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Zack Carson, Ph.D.

Astrophysicist and data scientist with 9 years of academic and industry experience eager to transition back to my passion at the forefront of space exploration and technology. With newly proven machine learning proficiency, I aim to leverage my varied skill set to drive innovation and impactful contributions to the space exploration domain.

Experience

Data Scientist III, Machine Learning — New York City, NY
Dataminr — *2021 - Present*

- Led the AI cybersecurity team using ML models to detect cybersecurity threats and vulnerabilities
- Collaborated with the team and stakeholders to design, collect data, train, test, and implement 6 net new ML models, each currently running with mean accuracies and precisions of 91% and 90% on live streaming data (up to 1 billion messages a day from 100,000 data sources) to produce 1,000+ new client alerts per day
- Designed and implemented a live data streaming/reduction pipeline converting 1 billion raw messages per day into filtered/processed data used for anomaly detection

Gravitational Wave Outreach (ongoing NSF Grant collaboration) — Charlottesville, VA
University of Virginia — *2022 - Present*

- Leads and mentors a team of undergraduates developing 3 educational General Relativity video games

Astrophysics Graduate Research Scientist — Charlottesville, VA
University of Virginia — *2015 - 2020*

- 17 publications (13 as lead author) published in leading peer-reviewed journals
- Awarded the 2020 University of Virginia Distinguished Research Fellowship Award
- 6 conference talks given domestically, 2 as an invited speaker
- Collaborated with the LIGO and LISA organizations to use observational gravitational wave data to place limits on theoretical parameters used to test General Relativity and study the neutron star interior structure
- Designed and built an Optical Parametric Oscillator to produce entangled qumodes with 3.2 dB of squeezing.
- Produced widely-used code among the CERN research community in simulating the Higgs decay modes

Lead Graduate Teaching Assistant — Charlottesville, VA
University of Virginia — *2014 - 2019*

- Awarded the 2019 University of Virginia Distinguished Graduate Teaching Award for STEM fields
- Implemented and published results on a new training program including mock teaching simulations and think-tanks at the beginning of each semester - currently training 15-20 new teaching assistants per year
- Managed and led the training of graduate TAs, and taught undergraduate physics labs and classes

Skills

Technical Skills: Scientific laboratory equipment, Electronics, Optics, Telescope operation and maintenance, High precision machining, bash, git, XMgrace, Airflow, Unity, AWS S3, Snowflake, Kibana, Elasticsearch

Programming Languages: Python, C#, C++, Mathematica, Cypher, SQL, LaTeX, HTML, Matlab, ROOT, R, Fortran

Education

University of Virginia
PhD Physics *(Thesis: Probing Fundamental Physics with Gravitational Waves)* — *2020*

University of Utah
BS Pre-Professional Physics, BS Applied Mathematics, Astrophysics minor — *2014*

Conferences and Presentations

1. "Multi-messenger probes of the neutron star equation of state" (Invited Speaker) – *Southeastern Section of the American Physical Society (SESAPS) meeting, Wrightsville, NC, November 2019*
2. "Probing beyond-Kerr spacetimes with the IMR consistency tests of gravitational waves" (Contributed Speaker) – *APS April Virtual Meeting, April 2020*
3. "Universal relations after GW170817" (Contributed Speaker) – *American Physical Society (APS) April Meeting, Denver Colorado, April 2019*
4. "Constraining nuclear matter parameters & improving Universal Relations after GW170817" (Invited Speaker - Web seminar, Youtube) – *Nuclear Theory Group (host: Dr. Bharat Kumar, University of Tsukuba), March 2019*
5. "Team based design of science laboratories" (Contributed Speaker) – *Innovation in Pedagogy Summit, University of Virginia, May 2016*
6. "Universal relations after GW170817" (Poster presentation) – *GWPAW, University of Maryland, December 2018*

Selected Publications

1. **Carson, Zack**. (2020). *Probing fundamental physics with gravitational waves* (Doctoral dissertation, University of Viginia). Retrieved from https://doi.org/10.18130/v3-pxdw-2144
2. **Carson, Zack**, & Yagi, K. (2020d). Probing einstein-dilaton gauss-bonnet gravity with the inspiral and ringdown of gravitational waves. *Phys. Rev. D*, *101*, 104030. Retrieved from https://link.aps.org/doi/10.1103/PhysRevD.101.104030
3. **Carson, Zack**, & Yagi, K. (Eds.). (2021). *Testing General Relativity with Gravitational Waves*, submitted as a chapter of the *"handbook of gravitational wave astronomy"* by C. Bambi, S. Katsanevas and K. Kokkotas; Springer Singapore.
4. **Carson, Zack**, & Yagi, K. (2020e). Probing string-inspired gravity with the inspiral-merger-ringdown consistency tests of gravitational waves. *Class. Quantum Grav.*. Retrieved from https://doi.org/10.1088/1361-6382/aba221
5. **Carson, Zack**, & Yagi, K. (2020a). Asymptotically flat, parameterized black hole metric preserving Kerr symmetries. *Phys. Rev. D*, *101*, 084030. Retrieved from https://link.aps.org/doi/10.1103/PhysRevD.101.084030
6. **Carson, Zack**, & Yagi, K. (2020c). Probing beyond-Kerr spacetimes with the inspiral-ringdown signals of gravitational waves. *Phys. Rev. D*, *101*, 084050. Retrieved from https://link.aps.org/doi/10.1103/PhysRevD.101.084050
7. **Carson, Zack**, & Yagi, K. (2020b). Parameterized and inspiral-merger-ringdown consistency tests of gravity with multiband gravitational wave observations. *Phys. Rev. D*, *101*, 044047. Retrieved from link.aps.org/doi/10.1103/PhysRevD.101.044047
8. **Carson, Zack**, & Yagi, K. (2019a). Multi-band gravitational wave tests of general relativity. *Classical and Quantum Gravity Letters*. Retrieved from https://iopscience.iop.org/article/10.1088/1361-6382/ab5c9a
9. **Carson, Zack**, & Yagi, K. (2019b). Parameterized and Consistency Tests of Gravity with Gravitational Waves: Current and Future. In *Proceedings, Recent Progress in Relativistic Astrophysics: Shanghai, China, May 6-8, 2019* (Vol. 17(1)). Retrieved from https://doi.org/10.3390/proceedings2019017005
10. **Carson, Zack**, Seymour, B. C., & Yagi, K. (2020). Future Prospects for Probing Scalar-Tensor Theories with Gravitational Waves from Mixed Binaries. *Class. Quant. Grav*, *37*(6), 065008. Retrieved from doi.org/10.1088%2F1361-6382%2Fab6a1f
11. **Carson, Zack**, Chatziioannou, K., Haster, C.-J., Yagi, K., & Yunes, N. (2019). Equation-of-state insensitive relations after GW170817. *Phys. Rev.*, *D99*(8), 083016. Retrieved from https://doi.org/10.1103/PhysRevD.99.083016
12. **Carson, Zack**, Steiner, A. W., & Yagi, K. (2019a). Constraining nuclear matter parameters with GW170817. *Phys. Rev.*, *D99*(4), 043010. Retrieved from https://doi.org/10.1103/PhysRevD.99.043010
13. **Carson, Zack**, Steiner, A. W., & Yagi, K. (2019b). Future Prospects for Constraining Nuclear Matter Parameters with Gravitational Waves. *Phys. Rev.*, *D100*(2), 023012. Retrieved from https://doi.org/10.1103/PhysRevD.100.023012