Is the $R_{KSS}$ lower bound for the ratio of viscosity/entropy a “universal lower bound” for strongly correlated quantum fluids?

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The anti-de Sitter/conformal field theory (AdS/CFT) correspondence has been used to determine a lower bound, $R_{KSS}$, [1], for the ratio, $\eta/s$, where, $\eta$, is the shear viscosity and $s$, is the entropy density. This leads to the well-known conjecture that there is a “universal lower bound,” $R_{KSS} = \hbar/4\pi k_B$ [1], for strongly correlated quantum fluids. (Quantum fluids that satisfy this lower bound have been called, “nearly perfect” quantum fluids.) This conjecture of a “universal lower bound,” has since drawn an enormous amount of attention from the condensed matter, nuclear, and particle physics communities. The unitary Fermi gases are strongly correlated quantum fluids and are expected to show the aforementioned universal behavior in the ratio, $\eta/s$. If the unitary Fermi gas undergoes a superfluid phase transition we have show that superfluid fluctuations above, $T_C$, cause $\eta/s \to 0$ as $T \to T_C$ [2]. This, clearly, violates the conjecture that $R_{KSS}$ is a universal lower bound for $\eta/s$. Recent experiments on the unitary Fermi gas, $^6Li$, shows a normal to superfluid phase transition at a high transition temperature, $T_C \approx 0.167T_F$, here $T_F$ is the Fermi temperature, [3], where we would expect that the superfluid fluctuations are strong. The ratio $\eta/s$ was also measured experimentally in this unitary Fermi gas where a minimum close to $3\hbar/4\pi k_B$ was found at a temperature above the superfluid transition temperature [4]. In our calculation we find a local minimum in $\eta/s$, where, $\eta/s > R_{KSS}$, close to the value seen experimentally, however, we also find that this ratio vanishes as $T \to T_C$ [2]. From our results we would argue that a superfluid unitary Fermi gas is “a perfect” quantum fluid. This raises the questions: Is the minimum found in $\eta/s$ of a “nearly perfect” quantum fluid due to universal quantum behavior predicted by the AdS/CFT correspondence? Or, is this just “a perfect” quantum fluid with a local minimum that is greater than the conjectured lower bound $R_{KSS}$ at a temperature below $T_F$, while, at even lower temperature the absolute minimum for the ratio of, $\eta/s$, is 0 when $T = T_C$?