Reply to "Comment on 'Interpretation of thermal conductance of the $\nu = 5/2$ edge' "

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Feldman argues that simply having a large velocity mismatch and long wavelength disorder is not likely to result in sufficient non-equilibration of Majorana edge modes at $\nu = 5/2$ to explain recent thermal transport experiments. I agree that this picture alone is probably too simple, although small modifications of the mechanism could still be viable.

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My paper [1] "Interpretation of thermal conductance of the $\nu = 5/2$ edge" makes one main point: (a) That the thermal edge conductance in the experiments by Banerjee *et al.* [2] would be in agreement with theory if the Majorana mode does not thermally equilibrate with the other edge modes. I also point out (b) that there are serious problems with the interpretation of the edge as being related to the so-called PH-Pfaffian phase, which is what motivated me to look for a mechanism for nonequilibration. My paper goes on to suggest (in two short paragraphs) the possibility that (c) long wavelength disorder along with a large ratio between edge mode velocities might be able to produce such nonequilibration.

In the preceding comment, Feldman [3] claims that (c) is not in agreement with experiment. The comment does not argue with (a) or attempt to address (b). Feldman's arguments, while being based on a number of estimates and suppositions, are reasonable and are generally useful for the community. These arguments show ample reason to doubt the mechanism (c) of nonequilibration, at least in the simple form presented in my earlier paper [1].

While Feldman presents his comment as providing definitive proof against mechanism (c), none of his arguments are iron clad. I would thus encourage the community to view these as suggestive but not definitive. For example, the issue most emphasized by Feldman is the momentum mismatch between edge modes (I agree that such a mismatch can occur and could be important in the manner he explains). However, one must remain keenly aware that there have been no simulations of anti-Pfaffian edges, nor detailed experimental probes. As such, we currently have no way of knowing, beyond dimensional estimates, whether this mismatch is large, small, or even zero. One could also argue with a number of the estimates Feldman obtains by extracting parameters from experiments which are either themselves controversial, or which come from experimental setups very different from that of Ref. [2]. While it may be a useful exercise to clarify our confidence level of various assumptions, it probably suffices to say that the concerns of Feldman's comment are legitimate, although, as is often the case in science, plenty of uncertainty remains.

Given that the mechanism (c) appears unlikely to work in the very simple incarnation discussed in Ref. [1], it is important to look for either (1) other possible mechanisms which would prevent thermal equilibration of the Majorana mode or (2) other (possibly exotic) scenarios which might explain the experimental data. To address (1) in a future paper I will explore a slightly more complicated, but similar, mechanism. However, it also seems that a natural first theoretical step would be a detailed simulation of an anti-Pfaffian edge. More complicated edge reconstruction, which could occur in experiment, might be important to understand. It may also be important to study subleading terms in the Lagrangian that might encourage, or inhibit, scattering.

In the end, it is likely that this debate will be resolved by further experimental input. As described in my paper [1], a simple experiment conceived by Halperin could give a clear signal that edge modes are not thermally equilibrating. On the other hand, if one wants to test the exotic possibility of having a PH-Pfaffian, one might look for phases at higher and lower filling fractions where the edge conductance is predicted to be quantized at a ladder of different values [4–6], of which the PH-Pfaffian is the middle value.

In summary, I agree with Feldman's statement that "...it is important to look for other interpretations, and more research is necessary...". It seems likely that full explanation of the experiment of Ref. [2] requires a mechanism we have not yet fully understood. It is possible that this mechanism involves the details of thermal equilibration as I emphasize in point (a).

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