

Oxford Physics Group Projects 2019 - 2020: Atomic Weapons Establishment (AWE)
GP_003

Project title	Pulse Correlation Reflectometry for measuring detonation velocity
Project type	Experimental
Company	AWE
Mentor	Dr James Ferguson
Local supervisor	TBC
Project description	<p>Pulse Correlation Reflectometry (PCR) is a technique based on time domain reflectometry (TDR), a technique used to measure the length of electrical cables and identify any faults along the cable. In PCR, only the round trip time for an electrical pulse to propagate the length of the cable, be reflected at the end, and return to the start is required. PCR requires a high repetition rate of pulses whereas this is not necessary in TDR.</p> <p>Measuring the lengths of electrical cables to high accuracy is essential in measurement systems where very short timescale events need to be recorded such as in a detector system on a particle accelerator. Furthermore, if an accurate distance measurement can be made at high repetition, a dynamic measurement of the length of a conductor being destroyed at a rapid rate may be made. This could potentially be applied to study detonation of explosives by dynamically measuring the length of a conductor in contact with the explosive.</p>

For this work we would like you to build a PCR system from readily available laboratory equipment (essentially a function generator, cables, connectors and an oscilloscope) and determine the accuracy by which a cable length can be measured. With a knowledge of electrical theory, you can then explain the operation of the instrument you have built and determine what improvements to the instrumentation can be made and how measurement error could be reduced.

The goal of the project would be to determine if a PCR system, based on relatively standard laboratory equipment, could be used to determine physical properties of detonating explosives, in particular the velocity of the detonation wave through the material.