LOCAL AND ENTANGLEMENT ENTROPY OF THE IDEAL FERMI GAS

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The ideal Fermi gas was created in 1926 by Enrico Fermi (1901-1954) as a quantum version of the (ideal) Maxwell-Boltzmann gas of non-interacting particles in Euclidean space by taking into account the Pauli exclusion principle. This requires that two indistinguishable particles cannot be simultaneously in the same one-particle state. The emerging many-particle correlations or entanglement dominate at low temperatures and have led to the early spectacular succeses of the ideal Fermi gas in explaining properties of metals and white dwarfs. In recent years it has turned out that a simple but useful quantifier of the spatial entanglement present in a given many-partice state is related to the (von Neumann) entropies of the two local substates associated with a bounded spatial subregion and its complement. The resulting spatial entanglement entropy (EE) can then be used, for example, to detect the appearance of long-range correlations by enlarging the subregion. For the ideal Fermi gas in thermal equlibrium the leading asymptotic growth of the EE is presented and discussed. The talk is based on joint work with A. V. Sobolev and W. Spitzer.