Quantum Oscillations in Pr-based 1-2-20s: $PrNi_2Cd_{20}$ and $PrPd_2Cd_{20}$

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Introduction

We set out to study members of the RT_2X_{20} class of compounds, where R is a rare earth element, T is a transition metal, and X is a simple metal like Zn, Al, or Cd. The RT_2X_{20} compounds have a crystal structure that features two caged ions on both the R and T sites, which are *f*-electron rare earth and *d*-electron transition metal sites, respectively. Both rare earth *f*-electron materials and transition metal *d*-electron materials have been studied in searching for novel physics, and the RT_2X_{20} systems provide an opportunity to study the interplay of the behavior of both *f* - and *d*-electrons in these systems. The PrT_2X_{20} compounds are of interest, in particular, because many of these compounds exhibit quadrupolar order of some kind [1]. Our lab discovered a new class of RT_2X_{20} compounds where X = Cd [2]. We have characterized the material properties of $PrNi_2Cd_{20}$ and $PrPd_2Cd_{20}$, including performing de Haas Shubnikov oscillation measurements. The goal of our recent measurements was to complete these measurements to get a full picture of the de Haas Shubnikov oscillations as a function of orientation.

Experimental

We prepared single crystals of $PrNi_2Cd_{20}$ and $PrPd_2Cd_{20}$ which we studied using the 60T pulsed magnet at Los Alamos National Laboratory NHMFL. Using a Proximity Detector Oscillator setup, we measured de Haas Shubnikov oscillations as a function of angle.

Results and Discussion

With these most recent measurements, we believe we have managed to complete our measurements of the de Haas Shubnikov oscillations in these materials and are in the process of comparing them to theoretical results. This research has been presented previously, in an incomplete form, at the APS March Meeting 2018 as an oral presentation [3], and as a poster at the 2018 J-Physics International Workshop and Summer School. Example oscillations from these most recent measurements can be seen in **Fig 1**.

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References

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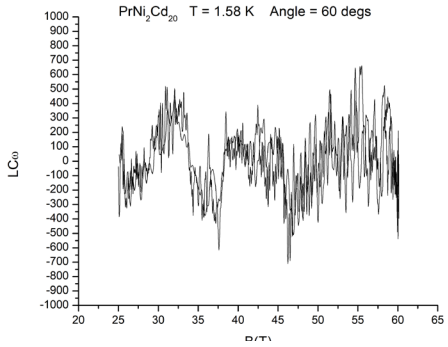

Fig.1 Quantum oscillations in de Haas Shubnikov measurements at 1.6 K for a single crystal of $PrNi_2Cd_{20}$.