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Comprehensive simulations of solar prominences with MURaM

Solar prominences consist of cool and dense plasma that is suspended in the corona, surrounded by hotter and less dense coronal material. As predecessors of coronal mass ejections, solar prominences are important drivers of space weather, but their exact formation mechanism is still unknown. We use the radiative magnetohydrodynamic code MURaM to simulate the formation and dynamics of prominences in the solar atmosphere. MURaM includes the relevant physical processes to realistically simulate the solar photosphere, chromosphere and corona.

By fixing bottom boundary conditions for the magnetic field, we create a stable dipped magnetic field configuration in a 3D box of 80 x 30 x 10 Mm in size and let it evolve. In the course of the simulation, a dense plasma seed ejected from the chromosphere settles into a magnetic dip and is cooled by radiative losses. The resulting pressure drop drives a strong flow of plasma into the feature and builds up a cool, long-lasting structure in the solar corona. This prominence is very dynamic but stable due to the stability of the underlying magnetic field. Its structure and dynamics are comparable to certain observations of real prominences. In this talk, we present the formation mechanism in our simulation and show how different radiative treatments influence the properties of the simulated prominence.

Primary author: ZESSNER, Lisa-Marie (Max Planck Institute for Solar System Research, Goettingen, Germany)

Co-authors: CAMERON, Robert (Max Planck Institute for Solar System Research); SOLANKI, Sami (Max Planck Institute for Solar System Research); PRZYBYLSKI, Damien (Max Planck Institute for Solar System Research)

Presenter: ZESSNER, Lisa-Marie (Max Planck Institute for Solar System Research, Goettingen, Germany)

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