Stanford

Jon Simon

Associate Professor of Physics and Applied Physics

CONTACT INFORMATION

- **Admin Contact**

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Bio

BIO

Jon grew up fascinated with electronics, programming, simulating the world, and soccer. He went to Montgomery Blair for highschool, where he was captain of the game programming club and the chess team. As an undergraduate at Caltech, he led the Beavers to a 1-63 record (seriously- we were terrible) over his 3 seasons on the NCAA DIII soccer team, all while learning physics and building electronics. As a graduate student and postdoc at MIT & Harvard, Jon focused primarily on cavity QED and synthetic quantum matter in optical lattices, while achieving the distinction of coming in dead last in the Head of the Charles Regatta Club 8's. On weekends he kitesurfed on the cape.

Jon's passions for light, simulation, and circuits have combined in the study of quantum & classical matter made of light. In his spare time he grapples, flies drones, and trains his cat Emmy to perform tricks.

ACADEMIC APPOINTMENTS

- Associate Professor, Physics
- Associate Professor, Applied Physics

LINKS

- Another Breakthrough in photon-photon Interactions: https://physics.uchicago.edu/news/article/another-breakthrough-in-photon-photon-interactions/

Research & Scholarship

CURRENT RESEARCH AND SCHOLARLY INTERESTS

Jon's group focuses on exploring synthetic quantum matter using the unique tools available through quantum and classical optics. We typically think of photons as non-interacting, wave-like particles. By harnessing recent innovations in Rydberg-cavity- and circuit- quantum electrodynamics, the Simonlab is able to make photons interact strongly with one another, mimicking collisions between charged electrons. By confining these photons in ultra-low-loss metamaterial structures, the teams "teach" the photons to behave as though they have mass, are in traps, and are experiencing magnetic fields, all by using the structures to tailor the optical dispersion. In total, this provides a unique platform to explore everything from Weyl-semi-metals, to fractional quantum hall puddles, to Mott insulators and quantum dots, all made of light.

The new tools developed in this endeavor, from twisted fabry-perot resonators, to Rydberg atom ensembles, Floquet-modulated atoms, and coupled cavity optical mode converters, have broad applications in information processing and communication. Indeed, we are now commissioning a new experiment aimed at interconverting optical and mm-wave photons using Rydberg atoms inside of crossed optical and superconducting millimeter resonators as the transducer.

Teaching

COURSES

2023-24

- Atoms, Fields and Photons: APPPHYS 203 (Aut)
- Back of the Envelope Physics: PHYSICS 216 (Spr)

2022-23

- Atoms, Fields and Photons: APPPHYS 203 (Aut)
- Back of the Envelope Physics: PHYSICS 216 (Spr)

STANFORD ADVISEES

Doctoral Dissertation Reader (AC)

Alexander Bourzutschky, Eric Cooper, Guglielmo Panelli, Tony Zhang

Postdoctoral Faculty Sponsor

Marius Juergensen, Sebastien Leger, Zeyang Li, Adam Shaw

Doctoral Dissertation Advisor (AC)

Bowen Li, Danial Shadmany

Publications

PUBLICATIONS

- **A cavity loadlock apparatus for next-generation quantum optics experiments** *REVIEW OF SCIENTIFIC INSTRUMENTS*
  Yin, C., Ando, H., Stone, M., Shadmany, D., Soper, A., Jaffe, M., Kumar, A., Simon, J.
  2023; 94 (8)
- **Disorder-assisted assembly of strongly correlated fluids of light.** *Nature*
  Saxberg, B., Vrajitoarea, A., Roberts, G., Panetta, M. G., Simon, J., Schuster, D. I.
  2022; 612 (7940): 435-441
- **Chiral cavity quantum electrodynamics** *NATURE PHYSICS*
  Owens, J., Panetta, M. G., Saxberg, B., Roberts, G., Chakram, S., Ma, R., Vrajitoarea, A., Simon, J., Schuster, D.
  2022; 18 (9): 1048-+
- **Observation of Laughlin states made of light** *NATURE*
  Clark, L. W., Schine, N., Baum, C., Jia, N., Simon, J.
  2020; 582 (7810): 41-+
- **Photonic materials in circuit quantum electrodynamics** *NATURE PHYSICS*
  Carusotto, I., Houck, A. A., Kollar, A. J., Roushan, P., Schuster, D. I., Simon, J.
  2020; 16 (3): 268-279
- **Interacting Floquet polaritons** *NATURE*
  Clark, L. W., Jia, N., Schine, N., Baum, C., Georgakopoulos, A., Simon, J.
  2019; 571 (7766): 532-+
- **Topological photonics** *REVIEWS OF MODERN PHYSICS*

Ozawa, T., Price, H. M., Amo, A., Goldman, N., Hafezi, M., Lu, L., Rechtsman, M. C., Schuster, D., Simon, J., Zilberberg, O., Carusotto, I.
2019; 91 (1)

- **A dissipatively stabilized Mott insulator of photons** *NATURE*
  Ma, R., Saxberg, B., Owens, C., Leung, N., Lu, Y., Simon, J., Schuster, D. I.
  2019; 566 (7742): 51-57
- **Electromagnetic and gravitational responses of photonic Landau levels** *NATURE*
  Schine, N., Chalupnik, M., Can, T., Gromov, A., Simon, J.
  2019; 565 (7738): 173-+
- **Probing the Berry curvature and Fermi arcs of a Weyl circuit** *PHYSICAL REVIEW B*
  Lu, Y., Jia, N., Su, L., Owens, C., Juzeliunas, G., Schuster, D., Simon, J.
  2019; 99 (2)
- **A strongly interacting polaritonic quantum dot** *NATURE PHYSICS*
  Jia, N., Schine, N., Georgakopoulos, A., Ryou, A., Clark, L. W., Sommer, A., Simon, J.
  2018; 14 (6): 550-554
- **Synthetic Landau levels for photons** *NATURE*
  Schine, N., Ryou, A., Gromov, A., Sommer, A., Simon, J.
  2016; 534 (7609): 671-675