Michinari Sakai

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Summary

- Expertise in Geant4 particle transport simulations with 8 years of experience.
- Experience with cosmogenic and nuclear decay radiation in 3 multinational particle/nuclear physics experiments.
- Innovative problem solving skills with the ability to interface original work with larger collaboration.

Experience

UC Berkeley — Post-doctoral Scholar June 2018 — *Current*

- Modeling and calibration of ^{238}U/^{232}Th decay radiation induced energy depositions in detector materials.
- Lead researcher for characterization of micro-physical optical properties of wavelength shifter thinfilms.
- Supervisor for Geant4 modeling of photon interactions with wavelength shifters and detector materials.

UCLA — Post-doctoral Scholar 2016 — 2018

- Lead developer of precision α decay spectrum model to improve characterization of $\alpha/\beta/\gamma$ backgrounds in $0\nu\beta\beta$ decay searches.
- Mentor for 2 PhD students to simulate radiation shielding structures in Geant4 to mitigate γ/β backgrounds for next generation $0\nu\beta\beta$ searches requiring ultra-low radiation backgrounds.

University of Hawaii at Manoa — Research Assistant 2009 — 2016

- Spearheaded development of a novel directional neutrino detection technology in scintillator and demonstrated with data for the first time that this can be applied to conduct indirect dark matter searches in scintillator. First ever physics application of neutrino directionaly in scintillator. Paper in preparation.
- Lead developer of Geant4 detector simulation to conducted case studies of neutron capture doping agents in solid scintillator. Simulation results were later used to oversee detector design and construction.

Skills

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

Leadership and Communacation

Mentor — *UC Berkeley, UCLA* March 2016 — *Current*

- Advised 2 students with Geant4 based optical simulation for current hardware project. Students are now undertaking independent research tasks and contribution original work.
- Taught weekly Geant4 tutorials to 3 PhD-level students for a semester. Students successfully learned to take on independent radiation modeling projects.

Teaching Assistant — *University of Hawaii at Manoa* 2007 — 2009

- Planned coursework and taught 2 weekly physics laboratory curriculum for classes of over 20 students each for 3 semesters. Received especially positive reviews for clarity of explanation of material, and teaching style.

Education

PhD, Experimental Particle Physics 2016

GPA: 3.97/4.00, University of Hawaii at Manoa

Dissertation: High Energy Neutrino Analysis at KamLAND and Application to Dark Matter Search

Double BS, Physics and Mathematics 2005

GPA: 4.33/4.50, Sun Moon University, S. Korea

President's Award 2005, Award for Outstanding Academic Achievement – Samsung Corp.

Oral Presentations and Posters

- Invited Talk: Results from the CUORE experiment — May 2019
  Sanford Underground Research Facility (SURF), South Dakota - Conference on Science at SURF 2019
- Seminar: Search for Physics Beyond the Standard Model with Neutrinos — May 2018
  Lawrence Livermore National Laboratory
- Invited Talk: Monte Carlo Tools in CUORE — Apr 2018
  Durham University, UK - Monte Carlo Tools for Beyond the Standard Model Physics
- Seminar: CUORE: A Bolometric Search for Lepton Number Violation — Feb 2018
  Argonne National Laboratory
- Talk: CUORE and Background Reduction Case Studies for CUPID — Oct 2017
  Pittsburgh/Carnegie Mellon University - Division of Nuclear Physics 2017
- Invited talk: Status of the CUORE $0\nu\beta\beta$ Decay Search — May 2017
  Sanford Underground Research Facility (SURF), South Dakota - Conference on Science at SURF 2017
- Invited talk: Particle ID and event reconstruction algorithms in scintillator — Mar 2016
  Fermilab - Frontiers of Liquid Scintillator Technology
- Seminar: High Energy Analysis at KamLAND and Application to Dark Matter Search — Nov 2015
  Los Alamos National Laboratory
- Seminar: High Energy Analysis at KamLAND and Application to Dark Matter Search — Nov 2015
  California Institute of Technology
- Seminar: High Energy Analysis at KamLAND and Application to Dark Matter Search — Oct 2015
  University of California, Los Angeles
- Talk: High Energy Analysis and Application to Dark Matter Search in KamLAND — Jul 2015
  University of Hawaii at Manoa - DOE project review
- Poster: Indirect Dark-Matter Detection Through KamLAND — Jun 2012
  Neutrino 2012, Kyoto, Japan
- Talks: What is a Neutrino?, mini-TimeCube: The World's Smallest Neutrino Detector — Nov 2010/2011
  University of Hawaii at Manoa - Campus Open-house
- Talk: mini-TimeCube: A Portable Directional Neutrino Detector — Aug 2010
  Applied Antineutrino Physics 2010, Sendai, Japan
- Talk: KamLAND Summary — Sep 2009
  University of Hawaii at Manoa - DOE project review
- Talk (Student Presentation): How to solve θ_{23} degeneracy — Jul 2009
  Fermilab - International Neutrino Summer School 2009

