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Magnetic flux rope model for solar coronal loops[1] LINDA SUGIYAMA, Massachusetts Institute of Technology, M. ASGARI-TARGHI, Harvard-Smithsonian Center for Astrophysics — Coronal loops on the surface of the sun appear to be magnetic flux ropes, but details are obscured by the difficulty of solar observations. Toroidal magnetic fusion plasmas provide a deep theoretical resource for analyzing their configuration and stability. Curved plasma loops with finite pressure are unstable to expansion in major radius, while the solar gravity and magnetic field can provide stabilizing forces. A MHD model for simple loops[2] parametrizes loop steady states in terms of the MHD gravity parameter $\hat{G} = ga/v_A^2$ relative to the plasma beta β and inverse aspect ratio $\epsilon = a/R_o$ (g is the acceleration due to gravity and v_A the shear Alfvén velocity). At the maximum $\hat{G}/\beta \sim \epsilon^2$, the plasma density varies strongly between the top and the bottom ends of the loop. Comparison to observed thin loops in solar active regions show that the predicted steady states fit the range of observed heights and that height increases with $\hat{G}$ up to the critical limit. The model also describes features of the thicker loops that give can rise to solar flares and coronal mass ejections and provides insight into a number of open questions in solar physics.

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[2]L. Sugiyama, M. Asgari-Targhi, Phys. Plasmas 24, 022904 (2017).

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