THE MAGNETIC FIELD DEPENDENCE OF NARROW BAND NOISE IN THE CHARGE DENSITY WAVE MATERIAL $Per_2Pt(mnt)_2$.

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Introduction

"Perhaps the most spectacular measurement of a Charge Density Wave (CDW) material is the detection of current oscillations in the nonlinear conductivity region"- G Gruner [1]. This phenomenon, referred to as narrow band noise, originates from the coherent motion of the CDW condensate: in the nonlinear transport regime the CDW depins, allowing a current to flow and dissipate the driving electric field. This drop in electric field in turn causes the CDW to repin until the potential is reestablished. For a commensurate CDW, the distance traveled between depinning and repining is an integer number of unit cell lengths, so that the current-frequency dependence of the oscillations is only determined by the CDW wavelength and the number density of carriers in the CDW condensate [1]. Here we report the observation of this phenomenon in the CDW material $Per_2Au(mnt)_2$ and use it as a measure of the CDW condensate fraction as the Pauli paramagnetic limit is approached.

Experimental

For the frequency of the narrow band noise to exhibit a linear dependence upon sample current, the CDW must be fully gapped and the measurement must be made at a temperature significantly lower than the CDW transition temperature so as to freeze out parallel conduction via thermally-excited carriers. In order to ensure this, the high field measurements were made using the portable dilution refrigerator and the hybrid magnet. To avoid rapid changes in the torque experienced by the sample at high field the I/V characteristics were measured using direct current whilst the spontaneous RF noise was observed between the voltage contacts.

Results and Discussion

The frequency of first harmonic of the narrow band noise exhibits a linear dependence upon the sample current in accordance with theory [1] (see Figure 1a). For a given sample current the frequency of spontaneous narrow band is observed to diverge as the magnetic field approaches the Pauli paramagnetic limit (≈21 T). Assuming that the periodicity of the CDW remains commensurate with the lattice in this low field regime, the divergence in frequency must correspond to a reduction of the CDW condensate fraction as the gap closes, (see Figure 1c).

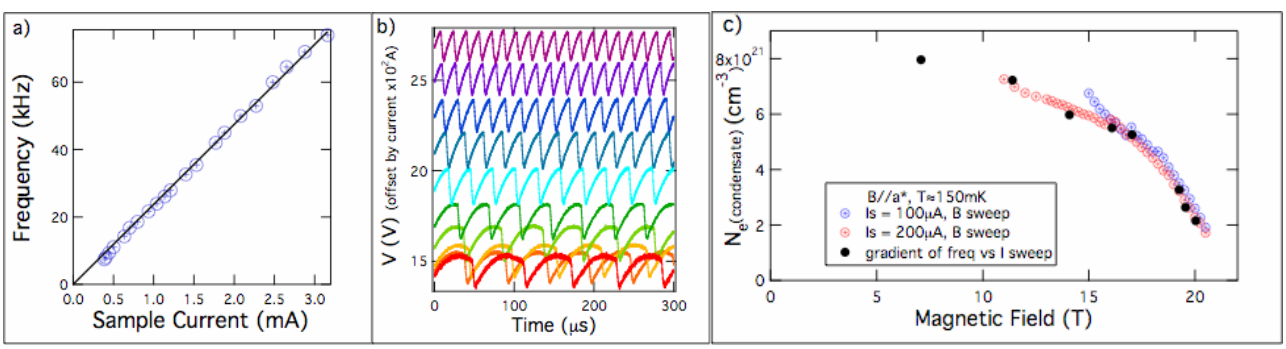

Figure 1a: the linear dependence of the narrow band noise frequency upon sample current measured at zero field and 1.9K, **b:** typical spontaneous voltage oscillations also recorded at zero field and 1.9K, **c:** the magnetic field dependence of the number of electrons in the CDW condensate, the current density is calculated assuming a the cross-section of the sample is 100x100μm.

Conclusions

This is further evidence of the form of magnetic field dependence of the CDW gap in $Per_2Pt(mnt)_2$ as the Pauli paramagnetic limit is approached [2].

References

[1] Gruner G. Rev. Mod. Phys., **60**, 1129-1181 (1988).
[2] McDonald R.D. Phys. Rev. Lett. **93**, 076405 (2004).