal rate modulations in the LUX experiment.” [Phys.Rev.D 98 \(2018\) 6, 062005](#). (Preprint: [arXiv:1807.07113](#))
26. D. S. Akerib et al. (LUX Collaboration) “LUX trigger efficiency.” [Nucl.Instrum.Meth.A 908 \(2018\) 401-410](#). (Preprint: [arXiv:1802.07784](#))
27. D. S. Akerib et al. (LUX Collaboration) “Liquid xenon scintillation measurements and pulse shape discrimination in the LUX dark matter detector.” [Phys.Rev.D 97 \(2018\) 11, 112002](#). (Preprint: [arXiv:1802.06162](#))
28. D. S. Akerib et al. (LUX Collaboration) “Calibration, event reconstruction, data analysis, and limit calculation for the LUX dark matter experiment.” [Phys.Rev.D 97 \(2018\) 10, 102008](#). (Preprint: [arXiv:1712.05696](#))

29. D. S. Akerib et al. (LUX Collaboration) “Position Reconstruction in LUX.” [JINST 13 \(2018\) 02, P02001](#). (Preprint: [arXiv:1710.02752](#))
 30. D. S. Akerib et al. (LUX Collaboration) “Ultralow energy calibration of LUX detector using ^{127}Xe electron capture.” [Phys.Rev.D 96 \(2017\) 11, 112011](#). (Preprint: [arXiv:1709.00800](#))
 31. D. S. Akerib et al. (LUX Collaboration) “3D Modeling of Electric Fields in the LUX Detector.” [JINST 12 \(2017\) 11, P11022](#). (Preprint: [arXiv:1709.00095](#))
 32. D. S. Akerib et al. (LUX Collaboration) “ $^{83\text{m}}\text{Kr}$ calibration of the 2013 LUX dark matter search.” [Phys.Rev.D 96 \(2017\) 11, 112009](#). (Preprint: [arXiv:1708.02566](#))
 33. D. S. Akerib et al. (LUX Collaboration) “Limits on spin-dependent WIMP-nucleon cross section obtained from the complete LUX exposure.” [Phys.Rev.Lett. 118 \(2017\) 25, 251302](#). (Preprint: [arXiv:1705.03380](#))
 34. D. S. Akerib et al. (LUX Collaboration) “First Searches for Axions and Axionlike Particles with the LUX Experiment.” [Phys.Rev.Lett. 118 \(2017\) 26, 261301](#). (Preprint: [arXiv:1704.02297](#))
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Conference Proceedings and Reports

1. V. Velan et al. “NEST, The Noble Element Simulation Technique: A Multi-Disciplinary Monte Carlo Tool and Framework for Noble Elements.” Snowmass 2021 Letter of Interest. [IF8-LOI-104](#).
 2. V. Velan et al. “Enhancing Particle Physics Education at the Graduate Level.” Snowmass 2021 Letter of Interest. [CommF4-LOI-023](#).
 3. Z. Ahmed et al. (CPAD Workshop Attendees) “New Technologies for Discovery. A report of the 2018 DPF Coordinating Panel for Advanced Detectors (CPAD) Community Workshop.” [arxiv:1908.00194](#)
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Invited Seminars and Presentations

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| 1. KA25 Meeting, Lawrence Berkeley National Laboratory
“Probing Sub-GeV Dark Matter with Superfluid He-4” | April 2019 |
| 2. Coordinated Panel for Advanced Detectors (CPAD) Instrumentation Frontier Workshop
“Probing Sub-GeV Dark Matter with Superfluid He-4” | Dec 2018 |
| 3. UC Berkeley Astrophysics Roundtable Fundraiser
“Searching for Dark Matter with Superfluid Helium” | November 2018 |
| 4. Rutgers University High Energy Experimental Seminar
“Probing Sub-GeV Dark Matter with Superfluid Helium and HeRALD” | September 2018 |
| 5. SLAC National Lab Experimental Seminar
“Probing Sub-GeV Dark Matter with Superfluid Helium” | January 2018 |
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Contributed Conference Talks

