

# Quasi-Periodic (QP) Emissions as Observed by Juno Waves

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## Abstract

A number of quasi-periodic (QP) wave, particle and auroral emissions with periods ranging from tens of seconds to tens of minutes have been detected at Jupiter. The Juno spacecraft with its highly eccentric polar orbit around Jupiter provides a new opportunity to examine these QP signatures. The Juno Waves instrument detects QP plasma and radio emissions during most of its orbits. We discuss the characteristics and occurrence of these emissions as detected by Juno and compare them to earlier observations at Jupiter, Earth and Saturn.

## 1. Introduction

Quasi-periodic (QP) wave emissions with periods ranging from tens of seconds to tens of minutes have been detected at Jupiter [1, 2, 3, 4]. Similar periodicities have also been detected in energetic particle observations [2, 5, 6] and in the brightness of the Jovian aurora [7, 8, 9, 10, 11]. The Voyager spacecraft, during their flybys of Jupiter, detected a QP radio emission occurring at a few kHz [1]. These emissions were originally called Jovian type III radio bursts due to their dispersive spectral shape similar to solar type III radio bursts, though on much shorter time scales. Ulysses observations found that these emissions were made up primarily of two periods, 15 and 40 minutes, and renamed the emissions quasi-periodic emissions because the Jovian type III designation might imply a specific generation mechanism [2]. Galileo observations found similar QP enhancements in the Jovian trapped continuum, but with a much less organized (more random) periodicity compared to Ulysses [12]. Joint Ulysses, Galileo and Cassini observations showed that the many of the QP events were seen simultaneously by multiple spacecraft at very different locations, suggesting that the emission is beamed in a strobe light or flash bulb like manner [3]. The Juno spacecraft with its polar orbit around Jupiter provides

a new opportunity to examine these and other QP signatures.

## 2. Juno Wave Observations

The Juno Waves instrument [13] detects QP emission during most of its orbits. In the outer magnetosphere, QP enhancements of the trapped continuum emission are often detected, with properties similar to the earlier Galileo observations. In the auroral zone, QP enhancements of the auroral plasma waves (primarily auroral hiss) are detected. These high latitude emissions have some similar properties to emissions observed at higher latitudes at Saturn [14, 15]. Juno also detects QP whistler emissions on L shells likely connected to the Io torus. These emissions have some similar properties to QP whistler mode emissions detected at Earth and Saturn.

## 3. Summary and Conclusions

A number of different QP emissions with periods ranging from a few seconds to many minutes are observed at Jupiter. The Juno spacecraft, and its low altitude and high inclination orbit provides a new opportunity to investigate these emissions.

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