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Solar coronal magnetic field measurements through MHD wave observations

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Being the primary source of energy in the solar corona, the magnetic field plays a dominant role in driving solar eruptions and heating the coronal plasma. However, direct measurement of the coronal magnetic field is very difficult to achieve. We have tried to infer information on the coronal magnetic field through a variety of techniques. For instance, we have performed microwave diagnostics of the magnetic field strengths in solar flare loops based on the theory of gyrosynchrotron emission [1], and found that the field strength typically decreases from 800 G near the loop footpoints to 100 G at a height of 10–25 Mm. We have also diagnosed the magnetic field structure of a coronal cavity observed during the 2017 total solar eclipse, through a combination of magnetic field modeling and linear polarization measurements of coronal forbidden lines [2]. Observations of MHD waves have been used to derive the magnetic field strengths of individual oscillating structures. However, most of these waves are observed in some local coronal regions and they often show quick damping, and thus the magnetic field diagnostics cannot be applied to a large region in the corona for a long time. The discovery of decayless/persistent oscillations makes this technique more promising [3,4]. Recently, with new observations of propagating transverse MHD waves in the corona, we have managed to produce the first map of the global coronal magnetic field based on actual coronal observations [5]. Our measurements show that the magnetic field strength is mostly in the range of 1-4 Gauss in the range of 0.05-0.4 solar radii from the solar limb.

References

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Figure 1: Persistent Doppler shift oscillations in coronal loops [4].