William E. Gabella — Curriculum Vitae

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Professional Experience

Vanderbilt University **Nashville, TN, USA**
- *Research Assistant Professor of Physics & Astronomy* *2002–2024*
- *Chief Scientist Compton X-ray Source, FEL Center* *2005–2008*
- *Associate Director for FEL Operations* *1995–2005*
- *Research Associate* *1993–2002*

University of California **Los Angeles, CA, USA**
- *Research Associate Physics & Astronomy* *1991–1993*

SLAC National Accelerator Laboratory **Menlo Park, CA, USA**
- *Research Associate Accelerator Beam Physics* *1991*

Education

Colorado School of Mines **Golden, CO, USA**
B. S. Engineering Physics *1980–1984*

University of Colorado **Boulder, CO, USA**
M. S., Ph. D. Physics *1984–1991*

Advisors: Prof. John Cary (CU), Dr. Ronald Ruth and Dr. Robert Warnock (SLAC), **Thesis Title:***Numerical Solution of The Hamilton-Jacobi Equation in 2 $\frac{1}{2}$ Degrees of Freedom*

University of California **Los Angeles, CA, USA**
Postdoctoral Researcher, Accelerator Physics *1991-1993*

Advisor: Prof. David Cline

Vanderbilt University **Nashville, TN, USA**
Postdoctoral Researcher, Free-electron Laser and Accelerator Physics *1993-1995*

Advisors: Prof. Charles Brau and Dr. Marcus Mendenhall

Select Publications

- Nicholas Spurlock, William E. Gabella *et al.*, *Fluorophore-quencher interactions effect on hybridization characteristics of complementary oligonucleotides.*, Anal. Meth. 18 (2024), `https://doi.org/10.1039/D4AY00083H`.
- The LIGO Scientific Collaboration, the Virgo Collaboration, the KAGRA Collaboration, R. Abbott *et al.*, *GWTC-3: Compact Binary Coalescences Observed by LIGO and Virgo During the Second Half of the Third Observing Run.*, Phys. Rev. X 13 (2023) 041039, `https://doi.org/10.1103/PhysRevX.13.041039`, arXiv:2111.03606.
- James B. Dent, William E. Gabella, Kelly Holley-Bockelmann, and Thomas W. Kephart, *Gravitational waves from a black hole orbiting in a wormhole geometry*, Phys. Rev. D **104** (2021) 044030, doi:10.1103/PhysRevD.104.044030.
- K. W. K. Wong, E. Berti, W. Gabella, and K. Holley-Bockelmann, *On the possibility of detecting ultrashort period exoplanets with LISA*, Mon. Not. Roy. Astron. Soc. **483** (2018) L33, doi:10.1093/mnrasl/sly208.
- E. M. Euliano, A. N. Hardcastle, C. M. Victoriano, W. E. Gabella, F. R. Haselton, and N. M. Adams, *Multiplexed Adaptive RT-PCR Based on L-DNA Hybridization Monitoring for Detection of Zika,*

Dengue, and Chikungunya RNA, Sci. Rep. **9** (2019) 11372, doi:10.1038/s41598-019-47862-6 .

- N. M. Adams, W. E. Gabella, A. N. Hardcastle, and F. R. Haselton, *Adaptive PCR Based on Hybridization Sensing of Mirror Image L-DNA*, Anal. Chem. **89** (2017) 728-735, doi:10.1021/acs.analchem.6b03291.
- W. E. Gabella *et al.*, *Generation and application of channeling x-rays using a novel, low-emittance electron beam—Status and Plans*, Nucl. Instrum. Meth. **B309** (2013) 10-14, doi:10.1016/j.nimb.2013.01.058.
- CMS Collaboration, *Observation of a new boson at a mass of 125 GeV with the CMS experiment at the Large Hadron Collider*, Phys. Lett. **B716** (2012) 30-61, doi:10.1016/j.physletb.2012.08.021.

