Quantum Oscillations in $EuFe_2As_2$ Single Crystals

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Introduction

The Fe-based superconductors (SC) are a subject of intense investigations since their discovery [1]. Although they all present a common structural element, the FeAs layers, there is a variety of dissimilarities in their physical properties, such as magnetic ordered moments, effective masses, SC gaps and the T_c [2]. A deep understanding of such differences is still a central open question. Thus, it becomes essential to unveil the Fermi surface (FS) properties, which in turn governs the structure of the magnetic fluctuations in momentum space. Low temperature quantum oscillations (QO) experiments have been reported on several members of the 122 family AFe_2As_2 (A = Ba, Ca, Sr) [3]. However, to date, no QO data have been reported for the Eu-member.

Experimental

We report a Shubnikov de-Haas (SdH) study of high quality $EuFe_2As_2$ single crystals (RRR = 25) grown by In-flux, as described elsewhere [4]. The in-plane resistivity ($\rho_{ab}(T)$) was measured using a standard four-probe method inside a He3 cryostat. Magnetic fields up to 35 T (Cell 12) and 45 T (Hybrid) were applied at the National High Magnetic Field Laboratory, Tallahassee.

Results and Discussion

Fig. 1 shows the background (a smooth 4th order polynomial) subtracted $\rho_{ab}(T)$ at 0.3 K as a function magnetic field at two different angles. As a result, QO are successfully observed above ~ 15 T and clearly display an anisotropic behavior. Seven peaks can be identified at θ = 25°, the first five being close to the ones previously identified in other members (A = Ba, Sr).

A comparison with In-grown $BaFe_2As_2$ effective masses reveal that m* is systematically larger for $EuFe_2As_2$, indicating a higher degree of correlation in the latter.

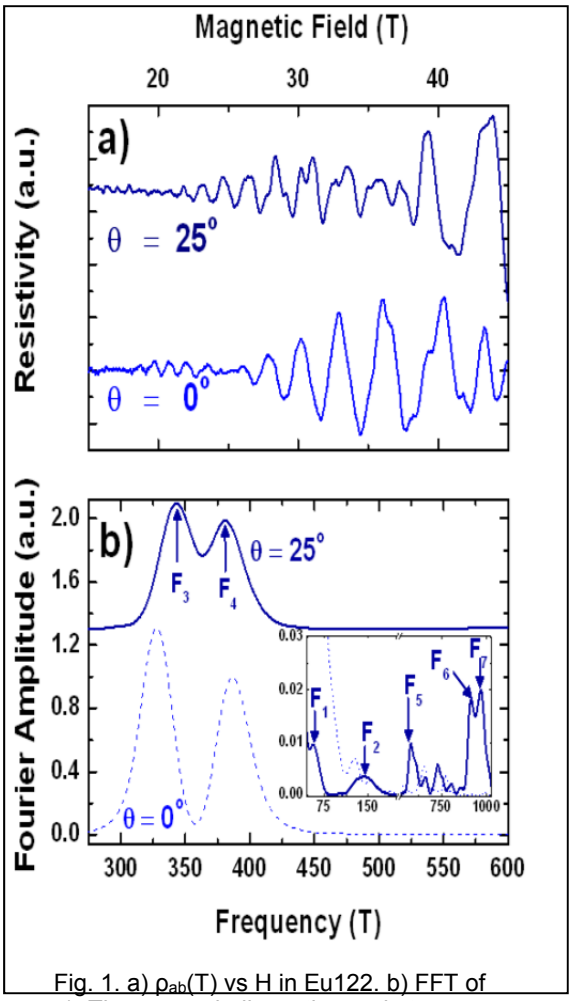

Fig. 1. a) $\rho_{ab}(T)$ vs H in Eu122. b) FFT of a). The arrows indicate the pocket frequencies

Conclusions

We have measured quantum oscillations in the electrical resistivity of $EuFe_2As_2$ high quality single crystals. We found seven small pockets, five of each (Fγ = 60(10) T, Fβ = 150(10) T, Fα1 = 340(10) T, Fα2= 380(10)$ T, Fδ = 580(10) T) are in agreement with previous studies in $BaFe_2As_2$ and $SrFe_2As_2$.

Our results show that the effective masses for $EuFe_2As_2$ are systematically larger than in the $BaFe_2As_2$ member, indicating that the former is more correlated than the latter. Two new higher frequency splitted pockets are observed at 910(10) T and 980(10) T and may be related to a magnetic breakdown.

Acknowledgements

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