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Towards Realistic Solar Flare Models

Solar flares release magnetic energy in reconnection events heating the atmosphere in the process. Solar flares are inherently multi-scale; The entire flare may stretch Mm scales and evolve on timescales of hours, while the reconnection region is far smaller, on the order of particle mean free path, and may have timescales of just a few seconds. The small scales break the fluid description (MHD) which is commonly used to model the solar atmosphere. To accurately model reconnection events a kinetic approach such as PIC is needed. PIC solvers are far more computationally demanding than MHD and modeling an entire flare with a kinetic approach is not feasible.

There are undoubtedly feedback effects between small and large scales. These effects are poorly understood as the resolution from observations is far too poor and currently, no simulation has resolved both small and large scales. The high-resolution, high cadence spectrograph observations available with SST/IRIS (and the extraordinary observational capabilities of MUSE in the future) combined with multi-scale simulations may offer new insights into these effects. Here we present the first steps towards an integrated solution where PIC and MHD solvers run concurrently in different parts of the computational domain. The ultimate goal is to model a solar flare and the surrounding corona in a realistic 3D simulation.

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