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Twisted magnetic flux tubes in the solar wind

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Magnetic flux tubes in the solar wind can be twisted as they are transported from the solar surface, where the tubes are twisted owing to photospheric motions. The twisted magnetic tubes can be detected as the variation of total (thermal+magnetic) pressure during their passage through observing satellite. The twist of isolated magnetic tube may explain the observed abrupt changes of magnetic field direction at tube walls. For the tubes aligned with the Parker spiral, the twist angle can be estimated from the change of magnetic field direction. The twisted tubes are unstable to kink instability when the twist exceeds a critical value. It is shown that the critical twist angle of the tube with a homogeneous twist is 70 degree, but the angle can be decreased owing to the motion of the tube with regards to the solar wind stream. Tangential velocity discontinuity near the boundaries of individual tubes may also result in the Kelvin-Helmholtz instability. It is shown that the axial magnetic field stabilizes the instability in the case of sub-Alfvenic speeds. But even small twist in the external magnetic field allows the Kelvin-Helmholtz instability to be developed for any speed. Therefore, twisted magnetic flux tubes can be unstable to Kelvin-Helmholtz instability when they move with small speed relative to main solar wind stream. The Kelvin-Helmholtz vortices may significantly contribute into the solar wind turbulence.

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