JOSHUA FAGIN

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EDUCATION

Cornell University *August 2016 - May 2020*
B.S., Physics and Mathematics.

CAREER OBJECTIVES

I would like to earn a PhD so that I can continue to do research within physics, either at a research university or a government lab.

RESEARCH EXPERIENCE

Fermilab Muon g-2 Experiment at Cornell *March 2018 - Present*
The Fermilab Muon g-2 experiment is trying to precisely measure the anomalous magnetic moment of the muon, since a previous discrepancy between observation and theory found at Brookhaven National Lab could be an indication of physics beyond the standard model.

- Worked with Research Associate Antoine Chapelain and Professor David Rubin to develop the Fourier method for extracting the momentum distribution of the muon beam from the fast rotation signal (FRS), which is the evolution of the intensity of the muon beam as it goes around the muon storage ring, and implement the method in Python
- Ran parameter scans and pseudo-data experiments to estimate the systematic and statistical uncertainty of the Fourier method
- Developed an analytic model of the fast rotation signal with noise, and implemented a Monte Carlo simulation of it
- Used the Monte Carlo model I developed to test the validity of the Fourier method using 1,000 simulated fast rotation signals over a wide ensemble of realistic cases as another way of estimating the uncertainty
- Wrote documentation for the Fourier method and Monte Carlo including the methodology and user guide for running the code

TECHNICAL SKILLS

Programming: Python, Numpy, Matplotlib, SciPy, Numba, PyROOT, Tensorflow, Keras, Multiprocessing, Machine Learning, Monte Carlo, Mathematica, Jupyter Notebook, LabView

Tools: LaTeX, MS Office, Linux, Windows, MacOS, Github

Language: French (Beginner)

RELEVANT UPPER LEVEL COURSEWORK

Physics: Relativistic Quantum Field Theory part 1 (QFT), QFT part 2*, Particle Physics, General Relativity, Statistical Mechanics, Advanced Lab*

Astronomy: Data Mining Machine Learning and Modeling in Astronomy

Math: Matrix Groups, Applied Complex Analysis, Partial Differential Equations, Abstract Algebra, Nonlinear dynamics and Chaos*

*will be taking in spring 2020

PROJECTS

Machine Learning on Muon Beam Monte Carlo
I used Machine Learning on the Monte Carlo simulation I developed for the muon g-2 experiment using Tensorflow with Keras in Python. I used a convolutional neural network to take in the muon fast rotation signal and output the electric field correction to the precession frequency of the muon spin, which is the value of interest normally calculated from the recovered momentum distribution. I trained the model with 40,000 short, simulated FRS.

CLEO-c Branching Fraction Measurement
CLEO-c is a particle at the Cornell Electron Storage Ring. I used data from the detector to estimate the branching fraction from the $D^+ \to K^-\pi^+\pi^+$ decay mode. The branching fraction of the decay mode was estimated using ROOT with C++ by finding the number of outgoing particles that have energies summing to the D^+ energy, and then dividing by the total number of particles.

Construction of a Laser Scanning Microscope
I built a laser scanning microscope. The microscope works by having two motors attached to a mirror control, one for each of the vertical and horizontal axes that is then controlled by a LabView virtual environment (VI). A photodiode reads in voltage information from the laser bouncing off the object of interest which is turned into a 2D image through an analog to digital conversion.

PUBLICATIONS

The following are internally published in the FermiLab g-2 collaboration:

- **J. Fagin**, A. Chapelain, D. Rubin, D. Seleznev, *On the background correction of the Cornell fast rotation Fourier analysis.* GM2-doc, 2019.
- **J. Fagin**, A. Chapelain, D. Rubin, D. Seleznev, *Cornell fast rotation Monte Carlo method and user guide.* GM2-doc, 2019.
- **J. Fagin**, A. Chapelain, D. Rubin, D. Seleznev, *Cornell fast rotation Fourier analysis user guide.* GM2-doc, 2019.
- **J. Fagin**, Tyler Barrett, A. Chapelain, D. Rubin, D. Seleznev, *Cornell momentum time correlation study.* GM2-doc, 2019.
- A. Chapelain, **J. Fagin**, D. Rubin, D. Seleznev, *Cornell fast rotation Fourier method.* GM2-doc, 2019.
- A. Chapelain, **J. Fagin**, D. Rubin, D. Seleznev, *Cornell fast rotation Fourier analysis performance study with toy Monte Carlo simulation.* GM2-doc, 2019.
- A. Chapelain, **J. Fagin**, D. Rubin, D. Seleznev, *Extraction of the radial distribution of the stored muon beam for the Run–1 60–hour data set via the Cornell fast rotation Fourier method: estimation of the electric field correction to the anomalous spin precession frequency.* GM2-doc, 2019.
- A. Chapelain, **J. Fagin**, D. Rubin, D. Seleznev, *Extraction of the radial distribution of the stored muon beam for the Run–1 9–day data set via the Cornell fast rotation Fourier method: estimation of the electric field correction to the anomalous spin precession frequency.* GM2-doc, 2019.

- A. Chapelain, **J. Fagin**, D. Rubin, D. Seleznev, *Extraction of the radial distribution of the stored muon beam for the Run–1 end game data set via the Cornell fast rotation Fourier method: estimation of the electric field correction to the anomalous spin precession frequency.* GM2-doc, 2019.

REFERENCES

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