

# Paul D. Cunningham

Baltimore, MD • pcunni1@umbc.edu

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## Positions Held

8/2010-Present: National Research Council Research Associate at Naval Research Laboratory

6/2004-5/2010: Graduate Research Assistant, UMBC, Physics Dept.,  
Researcher in the National Science Foundation Science and Technology Center for Materials and  
Devices for Information Technology Research (<http://stc-mditr.org>).

6/2003-6/2004: US Army Materiel Systems Analysis Activity, APG, MD  
Participant in the Acquisition Career Experience Program performing physics-of-failure analysis  
of weapons systems for the Reliability Branch of the Logistics Analysis Division.

## Education

2004-2010: University of Maryland, Baltimore County  
Ph. D., Applied Physics 2010  
Thesis: "Optical Pump Terahertz Probe Studies of Semiconducting Polymers"  
Mentor: Dr. L. Michael Hayden  
M.S., Applied Physics 2006, GPA: 3.76  
2000-2004: Towson University Honors College  
B.S., Applied Physics, Summa Cum Laude 2004, GPA: 3.78

## Awards and Honors

2012 - QD2012 CASP Solar Prize  
2012 - NRC/ASEE Postdoctoral Research Publication Award  
2010 - National Research Council Research Associate 2010-2012  
2005 - Graduate Assistance in Areas of National Need Fellow 2005-2007  
2003 - Jess Fisher Pre-Engineering Scholarship  
2003 - Edward I. Rubendall Physics Achievement Award  
2003 - Sigma Pi Sigma Honor Society (Physics)  
2000 - University Scholarship, Honors College Scholarship

## Professional Activities

Optical Society of America, member 2007-Present  
Peer Reviewer for Opt. Lett., Opt. Ex., Appl. Optics, JOSA A, JACS  
2011 NASA Planetary Instrument Definition & Development Program Review Panel

## Leadership Activities

Graduate Student and Post-Doctoral Advisory Council, NSF STC-MDITR, 8/2005-5/2010

I aided in organizing annual retreats, created an online instrument database to encourage interuniversity collaborations, and helped develop an outreach program where students can submit a proposal and apply for funds. I authored a wiki page on THz science as part of a larger wiki encyclopedia on organic photonics and nonlinear optics. ([http://depts.washington.edu/cmditr/mediawiki/index.php?title=Terahertz\\_Radiation](http://depts.washington.edu/cmditr/mediawiki/index.php?title=Terahertz_Radiation))

Graduate Student Association (GSA) – Senator, 8/2005 – 8/2007

I represented the Physics department as a GSA senator serving as a link between the students and this governing body and disseminated information to the department.

## Total Number of Publications: 12

- 9 Refereed journals
- 3 Book chapters, proceedings
- 5 H-index (93 total citations,  $h^2$  upper  $\sim 68\%$ , g-index = 9)

