Michinari Sakai

michsakai@ucla.edu • 808-206-4357

Education

PhD, Experimental Particle/Neutrino Physics 2016
GPA: 4.0/4.0, University of Hawaii at Manoa
Dissertation: High Energy Neutrino Analysis at KamLAND and Application to Dark Matter Search

Graduate Program in Mathematics 2006
GPA: 4.5/4.5, Sun Moon University, S. Korea

Double BS, Physics and Mathematics 2005
GPA: 4.3/4.5, Sun Moon University, S. Korea
President's Award 2005, Award for Outstanding Academic Achievement – Samsung Corp.

Teaching Experience

Teaching Assistant, *University of Hawaii at Manoa* 2007 - 2009

- Planned classwork and taught 2 weekly undergraduate Physics Laboratory classes of over 20 students each for 3 semesters, received "excellent" reviews
- Mentored undergraduate students in undergraduate Physics classwork for 2 hours each week for 3 semesters, got students repeatedly seeking my particular tutoring

Mentor, *University of California, Los Angeles, (UCLA)* 2016 - *Current*

- Taught weekly Geant4 simulation tutorials to 3 PhD students and 3 undergraduate students for 1 semester, students are now able to take on simulation tasks and collaborate in the group
- Led weekly Physics paper discussion groups for 3 PhD students, and promoted team work to increase dialogue and productivity within team

Research Experience

CUORE (Cryogenic Underground Observatory for Rare Events) Apr. 2016 - *Current*
Post-doctoral Scholar, UCLA

- Spearheading development of precision alpha background modeling in collaboration with a graduate student with goal for further background reduction to cover inverted neutrino mass hierarchy for $0\nu\beta\beta$ decay
- Mentored and worked with 2 undergraduate students for investigation of shielding structures to mitigate γ and beta backgrounds for next generation $0\nu\beta\beta$ decay searches requiring ultra-low background levels

Mini-TimeCube (Portable Neutrino Detector) 2009 - 2016
Research Assistant, University of Hawaii at Manoa

- Led development of Geant4 detector simulation and mentored 3 undergraduate students to contribute to the overall detector design
- Was responsible for background studies associated with long lived cosmogenic isotopes 8He/9Li, to quantitatively determine effect on detector live time

KamLAND (Kamioka Liquid Scintillator Antineutrino Detector) 2009 - 2016
Research Assistant, University of Hawaii at Manoa

- Spearheaded development of novel directional neutrino detection technique in scintillator and demonstrated with data that this can be used to conduct dark matter searches in scintillator
- Led unprecedented particle ID capability studies in scintillator using track profile reconstruction techniques using never before observed T2K events spilling into KamLAND
- Was solely responsible for high energy ($\gtrsim$1 GeV) energy calibration using cosmic ray muons and applying this to neutrino analysis for the first time

Skills

Human Languages:	English (native), Japanese/Korean (trilingual proficiency)
Programming Languages:	Proficient in C, C++, Python, Fortran, Mathematica, Bash
Software/Tools:	ROOT, Geant4, Pads, AutoCAD

Invited Talks and Presentations

- Division of Nuclear Physics, Pittsburgh/Carnegie Mellon University — Oct 2017
  Talk: CUORE and Background Reduction Case Studies for CUPID
- Conference on Science at SURF, South Dakota — May 2017
  Invited talk: Status of the CUORE $0\nu\beta\beta$ Decay Search
- Fermilab - Frontiers of Liquid Scintillator Technology — Mar 2016
  Invited talk: Particle ID and event reconstruction algorithms in scintillator
- DOE project review, Honolulu, Hawaii — Jul 2015
  Talk: High Energy Analysis and Application to Dark Matter Search in KamLAND
- Neutrino, Kyoto, Japan — Jun 2012
  Poster: Indirect Dark-Matter Detection Through KamLAND
- University of Hawaii Campus Open-house — Nov 2010, 2011
  Talks: What is a Neutrino?, mini-TimeCube: The World's Smallest Neutrino Detector
- Applied Antineutrino Physics, Sendai, Japan — Aug 2010
  Talk: mini-TimeCube: A Portable Directional Neutrino Detector
- DOE project review, Honolulu, Hawaii — Sep 2009
  Talk: KamLAND Summary
- Fermilab - International Neutrino Summer School — Jul 2009
  Talk: Student presentation: How to solve θ_{23} degeneracy

