Stanford | Pre-Collegiate Studies

This certifies that Harry Van Der Ark has completed the 2019 Stanford Pre-Collegiate Summer Institutes course in

The Frontiers of Physics

from June 24 to July 12, 2019, at Stanford University. Harry's admission into the Summer Institutes, and his participation in and successful completion of the program, demonstrate a high level of academic ability and intellectual curiosity.

Course Description:

In this Frontiers of Physics course we covered many of the groundbreaking breakthroughs in physics during the early 20th century that led to the formulation of modern physics. Specifically we reviewed Einstein's Special and General Theory of Relativity, Quantum Mechanics, and Particle Physics. In Einstein's theory of relativity we mathematically proved concepts such as time dilation and the mass energy equivalence. We reviewed many thought experiments, and paradoxes such as the twin paradox and the barn-pole paradox, as well as their resolutions. In Quantum Mechanics we learned the historical experiments that led to this strange theory, including black body radiation and the photoelectric effect. We learned about quantized energy levels and studied wave phenomena to see how it applied later to matter in the Quantum world. We went as far as finding particular solutions to Schrödinger's equation and found the associated quantized energy levels.

This is an intensive and rigorous course. There were three projects and a presentation completed in the short span of three weeks. The projects were a scientific article on relativity, complete with diagrams and equations, a lab experiment to confirm the wave nature of light and a popular science style article for the layman on a topic in modern physics. In addition to the projects, students had problem sets to work on during their free moments in the daily study session. In this course students gained a conceptual and mathematical understanding of the theories in physics that changed the way we view the world.

Student Evaluation (from Instructor):

Harry has the distinction of being on the very short list of best students in his class. Harry was a pleasure to have in class this summer. All of his completed projects were top notch, he frequently participated in class, and he has a great personality, which only benefitted the atmosphere of the classroom environment.

Harry seemed to be a natural at completing each of the three scientific projects that are required to complete the course. Each project tests a different scientific skill, and Harry demonstrated a high level of scientific maturity to complete these projects rather naturally. The first project is designed for theoretical physicists. It involves creating a technical write-up of Einstein's time dilation. This tests students' ability to synthesize a mathematical derivation based on a thought experiment, and then to clearly explain it in detail to their reader. Harry's paper read very smoothly considering it is a difficult and technical topic to write about. While other students chose a large

font and double spacing, Harry confidently did not. The formatting he chose for his paper made it look mature and like an actual scientific article, which was the goal.

For the third project, students wrote a non-technical paper on a topic of their choosing outside of the core content of the course. The challenge of this paper is to explain far-fetched physics ideas in a way that the general masses can understand. Harry chose to write on a crucial piece of the Standard Model, the Higgs boson. From reading Harry's paper and watching his presentation I can tell he learned a lot about his topic. He wrote about a lot of information that did not come from the classes I taught. In his presentation he got to demonstrate his natural passion for the topic to the class, which he did enthusiastically. I had the feeling I was watching a young Brian Greene as Harry used hand gestures and emotive speaking to demonstrate his points. He really captured the essence of this project, by explaining his topic in a totally approachable and non-intimidating way.

Beyond all of the great work that Harry produced in the three weeks, he was also just a great student to have in class. He enjoyed what we were learning about, often provided good questions or productive feedback in class. Moreover, he was a genuine student, genuine to the other students in class, contributing to the overall positive atmosphere, and genuine to the class by not looking to cut corners.

I am really glad to have met Harry this summer and to have been his teacher in Frontiers of Physics. He made the class better for me and for the other students with his interests and the way he interacted with everyone in the program. I am glad to have been able to help him grow in his physics journey.

Sincerely,

Paul McCullough