Prof. Jordan Hanson
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Whittier College

PHYS396 - Physics Research (for Credits 1-3)

The goal is to sort ourselves into various projects and to decide how many credits we think are appropriate. The credit decision is made between the student and the professor, based on how many hours per week can be devoted to the project.

Project: Complex Analysis of Askaryan Radiation 1. For example, see https://journals.aps.org/prd/abstract/10.1103/PhysRevD.105.123019 or https://arxiv.org/abs/2106.00804

- Learn complex analysis techniques as applied to electromagnetic fields, Fourier transforms, Laplace transforms, and the Cauchy integral formula
- Look for ways to enhance, update, or modify our current model of Askaryan radiation
- Applies to ultra-high energy neutrino research and cosmic ray research
- Example of theoretical or mathematical physics

Project: Complex Analysis of Askaryan Radiation 2.

- Work with partners to implement the original model above in a larger Python3 package called NuRadioMC
- https://github.com/nu-radio/NuRadioMC
- https://nu-radio.github.io/NuRadioMC/main.html
- We are currently working towards an *energy reconstruction* for ultra-high energy neutrinos using the implemented model

Dane Goodman

Project: 3D printing of RF Phased Array antennas. For example, see https://www.mdpi.com/2079-9292/10/4/415

- We have found a way to design and simulate RF antennas using open source CEM code.
- CEM stands for computational electromagnetism
- We can do this in 3D, with CAD programs all the way to radiated electromagnetic fields
- Currently we are trying to 3D print with conductive materials

Dane Goodman: 3 credits
Alex Ortiz Valenzuela: 3 credits
Ian Watanabe: 2 credits

Project: Application design for Introductory Physics Game-based learning module

- Think of DuoLingo for physics, with ability to add visuals to engage students
- Narrative that is meant to boost inclusion within introductory STEM courses
- Handle multiple-choice style responses
- Tailor student's direction through material based on previous practice and responses

Matthew Buchanan, 2 Credits.

Project: Solar Panel Circuit Design

- Construct a power circuit based around a solar panel
- Add in a cleaning device to clear dust/debris from solar panel surface
- Measure efficiency gains over time in various outdoor conditions

Natasha