

## **Summer Research Project 2010**

### **Pulsed NMR studies of Rare-Earth intermetallic compounds**

**Professor Seán Cadogan**

Intermetallic compounds formed between Rare-Earth (R) and Transition-Metal (T) elements are important from both fundamental and applied viewpoints. They allow us to study the interplay between the localized 4f electrons of the R atom and the delocalized 3d electrons of the T atoms. The magnetic structures formed by such compounds are the result of the intrinsic magnetic exchange and crystal-field interactions and in many cases the magnetic structure changes as one cools a sample or applies a magnetic field, due to the competition between these fundamental interactions. From an applied viewpoint, R-T intermetallics are the basis for the world's strongest permanent-magnets and will provide the next generation of refrigeration materials in the not too distant future.

We have recently taken delivery of a pulsed NMR spectrometer, probe and cryogenic system which will enable us to carry out NMR studies of the hyperfine interactions at a number of key nuclei in R-T intermetallics. Unlike the usual NMR experiments one sees in Chemistry and Biosciences laboratories, which involve large superconducting magnets, we carry out our NMR work in zero applied field – the hyperfine magnetic field at the nuclei under investigation provide the field necessary to observe NMR.

This project involves the optimization of the pulsed NMR spectrometer for studies of R-T intermetallics at low temperatures (below 20 K) and would suit someone who is very 'hands-on' and likes experimental work. Once the spectrometer and cryogenics are working properly, the student will have the opportunity to prepare samples using our arc-furnace, characterise these samples using x-ray powder diffraction and then carry out the low-temperature NMR measurements of the fundamental magnetic dipole and electric quadrupole interactions in a variety of intermetallic systems.

Contact: [cadogan@physics.umanitoba.ca](mailto:cadogan@physics.umanitoba.ca). 311 Allen Building. Extn 6195