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Field Line Bend in the Lunar Wake

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By taking advantage of the magnetic field measurements simultaneously observed by two ARTEMIS satellites in the Moon's upstream solar wind and in the downstream wake, we characterized the magnetic field line bends in the lunar wake. Magnetic flux tube are observed to be squeezed by the pressure gradient force in the Y direction; while in the XZ plane the field line bends can be decomposed to two components, according to the conventional diamagnetic current theory, caused by the pressure gradients in the X and Z directions, respectively. Our calculations show that, however, the pressure gradient in the X direction is not strong enough to make the field line bend as we observed and that additional processes are needed to make the field line bulge towards the Moon. The effect of the finite conductivity inside the Moon body can bend field lines in wake to the Moon, which, however, is eliminated since it seems not consistent with our observations. The interaction (pickup) between the heavy charged lunar dust grains floating above the lunar surface and the solar wind provides a reasonable mechanism both to slow down the solar wind plasma and bulge the magnetic field line towards the Moon. According to our calculations, the current associated with the pickup process is $\sim 3 \times 10$-9 A/m2 and the Pedersen conductivity of the lunar dust is $\sim 2 \times 10$-6 S/m. Thus, the field line bend in the lunar wake may provide another clue to the existence of the lunar dust other than the 'lunar horizon glow.