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# Apply Machine Learning to Particle Accelerators

**Keywords: Particle accelerator, machine learning**

Do you want to gain hands-on experience with the operation of a particle accelerator? Are you interested in using machine learning and analytical algorithms to solve real world problems? You can do these and more with this project! Particle accelerators are used by a wide range of applications from treatment of cancer to discovery of new science that revolutionize the world. Particle accelerators are complex machines with thousands of variables and subsystems that work together. Machine learning provides powerful techniques for solving complex problems by processing large amounts of data. There are many exciting opportunities for applying machine learning techniques to improve particle accelerators. The Australian Synchrotron is a world-class facility that is home to a 3 GeV electron accelerator. We are developing new ways that utilize machine learning to improve the operation of the current machine and the design for a new, next generation machine.

### **Student Opportunities:**

Several opportunities are available for students based on your interest.

1. Optics correction is a process to correct errors in the alignment and field strength of magnetic elements in particle accelerators. This project will develop ways to implement machine learning tools such as neural networks to improve the speed and accuracy of optics correction for current and future machines.
2. The next generation synchrotron requires strong, non-linear magnets that add complex perturbations to the behavior of the particle trajectory. This project will use machine learning techniques such as genetic algorithms to minimize the perturbative effects from non-linear magnets and improve the design for a new, next generation machine.
3. Faults can occur in various subsystems of the current machine that could lead to the machine going offline. This project will use machine learning techniques and our extensive archive of machine data to characterize key features that will be used to predict and diagnose machine faults.