NORTHERN MICHIGAN UNIVERSITY
Department of Physics

Faculty Search Committee
Texas Tech University, Department of Physics and Astronomy
BOX 41051
Lubbock, TX 79409-1051

21 Oct 2018

Dear Search Committee Chair and Members,

This letter, accompanied by the requested material, is my application for the tenure-track Assistant Professor position (15145BR) within the Department of Physics and Astronomy at Texas Tech University as advertised via the *Texas Tech University system careers* webpage and at *careers.aps.org*. I earned my Ph.D. in Physics from Texas Tech University in May 2014. I am currently in my final year of a three year (Aug 2016 to May 2019) non-tenure track appointment at the *Assistant Professor* level in the Department of Physics at Northern Michigan University (NMU). NMU is a small, primarily undergraduate and teaching-based state institution. Even though my officially assigned duties are limited to instruction of upper-level and service-level physics lectures and labs, I am maintaining an active research program (semiconductor physics and magnetic systems) that includes students and involves working at national labs in addition to our local research lab. I am also fully involved in department activities and provide service at the department, university, local community and international research community levels. From May 2014 through August 2016, I was in a full-time position as a *postdoctoral research associate* at Texas Tech University where I was able to spend nearly all of my time focused on research. During this time, I lead an experimental condensed matter group (advisor Dr. Roger Lichti; semiconductors and magnetic systems) where I created, lead and managed independent research projects; wrote several successful proposals resulting in experiment time on muon beamline instruments at Rutherford Appleton Laboratory in Didcot, UK and TRIUMF in Vancouver, BC (highly competitive application and review process); mentored graduate and undergraduate students; in addition to maintaining and operating electrical and magnetic characterization experiments in our local lab. Between my current position at NMU and previous post-doctoral position at Texas Tech, my instructional experience includes a broad range of upper-level and lower-level lectures and labs for majors and non-majors. By May 2019, I will have a total of five years of *post-doctoral* research and instructional experience. Through this experience, I have confirmed that I will be most effective and ultimately want to be in position where I will be able to continually develop an active research program while working with students at a variety of levels (in and out of the classroom). I can be available as early as June 2019.

I am very interested in a faculty position at Texas Tech University where I will be able to focus on growing my research program by developing a laboratory dedicated to studying the electrical, magnetic and optical properties of semiconductors (and related materials) complementing the existing facilities. I am very interested in collaborating with local researchers and students as well as continuing work with my existing research partners. I also have strong interests in physics education. Therefore, a position allowing for a healthy mixture of a strong research program and the ability to work with students at many levels, is well aligned with my long-term career goals.

My current research interests aim to address open questions relating to hydrogen impurities in semiconductors and the fundamental mechanisms responsible for phenomena, such as magnetism and tunable electrical properties, in a variety of materials that may lead to significant applications. My primary method of study involves the accelerator-based, Muon Spin Rotation, Relaxation and Resonance (MuSR) technique. The MuSR work is heavily supplemented with modelling and bulk characterization measurements (e.g. electrical, optical, structural, magnetic) that can be completed locally. One of my ongoing projects is investigating the characteristics and behavior of isolated hydrogen impurities in three polymorphs of TiO_2 – a material with a wide range of applications such as for use in hydrogen storage systems and as a replacement to SiO_2 as a gate oxide material in highly miniaturized transistors. Understanding how isolated hydrogen impurities interact with and affect the bulk electrical, optical and magnetic properties of a host is essential for effective development for applications. I am also interested in developing new experimental techniques to study semiconductors and novel materials. All of my current projects have several aspects that are ready for student involvement at any level and scalable from multiple-year graduate level projects to partial semester undergraduate projects depending on interest, expertise and available resources.

