Stephen Dugdale

The Fermi surface of PdCrO₂



Wigner 111, Budapest, Nov. 12th 2013

Outline

- Introduction to PdCrO₂
- Fermi surface measurement by Compton scattering
- Short-range magnetic order above T_N



PdCrO₂



Sample #1



"2D TL-AF"



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isotropic Curie-Weiss





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Paramagnetic calculation with spin-orbit coupling added in second-variational step





Paramagnetic calculation with spin-orbit coupling added in second-variational step













Measuring a Compton profile





Cauchois-type spectrometer on beamline BL08W

Tomographic reconstruction

 $J(p_z) = \int \int \rho(p_x, p_y, p_z) dp_x dp_y$





University of Measurement of photon energy distribution gives projection of BRISTOL momentum distribution along scattering vector

$$\rho(\mathbf{p}) = \sum_{\text{occ.}\mathbf{k},j} |\int d\mathbf{r} \psi_{\mathbf{k},j}(\mathbf{r}) \exp(-i\mathbf{p}.\mathbf{r})|^2,$$

$$= \sum_{j,\text{occ.k,}\mathbf{G}} |B_j(\mathbf{k}+\mathbf{G})|^2 \delta(\mathbf{p}-\mathbf{k}-\mathbf{G}),$$







T=300K











$$\rho(\mathbf{p}) = \sum_{\text{occ.}\mathbf{k},j} |\int d\mathbf{r} \psi_{\mathbf{k},j}(\mathbf{r}) \exp(-i\mathbf{p}.\mathbf{r})|^2,$$

$$= \sum_{j,\text{occ.}\mathbf{k},\mathbf{G}} |B_j(\mathbf{k}+\mathbf{G})|^2 \delta(\mathbf{p}-\mathbf{k}-\mathbf{G}),$$



$$\sum_{\mathbf{G}'} \sum_{\text{occ.}\mathbf{k},\mathbf{G},j} |B_j(\mathbf{k}+\mathbf{G})|^2 \delta(\mathbf{p}-\mathbf{k}-\mathbf{G}+\mathbf{G}').$$

 $\sum_{\mathbf{G}'} \rho(\mathbf{p} + \mathbf{G}') =$

$$\sum_{\mathbf{G}''}\sum_{\text{occ.}\mathbf{k},\mathbf{G},j}|B_j(\mathbf{k}+\mathbf{G})|^2\delta(\mathbf{p}-\mathbf{k}-\mathbf{G}'').$$

$$\rho(\mathbf{k}) = \sum_{i} n^{j}(\mathbf{k})$$













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Single crystal



38.5K







Summary

- We have measured the paramagnetic
 Fermi surface of
 PdCrO₂ by Compton scattering
- There is clear evidence of shortrange magnetic order which persists above T_N
- Crystal is different from powder!



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