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Complex nature of charge order and superconductivity interplay in correlated kagome superconductor CsV_3Sb_5

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Recent family of Kagome superconductors AV3Sb5 (A = Rb, K, Cs) offers a natural playground to study the interplay between different electronic states such as non-trivial chiral charge order (CO) and unconventional superconductivity [1-5]. This is because of its unique crystal structure that results in flat bands across the Brillouin zone, crossing of linear bands at K-corner, appearance of van Hove singularities at M-edges of the Brillouin zone. CsV3Sb5 is of particular interest compared to Rb and K counterparts due to distinct M-dome shaped two peak behaviors in its superconducting transition temperature Tc vs. pressure phase diagram. The phase diagram is however drawn through transport measurements accessing only macroscopic nature of interplay between CO and SC [6]. Thus, microscopic nature and theoretical understanding of their correlation remains unanswered. We have carried out muon spin relaxation/rotation (μSR) experiments under hydrostatic pressure up to 1.9 GPa. Nearly threefold enhancement in Tc and superfluid density ns at 1.74 GPa compared to their respective ambient pressure values has been observed. Interestingly, ns also displays two peak like feature with pressure. Three different regions of phase diagram manifest distinct linear relationship between Tc and ns. The μSR results and DFT calculations conjointly suggest possible evolution of CO from a superimposed tri-hexagonal Star-of-David phase at low pressures to the staggered tri-hexagonal phase at intermediate pressures [7]. Our studies thus uncover different regions of phase diagram with CO showing varying degree of interplay with SC.

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