

MICHIGAN STATE UNIVERSITY

September 14th 2015

ALFRED P. SLOAN FOUNDATION

630 Fifth Avenue, Suite 2550
New York, NY, 10111

Dear Members of the Award Committee,

We enthusiastically nominate Dr. Kendall Mahn for the Alfred P. Sloan Fellowship, and certify that she is eligible for this award, as stipulated by the program guidelines. Professor Mahn is an experimental particle physicist who specializes in neutrino physics, including neutrino scattering and neutrino oscillations. This is a large and competitive field in the United States' particle physics community and is work of fundamental importance. The otherwise incredibly successful "standard model" has been verified in almost all respects to unprecedented precision. Yet one phenomenon that the standard model cannot accommodate is the fact that the three known neutrino species mix and oscillate among themselves, requiring that they have masses. In order to precisely understand the parameters describing oscillations and neutrino mass, heroic experiments are under way all over the world. Programs in the United States and Japan lead the way and Professor Mahn is a key scientist in the efforts of both of these countries. With a Sloan Fellowship, she could extend her program to an experiment at the South Pole.



**College of
Natural Science**

**Department of Physics
and Astronomy**

Phillip Duxbury, Ph.D.
Chairperson and Professor

Biomedical Physical Sciences
567 Wilson Road, Room 4208
East Lansing, MI 48824

517-884-5515
Fax: 517-353-4500
chair@pa.msu.edu

<http://www.pa.msu.edu/~duxbury>

Professor Mahn is just beginning her second year as an Assistant Professor, and yet has already established leadership roles in neutrino experiments at the running Tokai to Kamioka (T2K) experiment in Japan, and in the planned Deep Underground Neutrino Experiment (DUNE) at Fermilab in Illinois. She is also a member of a third neutrino experiment, the IceCube Neutrino Observatory (and the PINGU extension) at the South Pole. She came to Michigan State as an established T2K leader and was actually asked to join the other two because of her established expertise in understanding the critical experimental and theoretical systematic uncertainties common to these difficult experiments. Her proposal to carry out a combined analysis of the data from the T2K and IceCube experiments has the potential for dramatic insights into the physics of the neutrino sector. She is an expert in the nuclear processes when low energy neutrinos strike complex nuclei and this expertise knits all of her neutrino programs together in mutually complimentary ways. Professor Mahn is in a unique position to carry out this analysis because she is the only US tenure stream professor who is a member of the T2K, DUNE, and IceCube experiments. Moreover the deputy spokesperson for IceCube and leader of the planning for the PINGU extension, Professor Ty DeYoung recently arrived at MSU. This provides Kendall with key collaborative opportunities with the IceCube experiment, and important opportunities have been identified between IceCube and T2K that will be explored using the SLOAN funds.

Dr. Mahn has been a member of the T2K neutrino collaboration at the High Energy Accelerator Research Organization (KEK) in Tokai, Japan, since she received her Ph.D. from Columbia University in 2010. T2K is an experiment that sends neutrinos to two detectors near the accelerator (one on the axis of the beam and one “off-axis”) and then 300 km through the earth across the island of Japan, to the large Kamioka detector. She quickly established herself as a leader in this international collaboration, and rose to the position of co-convenor of the oscillation analysis working group, leading T2K’s primary mission. She is both an expert in the theory of the complex nuclear physics involved in interpreting low energy neutrino interactions in large nuclei and also in detector design and construction. (She is also fluent in Japanese.) Professor Mahn is also expert in propagating systematic uncertainties from the near-detector measurements and analyses to those of the far detector—a limiting factor in T2K and other neutrino experiments.

The recent national planning exercise for the Department of Energy and the National Science Foundation decided that the next major experiment for the study of neutrino physics would be DUNE. This experiment will be the flagship experiment of U.S. based particle physics community well into the 2020’s and also employs the near-detector, far-detector strategy as used by T2K (and NOvA, a competing experiment). Beams from the Fermi National Accelerator Laboratory (Fermilab) will send neutrinos through the earth to compare the different species that are observed in the far detector in the Sanford laboratory located in a mine in South Dakota. It is because of her overall experience at T2K, but in particular because of her expertise in the complicated near-detector-far-detector T2K analysis that she has recently been asked to join DUNE and help lead this particular aspect of that program. It is very satisfying to us that Professor Mahn has been offered a leadership position in this experiment so soon after arriving at Michigan State.

But it is the recognition that IceCube measurements are competitive with accelerator-based oscillation experiments that is of particular interest to Professor Mahn. In order to properly compare future results from both, intimate knowledge of the proper treatment of systematic uncertainties is crucial. Professor Mahn is uniquely qualified to oversee this because of her roles in all three programs. To that end, a Sloan Fellowship would help enable this unusual collaborative approach to neutrino oscillation measurements.

Professor Mahn’s unique skillset has enabled her to join three of the major neutrino experiments in the world, with a leadership role in two of them. Her proposed research in combining data from T2K and IceCube, and the future installation of a unique detector at DUNE are potentially transformational, making her an outstanding candidate for this prestigious award.

Yours Sincerely,



Phillip M. Duxbury
Chair, Physics and Astronomy Department



Raymond Brock
University Distinguished Professor