PUBLICATIONS

[1] M. Sakai (corresponding author) *et al.*, "Directional Neutrino Detection and Topological Event Reconstruction Methods for GeV Scale Neutrinos in KamLAND," *Draft currently in preparation*, 2019 (tentative).

[2] C. Alduino *et al.*, "Study of Rare Nuclear Processes with CUORE," *Submitted to: Int. J. Mod. Phys. A*, 2018. https://arxiv.org/abs/1801.05403.

[3] C. Alduino *et al.*, "First Results from CUORE: A Search for Lepton Number Violation via $0\nu\beta\beta$ Decay of ^{130}Te," *Phys. Rev. Lett.*, vol. 120, no. 13, p. 132501, 2018. https://journals.aps.org/prl/abstract/10.1103/PhysRevLett.120.132501.

[4] C. Alduino *et al.*, "Search for Neutrinoless β^+EC Decay of ^{120}Te with CUORE-0," 2017. https://journals.aps.org/prc/abstract/10.1103/PhysRevC.97.055502.

[5] C. Alduino *et al.*, "Low Energy Analysis Techniques for CUORE," *Eur. Phys. J.*, vol. C77, no. 12, p. 857, 2017. https://link.springer.com/article/10.1140/epjc/s10052-017-5433-1.

[6] C. Alduino *et al.*, "CUORE sensitivity to $0\nu\beta\beta$ decay," *Eur. Phys. J.*, vol. C77, no. 8, p. 532, 2017. https://link.springer.com/article/10.1140/epjc/s10052-017-5098-9.

[7] C. Alduino *et al.*, "The projected background for the CUORE experiment," *Eur. Phys. J.*, vol. C77, no. 8, p. 543, 2017. https://link.springer.com/article/10.1140/epjc/s10052-017-5080-6.

[8] V. A. Li *et al.*, "Invited Article: miniTimeCube," *Rev. Sci. Instrum.*, vol. 87, no. 2, p. 021301, 2016. https://aip.scitation.org/doi/abs/10.1063/1.4942243.

[9] A. Gando *et al.*, "Search for electron antineutrinos associated with gravitational wave events GW150914 and GW151226 using KamLAND," *Astrophys. J.*, vol. 829, no. 2, p. L34, 2016. https://aip.scitation.org/doi/abs/10.1063/1.4942243.

[10] K. Asakura *et al.*, "Search for the proton decay mode $p \to \overline{\nu}K^+$ with KamLAND," *Phys. Rev.*, vol. D92, no. 5, p. 052006, 2015. https://journals.aps.org/prd/abstract/10.1103/PhysRevD.92.052006.

[11] K. Asakura *et al.*, "KamLAND Sensitivity to Neutrinos from Pre-Supernova Stars," *Astrophys. J.*, vol. 818, no. 1, p. 91, 2016. https://iopscience.iop.org/article/10.3847/0004-637X/818/1/91.

