

Statement of Purpose | Alex Dvornikov

alexdvornikov.github.io

"There are only two questions really worth asking. Why are we here? And what should we do about it while we are?" John Lloyd.

I have no idea why we are here. But I do know that I want to merge my backgrounds in astrophysics and particle physics to observe and model the universe. I am obsessed with physics and I want to infect the next generation. Ultimately, I want to be a professor.

I first forayed into particle physics at the University of California, San Diego. As an undergraduate, I worked with Professor Avi Yagil on top quark decays. The collimation of the outgoing particles depends directly on the top quark's speed. The faster it travels before it splits, the smaller the separation between the daughter particles. I used Monte Carlo simulations to check whether this collimation can shrink below experimental resolution for future, more energetic runs at the LHC. This project forced me to quickly absorb and implement prodigious heaps of information and undoubtedly stretched my mind.

Next year at San Francisco State University, I researched with Professor Jeff Greensite, a lattice theorist. Lattice theory, or the discretization of space, is an intriguing idea and I wanted to learn what it meant for the invisible substructure of matter. I picked up elements of both lattice and quantum field theory and worked with Professor Greensite on comparing the scaling of a pure $SU(3)$ Coulomb potential with asymptotic freedom. I moved to San Diego for family reasons and I regret not finishing but fortunately my current research is just as interesting.

At San Diego State University, I shifted my focus to cosmology. Presently, I am modeling neutrinos in the early universe with Professor Chad Kishimoto. Although I study at SDSU and Professor Kishimoto teaches at the University of San Diego, I read his papers and wanted to collaborate. Together, we are looking at how lepton asymmetry can produce sterile neutrinos. A sterile neutrino, if real, rewrites cosmology. It may fill in the gaps in our understanding of nucleosynthesis, dark matter, and structure formation. I will submit this work for my Masters Thesis and publish in spring.

I know that I have the grit for a Ph.D. I live and breathe physics and I cannot fathom any other occupation. Besides research, I have taken undergraduate and graduate classes on subjects ranging from astronomical techniques to string theory. I have observed supernovae at Mount Laguna Observatory, picked up several programming languages, and taught more than a dozen labs on electromagnetism, optics, atoms, and mechanics as a teaching assistant at San Francisco State University and San Diego State University. Currently, I am a lead TA at SDSU and in addition to teaching undergraduates, I set up and tinker with the equipment and train other teaching assistants. Periodically, I get emails from past students reminiscing about our class, thanking me for sharing my passion.

Thomas Edison once said, "We don't know one percent of one millionth about anything." What is matter? How does it form and clump into stars and galaxies? Is our mind just matter? Simply a chunk of neurons? True, we have only scratched the surface and we may never find out, but I cannot imagine a better job than searching for the answers.