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Time signatures of quasi-periodic fast-propagating waves in the solar corona

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Observations of fast magnetoacoustic wave trains, also known as quasi-periodic fast-propagating (QFP) waves, at large heights of the Sun's corona suggest that these waves can travel long distances from the excitation locations. We study characteristic time signatures of fully developed fast magnetoacoustic wave trains guided along the magnetic field by dense plasma slabs in the linear regime. Fast wave trains are excited by a localised impulsive driver and propagate along the waveguide as prescribed by the waveguide-caused dispersion. In slabs with steeper transverse density profiles, developed wave trains are shown to consist of three distinct phases: a long-period quasi-periodic phase with the oscillation period gradually shortening with time, a multi-periodic (peloton) phase in which the harmonics with distinctly different periods co-exist, and a short-lived periodic (Airy) phase. The appearance of these phases is attributed to a non-monotonic dependence of the fast wave group speed on the parallel wavenumber, and is shown to be different for axisymmetric (sausage) and non-axisymmetric (kink) modes. In the Morlet wavelet spectra, this corresponds to the transition from the previously known tadpole-shaped to a boomerang-shaped pattern, with two well-pronounced arms at shorter and longer periods. We describe a specific previously published radio observation of a coronal fast wave train, manifesting the apparent change of the wavelet spectrum shape from a tadpole to a boomerang, which is broadly consistent with our modelling. The applicability of these newly revealed boomerang-shaped fast wave trains for seismological probing of the transverse structuring of the waveguiding coronal plasma is discussed.

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