[12] C. Lane *et al.*, "A new type of Neutrino Detector for Sterile Neutrino Search at Nuclear Reactors and Nuclear Nonproliferation Applications," 2015. https://arxiv.org/abs/1501.06935.

[13] K. Asakura *et al.*, "Study of electron anti-neutrinos associated with gamma-ray bursts using KamLAND," *Astrophys. J.*, vol. 806, no. 1, p. 87, 2015. https://iopscience.iop.org/article/10.1088/0004-637X/806/1/87/meta.

[14] T. I. Banks *et al.*, "A compact ultra-clean system for deploying radioactive sources inside the KamLAND detector," *Nucl. Instrum. Meth.*, vol. A769, pp. 88–96, 2015. https://www.sciencedirect.com/science/article/pii/S0168900214011000.

[15] A. Gando *et al.*, "^{7}Be Solar Neutrino Measurement with KamLAND," *Phys. Rev.*, vol. C92, no. 5, p. 055808, 2015. https://journals.aps.org/prc/abstract/10.1103/PhysRevC.92.055808.

[16] S. Abe *et al.*, "Measurement of the 8B Solar Neutrino Flux with the KamLAND Liquid Scintillator Detector," *Phys. Rev.*, vol. C84, p. 035804, 2011. https://arxiv.org/abs/1106.0861.

[17] J. Kumar, J. G. Learned, M. Sakai, and S. Smith, "Dark Matter Detection With Electron Neutrinos in Liquid Scintillation Detectors," *Phys. Rev.*, vol. D84, p. 036007, 2011. https://journals.aps.org/prd/abstract/10.1103/PhysRevD.84.036007.

Statement of Research

I have a strong background in radiation/particle transport simulations and how they affect real hardware in particle detectors. My expertise also involves processing and analyzing large-scale physics data using analysis tools such as ROOT and Python. I have experience working in 3 multinational collaboration physics experiments where I spearheaded independent research initiatives and successfully interfaced my original work with the larger team. Some of my past accomplishments that I take pride in include development of unprecedented particle detection algorithms that I project will open whole new physics searches by the collaborations that I have worked with.

I have been involved with the CUORE (Cryogenic Underground Observatory for Rare Events) experiment at the University of California, Los Angeles, and University of California, Berkeley since 2016. The main objective of the CUORE experiment is to observe neutrinoless double beta ($0\nu\beta\beta$) decay in ^{130}Te, one of the most rarest processes thought to occur in nature. My work in the collaboration involves modeling and calibration of ^{238}U/^{232}Th decay radiation induced energy depositions in detector materials. The energy spectrum of the background isotopes that produce α dauthers ($\gtrsim$ 2.7 MeV) exhibit peculiar features that, if understood correctly, will better explain the types of contamination sources and their distributions in the materials comprising the experiment. This can help us to better understand our background sources and extrapolate this understanding to the energy region of interest (2465 keV to 2575 keV) for $0\nu\beta\beta$ decay in ^{130}Te. I have previously also mentored 2 undergraduate students and worked together with them to simulate and investigate new radiation shielding schemes for further background reduction in future $0\nu\beta\beta$ decay experiments requiring ultra-low radiation backgrounds. A paper for our first $0\nu\beta\beta$ analysis using CUORE data was published in March 2018 (https://arxiv.org/abs/1710.07988).

I led the development of the Geant4 simulation code for the mini-TimeCube (mTC) experiment at the University of Hawaii at Manoa from 2009 to 2016. mTC was an ambitious project to build the world's smallest portable neutrino detector. In this project, I mentored 3 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) photomultiplier tubes (PMTs) deployed in the detector. The studies were used to develop directional particle detection algorithms and to guide the overall design of the detector during its construction phase. I have also conducted radiation effects studies for cosmic-ray muons and long-lived cosmogenic background isotopes such as ^{8}He and ^{9}Li. These backgrounds are extremely difficult to tag due to their long life-time ($\gtrsim$ s scale) and travel distances. The studies have been vital to the project. A paper summarizing our accomplishments was published in 2016 (V.A. Li et al. Feb 3, 2016. 19 pp. Rev.Sci.Instrum. 87 (2016) no.2, 021301).

