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**A study of momentum entanglement and negativity in Bardeen-Cooper-Schrieffer states at finite temperature** CHUN KIT CHUNG, CHI KWONG LAW, Department of Physics and Institute of Theoretical Physics, The Chinese University of Hong Kong, Shatin, Hong Kong SAR, China — We study the momentum entanglement between the spin-up and spin- down particles of the homogeneous Bardeen-Cooper-Schrieffer (BCS) state at finite temperature. To achieve this, we construct from the BCS state the partial transposition $\rho_2^{\mathrm{T_A}}$ of the two particle density matrix in momentum space. The structure of $\rho_2^{\mathrm{T_A}}$ and its corresponding negativity $\mathcal{N}_2$ are examined. We show that $\rho_2^{\mathrm{T_A}}$ consists of infinitely many decoupled $2\times 2$ submatrices, and momentum entanglement coexists with the pairing order parameter $\Delta$. It is found that pairs with momenta slightly above a surface related to the Fermi energy contribute this entanglement most significantly. We propose an entanglement witness operator as a measurable quantity to detect momentum entanglement in BCS states.

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