Statement of Scholarship

I have been involved with the CUORE (Cryogenic Underground Observatory for Rare Events) experiment at the University of California, Los Angeles since 2016. The main objective of the CUORE experiment is to hunt for neutrinoless double beta ($0\nu\beta\beta$) decay using ^{130}Te. My work in the collaboration involves development of the Geant4 Monte Carlo simulation together with a graduate student colleague to better understand the radioactive backgrounds in the detector. The energy spectrum of the backgrounds in the so called alpha region ($\gtrsim 2.5\,\mathrm{MeV}$) exhibit peculiar features that, if understood correctly will better explain the types of background sources and their distributions in the various parts and materials comprising the detector. This can help us to better understand our backgrounds and to extrapolate this knowledge to the energy region of interest (2465 keV to 2575 keV) for $0\nu\beta\beta$ decay search in ^{130}Te. I have previously also mentored 2 undergraduate students and worked together with them to simulate and test new radioactivity shielding schemes for further background reduction in future $0\nu\beta\beta$ decay experiments that are to follow CUORE. The ultimate goal of this endeavor is to enable our laboratory to become the leading experts in this field at UCLA.

In order to promote more dialogue and efficient teamwork, I have also organized and led weekly Physics paper discussion group sessions involving both undergraduate and graduate students in our laboratory at UCLA. These sessions have helped us not only to know our own experiment better, but to increase our common understanding of the overall field of experimental $0\nu\beta\beta$ decay search. Ultimately this has been invaluable for our team to increase our teamwork and productivity, and become a valuable contributor to the CUORE experiment. A paper for our first $0\nu\beta\beta$ analysis using CUORE data was submitted for publication to PRL in late 2017, and is currently under review (https://arxiv.org/abs/1710.07988).

In addition, I have worked as the lead Geant4 simulation designer for the mini-TimeCube collaboration at University of Hawaii at Manoa. mini-TimeCube is an ambitious project to build the world's smallest portable neutrino detector. In this project, I mentored 3 undergraduate students and worked in collaboration with them to conduct case studies for optimizing the detector design, test candidate neutron capture doping elements in plastic scintillator, and simulate the response of the multi-channel-plate (MCP) PMTs deployed in the detector. These studies were used during construction of the detector, and to develop directional algorithms that are now being tested in analyses of neutrons from test sources as well as neutrinos from nuclear reactors. Working with the mini-TimeCube project has further involved designing and fabricating PCB boards as well as contributing to the FPGA firmware for the readout electronics. A paper summarizing our accomplishments was published in 2016 (V. A. Li et al. Invited Article: miniTimeCube. Rev. Sci. Instrum., 87(2):021301, 2016, 1602.01405).

Finally, my work in scintillator R&D for HanoHano, a proposed 10 kt-scale deep-sea based neutrino detector, involved designing and building apparatuses using CAD for measuring light output of Linear alkylbenzene (LAB) based liquid scintillators when put in large electric potential gradients as well as testing their light transmissivities under extreme temperatures and pressures such as those found in deep-sea environments. This project included mentoring an undergraduate student on techniques for shielding electronic apparatuses and working with another graduate student on designing and operating the cold high pressure environment device.