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Emma Stavropoulos

PROFILE– I am an experimental physicist with an interest in circuit & cavity quantum electrodynamics, quantum materials, and spintronics. My research background is primarily experimental & computational biophysics. Strong with optics, microscopy, image analysis, computational modeling, and designing, machining, & wiring devices.

EDUCATION

2015–present **BSc Physics**, ***Massachusetts Institute of Technology***, Cambridge, MA, ***GPA**: 4.8/5.0 (3.8/4.0)*
Degree anticipated Dec. 2021.

FALL 2015 Transfer student from Moorpark College, Moorpark, CA, ***GPA**: 4.0/4.0*

COURSEWORK

PHYSICS Atomic & Optical Physics, Quantum Computation, Quantum Physics I–III, Physics of Solids, Experimental Lab, Statistical Physics, Classical Mechanics I–II, Vibrations & Waves, Electromagnetism.

STEM Abstract Algebra, Real Analysis, Linear Algebra, Differential Equations, Multivariable Calculus, Electrical Engineering with Circuits, C++, Java, MATLAB, Organic Chemistry with Lab, Biology.

HUMANITIES Concentration in Russian & Eurasian Studies.

RESEARCH EXPERIENCE

2020–present **Researcher**, *MIT*, Cambridge, MA
Advisor: Prof. Seth Lloyd Dept. of Mechanical Engineering

Co-authoring a theory & computational paper—*The Free Energy Game*—which articulates a unique synthesis of game theory, stochastic thermodynamics, and the physics of information. Entropy and gained free energy influence player payoff functions and in turn impact optimal choice of player strategy. Working under graduate student Lara Booth and currently in the editing phase.

- Coding in Python to compute Nash equilibria & maximum free energy gains in two-player games.
- Analyzing, writing & editing with emphasis on physically intuitive explanations of results.
- Creating plots, charts, tables, & graphics that are concise & clear.

2016–2018 **Undergraduate Researcher**, *MIT*, Cambridge, MA
Advisor: Prof. Ibrahim Cissé Physics of Living Systems @ MIT*

Built a microscope-optical system capable of simultaneously imaging and detecting the entire spectrum of visible light emitted from a fluorescent point-source. A specially designed compound prism shifted the emitted light across one spatial dimension by a linear factor of wavelength. To obtain useful information from images, the system required deconvolution of two dimensions: a single spatial dimension and the visible light spectrum. This allowed us to eliminate the use of additional bandpass filters. Worked independently with guidance from postdoc Dr. Jan-Hendrik Spille.

- Aligned optical-microscope system and imaged fluorescent probes with four laser lines.
- Created a calibration protocol & deconvolution algorithm in MATLAB using ImageJ. Tested using fluorescent multicolor microbreads as proof-of-concept.
- Designed and machined a CCD camera mount and optical mounts using Solidworks.

PRESENTATION: ***A)*** *Oral Presentation for Dept. of Biology Building 68 and* ***B)*** *two Poster Presentations at Annual MIT Building 68 Retreat at the Seacrest Hotel in North Falmouth, MA in June* 2016 *&* 2017.

**Note:* Prof. Cissé is currently at the Max Plank Institute of Immunobiology and Epigenetics in Freiburg, Germany.

FALL 2017 **Undergraduate Researcher**, *MIT*, Cambridge, MA
Advisor: Prof. Vladan Vuletić Center for Ultracold Atoms

Contributed to a project involving atoms coupled to optical resonators in which a longer-term goal was setting up an FPGA with the ability to actively cancel noise. Briefly contributed to preliminary setup while working under graduate student Zak Vendeiro.

* Set up an FPGA on the network and implemented Verilog test code.
* Fabricated, machined, and soldered photodiode boxes.

SUMMER 2015 **NSF REU Intern**, *Institute of Microbiology of the Academy of Sciences*, Nové Hrady, Czech Republic
Advisors: Prof. Jannette Carey Dept. of Chemistry, Princeton University
Dr. Babak Minofar & Dr. David Řeha Center for Nanobiology and Structural Biology, Nové Hrady

Using molecular modeling, simulated the spontaneous binding of organic compounds. Of particular interest were complexes formed between neutral molecules (crown-ethers) and charged particles (cations). Compared simulation results with experimental data of crown-ether & cation binding.

* Simulated classical & quantum physics of molecules using programs Gromacs, Amber, Gaussian.
* Ran computations on remote GPU/CPU servers and analyzed large generated datasets.
* Coded input files using Vim and gained proficiency with UNIX-based systems.

PRESENTATION: ***A)*** *Oral Presentation to REU Program and* ***B)*** *Poster Presentation at REU Symposium at NSF Headquarters in Washington DC in Oct.* 2015*—only one nominee allowed per REU Program.*

SUMMER 2014 **NSF REU Intern**, *Princeton University*, Princeton, NJ
Advisor: Prof. Robert H. Austin Center for the Physics of Biological Function

Part of a larger project which applied evolutionary game theory models to various cellular populations– malignant prostate cancer cells and bacteria. Inside of specially designed microfluidics devices, populations could evolve as individual cells competed for resources and endured selective stress. Cancer cells and bacteria were introduced to chemotherapeutic and antibiotic agents respectively.

* Designed, machined, & wired a thermoregulation incubator to keep bacteria alive while imaging.
* Operated a piezoelectric micromanipulator to collect cells from wells while under microscopy.
* Fabricated microfluidics devices from PDMS (polydimethylsiloxane) and semiconductor silicon.
* Trained in Princeton Micro/Nano Fabrication Laboratory (PRISM) on lithography and etching.

PRESENTATION: *Oral Presentations to* ***A)*** *REU Program,* ***B)*** *Honors Transfer Council of California at UC Irvine in April* 2015†*, and* ***C)*** *Bay Honors Consortium at Stanford University in May* 2015*.*

†*Winner of the Outstanding Abstract Award & Scholarship*

PRESENTATIONS See poster and oral presentations: https://github.com/emstav/emstav-presentations

Teaching Experience

2018–present **Private Tutor**
Tutored middle school, high school, and college students in STEM subjects. Both remote and in person.

2017–2019 **Peer Tutor & Grader**, *MIT*, Cambridge, MA
Employed by MIT Department of Physics to tutor undergraduate peers in Quantum Physics I. Graded assignments from Quantum Physics I, Statistical Physics, and Introductory Biology.

2013–2015 **Math Center Tutor**, *Moorpark College*, Moorpark, CA
Drop-in center tutor for college-level STEM classes. Hired by Math department to TA and independently lead precalculus and algebra supplemental classes of 30+ students.

Personal Interests

* Meditation, hiking, creating digital & watercolor art, cross-stitching, psychology & therapeutic models, traditional folkloric music, semiotics of mythology & religion. Familiar with Russian language, history, & art.