

# Edward B. Flagg – Curriculum Vitae



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## Current Appointment

Associate Professor of Physics, *West Virginia University*

2019 – present

## Education

Ph.D. (Physics) University of Texas at Austin (2008)

Dissertation: *Coherent control and decoherence of single semiconductor quantum dots in a microcavity.*

Adviser: Chih-Kang (Ken) Shih

B.S. (Physics) Massachusetts Institute of Technology (2001)

## Previous Appointments

Assistant Professor of Physics, *West Virginia University*

2013 – 2019

Research Associate, *National Institute of Standards and Technology*

2008 – 2012

Post-doctoral Researcher, *Joint Quantum Institute, University of Maryland*

2008 – 2012

Research Assistant, *University of Texas at Austin*

2002 – 2008

Teaching Assistant, *University of Texas at Austin*

2001 – 2002

## Honors

WVU Foundation Outstanding Teacher Award (University-wide award)

2017 – 2018

Eberly College of Arts and Sciences Outstanding Teacher Award

2017 – 2018

Cottrell Scholars Award from Research Corp. for Science Advancement

2017

NSF CAREER Award

2015

## Research

*West Virginia University*

- Microphotoluminescence studies of semiconductor nanostructures
- Semiconductor-based indistinguishable single-photon sources
- Optically controlled electron spin resonance and measurement

*Joint Quantum Institute, NIST and University of Maryland*

- Measurements of photon indistinguishability
- Semiconductor-based single-photon & entangled-photon sources
- Cavity quantum electrodynamics
- Hybrid quantum information systems

*University of Texas at Austin*

- Quantum optics and cavity quantum electrodynamics involving semiconductor quantum dots in microcavities.
- Achieved the first observation of resonance fluorescence in a solid-state system.

- Patented a novel method for quickly and accurately determining the absolute value of the optical path length of a structure.
- Worked on the development of a method for mechanical slowing of a monochromatic supersonic atomic beam.

*Massachusetts Institute of Technology*

- Designed and constructed a high-Q spherical-mirror Fabry-Perot cavity for optical trapping of single atoms for use in quantum teleportation.

## Research Grants Received

1. Cottrell Scholars Award (PI), Research Corporation for Scientific Advancement  
July 1, 2017 – June 30, 2020  
Amount to WVU: \$100,000      Amount total: \$100,000
2. “Combined Coherent Manipulation and Single-Shot Measurement of an Electron Spin in a Quantum Dot” (PI), DOE-BES Physical Behavior of Materials Program, DE-SC0016848  
December 15, 2016 – December 14, 2019  
Amount to WVU: \$476,964      Amount total: \$476,964
3. “LIFIoVFO Laser Induced Fluorescence Imaging of Variable Flow Olfactometer Output,” (co-PIs: E. Scime, K. Daly) Centers for Neuroscience, West Virginia University  
June 1, 2016 – January 31, 2017  
Amount to WVU: \$53,082      Amount total: \$53,082
4. “CAREER Coherent Single-Photons for Quantum Information” (PI), National Science Foundation, DMR-1452840  
March 1, 2015 – February 29, 2020  
Amount to WVU: \$700,000      Amount total: \$700,000
5. “Quantum Eraser: Entangled Photon Source” (PI: E.B. Flagg; co-PIs: S. Polyakov, T. Thomay) Joint Quantum Institute, NSF Physics Frontier Center Seed Grant  
February 1, 2012 – January 31, 2013  
Amount to NIST: \$50,000      Amount total: \$50,000

## Teaching Experience

- 2018      Outstanding Teacher Award, Eberly College and WVU Foundation
- 2013-pres. **Associate/Assistant Professor**, West Virginia University  
Introduction to Modern Physics, PHYS 314 (2013 – 2015)  
Introductory Quantum Mechanics, PHYS 451 (2015 – 2019)  
Quantum Mechanics 2, PHYS 452 (2016 – 2020)  
Nonlinear Dynamics, PHYS 710 (2019 – present)  
Atomic Physics, PHYS 325 (2021)
- 2003-2005 **Physics Tutor**, University of Texas at Austin  
Tutored individual students in undergraduate-level physics courses.
- 2000-2001 **Head teaching assistant**, University of Texas at Austin  
Taught classical mechanics laboratory for natural sciences undergraduates.  
Trained and supervised 3 other teaching assistants and over 150 students.

