

Abdelghani Laraoui, Assistant Professor
Mechanical & Materials Engineering Department
900 N 16th Street, W312 NH, Lincoln, NE 68588
Email: alaraoui2@unl.edu, Phone: 402.472.7680
Group website: <https://engineering.unl.edu/laraoui/>

1.1 Education

- Ph.D. in Physics (Experimental Condensed Matter Physics), 10/2007, [University of Strasbourg Louis Pasteur](#), France. **Thesis title:** Magnetization dynamics of magnetic nanostructures: Studies performed with femtosecond magneto-optical microscopy, **Thesis.** Advisor: [Dr. Jean-Yves Bigot](#).
- M.S. in Condensed Matter Physics, 6/2003, [University of Upper Alsace](#), Mulhouse, France and [Institute of Physics and Chemistry of Materials of Strasbourg](#), Strasbourg, France. **Thesis title:** Elaboration and characterization of magnetic nanoparticles. Advisors: [Dr. Jean-Yves Bigot](#) and [Dr. Claude Estournès](#).

1.2 Employment History

- Mechanical & Material Engineering Department, University of Nebraska-Lincoln, *Assistant Professor*, 8/2019- Present.
- Department of Physics and Astronomy, University of Nebraska-Lincoln, *Courtesy Faculty Member*, 2/2022- Present.
- Center for High Technology Materials and School of Engineering, University of New Mexico, Albuquerque, NM, *Research Assistant Professor*, 9/2016-7/2019.
- Research Foundation of CUNY and City College of New York, New York, NY, *Research Associate*, 4/2009-7/2016. Group of [Prof. Carlos Meriles](#).
- University of Kaiserslautern of Technology, Kaiserslautern, *Marie Curie Postdoctoral Fellow*, 10/2007-3/2009. Group of [Prof. Burkard Hillebrands](#).

1.3 Ongoing research projects

- Nanoscale imaging of spin textures in magnetic oxides using diamond scanning probe microscopy (boron doped Cr₂O₃, REFe₅O₁₂ (RE = Tm, Tb, Eu), NiCo₂O₄). Collaborators: Christian Binek, Xiaoshan Xu, Xia Hong, and Alexey Kovalev, Department of Physics & Astronomy, UNL.
- Mapping topological spin textures in gradient engineered Co_{1-x}Pt_x thin films. Collaborator: Jingsheng Chen, National University of Singapore.
- Quantum biosensing of iron-contained biomolecules (ferritin, cytochrome C protein). Collaborators: Sy-Hwang Liou, Department of Physics & Astronomy, UNL and Rebecca Lai, Department of Chemistry, UNL.
- Nanoscale study of magnetic states of spin-crossover molecules (e.g., Fe(Htrz)₂(trz)](BF₄), (Htrz = 1H-1,2,4,-triazole). Collaborator: Rebecca Lai, Department of Chemistry, UNL.
- Study of spin-magnon interactions and entanglement effects in magnetic waveguides (rare-earth magnetic materials, YIG, CoFeB, Cr₂O₃) using diamond magnetic microscopy. Collaborators: Christian Binek, and Alexey Kovalev, Department of Physics & Astronomy, UNL.
- Quantum emitters for scalable photonics network. Collaborators: Christos Argyropoulos, Mathias Schubert, Department of Electrical & Computer Engineering, UNL.

2. Research Accomplishments

2.1 Publication Record (underlined: Laraoui group members at UNL)

1. Rupak Timalisina, Haohan Haohan, Adam Erickson, Bharat Giri, Xiaoshan Xu, **Abdelghani Laraoui** Excitation and detection of spin waves in rare-earth garnet insulator TmIG films using diamond nitrogen vacancy magnetometry, submitted to *Physical Review Materials* (Impact factor = 3.99).
2. N. Ristoff, B. Richards, **A. Laraoui**, I. Fescenko, J. Smits, N. Mosavian, P. Kehayias, J. Seto, L. Bougas, A. Jarmola and V. M. Acosta, Time resolved diamond magnetic microscopy of superparamagnetic iron-oxide nanoparticles, *Physical Review Applied* (Impact factor = 4.9), under review (2022).
3. Suvechhya Lamichhane, Kayleigh A McElveen, Adam Erickson, Shuo Sun, Ilja Fescenko, Rupak Timalisina, Sy-Hwang Liou, I Yinsheng Guo, Rebecca Y. Lai, and **Abdelghani Laraoui**, Studying the low spin state of individual Fe (II) triazole spin-crossover nanorods using nitrogen vacancy magnetometry. *Nano Letters* (Impact factor =12.5), under review, 2023.
4. Mohammadjavad Dowran, Andrew Butler, Suvechhya Lamichhane, Adam Erickson, Ufuk Kilic, Sy-Hwang Liou, Christos Argyropoulos, and **Abdelghani Laraoui**, Plasmon Enhanced Single Photon Emitters with Hybrid Hexagonal Boron Nitride Silver Nanocube System, *ACS Photonics* (Impact factor = 7.53), under review, 2023.
5. Prem Bahadur Karki, Rupak Timalisina, Mohammadjavad Dowran, Ayodimeji E. Aregbesola, **Abdelghani Laraoui**, Kapildeb Ambal, An efficient method to create high-density nitrogen-vacancy centers in CVD diamond for sensing applications. *Diamond and Related Materials* (Impact factor = 3.3.), under review, 2022.
6. Adam Erickson, Syed Qamar Abbas Shah, Ather Mahmood, Ilja Fescenko, Rupak Timalisina, Christian Binek, **Abdelghani Laraoui**, Nanoscale imaging of antiferromagnetic domains in epitaxial films of Cr₂O₃ via scanning diamond magnetic probe microscopy, *RSC Advances* (Impact factor = 4.05) 13 (1), 178-185 (2023). Published Online: 20 Dec 2022. <https://doi.org/10.1039/D2RA06440E>
7. **Abdelghani Laraoui** and Kapildeb Ambal, Opportunities for nitrogen-vacancy-assisted magnetometry to study magnetism in 2D van der Waals magnets, *Applied Physics Letters* (impact factor = 3.95) 121, 060502 (2022). Published Online: 09 August 2022. <https://doi.org/10.1063/5.0091931>
8. J. Smits, J. Damron, P. Kehayias, N. Mosavian, I. Fescenko, A. McDowell, **A. Laraoui**, A. Jarmola, V. M. Acosta. "Sub-Hertz two dimensional NMR spectroscopy of molecules using Nitrogen Vacancy centers in diamond," *Science Advances* 5 eaaw7895 (2019), [arXiv:1901.02952](https://arxiv.org/abs/1901.02952).
9. I. Fescenko, **A. Laraoui**, J. Smits, N. Mosavian, P. Kehayias, J. Seto, L. Bougas, A. Jarmola, V. M. Acosta, Diamond magnetic microscopy of malarial hemozoin nanocrystals, *Physics Review Applied* 11, 034029 (2019), [arxiv:1808.03636](https://arxiv.org/abs/1808.03636).
10. D. Kikuchi, D. Prananto, K. Hayashi, **A. Laraoui**, N. Mizuochi, M. Hatano, E. Saitoh, Y. Kim, C.A. Meriles, T. An, Long-distance excitation of nitrogen-vacancy centers in diamond via surface spin waves, *Applied Physics Express*, 10 103004 (2017), [arXiv:1708.00596](https://arxiv.org/abs/1708.00596).
11. P. Kehayias, A. Jarmola, N. Mosavian, I. Fescenko, F. M. Benito, **A. Laraoui**, J. Smits, L. Bougas, D. Budker, A. Neumann, S. R. J. Brueck, V. M. Acosta, Solution nuclear magnetic resonance spectroscopy on a nanostructured diamond chip, *Nature Communications* 8, 108 (2017), [arXiv:1701.01401](https://arxiv.org/abs/1701.01401).

