Whittier
College

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Recommendation for the Fletcher-Jones Fellowship

Greetings,

I am writing on behalf of Raymond Hartig in support of his application for the Fletcher-Jones Fellowship. Raymond has been my advisee since he was a first-year student, and he is currently completing his junior year. Raymond is a double major in physics and mathematics, and plans to attend graduate school to complete a doctoral degree (PhD) for theoretical physics. Raymond is a well-rounded student who serves his fellow students by tutoring in CAAS and who participates in the music program at Whittier College through his music scholarship. Raymond has been performing research with me ever since he arrived, and his GPA of 3.89 is remarkable, especially given all that he does for everyone around him.

Raymond's course work is exemplary. I notice that in addition to being a top-performing student, he helps his classmates learn. When I assign a student-designed final project, he sometimes takes the lead, and sometimes follows. The results are 100% correct, on-time, every time. He is a creative and dynamic student who has shown me how physics and engineering concepts he's learned from me turn up in his music. He has joined four of my courses, in physics, digital signal processing, and computer logic and digital circuit design. He is self-motivated and never quits, and has kept a positive attitude even during quarantine. Working with him is a source of inspiration for me, and he is my good friend.

Raymond began working on a project with me in Summer 2020 regarding the mathematical physics of electromagnetic radiation caused by neutrinos interacting in ice. This theoretical physics work has many applications for the IceCube Gen2 Collaboration (`https://icecube.wisc.edu`), and Whittier College is now a member. We are in the process of publishing it in *Physical Review D.* Raymond has asked me about applying our new model to data analysis efforts that search for neutrino signals from deep space in IceCube datasets. Although I outlined for him some simple options, Raymond has had a unique insight: it should be possible to measure the *energy* of the neutrinos by comparing the electromagnetic signatures they leave in ice with our model!

Raymond outlines the details in his research statement. If successful, the technique will give IceCube Gen2 the ability to measure neutrino energies in excess of 10^{17} eV. Isolating a neutrino signature with that energy should be possible in IceCube Gen2 data, and it would be a world record breaking discovery. I can think of no better pathway to graduate school for Raymond than beginning his research into high-energy particle physics with IceCube. Please contact me with any questions you may have about the project. We are really excited to get started this Summer.

Sincerely,

Jordan C. Hanson

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