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Tuning the electronic state in $CeCu_2Si_2$: Si $\rightarrow$ P substitution YOU LAI, SCOTT SAUNDERS, ANDREW GALLAGHER, KUAN WEN CHEN, SHENGZHI ZHANG, LUCAS NELSON, DAVID GRAF, FUMITAKE KAMETANI, ARKADY SHEKHTER, RYAN BAUMBACH, FSU-NHMFL — The chemical substitution series $CeCu_2Si_{2-x}Ge_x$ hosts two distinct superconducting regions that are accessed under applied pressure. The first of these surrounds an antiferromagnetic quantum critical point, while the second does not appear to be associated with the zero-temperature collapse a line of phase transitions. It has been speculated that the second superconducting dome encompasses a quantum phase transition that is associated with a Ce $4f$-electron valence collapse, but this has yet to be established. We report a study of the chemical substitution series $CeCu_2Si_{2-x}P_x$ for $x \leq 0.2$, which may expose a new dimension for investigation of quantum valence transitions. This ligand site tuning strategy has the advantage that it changes the number of s/p electrons without strongly modifying other important variables such as the strength of Coulomb, spin orbit, crystal electric field interactions, and the hybridization between f- and conduction electrons. We find that the superconductivity is rapidly suppressed and is replaced by strengthening antiferromagnetism with increasing x.An unexpected additional hysteretic phase transition (V) appears at temperatures below the antiferromagnetic ordering temperature for $x \geq 0.13$, which shows several characteristics of Ce valence physics. We will discuss this $T - x$ phase diagram and consider implications for understanding the proposed valence instability region of $CeCu_2Si_{2-x}Ge_x$ alloys at high pressure.

You Lai
FSU-NHMFL

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