



Mark J. Duvall

Curriculum Vitæ

Education

- 2011–2022 **PhD in Physics**, *University of Hawai'i at Mānoa*, Honolulu, HI, USA
2004–2008 **BS in Physics**, *University of Tulsa*, Tulsa, OK, USA
2004–2008 **BA in Music**, *University of Tulsa*, Tulsa, OK, USA

Doctoral Dissertation

2022 *New Approaches to Antineutrino Directionality*

Advisor Dr. John G. Learned

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Synopsis The directional detection of electron-antineutrinos undergoing inverse beta decay (IBD) has uses ranging from fundamental science to industrial and nonproliferation applications. This dissertation: 1) investigates the limit imposed by neutron scattering on previous reactor-IBD detector designs; 2) examines a proposed method for circumventing this limit; and 3) evaluates a variety of possible detector geometries for incorporating this method in a practically-viable experiment.

Experience

05/2022– **Postdoctoral Fellow**, *UH Physics Dept.*, Honolulu, HI, USA

08/2023 Simulation, analysis, and publication of work on the directional detection of reactor-antineutrinos.

Project lead; technical assistance with experiment prototype; mentoring of graduate and undergraduate students.

- Alongside PI, co-lead the design, development, and prototyping of a novel detector.
- Completed first paper as primary author (recently submitted to *Phys. Rev. Appl.*), and drafted two additional papers which are now undergoing revision.

2019–2022, **Graduate Research Assistant**, *UH Physics Dept.*, Honolulu, HI, USA

2013–2016 Design, simulation, construction, operation, analysis, and publication on the miniTimeCube, NuLat, and FROST experiments.

- Alongside advisor, co-invented the FROST detector design.
- Wrote an extensive collection of software and accompanying documentation in a variety of languages, most of which is now available open-source.
- Developed multiple detector and data visualizations.
- Helped identify and solve a previously-unknown cross-talk problem in Photonis Microchannel-Plate PMTs; co-authored a corresponding paper.

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🆔 [ORCID – MJD](#) • 📄 [Google Scholar – MJD](#)

🌐 trockscience.com/mjd

- 2016–2017 **Visiting Graduate Scholar**, *US Dept. of Energy (LLNL)*, Livermore, CA, USA
Simulation of the SANTA experiment as part of the WATCHMAN collaboration; manufacture, construction, testing, and publication on the SANDD experiment prototype, including analysis of custom plastic scintillators.
- 2011–2013 **Graduate Teaching Assistant**, *UH Physics Dept.*, Honolulu, HI, USA
Instruction and supervision of undergraduate Mechanics lab, with roughly 50 students per semester.
- 2009–2011 **Substitute Teacher / Teaching Assistant**, *Special School District of Saint Louis County*, St. Louis, MO, USA
Instruction and assistance of special-needs students in grades 4–12.

Publications

- Pending **(2024)**, † *FROST – A New Design for Reactor-Antineutrino Direction-Finding*
- Pending **(2024)**, † *A New Method for Evaluating the Angular Sensitivity of Small Neutrino Detectors*
- [arXiv](#) **2024**, † *Directional Response of Several Geometries for Reactor-Neutrino Detectors*, journal publication pending
- [NIM A](#) **2021**, *SANDD: A directional antineutrino detector with segmented ⁶Li-doped pulse-shape-sensitive plastic scintillator*
- [NIM A](#) **2019**, *A prototype for SANDD: A highly-segmented pulse-shape-sensitive plastic scintillator detector incorporating silicon photomultiplier arrays*
- [AIP Adv.](#) **2018**, *Studies of MCP-PMTs in the miniTimeCube neutrino detector*
- [RSI](#) **2016**, *Invited Article: miniTimeCube*
- [arXiv](#) **2015**, *A new type of Neutrino Detector for Sterile Neutrino Search at Nuclear Reactors and Nuclear Nonproliferation Applications*
- Note: †Primary Author

Software & Programming

- General ‡Linux / BASH | ‡Vim | C++ | Python | AWK | Lua
- Simulation ‡RAT-PAC | GEANT
- Analysis ‡ROOT | MATLAB / Octave
- Writing ‡L^AT_EX / Overleaf
- Visualization Asymptote | Unreal Engine 4 | Manim
- Note: ‡Expert

Awards, Achievements, & Other Works

- 1994–Present Musical Performance: Through a combination of formal lessons and self-study, spent at least one year each on the following instruments: percussion (various), piano, vibraphone, drumset, guitar, sitar, tabla, harmonica, mandolin / tenor banjo, Irish bouzouki, vocals
- 2022 *The Music of Earth*: Invited public talk on the *Voyager Golden Record* for the 1st annual Highlonesome Music Festival at Dockley Ranch, Ava, MO, USA

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- 2016 Department of Energy SCGSR Scholarship: Spent 1 year as Visiting Graduate Scholar at LLNL (see *Experience* above)
- 2008 Tenor Saxophone Multiphonics, Undergraduate Thesis (Physics): Measurement and analysis of inharmonic multimodal oscillations in conical resonators and comparison with related literature on cylindrical resonators
- Fall 2007 *Physics of Music*: Alongside undergraduate advisor, successfully acquired both student commitment and departmental approval to create a senior-level physics elective on musical acoustics
- Summer 2007 Study Abroad at Nirman School in Varanasi, India: Focused study of North Indian classical music (sitar)
- 2004–2008 Presidential Scholar, University of Tulsa: Academic scholarship; full tuition, room, and board
- 2002–2004 National Merit Scholar, Saint Louis University High School: Academic scholarship offered to students scoring in the top 1% of their state on the PSAT

Languages

- English Native speaker
Russian Intermediate