

# Report on the first SHOTS group meeting in Paris

Willi Exner

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|----------------|-----------------------------------|
| Visitor        | Willi Exner                       |
| Dates of visit | 29.05.2018-01.06.2018             |
| Home Institute |                                   |
| Short name     | IThP                              |
| Long name      | Institute for Theoretical Physics |
| City           | Braunschweig                      |
| Country        | Germany                           |
| Host Institute |                                   |
| Short name     | LESIA                             |
| Long name      | LESIA, Observatory de Paris       |
| City           | Meudon, Paris                     |
| Country        | France                            |

## Expert Program report

In the end of May 2018, the very first workshop/group meeting in the frame of our new SHOTS project (Simulations in Hybrid and Other TheorieS) finished in Meudon, Paris, France. The SHOTS project was launched during the Young Scientist Workshop of the last science working team of the BepiColombo (Joint ESA/JAXA satellite mission) meeting in Braunschweig (March 12-15th, 2018): Along with S. Aizawa (Tokyo, Japan), S. Fatemi (Kiruna, Sweden), L. Liuzzo (GATech, USA), L. Griton (LESIA, France), and me, we founded this project because we each use different simulation codes that have been already successfully used to understand key features in the magnetosphere of Mercury. However, the multiple approaches each have their sweet-spot in their physical applications, i.e. magnetohydrodynamic (MHD) codes that describe the solar wind plasma as a charge-neutralizing

fluid are well used for understanding the general shape, size and interaction with the upstream solar wind, full-particle codes that treat ions and electrons kinetically for very local reconnection events, cusp sizes and aurora, while the hybrid approach is working in between. Most of the cases, each code was successfully used to analyze and explain special orbits and spacecraft data (like Mariner 10, 1975, and MESSENGER, 2008-2015), but is rarely compared to other codes. Thus, our goal is to run the different simulation codes in order to create the worldwide very first comparison approach to a joint Mercury model.

For this endeavor, I met with Lea Griton in Meudon, Paris, to discuss parameters (physical and numerical) of the test simulations that should be used in order to compare the codes. We had 3 telecons on each day at 10 am to talk with the other group members in Sweden, Germany, USA and Japan. We decided on a normal set of solar wind parameters at Mercury of 20 nT magnetic field strength,  $30 \text{ cm}^{-3}$  solar wind density, 400 km/s solar wind velocity and a solar wind temperature of  $0.210^6 \text{ K}$ . The interplanetary magnetic field direction is to be analyzed in purely positive or negative z-component. The different results are sketched in figure 1. Over the span of the next weeks, we will have multiple further telecons to discuss the results of this first phase of simulations. The next meeting is scheduled to early September 2018. The first scientific results should be condensed into a poster-presentation at the next *American Geophysical Union* in December 2018 in Washington D.C.

To conclude this first meeting; for the first time European and international scientist of the different plasma simulation groups were able to meet (in person and by telecon) and set a developing workgroup for the next years into motion. We want to thank the EUROPLANET Expert Program to make this possible.

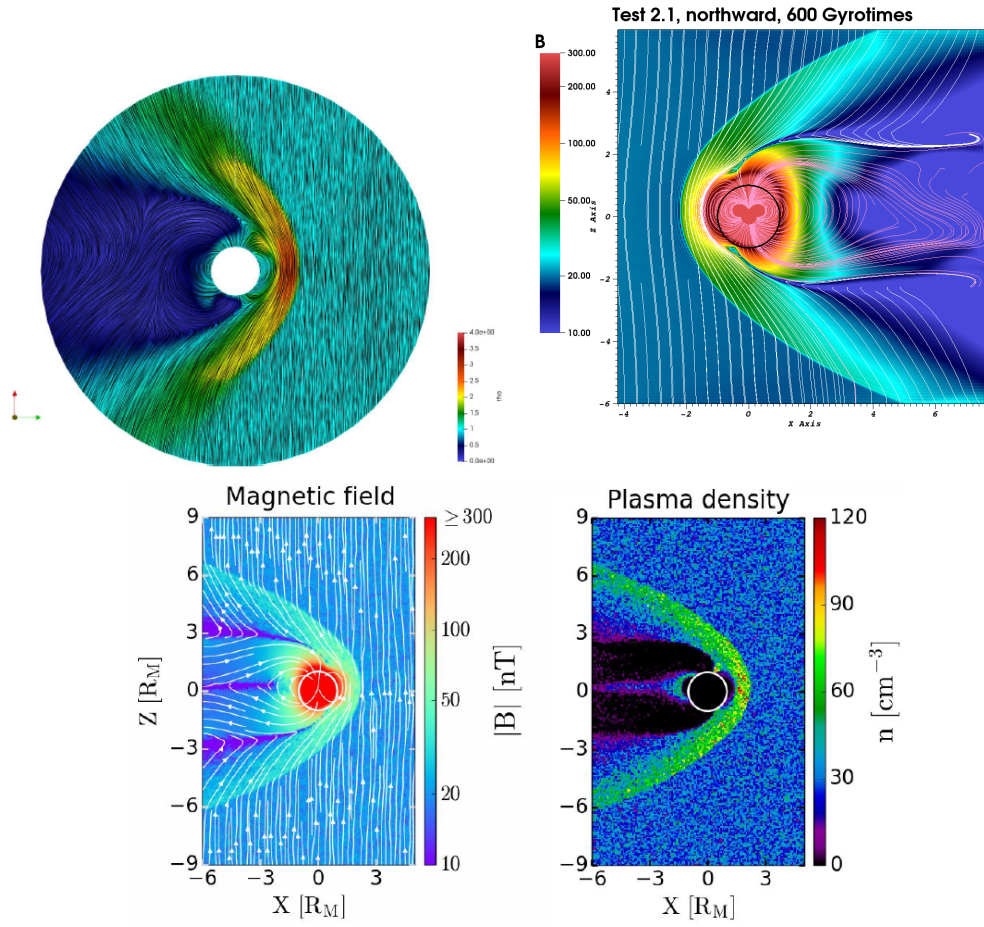


Figure 1: SHOTS simulation results of density and magnetic field situation at Mercury by different approaches: MHD *AMRVAC* upper left, hybrid CPU *AIKEF* upper right and hybrid GPU *AMITIS* bottom pictures.