

PROMOTION RECOMMENDATION
University of Michigan
College of Engineering
Department of Nuclear Engineering and Radiological Sciences

Alexander G. R. Thomas, assistant professor of nuclear engineering and radiological Sciences, Department of Nuclear Engineering and Radiological Sciences, College of Engineering, is recommended for promotion to associate professor of nuclear engineering and radiological sciences, with tenure, Department of Nuclear Engineering and Radiological Sciences, College of Engineering.

Academic Degrees:

Ph.D. 2007 Imperial College, Plasma Physics, London, UK
M.S. 2002 Imperial College, Physics (First Class), London, UK

Professional Record:

2008-Present Assistant Professor, Department of Nuclear Engineering and Radiological Sciences,
University of Michigan
2006-2008 Research Associate, Plasma Physics Group, Imperial College, London, UK

Summary of Evaluation:

Teaching: Professor Thomas is an outstanding and caring teacher as evidenced by his student evaluations and letters. He has taught undergraduate and graduate courses with an enthusiastic and engaging style. He originated and developed a new class, Computational Plasma Physics, which has drawn students from a number of different departments. This course was sorely needed to train students in the latest techniques for numerical computations of plasmas. Professor Thomas engaged students in a number of projects to demonstrate different modeling aspects of plasmas. He also took a strong interest in undergraduate teaching, including four undergraduate classes: introductory classes NERS211 and NERS250, and NERS471 (introductory plasma physics) as well as volunteering to teach a section of ENG100. It should be noted that he developed a new module for his section of ENG100: "Radiation: How Invisible Atomic Rays Impact Our World." In this class, students learned the science and applications of radiation, including a project in which they designed and built their own device to measure background radiation in the environment and from external sources. Finally, the students performed a project to design a radiation device that performed an important societal task; e.g., medical sterilization. Professor Thomas has been rewarded with outstanding teaching evaluation scores, with Q2 scores averaging 4.53 from the 10 courses he has taught. Students laud Professor Thomas for his meticulous preparation and delivery of lectures.

Professor Thomas has also devoted a great deal of time and effort to training and mentoring students in the laboratory. He has chaired or co-chaired committees of seven Ph.D. students, as well as an incredible 19 undergraduate student research projects. Students praise Professor Thomas' availability and monumental time commitment to them. Students commend the fact that he is passionate about both the research project and their success. Professor Thomas' dedication shows in the outstanding performance that he motivates from his students, including their many awards.

Research: Professor Thomas has had a major impact on his field of high-field laser science, intense laser plasma interactions and Laser-Wakefield Accelerators (LWFAs). He has already established an outstanding international reputation. In fact, one reviewer places Professor Thomas in the top three to four in the world in his cohort. Professor Thomas is what is considered a "double-threat," equally

proficient in theory/simulation and experimental research. He has studied the important problems of electron trapping in the plasma bubble created when an intense fs laser pulse propagates through a plasma. This phenomenon is crucial to generating efficient electron acceleration in plasmas. These laser-plasma accelerators are reaching record levels of energy, approaching 1 GeV, in part due to the understanding being gained by this work. Professor Thomas is making a great impact with his Vlasov-Fokker-Planck-Maxwell simulations of electrons in plasma irradiated by TW laser pulses of fs duration. Another major impact of Professor Thomas' research is in the science of x-ray radiation generated by these laser-accelerated electron beams. Professor Thomas has shown how the natural betatron oscillations of laser-accelerated electrons in an ion-channel can be used to produce spatially-coherent x-ray emission. These coherent beams of x-rays have been demonstrated to produce high resolution x-ray images of microscopic objects and will have important applications to medicine, biology and solid-state physics. Lastly, Professor Thomas has pioneered high-repetition-rate LWFA's on the UM Lambda-cubed facility, which will open up new applications in science and medicine. Professor Thomas' h-index is 16, which is outstanding for someone at this stage in his career.

Professor Thomas has published his research results in the top journals, including *Nature*, *Nature Physics*, *Physical Review Letters*, *Physics of Plasmas*, and *Journal of Computational Physics*. He has a remarkable publication list of 70 refereed journal papers. While many of these publications were part of large collaborations on major laser facilities, 24 publications have Professor Thomas or a Michigan student as first author. Professor Thomas has been extremely successful in attracting federal funding for his research. He is both an AFOSR Young Investigator and an NSF CAREER awardee. He has solicited many awards from NSF and other agencies, totaling some \$3.36M during his time at Michigan.

