Sam Dillavou, Ph.D.

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EDUCATION

2020 **Ph.D. in Physics**, Department of Physics, Harvard University, Cambridge, MA
Thesis: Hidden Dynamics of Static Friction Faculty Advisor: Shmuel M Rubinstein

2016 **M.A. in Physics**, Department of Physics, Harvard University, Cambridge, MA

2012 **B.A. in Physics**, Cornell University, Ithaca, NY

RESEARCH EXPERIENCE

2020- **Postdoctoral Fellow**, University of Pennsylvania, Dept of Physics and Astronomy
with Andrea J Liu & Douglas J Durian
Learning in Physical Networks; Clogging in Granular Flows; Machine Learning in Experimental Science

2020 **Postdoctoral Fellow**, Harvard University, School of Engineering and Applied Sciences
with Shmuel M Rubinstein and Ariel Amir
Memory effects in solid-solid interfaces; Data-driven analysis; Dynamic slip events

2018 **Visiting Researcher**, EPFL, Lausanne, Switzerland, Dept of Mechanical Engineering
with John M Kolinski
Developed ultrafast (rates ≥ MHz) imaging technique for any camera

TEACHING and MENTORING EXPERIENCE

Research Mentorship

U Penn: 3 local undergraduates (2021-), visiting students from U Maryland (2022), Moravian U (2022), Swarthmore (2021), U Texas Rio Grande Valley (2021)

Harvard U: 3 local undergraduates (2017-2020), visiting students from ESPCI Paris (2019), Tsinghua U (grad, 2017-2018), Hebrew U Jerusalem (2016)

Teaching Assistant

Introduction to Fluid Mechanics‡ (Spring 2018) Harvard U, 60 Undergraduate Students
Develop new materials, in-class demos, supervising labs, grading, overseeing projects
Won *Bok Center Certificate of Teaching Excellence*

Introduction to Soft Matter (Fall 2015) Harvard U, 20 Graduate Students
Write problem sets, develop new materials, teaching section, grading

Workshops

Taught two winter-term mini-courses at Harvard:
Intro to Long-Form Improvisation (2016),
Improving Presentation and Discussion Through Improvisation (2019).

Over a twenty improvisational workshops for middle and high school students, undergraduates, graduate students, business professionals (2011-present) at Harvard (GSAS), Tufts Engineering, Yale Splash, Cornell, and Deloitte Consulting NYC.

Pedagogical Training
Teaching and Communicating Physics (Spring 2015) Harvard U

Tutoring
Tutored high-school mathematics and physics, SAT prep, and college physics.

FELLOWSHIPS and AWARDS

Fellowships
Data Science Postdoctoral Fellow UPenn, $5,000/year, (2022-)
Smith Family Fellowship Harvard U, ~$90,000, 1 year (2015-16)
Purcell Fellowship Harvard U, ~$90,000, 1 year (2014-15)

Research & Teaching Recognition
Editor's Suggestion (Dillavou et. al. PR Applied, 2022)
Rising Stars in Soft and Biological Matter Honorarium, U Chicago (2021)
Editor's Suggestion (Dillavou & Rubinstein, PRL, 2018)
Bok Center Certificate of Teaching Excellence, Harvard U (Spring 2018)

PROFESSIONAL SERVICE

Journal Referee
Physical Review Letters (2019-present)
US Geological Survey Internal (2020)
Physical Review B (2021-present)

Science/Educational Outreach
DEEPenn, planning committee. STEM PhD prep workshop for ~50 URM students (2022)
Speaker at Penn REU Machine Learning Workshop (2022)
2nd Place, MRSEC National Science Slam: Learning Networks on the Radio (2022)
Science in the News Writer (2016-17), Harvard U
Splash at Yale Instructor, grades 7-9 and 10-12 (2016-17), Yale U

Professional Membership
American Physical Society (2016-present)

Miscellaneous
Part of a collaboration developing a 3D Printer-as-Ventilator during COVID-19 outbreak

PUBLICATIONS

Submitted & On Arxiv

[1] W Steinhardt, **S Dillavou**, M Agajanian*, SM Rubinstein, EE Brodsky, *Seismological Stress Drops for Confined Ruptures are Invariant To Normal Stress*, (Submitted to Geophysical Research Letters)