12. H. Jayakumar, J. Henshaw, S. Dhomkar, D. Pagliero, **A. Laraoui**, N. Manson, R. Albu, M. W. Doherty, C. A. Meriles, Optical patterning of trapped charge in nitrogen-doped diamond, *Nature Communications* **7**, 12660 (2016), [arXiv:1609.03085](#).
13. **A. Laraoui**, H. Aycock-Rizzo, X. Lu, Y. Gao, E. Riedo, C.A. Meriles, Imaging thermal conductivity with nanoscale resolution using a scanning spin probe, *Nature Communications* **6**, 8954 (2015), [arXiv:1511.06916](#).
14. **A. Laraoui**, D. Pagliero, C.A. Meriles, Imaging nuclear spins weakly coupled to a probe paramagnetic center, *Physical Review B* **91**, 205410 (2015), [arXiv:1512.00499](#).
15. D. Pagliero, **A. Laraoui**, J. Henshaw, C.A. Meriles, Recursive polarization of nuclear spins in diamond at arbitrary magnetic fields, *Applied Physics Letters* **105**, 242402 (2014), [arXiv:1412.5441](#).
16. M. E. Trusheim, L. Li, **A. Laraoui**, E.H. Chen, O. Gaathon, H. Bakhru, T. Schroeder, C.A. Meriles, D. Englund, Scalable Fabrication of High Purity Diamond Nanocrystals with Long-Spin-Coherence Nitrogen Vacancy Centers, *Nano Letters*, **14** (1), 32-36 (2014). In the News: [NanoTechWeb](#), [PhysicsWorld](#), [Nature News Feature](#).
17. **A. Laraoui**, C. A. Meriles, Approach to dark spin cooling in a diamond nanocrystal, *ACS Nano* **7**, 3403 (2013), [arXiv:1703.03988](#).
18. **A. Laraoui**, F. Dolde, C. Burk, F. Reinhard, J. Wrachtrup, C. A. Meriles, High-Resolution Correlation Spectroscopy of ¹³C Spins Near a Nitrogen-Vacancy Center in Diamond, *Nature Communications* **4**, 1651 (2013), [arXiv:1305.1536](#).
19. **A. Laraoui**, J. S. Hodges, C. A. Meriles, Nitrogen-Vacancy-assisted magnetometry of paramagnetic centers in an individual diamond nanocrystal, *Nano Letters* **12** (7), 3477–348 (2012).
20. J.-Y. Bigot, M. Vomir, M. Barthélémy, M. Albrecht, **A. Laraoui**, Nanophotonics devices based on magnetic materials, *Proc. SPIE* **8268**, 82682U (2012).
21. **A. Laraoui**, C. A. Meriles, Rotating frame spin dynamics of a Nitrogen-Vacancy center in a diamond nanocrystal, *Physical Review B* **84**, 161403(Rapid Communications) (2011), [arXiv:1110.2280](#).
22. **A. Laraoui**, J. S. Hodges, C. Ryan, C. A. Meriles, The diamond nitrogen-vacancy center as a probe of random fluctuations in a spin ensemble, *Physical Review B* **84**, 104301 (2011), [arXiv:1104.2546](#).
23. **A. Laraoui**, J. S. Hodges, C. A. Meriles, Magnetometry of random ac magnetic fields using a single nitrogen-vacancy center in diamond, *Applied Physics Letters* **97**, 143104 (2010). The Virtual Journal of Nanoscale Science and Technology **22**, 16 (October 2010), [arXiv:1009.0316](#).
24. H. Schultheiss, X. Janssens, M. van Kampen, F. Ciubotaru, S. J. Hermsdoerfer, B. Obry, **A. Laraoui**, A. A. Serga, L. Lagae, A. N. Slavin, B. Leven, and B. Hillebrands, Direct Current Control of Three Magnon Scattering Processes in Spin-Valve Nanocontacts, *Physical Review Letters* **103**, 157202 (2009). The Virtual Journal of Nanoscale Science and Technology **20**, 16 (October 2009), [arXiv:0905.0323](#).
25. **A. Laraoui**, J. Vénauat, V. Halté, M. Albrecht, E. Beaurepaire, J.-Y. Bigot, Study of individual ferromagnetic discs with femtosecond optical pulses, *Journal of Applied Physics* **101**, 09C105 (2007).

26. **A. Laraoui**, M. Albrecht, J.-Y. Bigot, Femtosecond Magneto-optical Kerr Microscopy, *Optics Letters* **32**, 936 (2007). The Virtual Journal of Ultrafast Science 6, 4 (April 2007).
27. **A. Laraoui**, V. Halté, M. Vomir, J. Vénuat, M. Albrecht, E. Beaurepaire, J.-Y. Bigot, Ultrafast spin dynamics of an individual CoPt₃ ferromagnetic dot, *The European Physical Journal D* **43**, 253 (2007).
28. L. H. F. Andrade, **A. Laraoui**, M. Vomir, D. Muller, J.-P. Stoquert, C. Estournès, E. Beaurepaire, J.-Y. Bigot, Damped Precession of the Magnetization Vector of Superparamagnetic Nanoparticles Excited by Femtosecond Optical Pulses, *Physical Review Letters* **97**, 127401 (2006). The Virtual Journal of Nanoscale Science and Technology 5, 10 (October 2006).

2.1.6 Conference Proceedings

1. J. Smits, J. Damron, P. Kehayias, A. McDowell, N. Mosavian, I. Fescenko, N. Ristoff, **A. Laraoui**, A. Jarmola, V. Acosta, Chemical resolution picolitre NMR with a Nitrogen-Vacancy diamond quantum sensor Symposium Latsis 2019 on Diamond Photonics - Physics, Technologies and Applications OSA Technical Digest (Optical Society of America, 2019), paper 62, <https://doi.org/10.1364/DP.2019.62>.
2. I. Fescenko, **A. Laraoui**, J. Smits, N. Mosavian, P. Kehayias, J. Seto, L. Bougas, A. Jarmola, V. M. Acosta, Magnetic imaging of malarial nanocrystals with diamond sensors, Laser Science, JW3A.89 (2019), The Optical Society (Optical Society of America, 2019), <https://doi.org/10.1364/FIO.2019.JW3A.89>.
3. J.-Y. Bigot, **A. Laraoui**, M. Vomir, M. Albrecht, Magneto-optical pump probe imaging, *Proc. IEEE* in Lasers and Electro-Optics, ISBN: 978-1-55752-859-9 (2008).
4. **A. Laraoui**, V. Halté, L. Andrade, J.-Y. Bigot, Ultrafast magnetization dynamics in cobalt nanoparticles studied with femtosecond laser pulses, *Proc. IEEE* in Lasers and Electro-Optics, ISBN: 978-1-55752-859-9 (2008).
5. J.-Y. Bigot, **A. Laraoui**, J. Vénuat, M. Vomir, E. Beaurepaire, Time resolved magneto-optical microscopy of individual ferromagnetic dots, *Springer Verlag series in Chemical Physics* **88**, 662 (2007).
6. **A. Laraoui**, M. Vomir, E. Beaurepaire, J.-Y. Bigot, Femtosecond imaging of the spin dynamics of CoPt nanostructures, *Proc. IEEE* in International Quantum Electronics Conference, ISBN: 978-1-4244-0931-0 (2007).

2.1.7 Conference Presentations (underlined: Laraoui group members at UNL, bolt: the presenter)

1. **Mohammadjavad Dowran**, Suvechhya Lamichhane, Adam Erickson, Andrew Butler, Sy-Hwang Liou, Christos Argyropoulos, Abdelghani Laraoui, Plasmon enhanced quantum properties of single photon emitters in hexagonal boron nitride flakes, MRS Spring Meeting, April 10-14, 2023, San Francisco, CA.
2. **Abdelghani Laraoui**, Mohammadjavad Dowran, Suvechhya Lamichhane, Adam Erickson, Andrew Butler, Sy-Hwang Liou, Christos Argyropoulos, Enhancement of Single Photon Emitters in hexagonal boron nitride multilayered flakes Via Plasmonic Resonance in metallic nanostructures, APS March Meeting March 5-10, 2023, Las Vegas, NV.

3. **Abdelghani Laraoui**, **Adam Erickson**, Ather Mahmood, Syed Qamar Abbas Shah, Ilja Fescenko, **Rupak Timalisina**, Christian Binek, Imaging voltage controlled antiferromagnetic domains' switching in B doped Cr₂O₃ epitaxial films using nitrogen-vacancy scanning microscopy, APS March Meeting March 5-10, 2023, Las Vegas, NV.
4. **Suvechhya Lamichhane**, Kayleigh McElveen, **Adam Erickson**, Shuo Sun, **Rupak Timalisina**, Yinsheng Guo, Rebecca Lai, Sy-Hwang Liou, **Abdelghani Laraoui**, Studying spin states of single nano-rods of [Fe(Htrz)₂(trz)](BF₄) spin-crossover molecules using diamond quantum sensing microscopy, APS March Meeting March 5-10, 2023, Las Vegas, NV.
5. **Adam Erickson**, Ather Mahmood, Syed Qamar Abbas Shah, Ilja Fescenko, **Rupak Timalisina**, Christian Binek, **Abdelghani Laraoui**, Studying the effect of boron doping and temperature on antiferromagnetic domains in epitaxial Cr₂O₃ films using diamond magnetometry, APS March Meeting March 5-10, 2023, Las Vegas, NV.
6. **Rupak Timalisina**, Haohan Wang, **Adam Erickson**, Bharat Giri, Xiaoshan Xu, **Abdelghani Laraoui**, Excitation and detection of spin waves in rare-earth garnet insulator TmIG films using diamond nitrogen vacancy magnetometry, APS March Meeting March 5-10, 2023, Las Vegas, NV.
7. **Abdelghani Laraoui**, **Rupak Timalisina**, Cody M. Schultz, **Suvechhya Lamichhane**, **Adam Erickson**, Sy-Hwang Liou, Rebecca Y. Lai, Magnetic imaging of iron in biomolecules using diamond quantum sensors, MRS Spring Meeting, May 23-25, 2022, Honolulu HI.
8. **Bryan Richards**, Nate Ristoff, **Abdelghani Laraoui**, Ilja Fescenko, Joshua Damron, Nazanin Mosavian, Janis Smits, Andrey Jarmola, Pauli Kehayias, Maziar Saleh Ziabari, Andrew Mounce, Dale Huber, Victor Acosta, Imaging Néel Relaxation of Superparamagnetic Nanoparticles using Diamond Magnetic Microscopy, March 14–18, 2022; Chicago, IL.
9. **Adam Erickson**, Ather Mahmood, Syed Qamar Abbas Shah, **Rupak Timalisina**, Christian Binek, **Abdelghani Laraoui**, Nansocale imaging of antiferromagnetic domains in epitaxial Cr₂O₃ films using diamond quantum sensing microscopy, March 14–18, 2022; Chicago, IL.
10. **Rupak Timalisina**, Cody Schultz, **Suvechhya Lamichhane**, **Adam Erickson**, Sy-Hwang Liou, Rebecca Lai, **Abdelghani Laraoui**, Magnetic sensing of iron in biomolecules using diamond nitrogen vacancy centers, APS March Meeting, March 14–18, 2022; Chicago, IL.
11. R. Skomski, D. Paudyal, B. Balasubramanian, **A. Ullah**, **A. Laraoui**, and D. J. Sellmyer, Exchange Interactions in Mixed-Rare-Earth Transition-Metal Compounds, 2022 Joint MMM-Intermag Conference, January 10-14, 2022, New Orleans, LA.
12. **A. Erickson**, **W. K. Chin**, **R. Timalisina**, and **A. Laraoui**, Nitrogen Vacancy Magnetic Microscopy of Spin Textures in Magnetic Nanomaterials, MRS Fall Meeting (virtual), December 6–8, 2021.
13. Time-resolved diamond magnetic microscopy of superparamagnetic nanoparticles, **N. Ristoff**, **A. Laraoui**, I. Fescenko, J. Damron, N. Mosavian, J. Smits, A. Jarmola, P. Kehayias, M. Salehziabari, A. Mounce, D. Huber, V. Acosta, APS March Meeting, March 2–6, 2020, Denver, CO.
14. Studying static and dynamic magnetic properties of individual 22.6-nm superparamagnetic nanoparticles using diamond magnetic microscopy, **A. Laraoui**, I. Fescenko, J. Smits, N. Mosavian, P. Kehayias, A. Jarmola, V. Acosta, APS March Meeting, March 4–8, 2019; Boston, MA.

