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Discussions

Interactive comment on "In-flight calibration of Hot Ion Analyser onboard Cluster" *by* A. Blagau et al.

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Dear Editor,

The authors would like to thank the referees for the careful reading of the manuscript and for their useful comments. Please find below our reply to their suggestions.

Referee #1:

1) The role of ion composition in the HIA - Whisper data comparison

The prevalent minor ions in SW and magnetosheath plasma are Alpha particles. Lets assume a mixture of protons (number density N_p, mass M_p, and charge Q_p) and Alphas (N_a, M_a and Q_a). For a particle detector like HIA, unable to discrimi-

nate between the ion species, the number density reported by the instrument will be $N_{HIA} = N_p + \sqrt{M_p/M_a}N_a = N_p + N_a/2$. On the other hand, the Whisper instrument will report a number density $N_{WHI} = N_p + (Qa/Qp)N_a = N_p + 2N_a$.

Typically the Alpha particles abundance in the solar wind and magnetosheath plasma is around few percents of the proton number density. Therefore the discrepancy between the readings of the two instruments is of the same magnitude and consequently considered not to play an important role. In addition, the procedure used to select the final set of calibration intervals (discussed in Section 4.1) tends to exclude intervals with lower (than expected) value of N_{HIA}/N_{WHI} ratio.

In the special case of HIA operating in SW mode, where the protons and Alpha particles are clearly separated in the energy/charge channels, the on-board software automatically computes the plasma moments separately for the two ion species. Therefore here one compares N_p with $N_p + 2N_a$. However, the clear separation between the protons and Alphas in the energy spectrogram allows us to select from the beginning intervals with low presence of Alphas, as described in the manuscript (lines 15 - 17 on page 419 in the typesetted version for the GID).

In the manuscript, two new paragraphs have been added at the end of Section 4 (lines 11 - 29 on page 416 and lines 1 - 2 on page 417) to explain this issue.

2) Test of the gyrotropy

This suggestion touches the problem of symmetric anode response, that so far has not been thoroughly investigated for HIA (like has been done for CODIF). Nevertheless, we tested pressure gyrotropy on few interval selected for calibration and the results are convincing enough. For example, for the event illustrated in Fig. 3, the deviation from gyrotropy, measured by the quantity $(P_{\perp 2} - P_{\perp 1})/[(P_{\perp 2} + P_{\perp 1})/2]$ is typically around or below 5 %.

In the manuscript, Fig. 3 has been modified to include one more panel showing the evolution of this quantity. The figure caption and the text (lines 16 - 20 on page 418) have been modified accordingly.

3) The energy dependence of the response, its degradation, MCP acceleration inappropriate for the epoch, radiation effects

As mentioned in the article, the energy dependence is assumed to be properly described by the coefficients obtained during ground calibration. The MCP gain fatigue, compensated by raising periodically the MCP high voltage, is assumed to be uniform. Therefore its effect could be later adjusted by changing the value of one parameter/section, i.e the absolute calibration coefficient. In the article, the authors showed they are aware of the limitations implied by this assumption (Section 4, lines 4 - 10 on page 416). Also, the need for a systematic study to investigate the changes in the efficiency energy dependence has been plainly discussed (see the last section in connection to Fig. 9). In spite of this, the statistical studies in Section 5 suggests that, at least in the plasma environments used for calibration, this effect is not so important in the statistical sense.

Your sincerely,
Adrian Blagau, on behalf of all co-authors