Kazuhiro Terao

Contact Information

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Research Interest

Neutrino oscillation physics, neutrino phenomenology, future neutrino detector R&D, trigger/readout electronics, large scale data production, analysis framework development, deep neural networks and machine learning techniques R&D.

Research Positions

Associate Staff Scientist, *Stanford University* — Jul. 2017 - Present
Elementary Particle Physics Group, SLAC National Laboratory

Postdoctoral Research Scientist, *Columbia University* — Apr. 2013 - Jul. 2017
Nevis Laboratories, Columbia University
Supervisor: Dr. Michael Shaevitz

Research Assistant, Lawrence Berkeley National Lab. — Jan. 2007 - Aug. 2008
Weak Interaction Group, Lawrence Berkeley National Laboratory
Supervisor: Dr. Stuart Freedman

Education

Massachusetts Institute of Technology, Cambridge, MA — 2008 - 2013
Ph.D Physics
Adviser: Dr. Janet Conrad
Thesis: "Measurement of $\sin^2 2\theta_{13}$ Using Delayed Neutron Capture on Hydrogen in Double Chooz"

University of California, Berkeley, Berkeley, CA — 2005 - 2007
B.A. Physics

Awards and Honors

Early Career Award, *U.S. Department of Energy* — 2018
Intensity Frontier Fellowship, *Fermilab* — 2017
University Research Association Visiting Scholar Award, *Fermilab* — 2016
Chateaubriand Fellowship, *French Embassy in U.S.* — 2010
Thomas Frank Fellowship, *MIT* — 2008
Pomerantz Scholarship, *UC Berkeley* — 2007

Workshop and Seminar Talks

EDG Particle Physics Seminar at BNL, *Brookhaven National Lab.* — 2018 Data Science and
Quantum Computing Workshop, *TRIUMF* — 2018
Neutrino Seminar Series, *Fermilab* — 2018
Neutrino Physics Seminar, *Virginia Tech* — 2018
Deep Learning on DUNE, *Fermilab* — 2017
A.I. at SLAC Seminar Series, *SLAC National Lab.* — 2017
Computational and Data Science School for High Energy Physics, *Princeton University* — 2017
Machine Learning at Fermilab, *Fermilab* — 2017

Conference Talks

Weak Interactions and Neutrinos, *UC Irvine* — 2017
Neutrino Factories and Future Neutrino Facilities, *Centro Brasileiro de Pesquisas Fsicas* — 2015
The 2nd International Symposium on Science at J-PARC, *Tsukuba, Japan* — 2014

Selected Publications

(or full list link)

A Deep Neural Network for Pixel-Level Electromagnetic Particle Identification in the MicroBooNE Liquid Argon Time Projection Chamber.
MicroBooNE Collaboration.
Final collaboration review stage, to be submitted to Physical Review D.

Machine Learning at The Energy and Intensity Frontiers of Particle Physics.
A. Radovic1, M. Williams, D. Rousseau, M. Kagan, D. Bonacorsi, A. Himmel, A. Aurisano, K. Terao, T. Wongjirad.
Nature volume 560, pages 41−48 (2018).

Convolutional Neural Networks Applied to Neutrino Events in a Liquid Argon Time Projection Chamber.
MicroBooNE Collaboration.
Journal of Instrumentation 12 P03011 (2017)

First Measurement of θ_{13} from Delayed Neutron Capture on Hydrogen
Double Chooz Collaboration.
Phys. Lett. B 723 66-70 (2013)

Reactor $\bar{\nu}_e$ Disappearance in Double Chooz Experiment
Double Chooz Collaboration.
Phys. Rev. D 86 052008 (2012)

A prototype detector for directional measurement of the cosmogenic neutron flux
J. Lopez, K. Terao, J.M. Conrad, D. Dujmic, L. Winslow.
NIM A 673, 22-31 (2012)

Indication of Reactor $\bar{\nu}_e$ Disappearance in the Double Chooz
Double Chooz Collaboration.
Phys. Rev. Lett. 108, 131801 (2011)

Recent Leadership

DeepLearnPhysics Founder/Organizer 2017 - Present

First application of deep learning in LArTPC published as the first MicroBooNE paper.
Co-led ν_e oscillation analysis using deep learning.
Organized shared GPU resources across institutions for R&D work.

MicroBooNE Deep Learning Analysis Group Convener (retired) 2016 - 2018

First application of deep learning in LArTPC published as the first MicroBooNE paper.
Co-led ν_e oscillation analysis using deep learning.
Organized shared GPU resources across institutions for R&D work.

MicroBooNE Readout/Trigger Electronics Team Leader 2015 - Present

Development of PMT and TPC readout and trigger electronics firmware.
Installation and commissioning of hardware, integration with DAQ software.
Organizing a team of operation experts for data taking.

MicroBooNE Data Management Group Convener 2015 - 2016

Foundation of the first online/offline data processing framework (PUBS).
Organized group effort for PUBS code development.
Commissioned the whole automated data process chain (DAQ to offline reconstruction) .
Organized operations team for data taking.

MicroBooNE Simulation Group Convener 2014 - 2016

Organized group effort to improve physics and detector simulation software.
Delivered software releases with requested features for three large scale simulation production.
Introduced the readout electronics simulation software that mimic FPGA firmware logic.

Double Chooz Hydrogen Analysis Group Leader 2012 - 2013

Enabled the new signal detection channel for θ_{13} measurement in the field.
Organized a group of graduate students and post-docs to establish the whole analysis scheme.
Published the result as the first measurement of θ_{13} using neutron capture on hydrogen.

Double Chooz Data Production Group Leader 2011 - 2013

Delivered a large scale data production software for simulation, data reconstruction and analysis.
Operated several large scale simulation and reconstruction productions.
Interfaced with administrators of Lyon Tier1 cluster (France) for optimized resource usage.

Programming Skills

Languages

C, C++, Python, Perl, SQL, PHP, XML, JSON, Bash

Software

GDB/LLDB, Valgrind, GNC/LLVM compilers, Cython, MySQL, Postgres, ROOT, Geant4, caffe, TensorFlow, PyTorch, MXNet, Python packages including numpy, scipy, scikit, PyTable, pandas

Software Experience

Developed number of software critical for operating the experiment in C++, Python, SQL, and PHP languages. Please see this document for the list of software I developed with brief descriptions.

Highlights for operations software include a large scale data production software, online and offline SQL database software for configuration, file storage, and detector calibration management.

Experienced in software framework development in C++ using known design patterns. Developed several frameworks for analysis and reconstruction purpose in MicroBooNE.

Hardware Experience

MicroBooNE

Installation and commissioning of the TPC and optical detector readout electronics, trigger electronics, and hosting electronics racks with low voltage power supplies. Helped interface to the firmware on DAQ. Maintained a separate readout electronics test-stand for testing and R&D work at Fermilab.

Double Chooz

Installation and commissioning of the Double Chooz far detector, in particular the initial PMT calibration, electronics firmware debugging, first calibration system deployment, and installation of DCTPC neutron tracking detector.

KamLAND

Helped with construction of MWPC (Multiwire Proportional Chamber) and scintillator based trigger system. Cleaned the system for shipping and deployment. Responsible for testing and repairing custom readout electronics boards. Participated in installation and commissioning task at Kamioka, Japan.