# Student Profile: Khachatur Nazaryan, PhD Candidate

by Sandi Miller


Khachatur Nazaryan, PhD candidate

## PhD Candidate
## Theoretical Condensed Matter Physics (Fu Group)

Khachatur Nazaryan is a second-year doctoral candidate working with Prof. Liang Fu in the Condensed Matter Theory group at MIT. Born in Armenia, Khachatur earned his BS in applied physics and mathematics, with a specialization in theoretical physics, from the Moscow Institute of Physics and Technology (MIPT). Beyond physics, he is a classically trained pianist, enjoys participating in art classes, and dedicates his winter breaks to tutoring Armenian students at the American University of Armenia, via MIT's International Science and Technology Initiative (MISTI).

**Khachatur, what inspired you to study physics, and how did you eventually come to MIT?**

I grew up in a mid-sized village near Yerevan, the capital of Armenia, nestled in the beautiful Ararat valley. Surrounded by such natural beauty, art became an integral part of my life early on. My journey in the arts started in the first grade when I began studying piano, which I pursued for nine years. By eighth grade, I had taken up painting; my work caught the attention of professional artists who encouraged me to pursue education in the arts. During the same period, my interest in the natural sciences began to blossom. Achievements in middle school physics Olympiads spurred my focus on physics. The big question for me was: science or art? I eventually realized that physics is, in fact, a form of art. Just as an artist contemplates nature and creates a painting, a physicist

studies nature to unravel its laws. This realization clarified my path and deeply influenced my approach to science. Nevertheless, painting and piano remain central to my life, alongside science.

After high school, I enrolled at the MIPT, quickly rising to become the top student in my class. There I chose to specialize in condensed matter theory, captivated by its rigorous mathematical approach to understanding physical phenomena. My undergraduate years provided numerous opportunities to engage in research with leading professors, a rewarding experience that paved my way to MIT.

**Could you tell us about your volunteer work with Armenian students?**

Living abroad for my studies helped me to realize my deep connection to Armenia. I vividly recall counting down the days until I could return home during vacations. I seized every opportunity to teach local students, beginning with my university sending me to Armenia to prepare them for competitions and Olympiads.

Realizing that my admission to MIT involved not only hard work but also a measure of luck, I believe that once you reach a certain level in life, you should aim to be that factor of "luck" for others. This inspired me to get involved with the MISTI Global Teaching Labs (GTL) program, which collaborates with Armenia. Through this program, I have traveled to Armenia twice to teach local students, some of whom have been admitted to prestigious universities, including two to MIT. Beyond structured courses, I initiated simple research projects in physics for a few students, helping them learn new concepts and apply them to real world problems, thus giving them a glimpse into what research involves. Additionally, I purchased several laptops on eBay and gifted them as New Year's presents to children in my village during my last teaching visit. The joy and gratitude they expressed were profoundly moving.

The last few years have been particularly challenging for Armenia. Following several conflicts, about 120,000 people from border areas were displaced, many of them children and teenagers. To support their education, I and another Armenian student at MIT have been advocating to secure yearly access keys to 60 MIT courses for these refugee children. This would include courses in Python programming, physics, and others, aiming to provide at least some educational stability in their lives. Unfortunately, we have not yet been successful in this effort, but we hope to revisit the issue in the future.

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>
> —KHACHATUR NAZARYAN

**Could you describe your research focus in condensed matter theory with Professor Liang Fu?**

At MIT, I have the privilege of working with Prof. Liang Fu. Our initial project together revealed a novel superconducting state with partial spin polarization, induced by a magnetic field. We've termed this state a "magnonic superconductor." Unlike traditional superconductors, which are defined by a conventional pairing order parameter, this state is characterized by a composite order parameter that integrates electron pairs with magnons. This research is a significant stride toward unraveling the physics of high-temperature superconductivity, a pivotal challenge in modern science.