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Selfconsistent gasdynamic model versus 'strange' boundaries and structures in magnetosheath

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Starting from 60s simple gasdynamic similarities inferred rather complicated structure of the magnetosheath (MSH) flow especially over cusps, including fans, secondary shocks, magnetopause (MP) indentation etc., the latter had been originally included in the simple-for-use models e.g. by Tsyganenko. Latter on the axisymmetric models had prevailed. The advanced MHD codes provide much more precise predictions, but its require analysis and visualization efforts as complicated as the data do.

In the multi spacecraft era it occurred necessary to get a tool, which facilitates case and statistical data analysis with a model, comparable in the convenient usage with the Tsyganenko ones, which permits to separate 'simple' gasdynamic effects from the temporal and kinetic ones.

We present a new gasdynamic model of the MSH- magnetosphere interaction for a PC application, recently developed in the Institute of Mechanics of Bulgarian Academy of Sciences. The model solves self-consistently in 3D the problems of the MP streamlining, using the pressure balance condition at MP from Tsyganenko magnetic field model. The cusp indentation at MP is reproduced in accordance with Interball-1 and

Cluster case studies. The shape of ion flux profiles across MSH is much better fitted to the data versus standard Spreiter codes. We relay the model flux overestimates with intermittent plasma jets behind the bow shock, the flux in which should be averaged in the space using 4 Cluster data, instead of time averaging.

The model also predicts fans and secondary shocks at the leading edge of the over-cusp indentation, compatible with the data, and accelerated flows at its trailing edge at MP. However to become a working instrument, the model requires its parameter optimization, promising to predict the majority of 'strange' MSH boundaries and structures, and account for the plasma stagnation and jetting over the indented cusp boundary. The latter agrees with MHD modeling. Only on such realistic background one can speculate e.g. on reconnection or structural MSH jets, MP surface waves etc., and proceed with kinetic fine effects at the MSH structures and magnetospheric boundaries.