Observations and data-initiated simulations on quiescent prominences

Although solar prominences have long been observed, one kind of fundamental prominence feature, prominence leg, has not been well understood. Using multi-perspective observations from the Solar Dynamics Observatory and the Solar Terrestrial Relations Observatory, we obtained true three-dimensional (3D) coordinates of substructures of three stable prominences via stereoscopic reconstruction, and faithfully measured the height, length, and inclination angle of prominences legs. We find that the prominences legs are not perpendicular (90 degrees inclination angle) to the solar surface with an average inclination angle of about 67 degrees, and over 90% of the footpoints of the legs are located at magnetic network tracing supergranular boundaries. To understand the origin of magnetic structures of prominence legs, we performed data-initiated 3D MHD simulations with the initial magnetic field built by linear force-free field extrapolation from an observed magnetogram covering a prominence breeding region. We used a data-constrained large-scale converging flow towards the polarity inversion line (PIL) at the bottom boundary to drive the formation of prominence magnetic structures. As the opposite-polarity magnetic flux elements were pushed together and canceling through magnetic reconnection, sheared arcades are connected to form two flux ropes above the PIL. Between the two flux ropes, a shear arcade did not transform to a flux rope due to weak magnetic field and weak flux cancellation. The flux ropes have hyperbolic forms with X lines and small arcades underneath, which is different from previous ideal flux-rope-formation models in which flux ropes touch down the bottom boundary. The magnetic dipped regions inside the flux ropes have irregular ribbon shapes and slightly deviate from the PIL.