SUPERFLUIDITY IN CONDENSED EXCITONS BELOW 20 K

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9.7 cm

In superconductivity the electrical conductivity is diverging at the critical temperature, in superfluidity the heat conductivity is diverging. Therefore, the measurement of heat conductivity and thermal diffusivity is giving the essential information if superfluidity occurs. Superfluidity needs a "fluid" to start with and in a solid this means a condensed state of bosons. Such bosons are Coulomb coupled electron-hole states, excitons, which can condense. In materials, which exhibit intermediate valence, 4f holes can be very heavy with masses around $100\,m_e$ and, nevertheless, the compounds can be narrow gap semiconductors. Such a material is $TmSe_{0.45}Te_{0.55}$ and its thermal properties have been measured as function of temperature (4 K) and pressure (17 kbar). Below 20 K the heat conductivity and the thermal diffusivity diverge exponentially with decreasing temperature, being indicative of superfluidity. Above this temperature the condensed excitons can order in a Wigner lattice, couple to phonons, and thus, creating exciton-polarons with very anomalous specific heat and sound velocities with a special dispersion. For the first time stable exciton condensation with permanent superfluidity has been observed.

13.4 cm

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1. Correlated Electrons and High Temperature Superconductors

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