While working at the University of Hawaii at Manoa, I also developed a novel directional event reconstruction algorithm for high-energy $\gtrsim$GeV scale neutrinos while working with KamLAND (Kamioka Liquid Scintillation Antineutrino Detector), and demonstrated with data that this technique can be applied to indirect dark matter search by looking for a directional flux of neutrinos from the core of the Sun and Earth. Studies done with Monte Carlo suggest that the accuracy of deducing the neutrino direction using this new method is better than that of water-Cherenkov detectors (the conventional method for directional neutrino detection) by $\sim$10° in this energy regime. This method was verified using never before observed neutrino events spilling into KamLAND from the T2K neutrino beam-line. The results were consistent with expectation. According to my knowledge, this is the first ever physics application of neutrino directionality in scintillator.

In summary my strong background in radiation/particle transport simulations and how they affect real hardware, as well as, my extensive experience in using tools to analyze large-scale physics data makes me a strong candidate. Also I would like to reemphasize my previous accomplishments in innovating novel particle detection techniques to solve complex problems and interface my original work with a large team of collaborators. I believe I can make a significant impact in your team.

References

Supplied upon request or please contact in person.

Huan Z. Huang — Professor, University of California, Los Angeles, +1-310-825-9297
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475 Portola Plaza #5-136, Los Angeles, CA 90095-1547, USA

John G. Learned — Professor, University of Hawaii at Manoa, +1-808-956-2964
jgl@phys.hawaii.edu
2505 Correa Rd. #327, Honolulu, Hawaii 96822, USA

Student No. 17451385
Date of Birth: 16-OCT

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Date Issued: 25-JAN-2018

Record of: Michinari Sakai
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Honolulu, HI 96817

Issued To: MICHINARI SAKAI
15232 MARTHA ST APT 15
Van Nuys, CA 91411-3201

Course Level: Graduate

Comments:
SUN MOON UNIVERSITY, KOREA - BS 2005

Degree Awarded: Doctor of Philosophy 14-MAY-2016
Major : Physics

Dissertation
"High Energy Neutrino Analysis at Kamland
and Application to Dark Matter Search."

Chairperson-John Learned

INSTITUTION CREDIT:

SUBJ NO.	COURSE TITLE	CRED GRD	PTS R
Fall 2007			
ADMITTED - DOCTORAL PROGRAM 08/20/07			
PHYS 400	Appl of Math in Physical Sci	3.00 A+	12.00
PHYS 610	Anlytical Mechanics I	3.00 A	12.00
Ehrs: 6.00 GPA-Hrs: 6.00 QPts: 24.00 GPA: 4.00			
Spring 2008			
PHYS 311	Theoretical Mechanics II	3.00 A	12.00
PHYS 430	Thermodynamics & Stat Mechanic	3.00 A-	11.10
PHYS 450	Electromagnetic Waves	3.00 A	12.00
Ehrs: 9.00 GPA-Hrs: 9.00 QPts: 35.10 GPA: 3.90			
Fall 2008			
PHYS 650	Electrodynamics I	3.00 A+	12.00
PHYS 670	Quantum Mechanics	3.00 A	12.00
Ehrs: 6.00 GPA-Hrs: 6.00 QPts: 24.00 GPA: 4.00			

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Institution Information continued:

