JACK DINSMORE

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EDUCATION

- Graduated Amherst Regional High School in 2018. Unweighted GPA: 3.998
- MIT class of '22, pursuing a BS in physics (Course 8-Focus) and minors in math and astronomy.
- Took two classes each on quantum mechanics, relativity, electromagnetism, classical mechanics, analysis, and other subjects totaling 309 units, including a planetary science class with a large independent research project
- Unweighted MIT GPA: 5.0

RESEARCH EXPERIENCE

Modeling the Galactic Center Excess MIT, remote Supervisor: Prof. Tracy Slatyer

September of 2020 to present, seven hours per week.

We assess whether the galactic center excess (GCE) can be explained entirely by a largely undetected millisecond pulsar (MSP) population in the galactic center by proposing several luminosity functions, constraining the space of possible parameters with observational data, and predicting how many MSPs are required to reproduce the GCE for each function.

In this ongoing project, I model the GCE with multiple luminosity functions, some taken from the literature, and calculate the number of pulsars they require to yield the excess. The paucity of point sources observed by the *Fermi* Large Area Telescope in the galactic center and the fraction of flux from the GCE it observes restrict some luminosity functions. In future work, I will improve the sensitivity of my analysis to determine which luminosity functions best fit point source observations.

Photometric Analysis Remote REU with Lehigh University Supervisor: Prof. Joshua Pepper

May to August of 2020, full-time, and December of 2020 to present, part-time.

We developed and tested an algorithm to extract error-corrected luminosity fluctuations from large images of several unresolved open clusters and globular clusters drawn from the TESS dataset as a first step to isolating the clusters' variable stars and determining the clusters' ages.

As an REU student, I worked on this problem from its infancy, developing, testing, and comparing different techniques for measuring background fluctuation. I applied these techniques to subtract the background from time series images of stellar clusters and extract position-distributed light curves for a selection of clusters, pinpointing the most variable stars. Working largely independently, I presented my results to my advisor on a weekly basis and to the larger REU group at the end of the summer.

This project is ongoing, but an article is projected to be submitted before the summer of 2021.

Machine learning & data flow MIT Supervisor: Prof. Phil Harris

Summer of 2019, 40 hours per week, and January of 2020, 30 hours per week.

We sought to increase the speed of event reconstruction in the high-level trigger (HLT) of the Large Hadron Collider CMS experiment by replacing a current, CPU-implemented regression algorithm with a GPU-implemented neural network.

In 2019, I designed, implemented, and trained a neural network (FACILE) that reconstructs particle energies with TensorFlow on simulated data and I measured its inference speed and accuracy on CPUs, GPUs, TPUs as a function of its design parameters.

In 2020, we deployed this network as a service and ran the full CMS HLT regression using FACILE, detecting a 10% decrease in total time when compared to the nominal algorithm for under 500 clients. This speedup could be used to increase the throughput of the HLT, or to devote a fraction of the machines currently running the HLT to other tasks.

Jeffrey Krupa *et al* 2021 *Mach. Learn.: Sci. Technol.* 2 035005

Black hole thermodynamics UMass Amherst Supervisor: Prof. Jennie Traschen

Summers of 2017, and 2018, about 2 hours per week, and about 1 hour per week during the school year.

We demonstrated that the heat capacity of a Schwarzschild-de Sitter (SdS) black hole exhibits an extremum at low temperature and that the entropy exhibits an inflection point at a different low temperature analogous to the classical Schottky anomaly, which occurs in low-temperature two-state systems.

After a few months of working on a different project, I noticed the heat capacity peak of an SdS black hole and pointed it out to my supervisor, which ignited this project. My role thereafter was primarily to probe aspects of the peak in heat capacity and inflection point in entropy. For example, I showed that they do not occur at the same temperature, and that the entropy inflection point occurs for Reissner-Nordström black holes, which have two horizons like SdS black holes.

Jack Dinsmore, Patrick Draper, David Kastor, Yue Qiu, and Jennie Traschen 2020 *Class. Quantum Grav.* 37 054001

SKILLS

- Longtime experience in C++, Python, and LaTeX, and proficiency in Java, Bash, Rust, and Mathematica
    - Experience in TensorFlow, Matplotlib, OpenGL, Astropy, Lightkurve, and other standard libraries, as well as platforms such as GitHub and Google Cloud
- Organization and time management
    - Attends five or six classes a semester with part-time jobs researching, grading, or running the school newspaper's copy-editing department, while maintaining personal projects
- Communication and teaching
    - One year of teaching kung fu at the Shaolin Kung Fu Center of Hadley from 2017-18
    - Two semesters teaching for MIT ATI in 2018-19, a program to prepare high school students for the SAT. I received ratings from the students of around 4.5/5 in both semesters
- Presenting
    - In addition to presentations as required by classes, my three most recent research projects involved weekly presentations of my work to my advisor and other group members, and less frequent presentations to more distant collaborators