Meera Patel

PhD Application to Dr. Alfons Weber's DUNE group at PRISMA++, JGU Mainz

Dear Dr. Weber,

I am writing to apply for the PhD position on the DUNE experiment within your working group at JGU Mainz and PRISMA++. I am currently completing my Master's in Physics and Astronomy at the University of Amsterdam (UvA), working on my thesis at Nikhef on detector R&D for liquid noble gas TPCs under Dr. Tina Pollmann.

The physics goals of DUNE are what draw me most to this position. Probing CP violation in the lepton sector through precision neutrino oscillation measurements could help explain the matter-antimatter asymmetry in the universe, which I studied in my astroparticle physics coursework at UvA. Your trajectory from the first indications of CP violation at T2K to leading the near detector design for DUNE is one I find compelling, and the DUNE-PRISM concept for controlling systematic uncertainties through off-axis measurements is an elegant approach I want to work on. My experience in detector R&D, hardware design, and data analysis maps directly onto the position's goals of optimizing detector design and developing methods to measure cross sections and oscillation parameters. The broader PRISMA++ environment, with its connections to XENONnT, other neutrino experiments, and the detector development laboratory, would also allow me to draw on and contribute to a community whose research interests closely overlap with my own.

My research experience spans both analysis and hardware in large experimental collaborations. During my undergraduate at Boston University, I worked on the Fermilab g-2 experiment, developing particle extrapolation algorithms in C++ using CERN's GEANE package and ROOT. This work gave me a solid foundation in the analysis tools and collaborative workflows of large particle physics experiments. My current thesis work on the VULCAN experiment at Nikhef involves measuring photoluminescence properties of wavelength-shifting materials at VUV wavelengths, connected to liquid noble gas TPC experiments like XENONnT. I am leading the effort to install an optical chopper for time-resolving photoluminescence decay, which is integral to modelling its effects in direct detection experiments like XENONnT, as well as designing hardware upgrades including a new SiPM cooling system, and refactoring the analysis pipeline. I have learned to work with large datasets, think about how hardware choices affect data quality and analysis, and to design and execute improvements to both hardware and software. I also received the Olga Igonkina Foundation Travel Grant to conduct measurements complementary to my thesis in a liquid argon (LAr) setup at AstroCENT in Poland, giving me direct hands-on experience with LAr systems relevant to DUNE.

Working on VULCAN has taught me that I thrive when given independence within a supportive group. My supervisor entrusted me with designing and executing improvements on my own initiative during waiting periods for the main measurement, and I have found this kind of self-directed problem solving to be where I do my best work. I also enjoy the collaborative side; I regularly help officemates with CAD, programming questions, and the occasional integral check. I have also been supervising a bachelor's student who recently joined the VULCAN project, helping him get familiar with the setup and analysis. I look forward to continuing this balance of independent research and mentorship in a PhD.

Thank you for considering my application. I would be glad to discuss how my experience could contribute to your group's work on DUNE.

Sincerely,
Meera Patel