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Probing the Nature of Superconductivity in the Heavy Fermion $PuMGa_5$ and $PuMIn_5$ (M=Co, Rh) Compounds[1] ERIC BAUER, PAUL TOBASH, JEREMY MITCHELL, JOE THOMPSON, Los Alamos National Laboratory — The discovery of superconductivity in $PuCoGa_5$ with a $T_c = 18.5$ K has generated renewed interest in Pu-based compounds. $PuCoGa_5$, and its superconducting cousin $PuRhGa_5$ ($T_c = 8.7$ K), have the same crystal structure as the tetragonal $CeMIn_5$ (T=Co, Rh, Ir) heavy fermion superconductors, suggesting that the structure plays a key role in generating superconductivity in these materials. While a variety of measurements have firmly established that the $CeTIn_5$ compounds are unconventional *d*-wave superconductors, most probably mediated by antiferromagnetic spin fluctuations, it is less clear what drives the high transition temperature in $PuCoGa_5$, which is an order of magnitude larger than all other know Ce- or U-based heavy fermion superconductors. The physical properties of two new members of this "115" family of superconductors, $PuRhIn_5$ and $PuCoIn_5$, indicate that they reside close to an antiferromagnetic quantum critical point, while the smaller effective masses and much smaller unit cell volumes of $PuCoGa_5$ and $PuRhGa_5$ suggest that they may be near a T=0 valence instability or that the Pu 5f electrons couple to conduction electrons in multiple channels to form "composite" superconducting pairs. The nature of superconductivity in these four Pu115 materials will be discussed.

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