Fermi surface investigations of pyrochlore iridates

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Introduction

The family of $Ln_2Ir_2O_7$ pyrochlore iridates (*Ln* = Nd–Ho) exhibits a metal-to-insulator transition at a critical temperature T_{MI} accompanied by magnetic ordering, see **Fig. 1**. Due to their lattice structure, which is composed of connected tetrahedra, the $Ln_2Ir_2O_7$ compounds can host different configurations of magnetic frustration that may lead to novel electronic states such as a topological band structure or Weyl semimetal behavior [1].

Experimental

Single crystals of the *Ln* = Nd member of the family and of $Pr_2Ir_2O_7$ which does not show MIT but is placed close to the critical point in **Fig. 1** were prepared. In addition, we investigated single crystals of the related compound $Bi_2Ir_2O_7$. All these materials grow in the form of truncated octahedra with an edge length of 200-300 µm. Preliminary measurements have confirmed the excellent quality of our samples and shown accordance with previously published results. A range of techniques were employed to look for quantum oscillations, in particular experiments using compensated-coil magnetometry, electric transport, magnetic torque and contactless conductivity by the PDO method. The measurements took place at the NHMFL-LANL in a 65 T short-pulse magnet equipped with a ^{3}He system. Due to the small dimensions of the single crystals and the subsequent small signals, several datasets were collected to allow for averaging and, where possible, measurements were performed on a number of different crystals or stacks of crystals as in the case of compensated-coil magnetometry (see **Fig. 2**).

Results and Discussion

Despite extensive measurements on several crystals with a variety of experimental techniques, no quantum oscillations could be detected in the signals. Data obtained at the same temperature was averaged over several pulses but no oscillatory signal emerged.

Conclusions

The experimental determination of the Fermi surface characteristics of the pyrochlore iridates remains a challenging task. We will continue to work on the growth of larger high-quality single crystals that will help to pursue the work on resolving the band structure of these materials.

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References

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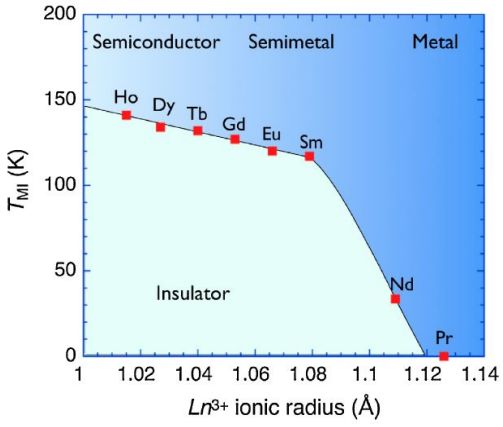

Fig.1 Phase diagram of $Ln_2Ir_2O_7$. T_{MI} is suppressed with increasing ionic radius of *Ln*. Figure taken from [2].

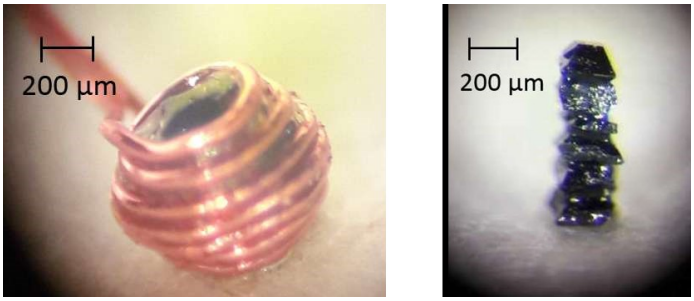

Fig.2 $Pr_2Ir_2O_7$ crystal in PDO coil (left) and stack of $Nd_2Ir_2O_7$ crystals (right).