Kyle C. Nelli

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EDUCATION

- **California Institute of Technology (Caltech), CA**   August 2020 - Present
  Doctorate of Philosophy: *Physics*
- **University of Illinois Urbana-Champaign, IL**   August 2016 - May 2020
  Bachelor of Science: *Engineering Physics, Highest Honors*
  Bachelor of Science: *Astronomy, Summa Cum Laude and with High Distinction*

EXPERIENCE

- **Teukolsky Group, Caltech**   November 2020 - Present
  Graduate Research Assistant
  - Member of Simulating eXtreme Spacetimes (SXS) collaboration (150+ people, 8+ institutions).
  - Updated and significantly reduced complexity of control loops in MPI-based Spectral Einstein Code (SpEC).
  Lead SpECTRE Developer/Engineer (500k+ lines of C++ 20)
  - Open-source software designed to run highly accurate simulations of binary black hole mergers and general relativistic magneto-hydro dynamics on HPC and exascale machines.
  - Utilized task-based (asynchonous) parallelism to achieve **3x speedup** when solving partial differential equations on exascale computing resources.
  - **Visualized ~1TB** of output from simulations using Paraview and its Python scripting framework.
  - Implemented detailed memory diagnostics. **Reduced memory usage by 5x** and found three bugs.
  - Designed and oversaw five student projects. Mentored undergraduate, masters, and other doctoral students.
- **Shapiro Group, University of Illinois Department of Physics, REU**   May 2018 - July 2020
  Undergraduate Researcher
  - Created visualizations of numerical simulations of black hole and compact star mergers.
  - Wrote novel code in Python and C++ (27k+ lines) to automate visualization using VisIt software and Blue Waters supercomputer.
- **Dr. Christopher Powell, Argonne National Laboratory Internship**   May 2017–July 2017
  Undergraduate Researcher
  - Utilized Advanced Photon Source (X-rays) to record fuel injector spray patterns.
  - Generated novel Python scripts to analyze experimental data for start of injection time; implemented visualizations with Blender software.

SKILLS SUMMARY

- **Languages:**   C/C++11-20, Python, Bash, Perl, Mathematica
- **Software:**   SpECTRE, VSCode, LaTeX, GNUPlot, VisIt, Paraview, Blender
- **Tools:**   GIT/GitHub, Docker/DockerHub, Make, CMake, LLVM, GCC, GDB, HPCToolkit, SLURM
- **Parallelism:**   Charm++, MPI, OpenMP
- **Platforms:**   Linux (Ubuntu, Mint, CentOS, RedHat), Windows, MacOS
- **Clusters:**   Wheeler (Caltech), Caltech HPC (Caltech), Frontera (TACC), Anvil (ACCESS, formerly XSEDE), Expanse (ACCESS), Bridges2 (ACCESS), Pleiades (NASA), Ocean (CSUF), Blue Waters (NCSA)

HONORS AND AWARDS

- **APS DGRAV Travel Grant**, $300   April 2023,24
- **ICERM Travel Grant**, $840   August 2022
- **David and Barbara Groce travel fund**, $500 per year   2022-2024
- **Rochus E. Vogt Graduate Fellowship**, $36,500   Fall 2020 - Fall 2021
- **Excellence in Physics Scholarship**, $3,000   Spring 2020
- **Anthony Research Scholarship**, $1,000   Spring 2020
- **Wyatt, Stanley Memorial Award**, $700   Spring 2020
- **University of Illinois Dean's List**, Top 20% in College of Engineering   August 2016 - May 2020
- **Illinois Tool Works Scholarship**, $1,500 per academic year   August 2016 - May 2020
- **Phi Beta Kappa Honor Society**, Member   2019
- **A.C. Anderson Undergraduate Research Award**   Summer 2018

PRESENTATIONS

- "The SpECTRE CCE Module", North American Einstein Toolkit Workshop, June 3 2024, Baton Rouge, LA

- "Horizon Tracking in SpECTRE with Task-Based Parallelism", April APS Meeting, April 3 2024, Sacramento, CA

- "Horizon Tracking in SpECTRE with Task-Based Parallelism", Pacific Coast Gravity Meeting, March 1 2024, Santa Barbara, CA

- "Cauchy-Characteristic Matching in SpECTRE", April APS Meeting, April 16 2023, Minneapolis, MN

- "Cauchy-Characteristic Matching in SpECTRE", Pacific Coast Gravity Meeting, April 1 2023, Caltech, CA

- "SpECTRE, Numerical Relativity Community Summer School 2022", Numerical Relativity Community Summer School, Aug. 11 2022, ICERM at Brown University, MA

PUBLICATIONS

[1] Yitian Chen, ..., **Kyle C. Nelli**, et al. "Improved frequency spectra of gravitational waves with memory in a binary-black-hole simulation" (2024).

[2] Guillermo Lara, ..., **Kyle C. Nelli**, et al. "Scalarization of isolated black holes in scalar Gauss-Bonnet theory in the fixing-the-equations approach" (2024).

[3] Teagan A. Clarke, ..., **Kyle C. Nelli**, et al. "Toward a self-consistent framework for measuring black hole ringdowns". *Phys. Rev. D* 109 (12 June 2024), p. 124030.

[4] Sizheng Ma, Jordan Moxon, ..., **Kyle C. Nelli**, et al. "Fully relativistic three-dimensional Cauchy-characteristic matching for physical degrees of freedom". *Phys. Rev. D* 109 (12 June 2024), p. 124027.

[5] Hengrui Zhu, Justin L. Ripley, ..., **Kyle C. Nelli**, et al. "Nonlinear Effects In Black Hole Ringdown From Scattering Experiments I: spin and initial data dependence of quadratic mode coupling" (Jan. 2024).

[6] Hengrui Zhu, ..., **Kyle C. Nelli**, et al. "Black Hole Spectroscopy for Precessing Binary Black Hole Coalescences" (Dec. 2023).

[7] Nils Deppe, ..., **Kyle C. Nelli**, et al. "Simulating magnetized neutron stars with discontinuous Galerkin methods". *Phys. Rev. D* 105.12 (June 2022).

[8] Milton Ruiz, Antonios Tsokaros, Stuart L. Shapiro, **Kyle C. Nelli**, and Sam Qunell. "Magnetic ergostars, jet formation, and gamma-ray bursts: Ergoregions versus horizons". *Phys. Rev. D* 102.10 (Nov. 2020).

[9] Roberto Torelli, ..., **Kyle C. Nelli**, et al. "Evaluation of Shot-to-Shot In-Nozzle Flow Variations in a Heavy-Duty Diesel Injector Using Real Nozzle Geometry" (Apr. 2018).