15. Microscale nuclear magnetic resonance imaging with diamond chips, **J. Smits**, A. Jarmola, L. Bougas, N. Mosavian, I. Fescenko, P. Kehayias, A. Laraoui, V. Acosta, APS March Meeting, March 5–9, 2018; Los Angeles, CA.
16. Picoliter NMR spectroscopy using nitrogen-vacancy centers in nanofabricated diamond, **P. Kehayias**, A. Jarmola, N. Mosavian, I. Fescenko, F. Benito, A. Laraoui, J. Smits, L. Bougas, D. Budker, A. Neumann, S. Brueck, V. Acosta, 48th Annual Meeting of the APS Division of Atomic, Molecular and Optical Physics, June 5–9, 2017, Sacramento, CA.
17. Optical patterning of trapped charge in nitrogen-doped diamond, **S. Dhomkar**, H. Jayakumar, D. Pagliero, A. Laraoui, R. Albu, N. Manson, M. Doherty, J. Henshaw, C.A. Meriles, APS March Meeting March 14–18, 2016; Baltimore, MD.
18. Structure determination of individual electron-nuclear spin complexes in a solid-state matrix, A. Laraoui, D. Pagliero, **C.A. Meriles**, APS March Meeting, March 2–6, 2015; San Antonio, Texas.
19. Recursive polarization of nuclear spins in diamond at arbitrary magnetic field D. Pagliero, A. Laraoui, **J. Henshaw**, C.A. Meriles, APS March Meeting, March 2–6, 2015; San Antonio, Texas.
20. High-resolution correlation spectroscopy of ^{13}C spins near a nitrogen-vacancy center in diamond, A. Laraoui, F. Dolde, C. Burk, J. Wrachtrup, F. Reinhard, C.A. Meriles, APS March Meeting, March 18 - 22, 2013, Baltimore, MD.
21. High-resolution correlation spectroscopy of ^{13}C spins near a nitrogen-vacancy center in diamond, **C. A. Meriles**, A. Laraoui, F. Dolde, C. Burk, F. Reinhard, J. Wrachtrup, APS March Meeting, March 18 - 22, 2013, Baltimore, MD.
22. Spin Sensing of Paramagnetic Centers in an Individual Diamond Nanocrystal, A **Laraoui**, C.A. Meriles, MRS Fall meeting, November 25-30, 2012, Boston, MA.
23. Nitrogen-Vacancy-assisted magnetometry of paramagnetic centers in an individual diamond nanocrystal, **C.A. Meriles**, A. Laraoui, J. S. Hodges, 4th Nano-MRI Conference, July 22-27, 2012, Monte Verita, Switzerland.
24. Spin dynamics of Nitrogen-Vacancy centers in a diamond nanocrystal, A **Laraoui**, C.A. Meriles, APS March Meeting, February 27 - March 2, 2012, Boston, MA.
25. Spin-wave radiation and dc current controlled three-magnon-scattering efficiency in a spin-torque nanocontact device, H. Schultheiss, **A. Laraoui**, F. Ciubotaru, M. Manfrini, M. van Kampen, L. Lagae, A. N. Slavin, B. Leven, B. Hillebrands, The first international workshop on Magnetic Single Nano-Objects, November 26-28, 2008, Nancy, France.
26. DC current controlled three magnons scattering efficiency in spin torque nano-oscillators, H. Schultheiss, **A. Laraoui**, F. Ciubotaru, M. Manfrini, M. van Kampen, L. Lagae, A. N. Slavin, B. Leven, B. Hillebrands, Spin momentum transfer workshop, October 3-5, 2008, Krakow, Poland.
27. Ultrafast magnetization dynamics of magnetic films and nanostructures, **M. Vomir**, A. Laraoui, V. Halté, M. Albrecht, E. Beaupaire, J.-Y. Bigot, Nano science Grand East Meeting: spintronics and nanomagnetism, Oct 2007, Strasbourg, France.

28. Damped precession of the magnetization in cobalt nanoparticles induced by femtosecond laser pulses, **V. Halté**, **A. Laraoui**, L.H.F. Andrade, M. Vomir, J.-Y. Bigot, FCILA 2007, June 4-7, 2007, Lyon, France.
29. Ultrafast magneto-optical Kerr microscopy: Spin dynamics in individual ferromagnetic dots, **A. Laraoui**, J.-Y. Bigot, 11th Louis Néel Colloquium, March 11-16, 2007, Lyon, France.
30. Time resolved magneto-optical microcopy of individual ferromagnetic dots, **J.-Y. Bigot**, **A. Laraoui**, J. Vénuat, M. Vomir, E. Beaurepaire, 15th International Conference Ultrafast Phenomena, July 30, - August 4, 2006, Pacific Grove/CA.

2.1.7 Posters (underlined: Laraoui group members at UNL, bold: the presenter)

1. Wire Bonding Thin Films for Ferromagnetic Resonance and Optically Detected Magnetic Resonance Measurements, **Ben Hammons**, Rupak Timalisina, and Abdelghani Laraoui, UNL Lincoln Summer Research Fair, August 5, 2022.
2. Automating A Ferromagnetic Resonance Spectroscopy Setup, **Patrick Osborn**, Rupak Timalisina, and Abdelghani Laraoui, UNL Lincoln Summer Research Fair, August 5, 2022.
3. Studying Hexagonal Boron Flakes By Using Atomic Force Microscopy For Quantum Photonics, **John Kunkee**, Mohammadjavad Dowran, and Abdelghani Laraoui, UNL Lincoln Summer Research Fair, August 5, 2022.
4. Imaging and Control of Antiferromagnetic Domains in Cr₂O₃, **Adam Erickson**, Rupak Timalisina, Syed Qamar Abbas, Ather Mahmood, Christian Binek, Abdelghani Laraoui, 2022 NRIC Workshop, Commercializing Quantum Technologies in Nebraska: From Research To Licensing, April 14, 2022, Lincoln, NE.
5. **Suvechhya Lamichhane**, Rupak Timalisina, Cody M. Schultz, Adam Erickson, Sy-Hwang Liou, Rebecca Y. Lai, Abdelghani Laraoui, T1 relaxometry of Fe Contained Biomolecules Using Nitrogen Vacancy Centers in Diamond, 2022 NRIC Workshop, Commercializing Quantum Technologies in Nebraska: From Research To Licensing, April 14, 2022, Lincoln, NE.
6. **Abdelghani. Laraoui** and V. Acosta, Time resolved diamond magnetic microscopy of single transition metal magnetic nanoparticles, APS March Meeting 2020, March 2–6, 2020, Denver, CO.
7. **Abdelghani. Laraoui**, I. Fescenko, J. Smits, N. Mosavian, P. Kehayias, A. Jarmola, V. Acosta, Gordon conference, Time resolved diamond microscopy of magnetic nanostructures, Quantum Sensing Applications in Metrology and Imaging, June 2 - 7, 2019, Hong Kong, China.
8. **N. Arnold**, A. Laraoui, I. Fescenko, J. Smits, V. Acosta, Diamond Magnetic Microscopy of Individual Superparamagnetic Nanoparticles, 2018 Annual Meeting of the APS Four Corners Section, October 12–13, 2018; University of Utah, Salt Lake City, UT.
9. **I. Fescenko**, A. Laraoui, J. Smits, N. Mosavian, P. Kehayias, J. Seto, L. Bougas, A. Jarmola, V. Acosta, Diamond magnetic imaging of single paramagnetic biocrystals, Southwest Quantum Information and Technology Workshop, February 22-24, 2018. Santa Fe, N September 2017, CINT Sandia-LANL meeting, Santa Fe, NM.
10. **A. Laraoui**, N. Mosavian, J. Smits, I. Fescenko, V. Acosta, Imaging individual 25-nm superparamagnetic nanoparticles using diamond magnetic microscopy, Southwest Quantum

Information and Technology Workshop, February 22-24, 2018. Santa Fe, N September 2017, CINT Sandia-LANL meeting, Santa Fe, NM.

