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Stratification and time scale of the heating from long period intensity pulsations in coronal loops

The discovery of long-period intensity pulsations in coronal loops bring a major constraint for loop heating theories. These EUV pulsations, with periods between 2 and 16 hours, can be found at least in half of the active regions, in particular in loops (Auchère et al. 2014). They are understood to be due to evaporation and condensations cycles, resulting of a quasi-constant and highly-stratified heating (Froment et al. 2015, 2017; Auchère et al. 2016). These loops enter in a regime of thermal non-equilibrium (TNE). The thermal runaway triggered during the cooling phase of TNE cycles is believed to play a major role in the formation of coronal rain (Müller et al. 2003, 2004; Antolin et al. 2010,) and prominences (e.g., Antiochos & Klimchuk 1991; Karpen et al. 2006).

In order to understand the physical conditions that favor such cycles, we conducted 1D hydrodynamic simulations to scan different loop geometries and heating configurations. This study reveals that TNE cycles are confined to specific ranges in the parameter space. This naturally explain why these pulsations, remaining during several days, are encountered in some loops but not in all. In an active region both loop geometry and heating properties are varying from a loop to another, only the loops with a good match between both can enter in a TNE evolution. Moreover, this parameter space study reveals multiple scenarios, in particular concerning the condensation thermodynamics and their localisations. For example, some heating configurations lead to “incomplete” condensations (the temperature and density remaining coronal, i.e. Mikić et al. 2013) while others show “complete” condensations (high density blobs, chromospheric temperature) that develop locally in the corona. These various scenarios need to be further explored. The characterisation of TNE cycles, combining observation and modeling, is indeed a key step to constraint the frequency and the location of the heating in coronal loops.