

## Short review for recent studies of pulsating aurora in Japan during Arase era

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Pulsating aurora (PsA) is one of the major types of aurora often seen in the lower latitude part of the auroral region in the morning side. PsA is known to have two distinct periodicities. One is the main pulsation whose period ranges from a few to a few tens of seconds. The other is so-called internal modulation which is  $\sim 3$  Hz luminosity modulation during the ON phase of main pulsation. Previous studies indicated that  $\sim 50\%$  of PsA are accompanied by the internal modulation (i.e., internal modulation is often seen, but not always observed during PsA). Recent coordinated ground/satellite observations of PsA suggested that these two periodicities are closely associated with the intensity modulation of whistler mode chorus waves in the morning side magnetosphere. In particular, the association between the main pulsation and bursts of chorus was confirmed for example by Nishimura et al. (2010) and more recently by Kasahara et al. (2018). However, it has still been under debate which characteristics of chorus waves control the existence/absence of internal modulation. This review talk will be focused on several results from recent coordinated ground/satellite observations of PsA (e.g., Ozaki et al., 2019; Hosokawa et al., 2020) since the launch of the Arase satellite. Especially, we will introduce conjugate high-time resolution measurements of fine-scale temporal variations of chorus waves in space and PsA seen from the ground. In addition, we will talk about recent ground-based radar observations of PsA showing the simultaneous precipitation of sub-relativistic electrons during PsA, which will be one of the primary scientific objectives of EISCAT\_3D currently being prepared in Scandinavia.

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