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Microscopic Approach to Viscosities in Superfluid Fermi Gases: From BCS to BEC PETER SCHERPELZ, HAO GUO, DAN WULIN, James Franck Institute and Department of Physics, University of Chicago, CHIH-CHUN CHIEN, Los Alamos National Laboratory, KATHRYN LEVIN, James Franck Institute and Department of Physics, University of Chicago — We compute the shear viscosity, η, in a BCS-BEC crossover scheme which is demonstrably consistent, via sum rules, with conservation laws. The onset of a normal state pairing gap and the contribution from bosonic (non-condensed pair) degrees of freedom lead to a considerable reduction in the magnitude of these viscosities at general temperatures T. When quantitatively compared with shear viscosity experiments (we independently infer an estimated lifetime from radio frequency data) the agreement is reasonable, as is a comparison of η/s, where s is the trap entropy density. Our fermionic picture is to be contrasted with that of others in the literature which presume that Goldstone bosons are crucial. As in conventional BCS superconductors, we show these Goldstone bosons do not couple to transverse probes such as the shear viscosity. As a result our calculated viscosity at low T becomes arbitrarily small, rather than exhibiting the upturn predicted by others.

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