High Pressure Magnetic Measurements of 2H-$NbSe_2$

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With superconductivity often found in the vicinity of ordered states such as charge density waves (CDW) and antiferromagnetism, the ability to tune materials through these states serves as a vital tool in exploring the interplay of these phases with superconductivity. For characterizing a given superconductor, magnetic measurements provide a non-invasive method of measuring critical temperatures and fields, and thus deducing key parameters of the superconducting state, such as the coherence length and London penetration depth.

High pressures serve as an avenue to continuously and systematically tune across many of these phases in a single high purity sample. As such, the application of pressure provides a method to both access novel structures not available at ambient pressure, and to explore the competition between phases such as the CDW and superconducting order. Here, we present pressure cell technology compatible with commercial SQUID magnetometers, in both piston cylinder and gemstone anvil type cells. We include our results on 2H-$NbSe_2$, where CDW order is suppressed around 5 GPa, whilst superconductivity is enhanced under pressure.

Here, we use the aforementioned pressure cells for magnetic susceptibility measurements, mapping the behaviour of both $T_c(P)$ and the evolution of critical fields in 2H-$NbSe_2$ with temperature and pressure. Tc(P) is seen to vary for different pressure media and is discussed within scenarios relating to both quantum critical enhancement of superconductivity, along with alternative theories.

With previous evidence of multiband superconductivity [1], the critical fields are analysed within a two-band model to provide magnitudes for the superconducting gaps on each of the main Fermi sheets.

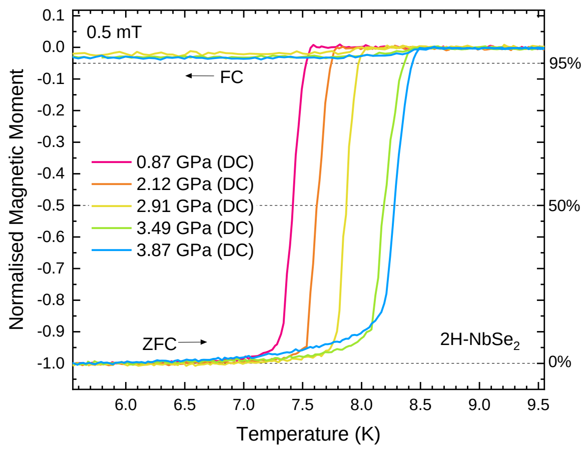

Figure 1. M(T) sweeps for 2H-$NbSe_2$ in the Magnetic Property Measurement System (MPMS) compatible gemstone anvil cell.

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