A low-resource magnetometer for an ice giant atmospheric probe

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Abstract

At both the mysterious ice giant planets the flow of energy from the Sun to the atmosphere is very poorly understood. Upper atmospheric temperatures are higher than expected by a factor of _˜5 at both Uranus and Neptune, presenting a problem often referred to as the giant planet energy crisis. Constraining energy inputs that result from solar wind-magnetosphere-atmosphere coupling is often cited as the route to a solution. However, our limited understanding of all aspects of this coupling is a barrier to progress, adding to the strong case for future exploration of both the Uranian and Neptunian systems. Here we present a low-resource magnetometer concept for an ice giant atmospheric probe that would allow measurement of the electrical conductivity of the ionised upper atmosphere (the ionosphere), which is key for understanding the above coupling. Magnetic field measurements during descent would also lead to cross-disciplinary science of not only the magnetosphere but also the planetary interior. We present a concept for a probe-mounted magnetometer comprising two hybrid anisotropic magnetoresistive sensors together with an electronics card, with a combined total instrument mass of _˜100 g and with a power consumption of _˜0.4 W. We have flown similar low-resource instruments (*CINEMA*, *SOS-MAG*) and are now building an instrument for the upcoming *RADCUBE* mission, leading to a high level of technology readiness.

Keywords: Magnetometer, ice giants, probes, ionosphere, conductivity, dynamo, magnetosphere.

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