RORY O'DWYER

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EDUCATION

Stanford University

Pursuing Phd in Physics *September 2020-Present*

Texas A&M University

MS in Mathematics *Dec 2019-August 2020*

Summa Cum Laude with BS in Physics (Honors) and Mathematics (Honors) *August 2016-Dec 2019*

RESEARCH AND LEADERSHIP EXPERIENCE

LDMX Project December 6,2020 - present
Graduate Researcher *Stanford, California*

The Light Dark Matter Experiment (LDMX) at Stanford's Linear Accelerator (SLAC) aims to explore sectors of Dark Matter previously outside the realm of detector sensitivities. Whereas some proposed heavier mechanisms for Dark Matter (WIMPS, for instance) could have their phase space explored at higher energy detectors, for the lighter mechanisms the constraining factor is not the energy required to create those particles but sufficient statistics and sensitivity to the low mass interactions. This is where smaller scale experiments like LDMX hope to provide new insight into the problem of Dark Matter.

Since the LDMX project, at the time of writing, is still in development stages, much of my work with the project is simulation based. My work is focused on the detectors' Triggering System. To this end I developed the firmware required to run the Triggering Scintillator, and fast electron counting detector system which, in conjunction with the ECal, will facilitate the LDMX's triggering needs in its first runs. Furthermore I evaluated the hit efficiency of this detector subsystem by analysis data extracted from a April 2022 prototype test run performed at the PS circle at CERN. I have also been involved in a multi-electron triggering study for the TS system, wherein I evaluated the detectors capacity to perform with higher multiplicity of electrons. With these studies, I have helped to demonstrate the feasibility of the experiment.

HPS Project July 12 2021 - present
Graduate Researcher *Stanford, California*

The HPS Experiment at Jefferson Laboratories (JLab) is a predecessor to the LDMX. In a similar manner to the LDMX, it also looks for dark matter models using transverse momenta and missing energy searches. The decay model it probes features final decay products which would pass undetected through most similar experiments due to a gap in acceptance. The HPS features detecting material just outside from a small gap about the electron beam; the gap allows the detector to perform at high beam luminosity and its proximity to the beam gives it the required acceptance to these rare decays. My focus for the HPS has been optimizing the performance of event reconstructing in the HPS silicon vertex tracker. Over several months I systematically probed the hit reconstruction algorithm looking for misidentified pulse numbers and other issues. While implementing changes, I determined that obtaining the correct baselines for the SVT channels (the default voltages they are set at during run-time) would grant a 20 percent increase in our signal tracks. This lead to a significant improvement in the HPS' sensitivity to new physics. I wrote programs to collate and remove dead channels from simulations performed on the HPS, which will better bring into agreement the data we obtained from a 2021 run (for which I acted as a shift expert) and offline simulation.

Stanford Schnitzer Lab May 5,2020 - December 6,2020
Graduate Researcher *Stanford, California*

An important question in the field of neuroscience is the role of feedback mechanisms in the brain. It is already established that feedback from deeper portions of the brain establish a bias towards expected stimuli, but it is not established whether the neural networks in earlier stages of information processing also exhibit feedback phenomena. The Schnizter lab at Stanford is using the early visual system in the rat brain to study this phenomena. Using in vivo double photon spectroscopy in genetically modified mobile rats, the Schnitzer group gathered the spiking information of rats during a random-dot coherence task. The rats viewed dots moving either left or right with varying degrees of noise and were rewarded upon choosing the correct direction of dot movement. Furthermore before a trial the rats were biased towards a particular direction by repeated applications of that direction's stimulus to determine the effect of expectation on the rat's decision. With the collected data in hand, it is our objective to fit said spiking information with a dynamic system that could account for its final computation and its internal dynamics. By studying the dynamical system, our team hopes to uncover evidence for whether or not the early visual system already exhibits evidence of feedback mechanisms.

