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Schumann Resonance on Titan : Huygens Observations Critically Re-Assessed and prospects for the Dragonfly Mission

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The Huygens probe to Titan in 2005 was the first planetary probe or lander to feature ELF electric field sensing and atmospheric conductivity measurements. The atmospheric electricity community showed great interest in the claimed detection of a Schumann resonance signal on another world (despite its unexpected dominant frequency of 36 Hz), and the planetary science community embraced an interpretation of the altitude dependence of the signal as evidence of a theoretically-anticipated internal water ocean beneath an ice crust many tens of km thick.

Quantitative scrutiny suggests that prospects of detecting a Schumann signal at Titan with the Huygens experiment were in fact very poor, due to short measurement time, a horizontal antenna orientation, a lack of lightning, and the likely presence of severe dynamical effects on the probe. Although the latter objections were considered, and arguments developed against them (notably the novel postulated Saturn-magnetospheric excitation of the resonance), we have re-examined the data in the light of a better understanding of the probe dynamics. The evolution of the 36Hz power shows a very strong correlation with accelerometer records of short-period motions of the probe under its small stabilizer parachute, suggesting that mechanical oscillations of the probe and/or the antenna booms were actually the cause. The 'signal' ramped up just as the probe accelerated from the much more quiescent main parachute, and ceased abruptly a couple of seconds after impact.

While the Huygens signal may therefore have been an artifact, this does not mean that a Schumann resonance does not occur on Titan. Most likely if it occurs, it may be very sporadic, responding to the infrequent rainstorms on Titan. A search for such signals should therefore be a long-duration monitoring exercise (not unlike listening for seismic events that could also probe Titan's interior). The Dragonfly mission to Titan, recently selected for launch in 2026 with arrival planned in 2034 and over two years of surface operation, provides an opportunity to perform such monitoring.