Badih A. Assaf

Franck M. Freimann Assistant Professor

Department of Physics, University of Notre Dame

335 Nieuwland Science Center, Notre-Dame, IN 46556

+1-574-631-0671

bassaf@nd.edu

https://thequantumirish.com

Education:

2014: Northeastern University. Dept. of Physics: PhD: Physics

Advisor: Don Heiman

2011: Northeastern University. Dept. of Physics: M.Sc.: Physics

2009: American University of Beirut*:* B.Sc.: Major: Physics, Minor: Mathematics

Appointments

August 2018 – present: Assistant Professor, Department of Physics, University of Notre Dame

September 2014 – July 2018: Post-doctoral Fellow - Junior Research Chair

LabEx ENS-ICFP – Département de Physique, Ecole Normale Supérieure - Paris

November 2014: Visiting Scientist

Madhavan group, Physics, Boston College

July 2011 – May 2014: Visiting Scientist

Moodera group, Francis Bitter Magnet Lab, MIT

January 2011 – May 2014: Research Assistant

Heiman group, Physics, Northeastern University.

Thesis: Magnetotransport in Thin Films and Heterostructures of Topological Matter

Funding and awards

NDnano seed grant 2019 (co-PI with D. Burghoff as PI and X. Liu as co-PI). USD 70,000

Ecole Normale Supérieure ANR Labex-ENS ICFP, 09/2014-07/2018. EUR100,000

Reviewer activities

Physical Review Letters, Physical Review (B, Materials, Applied), Nature Communications, 2D Materials, IEEE Transactions on Terahertz Science and Technology, Europhysics Letters, Journal of Applied Physics, Applied Physics Letters, Physica Status Solidi B, Polish Research Council (NCN), Agence Nationale de la Recherche, National Science Foundation.

Scientific Expertise

- Infrared and THz Magnetooptics
- Topological phases of matter
- DC and RF Transport
- High magnetic fields
- Chemical vapor deposition: IV-VI and V-VI semiconductors

- Molecular beam epitaxy: IV-VI, V-VI and III-V materials

Teaching

August 2018 – present: Assistant Professor, Physics, University of Notre Dame
PHYS 90507 Topology and Dirac fermions in condensed matter
PHYS 10310 Engineering Physics 1
PHYS 10320 Engineering Physics 2

September 2014 – July 2018: Instructor, *Département de Physique, Ecole Normale Supérieure*
Advanced Experimental Physics Projects

September 2009 – April 2011: Teaching Assistant, *Department of Physics, Northeastern University*

Publications

Since August 2018

1. G. Krizman, T. Schumann, S. Tchoumakov, B.A. Assaf, S. Stemmer, L.A. de Vaulchier, Y. Guldner. "Determination of the crystal field splitting parameter in Cd3As2 using magnetooptics." Phys. Rev. B 100 155205 (2019)
2. A. Inhofer, T. Wilde, J. Duffy, M. Boukhicha, J. Palomo, K. Watanabe, T. Taniguchi, J.M. Berroir, G. Fève, E. Bocquillon, B. Plaçais, B.A. Assaf. "RF compressibility of topological surface and interface states in metal-hBN-Bi2Se3 capacitors" Submitted. J. Phys. Mater. 2 044003 (2019)
3. G. Krizman, B.A. Assaf, T. Phuphachong, G. Bauer, G. Springholz, L.A. de Vaulchier, Y. Guldner. "Dirac parameters and topological phase transition of Pb1-xSnxSe from magneto-spectroscopy" Phys. Rev. B. 98 245202 arxiv 1810.10490 (2018)
4. G. Krizman, B.A. Assaf, M. Orlita, T. Phuphachong, G. Bauer, G. Springholz, G. Bastard, R. Ferreira, L.A. de Vaulchier, Y. Guldner. "Avoided level crossing at the magnetic field induced topological phase transition due to orbital mixing" Phys. Rev. B. 98 161202 (2018). arxiv 1808.03361. Editors' Suggestion.

