火星磁気異常帯の下流で観測された磁気フラックスロープの空間構造推定

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Spatial configuration of a flux rope observed downstream of the Martian crustal magnetic fields

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Flux ropes are characteristic magnetic field structures seen throughout the solar system, e.g., at the Sun, in the interplanetary space, and in the Earth's magnetosphere. Flux ropes are also observed at planets such as at Venus and Mars [e.g., *Russell and Elphic*, 1979; *Vignes et al.*, 2004], which do not possess a global intrinsic magnetic field. In particular, Mars is a unique planet, since it locally possesses strong crustal magnetic fields mainly located in the southern hemisphere [e.g., *Acuna et al.*, 1999]. The Martian electromagnetic environment can thus be highly complicated and variable, since the interplanetary magnetic field (IMF) embedded in the solar wind interacts with the Martian crustal magnetic field. Whereas it is known that the Martian upper atmosphere is escaping to the interplanetary space due to the interaction with the solar wind [e.g., *Lundin et al.*, 1989; *Barabash et al.*, 2007], the role of the crustal magnetic fields in the atmospheric escape from Mars is not well understood.

Recently, *Brain et al.* [2010] found a large-scale isolated flux rope, filled with the Martian atmospheric plasma and located downstream of the crustal magnetic fields with respect to the solar wind flow, based on their analyses of the magnetic field and suprathermal electron measurements from the Mars Global Surveyor (MGS) spacecraft. We hereafter call this large-scale isolated flux rope identified by *Brain et al.* [2010] as "Brain's flux rope". They suggested that Brain's flux rope is an evidence that significant amounts of the atmosphere can be intermittently carried away from Mars by a bulk removal process such as via magnetic reconnection between the IMF and the crustal magnetic fields: this process occurs frequently and may account for as much as 10 % of the total present-day ion escape from Mars.

We here attempt to reconstruct the spatial configuration of Brain's flux rope using Grad-Shafranov (GS) reconstruction technique, which is capable of recovering a magnetohydrostatic, two-dimensional magnetic field structure from single-spacecraft data [*Hu and Sonnerup*, 2002]. Since there is no ion detector onboard MGS, we assumed thermal pressure in the Martian ionosphere at MGS altitudes to have a negligible gradient. It is also assumed that the spacecraft velocity is the dominant component to cause apparent movement of the flux rope relative to the MGS spacecraft. The reconstructed structure of Brain's flux rope indicates stretching in the anti-sunward direction, which is consistent with *Brain et al.* [2010]. We also find that the stretching of the reconstructed structure has a significant component in the dawn-dusk direction. The result provides a more reliable observational restriction on the spatial scales of the flux rope. In the presentation, we will also discuss effects of the flux rope on the atmospheric escape from Mars.

References:
Acuna M. H., et al. (1999), *Science*, *284*, 790–793.
Barabash, S., et al. (2007), *Science*, *315*, 501–503.
Brain, D. A., et al. (2010), *Geophys. Res. Lett.*, *37*, L14108.
Lundin, R., et al. (1989), *Nature*, *341*, 609–612.
Hu, Q., and B. U. O. Sunnerup (2002), *J. Geophys. Res.*, *107*(A7), 1142.
Russell C. T., and R. C. Elphic (1979), *Nature*, *279*, 616–618.
Vignes, D., et al. (2004), *Space Sci. Rev.*, *111*, 223–231.