Recent and Significant Publications:

- A. G. R. Thomas, M. Sherlock, C. Kuranz, C. P. Ridgers and R. P. Drake, "Hybrid Vlasov-Fokker-Planck-Maxwell simulations of fast electron transport and the time dependence of K-shell excitation in a mid-Z metallic target," *New Journal of Physics*, 15, 015017 (2013).
- A. G. R. Thomas, C. P. Ridgers, S. S. Bulanov, B. J. Griffin and S. P. D. Mangles, "Strong Radiation-Damping Effects in a Gamma-Ray Source Generated by the Interaction of a High-Intensity Laser with a Wakefield-Accelerated Electron Beam," *Physical Review X*, 2, 041004 (2012).
- A. G. R. Thomas, M. Tzoufras, A. P. L. Robinson, R. J. Kingham, C. P. Ridgers, M. Sherlock and A. R. Bell, "A review of Vlasov-Fokker-Planck numerical modeling of inertial confinement fusion plasma," *Journal of Computational Physics*, 231, 1051 (2012).
- A. G. R. Thomas, "Scalings for radiation from plasma bubbles," *Physics of Plasmas*, 17, 056708 (2010).
- A. G. R. Thomas, "Algorithm for calculating spectral intensity due to charged particles in arbitrary motion," *Physical Review Special Topics Accelerators and Beams*, 13, 020702 (2010).
- A. G. R. Thomas and K. Krushelnick, "Betatron x-ray generation from electrons accelerated in a plasma cavity in the presence of laser fields," *Physics of Plasmas*, 16, 103103 (2009).

Service: Professor Thomas has contributed to service activities within the department, college and in his profession. In his department, he is assuming the role of undergraduate program advisor during the winter 2014 term, while another faculty member is on sabbatical. Professor Thomas has also been an advisor to undergraduate students for three years. These activities represent major time commitments for such a junior faculty member. At the college level, he serves on the College of Engineering freshman advising team. In the profession, he has served as the chair of the High Energy Density Science Association and helped convince Federal officials to restore funding for this research area.

External reviewers:

Reviewer A: "If I compare [his CV] with other scientists as his career stage (5-10 years after PhD) in the field of laser-driven particle acceleration I would rank him amongst the top 10 researchers worldwide in terms of quality of output and volume of research activity."

Reviewer B: "Alec has co-authored some of the most highly cited papers in this field over the past decade, and in my judgment has an outstanding publication/citation record for such a researcher [of his cohort]. In the last few years he has put his unique stamp on the field and emerged as one of its leaders."

Reviewer C: "He has contributed significantly to the success of the Center for Ultrafast Optical Science...His leadership stature is demonstrated by being asked to write a review paper for the Journal of Computational Physics on the Vlasov Fokker Planck codes in 2012."

Reviewer D: "Alec's scholarly profile at the national and international level is high. There can be few researchers with such a strong publication list within 7 years of completing their Ph.D...He has the ideas and ability to make substantial contributions to a research field which is progressing rapidly and which promises to flourish and develop in fruitful directions for many years."

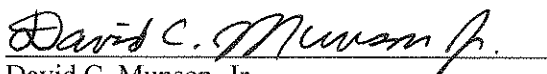
Reviewer E: "I have heard him speak at many conferences and I am impressed with how far he has come in such a short time in establishing his own research program at Michigan...Professor Thomas' publication record is really excellent for someone at this stage of his/her career."

Reviewer F: "I would assess Alec's scholarly visibility at the national and/or international level to be very high...Further, in my view, I predict that Alec will continue to grow in his ability to perform and guide the research of graduate students on a variety of cutting edge problems in the field..."

Reviewer G: "He is an extremely dynamic individual [and] a gifted researcher and an excellent teacher judging from the talks he gives at conferences...He has an excellent reputation throughout the world in the field of laser plasma interactions."

Reviewer H: "This record of productivity is well beyond what almost any faculty [of his cohort] can achieve prior to tenure...I have rarely seen such a strong tenure case."

Summary of Recommendation: Professor Thomas is an internationally recognized scholar in the area of high intensity laser plasma interactions. He has made a major impact in the fields of laser Wakefield Accelerators and coherent x-ray sources. He is a dedicated teacher of classes and laboratory mentor to a large number of undergraduate and graduate students. His service to department, college and the profession are exemplary. It is with the support of the College of Engineering Executive Committee that I recommend Alexander G. R. Thomas for promotion to associate professor of nuclear engineering and radiological sciences, with tenure, Department of Nuclear Engineering and Radiological Sciences, College of Engineering.



David C. Munson, Jr.

Robert J. Vlasic Dean of Engineering
College of Engineering

May 2014