Research Activities

Polymerase Chain Reaction (PCR) Point-of-Care Thermocycler

- *with Prof. Rick Haselton and Nick Spurlock*, Vanderbilt University *2022–2024*

Building and programming small thermocyclers to carry out real-time PCR amplification to test for various viruses and bacteria. Using custom code running on a Raspberry Pi computer to control the hardware and make the fluorescence measurements. Code base makes use of HTML, Javascript, Node.js, and C++.

Gravitational waves, astrophysics, numerical simulations, and LIGO-LSC Collaboration

- *with Prof. Kelly Holley-Bockelmann and Prof. Robert Weller*, Vanderbilt University *2016–2022*

Studies and estimates of gravitational wave strength from sources for LIGO and LISA, a space-based detector. Also exploring novel sources like black hole-wormhole gravitational waves. Using the Einstein Toolkit for numerical modeling of gravitational waves from binary black holes and other sources. As member of the LIGO Science Collaboration (LSC) analyzing heavy mass signals with the RIFT code pipeline, working to improve RIFT. Focus on heavy mass black holes that cannot form directly from stellar evolution—intermediate mass black holes.

Polymerase Chain Reaction (PCR) DNA Amplification

- *with Prof. Rick Haselton, Dr. Nicholas Adams, and Dr. David Wright*, Vanderbilt University *2014–2018*

Built and characterized compact instruments to perform DNA amplification using PCR where the hybridization state of the DNA is known by monitoring fluorescent dyes on L-DNA (left-handed and non-biological) of the same sequence. Built hardware, electronics, and programmed the LabVIEW control system. Also built hardware and wrote control software to amplify DNA using PCR, where magnetic beads are used to prepare the sample. Used the National Instruments' LabVIEW program, their real-time OS single-board RIO computer, for control, data acquisition, and operating a Qiagen fluorimeter.

Discovery of the Higgs Boson at CMS

- *with Prof. Will Johns, Dr. Gino Bolla, and Dr. Charles Newsom*, Vanderbilt University *2008–2011*

Member of the Compact Muon Solenoid detector collaboration at CERN prior to and during the discovery of the Higgs Boson particle. Safety officer for the Pixel subsystem and co-leader of the Tracker subsystem control software team, during first beams, first collisions, and the first colliding beam run. Collected data was used to discover the Higgs boson, the particle responsible for unification of the electromagnetic and weak nuclear forces.

Electron emission from diamond needle(s)

- *with Prof. Charles Brau and Dr. Jonathan Jarvis*, Vanderbilt University *2012–2014*

Using diamond needle arrays or single diamond needles with tip radius around 6 nm to create electron beams either with larger current and beam size, or with exquisitely small size and small current, respectively. Collaborated with Fermi National Accelerator Laboratory's ASTA accelerator and Dr. Philippe Piot. Goal at ASTA to channel electrons in a crystal lattice to generate X-rays of well-defined

wavelengths for biological imaging.

Compton Backscatter X-ray source

- *with Dr. Marcus Mendenhall and Gary Shearer*, FEL Center, Vanderbilt University *2005–2008*

As chief scientist recommissioned and operated the Compton X-ray Source, a tunable X-ray device based on colliding a high-power laser with a relativistic electron beam. With Dr. Ed Donnelly and Dr. Frank Carroll performed experiments on phase contrast enhanced images.

Vanderbilt Free-electron Laser

- *with Dr. Charles Brau and Dr. Marcus Mendenhall*, FEL Center, Vanderbilt University *1995–2005*

As the Associate Director of the Vanderbilt Free-electron Center (FEL) was responsible for operations, maintenance, and scheduling of the FEL. Oversaw a 10 person team of technicians, engineers, and physicists. Carried out a half million dollar upgrade of the FEL in preparation for eye and brain surgeries—all were successful.

