Ann. Geophys. Discuss.,
https://doi.org/10.5194/angeo-2018-40-AC3, 2018

Annales Geophysicae Discussions

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

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Received and published: 4 July 2018

In our reply we mentioned that for the large number of trapped ions in anyone of the mirror bubbles the ratio q/m of charge and mass remains unaffected even when many particles are trapped and the mirror mode evolves along the indicated lines until reaching its thermodynamic final equilibrium state. This is doubtlessly true.

However Reviewer 2 noted that in some places the mass occurs without reference to charge, and there the "effective mass" might assume a different value. This is also true. We have been aware of that problem but did not want to mention it for not unnecessarily overloading the anyway complicated theory. We answered the problem affirmatively in very simple terms (see our reply to R2).

To make it short: Indeed the effective mass of the mirror-trapped ions changes when all the excess ions behave like one correlated object (in superconductivity the mass doubles when Cooper pairs form). In mirrors no pairs form, thus the mass increases by the ratio of excess number of particles to total particle number $\delta\mathcal{N}/\mathcal{N} = \zeta$, where $\zeta < 1.$ Hence the effective mass of the particles which contribute to the thermodynamic state of the mirror mode becomes $m^* = (1+\zeta)m_i$. This value is bounded as $m_i < m^* < 2m_i$ which is very similar to superconductivity.

In real mirror modes the number of trapped particles varies from bubble to bubble. The value $\zeta(\vec{x})$ depends on space and must be averaged over the total chain of mirror modes. The effective mass then becomes $m_{\mathit{eff}} \equiv \langle m^*(\vec{x})\rangle = m_i(1+\langle\zeta(\vec{x})\rangle)$. The above range of the effective mass remains unaffected.

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