

Advances in superfluid helium cooling for superconducting applications

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Superfluid helium (He II) is used in many superconducting applications with the largest being particle physics accelerators and high field superconducting magnets. In these systems, He II enables higher performance by its lower base temperature ($T < 2.2$ K) and its unique heat transport properties. In the latter case, heat is carried in He II by thermal counterflow, which involves the relative motion of two fluid components. The normal fluid component carries the entropy away from the heat source and the superfluid component flows in opposition to conserve fluid mass and momentum. This mechanism leads to an effective thermal conductivity for He II many orders of magnitude larger than that of classical fluids. It also allows for rapid propagation of intense heat pulses. The talk will begin with a discussion of the challenges associated with cooling large scale superconducting systems with He II. We will then turn to a review of the relevant He II heat transport properties. Finally, we will present some recent work on flow visualization of He II heat and mass transport and how the insight gained could benefit development of future superconducting systems.