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Superfluid and quantum turbulence in porous media

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Below 2.17 K, helium no longer behaves as a classical fluid: it has almost no viscosity and a high effective thermal conductivity that is used to cool superconducting devices such as the Large Hadron Collider's magnets. Beyond a critical velocity, quantum turbulence arises and complex flow patterns appear.

We developed a numerical tool to simulate helium superfluid flow in porous media at the pore-scale. We were able to reproduce and explain, for the first time, interesting and unexpected experimental observations about thermal counterflow of He II past a cylinder reported ten years ago. Eddies are generated through a complex transient process that involves the friction of the normal fluid species with the solid walls and the mutual friction between the superfluid and normal species. The vortices remain in single pores and eddies spanning over several pores are not observed suggesting that a Darcy-Forchheimer type law can be used to model quantum turbulence in porous media.

References

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