Response to the Third Referee

The referee does not find a specific flaw in my argument. Nevertheless s/he is inclined to disbelieve it and so speculates that it "*must be wrong, most probably in some subtle sense which I am not able to identify clearly*." To "*show this*", s/he proposes a mechanical analogy that according to him/her would lead, with my reasoning, to the conclusion that hydrodynamics is wrong.

However the situation the referee proposes is not analogous to mine but qualitatively different. Consider a "thought experiment" where we don't allow the normal electrons to pick up momentum due to the Faraday electric field E_F while the temperature is changing. The system will reach the same final state, with no Joule heat generated. If instead we "release" the normal electrons and let them pick up momentum from E_F, Joule heat is generated. Instead, in the mechanical "analogy" of the referee if we prevent the gas molecules from flowing down while we cool, at the end of cooling we will have to "release" them and let them flow down, otherwise they don't reach the same final state. So the two situations are qualitatively different. For our situation, the "thought experiment" is of course realized by a system where the normal state resistivity is infinite. No Joule heat is generated in that case, yes in a system that is identical in every respect except its normal state resistivity is finite.

For the referee's example, imagine we cool a gas in a gravitational field at a fast rate, there will be entropy change due to the cooling and there will be also be entropy generated by macroscopic flow of matter and internal friction. The sum of those two entropies will be the same as the entropy change due to cooling at a very slow rate, where there is no entropy generation due to internal friction. There is no violation of thermodynamics nor hydrodynamics in the referee's example. Similarly, if we cool the system such that it temporarily develops a non-uniform temperature, there will be entropy generated due to heat flow that homogenizes the temperature, added to the entropy generated by the initial cooling, the sum of course will be the same as if we had cooled the system uniformly, assuming the final state reached is the same.

Because of this qualitative difference with my situation, I argue that the example proposed by the referee does not provide support to his/her speculation that "*the presented argument is incorrect*". I hope the referee will reconsider and agree that his/her analogy does not cast doubt on my argument.

If so, in the absence of another argument or analogy I hope the referee will agree that my paper should be published, so that the community at large can consider it, possibly find the "subtle sense" why it is wrong that the refeee is not able to identify, or agree that it is right as I am convinced it is.

Thank you for considering these comments.