## PUBLICATIONS

- P.D. Cunningham**, J.B. Boercker, E. E. Foos, M.P. Lumb, A.R. Smith, J.G. Tischler, J.S. Melinger, "Multiple exciton generation in PbSe nanorods," Proceedings of SPIE, Volume 8256, 825610 1-10, Physics, Simulation, and Photonic Engineering of Photovoltaic Devices; Alexandre Freundlich, Jean-Francois F. Guillemoles; Eds. (Jan. 2012) DOI:10.1117/12.908939
- P.A. Lane, **P.D. Cunningham**, J.S. Melinger, G.P. Kushto, O. Esenturk, E.J. Heilweil "Photoexcitation Dynamics in Nanolayered C<sub>60</sub>-Zinc Phthalocyanine Films," Physical Review Letters, **108**, 077402 (2012) DOI:10.1103/PhysRevLett.108.077402
- P.D. Cunningham**, J.B. Boercker, E. E. Foos, M.P. Lumb, A.R. Smith, J.G. Tischler, J.S. Melinger "Enhanced multiple exciton generation in quasi one-dimensional semiconductors," Nano Letters, Volume 11, Issue 8, 3476-3481 (2011) DOI:10.1021/nl202014a
- P.D. Cunningham**, N.N. Valdes, F.A. Vallejo, L.M. Hayden, B. Polishak, X.-H. Zhou, J. Luo, A.K.-Y. Jen, J.C. Williams, R.J. Twieg "Broadband terahertz characterization of the refractive index and absorption of some important polymeric and organic electro-optic materials," Journal of Applied Physics, Volume 109, Issue 4, 043505-043510 (2011). DOI: 10.1063/1.3549120
- P.D. Cunningham**, L.M. Hayden, "Optical properties of DAST in the THz range," Optics Express, Volume 18, Issue 23, 23626-23632 (2010). DOI: 10.1364/OE.18.023620
- P.D. Cunningham**, L.M. Hayden, H.L. Yip, A.K.-Y. Jen, "Charge carrier dynamics in metallated polymers investigated by optical-pump terahertz-probe spectroscopy," Journal of Physical Chemistry B, Volume 113, Issue 47, 15427-15432 (2009). DOI: 10.1021/jp906454g
- X.L. Cross, X. Zheng, **P.D. Cunningham**, L.M. Hayden, S. Chromik, M. Valerianova, V. Strbik, P. Odier, R. Sobolewski, "Pulsed-THz Characterization of Hg-Based High-Temperature Superconductors," IEEE Transactions on Applied Superconductivity, Volume 19, Issue 3 Part 3, 3614-3617 (2009). DOI:10.1109/TASC.2009.2018122
- P.D. Cunningham**, L.M. Hayden, "Carrier Dynamics Resulting from Above and Below Gap Excitation of P3HT and P3HT/PCBM Investigated by Optical-Pump Terahertz-Probe Spectroscopy," Journal of Physical Chemistry C, Volume 112, Issue 21, 7928-7935 (2008). DOI:10.1021/jp711827g
- X. Zheng, C. V. McLaughlin, **P.D. Cunningham**, and L.M. Hayden, "Organic Broadband Terahertz Sources and sensors," Journal of Nanoelectronics and Optoelectronics, Volume 2, 58-76 (2007). DOI:10.1166/jno.2007.005
- X. Zheng, C. V. McLaughlin, **P. Cunningham**, L.M. Hayden, "Terahertz science and applications based on poled electro-optic polymers," Proceedings of SPIE, Volume 6472 Terahertz and Gigahertz Electronics and Photonics VI. (February 2007). DOI: 10.1117/12.696650
- M.R. Leahy-Hoppa, **P.D. Cunningham**, J.A. French, and L.M. Hayden, "Atomistic molecular modeling of the effect of chromophore concentration on the electro-optic coefficient in nonlinear optical polymers," Journal of Physical Chemistry A, Volume 110, Issue 17, 5792-5797 (2006). DOI:10.1021/jp0565397

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M.R. Leahy-Hoppa, J.A. French, **P.D. Cunningham**, and L.M. Hayden, "Atomistic molecular modeling of electric field poling of nonlinear optical polymers," in *Nonlinear optical properties of matter: From molecules to condensed phases*. (Kluwer) 337-357 (2006). DOI:10.1007/1-4020-4850-5\_11

