

Abdelghani Laraoui, PhD

Center for High Technology Materials, University of New Mexico
 1313 Goddard St. SE, Albuquerque, NM 87106, alaraoui@unm.edu, 347-332-3699
 Webpage: <https://sites.google.com/view/abdelghanilaraoui/>

Education

- 2007 Ph.D. in Physics (Experimental Condensed Matter Physics), [Louis Pasteur University of Strasbourg](#), France. Title: Femtosecond spin dynamics of magnetic nanostructures, Advisor: [Prof. Jean-Yves Bigot](#). Thesis.
- 2003 M.S. in Condensed Matter Physics, [University of Upper Alsace](#), Mulhouse, France

Professional Experience

- 2016- Research Assistant Professor, [Center for High Technology Materials](#), University of New Mexico, Albuquerque, NM. Research: Quantum sensing, Nanophotonics
- 2014-2016 Senior Research Scientist, City College of New York, New York, NY.
 Research: Scanning spin-probe microscopy, Nanoscale Thermometry, 2D materials
- 2009-2013 Postdoctoral Researcher, City College of New York, New York, NY. [Prof. Carlos Meriles](#) group: Spin physics of color centers in diamond, Magnetometry, Nanoscale Metrology
- 2007-2009 Marie Curie Postdoctoral Fellow, University of Kaiserslautern, Kaiserslautern, Germany
 Group of [Prof. Burkard Hillebrands](#): Spin-torque nano-oscillators, Magneto-optical Kerr microscopy imaging of current control of domain-wall motion in ferromagnetic nanowires

Research Funding (Pending, Current, and Past)

1. **DoD-ARO**, [BAA#W911NF-17-S-0002](#), Program manager: Dr. Sara Gamble, **\$390,000**, **Pending** (accepted white paper, the main proposal is being submitted). “Hybrid diamond-ferromagnet network for scalable quantum information processing”, **Role: PI**.
2. **DoE**, [FOA-0001909](#), **\$4,389,942**, **Pending**. “Multimodal Systems for quantum-to-quantum transduction and coherent transport, **Role: Senior Personal** (my 6-month/year salary can be transferred to lab equipment and supplies).
3. **NSF-DMR** [#1809800](#), **\$389,000**, **9/1/2018-8/31/2021** (continuing grant). “Objective-first sorting and time resolved diamond magnetic microscopy of superparamagnetic nanoparticles”. **Role: PI**.
4. **NSF-MRI** [#1828744](#), **\$387,010** (\$110,574 UNM’s contribution), **7/26/2018-7/31/2021**, “MRI: acquisition of a Magnetic Property Measurement System (MPMS) to support research and education in the state of New Mexico”. **Role: Co-PI**.
5. **NIH-NIBIB** [#1R21EB027405-01](#), **\$592,479**, **9/20/2018-6/30/2021** (continuing grant). “Sub-cellular studies of immunomagnetic labeling using diamond magnetic microscopy and

multiplexed probes”. **Role: Co-Investigator** (my 6-month/year salary can be transferred to lab equipment and supplies).

6. **NIH-NIGMS #GM119925-01**, \$216,281, 9/01/16 - 8/31/17. “Nanoliter electron paramagnetic resonance sensor based on diamond nanophotonics: a new tool for biomarker monitoring”, **Role: Senior Personnel** (my salary was paid through the grant).
7. **The European Research Training Network**, [ID#35327](#). 10/01/2007 - 3/31/2009. 120,000 EUR. “Spin current induced ultrafast switching”. **Role: Postdoctoral Fellow**.

Awards

| | |
|-----------|--|
| 2013 | New York Academy of Sciences’ Blavatnik Award (nominated) for best postdoctoral research work on quantum sensing, New York, NY |
| 2012 | CUNY Postdoctoral Travel Award, CCNY, New York, NY |
| 2007-2009 | Marie Curie Postdoctoral Fellowship, Kaiserslautern, Germany |
| 2007 | Best doctoral research award at the University of Strasbourg, Strasbourg, France |
| 2005 | French Optical Society Award to attend Spintronics Summer School, Cargese, France |

Teaching Experience

| | |
|-----------|---|
| 2004-2007 | Teaching Assistant: Optics, Electricity & Magnetism, Physics Department, Louis Pasteur University of Strasbourg, Strasbourg, France |
| 2001-2002 | Middle School Teacher of Physics, Bordj Bou Arreridj, Algeria |