11. A. Laraoui, H. Aycock-Rizzo, X. Lu, E. Riedo, **C.A. Meriles**. Nanoscale thermal conductivity imaging using scanning spin probe, 5th annual NanoMRI Conference, July 27-31, 2015, Waterloo, Canada.
12. **T. An**, A. Laraoui, C.A. Meriles. Broadening of ODMR Signal of NV center in Nanodiamond by Domain Wall Motion, 5th annual NanoMRI Conference, July 27-31, 2015, Waterloo, Canada.
13. **A. Laraoui**, H. Aycock-Rizzo, X. Lu, E. Riedo, C.A. Meriles. Imaging Thermal Conductivity with Nanoscale Resolution via a Scanning Spin Probe, NanoscienceNY meeting, February 19th, 2015, New York, NY.
14. **A. Laraoui**, C.A. Meriles. Exploring the Nitrogen Vacancy center as a high-resolution magnetic sensor in bulk and nanostructured diamond crystals, APS March Meeting, February 27 - March 2, 2012, Boston, MA.
15. **A. Laraoui**, J. S. Hodges, C. Ryan, C. A. Meriles. Exploring the Nitrogen Vacancy center as a high-resolution magnetic sensor, Gordon Research Conferences, Magnetic resonance, June 12-17, 2011, University of New England, Biddeford, ME.
16. **C.A. Meriles**, A. Laraoui, J. S. Hodges. T1-limited Nitrogen-Vacancy magnetometry of fluctuating AC magnetic fields, APS March Meeting 2011, March 21-25, 2011, Dallas, Texas.
17. A. Laraoui, J. S. Hodges, **C.A. Meriles**. T1-limited Nitrogen Vacancy magnetometry of fluctuating AC magnetic fields, Artificial atoms in diamond Workshop, November 11-13, 2010, Harvard University, Cambridge, MA.
18. A. Laraoui, J. S. Hodges, **C. A. Meriles**. Characterization of random AC magnetic fields using a single Nitrogen-Vacancy center, 3rd nano-MRI research conference: Exploring the Frontiers of Magnetic Resonance Imaging, July 12-16, 2010, Le Tremblay sur Mauldre, France.
19. **F. Ciubotaru**, H. Schultheiss, A. Laraoui, A. Serga, X. Janssens, M. van Kampen, L. Lagae, A.N. Slavin, B. Leven, B. Hillebrands. Oersted field influence on three-magnon-scattering processes in nano-point contact spin-valves, SPINSWITCH Summer School: Spin torque transfer and domain wall dynamics, September 14-18, 2009, Iași, Romania.
20. **A. Laraoui**, M. Albrecht, M. Vomir, J.-Y. Bigot. Magneto-optical pump probe Imaging of CoPt nanostructures, 20th International Colloquium on Magnetic Films and Surfaces, July 20–24, 2009, Berlin, Germany.
21. H. Schultheiss, **F. Ciubotaru**, **A. Laraoui**, A. Serga, X. Janssens, M. van Kampen, L. Lagae, A. N. Slavin, B. Leven, B. Hillebrands. Current controlled three-magnon-scattering in spin-torque nanocontact devices, 20th International Colloquium on Magnetic Films and Surfaces, July 20–24 2009, Berlin, Germany.
22. **A. Laraoui**, F. Ciubotaru, H. Schultheiss, A. Serga, S. Hermsdörfer, M. van Kampen, L. Lagae, B. Leven, A. N. Slavin, B. Hillebrands. Effect of a DC current on the magnetization dynamics in spin-valve nanocontacts, German Physical Society (DPG) spring meeting, March 22-27, 2009, Dresden, Germany.

23. H. Schultheiss, **F. Ciubotaru, A. Laraoui**, M. Manfrini, M. van Kampen, L. Lagae, A. N. Slavin, B. Leven, B. Hillebrands. Nonlinear spin-wave radiation in spin-torque nanocontact devices, Spin momentum transfer workshop, October 3 -5, 2008, Krakow, Poland.
 24. **H. Schultheiss**, X. Janssens, M. van Kampen, S. Cornelissen, F. Ciubotaru, A. Laraoui, B. Leven, A. N. Slavin, L. Lagae, B. Hillebrands. Investigation of spin-wave radiation and current controlled three-magnon-scattering in spin-torque nanocontact devices, INTERMAG 2008, Madrid, Spain, May 4-8, 2008.
 25. A. Laraoui, M. Vomir, M. Albrecht, **J.-Y. Bigot**. Magnetization dynamics of ferromagnetic dots: Studies with a femtosecond magneto-optical microscope, 11th France condensed matter meeting, August 25-29, 2008, Strasbourg, France.
 26. **V. Halté**, L.H.F. Andrade, A. Laraoui, M. Vomir, J.-Y. Bigot. Magnetization precession of magnetic nanoparticles induced with femtosecond laser pulses, 11th France condensed matter meeting, August 25-29, 2008, Strasbourg, France.
 27. **A. Laraoui**, V. Halté, M. Vomir, J. Vénuat, M. Albrecht, E. Beaurepaire, J.-Y. Bigot. Femtosecond spin dynamics of an individual, School on Nanomaterials for magnetism and spintronics, February 18-23, 2008, Strasbourg, France.
 28. **A. Laraoui**, M. Albrecht, M. Vomir, E. Beaurepaire, J.-Y. Bigot. Time-resolved magneto-optical imaging of magnetic domains written in CoPt films with femtosecond laser pulses, Optics Grenoble 2007, July 2-5, 2007, Grenoble, France.
 29. A. Laraoui, V. Halté, M. Vomir, E. Beaurepaire, **J.-Y. Bigot**. Time resolved magneto-optical imaging of magnetic domains written in CoPt films with femtosecond laser pulses, International Symposium on Spin Waves, June 16-21, 2007, Saint Petersburg, Russia.
 30. **A. Laraoui**, J. Vénuat, V. Halté, M. Albrecht, M. Vomir, E. Beaurepaire, J.-Y. Bigot. Study of individual ferromagnetic dots with femtosecond optical pulses, 10th Joint MMM/Intermag Conference, January 7-11, 2007, Baltimore, Maryland.
 31. **A. Laraoui**, V. Halté, M. Vomir, J. Vénuat, M. Albrecht, E. Beaurepaire, J.-Y. Bigot. Ultrafast spin dynamics of individual ferromagnetic dots, 3rd TMN (Trends in Materials and Nanosciences) Conference, November 5, 2006, Strasbourg, France.
 32. **A. Laraoui**, V. Halté, M. Vomir, J. Vénuat, M. Albrecht, E. Beaurepaire, J.-Y. Bigot. Femtosecond spin dynamics of a single CoPt₃ dot, 13th ISSPIC Conference, July 23- 28, 2006, Goteborg, Sweden.
 33. **M. Vomir**, L. Andrade, E. Beaurepaire, A. Laraoui, J.-Y. Bigot. Magnetization trajectory induced with femtosecond laser pulses: tridimensional study of magnetic anisotropy effects. 7th meeting on ultrafast phenomena, December 5-7, 2005, Lille, France.
- 2.1.8 Invited talks or Keynote Speeches** (underlined: the presenter at UNL, bolt: the presenter)
1. **Abdelghani. Laraoui**, Diamond magnetometry of spin textures in thin magnetic films, **Invited Talk**, Gordon Research Conference, [Frontiers of Sensing in the Quantum Regime with Atomic, Solid-State and Photonic Systems](#), July 23 – 28, 2023, Les Diablerets, Switzerland.