[2] A Srivastava et. al. (100s of authors), *Beyond the Imitation Game: Quantifying and extrapolating the capabilities of language models*, arXiv

[3] M Pasquet, N Galvani, O Pitois, S Cohen-Addad, R Höhler, AT Chieco, **S Dillavou**, JM Hanlan, DJ Durian, E Rio, A Salonen, D Langevin, *Aqueous foams in microgravity, measuring bubble sizes,* (In Review, Comptes rendus de l'Académie des Sciences) arXiv

[4] T Martin, **S Dillavou**, *Calculations Without Math: "Smart instruments" and the transposition of complex shapes in the wooden boat workshop* (Submitted to Learning, Culture and Social Interaction)

Published & Accepted

[5] **S Dillavou**, Y Bar-Sinai, MP Brenner, and SM Rubinstein, *Contact Distribution Encodes Frictional Strength,* Physical Review E, 106, L033001 (2022) Letter

[6] **S Dillavou**, M Stern, DJ Durian, AJ Liu, *Demonstration of Decentralized, Physics-Driven Learning*, Physical Review Applied, 18, 014040 (2022) **Editor's Choice**

[7] M Stern, **S Dillavou**, MZ Miskin, DJ Durian, AJ Liu, *Physical Learning Beyond the Quasistatic Limit*, Physical Review Research, 4, L022037 (2022)

[8] JF Wycoff*, **S Dillavou**, M Stern, AJ Liu, DJ Durian, *Learning Without a Global Clock: Asynchronous Learning in a Physics-Driven Learning Network*, Journal of Chemical Physics, 156, 144903 (2022)

[9] SCL Durian*, **S Dillavou**, K Markin*, A Portales*, BOT Maldonado, WTM Irvine, PE Arratia, DJ Durian, *Spatters and Spills: Spreading Dynamics for Partially Wetting Droplets* Physics of Fluids, 34, 012112 (2022)

[10] S Zheng, **S Dillavou**, JM Kolinski *Air Mediates the Impact of a Compliant Hemisphere on a Rigid Smooth Surface* Soft Matter, 17, 3813–3819 (2021)

[11] **S Dillavou** and SM Rubinstein, *Shear Controls Frictional Aging by Erasing Memory*, Physical Review Letters 124, 085502 (2020)

[12] T Pilvelait*, **S Dillavou**, and SM Rubinstein, *Influences of Microcontact Shape on the State of a Frictional Interface*, Physical Review Research 2, 012056 (2020)

[13] **S Dillavou**, SM Rubinstein, and JM Kolinski, *The Virtual Frame Technique: Ultrafast Imaging With Any Camera*, Optics Express 27, 8112–8120 (2019)

[14] **S Dillavou** and SM Rubinstein, *Nonmonotonic Aging and Memory in a Frictional Interface*, Physical Review Letters 120, 224101 (2018) **Editor's Choice**

[15] JL Silverberg, **S Dillavou***, L Bonassar, and I Cohen, *Anatomic Characterization of Depth-Dependent Mechanical Properties in Neonatal Bovine Articular Cartilage*, Journal of Orthopaedic Research 31, 686–691 (2012)

Conference Papers

[16] M Stern, **S Dillavou**, MZ Miskin, DJ Durian, AJ Liu, *Out of Equilibrium Learning Dynamics in Physical Allosteric Resistor Networks*, NeurIPS, Fourth Workshop on Machine Learning and the Physical Sciences (2021)

* Undergraduate student at the time work was performed

Patents

US Patent Application No 17750072 **S Dillavou**, M Stern, MZ Miskin, AJ Liu, DJ Durian *Coupled Networks for Physics-Based Machine Learning* (2022)