SUBJ NO.	COURSE TITLE	CRED GRD	PTS R
Spring 2009			
PHYS 600	Methods of Theoretical Physics	3.00 A+	12.00
PHYS 651	Electrodynamics II	3.00 A	12.00
PHYS 671	Quantum Mechanics	3.00 A-	11.10
Ehrs: 9.00 GPA-Hrs: 9.00 QPts: 35.10 GPA: 3.90			
Fall 2009			
PHYS 460	Physical Optics	3.00 A	12.00
PHYS 690	Seminar	1.00 CR	0.00
PHYS 699	Directed Research	3.00 A	12.00
PHYS 711	Topics in Particles and Fields	3.00 A	12.00
PHYS 772	Quantum Field Theory I	3.00 A	12.00
Ehrs: 13.00 GPA-Hrs: 12.00 QPts: 48.00 GPA: 4.00			
Spring 2010			
PHYS 660	Advanced Optics	3.00 B+	9.90
PHYS 699	Directed Research	3.00 A	12.00
PHYS 712	Spec Tpc: Experimental Physics	3.00 A	12.00
PHYS 773	Quantum Field Theory II	3.00 A	12.00
Ehrs: 12.00 GPA-Hrs: 12.00 QPts: 45.90 GPA: 3.82			
Fall 2010			
COMPREHENSIVE EXAMINATION PASSED 11/24/10			
PHYS 699	Directed Research	3.00 A	12.00
PHYS 777	Nuclear & Particle Physics I	3.00 A	12.00
Ehrs: 6.00 GPA-Hrs: 6.00 QPts: 24.00 GPA: 4.00			
Spring 2011			
PHYS 699	Directed Research	9.00 A	36.00
Ehrs: 9.00 GPA-Hrs: 9.00 QPts: 36.00 GPA: 4.00			

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REGISTRAR

ISSUED TO STUDENT

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Student No. 17451385
Date of Birth: 16-OCT

Date Issued: 25-JAN-2018

Record of: Michinari Sakai
Level: Graduate

SUBJ NO.	COURSE TITLE	CRED GRD	PTS R
Institution Information continued:			
Ehrs: 6.00 GPA-Hrs: 6.00 QPts: 24.00 GPA: 4.00			
Fall 2015			
PHYS 800	Dissertation Research	9.00 S	0.00
Ehrs: 9.00 GPA-Hrs: 0.00 QPts: 0.00 GPA: 0.00			
Spring 2016			
Degree Conferred 05/14/16			
PHYS 800	Dissertation Research	1.00 S	0.00
Ehrs: 1.00 GPA-Hrs: 0.00 QPts: 0.00 GPA: 0.00			
Fall 2011			
PHYS 475	Electronics for Physicists	3.00 A	12.00
PHYS 699	Directed Research	6.00 A	24.00
Ehrs: 9.00 GPA-Hrs: 9.00 QPts: 36.00 GPA: 4.00			
Spring 2012			
PHYS 476	Mod Electronics for Physicists	3.00 A	12.00
PHYS 699	Directed Research	6.00 A	24.00
Ehrs: 9.00 GPA-Hrs: 9.00 QPts: 36.00 GPA: 4.00			
Fall 2012			
PHYS 699	Directed Research	6.00 A	24.00
Ehrs: 6.00 GPA-Hrs: 6.00 QPts: 24.00 GPA: 4.00			
Spring 2013			
PHYS 699	Directed Research	9.00 A	36.00
Ehrs: 9.00 GPA-Hrs: 9.00 QPts: 36.00 GPA: 4.00			
Fall 2013			
PHYS 699	Directed Research	12.00 A+	48.00
Ehrs: 12.00 GPA-Hrs: 12.00 QPts: 48.00 GPA: 4.00			
Spring 2014			
PHYS 699	Directed Research	9.00 A	36.00
Ehrs: 9.00 GPA-Hrs: 9.00 QPts: 36.00 GPA: 4.00			
Fall 2014			
PHYS 699	Directed Research	9.00 A+	36.00
Ehrs: 9.00 GPA-Hrs: 9.00 QPts: 36.00 GPA: 4.00			
Spring 2015			
PHYS 699	Directed Research	6.00 A	24.00

********** CONTINUED ON NEXT COLUMN **********

********** TRANSCRIPT TOTALS **********

	Earned Hrs	GPA Hrs	Points	GPA
TOTAL INSTITUTION	149.00	138.00	548.10	3.97
TOTAL TRANSFER	0.00	0.00	0.00	0.00

