



Seaborg Institute Seminar
2019 Postdoctoral Publication Prize in Actinide Science

**Discovery of ^{239}Pu nuclear magnetic resonance in
plutonium tetraboride**

Dr. Adam Paul Dioguardi

Recipient of the 2019 Postdoctoral Publication Prize in Actinide Science

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12:00 p.m. MT

Abstract: Plutonium materials are of great interest due to their unique properties and applications in weapons, nuclear power, and deep-space travel. From a condensed matter physics perspective, the rich $5f$ -electron physics in Pu-based materials drives emergent behavior such as magnetism, Kondo physics, superconductivity, and more recently possible correlated topological behavior. In this talk I will present our discovery of ^{239}Pu nuclear magnetic resonance (NMR) in plutonium tetraboride (PuB_4), which constitutes the second-ever direct observation of the ^{239}Pu NMR signal. Theoretical calculations and experimental bulk measurements suggest that PuB_4 is a correlated topological insulator. Our NMR results are consistent with a non-magnetic ground state and provide unique sensitivity to the electronic configuration and fluctuations of the Pu f electrons via the spin-lattice

relaxation rate T_1^{-1} and Knight shift (K_s). I will also highlight the significance of the temperature-independent orbital shift (K_0); a novel tool for the investigation of chemical bonding in Pu materials. Finally, I will discuss possible future directions informed by this exciting result.

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BIOGRAPHY



Adam Paul Dioguardi is a condensed matter physicist, specializing in solid state nuclear magnetic resonance (NMR) at the Leibniz Institute for Solid State and Materials Research (IFW) in Dresden, Germany. Adam completed his bachelors in physics at Colgate university in 2007, followed by his MS and PhD in physics at UC Davis in 2013. He was a postdoctoral scholar at UC Davis until 2015, before being awarded a director's postdoctoral fellowship at LANL. Adam has been a research fellow at the IFW Dresden since 2017. His current research interests include iron-based unconventional superconductors, quasi-two-dimensional magnetism, and development of rolled-up microcoils for nanoliter NMR.

Adam is the recipient of the **2019 Postdoctoral Publication Prize in Actinide Science**. The Postdoctoral Publication Prize in Actinide Science, created and funded by Laboratory Fellow Jaqueline L. Kiplinger and administered by the Postdoctoral Program Office, recognizes the high impact of the theoretical and/or experimental research in fundamental and applied areas of actinide science at LANL. This prize is competed and presented to the nominee whose actinide science article describes work performed during the tenure of the postdoctoral appointment at the Laboratory. The successful candidate must be nominated by a member of LANL's technical staff, including postdocs, who submits a nomination package that highlights the significance and impact of the work, both internal and external, within the field of expertise. The prize winner receives a monetary award and certificate and is provided the opportunity to give a seminar regarding the research represented in the winning publication.

Adam's award winning paper can be found at DOI: <https://doi.org/10.1103/PhysRevB.99.035104>
Dioguardi, A. P., et al. (2019). "²³⁹Pu nuclear magnetic resonance in the candidate topological insulator PuB₄." *Physical Review B* **99**(3): 035104.

This announcement has been DC reviewed and deemed UNCLASSIFIED. FJF 09/03/21