Statement of Teaching Philosophy and Experience

Throughout my academic career, I have been heavily involved in teaching and mentoring students from a wide range of cultures and backgrounds. This has included working as a teaching assistant during my graduate studies at University of Hawaii at Manoa where I organized and led 2 undergraduate Physics Laboratory classes of over 20 students each for a total of 3 semesters. In addition, I have also led weekly, 2 hour long, one-on-one tutoring sessions for 3 semesters. The ethnic and cultural atmosphere in Hawaii is one of the most diverse on the planet. The University of Hawaii system not only attracts students internationally from Asia and from around the globe, but also serves as the hub of higher learning for students coming from countries in the Pacific Rim such as the Marshall Islands and Micronesia. In this cultural melting pot, instructors are required to effectively convey information in an inclusive and efficient way while understanding each of the students' cultures and needs as best as possible. For example, these needs may include supplemental instruction if English is not the student's primary language, or additional attention if the student comes from a background where little emphasis is placed on STEM fields. Student evaluations for the effectiveness of my teaching and ability to communicate were "excellent".

My philosophy for teaching undergraduate Physics is to never get bogged down by the theory or equations. The primary driving force of a person's ability to learn is one's own self motivated curiosity. No other incentive to learn is more powerful and longer lasting than this. Therefore an instructor's priority at the undergraduate level should be focused on encouraging and cultivating the student's interest and curiosity. When I begin a class or introduce a new concept to students, I never begin with equations. I always first show them the experiment itself or introduce the context in an illustrative way. This is to engage the students' interest and entice their curiosity before going into anything that may slow them down and deter their motivation. Curiosity is where science is born from and curiosity is what drives science forward. This is true whether one is an undergraduate student or a Nobel laureate.

In society today, there is an unfortunate misconception that Physics is a difficult subject and that it is only for *smart* students. Nothing could be further from the truth. When students feel that they are not good enough or smart enough to follow the class, it is important to let them know that Physics is not about intelligence, but about curiosity driven diligence and hard work. All professional Physicists today stand on the shoulders of the giants of the past, and almost no research is done solely alone, but through collaboration and teamwork. No one is *smart* enough to do all the work by one's self. I usually use myself as an example. I could not attend a leading world-class research institute during my undergraduate school days, but I believe through diligence and hard work, I have had the opportunity to work with some of the most talented and innovative Physicists in the field.

Finally, my experience in mentoring students has also included teaching Geant4 Monte Carlo particle simulations to 3 undergraduate and 3 Ph.D. students at the University of California, Los Angeles (UCLA). My method for teaching this simulation coding toolkit is to learn together with the students by going into the gritty details of the code together. This is because learning how to code is not just about acquiring the skill to code, but about learning the culture of coding. By this I mean that there are certain useful tools and methods of accomplishing a task that can only be learned through going into the gritty details and getting *dirty* with someone more knowledgeable than you instead of learning from a straightforward top-down approach. This can be summed up in the popular saying: "looking at someone else coding is the best way to learn how to code". Through this method my students have grown to successfully been able to take on simulation tasks of their own and contribute effectively to the collaboration.

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.

References

Supplied upon request or please contact in person.

Huan Z. Huang	Professor, University of California, Los Angeles, +1-310-825-9297 huang@physics.ucla.edu
John G. Learned	Professor, University of Hawaii at Manoa, +1-808-956-2964 jgl@phys.hawaii.edu
Yury Kolomensky	Professor, University of California, Berkeley, +1-510-642-9619 ygkolomensky@lbl.gov
Brian K. Fujikawa	Staff Scientist, Lawrence Berkeley National Laboratory, +1-510-486-4398 bkfujikawa@lbl.gov
Lindley Winslow	Jerrold R. Zacharias Assistant Professor, MIT, +1-617-253-2332 lwinslow@mit.edu
Thomas O'Donnell	Assistant Professor, Virginia Tech, +1-540-231-3308 todonnell@vt.edu