Visiting Research

| | |
|----------------|---|
| Aug- Sept 2008 | University of Paris Sud, Orsay, France. Group of Dr. Jacques Miltat Research: Micromagnetic modeling of spin-torque nano-oscillators |
| Jan-Feb 2009 | Imperial College of London, London, UK. Group of Prof. Russell Cowburn Research Magneto-optical imaging of current induced domain-wall motion in nanowires |
| March 2017 | Japan Advanced Institute of Science and Technology (JAIST), Nomi, Japan. Group of Prof. Toshi An . Research: Spin-wave control of spin-qubits in diamond |
| March 2018 | Australian National University, Canberra, Australia. Group of Dr. Marcus Doherty Research: Scalable quantum processing based on hybrid spin-qubits-in-diamond to ferromagnetic nanowires |

Research Interests

- Exploring high-performance quantum memories based on defects in wide-band-gap semiconductors (diamond, ZnO, SiC, GaN) and 2D materials (hBN, WSe₂, MoS₂, etc.) for quantum information processing and quantum sensing.
- Scalable quantum information processing networks: hybrid systems based on magnetic or photonic cavities coupled to spin qubits in wide-band-gap semiconductors (diamond, silicon carbide, etc.).
- Nanoscale spin sensing and spin dynamics of novel magnetic nanomaterials based on topological states of ferromagnets/antiferromagnets and insulators: magnetic skyrmions, surface spin current generated in topological insulators, vortices in superconductors, magnetic nanostructures for spintronics and data storage applications.
- Biosensing and biomolecular imaging.

List of Publications: [Google Scholar](#)

1. **A. Laraoui**, J. Smits, N. Mosavian, I. Fescenko, P. Kehayias, A. Jarmola, V. M. Acosta. “Correlative characterization of individual 25-nm magnetic nanoparticles' relaxation, hysteresis, and morphology”, under preparation.
2. J. Smits, J. Damron, P. Kehayias, **A. Laraoui**, I. Fescenko, N. Mosavian, A. Jarmola, V. M. Acosta. “Sub-Hertz two dimensional NMR spectroscopy of molecules using Nitrogen Vacancy centers in diamond”, under preparation.
3. 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”, *Science Advances*, under review, [arxiv:1808.03636](#) (2018).
4. 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](#).
5. 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](#).
6. 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](#).
7. **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](#).
8. **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](#).

9. 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](#).
10. 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](#).
11. **A. Laraoui**, C. A. Meriles. “Approach to dark spin cooling in a diamond nanocrystal”, *ACS Nano* **7**, 3403 (2013). [arXiv:1703.03988](#).
12. **A. Laraoui**, F. Dolde, C. Burk, F. Reinhard, J. Wrachtrup, C. A. Meriles. “High-Resolution Correlation Spectroscopy of ^{13}C Spins Near a Nitrogen-Vacancy Center in Diamond”, *Nature Communications* **4**, 1651 (2013). [arXiv:1305.1536](#).
13. **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).
14. J.-Y. Bigot, M. Vomir, M. Barthélémy, M. Albrecht, **A. Laraoui**. “Nanophotonics devices based on magnetic materials”, *Proc. SPIE* **8268**, 82682U (2012).
15. **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](#).
16. **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](#).
17. **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](#).
18. 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](#).
19. 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).
20. **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).
21. **A. Laraoui**, J. Vénuat, 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).
22. **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).

23. **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).
24. 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).
25. **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).
26. 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).

Patents

1. **A. Laraoui**, V. M. Acosta, M. Doherty, Hybrid diamond-ferromagnet network for scalable quantum information processing”, under preparation.
2. **A. Laraoui**, V.M. Acosta, T. Karaulanov, “Wide-field thermometry”. US patent, Pending.
3. C.A. Meriles, D. Pagliero, **A. Laraoui**, “Method for hyper-polarizing nuclear spins at arbitrary magnetic fields”, **US Patent App. 14/961,974**.

