Priyaben Patel

In Summer of 2015, I carried out a research placement at Virginia Polytechnic Institute and State University as an Undergraduate Summer Aerospace Engineering Researcher. I worked on a project which involved simulating and investigating the motion of particles in a Hall thruster. This project contained theory from topics such as fluid dynamics, plasma physics and electromagnetism, thus I carried out **extra lessons provided by Virginia Tech professors in the above subjects**.

Through this placement I improved on many analytical, numerical and problem solving skills as I **learnt a new programming language (Matlab)** which proves to be invaluable time after time. I demonstrated perseverance and motivation by working on my project alone and managing to complete it in the given time. At the placement, **I participated in an outreach** program for a week, where interactive lessons were conducted for children from ages ranging from 3 to 16 years old. The lessons involved conducting experiments such as dry ice comets, making a battery powered motors, water rockets and mentos and coke cars. From this I gained insight in how to lesson plan, teach different ages and team work.

For most of the placement, I **worked alongside a research group** on my project where weekly meeting were held. These meetings taught me how to summarise progress and explaining the particulars of my project to an unfamiliar audience. This was followed by constructive criticism which I learned to incorporate into my project. At the end of the project **I wrote a detailed report on Latex**, containing the research I carried out and the results I found. Also, I participated in a **poster symposium** held at Virginia Tech for all summer research programs. Through this, I enhanced my written and oral skills especially when presenting scientific work to expert audiences.

In this project I learnt that, Hall thrusters are a form of ion thrusters; an ion thruster is used for spacecraft propulsion that creates thrust by accelerating ions. They are simple devices entailing of a cylindrical channel with an interior anode, a magnetic circuit that generates a primarily radial magnetic field across the channel, and a cathode external to the cylindrical channel. As part of the project, the following was examined; the necessity of a radial electric field to provide a centripetal force in order to insure that the electrons move circularly in the chamber and the definition of a spatially defined magnetic field. This was done by simulating the set up in cylindrical coordinates using Matlab. An examination of a spatially defined magnetic field and the impact of a radial electric field were conducted with a combination of a parametric model and a Boris particle mover. After application of the magnetic field, simple test examples were ran with varying initial conditions to gain insight into the operating conditions of a Hall thruster. By examining of the Lorentz force equation proved it was essential for a radial electric field to exist for a circular motion of the electrons. However, as the magnetic field is also defined as constant and purely radial, an error exists due to the violation of Gauss' Law of Magnetism. For a field that is defined as purely radial, but with a gradient in the radial direction, the magnetic field gradient caused variation in the Larmor radius, E-cross-B velocity, and gyro frequency in the radial direction. Thus a solenoidal magnetic field was placed in the set-up.