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Interactive comment on "The mirror mode: A superconducting space plasma analogue" *by* Rudolf A. Treumann and Wolfgang Baumjohann

Rudolf A. Treumann and Wolfgang Baumjohann

treumannr@gmail.com

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Thank you very much for the kind and constructive review and criticisms, detection of the typo ($>$ instead of $<$) and the suggestion to include the absolute signes in $|N_m|$.

In particular, however, thanks very much for alerting us concerning the real value of the mass m. Indeed, we have skipped the discussion of this problem which may become quite sensible in other cases because it is not in general solvable. In the mirror mode it can however be solved similar to solid state superconductivity.

In metallic superconductivity, as you rightly remark, pairing requires introducing $m* = 2m$ for the mass because the mass doubles due to pairing. It is thus known and remains uncompensated by the double charge. This is the similar in the mirror bubbles with the

important difference that there is of course no pairing and the absolute number of trapped particles $\delta\mathcal{N}$ which contribute to pressure balance is not known and changes from bubble to bubble. Only the density excess N_m is known.

However, this is a normalised quantity. We know that $|N_m| = |\delta\mathcal{N}|/\mathcal{N} = \zeta < 1$. Hence the relevant mass becomes $m^* = (1+\zeta)m_i = \Delta m_i$. Again, however, this is a function of space $\vec{x}$ since it is different from bubble to bubble.

On the other hand, one may define an *average* equivalent mass $m = \langle m^*(\vec{x})\rangle$ averaged over the entire length of the mirror chain. This then becomes $m_i < m < 2m_i$ and is the mass which is to be understood in all following equations.

We are very grateful to this reviewer for insisting on us to include this clarification.

We will include a short clarifying remark on this item in the MS when resubmitting. So far we gently went by this problem as we thought it might cause more complications than clarifications when applied to other instabilities where the additional constraint $|N_m| < 1$ is lacking. Nevertheless, we agree with this reviewer that it is quite reasonable to point this difficulty out clearly also at this place and show the way how to include the modification of m^* in mirror modes. The practical realisation of this programme still remains problematic.

We feel that by imposing thermodynamic considerations of this kind in discussing the final quasi-equilibrium state of an instability like the mirror mode makes very much sense since it is in praxi not feasible to calculate the full chain of interactions in weak or strong turbulence theory. The many contributing modes and particle populations can hardly be defined. Thermodynamics as the global theory gives instead a clue on the final equilibrium state. It works perfectly in superconductivity. That it also works, if only approximately, also in the mirror mode is very satisfactory though not that much surprising.

Once more many thanks for this most constructive review and the suggestions.

With best wishes Wolfgang and Rudolf

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