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Title:	Variable temperature Magnetic Force Microscopy studies of Ferromagnetic Crystals, Films and Nanoislands
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Abstract:	This thesis consists of two parts. The first part consists of low temperature MFM studies of Co ₃ Sn ₂ S ₂ , a Weyl semimetal that is also a ferromagnet with Curie temperature around 180K. Available literature indicates that this phase transition possibly occurs through an intermediate phase, often called an Anomalous phase or 'A phase' whose nature is unknown. We have attempted to study this phase using MFM. The second part focusses on optimising the procedure to fabricate and study a Superconductor-ASI device. This device consisting of nanoislands of a ferromagnet (Permalloy) that acts as Artificial Spin Ice (ASI) to be constructed on top of a layer of superconducting film (NbN). Spin ice is a term used to refer to a system of magnetic spins whose magnetic dipole moments shows some properties analogous to the electric dipole moments in ice crystal (Solid H ₂ O). Despite the availability of real materials that show spin ice behaviour, it is not possible to easily probe every individual spin in a crystal lattice and truly understand the consequence of geometric frustration. So, there have been attempts to artificially construct a lattice of ferro magnetic nanoislands that are arranged in a geometry that mimics the properties of spin ice. These are called ASI systems. We have grown Permalloy and NbN thin films and studied them using AFM. We have also attempted to make ASI device using Electron Beam Lithography.
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