PRESENTATIONS and PRESS

Invited Talks

AI and Optical Data Sciences Conference at SPIE Photonics West, (San Francisco, CA, 2023)
"Circuits that train themselves: decentralized, physics-driven learning" (**upcoming**)
Google Brain Weekly Seminar, (Mountainview, CA, 2022)
"Hijacking Physics to Learn for Us"
American Physical Society March Meeting, (Chicago, IL, 2022)
"Decentralized Physics-Driven Learning: Using Physics to Learn without a Processor"
Bucknell University, Physics Seminar, (Lewisburg, PA, 2021)
"Decentralized Physics-Driven Learning"
New York University, Applied Math Seminar, (New York, NY, 2020)
"Hidden Dynamics of Static Friction"
Princeton University, Soft Matter Coffee Hour, (Princeton, NJ, 2020)
"Hidden Dynamics of Static Friction"
University of Pennsylvania, Soft Matter Theory Group, (Virtual, 2020)
"Hidden Dynamics of Static Friction"
Pennsylvania State University, Geomechanics Seminar, (State College, PA, 2018)
"Static Friction: Aging and Memory"
École Polytechnique Fédérale de Lausanne, Mech Eng Seminar, (Lausanne, Switzerland, 2018)
"Memory in Solid-Solid Interfaces"

Contributed Talks

Coherent Network Computing, (Palo Alto, CA, 2022)
"A Physics-Driven Self-Learning Transistor Network"
American Physical Society March Meeting, (Chicago, IL, 2022)
"Beyond Quality and Quantity: Contact Distribution Encodes Frictional Strength"
Rising Stars in Soft and Biological Matter Symposium, U of Chicago, (Chicago, IL, 2021)
"Decentralized Physics-Driven Learning"
American Physical Society March Meeting, (Virtual, 2021)
"Building a Physical Learning Network"
American Physical Socity March Meeting, (Boston, MA, 2019)
"Memory in Solid-Solid Interfaces"
Dynamics Days, Northwestern University, (Evanston, IL, 2019)
"Hidden Dynamics of Static Contact and Static Friction"
U Massachusetts, Northeast Research Alliance & BASF Collaboration Days, (Amherst, MA, 2019)
"Extreme Mechanics of Elastomer Impact"
American Physical Society March Meeting, (Los Angeles, CA, 2018)

"Two Solids Make a Glass: Memory in Solid-Solid Interfaces"
U Massachusetts, Northeast Research Alliance & BASF Collaboration Days, (Amherst, MA, 2017)
"Elastomer Wear: The NBA's Shoe Problem"
Weizmann Institute, Physics Department Symposium, (Rehovot, Israel, 2017)
"Memory in the Frictional Interface"

Selected Press

On Physics-Driven Learning
Quanta Magazine, 2022
"How to make the universe think for us"
Science News, 2022
"Simple electrical circuit learns on its own – with no help from a computer"
American Physical Society News, 2021
"Programming matter to a computer's job"

On the Virtual Frame Technique
MIT Technology Review, 2018
"How to mod a smartphone camera so it shoots a million frames per second"
American Physical Society, Phys.org, 2019
"Imaging technique lets ordinary cameras capture high-speed images of crack formation"

On Memory in Frictional Interfaces
American Physical Society Physics Focus, 2018
"Friction Remembers Its Origins"
Physics Today, 2018
"Friction Remembers Its Past"

Posters/Rapid Talks

Physical Learning Machines, Simons Collaboration on Cracking the Glass Problem Annual Meeting, 2022
Building a Physical Learning Network, Northeast Complex Fluids Workshop, 2021
Tabletop Nucleation, Southern California Earthquake Center Annual Meeting, Palm Springs, CA 2019
The Hidden Dynamics of Static Friction, Gordon Conference: Soft Matter Physics, New London, NH, 2019
The Virtual Frame Technique, 77th New England Complex Fluids Workshop, Harvard U 2018
Memory in the Frictional Interface, 73rd New England Complex Fluids Workshop, Harvard U 2018; Jay (Fineberg) Fest, Hebrew U in Jerusalem, 2017
Beyond Rate and State: Frictional Memory, Institute for the Study of the Continents Conference, Cornell U, 2017
Wear in Basketball Shoes, Northeast Research Alliance & BASF Challenges, Cornell U, 2017
Visualizing Frictional Interfaces, 69th New England Complex Fluids Workshop, Harvard U 2018; 67th New England Complex Fluids Workshop, MIT 2016
Loading History of Frictional Interfaces, Physics & Mechanics of Soft Complex Materials, Cargese, France, 2016; Gordon Conference: Tribology, Lewiston, ME, 2016
Visualizing Growth of a Multicontact Interface (MCI), 65th New England Complex Fluids Workshop, Harvard U 2015
Aging of Multi-Contact Interfaces, Soft Matter Symposium: Friction, Rheology, Tribology U Florida, Gainesville, FL 2015