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A relation connecting thermodynamic quantities and transport coefficients in unitary Fermi gases CHIH-CHUN CHIEN, University of California, Merced, HAO GUO, WEIMIN CAI, Southeast University, China, YAN HE, Sichuan University, China — From kinetic theory it is known that in a scale-invariant system like an unitary Fermi gas, the sheer viscosity is proportional to the pressure at high temperatures, and their ratio is the relaxation time. This is an example of a relation connecting thermodynamic quantities (the pressure) and transport coefficients (the sheer viscosity). At low temperatures, however, the presence of superfluid calls for a revised relation. By implementing a gauge-invariant linear response theory, we found that the sheer viscosity is related not only to the pressure and relaxation time, but also to the superfluid density and an additional response function involving a tensor structure of the fluctuations of the Cooper pairs. Incidentally, the additional response function is negligible as the system approaches the ground state. We have tested the relation with and without pairing fluctuations that are crucial in describing the BCS-BEC crossover and reached qualitatively the same conclusion. A direct measurement of the relaxation time in quantum gases can be a challenge, and the new relation may be implemented experimentally for determining the relaxation time of unitary Fermi gases.

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