

Statement of purpose

"No one has ever been able to define the difference between interference and diffraction satisfactorily"-Richard P Feynman. The way physicist Richard Feynman approached physics has fascinated me ever since I started attending secondary school. His attitude towards problems of the world has struck me strongly. The Quantum properties and wave nature of light have interested me since its introduction to me. I desired as a school student to become a physicist who understands light and develops technology that will benefit human society. In my undergraduate studies, the experiments in the labs are something I enjoyed. I then desired to become an experimental physicist. Pursuing this PhD will make my dream come true.

In the year 2010, the Nobel prize was given for the discovery of graphene as a 2D material with unique physical properties by two scientists namely Andrew Geim and Konstantin Novoselov. This opened a new avenue for scientific exploration for other types of 2D materials beyond graphene due to the lack of bandgap in graphene which limits its application in emerging semiconductors. The National Graphene Institute at the University of Manchester is focused on this very particular research area and beyond graphene. This will give me a unique experience and the exposure that I will acquire in the elite institute.

At IIT Kharagpur, the Material Science Centre has a very active group in developing exotic 2D semiconducting heterostructures in their lab. Their recent papers on the subject helped me to understand that this field has opened a whole new area of research on which our future will be shaped. My brief visit to the lab was worthwhile. I got to know in gist about the instruments and the scope of the research that is awaiting me through this project. This research will open the doors to the development of new types of optoelectronic devices, such as high-performance lasers, quantum light-emitting diodes (LEDs), and single photon emitters, that rely on the coherent emission of quantum light. I am delighted to be a part of the project.

My Master's thesis on Terahertz Time Domain Spectroscopy (Thz-TDS) at IIT Kharagpur has helped me to explore lasers. I have taken courses like Physics of Photonics Devices and quantum and Photonic Quantum Information Technologies (ongoing). These courses have given me a solid foundation on the properties, structures, and working principles of photonic devices. These topics are quite closely related to the Joint Doctoral Programme (JDP) project, entitled "Design and Fabrication of 2D Heterostructures towards Coherent in-plane Quantum Light Emission and Optoelectronic Devices", and will help me in my future career in academia as a scientist or a professor. I have gained experience with handling optics to align lasers, set up laser cavities and interferometers (Michelson Interferometers and Fabry Perot), and operated nonlinear effects like second harmonic generation using a terahertz setup. I have also obtained material properties like absorption coefficients and refractive indices.

I have planned to do a summer internship at IIT KGP under the supervision of Prof Prasana Kumar Sahoo, the supervisor for the JDP at IIT KGP. With the help of my knowledge of (Thz-TDS), I will be able to better understand 2D heterostructures. This will give me a good experience before the start of the Joint Doctoral Programme.

I have a deep desire to explore and contribute to society as a scientist. This programme at both elite institutes will help me achieve my dream.