Texas A&M University High Energy Lab September 4,2018 - August 1, 2020
Undergraduate Researcher *College Station, Texas*

*My more recent work with this group will be described in my section on the Compact Muon Solenoid(CMS) Project; this section will detail my efforts with TAMU High Energy Lab in College Station before working directly at the European Organization for Nuclear Research(CERN).*Currently, the Large Hadron Collider(LHC) at CERN is undergoing a long term shutdown, under which upgrades are being prepared for increased particle luminosity. Luminosity, in the context of high energy, is the ratio of the number of events detected to the interaction cross section over time. As luminosity increases at the LHC, detector devices will need upgrades to handle the higher amount of data and radiation. The silicon components used in these upgrades will need to last at least a decade in a high radiation environment without physical hardware failure due to the total ionizing dose(TID). Another effect that must be handled are excessive device resets. These are due to radiation induced flipped data bits on memory registers and are an ongoing problem throughout a detector's lifespan. My task was to sort through a selection of viable component chips and determine which of those chips could withstand 30 kRads of exposure (the expected TID at CMS site over a decade of high luminosity) without failure or excess bit flipping errors requiring resets. My results are included in the first publication in my publications section.

Texas A&M University Department of Mathematics January 3,2018 - August 1, 2020
Graduate Researcher *College Station, Texas*

Isoperimetric problems constitute a large portion of the work of geometric measure theory. They are chiefly concerned with determining curves of minimal perimeter containing some fixed volume. Solutions to certain problems with a volume taken with the standard Lebesgue measure (in lower dimensions) and with an Euclidean perimeter have been known since antiquity. However, solutions to isoperimetric problems with multiple bodies and non-Euclidean perimeters represent an open field. An optimizing solution for 2 contained volumes in 3 dimensions with surface area measured using the taxicab metric had not yet been established until now.

The results we obtained would be something of interest in some areas of physics. l_1(or taxicab) like environments have been observed in crystal growth, and in these environments our new methods could be used to more easily explain their formation.

We developed a method that solves the known 2 dimensional l1 minimizer in a manner more suited towards generalization to 3 dimensions. A paper detailing this new method is included below.

CERN CMS Project (TAMU Branch) June 20,2019-August 23,2019
Undergraduate Researcher *Geneva, Switzerland*

- As a continuation of my previous work on preparing CMS DAQ Systems for high luminosity, my current task is to implement upgrades to the CMS data acquisition system's ability to handle dramatically increased events in the upcoming high luminosity LHC environment. Currently the CMS hardware is capable of processing 6 Gbs^{-1} which is what is produced in the current CMS environment. To handle the expected tenfold increase of detected events, CMS's data compression algorthims will have to be enhanced to throw out more of the non-interesting events. My work while at CERN was to create the surrounding software environment for the enhanced data sieve, and to perform calibration tests on the existing CERN detector hardware. Results concerning these upgrades and the tests on the detector system will be published with the Undergraduate Research Scholars program in a TAMU journal later this year.

Texas A&M University Cyclotron Institute August 30,2017 - May 30,2019
Undergraduate Researcher *College Station, Texas*

- When the first design of TAMU's Tex-AT active target detector was tested with sample interactions, the particles tracks inside the argon gas chamber were observed to curve, implying that the electrical field was non-uniform in the detector chamber. The electrical field of the chamber is generated by a high voltage top plate, a bottom plate ground state, and in between, a stack of horizontal layers of rectangular shaped wires. Each rectangular wire layer is a step down in voltage from the layer above. The chamber looks like a horizontally-barred cage with solid top and bottom plates. The uniformity of the electrical field is determined by the isopotential surfaces that envelope wires and components which are held in tension with a graduated voltage. The uniformity of the electric field inside the detector chamber is almost uniquely determined by it's component geometry.

