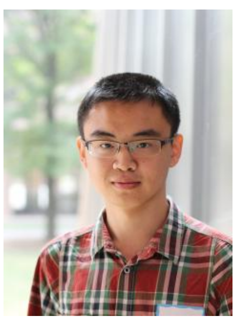
Joseph Taylor Graduate Student Fellowship

2019 Recipient

Benjamin Weiner works on theoretical questions at the interface of physics and biology. He is interested in how living systems use physical principles to self-organize. He has studied how the collective properties of ecosystems are shaped by biophysical constraints such as energy fluxes and spatial structure. He demonstrated that a spatially-varying environment can reduce biodiversity but render it more robust, a counterintuitive result that requires recognizing ecological interactions as physical processes. More recently he has focused on the emergence of spatial organization within eukaryotic cells. Cells must compartmentalize biomolecules to function and grow, and recent experiments have highlighted the major organizational role played by dynamic liquid droplets. These "membraneless organelles" arise via intracellular phase transitions, and Ben is studying how the genetic information encoded in protein sequences governs the statistical physics of such transitions. He is advised by Professor Ned Wingreen.

2018 Recipients

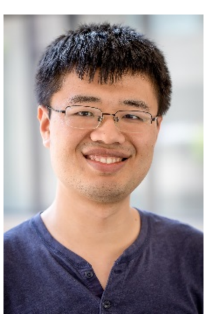
Stephane Cooperstein is an experimentalist in high energy physics, working for the Compact Muon Solenoid (CMS) experiment at CERN. His primary research focus has been the search for the Higgs boson decay to bottom quarks. More than half of the Higgs bosons produced at the LHC decay to a bottom quark-antiquark pair, however it is experimentally very difficult to differentiate these events from other Standard Model processes with similar topologies and production rates many orders of magnitude larger. His work has recently culminated in the first observation of the Higgs decay to bottom quarks. This discovery opens the door to an era of precision measurements of the Higgs boson in its dominant decay channel. It also allows for the indirect constraint of the Higgs coupling to beyond the Standard Model particles at a level better than ever before. He has performed this work under the supervision of Professor James Olsen.



Jingyu Luo is an experimentalist in high energy physics and works in Prof. Dan Marlow's group. His research focuses on hadron particle physics. More specifically, he works on the CMS experiment, one of the two general purpose detectors at the large hadron collider (LHC). His contributions include the luminosity measurement based on the pixel cluster counting, which is one of the main components of the CMS offline luminosity data and is important for physics results of CMS. He also conducted a search for long-lived particles decaying to displaced jets with the CMS detector. There are a large number of physics cases beyond the standard model of the particle physics predicting the existence of displaced jet signatures (like supersymmetry with small R-parity violation, or with heavy intermediate states). The search provides a powerful tool to probe new physics in these scenarios.

2017 Recipient

Xiao Mi is an experimentalist in condensed matter physics, working on quantum information processing using single

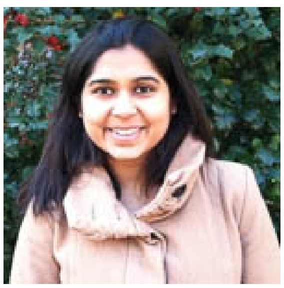


electrons confined in silicon gate-defined quantum dots. The zero nuclear spin carried by the natural abundant isotope of silicon, ^{28}Si, minimizes the effects of hyperfine-induced dephasing of electron spins, which have extraordinarily long coherence times. Xiao works on coupling silicon spin qubits to single photons confined within superconducting cavities, which can be used for quantum non-demolition readout of spin qubits and serve as a quantum bus connecting distant spin qubits. He has demonstrated the first device achieving the strong-coupling regime between a semiconductor electron and a microwave photon, in which the photonic degree of freedom is coherently hybridized with the electron charge. More recently, he has used the new hybrid quantum device to perform high resolution spectroscopy of valley states in silicon and been working toward improving the device architecture to couple the spin state of a silicon electron to a cavity photon.

2015 Recipient

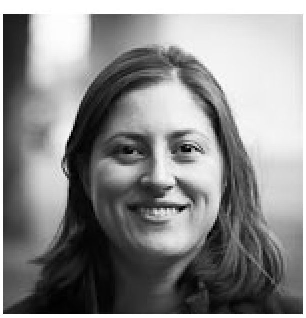
Max Hirschberger's research is in experimental condensed matter physics. In close collaboration with Professor Cava's Chemistry Department group, he has investigated heat transport phenomena related to the quantum-mechanical concept of the Berry curvature. He has studied the anomalous Lorentz-force in ferromagnetic insulators, where for certain crystal structures magnons can be deflected by a magnetic field - even though magnons have no electric charge. Similarly, he has shown that such a Lorentz force also exists in some frustrated magnets, where magnetic interactions are strong but there is no long-range order even at the lowest temperatures. The existence and magnitude of this anomalous Lorentz force in frustrated magnets can guide us to a better understanding of their quantum-mechanical ground state and elementary excitations. More recently, Max has devoted his time to the study of new electronic materials, the so-called Dirac and Weyl semimetals. These are 3-dimensional analogues of graphene. He is a graduate student in Professor Ong's laboratory.

2014 Recipient



Vedika Khemani is a condensed matter theorist. Her research spans several topical and active areas of Condensed Matter Physics---the theory of topological phases, the role of entanglement in the quantum mechanics of many-body systems and the behavior of isolated quantum systems out of equilibrium. Her work has elucidated out of equilibrium behavior of systems near critical points including systems with topological order, established limits on the universality of the entanglement spectra of many-body quantum states and shown that large subsystems of even larger quantum systems can be described accurately by pure quantum states despite being entangled with their complements. Currently she is focused on better understanding the phenomenon of many-body localization in which certain quantum systems fails to obey statistical mechanics and are found generically in non-equilibrium states. Her work has elucidated ordering in such systems and established their surprising non-local response to local probes and she is engaged in developing computational tools to better understand their properties.

2013 Recipients



Jon Gudmundsson and **Alexandra (Sasha) Rahlin** share the inaugural award of the Joseph Taylor Graduate Student Fellowship. Jon and Alexandra work together and with colleagues on measuring and understanding the cosmic microwave background (CMB), the faint remnant radiation from the Big Bang. Their research uses the CMB to probe fundamental problems physics that blur the distinction between cosmology and particle physics. More specifically they work on SPIDER, a stratospheric balloon-borne millimeter wavelength polarimeter that is designed to image the temperature and polarization anisotropy in the CMB with unprecedented accuracy and sensitivity on scales larger than a half degree. SPIDER's primary goal is to measure or limit the presence of gravitation radiation generated in the very early universe. SPIDER is scheduled to fly from Antarctica on its maiden voyage in late 2013 or early 2014. In addition, both Jon and Alexandra work on the analysis of data from the HFI instrument aboard the Planck satellite. They are members of Prof. Jones's experimental cosmology group.