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Study of the Impact of Coronal Rain on Kink Oscillations of Coronal Loops

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Abstract. Coronal rain occurs in thermally unstable coronal loops, and comprises cool plasma condensations, falling towards the solar surface, guided by the magnetic field. Sometimes the coronal rain clumps are seen to be subjected to transverse oscillations. The numerical simulations have indicated that coronal rain can onset kink oscillations in coronal loops and can affect the properties of oscillations. In this proceeding, we present the analysis of transverse oscillations in conjunction with coronal rain. Atmospheric Imaging Assembly (AIA) is used to examine the characteristics of coronal loop oscillation before and after coronal rain development. The analysis showed that the amplitude and period of oscillations are greater during coronal rain.

Keywords. magnetohydrodynamics (MHD) - Sun: corona - Sun: magnetic fields - Sun: flares - waves

1. Introduction

Transverse displacements of coronal loops are understood as standing kink modes (Edwin & Roberts 1983). They can be generated by nearby flare or any energetic event and can have decaying behaviour (White et al. 2012, Sarkar et al. 2016). The other type of kink oscillations, known as decay-less kink oscillations, can be persistent without any decaying behaviour and are very common in the solar corona (Anfinogentov et al. 2015). The responsible drivers for the generation of these oscillations are suggested as random footpoint motions or supergranular motions near footpoints (Nisticò et al. 2013, Nakariakov et al. 2016).

Other than the excitation mechanism of kink oscillations mentioned above, Verwichte & Kohutova (2017) presented the first observational evidence of excitation of kink oscillation by coronal rain production at the loop apex of a coronal loop. Their study revealed the variation of the oscillation properties due to the loop's evacuation caused by the descent of coronal rain clumps. Their study also indicated some signs of transverse oscillations before coronal rain in an overlying loop but not in the same loop due to the coarser resolution of AIA. The quantification of oscillation properties of a coronal loop before and after the development of coronal rain can provide information about the effect of coronal rain on kink oscillations.

In this article, we discuss the properties of kink oscillation before and after the production of coronal rain and examine the change in the properties of oscillations due to coronal rain.

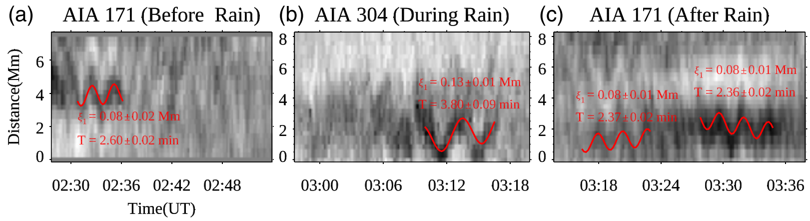

Figure 1. Motion Magnified x-t maps for Slit 3 in (a) AIA 171 before coronal rain, (b) AIA 304 during coronal rain, and (c) AIA 171 after coronal rain. The x-t maps are inverted in intensity. ξ_1 and T represent the amplitude and period of oscillations obtained after fitting.

2. Our Work

The event was observed in the 304 and 171 passbands of AIA and 1400 and 2796 passbands of Slit-Jaw Imager (SJI). These passbands allow us to track the oscillations at similar positions before, during, and after the formation of the coronal rain. The oscillations amplitudes detected in SJI passbands during coronal rain are below $\approx$ 1Mm, which is near the resolution of AIA. This fact motivated us to use the motion magnification technique (Anfinogentov & Nakariakov 2016) with a motion magnification factor of 7 to magnify the transverse oscillations in AIA passbands. We placed nine artificial slits in two coronal loops exhibiting transverse oscillations and coronal rain simultaneously. We obtained properties of these oscillations by fitting individual oscillating threads. Figure 1 shows an example of oscillations detected in Slit 3 before, during and after coronal rain.

3. Conclusions

AIA 171 x-t maps show that the oscillation periods and amplitudes are lower before and after coronal rain. The increase in amplitude during coronal rain can be due to its formation in a small time scale which can act as a sudden perturbation. The change in density profile along the loop due to the fall of coronal rain can be the reason behind the low period after coronal rain (Verwichte & Kohutova 2017, Kohutova & Verwichte 2017). For a detailed information on the work, please see this presentation.

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