I am active in the defects in semiconductor and Muon Spin Research communities. In addition to my continuing work on several projects, I was recently notified of the acceptance for publication (by the editor and review team) of a chapter that I was invited to write entitled ‘The role of muons in semiconductor research’ in an upcoming book titled

Characterisation and control of defects in semiconductors, edited by F. Tuomisto (IET: London, 2019). This intended audience of this book is professional researchers in material science. The goals of this chapter are to provide a tutorial to studying semiconductors with the MuSR technique and a review of important contributions MuSR has made to the semiconductor field within the last decade – most of which I, or members of my small collaboration, have been directly involved. In June 2017, I was appointed to serve on the *Experimental Facility Access Panel* for Muon Experiments at *Rutherford Appleton Laboratory* (RAL; Didcot, UK) – one of a few facilities worldwide with MuSR capabilities. This panel is a small group of experienced researchers that review all submitted MuSR experiment proposals for scientific validity, feasibility and then provide recommendations to the Director of the *Rutherford Appleton Laboratory Neutron and Muon* source relating to the overall scientific program. In March 2017, I delivered an *invited talk* at an invited session at the *March Meeting* of the *APS* (New Orleans, LA) relating to using MuSR techniques to study semiconductors.

As part of my *postdoctoral research associate* and previous graduate research assistant positions at TTU, I had the privilege of mentoring graduate and undergraduate students working within our *experimental condensed matter* research group. I have provided significant guidance on many aspects of a Ph.D. student's project focusing on the motional properties of a hydrogen-like impurity in transparent conducting oxides [B.B. Baker. Mu motion in Transparent Conducting Oxides. *PhD Dissertation*. Texas Tech, Aug-2015]. I co-supervised a M.Sc. student whose project focused on studying the early time history of hydrogen defects in Silicon Germanium alloys [G. Jayarathna. Transition Dynamics for Muonium Acceptor States in Silicon Germanium Alloys. *M.Sc. Thesis*. Texas Tech, Dec-2014].

I am very interested in encouraging early involvement in Physics research both in and out of the classroom. At Northern Michigan University (undergraduate only), two Physics majors are working on original research projects under my supervision. One, a first generation college student, started in my group as a sophomore (now a senior) and is working on characterizing the Muonium (Hydrogen-like) impurity in Anatase TiO_2. I provided significant guidance in his successful application for highly competitive research funding as a *Ronald E. McNair Scholar* at NMU. Although unsuccessful, I helped him apply for other funding opportunities, such as a *Barry Goldwater Scholarship.* My other student is now a sophomore (started as freshman), studied the magnetic phase in Ti-doped VO_2 by MuSR and presented a portion of her work at a regional APS meeting in January 2018. She has since been working on characterizing the Muonium (Hydrogen-like) impurity in Brookite TiO_2. Both of these students have made significant contributions to the planning, setup, operation, analysis and interpretation of data from several MuSR experiments at two national laboratories (Rutherford Appleton lab, UK; and TRIUMF in Canada). Part of their work includes modelling and simulations of the interactions and behavior of the muon in these systems, which is an essential component to analyzing and interpreting the data. They have also done some work in our local research lab in putting together experiments to provide basic electrical characterization of our samples. Both students have presented their work at either a national or regional conference, several campus-wide student research symposia and made significant contributions to presentations I have given at international conferences relating these projects. Once finalized, their work will form the core of the published work associated with these projects. Funding for these students' and my work are sourced from a combination of internal and external funds.

I have taught two different courses that involved lab-based experimentation for Physics majors (*Modern Physics*; *Intermediate Lab*) where students were introduced to experiment techniques, data acquisition, analysis, formal report writing, collaborating with others and presenting results in a professional environment. One example of a lab I have written for these courses is a semiconductor characterization exercise where students measure the resistivity of several semiconductor materials (four-point probe), experimentally distinguish between *n*- and *p*- type materials and characterize a home-built hall probe. I have also incorporated data visualization and analysis with custom models. For example, an exercise I use as an introduction for undergraduates (in modern), involves collecting light intensity and position data from a single-slit diffraction pattern, then processing and fitting the collected data (using *MATLAB*) to extract parameters such as slit width, source wavelength and screen distance. I find mentoring students working on independent research projects and teaching upper-level courses to be very rewarding. Encouraging healthy collaborations, challenging students to learn in a non-traditional environment and interact directly with faculty, all contribute to a solid foundation so that they may be successful with their journey and future career, wherever it leads.

