Observation of wake edge turbulence polarized around the Moon in the solar wind

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As a result of the solar wind interruption by obstacles, whistler / fast and slow magnetosonic wakes or shocks are formed depending on effective scales of the obstacles [Omidi et al., 2002, 2003; Blanco-Cano et al., 2003; Russell et al., 2005]. The Moon, a less-conductive and airless body without global magnetic field but with local magnetic anomalies, forms the global lunar wake and local wakes of the magnetic anomalies in the solar wind. The wake edge is predicted to be perturbed or phase-standed in the solar wind. However, signatures of the wake edge turbulences have not been clarified because of their small phase velocity in the Moon frame, which makes it difficult to observe them.

We find the evidence of the wake edge turbulence by utilizing ARTEMIS observations, when the two probes simultaneously passed through almost the same region but in opposite directions. At that duration, the probes detected low frequency magnetic turbulences less than ~0.01 Hz with different polarizations, indicating that they are the same waves Doppler-shifted by opposite spacecraft velocities. The waves should be phase-standing in the Moon frame, and propagating upstream against the solar wind with the phase velocity comparable to the solar wind velocity. They are suggested to be whistler-mode waves because they are right-hand polarized when the spacecraft orbits in the solar wind direction, which would be the opposite direction of the wave phase velocity, and are left-hand polarized in the opposite case. We investigate the waves observed by Kaguya and ARTEMIS, and reveal their statistical properties. The results suggest that they are whistler wake turbulences phase-standing in the Moon frame caused by the solar wind interruption with the charged surface or the magnetic anomalies.