Advances in optically pumped helium magnetometers for space and Earth science

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A b s t r a c t: Recent advances in optically pumped He^4 scalar and vector magnetometers at Polatomic and JPL are reported. A significant new innovation in helium magnetometers is replacement of the gas discharge He^4 lamp with a laser pump source developed by Polatomic under initial sponsorship from JPL. A semiconductor laser is tuned to the helium pumping line at 1083 nm and produces a sensitivity improvement of a factor of 25 over conventional lamp pumped helium magnetometers. The first laser pumped scalar He^4 magnetometer, the POLATOMIC 2000, is described. A pair of these laser magnetometers was operated as a short baseline gradiometer in order to demonstrate a sensitivity approaching 0.1 pT/√Hz. A unique hybrid vector/scalar He^4 space magnetometer using one sensor to make either tri-axial vector measurements or scalar measurements is also described. This instrument is used by JPL to observe the magnetic field of Saturn from the Cassini spacecraft. Recent Cassini scalar field measurements made from altitudes as low as 1100 km to 4 Earth radii during the August 1999 Earth fly-by of the Cassini spacecraft are presented. Design of a miniature scalar magnetometer for the proposed JPL Discovery Mission INSIDE Jupiter is described.

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