## CONFERENCES

- P.A. Lane, **P.D. Cunningham**, J.S. Melinger, E.J. Heilweil, "Photocarrier and exciton dynamics in films of C<sub>60</sub> and ZnPc with a layered nanostructure" *submitted to* SPIE Optics & Photonics 2012: Physical Chemistry of Interfaces and Nanomaterials XI (August 2012)
- (Invited Talk) P.A. Lane, M.A. Wolak, **P.D. Cunningham**, J.S. Melinger, "Energy transfer and excitation migrations in organic semiconductors" SPIE Optics & Photonics 2012: Organic Electroluminescence XV (August 2012)
- P.D. Cunningham**, J.B. Boercker, E. E. Foos, M.P. Lumb, A.R. Smith, J.G. Tischler, J.S. Melinger, "Increased Multiple Exciton Generation in PbSe Nanorods," International Conference on the Physics of Semiconductors (July 2012).
- P.D. Cunningham**, J.B. Boercker, E. E. Foos, M.P. Lumb, A.R. Smith, J.G. Tischler, J.S. Melinger, "Increased multiple exciton generation efficiency in PbSe nanorods," 7<sup>th</sup> International Conference on Quantum Dots (May 2012). *CASP Solar Prize for Best Student/Postdoctoral Paper*
- P.D. Cunningham**, J.B. Boercker, E. E. Foos, M.P. Lumb, A.R. Smith, J.G. Tischler, J.S. Melinger, "Multiple exciton generation in PbSe nanorods," SPIE Photonics West OPTO 2012: Physics, Simulation, and Photonic Engineering of Photovoltaic Devices I & Green Photonics 2012 (8256-34) (January 2012).
- P.A. Lane, **P.D. Cunningham**, J.S. Melinger, E.J. Heilweil, "Charger transfer and Photocarrier dynamics in Nanolayered Films of ZnPc and C<sub>60</sub>," SPIE Optics & Photonics 2011: Organic Photovoltaics XII (8116-34) (August 2011). (*available online*: <http://bcove.me/1kss2s30>)
- P.D. Cunningham**, N.N. Valdes, F.A. Vallejo, L.M. Hayden, "Broadband terahertz characterization of linear and electro-optic polymeric materials," International Workshop on Optical Terahertz Science and Technology (MF22) (March 2011).
- F.A. Vallejo, **P.D. Cunningham**, L.M. Hayden, H.-L. Yip, A. K.-Y. Jen, "Charge Transfer Dynamics in Donor- $\pi$ -Bridge-Acceptor Side-Chain Polymers for Solar Cells," *Frontiers in Optics / Laser Science* (JTUA61) (Oct. 2010).
- P.D. Cunningham**, L.M. Hayden, "Optical-pump THz-Probe spectroscopy of P3HT," Conference on Lasers and Electro-Optics/Quantum Electronics and Laser Science (JWA19) (June 2009).
- P.D. Cunningham**, L.M. Hayden, "Optical-pump THz-Probe studies of above and below gap excitations in P3HT/PCBM," International Workshop on Optical Terahertz Science and Technology (TuB2) (March 2009).
- X. Li, R. Sobolewski, X. Zheng, **P.D. Cunningham**, L.M. Hayden, S. Chromik, M. Valerianova, V. Strbik, P. Odier, "Pulsed-THz Characterization of Hg-Based High-Temperature Superconductors," Applied Superconductivity Conference (M2.1) (Aug. 2008).
- P.D. Cunningham**, L.M. Hayden, "Optical-Pump THz-Probe Spectroscopy of Above and Below Gap Excitations in P3HT," 10<sup>th</sup> International Conference on Organic Nonlinear Optics (May 2008).
- X. Li, X. Zheng, **P. Cunningham**, L.M. Hayden, S. Chromik, V. Strbik, P. Odier, D.D. Barros, R. Sobolewski, "Optical-Pump-THz-Probe Studies of Carrier Dynamics in Hg-Based High-Temperature Superconducting Thin Films," Conference on Lasers and Electro-Optics/Quantum Electronics and Laser Science (JWA99) (May 2007).

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- X. Zheng, X. Li, **P. Cunningham**, L.M. Hayden, S. Chromik, V. Strbik, P. Odier, D.D. Barros, R. Sobolewski, "Terahertz Probing of Carrier Dynamics in Hg-Based High-Temperature Superconducting Thin Films," Optical THz Science and Technology Optical Society of America Topical Meeting (MD14) (March 2007).
- X. Zheng, C. V. McLaughlin, **P. Cunningham**, L.M. Hayden, "Terahertz science and applications based on poled electro-optic polymers," SPIE Photonics West OPTO 2007: Terahertz and Gigahertz Electronics and Photonics VI (6472-14) (Jan. 2007).