Relevant Skills

- Scanning probe microscopy (AFM, MFM, NSOM), Electron-beam lithography, electron microscopy (TEM, SEM), reactive ion etching, magnetic thin-film deposition (MBE, sputtering), confocal microscopy, diode/fiber/Ti:sapphire lasers, Magneto-optical microscopy (MOKE, BLS, Faraday, etc), laser spectroscopy (pump-probe, Raman, fluorescence, 4-wave mixing, etc.).
- Matlab, LabView, some C/C++, etc.
- Electrotransport & Magneto-transport measurements techniques.
- MW/RF electronics circuits: built and designed different circuits for single spin qubit control.

Synergistic Activities

- | | |
|--------------|--|
| 2010-present | Reviewer for <i>Nature Communications</i> , <i>Scientific Report</i> , <i>Physical Review Letters</i> , <i>Physical Review A/B/X/Applied</i> , <i>Applied Physics Letters</i> , <i>Optics Express</i> , <i>Diamond & Related Materials</i> |
| 2007-2017 | Graduate/undergraduate students’ mentor. Hosted and advised incoming graduate students for the University of Kaiserslautern, City College of New York-CUNY, and University of new Mexico |
| 2008 | Organized a Marie Curie Younger Scientists’ Meeting, Kaiserslautern, Germany |
| 2004-2007 | Organized several high-school students’ visits at the University of Strasbourg, France |

2004-2007 Member of astrophysics/physics graduate students club, University of Strasbourg, France

Current Collaborators

[Prof. Victor Acosta](#), Physics & Astronomy Department, University of New Mexico, Albuquerque, NM

[Dr. Dale Huber](#), Sandia National Laboratories, Albuquerque, NM

[Prof. Toshu An](#), JAIST, Nomi, Japan

[Dr. Christoph Adelmann](#), IMEC, Leuven, Belgium

[Dr. Marcus Doherty](#), ANU, Canberra, Australia

Professional Membership

2010- The New York Academy of Sciences (NYAS)

2011- American Physical Society (APS)

2012– 2014 Materials Research Society (MRS)

2007 – 2009 German Physical Society (DPG)

2004 – 2007 French Optical Society (SFO)

Invited Talks & Seminars

June 2019 Gordon conference, Quantum Sensing Applications in Metrology and Imaging,
Hong Kong, CN

February 2018 Seminar at the Physics & Astronomy Department, Georgia State University, Atlanta, GA

February 2018 Seminar at the Physics & Astronomy Department, University of Wisconsin–Madison,
Madison, WI

April 2017 Keynote talk at NMR2 meeting, Albuquerque, NM

April 2017 OSE seminar at Physics & Astronomy Department, University New Mexico,
Albuquerque, NM

March 2017 16th MS-Seminar, School of Materials Science - JAIST, Nomi, Japan

March 2017 Seminar at NIMS, Tsukuba, Ibaraki, Japan

May 2016 Seminar at Center for High Technology Materials-UNM, Albuquerque, NM

March 2016 Seminar at the Physics & Astronomy Department, Texas A&M, Commerce, TX

August 2015 META'15, the 6th International Conference on Metamaterials, Photonic Crystals and
Plasmonics, New York, NY

March 2014 Seminar at the Physics & Astronomy Department, City College of New York-CUNY,
New York, NY

April 2013 Workshop on Diamond- spintronics, photonics, bio-applications, Hong Kong

January 2012 SPIE Photonics West, San Francisco, CA
 June 2011 Gordon Research Conferences in magnetic resonance, Biddeford, ME
 September 2009 Trends in NanoTechnology International Conference, Barcelona, Spain
 May 2009 Seminar at Physics Department, New York University, New York, NY
 May 2009 International Magnetism Conference, Sacramento, CA
 November 2008 Seminar at SPINTEC, CEA, Grenoble, France
 October, 2008 Seminar at Physics department, University of Konstanz, Konstanz, Germany
 October 2008 IEEE nanotechnology materials and devices Conference, Kyoto, Japan
 September 2008 Seminar at Laboratory of solid state physics, University of Paris 13, Orsay
 April 2008 Seminar at Physics department, Kaiserslautern University of Technology
 June 2007 International Quantum Electronics Conference – Europe, Munich, Germany
 June 2007 FCILA 2007, Lyon, France
 October 2005 Workshop on Novel trends in magnetism, Corfu, Greece
 April 2004 Seminar at the Zernike Institute for Advanced Materials, Groningen, the Netherlands

