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Search for predicted pulsations in plasma velocity, temperature and density in loops undergoing thermal non-equilibrium

Long-period intensity pulsations have been recently detected in coronal loops with EUV images of both SoHO/EIT (Auchère et al., 2014) and SDO/AIA (Froment et al., 2015). They are observed with periods ranging from 3 to 16 h, and in loops at coronal temperatures, thus visible at EUV wavelengths. These pulsations have been interpreted as resulting from thermal non-equilibrium (TNE), thus providing a signature of a highly-stratified and quasi-constant heating at the loops footpoints (Froment et al., 2017; Auchère et al., 2016). Depending on the adequacy between the geometry of the loop and the characteristics of the heating, this can result in either complete (at chromospheric temperatures, i.e. those of coronal rain) or incomplete (> 1 MK) condensation and evaporation cycles, that are responsible for the observed intensity pulsations. These events now appear to be common in active regions (see the abstract by F. Auchère).

Using 1D hydrodynamic simulations, Froment et al. (2017) were able to reproduce the observed intensity, temperature, and density pulsations, with incomplete condensation for the active region studied in their previous paper (see the abstract by C. Froment). However, the simulations also predict periodic plasma upflows and downflows along the loops, with velocities up to 40 km/s. Detecting these velocities is thus necessary in order to confirm that the observed intensity pulsations are indeed due to TNE.

In order to characterise these plasma flows in the loops footpoints, we use time series of spatially resolved spectra from the EUV spectrometer Hinode/EIS. From these data, we derive series of Doppler velocity maps which, allows us to track the evolution of the plasma velocity over several pulsation periods. In addition, these spectroscopic measurements allow us to make a more accurate diagnostic of the plasma temperature and density in the loops, which we then compare to the results of the simulations, and to the observations from AIA and EIT.

We will present the analysis of four sets of EIS data, each corresponding to the observation of a region where intensity pulsations where detected in AIA data by Froment et al. (2015). So far, the plasma flows predicted by simulations for pulsating loops (with measured velocities expected around 20 km/s due to the projection) could not be identified in any of the EIS data sets that we studied. Observational effects like line of sight ambiguities or insufficient resolution might be the reason for this non-detection. However, the fact that we consistently detect no signature of the predicted periodic flows suggests that the 1D hydrodynamic codes used by Froment et al. to model the pulsations do not properly reproduce the physics of the phenomenon.