  My research involved writing a computer program to simulate the electric field in the chamber with various geometries, establishing an optimal detector geometry (by minimizing an electrical field non-uniformities), and fabricating the modifications to our Tex-AT System. At the conclusion of my work, we conducted a simple test by firing protons at an argon CO_2 gas target and the previous non-uniformities were no longer observed. A paper detailing the Tex-AT detector and its current geometry is included below.

Texas A&M University Computational Physics Jan 1,2019-August 23, 2019
Undergraduate Researcher *College Station, Texas*

- This research effort was largely self-lead. After making an acknowledged contribution to a computational physics paper by Dr. Sui Chin (included in my publications), I worked with him to explore means of expressing electrodynamics in some form without having to rely on a gauge. Using the Poissonian formulation, previous work by Dr. Chin demonstrated that classical electrodynamics can be calculated without the need for a gauge (not necessarilly explicitly, but in the form of a symplectic integrator). This was performed by using a special variant on known splitting algorithms. It was our hope that in working in analogous interpretations of Quantum Mechanics a similar non-gauge method could be derived, perhaps restricted to particular cases.

  We tried a couple of formulations of Quantum Mechanics, ultimately arriving at the psuedo-Newtonian formulation derived by Bohm. While our original goal was not achieved, preliminary results seem to suggest that there was no mechanism by which the Aharonov-Bohm Effect could be explained in that formulation. This may provide evidence to the proposition that the pilot-wave formulation of Quantum Mechanics requires modification for electrodynamics even in a non-relativistic setting. This, however, will need a deeper look at the literature before the publication of any results.

PUBLICATIONS

0.1 Peer Reviewed Journal Articles

- 1.Zamora, J. *Direct Fusion Measurement of the ^8B Proton-Halo Nucleus at Near-barrier Energies. Physics Letters B. 29 March, 2021.*

  available at https://www.sciencedirect.com/science/article/pii/S0370269321001969

- *2.E. Koshchiy et. al, TexAT: Texas Active Target Detector System for Experiments with Rare Isotope Beams.Nuclear Instruments and Methods in Physics Research Section A: Accelerators, Spectrometers, Detectors and Associated Equipment Volume 957, 21 March 2020.*

  available at https://www.sciencedirect.com/science/article/pii/S0168900220300073

- *3. J. Bishop et. al, Beta-delayed charged-particle spectroscopy using TexAT.Nuclear Instruments and Methods in Physics Research Section A: Accelerators, Spectrometers, Detectors and Associated Equipment. Volume*

- *4.Parker Duncan,Rory O'Dwyer and Eviatar B. Procaccia. An Elementary Proof for the Double Bubble problem in 1 Norm. Journal of Geometric Analysis. Springer. 2022. Web,*

  Available from https://link.springer.com/article/10.1007/s12220-022-01008-9

- *5.Parker Duncan,Rory O'Dwyer and Eviatar B. Procaccia. Discrete 1 Double Bubble solution is at most ceiling+2 of the continuous solution. Journal of Discrete and Computational Geometry. Springer. 2023. Web,*

  Available from https://link.springer.com/article/10.1007/s00454-023-00501-4

- *6. O'Dwyer, Rory. Stepping Stone Problem on Graphs. The Mathematics Enthusiast. University of Montana. July, 2023*

  Available from https://scholarworks.umt.edu/tme/vol21/iss1/4/

- *7. Akesson, T. et al. Photon-rejection power of the Light Dark Matter eXperiment in an 8 GeV beam. Journal of High Energy Physics. Springer. 2023. Web,*

  Available from https://link.springer.com/article/10.1007/JHEP12(2023)092

- *8. Sui Chin and J. Massey. The Hardwall Method of Solving the Radial Schrodinger Equation and Unmasking Hidden Symmetries American Journal of Physics, Vol 87, Issue 8. August, 2019.*

  Available from https://aapt.scitation.org/doi/full/10.1119/1.5111839

  This (8) is the only entry where not credited as an Author, but included in Acknowledgements for my contribution to the publication.