Teaching & Mentoring

Student mentoring

- *Mohammad Malik*, Vanderbilt University *2023-24*
  Co-faculty for graduate research in gravitational waves, using Mathematica tools and multipole expansions.
- *Ashley White*, Vanderbilt University *2023-24*
  Faculty for independent research in gravitational waves, with focus on using Post-Newtonian orbit codes, also exploring three-body orbits.
- *Joseph Rebak*, Vanderbilt University *Spring 2022*
  Faculty for independent research in gravitational waves, especially using Mathematica tools.
- *Sammi Hamden*, Blackman High School, Murfreesboro, TN *Fall 2019*
  Professional Advisor for his capstone project involving QuarkNet cosmic ray muon detectors.
- *Astrofield House*, Vanderbilt University *Fall 2017–Spring 2018*
  Faculty Advisor for the Mayfield House *Astrofield*, student interest in astronomy and astrophysics, independent research into radio astronomy and pulsars, followed the Pulsar Search Collaboratory.
- *Justin Stevens*, Vanderbilt University *Fall 2016–Spring 2019*
  Mentored discussions of astronomy and astrophysics, especially special and general relativity, and pulsars, followed the Pulsar Search Collaboratory.
- *Jake Sindelar*, Vanderbilt University *Fall 2016–Spring 2017*
  Mentored discussions of astronomy and astrophysics, especially special and general relativity, and pulsars, followed the Pulsar Search Collaboratory.

Lecturing

- Instructor at Ravenwood High School, Brentwood, TN *Spring 2012*
  AP Physics and Astronomy
- Instructor at 2009 U.S. Particle Accelerator School, Vanderbilt University *Jan 2009*
  Introductory Accelerator Physics
- Instructor in Physics & Astronomy, Vanderbilt University *Fall 2006*
  Phys 116B, Second Semester Introductory Physics
- Instructor in Physics & Astronomy, Vanderbilt University *Spring 2005*
  Senior Seminar, *Einstein's Legacy*

Leadership & Professional Service

Committees

- Laser Safety Committee, Vanderbilt University *Spring 2020–Summer 2024*

Professional affiliations

- LISA Consortium, Member
- Professional Societies: APS, AMS, Sigma Xi, Tau Beta Pi, Sigma Pi Sigma

Outreach & Media Engagement

Outreach

- QuarkNET mentor for the high school particle physics program *2014-2024*

  These include mentoring high school science teachers for the NSF-DOE QuarkNet program, especially the use of muon detectors in the classroom. Responsible for the maintenance of three "in house" detectors that are loaned to high schools, as well as assisting teachers in the use and maintenance of their own cosmic ray muon detectors. Organize and host the Vanderbilt QuarkNet summer workshop to explore the use of the detectors, to enrich the physics curriculum, and to engage in other physics activities. Vanderbilt QuarkNet site and National site.
- Assisted QuarkNET mentor Prof. Med Webster *2011-2013*

Press/Media coverage

- *What happens if black holes fall into wormholes? A new way to find out.* *Aug 2020*
- *Could a black hole (hypothetically) fall into a (hypothetical) wormhole...* *Aug 2020*

  Discussion of our paper on a black hole falling in and out of a wormhole, and the gravitational waves it would emit.
- *DNA duplicator small enough to hold in your hand* *Jan 2017*

  Description of PCR instrument using left-handed (non-biological) DNA and the possibility to use the technique to make small, point-of-care tests for patient infection with bacteria or virus infections.
- *Free electron laser shines in first surgical test* *Jan 2000*

  Description of first use of the FEL for the resection of a meningioma brain tumor.

Skills

- **OS:** Linux/UNIX, Windows, MacOS, Raspian/Raspberry Pi
- **Programming:** Python (advanced), C/C++, UNIX shell scripting, HTML, Javascript, Node.js, High-performance cluster computing, Open Science Grid high-throughput computing
- **Scientific:** Python, Mathematica, Matlab
- **Control Systems/SCADA:** LabVIEW, Python, PVSS/WinCC, Siemens Step 7 (PLC)
- **Typography:** LaTeX, Bibtex, Microsoft Office, LibreOffice