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► **To cite this version:**

Frantisek Nemec, Jolene S. Pickett, George Hospodarsky, Ondrej Santolik, Barbora Bezdekova, et al..
Multi-spacecraft observations of quasiperiodic emissions. EGU General Assembly 2016, Apr 2016,
Vienne, Austria. insu-03573540

HAL Id: insu-03573540

<https://insu.hal.science/insu-03573540>

Submitted on 15 Feb 2022

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Multi-spacecraft observations of quasiperiodic emissions

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Whistler mode electromagnetic waves observed in the inner magnetosphere at frequencies of a few kilohertz sometimes exhibit a nearly periodic modulation of the wave intensity. The modulation periods may range from several tens of seconds up to a few minutes, and such emissions are usually called quasiperiodic (QP) emissions. The origin of these events is still unclear, but it seems that their generation might be related to compressional ULF magnetic field pulsations which periodically modulate resonance conditions in the source region. From an observational point of view, single-point measurements are quite insufficient, as they do not allow us to distinguish between spatial and temporal variations of the emissions. Multipoint observations of these events are, on the other hand, rather rare. We present several QP wave events observed simultaneously by several different spacecraft (Cluster, Van Allen Probes, THEMIS, DEMETER). We demonstrate that although the quasiperiodic modulation is observed over a huge spatial region, individual spacecraft do not see the QP elements at exactly the same times. Moreover, when an event is observed simultaneously on the dawnside and on the duskside, the modulation period observed on the duskside is about twice larger than the modulation period observed on the dawnside. We present a qualitative explanation of these phenomena.