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Geoscientific Instrumentation Methods and Data Systems Discussions

Interactive comment on "Observation of 2nd Schumann eigenmode on Titan's surface" *by* C. Béghin et al.

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General Comments: The manuscript tries to demonstrate that a 36Hz signal was present hidden by noise after the landing of the Huygens Probe on the surface of Titan. There are few assumptions about what happened with the HASI-PWA and some simulations to reproduce the data send by telemetry to Earth. The signal from PWA-ELF seemed to disappear at the surface of Titan, and the simulations were addressed to show that a 36Hz signal was present however at SNR near zero.

From the point of view of this reviewer it is important to show how the data was processed in order to make clear for the reader and researchers on the field. The authors have the chance to show the way the data was obtained and submitted by telemetry

to Earth. Although it was describe in the referred report (Jernej, I., and Falkner, P. HASI-PWA Calibration Document, HASI-PWA-FM-DOC-41) authors could explain the procedure in this manuscript, and this is the scope of the journal.

Because of the importance of the HASI-PWA experiment, authors should provide a link were workers on the field could obtain the data in order to reproduce the calculations made in the manuscript. The manuscript should include a data sharing statement which either says where extra data can be accessed (e.g. "Extra data is available by emailing XYZ") or simply "There is no additional data available".

Specific/Technical Comments:

Section 2

1- Beginning of section 2: This phrase is not clear and misleading and this section sustains the subject of the manuscript: "The ELF power spectral density (PSD) was computed onboard by applying a DFT after a 16-bit analog-digital conversion of two consecutive waveform samples of 333 ms was logarithmically compressed, and the lower byte (8 bits) was transmitted without the phases to Earth by " By reading HASI_PWA_CALIBRATION_REPORT.PDF I understand that DFT was applied to 2x1024 electric field measurements, and this measurements were send (compressed) by telemetry, however the procedure to generate the bins seems obscure.

2-Equation (1) and paragraph around line 50 are not clear. Vadc is the peak amplitude at what frequency? Is the frequency given by the integer Im? Im is the bin? This is the key part of the manuscript and is related to the above comment.

3-The regression analysis is made for linear dependences and equations are not linear, the reader understands they make a logarithmic regression analysis.

Section 4 4-Paragraph 10-20: Simulation seems not valid because assumes a sinusoidal signal as noise, noise does not follow any given waveform, then the analysis is to see differences with sinusoidal interferences.

5-The simulation is not clear, should follow exactly the way in which measurements are transferred to the bins. A proper re-organization of the procedure in section 4, with the proper explanation would improve the manuscript.

6-Page 7 end of paragraph-line-10: This is not clear: “This effect occurs when the mean amplitude of the sample series lies in the vicinity of a step of the transfer function, which is actually I_TM = 85 for bin 36 on the surface. The simulation retrieves the predicted jump from S36 < 1 to > 1 at. . ..” Authors should make some plot of graphical explanation of this jump.

7- Page 6: Assumption (ii) “In order to estimate this margin we assume that the statistical parameters of both signal and noise were staying stationary. . ..”. That is a huge assumption because the electric field measurements (not magnetic) at ELF seems far from stationary in a variable environments as it may be the surface of Titan.

Additional/Important Comments:

8- Authors do a large effort to demonstrate with statistics that a signal of 36Hz was present at SNR near zero, however they do not use the “statistical significance” to demonstrate the validity of the results, that is a key parameter in any statistical analysis.

9- Although the authors focus the paper in the 36Hz signal, and authors do a huge effort to demonstrate that the 36Hz signal is not an artifact, this reviewer is skeptical about the HASI-PWA instrument, and now has the chance to ask some questions to the authors and members of the HASI-PWA team: - The measurements of the electric field at ELF are very dependent on the changing environment as wind and displacements. Why HASI-PWA instrument was intended to measure the electric field instead of the magnetic field? The answer seems evident: Avoiding interferences with signals from equipment, however these signals are known and could be modelled to make corrections to the measurements. It seems authors are now doing the corrections-back with the electric field measurements, but more noisy.

10-Why there is no evidence of the fundamental mode? In electromagnetic resonators under normal operation always is present the fundamental mode, actually it is very difficult to avoid it. For instance in waveguides it is almost impossible to excite a higher order mode without the presence of the fundamental mode. Authors try to explain this issue in a previous paper referred in the manuscript (F. Simoes et al. Planetary andSpaceScience 55,(2007) ,pp.1978–1989). A failure in the HASI-PWA?.

11-Authors should cite the work of Morente et al. (“Evidence of electrical activity on Titan drawn from the Schumann resonances sent by Huygens probe" by J.A. Morente, J.A. Portí, A. Salinas, E.A. Navarro, doi:10.1016/j.icarus.2008.02.004.). They use the raw data from HASI-PWA, and they follow a very simple procedure to deduce the Schumann resonances in Titan using the HASI-PWA data, 7.2Hz, 24.0Hz, 36.4Hz, 54.4Hz, 71.6Hz, and 87.2Hz. The calculations with raw data curiously showed a peak at 36.4Hz, but also other resonant modes.

Interactive comment on Geosci. Instrum. Method. Data Syst. Discuss., 3, 157, 2013.