



## Glenn T. Seaborg Center Seminar

### **PuCoGa<sub>5</sub>: Dazed and confused superconducting 5f electrons?**

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The discovery of superconductivity in PuCoGa<sub>5</sub> with a transition temperature of  $T_c = 18.5$  K has generated renewed interest in Pu-based intermetallic compounds [1]. The Pu 5f electrons appear to be neither fully localized nor fully itinerant [2]; elements of both kinds of behavior manifest themselves in such properties as an effective magnetic moment  $\mu_{\text{eff}} = 0.7 \mu_B$ , close to that expected for localized Pu<sup>3+</sup> (0.84  $\mu_B$ ) and an enhanced electronic specific heat coefficient  $\gamma \sim 100$  mJ/mol-K<sup>2</sup> consistent with moderately heavy fermion behavior. Recent nuclear magnetic resonance measurements [3] provide strong evidence for unconventional *d*-wave superconductivity that is mediated by magnetic (spin) fluctuations rather than by phonons in the case of conventional superconductors such as Al. In addition, these NMR measurements reveal a characteristic energy scale in PuCoGa<sub>5</sub> that is intermediate between two other classes of unconventional superconductors, the Ce- and U-based heavy-fermions and high- $T_c$  cuprates. These results are taken as evidence that there exists a continuum of energy scales within this mechanism of magnetically mediated superconductivity over three orders of magnitude, from millikelvins to  $\sim 100$  K, suggesting that novel superconducting materials with transition temperatures greater than 100 K may yet be discovered. In this talk, I will describe the remarkable properties of PuCoGa<sub>5</sub>.

[1] J. L. Sarrao et al., *Nature* **420**, 297 (2002).

[2] J. J. Joyce et al., *Phys. Rev. Lett.* **91**, 176401 (2003).

[3] N. J. Curro et al., *Nature* **434**, 622 (2005).