0.2 Pre-Prints

- 1. O'Dwyer, Rory. Relativistic Propagators on Lattices. arXiv.org. Sep 18, 2023

  Available from https://arxiv.org/abs/2309.09535

- 2. O'Dwyer, Rory. A Geometric Picture of Peturbative QFT. arXiv.org. Oct 12, 2023

  Available from https://arxiv.org/abs/2310.08695

- 3. Parker, Duncan, Rory O'Dwyer, and Eviatar B. Procaccia. The Double Bubble Problem in the Hexagonal Norm. arXiv.rog. Jan 18, 2024.

  Available from https://arxiv.org/abs/2401.09893

0.3 Conference Series and Other

- 1.O'Dwyer,Rory V. *Radiation Hardness Assessment for muon System Electronics Installed in the 2020 CMS Upgrade. Undergraduate Research Scholars Program.*

  Available at http : / /hdl .handle .net /1969 .1 /175438
- *2.State of the Art Measurements with TexAt Journal of Physics Conference Series. IOP Publishing Ltd. 2019. Web,*

  Available at https://iopscience.iop.org/article/10.1088/1742-6596/1308/1/012006
- *3.Nathan Baltzell, et al. "The Heavy Photon Search Experiment"/ arXiv.org. March 16, 2022*

  Available from https://arxiv.org/abs/2203.08324

RESEARCH PRESENTATIONS

R. O'Dwyer. "Commissioning High Rate Capabilities of the New CMS GE11 Muon Detector Readout System for the High Luminosity Operations at the Large Hadron Collider". Undergraduate Research Scholars Virtual Presentation Session. March 27, 2020. Web.

R. O'Dwyer. "Radiation Hardness Assessment for Muon System Electronics Installed in the 2020CMS Upgrade". Undergraduate Research Scholars Virtual Presentation Session. March, 2019. Web.

Bishop,Jack et. al. "Measurement of near-threshold states in 12C using beta-delayed charged particle decay". 2019 Fall Meeting of the APS Division of Nuclear Physics. October 16, 2019. Web

available from https://meetings.aps.org/Meeting/DNP19/Session/MB.5

R. O'Dwyer, E. Procaccia. "Double Bubble Problem with R_2 under L_1". pres at LA-TX Undergraduate Mathematics Conference. Baton Rouge, LA, October 2018.

R. O'Dwyer, E. Procaccia. "Double Bubble Problem with R_2 under L_1". pres at Mathfest. Denver, CO, August 2018.

R.O'Dwyer. "Decreasing Non-Uniformity in Nuclear Physics" pres. at TAMU Undergraduate Research Week 2018, College Station, TX, March 2017

HONORS AND AWARDS

2023 HEPCAT Scholar

2019-2020 Recipient of the Philip and Doris Moses Fund Honors Scholarship

2019 Graduation with Departmental Physics Honors and Departmental Math Honors.

2018-2019 Undergraduate Research Scholar.

2018-2019 Recipient of the Philip and Doris Moses Fund Honors Scholarship

2018 AMC national math competition 4^{th} place (Mathfest)

2017-2018 Departmental Awards for Math 411,416,409

2016-2019 Dean's list for 8 Semesters for Academic Excellence

CO-CURRICULAR ACTIVITIES

2023-present Stanford Graduate Student Union Bargaining Committee representative, Treasurer, and Communications Team

2023-present LDMX CIDER (Committee of Inclusion, Diversity, Equity, and Recruitment) Co-Chair

2022 Referee for the Transactions of the American Mathematical Society

2018-present Member of Pi Mu Epsilon and Phi Kappa Phi (Mathematical and Academic Societies resp.)

2016-2018 Tutor for Math 411, 416, and Phys 331

2018-2020 TAMU Undergraduate Research Scholar

Treasurer (2018) and Safety Officer (2019) TAMU Wrestling Team

NAACP Wrestler 2016, 2017.