## PRESENTATIONS

- P.D. Cunningham**, J.B. Boercker, E. E. Foos, M.P. Lumb, A.R. Smith, J.G. Tischler, J.S. Melinger "Multiple exciton generation in PbSe nanorods," Sigma Xi NRL NRC/ASEE Postdoctoral poster session (Dec. 2011)
- P.D. Cunningham**, N.N. Valdes, F.A. Vallejo, L.M. Hayden, H.-L. Yip, B. Polishak, X.-C. Zhou, J. Lou, A. K.-Y. Jen, J. C. Williams, R. J. Twieg "Broadband THz characterization of the refractive index and absorption of some important polymeric and EO materials", Center for Materials and Devices for Information Technology Research Annual Retreat (Feb. 2011)
- F.A. Vallejo, **P.D. Cunningham**, N.N. Valdes, L.M. Hayden, H.-L. Yip, B. Polishak, J. Lou, A. K.-Y. Jen, "Terahertz spectroscopic studies of polymers", NSF Annual Review of the Science and Technology Center on Materials and Devices for Information Technology Research (June 2010)
- B. M. Polishak, S. Huang, Z. Shi, X.-H. Zhou, J. Lou, C. V. McLaughlin, **P.D. Cunningham**, C. DeRose, R. Norwood, N. Peyghambarian, L. M. Hayden, A K.-Y. Jen, "Highly Efficient Nonlinear Optical Polymers in High Performance Electro-Optic Devices", NSF Annual Review of the Science and Technology Center on Materials and Devices for Information Technology Research (June 2010)
- P.D. Cunningham**, N. N. Valdes, L.M. Hayden, H.-L. Yip, B. Polishak, J. Lou, A. Jen, "Terahertz spectroscopic studies of polymers", Center for Materials and Devices for Information Technology Research Annual Retreat (Feb. 2010)
- (Invited Talk) **P.D. Cunningham**, L.M. Hayden, H.-L. Yip, A. Jen, X. Zhang, S. R. Marder "Optical-pump THz-probe studies of organic photovoltaic materials", NSF Annual Review of the Science and Technology Center on Materials and Devices for Information Technology Research (June 2009)
- P.D. Cunningham**, L.M. Hayden, H.-L. Yip, A. Jen, "Investigating charge transport in metallated polymers through optical-pump THz-probe spectroscopy" University of Maryland, Baltimore County, Graduate Research Conference (Apr. 2009).
- (Invited Talk) **P.D. Cunningham**, L.M. Hayden, H.-L. Yip, A. Jen, "Optical-pump THz-probe studies of solar cell materials", Center for Materials and Devices for Information Technology Research Annual Retreat (Feb. 2009)
- P.D. Cunningham**, L.M. Hayden, K. Noone, D.S. Ginger, "Optical-Pump THz-Probe Studies of P3HT/PCBM," NSF Annual Review of the Science and Technology Center on Materials and Devices for Information Technology Research (June 2008)
- P.D. Cunningham**, L.M. Hayden, "Optical-Pump THz-Probe Studies of P3HT/PCBM," University of Maryland, Baltimore County, Graduate Research Conference (Apr. 2008).
- P.D. Cunningham**, L.M. Hayden, K. Noone, D.S. Ginger, "Optical-pump THz-probe studies P3HT/PCBM", Center for Materials and Devices for Information Technology Research Annual Retreat (Feb. 2008)

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**P.D. Cunningham**, X. Zheng, L.M. Hayden, B. Domercq, S. Sun, D.S. Ginger, “Optical Pump THz Probe Studies of Photoconductive Materials”, NSF Annual Review of the Science and Technology Center on Materials and Devices for Information Technology Research (May 2007)

**P.D. Cunningham**, X. Zheng, L.M. Hayden, “Optical-Pump THz-Probe Studies of Photoconductive Materials,” University of Maryland, Baltimore County, Graduate Research Conference (Apr. 2007). *Best Oral Presentation Award*

**P.D. Cunningham**, X. Zheng, L.M. Hayden, B. Domercq, “Optical Pump THz Probe Studies of Photoconductive Materials”, Center for Materials and Devices for Information Technology Research Annual Retreat (Feb. 2007)

M.R. Leahy-Hoppa, **P.D. Cunningham**, J.A. French, L.M. Hayden, B.H. Robinson, and B. Eichinger, “Effect of Chromophore Concentration on the Electro-Optic Coefficient in Poled Polymers: An Atomistic Molecular Modeling Study”, NSF Annual Review of the Science and Technology Center on Materials and Devices for Information Technology Research (June 2005)