Contributed Talks

March 2019 APS March Meeting, Boston, MA
 April 2018 MRS Spring Meeting, Phoenix, AZ
 March 2018 APS March Meeting, Los Angeles, CA
 July 2017 The 20th ISMAR conference, Quebec City, QE, Canada
 April 2017 MRS Spring Meeting, Phoenix, AZ
 February 2017 SPIE Photonics West, San Francisco, CA
 March 2016 APS March Meeting, Baltimore, MD
 March 2015 APS March Meeting, San Antonio, TX
 March 2014 APS March Meeting, Denver, CO
 March 2013 APS March Meeting, Baltimore, MD
 November 2012 MRS Fall meeting, Boston, MA
 July 2012 4th Nano-MRI Conference, Monte Verita, Switzerland
 March 2012 APS March Meeting, Boston, MA
 November 2008 The first international workshop on Magnetic Single Nano-Objects, Nancy, France
 August 2008 Spin momentum transfer workshop, Krakow, Poland
 October 2007 Nanoscience Grand East Meeting: spintronics and nanomagnetism, Strasbourg, France
 June 2007 FCILA 2007, Lyon, France
 March 2007 11th Louis Néel Colloquium, Lyon, France

August 2006 15th International Conference Ultrafast Phenomena, Pacific Grove, CA
 May 2006 MRS-Europe meeting, Strasbourg, France

Posters

March 2019 APS March Meeting, Boston, MA
 March 2018 APS March Meeting, Los Angeles, CA
 February 2018 Southwest Quantum Information and Technology Workshop, Santa Fe, NM
 September 2017 CINT Sandia-LANL meeting, Santa Fe, NM
 April 2017 ENC conference, Pacific Grove, CA
 July 2015 5th annual Nano-MRI Conference, Waterloo, ON, Canada
 February 2015 NanoscienceNY meeting, New York, NY
 February 2012 APS March Meeting, Boston, MA
 June 2012 Gordon Research Conferences in magnetic resonance, Biddeford, ME
 March 2011 APS March Meeting, Dallas, Texas
 November 2010 Artificial atoms in diamond Workshop, Harvard University, Cambridge, MA
 July 2010 Nano-MRI research conference: Exploring the Frontiers of Magnetic Resonance Imaging, Le Tremblay sur Mauldre, France
 September 2009 Summer School: Spin torque transfer and domain wall dynamics, Iași, Romania
 July 2009 20th International Colloquium on Magnetic Films and Surfaces, Berlin, Germany
 March 2009 German Physical Society spring meeting, Dresden, Germany
 September 2008 Spin momentum transfer workshop, Krakow, Poland
 August 2008 11th France condensed matter meeting, Strasbourg, France
 May 2008 INTERMAG conference, Madrid, Spain
 February 2008 School on Nanomaterials for magnetism and spintronics, Strasbourg, France
 July 2007 Optics Grenoble 2007, Grenoble, France
 June 2007 International Symposium on Spin Waves, Saint Petersburg, Russia
 January 2007 10th Joint MMM/Intermag Conference, Baltimore, MD
 November 2006 3rd Trends in Materials and Nanosciences Conference, Strasbourg, France
 July 2006 13th ISSPIC Conference, Gothenburg, Sweden
 December 2005 7th meeting on ultrafast phenomena, Lille, France

List of references

1. [Prof. Carlos A. Meriles](#)

Professor of Physics, City College of New York-CUNY

Marshak Building, Room 419

160 Convent Avenue, New York, NY 10031

Email: cmeriles@ccny.cuny.edu

Tel#212-650-5625

2. [Prof. Victor M. Acosta](#)

Assistant Professor, Department of Physics & Astronomy and Center for High Technology Materials

University of New Mexico

1313 Goddard St. SE

Albuquerque, NM 87106

Email: victormarcelacosta@gmail.com

Tel# 510-717-6147

3. [Prof. Toshu An](#)

Associate Professor

School of Materials Science, Japan Advanced Institute of Science and Technology (JAIST),

1-1 Asahidai, Nomi, Ishikawa 923-1292, Japan

E-mail: toshuan@jaist.ac.jp

Tel# +81-76-151-1551

4. [Dr. Marcus Doherty](#)

Research Scientist

Laser Physics Center and Physics Education Center

Australian National University

Mills Rd, Acton ACT 2601, Canberra, Australia

Email: marcus.doherty@anu.edu.au

Tel# +61 2 61259276