Cooling quasiparticles in A_3C_{60} fullerides by excitonic mid-infrared absorption

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A fresh inroad in the ever-surprising physics of alkali-doped fullerides has been the behavior under intense infrared (IR) impulse excitation. Signatures attributable to a transient superconducting state extending up to temperatures ten times higher than the equilibrium $T_c \sim 20K$ have been discovered [1] in K_3C_{60} after ultra-short pulsed IR irradiation. Motivated by the observation that the phenomenon is observed in a broad pumping frequency range that coincides with the mid-infrared electronic absorption peak still of unclear origin, we advance here a radically new mechanism [2]. First, we argue that this broad absorption peak represents a "super-exciton" involving the promotion of one electron from the t_{1u} half-filled state to a higher-energy empty t_{1g} state, dramatically lowered in energy by the large dipole-dipole interaction acting in conjunction with the Jahn-Teller. Both long-lived and entropy-rich because they are triplets, the IR-induced excitons act as a sort of cooling mechanism by absorbing thermally excited quasiparticle-quasihole spin-triplet excitations, which permits transient superconductive signals to persist up to much larger temperatures.

References

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