2. **Abdelghani. Laraoui**, Probing Nanoscale Magnetic Phenomena Using Diamond Quantum Sensing Microscopy, **Invited Lecture**, [Virtual Lecture Series on Nanodiamond](#), January 19, 2023.
3. **Abdelghani. Laraoui**, Quantum Sensing, UNL's Grand Challenges 2025 vision, **Invited Talk**, workshop on Quantum Science and Engineering, October 19-20, 2021, Lincoln, NE.
4. **Abdelghani Laraoui**, Quantum Sensing and Technologies, **Invited Talk**, EPSCoR workshop on Emergent quantum materials and Technologies (EQUATE), March 26-27, 2021, Lincoln, NE.
5. **Abdelghani Laraoui**, Diamond quantum sensing, **Invited Lecture**, Quantum Information Science biweekly seminar series, April 5th, 2020, Ames Laboratory-Iowa State University, Ames, IA.
6. **A. Laraoui**, Nanoscale Magnetic Resonance Spectroscopy using Nitrogen Vacancy Centers in Diamond, **Keynote Lecture**, 2017 NMR², April 15, 2017, Albuquerque, NM.
7. **A. Laraoui**, I. Fescenko, N. Mosavian A. Jarmola, P. Kehayias, V. Acosta, Solution NMR and EPR on a diamond chip, **Invited Talk**, The 20th Meeting of the International Society of Magnetic Resonance (ISMAR 2017), July 23-28, 2017, Québec City, Canada.
8. A. Laraoui, H. Aycock-Rizzo, Y. Gao, E. Riedo, **C.A. Meriles**, Nanoscale thermal imaging using a scanning spin probe, APS March Meeting March 14–18, 2016, Baltimore, MD.
9. **A. Laraoui**, H. Aycock-Rizzo, X. Lu, E. Riedo, C. A. Meriles, Nanoscale Imaging of Thermal Conductivity Using Nitrogen Vacancy Center in Nanodiamond, **Invited talk** META'15, the 6th International Conference on Metamaterials, Photonic Crystals and Plasmonics, August 3-7, 2015, New York, NY.
10. **A. Laraoui**, C. A. Meriles, Approach to dark spins initialization in nanodiamond, **Invited talk**, Workshop on Diamond- spintronics, photonics, bio-applications, April 27-29, 2013, Hong Kong.
11. **C. A. Meriles**, A. Laraoui, The Nitrogen-Vacancy center as a probe of mesoscopic spin ensembles, **Invited talk**, Gordon Research Conferences, Magnetic resonance, June 12-17, 2011, University of New England, Biddeford, ME.
12. **B. Hillebrands**, H. Schultheiss, F. Ciubotaru, A. Laraoui, M. van Kampen, L. Lagae, and A. N. Slavin, Current Induced Spin-Wave Emission from Ferromagnetic Nanostructures, **Invited talk**, International Symposium: Twenty Years of Spintronics Retrospective and Perspective, December 8-9, 2009, Paris, France.
13. **B. Hillebrands**, H. Schultheiss, B. Obry, F. Ciubotaru, A. Laraoui, S. Hermsdörfer, A.A. Serga, M. van Kampen, X. Jenssens, L. Lagae, and A. N. Slavin, Nanomagnetism – a perspective from the dynamic side, **Keynote Lecture**, Trends in NanoTechnology International Conference, September 07-11, 2009, Barcelona, Spain.
14. **B. Hillebrands**, H. Schultheiss, F. Ciubotaru, A. Laraoui, M. van Kampen, L. Lagae, and A. N. Slavin, Current Induced Spin-Wave Emission from Ferromagnetic Nanostructures, **Invited talk**, International Magnetism Conference 2009, May 4-8, 2009, Sacramento, California.
15. **B. Hillebrands**, H. Schultheiss, F. Ciubotaru, A. Laraoui, M. van Kampen, L. Lagae, and A. N. Slavin, Current Induced Spin-Wave Emission from Ferromagnetic Nanostructures, **Invited talk**, IEEE nanotechnology materials and devices Conference. October 20-22, 2008, Kyoto, Japan.

16. **A. Laraoui**, M. Vomir, E. Beaurepaire, J.-Y. Bigot. Femtosecond spin dynamics in magnetic nanostructures, July 16th, 2007, **Invited talk**, International Quantum Electronics Conference – Europe, June 17-22, 2007, Munich, Germany.
17. **J.-Y. Bigot**, A. Laraoui, M. Vomir, M. Albrecht, Ultrafast magnetization dynamics: concept and applications to spin photonics, **Invited talk**, FCILA 2007, June 4-7, 2007, Lyon, France.
18. **J.-Y. Bigot**, M. Vomir, L.H.F. Andrade, E. Beaurepaire, A. Laraoui, Recent progresses in Femtomagnetism: Time dependent anisotropy and dynamics of superparamagnets, **Invited talk**, Workshop on Novel trends in magnetism, October 1-7, 2005, Corfu, Greece.

Section 2.1.9 Invited seminars at UNL

1. **A. Laraoui**, Diamond Magnetometry studies of nanoscale magnetic phenomena, April 2023, Department of Physics, University of Nebraska-Kearny.
2. **A. Laraoui**, Probing solid state Phenomena in quantum materials using quantum sensors, March 2023, Department of Physics and Astronomy, Wichita State University, Wichita, KS.
3. **A. Laraoui**, Studying individual spin-crossover Fe-triazole nanorods, March 2023, Department of Physics and Astronomy, City College of New York, New York, NY.
4. **A. Laraoui**, Diamond quantum sensing microscopy for chemistry applications, November 2022, Department of Chemistry, University of Nebraska-Lincoln,
5. **A. Laraoui**, Diamond scanning probe microscopy of antiferromagnets, April 2021, Optical Science Engineering seminar at Center of High Technology Materials- University of New Mexico, Albuquerque, NM.
6. **A. Laraoui**, Diamond quantum sensing, October 2020, Department of Chemistry, University of Nebraska-Lincoln, invited guest lecture for Prof. Rebecca Lai course, Lincoln, NE.
7. **A. Laraoui**, Quantum diamond microscopy: A new tool for quantum sensing, September 2020, Department of Physics and Astronomy, Creighton University, Omaha, NE.
8. **A. Laraoui**, Diamond Nitrogen Vacancy Centers for Quantum Sensing, October 2019, Nebraska Center of Materials Nanoscience Seminar series, Lincoln, NE.

2.2 Research Funding Record

2.2.1 Internally Funded Research Grants

| <i>Project Title</i> | <i>Sponsor</i> | <i>Role (PI or Co-PI)</i> | <i>Dates</i> | <i>Total Amount (do not include UNL cost share)</i> | <i>% Attributed to Candidate (do not include UNL cost share)</i> |
|--|------------------|---------------------------|-----------------------------|---|--|
| <i>Probing Room-temperature Skyrmions at the Nanoscale using Diamond Quantum Sensors</i> | <i>UNL-MRSEC</i> | <i>PI</i> | <i>10/1/2019-10/31/2020</i> | \$50,000 | %100 |

- Title:** Probing Room-temperature Skyrmions at the Nanoscale using Diamond Quantum Sensors, **Funding Agency:** UNL-MRSEC, **Dates:** 10/1/2019-10/31/2020 PI: Abdelghani Laraoui, **Total Amount:** \$50,000, SAP WBS# 25-0521-0184-043.

2.2.2.a Externally Funded Research Grants at UNL.

| <i>Project Title</i> | <i>Sponsor</i> | <i>Role (PI or Co-PI)</i> | <i>Dates</i> | <i>Total Amount (do not include UNL cost share)</i> | <i>% Attributed to Candidate (do not include UNL cost share)</i> |
|--|-------------------------|---|---------------------------|---|--|
| <i>1. Objective-first sorting and time resolved diamond magnetic microscopy of superparamagnetic nanoparticles</i> | <i>NSF-UNM subaward</i> | <i>PI</i> | <i>8/1/2019-8/31/2021</i> | <i>\$122,500</i> | <i>%100</i> |
| <i>2. RII Track-1: Emergent Quantum Materials and Technologies (EQUATE)</i> | <i>NSF</i> | <i>Co-PI, Focused Research Group 2 leader</i> | <i>6/1/2021-5/31/2026</i> | <i>\$20,000,000 My part is \$1,150,607</i> | <i>%6</i> |
| <i>3. MRI: Acquisition of Optical Access in a Cryogenic Scanning Probe Microscope</i> | <i>NSF</i> | <i>Co-PI, initiator and main contributor of the writing</i> | <i>9/1/2021-8/31/2025</i> | <i>\$358,171 My part is: \$89,542.75</i> | <i>%25</i> |

- Title:** Objective-first sorting and time resolved diamond magnetic microscopy of superparamagnetic nanoparticles, **Funding Agency:** NSF sub-award from University of New Mexico, **Dates:** 8/1/2019-8/31/2021, PI: Abdelghani Laraoui, **Total amount:** \$122,500, **SAB WEB#** 26-1123-0243-001. **Abstract:** The goal of this research is to develop alternative strategies for high-sensitivity, parallel characterization of individual magnetic nanoparticles. The research project aims to study the magnetic dynamics of superparamagnetic iron oxide nanoparticles with 15-25 nm diameter, with a goal of improving their applicability in nanoscience applications. The magnetic properties of thousands of individual nanoparticles are simultaneously characterized using a magnetic microscope based on color centers doped near the surface of a diamond chip. Correlative transmission electron microscopy and magnetic images of numerous individual nanoparticles is used to elucidate the relationship between nanoparticle size, shape, magnetization relaxation, and hysteresis curve properties. A second aim of this research project is to study the correlation of composition, morphology, and magnetic dynamics of small transition metallic magnetic nanoparticles with a size range (2-10 nm) and establish a fundamental understanding of the effect of size, surface structure, and inter-particle dipolar interactions on their magnetic properties. The target magnetic sensitivity of 10 nT in 1 second integration time for a 400 nm x 400 nm pixel is sufficient to characterize particles down to 2 nm in diameter.
- Title:** RII Track-1: Emergent Quantum Materials and Technologies (EQUATE), **Funding Agency:** NSF, **Dates:** 6/1/2021-5/31/2026, PI: Matthew Andrews, CoPI: Christian Binek, Focused Research Group 2 Leader: Abdelghani Laraoui, **Total amount:** \$20, **SAB WEB#**25-0521-0238-005 (\$679,203) + 25-0521-0238-018 (\$471,404 for Equipment), **My part = \$1,150,607.** **Abstract:** In the “second quantum revolution,” quantum mechanics is applied to information theory and information technology. The State of Nebraska is participating in the second quantum revolution

by launching an interdisciplinary, interdepartmental, and multi-campus research and education cluster on Emergent Quantum Materials and Technologies (EQUATE) to increase jurisdictional competitiveness in the area of quantum science and technologies. The project focuses on research and workforce development to advance knowledge on topics related to quantum materials, technologies, and computation. Quantum materials are a new class of materials that exhibit quantum phenomena at macroscopic length scales and are expected to advance the technological landscape through the advent of quantum technologies. These new technologies will revolutionize fields such as information technology, medical technology, and cryptography, with impact on security areas such as defense and banking. EQUATE converges for the first-time the complementary quantum science and technology expertise of the University of Nebraska at Lincoln, the University of Nebraska at Omaha, the University of Nebraska at Kearney, and Creighton University, in partnership with Nebraska's community and tribal colleges, to open up unique opportunities for Nebraska. EQUATE consolidates the quantum science and technology expertise of 20 faculty researchers across the four Nebraska research institutions, establishing collaboration and feedback between theory and experiment to guide discoveries and expedite the findings of new emergent quantum materials and phenomena.

