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# Flares on the sun and young stars

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Magnetic reconnection is a general driver of various kinds of explosions in the astrophysical systems. Solar flares are a typical example of explosions driven by magnetic reconnection. Magnetic reconnection occurs in a thin, localized electric current sheet. However, change in magnetic topology leads to rapid releases of magnetic energy stored in a volume with a larger scale, and mass ejection to the interplanetary space. Because of the characteristics, solar flares intrinsically involve both small scale (kinetic) and large scale (MHD) processes. The key MHD processes for solar flares are the emergence of magnetic field from the solar interior to the solar atmosphere, the formation of electric current sheet in the corona, the onset of magnetic reconnection, and the consequences of magnetic reconnection that involve the formation of jets, the shock heating, and particle acceleration. In this talk, we will discuss how solar flares occur on the basis of our simulations and observations. We particularly focus on the energy release processes that are associated with shock formation and plasmoid formation. Our numerical simulations show that flaring regions will be full of shocks, and these shocks change their shapes dynamically. The strongest shock (so-called termination shock) is highly affected by the backflow of the reconnection outflow, and changes its strength quasi-periodically. Shocks are regarded as a promising site for particle acceleration, and observations show that many flares display quasi-periodic pulsations in non-thermal emissions. Therefore, our results could be relevant for understanding the particle acceleration in solar flares. Not only shocks but also plasmoids (magnetically confined plasma) are believed to play important roles in particle acceleration. We will present an observational example in which spatially resolved plasmoid dynamics and non-thermal radio emissions are tightly correlated. Observations have shown that young stars produce more violent flares. We will briefly discuss how such flares can occur on young stars.

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