

Chez Pierre

Presents ...

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Special Chez Pierre Seminar

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“Charge- $4e$ and charge- $6e$ superconductivity in kagome superconductor CsV_3Sb_5 “

Since its discovery more than one century ago, superconductivity has always played an important role in the physical sciences. Despite of the various forms of superconductivity, conventional or unconventional, topologically trivial or nontrivial, the condensation of charge- $2e$ Cooper pairs has remained the origin and character of all superconductivity, as described by the BCS theory. We

report our experimental discoveries of the charge- $4e$ and charge- $6e$ superconductivity in nanopatterned ring devices fabricated using the new kagome superconductor CsV_3Sb_5 , which has been revealed by STM to have a pair density wave (PDW) ground state. These new macroscopic phase coherent states are discovered by the observation of the quantized magnetic flux in units of $h/4e$ and $h/6e$ in systematic magneto-transport measurements, revealing the condensate of bound states of four and six electrons. Specifically, we study the temperature evolution of the magneto-resistance below the onset temperature for superconductivity. At the lowest temperatures, we observe quantum oscillations with period of $h/2e$, expected for a superconducting condensate of charge- $2e$ Cooper pairs; increasing the temperature, these charge- $2e$ oscillations are suppressed and novel magnetoresistance charge- $4e$ oscillations with $h/4e$ periodicity are observed, indicating the existence of charge- $4e$ superconductivity; suppressing the charge- $4e$ oscillations by further increasing the temperature, charge- $6e$ oscillations with $h/6e$ periodicity emerge with the charge- $6e$ superconductivity. Our observations provide direct experimental evidence for the existence of macroscopic phase coherent paired quantum matter beyond the charge- $2e$ superconductors, and provide ground work for exploring the physical properties of the charge- $4e$ and charge- $6e$ superconductivity as unprecedented phases of matter beyond the condensation of Cooper pairs described by the BCS theory.

Reference:

Jun Ge, Pinyuan Wang, Ying Xing, Qiangwei Yin, Hechang Lei, Ziqiang Wang, Jian Wang, Discovery of charge- $4e$ and charge- $6e$ superconductivity in kagome superconductor CsV_3Sb_5 , arXiv: 2201.10352