## Professional Memberships

- American Physical Society, since 2007  
Optical Society of America, since 2013

## Publications and Patents (reverse chronological)

1. Wilkinson, T.A., Maurer, C.E., Flood, C.J., Lander, G., Chafin, S., Flagg, E.B. “Complete Stokes vector analysis with a compact, portable rotating waveplate polarimeter.” *Review of Scientific Instruments*, 92(9):093101 (2021). doi:10.1063/5.0052835
2. Solomon, G.S., Muller, A., and Flagg, E.B. “Quantum light from optically dressed quantum dot states in microcavities.” In S. T. Cundiff and M. Kira, editors, *Semiconductor Quantum Science and Technology*, volume 105 of *Semiconductors and Semimetals*, pages 305 – 346. Elsevier, Nov 2020.
3. Wilkinson T.A., Cottrill D.J., Cramlet J.M., Maurer C.E., Flood C.J., Bracker A.S., Yakes M., Gammon D., Flagg E.B. “Dynamic nuclear polarization in a charged quantum dot induced by the AC Stark effect.” *Quantum Nanophotonic Materials, Devices, and Systems 2019*, 11091:110910I (2019). doi:10.1117/12.2529455
4. Lander G.R., Isaac S., Chen D., Demircan S., Solomon G.S., Flagg E.B. “Auger recombination-induced neutralization and stretched exponential recharging in an InAs quantum dot.” *Quantum Dots and Nanostructures: Growth, Characterization, and Modeling XVI*, 10929:109290F (2019). doi:10.1117/12.2506555
5. Wilkinson T.A., Cottrill D.J., Cramlet J.M., Maurer C.E., Flood C.J., Bracker A.S., Yakes M., Gammon D., Flagg E.B. “Spin-selective AC Stark shifts in a charged quantum dot.” *Applied Physics Letters*, 114(13):133104 (2019). doi:10.1063/1.5084244
6. Gazzano, O., Huber, T., Loo, V., Polyakov, S., Flagg, E. B., and Solomon, G. S. “Effects of Resonant-Laser Excitation on the Emission Properties in a Single Quantum Dot” *Optica* 5, no. 4 (2018): 354–359. doi:10.1364/OPTICA.5.000354
7. Chen, D., Lander, G. R., Flagg, E. B. “Resonance Fluorescence of an InGaAs Quantum Dot in a Planar Cavity using Orthogonal Excitation and Detection” *Journal of Visualized Experiments* 128, (2017): e56435. doi:10.3791/56435
8. Chen, D., Lander, G. R., Solomon, G. S., and Flagg, E. B. “Polarization-Dependent Interference of Coherent Scattering from Orthogonal Dipole Moments of a Resonantly Excited Quantum Dot” *Physical Review Letters* 118, no. 3 (2017): 037401. doi:10.1103/PhysRevLett.118.037401
9. Chen, D., Lander, G. R., Krowpman, K. S., Solomon, G. S., and Flagg, E. B. “Characterization of the Local Charge Environment of a Single Quantum Dot via Resonance Fluorescence” *Physical Review B* 93, no. 11 (2016): 115307. doi:10.1103/PhysRevB.93.115307
10. Flagg, E. B. and Solomon, G. S. “Optical Spin Readout Method in a Quantum Dot Using the Ac Stark Effect” *Physical Review B* 92, no. 24 (2015): 245309. doi:10.1103/PhysRevB.92.245309
11. Solomon, G. S., Flagg, E. B., Polyakov, S. V., Thomay, T., and Muller, A. “Manipulating Single Photons from Disparate Quantum Sources to Be Indistinguishable [Invited]” *Journal of the Optical Society of America B* 29, no. 3 (2012): 319–327. doi:10.1364/JOSAB.29.000319

