TORSIONAL OSCILLATIONS OF THE SUN*

(Invited Review, Abstract)

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Abstract. A series of digitized synoptic observations of solar magnetic and velocity fields has been carried out at the Mount Wilson Observatory since 1967. In recent studies (Howard and LaBonte, 1980; LaBonte and Howard, 1981), the existence of slow, large-scale torsional (toroidal) oscillations of the Sun has been demonstrated. Two modes have been identified. The first is a travelling wave, symmetric about the equator, with wave number 2 per hemisphere. The pattern–alternately slower and faster than the average rotation–starts at the poles and drifts to the equator in an interval of 22 years. At any one latitude on the Sun, the period of the oscillation is 11 years, and the amplitude is 3 m s^{-1}. The magnetic flux emergence that is seen as the solar cycle occurs on average at the latitude of one shear zone of this oscillation. The amplitude of the shear is quite constant from the polar latitudes to the equator. The other mode of torsional oscillation, superposed on the first mode, is a wave number 1 per hemisphere pattern consisting of faster than average rotation at high latitudes around solar maximum and faster than average rotation at low latitudes near solar minimum. The amplitude of the effect is about 5 m s^{-1}. For the first mode, the close relationship in latitude between the activity-related magnetic flux eruption and the torsional shear zone suggests strongly that there is a close connection between these motions and the cycle mechanism. It has been suggested (Yoshimura, 1981; Schüssler, 1981) that the effect is caused by a subsurface Lorentz force wave resulting from the dynamo action of magnetic flux ropes. But, this seems unlikely because of the high latitudes at which the shear wave is seen to originate and the constancy of the magnitude of the shear throughout the life time of the wave.

References

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