3. Title: *MRI: Acquisition of Optical Access in a Cryogenic Scanning Probe Microscope*, Funding Agency: NSF, Dates: 9/1/2022-8/31/2025, PI: Christian Binek, Co-PIs: Abdelghani Laraoui, Xia Hong, Xiaoshan Xu, Total amount: \$358,171, **SAB WEB** (not assigned yet), **My part = \$89,542.75**.
Abstract: This Track 1 Major Research Instrumentation award is for the acquisition of a Nitrogen Vacancy (NV)-Attocube (Atto) atomic force microscope (AFM) integrated with a confocal microscope (CFM), which allows magnetic, optical, and quantum measurements at the nanometer scale. The instrument will be located at the Surface and Materials Characterization division of the Nebraska Center for Materials and Nanoscience (NCMN) at the University of Nebraska-Lincoln (UNL). The acquisition of the module will transform the existing NSF-funded low-temperature high-magnetic-field multifunctional scanning probe microscope into a versatile platform for NV quantum sensing and fundamental research on quantum entanglement. The point defect atomic nature of the NV center and its spin millisecond quantum coherence lifetime allow measurements of a wide range of quantum materials with high sensitivity and spatial resolution (< 40 nm). Additionally, it operates at high magnetic fields and across a wide range of temperatures. The system can support various experiments, including magnetic imaging of solid-state materials and biomolecules as well as mapping optical and thermal properties of low-dimensional materials. Currently, there are five similar instruments in the U.S. with limitations in types of materials studied (e.g., only superconductors) or magnetic field range (only < 0.5 T). In acquiring the NV-AttoAFM/CFM, the goal is to position UNL at the forefront of quantum sensing capabilities ushering in the age of applied quantum technologies in Nebraska and U.S. Midwest. The infrastructure of NCMN, a user facility serving the Midwest research community and startup companies, includes the technical support of a PhD-trained expert in scanning probe microscopy, which ensures long-term maintenance, sustainability, and user support.

2.2.2.b Other Externally Funded Research Grants.

1. **Title:** MRI: acquisition of a Magnetic Property Measurement System (MPMS) to support research and education in the state of New Mexico, **Funding Agency:** NSF. **Dates:** 7/26/2018-7/31/2021, **Institution:** University of New Mexico, **PI:** Martin Kirk, Co-PI's: Abdelghani Laraoui, Victor Acosta, Daniel Feezell, Francesca Cavallo, **Sponsor Amount:** \$276,436, **UNM Cot share amount:** \$110,574, **Total amount:** \$387,010.
2. **Title:** Objective-first sorting and time resolved diamond magnetic microscopy of superparamagnetic nanoparticles, **Funding Agency:** NSF, **Dates:** 8/1/2019-8/31/2021, **PI:** Abdelghani Laraoui, **Co-PI:** Victor Acosta (PI since 8/1/2019), **Total Amount:** \$389,999. **Amount Attributed to candidate:** \$195,000 (\$122,500 transferred to UNL).

2.2.3 External Research Grants that have been submitted through the University of Nebraska-Lincoln Office of Sponsored Programs.

1. **Title:** QuSeC-TAQS Preliminary Proposal: Diamond quantum biosensors to elucidate cellular electron transport, **Funding agency:** NSF, dates of project: 09/01/2023 - 08/31/2027, **PI:** Abdelghani Laraoui, **Co-PIs:** Nicole Buan, Rebecca Lai, Karrie Weber, **Sponsor amount:** \$2,500,00, **UNL Cost share amount:** \$0, **Total amount:** \$2,500,000, **Amount attributable to me:** \$625,000, **Date of submission:** 12/16/2022.
2. **Title:** QuSeC-TAQS Preliminary Proposal: Probing quantum entanglement in correlated spin systems via qubit spectrometry and spin correlation measurements, **Funding agency:** NSF, dates of project: 09/01/2023 - 08/31/2027, **PI:** Christian Binek, **Co-PIs:** Abdelghani Laraoui, Aleksander Wysocki, Alexey Kovalev, Xia Hong, **Sponsor amount:** \$2,500,000, **UNL Cost share amount:** \$0, **Total amount:** \$2,500,00, **Amount attributable to me:** \$625,000, **Date of submission:** 12/16/2022.
3. **Title:** CAREER: Studying collinear antiferromagnetic oxides using diamond quantum sensing microscopy, **Funding agency:** NSF, dates of project: 09/01/2023 - 08/31/2028, **PI:** Abdelghani Laraoui, **Sponsor amount:** \$692,067, **UNL Cost share amount:** \$0, **Total amount:** \$692,067, **Amount attributable to me:** \$692,067, **Date of submission:** 7/27/2022.
4. **Title:** MRI: Acquisition of optical access in a cryogenic scanning probe microscope for quantum sensing capabilities, **Funding agency:** NSF, dates of project: 08/01/2022 - 07/31/2025, **PI:** Christian Binek, **Co-PI's:** Abdelghani Laraoui, Xia Hong, Xiaoshan Xu, David Sellmyer, **Sponsor amount:** \$358,171, **UNL Cost share amount:** \$153,527.28, **Total amount:** \$511,698.28, **Amount attributable to me:** \$89,542.75, **Date of submission:** 1/19/2022.
5. **Title:** Study topological spin textures and magnons in rare-earth iron garnets using nitrogen vacancy center magnetometry, **Funding agency:** NSF, dates of project: 9/1/2022-8/31/2025, **PI:** Abdelghani Laraoui, **Co-PI:** Alexey Kovalev, **Senior Personnel:** Xiaoshan Xu, **Sponsor amount:** \$569,999, **UNL Cost share amount:** \$0, **Total amount:** \$569,999, **Amount attributable to me:** \$224,523, **Date of submission:** 11/30/2021.
6. **Title:** CAREER: Studying Nanoscale Magnetic Phenomena in Magnetic Insulators and Oxides Using Diamond Quantum Sensing Microscopy, **Funding agency:** NSF, dates of project: 09/01/2022 - 08/31/2027, **PI:** Abdelghani Laraoui, **Sponsor amount:** \$752,665, **UNL Cost share amount:** 0, **Total amount:** \$752,665, **Amount attributable to me:** \$752,665, **Date of submission:** 7/23/2021.
7. **Title:** Novel Quantum Phenomena in Rare-Earth Nanostructures for Quantum Sensing, **Funding agency:** DOE, dates of project: 10/1/2021-9/30/2024, **PI:** Abdelghani Laraoui, **Co-PI's:** Ralph Skmoski, David Sellmyer, Balamurugan Balasubramanian, Durga Paudyal, Jonathan Smith, Matt Kramer, **Sponsor amount:** \$2,926,902. **UNL Cost share amount:** \$0, **Total amount:** \$2,926,902, **Amount attributable to me:** \$450,000, **Date of submission:** 4/14/2021.
8. **Title:** MRI: Acquisition of optical access in a cryogenic scanning probe microscope for quantum sensing capabilities, **Funding agency:** NSF, dates of project: 08/01/2021 - 07/31/2022, **PI:** Christian Binek, **Co-PI's:** Abdelghani Laraoui, Xia Hong, Xiaoshan Xu, David Sellmyer, **Sponsor amount:** \$328,170, **UNL Cost share amount:** \$140,644, **Total amount:** \$468,814, **Amount attributable to me:** \$65,634, **Date of submission:** 1/19/2021.
9. **Title:** Studying skyrmions and magnon modes in rare-earth garnet heterostructures using diamond, **Funding agency:** NSF, dates of project: 08/01/2021 - 07/31/2024, **PI:** Abdelghani Laraoui, **Co-PI:**

Alexey Kovalev, **Sponsor amount:** \$449,865, **UNL Cost share amount:** \$0, **Total amount:** \$449,865, **Amount attributable to me:** \$225,000, **Date of submission:** 10/30/2020.

10. **Title:** RII Track-1: Emergent Quantum Materials and Technologies (EQUATE), **Funding agency:** NSF, dates of project: 08/01/2021 - 07/31/2026, **PI:** Christian Binek, **Co-PI's:** Abdelghani Laraoui, Alexey Kovalev, Peter Dowben, Xia Hong, Xiaoshan Xu, Shireen Adenwalla, Rebecca Lai, Eva Schubert, Mathias Schubert, Wei Bao, Sy-Hwang Liou, Ralph Skomski, Yinsheng Guo, Mark Griep, **Sponsor amount:** 9,870,687, **UNL Cost share amount:** \$1,974,136, **Total amount:** \$11,844,823, **Amount attributable to me:** \$651,849 (estimated) + \$471,404 (for equipment). **Date of submission:** 07/29/2020.
11. **Title:** EFRC: FerroElectronic Materials and Structures (FEMS) for Energy-Efficient Information Technologies, **Funding agency:** DOE, dates of project: 09/01/2020 - 08/31/2024, **PI:** Evgeny Tsybmal, **Co-PI's:** Peter Dowben, Xia Hong, Christian Binek, Xiaoshan Xu, Shireen Adenwalla, Abdelghani Laraoui, Rebecca Lai, Alexei Gruverman, Yongfeng Lu, **Sponsor amount:** \$15,470,425, **UNL Cost share amount:** \$843,442, **Total amount:** \$16,313,867, **Amount attributable to me:** \$586,750, **Date of submission:** 04/21/2020.
12. **Title:** Coupling diamond spin qubits through ferromagnetic spin waves, **Funding agency:** ARO, dates of project: 09/01/2021 - 08/31/2024, **PI:** Abdelghani Laraoui, **Co-PI's:** Victor Acosta, Marcus Doherty, **Sponsor amount:** \$403,140, **UNL Cost share amount:** 0, **Total amount:** \$403,140, **Amount attributable to me:** \$150,000, **Date of submission:** 05/31/2019.