12. Polyakov, S. V., Flagg, E. B., Thomay, T., and Solomon, G. S. “Dynamics of a Pulsed Single Photon Source” *AIP Conference Proceedings* 1508, no. 1 (2012): 67–74. doi:doi:10.1063/1.4773117
13. Polyakov, S. V., Flagg, E. B., Thomay, T., Migdall, A., and Solomon, G. S. “Time-Resolved Nonclassical Photon Field Characterization” *Conference on Lasers and Electro-Optics (CLEO)* (2012):
14. Flagg, E. B., Polyakov, S. V., Thomay, T., and Solomon, G. S. “Dynamics of Nonclassical Light from a Single Solid-State Quantum Emitter” *Physical Review Letters* 109, no. 16 (2012): 163601. doi:10.1103/PhysRevLett.109.163601
15. Polyakov, S. V., Muller, A., Flagg, E. B., Ling, A., Borjemscaia, N., Van Keuren, E., Migdall, A., and Solomon, G. S. “Coalescence of Single Photons Emitted by Disparate Single-Photon Sources: The Example of InAs Quantum Dots and Parametric Down-Conversion Sources” *Physical Review Letters* 107, no. 15 (2011): 157402. doi:10.1103/PhysRevLett.107.157402
16. Flagg, E. B., Muller, A., Polyakov, S. V., Ling, A., Migdall, A., and Solomon, G. S. “Interference of Single Photons from Two Separate Semiconductor Quantum Dots” *Proceedings of SPIE* 7948, no. 1 (2011): 794818-794818–7. doi:doi:10.1117/12.874853
17. Muller, A., Flagg, E. B., Lawall, J. R., and Solomon, G. S. “Ultrahigh-Finesse, Low-Mode-Volume Fabry-Perot Microcavity” *Optics Letters* 35, no. 13 (2010): 2293–2295. doi:10.1364/OL.35.002293
18. Flagg, E. B., Muller, A., Polyakov, S. V., Ling, A., Migdall, A., and Solomon, G. S. “Interference of Single Photons from Two Separate Semiconductor Quantum Dots” *Physical Review Letters* 104, no. 13 (2010): 137401. doi:10.1103/PhysRevLett.104.137401
19. Muller, A., Flagg, E. B., Metcalfe, M., Lawall, J., and Solomon, G. S. “Coupling an Epitaxial Quantum Dot to a Fiber-Based External-Mirror Microcavity” *Applied Physics Letters* 95, no. 17 (2009): 173101-173101–3. doi:doi:10.1063/1.3245311
20. Flagg, E. B., Robertson, J. W., Founta, S., Ma, W., Xiao, M., Salamo, G. J., and Shih, C.-K. “Direct Evidence of Interlevel Exciton Transitions Mediated by Single Phonons in a Semiconductor Quantum Dot Using Resonance Fluorescence Spectroscopy” *Physical Review Letters* 102, no. 9 (2009): 097402. doi:10.1103/PhysRevLett.102.097402
21. Flagg, E. B., Muller, A., Robertson, J. W., Founta, S., Deppe, D. G., Xiao, M., Ma, W., Salamo, G. J., and Shih, C. K. “Resonantly Driven Coherent Oscillations in a Solid-State Quantum Emitter” *Nature Physics* 5, no. 3 (2009): 203–207. doi:10.1038/nphys1184
22. Muller, A., Flagg, E. B., Bianucci, P., Wang, X. Y., Deppe, D. G., Ma, W., Zhang, J., Salamo, G. J., Xiao, M., and Shih, C. K. “Resonance Fluorescence from a Coherently Driven Semiconductor Quantum Dot in a Cavity” *Physical Review Letters* 99, no. 18 (2007): 187402. doi:10.1103/PhysRevLett.99.187402
23. U.S. Patent #7289220. “Broadband cavity spectrometer apparatus and method for determining the path length of an optical structure.” Developed for the SEMATECH not-for-profit consortium of chip manufacturers in 2007.

## **Invited Talks** (reverse chronological)

1. Invited Conf. Talk      IEEE RAPID      Aug 12, 2020  
    “Mimicking Magnetic Effects in a Quantum Dot with Light”
2. Colloquium      SUNY Geneseo      Nov 7, 2019  
    “Artificial Atoms and Quantum Optics”
3. Seminar      Pittsburgh Quantum Institute      Oct 3, 2019  
    “Artificial Atoms: Quantum Optics and Spin Physics of Quantum Dots”
4. Colloquium      Boston College      Sep 18, 2019  
    “Artificial Atoms: Quantum Optics and Spin Physics of Quantum Dots”
5. Colloquium      Ohio University      Mar 25, 2016  
    “Quantum Dots and Quantum Optics”
6. Condensed Matter Seminar; Indiana University Bloomington      Feb 13, 2015  
    “Quantum Dots and Quantum Optics”

## **Professional Service**

- Member, Technical Committee on Quantum Optics of Atoms, Molecules, and Solids for the Conference on Lasers and Electro-Optics (CLEO); 2016 – 2018.
- Session chair at conferences:
  - Optical Society of America Incubator: Integrated Semiconductor Quantum Photonic Devices, 2017
  - Conference on Lasers and Electro-Optics, 2016, 2017.
  - American Physical Society Mid-Atlantic Section Meeting, 2015
- Refereed publications for journals: Physical Review Letters, Physical Review A, Physical Review B, Physical Review X, Physical Review Applied, Optica, Optics Letters, Nano Letters, Applied Physics Letters, Journal of Quantum Electronics, Physica Status Solidi, American Chemical Society Nano.
- *Ad hoc* reviewer for National Science Foundation proposals, 2014 – present.