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| 1. Light Detection in Noble Elements (LIDINE)
“Electronic versus nuclear recoil discrimination in liquid xenon with PIXeY” | September 2021 |
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2. Technology and Instrumentation in Particle Physics (TIPP) May 2021
“Electronic vs. nuclear recoil discrimination and single electron emission in PIXeY”
 3. American Physical Society April Meeting April 2021
“Electronic and nuclear recoil discrimination in xenon TPCs with the PIXeY experiment”
 4. CPAD Instrumentation Frontier Workshop March 2021
“Modeling xenon and argon physics with the Noble Element Simulation Technique (NEST)”
 5. American Physical Society April Meeting April 2020
“Discrimination of electron recoils from nuclear recoils in two-phase xenon time projection chambers”
 6. American Physical Society April Meeting April 2019
Winner of first annual “Grad Slam” competition; 3-minute “elevator pitch” of research talk.
 7. American Physical Society April Meeting April 2019
“Projected Performance of Future Liquid Xenon Detectors”
 8. Identification of Dark Matter July 2018
“ER/NR Discrimination in Liquid Xenon with the LUX Experiment”
 9. American Physical Society April Meeting April 2018
“Signal Yields in Liquid Xenon with the LUX Experiment”
 10. NorCal HEP-EXchange December 2017
“Recombination in liquid xenon using the Large Underground Xenon (LUX) Experiment”
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Contributed Conference Posters

1. American Physical Society April Meeting April 2019
“The Noble Element Scintillation Technique (NEST) Version 2.0”
 2. American Physical Society Division of Plasma Physics October 2014
“Reconstruction of electron temperature and density profiles from Thomson scattering system using neural networks.”
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Other Conferences and Workshops Attended

1. NorCal HEP-EXchange December 2018
2. LUX Analysis Workshop, LIP Coimbra April 2018
3. LUX Analysis Workshop, Lawrence Berkeley National Laboratory October 2017
4. Light Detection in Noble Elements (LIDINE) September 2017
5. LUX Analysis Workshop, The Pennsylvania State University June 2017
6. Nuclear Analytical Techniques Summer School July 2016

Vetri Velan, PhD

Science Policy + Outreach

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Science Policy Experience

Science Policy Group at Berkeley

September 2017 – August 2022

President, May 2019 – April 2020

Vice President of External Affairs, May 2018 – April 2019

Science Ethics & Policy Symposium, April 2022

May 2019 – April 2022

Co-organized a national interdisciplinary two-day conference on science ethics, policy, and communication. The event was organized by about 30 grad students and postdocs, primarily from UC Berkeley and UC San Francisco. Our attendance was 200 people, with about 125 in person and 75 joining virtually. The budget was >\$50k. Participants participated in keynote addresses, panels, workshops, and social activities; these focused on ethical responsibility at the intersection of science, technology, and modern society. Examples included: data in criminal justice systems, the use of indigenous DNA, mental health policy, engaging with faith communities, and greenhouse gas emissions. Planning took nearly 3 years, because of multiple delays due to the COVID-19 pandemic.

Catalyzing Advocacy in Science and Engineering (CASE) Workshop

March 2019

As part of this workshop organized by the AAAS, I traveled to Washington, D.C. to learn about federal policymaking and speak to legislators. I met with the staffs of several members of Congress to talk about my research and advocate for federal funding of DOE, NSF, NIH, and other scientific research agencies. These included the offices of Sens. Harris, Feinstein, and Baldwin; Speaker Pelosi; Leader McCarthy; and Reps. DeSaulnier, Lee, Lipinski, Pascrell, and Swalwell. To facilitate the meetings, I made a “one-pager” summarizing my research and the importance of maintaining funding for it. This document can be found [here](#).

Activism on Tax Cuts and Jobs Act of 2017

November – December 2017

I wrote an analysis of H.R. 1, the Tax Cuts and Jobs Act of 2017, describing how it created a “graduate student tax” by taxing tuition stipends and showing that graduate students could see their tax liabilities increase by up to 300%. With Kathy Shield, I also created a calculator that allowed graduate students to determine how their own tax burden would change. Both documents were spread nationwide, spurring students to combat the provision by contacting their legislators, writing op-eds, and launching protests. The provision was removed in the final version of the bill that was signed into law.