2.2.4 External Research Grants that have been submitted through other institutions

1. **Title:** QLCI - CI: New Experimental and Theoretical Advantages of Quantum Sensing (NExT-ArQs), **Funding Agency:** NSF, dates of project: 09/01/2001 - 08/31/2026, **PI:** Kather Murch, **Co-PI's:** Abdelghani Laraoui, and other 10 Co-PIs at University Washington at St Louis, **Sponsor amount:** \$25,000,000, **UNL Cost share amount:** 0, **Total amount:** \$25,000,000, **Amount attributable to me:** \$773,000, **Date of submission:** 08/14/2020.

2.2.5 External Research Grants Submitted through the University of Nebraska Lincoln Office of Sponsored Programs but not Funded

1. **Title:** Study topological spin textures and magnons in rare-earth iron garnets using nitrogen vacancy center magnetometry, **Funding agency:** NSF, dates of project: 9/1/2022-8/31/2025, **PI:** Abdelghani Laraoui, **Co-PI:** Alexey Kovalev, **Senior Personnel:** Xiaoshan Xu, **Sponsor amount:** \$569,999, **UNL Cost share amount:** \$0, **Total amount:** \$569,999, **Amount attributable to me:** \$224,523, **Date of submission:** 11/30/2021.
2. **Title:** Novel Quantum Phenomena in Rare-Earth Nanostructures for Quantum Sensing, **Funding agency:** DOE, dates of project: 10/1/2021-9/30/2024, **PI:** Abdelghani Laraoui, **CoPIs:** Ralph Skomski, David Sellmyer, Balamurugan Balasubramanian, Durga Paudyal, Jonathan Smith, Matt Kramer, **Sponsor amount:** \$2,926,902. **UNL Cost share amount:** \$0, **Total amount:** \$2,926,902, **Amount attributable to me:** \$450,000, **Date of submission:** 4/14/2021.
3. **Title:** CAREER: Studying Nanoscale Magnetic Phenomena in Magnetic Insulators and Oxides Using Diamond Quantum Sensing Microscopy, **Funding agency:** NSF, dates of project: 09/01/2022 - 08/31/2027, **PI:** Abdelghani Laraoui, **Sponsor amount:** \$ 752,665, **UNL Cost share amount:** 0, **Total amount:** \$752,665, **Amount attributable to me:** \$752,665, **Date of submission:** 7/23/2021.
4. **Title:** MRI: Acquisition of optical access in a cryogenic scanning probe microscope for quantum sensing capabilities, **Funding agency:** NSF, dates of project: 08/01/2021 - 07/31/2022, **PI:** Christian

Binek, **Co-PI's:** Abdelghani Laraoui, Xia Hong, Xiaoshan Xu, David Sellmyer, **Sponsor amount:** \$328,170, **UNL Cost share amount:** \$140,644, **Total amount:** \$468,814, **Amount attributable to me:** \$65,634, **Date of submission:** 1/19/2021.

5. **Title:** Studying skyrmions and magnon modes in rare-earth garnet heterostructures using diamond, **Funding agency:** NSF, dates of project: 08/01/2021 - 07/31/2024, **PI:** Abdelghani Laraoui, **Co-PI:** Alexey Kovalev, **Sponsor amount:** \$449,865, **UNL Cost share amount:** \$0, **Total amount:** \$449,865, **Amount attributable to me:** \$225,000, **Date of submission:** 10/30/2020.
6. **Title:** EFRC: FerroElectronic Materials and Structures (FEMS) for Energy-Efficient Information Technologies, **Funding agency:** DOE, dates of project: 09/01/2020 - 08/31/2024, **PI:** Evgeny Tsymbol, **Co-PI's:** Peter Dowben, Xia Hong, Christian Binek, Xiaoshan Xu, Shireen Adenwalla, Abdelghani Laraoui, Rebecca Lai, Alexei Gruverman, Yongfeng Lu, **Sponsor amount:** \$15,470,425, **UNL Cost share amount:** \$843,442, **Total amount:** \$16,313,867, **Amount attributable to me:** \$586,750, **Date of submission:** 04/21/2020.
7. **Title:** QLCI - CI: New Experimental and Theoretical Advantages of Quantum Sensing (NExT-ArQs), **Funding Agency:** NSF, dates of project: 09/01/2001 - 08/31/2026, **PI:** Kather Murch, **Co-PI's:** Abdelghani Laraoui, and other 10 Co-PIs at University Washington at St Louis, **Sponsor amount:** \$25,000,000, **UNL Cost share amount:** 0, **Total amount:** \$25,000,000, **Amount attributable to me:** \$773,000, **Date of submission:** 08/14/2020.

2.3.1 Internally Funded Non-Research Grants.

| <i>Project Title</i> | <i>Sponsor</i> | <i>Role (PI or Co-PI)</i> | <i>Dates</i> | <i>Total Amount</i> <i>(do not include UNL cost share)</i> | <i>% Attributed to Candidate</i> <i>(do not include UNL cost share)</i> |
|--|--|---------------------------|---------------------------|---|--|
| <i>Name of Distinguished Lecturer: Prof. Maria-Carmen Asensio, Materials Science Institute of Madrid (ICMM) of the Spanish Scientific Research Council</i> | <i>UNL-Office of Research and Economic Development</i> | <i>Co-PI</i> | <i>5/2/2021-5/20/2021</i> | \$3,000 | 0 |

1. **Title:** Name of Distinguished Lecturer: Prof. María-Carmen Asensio, Materials Science Institute of Madrid (ICMM) of the Spanish Scientific Research Council, **Funding Agency:** UNL's Office of Research and Economic Development, **Dates:** 5/2/2021-5/20/2021, **PI:** Peter Dowben. **Co-PI's:** Abdelghani Laraoui, Alexander Sinitskii, Takashi Komesu, **Total amount:** \$3,000. **SAP WBS #** 26-0521-9001-007.

2.4 Research Patents and Awards

2.4.1 Research Patents

Method for hyper-polarizing nuclear spins at arbitrary magnetic fields, C. A. Meriles, D. Pagliero, A. Laraoui, 2019-01-15, [US Patent App. 14/961,974](#).

2.4.2 Awards

1. New York Academy of Sciences' Blavatnik Award (nominated) for best postdoctoral , City College of New York. 10/2013.
2. Marie Curie Postdoctoral Fellowship,10/2007-3/2009, University of Kaiserslautern of Technology Kaiserslautern, Germany.
3. French Optical Society Award to attend Spintronics Summer School, Cargese, France, 5/2005-6/2005.

3 Teaching Accomplishments

3.1 Teaching Accomplishment:

- **Spring 2023:** MATL-492/892: Introduction to Quantum Materials and technologies. **Course Description:** This course introduces basic laws of quantum mechanics (coherence, entanglement, two-level system, topology, etc.) and provides an introduction to revolutionary quantum technologies including quantum communications, quantum sensing, and quantum computing. The boundary between classical and quantum physics, quantization of electromagnetic (EM) field and its consequences, quantum electromagnetic and atomic physics, quantum topological materials and their applications in quantum technologies are discussed. **Number of Students Attended:** 15 (4 undergraduate + 11 graduates). **Course evaluation results:** Results will be displayed in 5/31/2023.
- **Fall 2022:** MATL360/260, Elements of Materials Science Relation of atomic, molecular and crystal structure to the physical, mechanical and chemical properties of metals, alloys, polymers and ceramics, Experience in investigation of properties of engineering materials. **Number of Students Attended:** 70, **Course evaluation results:** 4.28 (averaged) for the lecture part and 4.54 (averaged) for the labs part.
- **Spring 2022:** MATL-492/892: Introduction to Quantum Materials and technologies. **Course Description:** This course introduces basic laws of quantum mechanics (coherence, entanglement, two-level system, topology, etc.) and provides an introduction to revolutionary quantum technologies including quantum communications, quantum sensing, and quantum computing. The boundary between classical and quantum physics, quantization of electromagnetic (EM) field and its consequences, quantum electromagnetic and atomic physics, quantum topological materials and their applications in quantum technologies are discussed. **Number of Students Attended:** 26 (7 undergraduate + 19 graduates). **Course evaluation results:** 3.75 (averaged).
- **Fall 2021:** MATL360/260, Elements of Materials Science Relation of atomic, molecular and crystal structure to the physical, mechanical and chemical properties of metals, alloys, polymers and ceramics, Experience in investigation of properties of engineering materials. **Number of Students Attended:** 71, **Course evaluation results:** 4.01 (averaged) for the lecture part and 4.36 (averaged) for the labs part.
- **Spring 2021:** Devolved a new class MATL-492/892: Introduction to Quantum Materials and technologies. **Course Description:** This course introduces basic laws of quantum mechanics (coherence, entanglement, two-level system, topology, etc.) and provides an introduction to revolutionary quantum technologies including quantum communications, quantum sensing, and quantum computing. The boundary between classical and quantum physics, quantization of electromagnetic (EM) field and its consequences, quantum electromagnetic and atomic physics,

quantum topological materials and their applications in quantum technologies are discussed. **Number of Students Attended:** 12 (2 students from UNL's Physics & Astronomy Department), **Course evaluation results:** 3.841(averaged).