## **Outreach**

- 4-H Optics Learning Module (2015 – present). Developed as part of CAREER grant educational activity.
- Celebrating Einstein, demonstrations (2017). Interdisciplinary celebration of the centennial of Einstein’s prediction of gravitational waves. <https://einstein.wvu.edu/>
- Great American Solar Eclipse, demonstrations (sun spotter) (2017). Statewide community outreach event before and during the eclipse.
- Laboratory tours for students in Summer Science Camp and Pulsar Search Collaboratory (2015 – present)

## **Department Committee Service**

- Undergraduate Advising Committee (2013 – present)
- Qualifier Reform Task Force (2016)
- Quantum Mechanics Qualifier Committee (2016 – present; Chair 2019)
- Electricity and Magnetism Qualifier Committee (2013 – 2015)
- Laser Safety Committee (2015 – 2016)
- Scholarship Committee (2018 – 2020)
- Social Committee (2018-2019)

- Faculty Search Committees: Biophysics; Teaching Assistant Prof.; Condensed Matter Senior hire (2014 – 2021)

## **Mentorship**

### *Graduate Students*

1. Disheng Chen, Jan 2014 – Aug 2017  
Graduated with Ph.D.; Postdoctoral researcher at Nanyang Technological University in Singapore, studying NV centers in diamond.
2. Gary R. Lander, Mar 2013 – present
3. Cabot Zabriskie, Aug 2013 – May 2015  
Graduated with M.S.; Ph.D. student at WVU in physics education research
4. Raju Bhai KC, Aug 2015 – present
5. Tristan Wilkinson, May 2017 – present
6. Fenton Clawson, Jan 2019 – present
7. Braden Warr, Sep 2020 – present
8. William Eshbaugh, Jan 2021 – present

### *Undergraduate Students*

1. Samet Demircan, May 2013 – May 2017  
Graduated with B.S. Now a graduate student in physics at SUNY Stony Brook
2. Jennifer Mangano, Sept 2013 – Jul 2015  
Graduated with B.S. in business and economics.
3. Patrick Nelson, Mar 2014 – May 2016  
Graduated with B.S. Now a graduate student in physics at WVU
4. Samantha Isaac, Oct 2014 – May 2018  
Graduated with B.S. Now a graduate student in physics at U. Illinois Urbana-Champaign
5. Kyle Krowpman, Jan 2015 – May 2016  
Graduated with B.S. Now a graduate student in physics at Michigan State University
6. Jaxon Lee, May 2016 – Aug 2016  
Graduated with B.S. in math.
7. Joshua Cramlet, Sep 2016 – Sep 2018  
Graduated with B.S. in physics.
8. Cainan Nichols, Jan 2017 – May 2018  
Graduated with B.S. Now a graduate student in physics at Eastern Michigan University
9. Collin Flood, Apr 2017 – May 2019  
Graduated with B.S. Now an actuarial analyst for Homesite Insurance in Boston, MA.

10. Kimberly Matsinger, May 2017 – July 2017  
Summer REU student from Slippery Rock University.
11. Cole Maurer, Aug 2017 – May 2021  
Graduated with B.S. Now a graduate student in physics at Univ. of New Mexico
12. Eva Beeching, May 2018 – July 2018  
Summer REU student from Slippery Rock University.
13. Dillion Cottrill, May 2018 – May 2021  
Graduated with B.S. Now a graduate student in physics at SUNY Stony Brook
14. Samuel Cyphert, Aug 2018 – Dec 2019  
Mechanical/Aerospace Engineering major at WVU.
15. Sadie Chafin, Aug 2018 – present  
Senior physics major at WVU.
16. Emma Martin, Aug 2019 – May 2020  
Graduated with B.S. in EE and minor in Physics. Now a graduate student in EE at Berkeley.
17. Anthony Southmayd, May 2021 – present  
Senior electrical and mechanical engineering major at WVU.
18. Bariana Wimmer, May 2021 – present  
Senior physics major at WVU.
19. Jordan Stanley, Sep 2021 – present  
Sophomore physics major at WVU.