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# Simulation of prominence oscillations triggered by a coronal shock

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Solar prominences are plasma structures hundred times colder and denser than the background corona in which they reside. They are characterized by their magnetic topology, usually in the form of a magnetic arcade or a flux rope. Prominences (particularly in the quiet Sun regions) are often perceived as very stable and static structures. When observing them up-close it becomes clear they are highly dynamic. They exhibit multiple flows (counterstreamings) and small thread-like structures (fibrils) that can change on a time scale of minutes. Embedded in the magnetically dominated, dynamic corona, prominences are also often seen oscillating [1]. Very frequently, those oscillations are induced by coronal shock waves. Understanding the interplay of mechanisms that cause prominence and thread oscillations provides important insight into the solar corona. Multiple numerical simulations of oscillations have been conducted [2, 3, 4] in order to analyze the exact mechanisms governing prominence behavior. However, to date, most of the studies on oscillation in prominences ignored their fine structure. Further on, most studies simply imposed velocity perturbations directly on the prominence. Making it numerically simple, but in such a way ignoring every possible effect induced by the presence of the driver in the domain. We simulate a 2D adiabatic prominence where we focus on its thread-like structure and their large amplitude oscillations induced by the realistic source we impose. We aim to study causal relations between a localized energy source (positioned in the left foot of the coronal arcade) and a remote prominence oscillation. The ideal magnetohydrodynamic (MHD) equations are solved using an open source MHD code, MPI-AMRVAC ([5], http://amrvac.org/). The grid we employ allows us to resolve lengths of 36×7.5 km. This exceeds resolution limits of observations. The full extent of the domain is shown in Fig. 1, where the gravity is already taken into account. Beside the global, longitudinal motion that resulted from the shock's impact, small scale transverse oscillations are also evident. As for the longitudinal oscillations, our results show that the pendulum model failed to estimate the period of the prominence oscillation. The influence of the source is highly important and should be taken into account in order to improve our understanding of the prominence oscillatory dynamics. The transverse oscillations represent small scale oscillations that nonetheless have important influence on the total motion of the individual threads. Also, multiple high frequency oscillations are clearly observed in the studied parameters (displacement, velocity and the magnetic field) of each thread. They seem to be caused by the propagation of Alfven and magnetosonic waves. This has important implications considering these waves connect the chromospheric system (where the coronal arcade is rooted) and the corona where the prominence is located.

References

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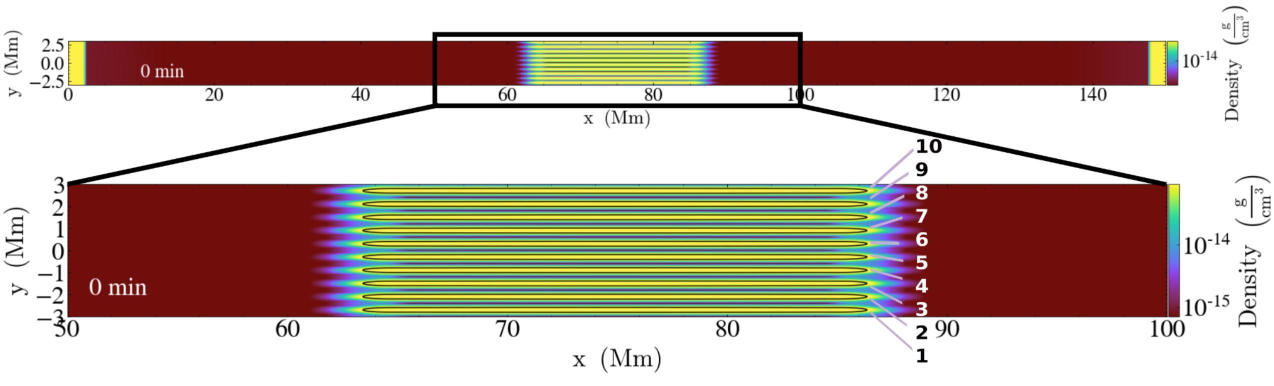


**Figure 1**: A density plot of the domain at t=0 (after the relaxation phase). In the lower part of the figure, a cut-out focusing on the area of the threads is shown. The black contour lines mark the area with a number density higher than $5\times10^{10}$ $cm^{-3}$. We label the threads with 1-10, starting from the bottom to the top one.