Before August 2018

5. P.M. Hosseinpour, F. Jiménez-Villacorta, J. Liu, B.A. Assaf, I.J. McDonald, D. Arena, D. Heiman, L. Menon, and L.H. Lewis. "Fe-incorporated TiO2nanotube arrays: Electronic structure and magnetic response" Phys. Rev. B 98 195145 (2018)
6. G. Krizman, B.A. Assaf, T. Phuphachong, G. Bauer, G. Springholz, G. Bastard, R. Ferreira, L.A. de Vaulchier, Y. Guldner. "Tunable Dirac interface states in topological superlattices" Phys. Rev. B **98** 075303 (2018). Arxiv1806.04676.
7. D. Walkup, B.A. Assaf, K.L. Scipioni, R. Sankar, F. Chou, G. Chang, H. Lin, I. Zeljkovic, V. Madhavan, "Interplay of orbital effects and nanoscale strain in topological crystalline insulator." Nature Communications 9 1550 (2018). arxiv1610.09337.
8. Inhofer, J. Duffy, M. Boukhicha, E. Bocquillon, J. Palomo, K. Watanabe, T. Taniguchi, I. Estève, J.M. Berroir, G. Fève, B. Plaçais, B.A. Assaf. "RF compressibility of topological insulator Bi2Se3- in the bulk depleted regime", Physical Review Applied 9 024022 (2018). arxiv1707.01657
9. B.A. Assaf, T. Phuphachong, E. Kampert, V. Volobuev, P. Mandal, J. Sanchez-Barriga, O. Rader, G. Bauer, G. Springholz, L.A. de Vaulchier, Y. Guldner, "Negative magnetoresistance from anomalous N=0 Landau level in topological matter". Physical Review Letters 119, 106602 (2017) arxiv 1704.02021. Editors' Suggestions.

10. Inhofer, S. Tchoumakov, B.A. Assaf, G. Fève, J.M. Berroir, V. Jouffrey, D. Carpentier, M. Goerbig, B. Plaçais, K. Bendias, D.M. Mahler, E. Bocquillon, E. Schlereth, C. Brüne, H. Buhmann, L.W. Molenkamp. "Topological confined massive surface states in strained bulk HgTe probed by RF compressibility", Physical Review B 96 195104 (2017) arxiv.1704.04045. Editors' Suggestions.
11. T. Phuphachong, B.A. Assaf, V.V. Volobuev, G. Springholz, G. Bauer, L.A. de Vaulchier, Y. Guldner. "Magnetooptical evidence of the topological phase transition in (111)-Pb1-xSnxTe. Journal of Physics: Conference Series. 864, 012038 (2017).
12. B.A. Assaf, T. Phuphachong, V.V. Volobuev, G. Springholz, G. Bauer, L.A. de Vaulchier, Y. Guldner. "Magnetooptical determination of a topological index". Nature partner journals Quantum Materials. 2, 26 (2017) arxiv: 1608.08912
13. T. Phuphachong, B.A. Assaf, V.V. Volobuev, G. Springholz, G. Bauer, L.A. de Vaulchier, Y. Guldner. "Dirac Landau Level Spectroscopy in Pb1−xSnxSe and Pb1−xSnxTe across the Topological Phase Transition: A Review". Crystals 7, 29 (2017)
14. V. Callewaert, K. Shastry, R. Saniz, I. Makkonen, B. Barbiellini, B. A. Assaf, D. Heiman, J.S. Moodera, B. Partoens, A. Bansil, A. Weiss, "Positron surface state as a new spectroscopic probe for characterizing surfaces of topological insulator materials". Physical Review B. 94, 115411 (2016)
15. F. Katmis, V. Lauter, F.S. Nogueira, B.A. Assaf, M.E Jamer, P. Wei, B. Satpati, J.W. Freeland, I. Eremin, D. Heiman, P. Jarillo-Herrero, J.S. Moodera, "A high-temperature ferromagnetic topological insulating phase by proximity coupling." Nature 533, 513, (2016).
16. B.A. Assaf, T. Phuphachong, V.V. Volobuev, A. Inhofer, G. Springholz, G. Bauer, L.A. de Vaulchier, Y. Guldner. "Massive and massless Dirac fermions in Pb1-xSnxTe topological crystalline insulator probed by magnetooptical absorption". Scientific Reports 6, 20323 (2016). arxiv: 1510.01081
17. K. Shastry, A.H. Weiss, B. Barbiellini, B.A. Assaf, Z.H. Lim, P.V. Joglekar, D. Heiman. "Evidence of positron bound State on the surface of a topological insulator." Journal of Physics: Conference Series. 618, 012006 (2015).
18. I. Zeljkovic, D. Walkup, B.A. Assaf, K. Scipioni, R. Sankar, F. Chou, V. Madhavan. "Strain engineering Dirac surface states in heteroepitaxial topological crystalline insulator thin films." Nature Nanotechnology 10, 849 (2015). arxiv: 1501.01233.
19. B.A. Assaf, F. Katmis, P. Wei, C.Z. Chang, B. Satpati, J.S. Moodera, D. Heiman. "Inducing magnetism onto the surface of a topological crystalline insulator". Physical Review B 91, 195310, (2015). arxix: 1504.06121
20. C.Z. Chang, W. Zhao, D.Y. Kim, H. Zhang, B.A. Assaf, D. Heiman, S.C. Zhang, C. Liu, M.H.W. Chan, J.S. Moodera. "High-precision realization of robust quantum Hall states in a hard ferromagnetic topological insulator." Nature Materials, 14, 473 (2015). arxiv: 1412.3758
21. M.E. Jamer, B.A. Assaf, G.E. Sterbinsky, D. Arena, L.H. Lewis, A.A. Saul, G. Radtke, D. Heiman, "Antiferromagnetic phase in gapless semiconductor V3Al", Physical Review B, 91, 094409, (2015)
22. M.E. Jamer, B.A. Assaf, G.E. Sterbinsky, D.A. Arena, D. Heiman, "Atomic moments in Mn2CoAl thin films analyzed by X-ray magnetic circular dichroism", Journal of Applied Physics, 116, 213914 (2014).
23. B.A. Assaf, F. Katmis, P. Wei, B. Satpati, Z. Zhang, J.S. Moodera, D. Heiman, "Quantum coherent transport in SnTe topological crystalline insulator thin films", Applied Physics Letters, 105, 102108 (2014), arxiv 1403.1810
24. M.E. Jamer, B.A. Assaf, S. P. Bennett, L.H. Lewis, D. Heiman, "Magnetic properties and large coercivity in MnxGa nanostructures", Journal of Magnetism and Magnetic Materials, 358-359, 285 (2014).
25. G.X. Miao, J. Chang, B.A. Assaf, D. Heiman and J.S. Moodera, "Spin regulation in composite spin-filter barrier devices", Nature Communications, 5, 3682 (2014).
26. T. Nan, Z. Zhou, M. Liu, X. Yang, Y.Gao, B.A. Assaf, H. Lin, S. Velu, X.Wang, H. Luo, J. Shen, S. Akhtar, E. Hu, R. Rajiv, K. Krishnan, S. Sreedhar, D. Heiman, B.M. Howe, G.J. Brown and N.X. Sun,

