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Observation of interference patterns between Schumann and Ionospheric Alfvén Resonances

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High frequency measurements of the extremely low frequency (ELF) magnetic field are typically analysed using dynamic spectrograms. The sources of magnetic field variation at 1–50 Hz are primarily from the broadband emission of electromagnetic energy from global lightning strikes. The continuous emission allows certain frequencies to resonate within the earth-ionosphere cavity and creates the so-called Schumann Resonances (SR) which occur at around 8, 14 and 22 Hz. Within the same frequency range, Ionospheric Alfvén Resonances (IAR) are created by partial wave reflection between the lower and upper ionosphere. These resonances are often observed as a series of thin fringes typically occurring around 1–8 Hz during local night time in the winter. In addition, Pc1-type magnetospheric pulsations are occasionally recorded. Measurements from two search coil magnetometers at Eskdalemuir (Geomag Lat = 57.5 °N, L = 3.5) in the UK show several unusual features of the IAR including (i) their expansion out to 30 Hz, (ii) destructive interference with the first three SR, (iii) non-linear variation over periods of a few hours and (iv) co-existence of SR, IAR and pulsations. Analysis of data from five years of data (Sep 2012 – Sep 2017) reveal 146 days where IAR clearly destructively interfere with SR. The occurrence of this phenomena is strongly linked to geomagnetic activity and inversely correlated with the solar cycle. We investigate the detailed interaction between the resonances in the time-series data and compare their occurrence against ionospheric conditions as derived from $f_0\mathrm{F}_2$ ionosonde measurements.