********** END OF TRANSCRIPT **********

REGISTRAR

ISSUED TO STUDENT

THE COLLEGE NAME APPEARS IN GREEN PRINT ACROSS THE FACE OF THIS RECORD

TRANSCRIPT RECORD

No. B06-7745
Date. June 21, 2006

SUN MOON UNIVERSITY

Name	SAKAI MICHINARI	sex	Male	Date of Birth	October 16, 1980
				Date of Admission	March 2, 2001
Department	NATURAL SCIENCE			graduation	August 19, 2005

Subject	Grade	Credits
Total recognition: 0		
2001 Year 1st Semester		
Bible and Divine Principle I	B+	2
Chapel	P	
Calculus I	A+	3
General Chemistry I	A+	3
Information Processing I	A+	3
The Understanding of Myungsimbogam	A+	3
Freshman English I	A+	3
General Physics and Physics Experiment I	A+	3
Total	4.4	20
2001 Year 1st Semester		
AUF Inernational Fellowship Program	A+	2
Total	4.5	2
2001 Year 2nd Semester		
Bible and Divine Principle II	A+	2
Chapel	P	
Science and Philosophy	A+	3
Introcuction To The Creativity	A+	3
Information Processing II	B+	3
General Physics and Physics Experiment II	A+	3
General Chemistry II	A+	3
Calculus II	A+	3
Total	4.35	20
2002 Year 2nd Semester		
Chapel	P	
Electromagnetic Engineering	A+	3
Introduction to Mathematical Physics II	A+	3
Digital Circuits Lab.	A+	2
Vacuum Science	B	3
Conternporary Modern Western Philosophy	B+	3
Digital Circuit	A+	3
Korea Global Issues	B	3
Total	3.9	20
2003 Year 1st Semester		
Chapel	P	
Sensor and Vacuum Experiments	A+	3
Thermal and Statistical Mechanics	A	3
Introduction to Modern Optics	A+	3
Real Analysis I	A	3
Analytical Geometry	A+	3
Chinese I	A+	3
Fineart Life	A+	2
Total	4.35	20
2003 Year 2nd Semester		
Chapel	P	
Japanese II	A+	3
Introduction to Quantum Mechanics	A+	3
Application of Photo-electrical Experiments	A+	3
Differential Equations	A+	3
Laser Physics	A+	3
Real Analysis II	A+	3
Em-Yang constitution and health	B+	2
Total	4.4	20
2004 Year 1st Semester		
Chapel	P	
Solid State Physics	A+	3
Experiments in Physical Prorerties of Materials I	A+	3
Introduction to Material Science	A+	3
Linear Algebra	A+	3
Number Theory	A+	3
C Programing Language	A	2
Discrete Mathematics	A+	3
Total	4.45	20
2004 Year 2nd Semester		
Applied Linear Algebra	A+	3
Advanced Calculus	A+	3
Statistics	A+	3
Numerical Analysis	A+	3
Digital Control Lab.	A+	3
Fuzzy Theory	A+	3
Total	4.5	18
2005 Year 1st Semester		
Assemble and Application of PC	A	2
Actuarial Mathematics	A+	3
Special Topics in Advanced Materials	A+	3
Chinese II	A	3
Differential Geometry	A+	3
Abstract Algebra I	A+	3
Unification Thought	B+	2
Total	4.26	19

Total Credits : 159
Points : 688.0
Total Grade Average : 4.33(95.8/100)

Remarks:
1. Hours-Per_Week :
   50 Minutes class work per week for 1 semester makes 1 credits. (100 minutes of laboratory work per week for 1 semester makes 1 credit)
2. Week-Per-Year :
   16 weeks make 1 semester and 2 semesters a year
3. Grade Points :
   A+ =95-100, A=90-94, B+ =85-89, B=80-84
   C+ =75-79, C=70-74, D+ =65-69, D=60-64
   The lowest passing grade is D (60)

BONG TAE KIM
President

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