The Texas Tech University Department of Physics and Astronomy website and reputation demonstrate that direct faculty-student interaction, research, collaboration with others, general involvement in department activities and public outreach are important aspects of one's education and training for the future; all of which I am able and looking forward to continuing as I am now at Northern Michigan University and as I had previously done at Texas Tech. I especially look forward to working with dedicated and diverse groups of faculty and students. Working closely with students on a variety of levels fuels my enthusiasm about furthering my development as an educator, scientist and mentor so that I may continue to have a positive influence on their lives. Independent of any student's background or plans, a strong and supportive environment can make an enormous impact on their development. Throughout my education and career, I am fortunate enough to have had professors and colleagues that are highly committed to their role as mentors, researchers and educators, in and out of the classroom. I link a lot of my achievements to the close-knit and supportive environment in which I developed the foundation that continues to support me today. The impact of this environment contributes to what drives me to provide the same for my students and colleagues.

Outside of my research and teaching efforts, I have been actively involved with department and university activities at Northern Michigan University. I regularly participate in Physics club meetings and events such as Physics demonstrations at local schools and campus events; recruitment efforts; meeting with scientists within the community (e.g. medical Physicists, Meteorologists, bridge engineers) so that students may interact with professionals and learn about possible career paths and other fields. I serve as an event supervisor for the regional *Science Olympiad* tournament. I serve on a university-wide committee whose focus is to provide guidance to the academic on matters relating to understanding and utilizing technology for the enhancement of instruction. I have also been working with the Physics faculty to develop and implement assessment activities to evaluate the stated learning goals and outcomes of the Physics program. I have significantly contributed to the development and implementation of an experimental assessment focusing on the student's critical thinking and real-time problem solving skills.

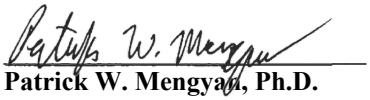
At Texas Tech University, I helped reinstate and presided over the chapter of Sigma Pi Sigma (ΣΠΣ, Physics honor society) and supported the Society of Physics Students (SPS, undergraduate organization) where I assisted with community outreach, operational logistics for SPS and provided guidance for these students as they progress through their undergraduate career. I served as the head of the Physics graduate student organization and liaison between faculty and graduate student body for Texas Tech from September of 2008 to May of 2014. All of these interactions continue to reinforce my desire and excitement for a role at an institution, such as Texas Tech University, that value such a welcoming environment for their students and look to support any who are interested.

Promoting diversity and inclusion in scholarship, instruction and engagement is all very important to me as demonstrated by my long-standing and ongoing efforts with students, public outreach and in maintaining an active research program with international collaborators and connections.

I plan to contribute to the Department of Physics and Astronomy at Texas Tech University, as I have at Northern Michigan and previously at Texas Tech (as a postdoctoral research associate and graduate student), in ways such as fully investing myself in research, teaching, the department, community outreach and being a positive role model.

I am very excited about the potential opportunity to join the Department of Physics and Astronomy at Texas Tech University as an Assistant Professor. Thank you for your time, efforts and consideration. I look forward to hearing from you and the opportunities that may follow.

Sincerely,



Patrick W. Mengyan, Ph.D.
Assistant Professor of Physics
Northern Michigan University
1401 Presque Isle Ave
Marquette, MI 49855
pmengyan@nmu.edu | T: 906.227.2183 (Office)
http://physics.nmu.edu/~pmengyan

2722 Scenic Dr APT 108
Marquette, MI 49855
Rick.Mengyan@gmail.com
T: 847.833.7679 (Mobile)