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MHD numerical simulations of a magnetic flux tube emerging into the solar corona and associated active phenomena

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It is suggested that emerging flux build up magnetic energy in the solar corona that could become the source of flares or CMEs. Emerging flux also plays an important role in active region formation and disappearance. To investigate these phenomena, it is necessary to study the evolution of an emerging flux from the convection zone to the corona. Photosphere is gas pressure dominant (high plasma beta) region. So a magnetic flux tube in there could have some twists. To study emerging process of twisted flux tube, three dimensional MHD simulation is necessary. However, in almost all past numerical simulations for studying emerging process of twisted flux tube from convection zone to the upper corona, very strong twist (more than one times round in half wavelength at initial state) is approximated. On the other hand, from observation, more weak twist flux tubes are often seen. So in this paper we will show the results of our three-dimensional MHD simulations of emergence of a twisted flux tube for studying effects of twist intensity, especially for weak twist case. We found that in weak twist case (including no twist case), a tube fragments once around the photosphere, and is extended to horizontal direction. Then emerging motion is rapidly suppressed. However, new emergence starts after fragmentation as continuously emerged flux from the bottom of the tube filling the photosphere. Also magnetic energy brought into the corona by emerging flux tube depends on twist intensity. We will also show that active phenomena, jet or surge caused by interaction between emerging flux tube and overlying active region magnetic fields.