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Future magnetometer measurements at Titan

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Abstract

Future magnetic field science objectives at Titan include:

- resolution of any Titan intrinsic magnetic field
- measurement of induced subsurface signatures to confirm the existence of any subsurface liquid as well as place constraints on the conductivity and depth of any ocean
- characterization of the magnetic history of the crust
- support plasma and energetic particle measurements.

The best way to enable such measurements would be via observations from a Titan Orbiter made over a period of months to allow the varying multiple frequencies in the signal to be resolved which is critical in order to define both the background inducing magnetic field as well as the resulting induction signature; and then enable possible resolution of any remaining intrinsic magnetic field. To unequivocally constrain the induction signatures these orbiter observations would be made in conjunction with magnetic field observations on a balloon in the atmosphere or from a lander on the surface.

The key drivers for magnetometers for balloons or surface elements at Titan are:

- extremely low mass and low power
- the ability to integrate closely with other payload.

Magnetoresistive (MR) sensors

Magnetoresistive (MR) sensors offer a potential solution to these challenges. MR sensors are ultra low mass thin film devices whose operation is based on the variation in resistance of certain magnetic materials in the presence of an applied field.). They are thus well suited for use within the very tight volume and mass constraints imposed by a Titan balloon/surface element. We describe a closed loop three axis magnetometer incorporating an Anisotropic Magnetoresistive hybrid sensor that utilizes novel driving to achieve accuracy of 2nT and discuss the capability of such a design in the context of the stated magnetic field science objectives.