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The external and internal magnetic fields of Titan: Cassini observations

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Titan has a thick atmosphere, the top of which is ionized and interacts with its plasma environment, i.e. usually the Saturnian magnetospheric plasma, but occasionally the magnetosheath or even the solar wind plasma. When the upstream plasma flow encounters Titan, the plasma slows down and diverts around Titan, and the magnetic field slowly diffuses into Titan's ionosphere and induces currents in the ionosphere. The resulting magnetic field pattern is that, in the upstream of Titan, field lines drape around it, and in the downstream, the field lines stretch tail-like. Gradually these external fields penetrate into the lower atmosphere and the interior of Titan, and induce currents in any conductive layer if a conductive layer does indeed exist in Titan's interior. This internally induced current acts to exclude the penetrated field. Both the internally induced field and the externally induced ionospheric field have strength and orientation variable with certain time scales because they are responses to the penetrated external field. The Cassini observations are a sum of fields from both internal and external sources. In this paper, we review the low altitude observations from all Cassini Titan flybys and examine the different behaviors of the external and internal fields, which ultimately provide an upper limit to Titan's internal field leading to indications for Titan's interior.