Geophysical Research Abstracts
Vol. 17, EGU2015-1093, 2015
EGU General Assembly 2015

Galactic Cosmic Rays in the inner magnetosphere of Saturn

Anna Kotova (1,2), Elias Roussos (1), Norbert Krupp (1), and Iannis Dandouras (3)

(1) Max Planck Institute for Solar System Research, Göttingen, Germany (ann-kotova@yandex.ru), (2) Université de Toulouse, UPS-OMP, IRAP, Toulouse, France, (3) CNRS, IRAP, Toulouse, France

Existence of the Saturn innermost radiation belt in the tiny gap between planetary atmosphere and D-ring was first proposed in 2004 after the discovery of the significant fluxes of the energetic neutral atoms (ENA) coming from this area, what was measured by Ion and Neutron Camera on board of Cassini during the insertion orbit (1). One of the main sources of energetic charged particles for such inner radiation belt is the interaction of the Galactic Cosmic Rays (GCR) with the Saturn's atmosphere and rings, which due to CRAND process can produce the keV-MeV ions or electrons in the region.

Using charged particles tracer developed in our group, we simulate the motion of the GCR using the backward tracing method and analyze the differences, arising from the usage of different magnetospheric models. The simulation was performed under assumptions of the dipole magnetic field model, then using more complex model with a magnetic equator offset and some other non-dipolar effects and later on using the Khurana model (2), which is based on the Cassini observations and for today is the most realistic model of the Saturn magnetosphere. We created maps of the GCR access to the Saturn atmosphere, analyzed changes of the minimum energy needed for GCR to reach the planet from different directions depending on the latitude and longitude and explained difference with analytically derived by Stormer theory values.

Using those simulations and combine its results with Saturn atmospheric model and rings composition model, we estimate the production of secondaries resulting from the interaction of the GCR with atmosphere and from its penetration of the rings. This allows us to estimate the flux of energetic particles close to the planet, what will be useful for the preparation of the final "proximal" orbits of the Cassini spacecraft in 2017. For the validation of the results they are compared with the data from the Cassini insertion orbit.

References:
(1) S. M. Krimigis et al., "Dynamics of Saturn's Magnetosphere from MIMI During Cassini's Orbital Insertion", Science 25 February 2005: 307 (5713), 1270-1273.
(2) Khurana, K. K., C. S. Arridge, H. Schwarzl, and M. K. Dougherty (2006b), A model of Saturn's magnetospheric field based on latest Cassini observations, Eos Trans. AGU, 87(36), Jt. Assem. Suppl., Abstract P44A-01.