- **Fall 2020:** MATL360-260, Elements of Materials Science Relation of atomic, molecular and crystal structure to the physical, mechanical and chemical properties of metals, alloys, polymers and ceramics. Experience in investigation of properties of engineering materials. **Number of Students Attended:** 70, **Course evaluation results:** 4.048 (averaged for labs and lecture).
- **Spring 2020:** MATL360-260, Elements of Materials Science Relation of atomic, molecular and crystal structure to the physical, mechanical and chemical properties of metals, alloys, polymers and ceramics. Experience in investigation of properties of engineering materials. **Number of Students Attended:** 72. **Course evaluation results:** 3.866 (averaged for labs and lecture).

3.2 PhD Students

3.2.2 PhD students currently supervised

1. Adam Erickson, UNL, **Funding:** 1/1/2020-10/31/2020 (MRSEC), 11/1/2020- 7/31/2021 (UNL startup), 8/1/2021- present (EQUATE), **Expected graduation date:** 5/2025.
2. Rupak Timilsina, UNL, **Funding:** 9/1/2020-5/31/2021 (UNL startup), 6/1/2021-present (EQUATE), **Expected graduation date:** 12/2024.
3. Wai Kiat (Walter) Chin, UNL, **Funding:** 1/1/2020- 5/31/2021 (UNL startup), 6/1/2021-8/31/2021 (EQUATE), **Expected graduation date:** Switched to the group of Dr. Jeffery Shield on 9/1/2021.

3.2 Postdocs

1. Dr. Mohammadjavad Dowran, PhD in Atomic-Molecular & Optical Physic, University of Oklahoma; Norman, OK, August 2021, **Funding:** 9/1/2021- Present (UNL startup), **Expected Contract End:** 8/31/2023.

3.4 Undergraduate Students

3.4.1 List of undergraduate students supervised in independent research study

1. Nathan Rieneke, Agricultural engineering (AGEN), UNL, **Funding:** 1/17/2023- present (UNL startup), **Number of research hours:** 12h/week.
2. Patrick Osborn, Department of Physics and Astronomy, Ohio State University, **Funding:** 6/1/2022- 8/31/2022 (REU/NSF), **Number of research hours:** 40h/week.
3. John Kunkee, Department of Physics, Nebraska Wesleyan University, **Funding:** 6/1/2022- 8/31/2022 (REU/NSF), **Number of research hours:** 40h/week.
4. Riley Chase, Mechanical & Materials Engineering (MME) -UNL, **Funding:** 10/1/2021- 12/31/2022 (UNL startup), **Number of research hours:** 12h/week.
5. Mohammad Sbai, Mechanical & Materials Engineering (MME) -UNL, **Funding:** 9/1/2020- 5/31/2022 (NSF), **Number of research hours:** 10h/week.
6. Thomas Baumert, Mechanical & Materials Engineering (MME)-UNL, **Funding:** 1/1/2020- 5/31/2020 (NSF), **Number of research hours:** 10h/week.
7. Abdul Majeed Al Naabi, Mechanical & Materials Engineering (MME) -UNL, **Funding:** 10/1/2019- 3/31/2020 (NSF), **Number of research hours:** 10h/week.

3.4.2 Average number of undergraduate students advised per year: 3

3.4.3 High School Students

1. Ben Hammons, Lincoln Public Schools, **Funding:** 6/1/2022- 8/12/2022 (Young Nebraska Scientists), **Number of research hours:** 30h/week.

4 Service Accomplishments

4.1 Professional Service

4.1.2 List of Journals for which I have reviewed papers since joined UNL

1. Advanced Materials: 1 in 2022
2. Nanophotonics: 1 in 2022
3. Nature Communications: 2 in 2020, 1 in 2019
4. Physics Review Letters: 2 in 2022, 3 in 2021, 2 in 2020, 1 in 2019
5. Physics Review X: 1 in 2020, 1 in 2019
6. Physics Review X Quantum: 1 in 2020
7. Applied Physics Letters: 2 in 2022, 2 in 2021, 2 in 2020, 1 in 2020
8. Physics Review Applied: 2 in 2022, 2 in 2021, 1 in 2020
9. APL Photonics: 1 in 2021, 1 in 2020
10. Physical Review B: 2 in 2022, 2 in 2021, 2 in 2020, 2 in 2019
11. Physics Review Materials: 2 in 2021, 1 in 2020
12. International Laser Physics: 1 in 2020

4.1.3. Other service.

- Reviewer for NSF, Convergence Accelerator Track C (Quantum Sensing), 3/2021-6/2021, reviewed 10 proposals (total amount for funding is \$20m distributed over 4 proposals (3-year Phase 2 projects), Served in the review panel on June 17-18, 2021.
- Reviewer for NSF SBIR/STTR program, 4/2021-present.
- Session Chair, [Nanomagnetic Core Shell Structures and Antiferromagnetic Systems](#), APS March Meeting, March 5-10, 2023, Las Vegas, NV.

4.2 University Service

4.2.1 List of membership positions

1. 2022-present: Co-chair PhD committee of Kun Wang (PhD Supervisor: Xia Hong), Graduate Research Assistant, Physics & Astronomy.
2. 2022-present: Co-chair PhD committee of Kai Huang (PhD Supervisor: Evgeny Tsymbal), Graduate Research Assistant, Physics & Astronomy.
3. 2021-2022: Co-chair PhD committee of Haohan Wang (PhD Supervisor: Xiaoshan Xu), Graduate Research Assistant, Physics & Astronomy. Graduated in August 2022.
4. 12/1/2021- Present, member of UNL's Physics & Astronomy Department, EQUATE Search. Committee members: Christian Binek (lead), Abdelghani Laraoui, Xia Hong, Evgeny Tsymbal, Robert Streubel, Goal: hire an Assistant Professor to join EQUATE center.

4.2.2 College of Engineering Service

1. Member of Materials Science graduate admissions committee, 2021-present, Department of Mechanical and Materials Engineering, University of Nebraska-Lincoln.

2. 2022- present: PhD committee member of Ali Al-Ramini (PhD Advisor: Fadi Alsalem), Graduate Research Assistant, Mechanical and Materials Engineering Department.
3. 2022- present: Co-chair PhD committee of Megan Stokey (PhD Advisor: Mathias Schubert), Graduate Research Assistant, Electrical and Computer Engineering department.
4. 2022- present: Co-chair PhD committee of Alexander Ruder (PhD Advisor: Mathias Schubert), Graduate Research Assistant, Electrical and Computer Engineering department.
5. 2021-2022: Co-chair PhD committee of Matt Hilfiker, Graduate Research Assistant, Electrical and Computer Engineering department. Graduated in May 2022.
6. 11/1/2020- 4/30/2021, served as a member of the Electrical & Computer Engineering (ECE) Quantum Materials Search. Committee members: Yongfeng Lu (lead), Abdelghani Laraoui, Wei Bao, Eva Schubert, Christos Argyropoulos. Goal: hire an Assistant Professor to join ECE and UNL's quantum initiative. Accomplishment: we hired [Laura Wang](#), an expert in hybrid quantum optics systems.

4.5 Other Service Accomplishments

1. I gave a plenary talk on quantum sensing aspects at UNL's Grand Challenges "Quantum Science and Engineering" meeting on October 19-20, 2021.
2. I was part of the group directed by Christian Binek to draft the next 5-year grand challenges of UNL in the Quantum Science and Engineering along the N2025 vision. Over the course of 6 months, I participated and hosted online sessions to choose the urgent challenges of UNL to make it recognized nationally and internationally in quantum technologies. We were fortunate that we got selected, drafted with help of some department chairs (e.g., Jeffery Shield), and submitted a 3-page document to ORED (Nathan Meier).
3. I was part of the group lead by Christian Binek, selected by Nebraska-EPSCoR office, to submit \$24-m proposal to NSF. The goal of this proposal is to create a center in emergent quantum materials and quantum technologies (EQUATE) from 2021-2026. I was the Focused Research Group (FRG)-2 leader in quantum sensing and technologies, drafted a significant part of the proposal, organized more than 15 meetings with FRG2- Co-PIs, and attended more than 20 meeting with EPSCoR director. I also helped in organizing the first workshop in emergent quantum materials and quantum technologies at UNL and presented FRG2 research plans along the EQUATE center. Link: <https://ncmn.unl.edu/equate-test>.

5. Other Accomplishments

5.1 Professional Development

1. 1/1/2020-present: I was selected by ORED as a fellow for the CAREER Club (worth \$10,000). I have attended all meetings with experts in proposal writing, NSF program managers, etc. to write a competitive CAREER proposal.
2. 10/1/2019: 5/31/2020: I was selected by UNL's Office of Research and Development (ORED) to participate for 2019/2020 Research Development Fellows Program (RDFP). I have attended all the meetings and selected to go to Washington DC and meet with NSF program managers. COVID-19 affected the travel and will reschedule it to another date.