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COMMENT ON "A TANGENT SUBSOLAR MERGING LINE" BY N. U. CROOKER ET AL.

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About 15 years after quantitative models were presented on magnetopause reconnection involving a tilted reconnection line across the magnetopause's stagnation-subsolar region [Gonzalez and Mozer, 1974; Sonnerup, 1974; Hill, 1975], it was interesting to see the recent work by Crooker et al. [1990] (hereinafter C et al.) in which they try to extend the above mentioned models toward a more globally defined reconnection line. However the following comments seem necessary.

1. In what follows I will refer only to the work by Gonzalez and Mozer [1974] (hereinafter GM), although similar results were also given by Sonnerup [1974] and Hill [1975].

The tilted reconnection line was defined locally at the subsolar region of the magnetopause by GM assuming that this line lies along the direction on which the magnetosheath ($\underline{B}_M$) and geomagnetic ($\underline{B}_G$) fields have equal parallel (to the reconnection line) components, which would not affect the transverse reconnection flows. Then, it was also assumed that such a direction obtained at the subsolar region extends globally across the dayside magnetopause. Further, for practical purposes, it was also assumed that the "clock angle", θ, between $\underline{B}_G$ and $\underline{B}_M$, is the same as that between $\underline{B}_G$ and the pre-shock solar wind's transverse (to the Sun-Earth line) component $\underline{B}_T$.

With those simple assumptions GM projected the solar wind's electric field $\underline{V} \times \underline{B}_T$ (with $\underline{V}$ being the solar wind's velocity) along the reconnection line to obtain a reconnection potential across the dayside magnetopause. Since this potential is expected to map across the polar caps, it provided a quantitative model ready to be tested by observations. In fact, several balloon and satellite observations of the polar cap electric field and related parameters were successfully compared with the model predictions [e.g., Gonzalez and Mozer, 1974; Reiff et al., 1981; Wygant et al., 1983; Doyle and Burke, 1983; Reiff and Luhmann, 1986; Gonzalez, 1990 and references therein].

Thus, since GM's model for the reconnection potential was successfully tested by observations, regardless of its simplicity, immediate questions that emerge about the recent C et al.'s model refer to its ability to be tested by observations and also to the physical significance of the new assumptions involved with it. In this model the tilt of the reconnection line depends on θ and on a ratio of the leaking (L) to the penetrating (P) fluxes of the internal ($\underline{B}_G$) and external ($\underline{B}_M$) fields at the magnetopause. The L/P ratio that shows up in the expression for the angle between $\underline{B}_G$ and the reconnection line of this model is practically a free parameter and it is not clear to which reconnection properties the L and P quantities are related. Observationally perhaps one could obtain best fit values for L/P but, again, one would not know of their clear physical meaning; and in the case that the best fit values approach B_G/B_M one would not have gained more than what already exists in GM's model. Further, if one decides to search for a globally defined reconnection line as "a line along the locus of first contact" between the approaching magnetosheath and magnetospheric fields, it appears that only a self-consistent solution of the shocked-magnetosheath, magnetospheric and magnetospause flows would provide more meaningful information for such a "first tangency" condition.

Physically, the reconnection electric field is probably the final parameter that defines and governs the reconnection flows and therefore also the "first tangency" location for the reconnection line. However, in a time-dependent situation even the normally assumed continuous reconnection electric field across the magnetopause may cease to be so, thus complicating its possible relationship to the L/P ratio.

A global relationship of the L and P parameters to partial shielding magnetopause currents in C et al.'s model does not seem to help much for a quantitative knowledge of the L/P ratio, since a correct knowledge of the final "Chapman-Ferraro" currents at the magnetopause (modified by the reconnection process) will only be obtained after the above mentioned self-consistent study on magnetopause flows is performed.

In summary, in the new C et al.'s reconnection line model one does not know which physically meaningful values of L and P to use in order to compute models for the reconnection potential. The L/P ratio seems to be a free parameter as compared to its corresponding but fixed value, B_G/B_M, which can be measured, in GM's reconnection line model.

2. In GM's model, the reconnection line was defined locally at the subsolar magnetopause. In order to extend it to a more global definition it seems that one would need to worry about several complicating factors, most importantly about possible asymmetries with respect to the subsolar region. For instance, if the archimedean component of the solar wind's magnetic field is large enough, regions at the dayside magnetopause other than the subsolar one may become more appropriate for "first tangency". As a result the globally defined reconnection line may become restricted to smaller regions at the magnetopause and in some instances it may even not necessarily cross the subsolar point. Such a "partial" reconnection line may perhaps help to

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