3D MHD modeling of coronal loops

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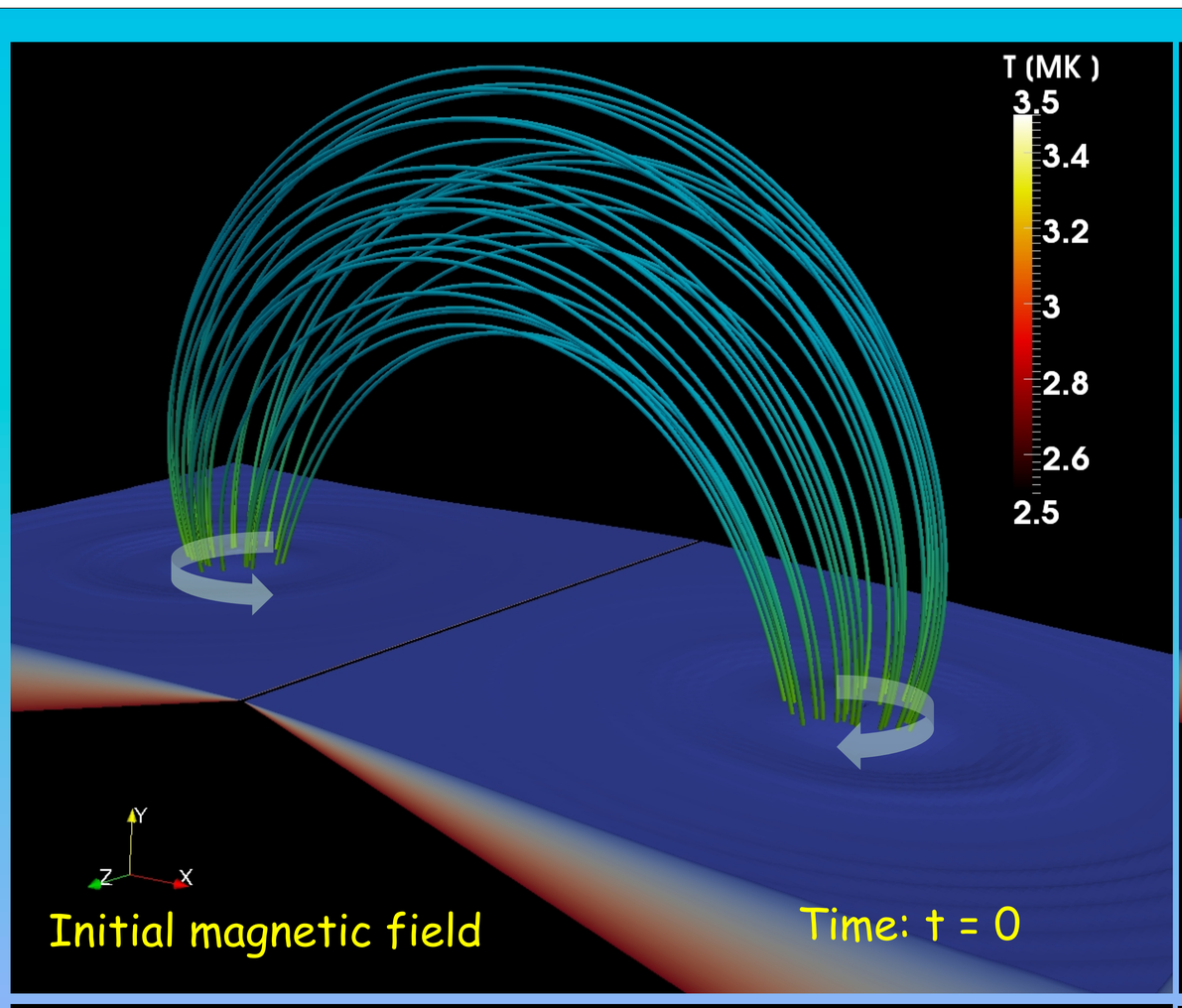
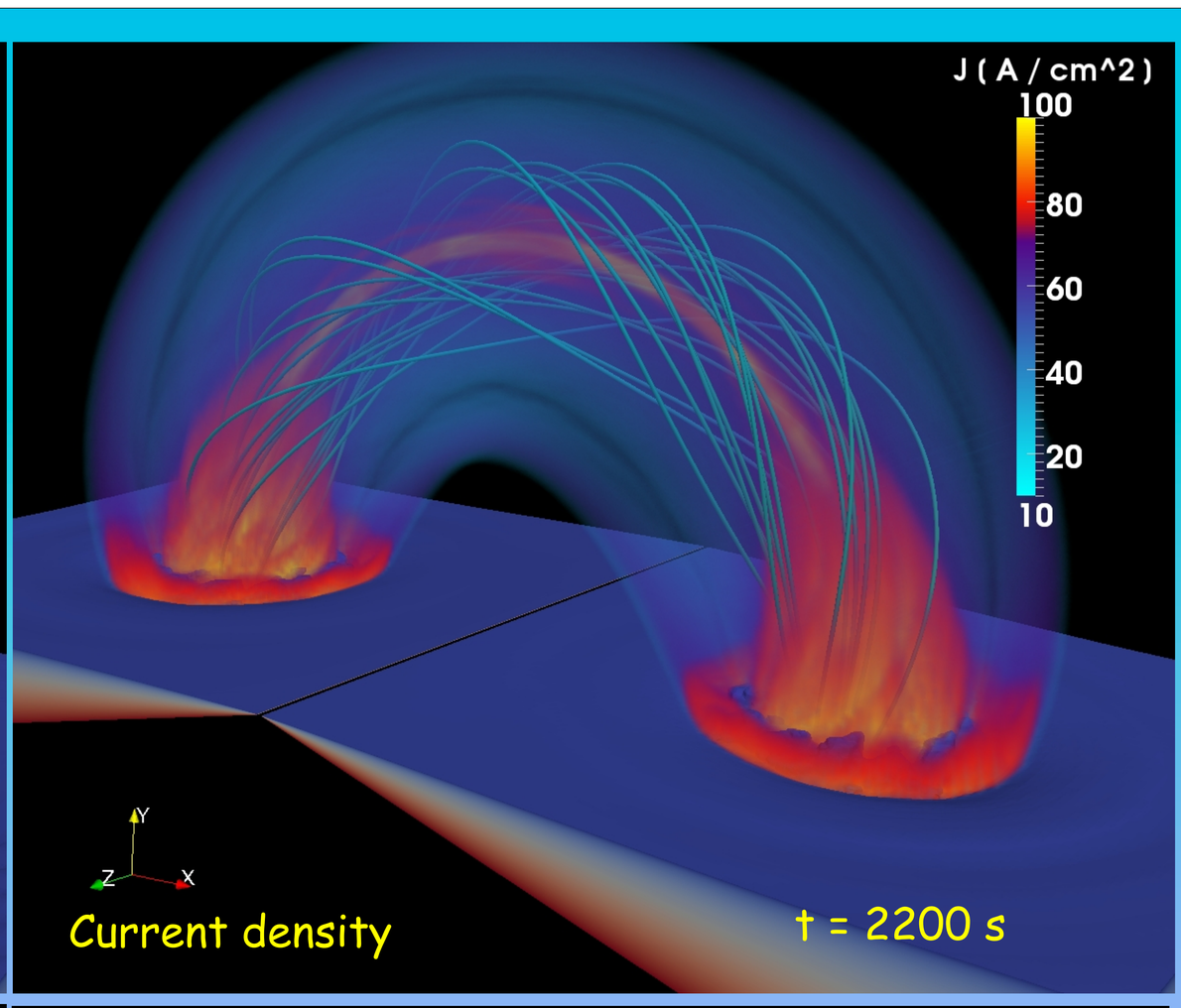
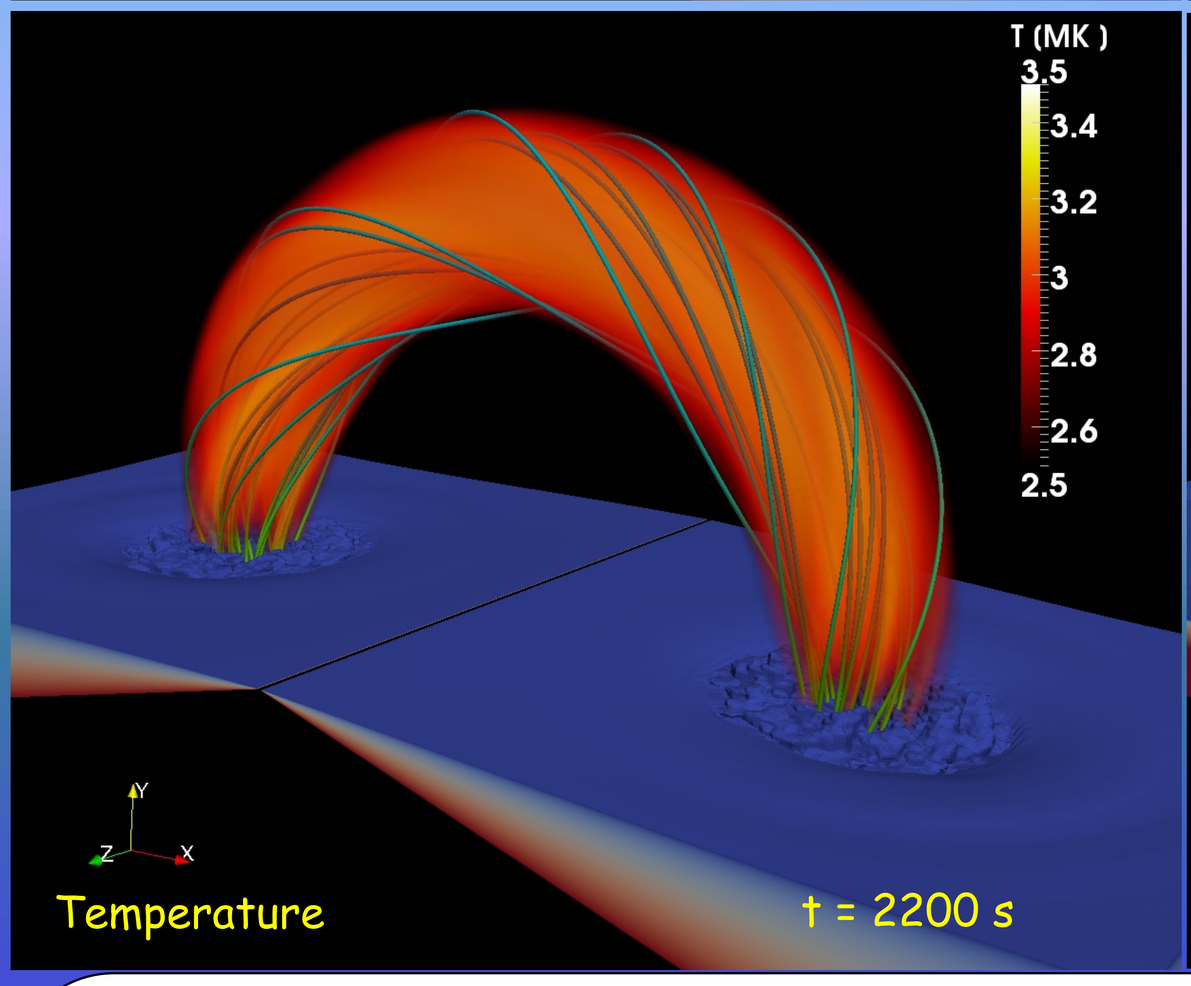
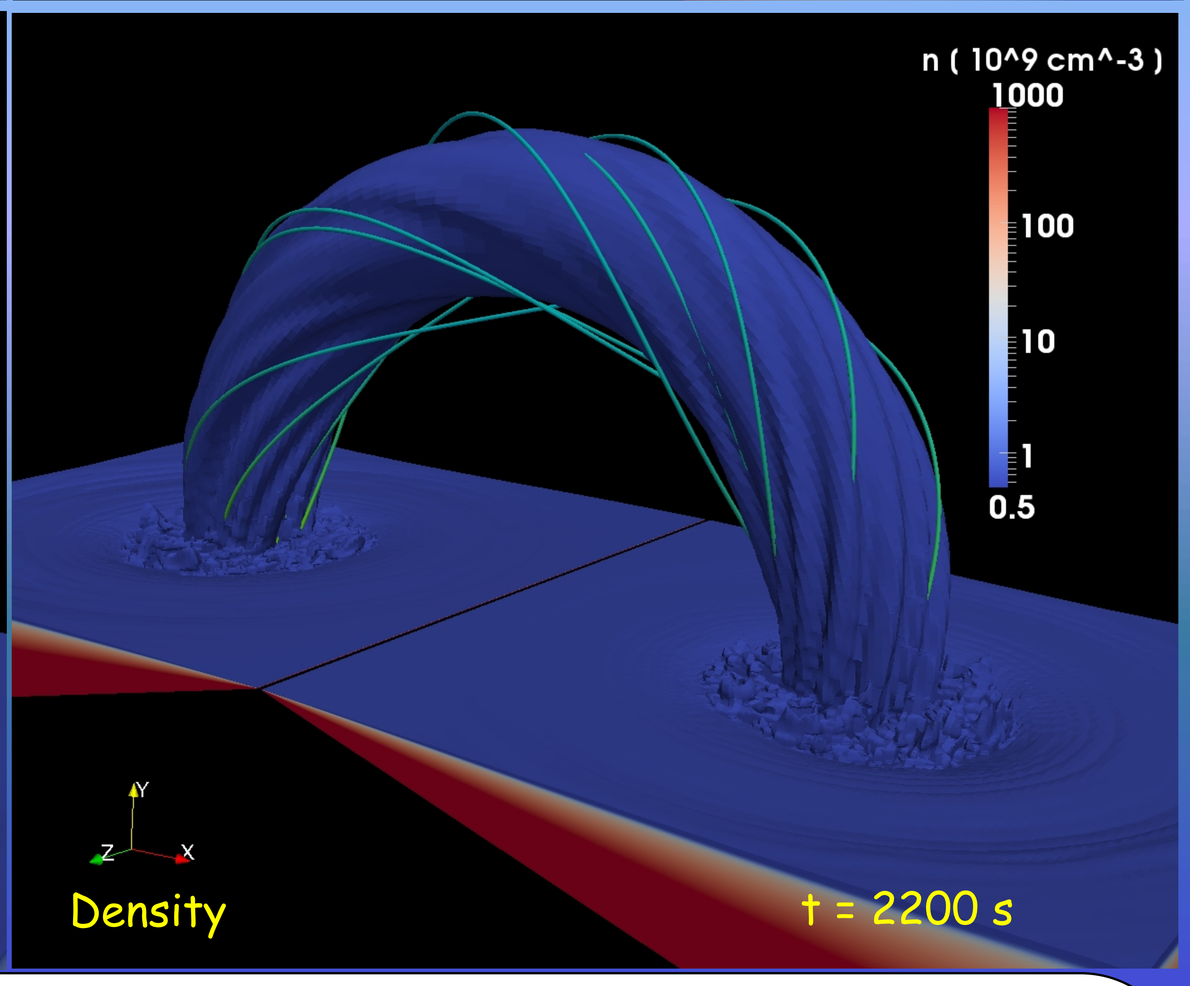
We extend modeling single bright coronal loops to include the interaction with a non-uniform magnetic field. The field is stressed by footpoint rotation in the central region and its energy is dissipated into heating through the induced currents. We model an entire single magnetic flux tube with gravity of a curved loop, in the solar atmosphere from the high-beta chromosphere to the low-beta corona through the steep transition region. The magnetic field expands from the chromosphere to the corona. We obtain a loop evolution typical of previous loop modeling. The plasma confined in the flux tube is gradually heated to active region temperature (~3 MK) and upflows from the chromosphere gradually fill the core of the flux tube.









Rationale

- 3D MHD simulation (cylindrical geometry, r,φ,z) of a twisted coronal flux tube [PLUTO MHD code (Mignone et al. 2007)]
- The tube is tapered below the transition region
- The twisting is driven by plasma rotation at the footpoints
- Coronal heating is produced by the dissipation of currents through anomalous resistivity (above a current threshold)
- Filamentary structure is caused by random perturbations that we put in the footpoint rotation
- Currents are dissipated mostly in the low corona, where the magnetic field is more intense
- The evolution is globally similar to that obtained with standard loop modeling, including coronal temperature and chromospheric evaporation