Uranus' weird magnetosphere: The case for a low-resource magnetometer on an entry probe.

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Since the Voyager 2 flyby in 1986 it has been known that Uranus has one of the most unusual magnetic fields of all the Solar System planets. The quadrupole and dipole components of the field are of similar magnitude, and the axis of the dipole makes a large angle to the planet's rotation axis. The dynamo might be sustained in a relatively shallow layer of ionic water, the surrounding magnetosphere should be highly dynamic, and coupling between the magnetosphere and the ionosphere may hold the key to understanding why Uranus' upper atmosphere has been steadily cooling since the flyby. All of this is uncertain, making science of the dynamo and magnetosphere one of the pillars supporting the Uranus flagship mission that has recently been prioritized. In addition to a high-priority magnetic field investigation on the planned Uranus orbiter, here I make the case for a low-resource magnetometer to be included in the payload of the planned atmospheric entry probe. Magnetic field measurements from the probe would provide a highly valuable determination on the ionospheric conductivity that is a critical input to magnetosphere-ionosphere coupling models, and also provide a constraint on the structure of the planetary field itself. I propose that these measurements could be made by an instrument comprising two robust, coin-sized Hybrid Anisotropic Magnetoresistive (AMR) sensors. Electromagnetic cleanliness requirements applied to the platform would be limited, meaning no need for a boom deployment system. The total instrument volume, mass, and power is 18.3 cm^3, 110 g, and 0.7 W. I outline the flight heritage of Hyrbid AMR sensors built at Imperial's Space Magnetometer Laboratory.