"Quantification of strain and charge co-mediated magnetoelectric coupling on ultra-thin Permalloy PMN-PT interface", Scientific Reports, 4, 3368 (2014)

27. M.E. Jamer, B.A. Assaf, T. Devakul and D. Heiman, “Magnetic and transport properties of spin gapless Mn2CoAl films”, Applied Physics Letters, 103, 142403 (2013), arxiv 1309.6660.
28. P. Wei, F. Katmis, B.A. Assaf, H. Steinberg, P. Jarillo-Herrero, D. Heiman, J.S. Moodera, “Magnetic proximity-induced symmetry breaking in topological insulators”, Physical Review Letters, 110, 186807 (2013)
29. B.A. Assaf, T. Cardinal, P. Wei, F. Katmis, J.S. Moodera, D. Heiman, “Linear Magnetoresistance in Topological Insulator Thin Films: Quantum Phase Coherence Effects at High Temperatures”, Applied Physics Letters 102, 012102 (2013), arxiv: 1205.4635.
30. B. Li, N. Roschewsky, B.A. Assaf, M. Eich, M. Epstein-Martin, D. Heiman, M. Münzenberg, J.S. Moodera, “Superconducting Spin Switch with Infinite Magnetoresistance Induced by an Internal Exchange Field”, Physical Review Letters, 110, 097001 (2013)
31. B.A. Assaf, T. Cardinal, P. Wei, F. Katmis, J.S. Moodera, D. Heiman, “Modified Electrical Transport Probe Design for Standard Magnetometer”, Review of Scientific Instruments 83, 033904 (2012), arxiv: 1203.0682.

Invited talks

Argonne National Lab, IL, September 2019
Michigan State University, East Lansing, MI, September 2019
Army Research Lab, Adelphi, MD, June 2019
Naval Research Lab, Washington DC, June 2019
Anhui University, Hefei, China, May 2019
Massachusetts Institute of Technology, Physics Department Seminar, Cambridge, MA, March 2019,
American Physical Society, March meeting 2019, Boston MA, March 2019
GDR NanoTeraMIR, Montpellier, May 2018
Laboratoire Charles Coulomb, Université de Montpellier, March 2018.
Quantum Matter Institute, University of British Columbia, Vancouver, Canada, June 2017.
ENS-Princeton 2017 Workshop, Paris, France, January 2017.
ENS-University of Tokyo 2016 Workshop, Paris, France, November 2016.
The Hong Kong University, Hong Kong, China, November 2016.
Hong Kong University of Science and Technology, Hong Kong, China, November 2016.
Université Pierre et Marie Curie, INSP Seminars, Paris, October 2016.
GDR Physique Mésoscopique, Aussois, France, December 2014.