

Effects of elongation in expansion of cylindrical flux ropes

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We included effects of elongation of a cylindrical flux rope as well as radial expansion in 1-dimensional MHD simulations. The elongation rate was assumed to be the same as the radial expansion rate. The simulation results showed that a flux rope expands preserving the force-free state. The results suggest a new analytical force-free flux rope model for data fitting. Some of the observational data were fitted to this model better than the previous one.

The magnetic field of a flux rope in interplanetary space is believed to be in the force-free state. However the cylindrical flux rope model that has been used for fitting to observational data is in the force-free state only when a spacecraft encounters a flux rope. The force-free state is not satisfied as the flux rope expands. In this study we included effects of elongation of a cylindrical flux rope as well as radial expansion in 1-dimensional MHD simulations. The elongation rate was assumed to be the same as the radial expansion rate. The simulation results showed that a flux rope expands preserving the force-free state. The results suggest a new analytical force-free flux rope model for data fitting. Some of the observational data were fitted to this model better than the previous one.