A sampling of media outlets that covered this story: [The New York Times](#), [Nature](#), [Politico](#), [Wired](#), [Fortune](#), [Los Angeles Times](#), [KQED News](#), and [The Chronicle of Higher Education](#).

Honored by Congresswoman Barbara Lee (CA-13) in the U.S. Congressional Record, Vol. 164, No. 7, Extensions of Remarks: [“Recognizing Vetri Velan and Kathy Shield”](#).

Original [analysis](#) and [calculator](#) attached in hyperlinks.

Publications, Memos, and Talks

V. Velan, R. Woods-Robinson, E. Case, I. Warner, A. Poppiti, B. Abramowitz (2021). “The Federal Science Project: A Scientist in Every Classroom.”

Selected for special issue on “Shaping the Future of Science Policy.”

https://www.sciencepolicyjournal.org/article_1038126_jspg180308.html

Reclaiming STEM

October 2020

Invited conference talk: “Developing a Pitch to Policymakers”

https://www.vetrivelan.com/s/ReclaimingSTEM_Policy_Pitch.pdf

C. Jackson, V. Velan, M. Livingston, E. Lee, K. Huynh, R. Eckert (2020). “Regulation of Facial Recognition Systems at the Municipal Level.”

<https://escholarship.org/uc/item/7qp0w9rn>

S. Hartman, W. Horner, C. Jackson, E. Kovak, V. Velan (2020). “Streamlining Regulation of Gene Editing Benefits California Agriculture.”

https://www.sciencepolicyjournal.org/article_1038126_jspg170108.html

A. Saintsing, S. Stoudt, and V. Velan. “CRISPR Consensus?” Berkeley Science Review (January 2020). <https://berkeleysciencereview.com/2020/01/crispr-consensus/>

E. Sullivan, C. Jackson, D. Broberg, M. O’Dair, V. Velan (2019). “California Lawmakers Should Take Action to Mitigate the Effects of the 2019 PG&E Bankruptcy.”

<https://escholarship.org/uc/item/3vm5d69x>

E. Lee, E. Sullivan, V. Velan, and Q. Yu. “Bridging the culture gap between science and policy.” Berkeley Science Review (July 2019).

<https://berkeleysciencereview.com/article/election-quality-control/>

V. Velan. “Election Quality Control.” Berkeley Science Review (April 2019).

<https://berkeleysciencereview.com/article/election-quality-control/>

Grounds for Science

April 2019

Public talk: “Engaging in Public Policy as a Scientist”

https://www.vetrivelan.com/s/Grounds_for_Science.pdf

Physics Graduate Student Seminar

March 2018

Seminar talk: “The Mathematics of Gerrymandering”

https://www.vetrivelan.com/s/Mathematics_of_Gerrymandering.pdf

Science Communication and Outreach Experience

Science at Cal / LBNL Midday Science Café

October 2020

Public talk: “Dark Matter: A Hidden Sea”

<https://www.youtube.com/watch?v=bQvwqVv7sYE>

The Graduates (Podcast): Dark Matter with Vetri Velan

October 2020

<https://podcasts.apple.com/us/podcast/vetri-velan/id1533729474?i=1000509475363>

Physics After Hours (Podcast): Dark Matter Chats with Vetri Velan https://www.youtube.com/watch?v=qFqYeZyRvTw	May 2020
Popping the Science Bubble Public talk: “Dark Matter: A Cosmic Mystery”	July 2017
QuarkNet Workshop: Physics In and Through Cosmology LBNL lecture for high school students: “Searching for Dark Matter”	June 2017
Bay Area Scientists in Schools (BASIS) <i>Volunteer</i>	January 2016 – February 2017
New Jersey Governor’s School of Engineering & Technology <i>Resident Teaching Assistant</i>	June 2012 – July 2012