17th European Solar Physics Meeting ESPM-17

Contribution ID: **28** Type: **Poster**

Magnetic Helicity Evolution During Active Region Emergence and Subsequent Flare Productivity

Solar active regions (ARs), which are formed by flux emergence, serve as the primary sources of solar eruptions. However, the specific physical mechanism that governs the emergence process and its relationship with flare productivity remains to be thoroughly understood. In this study, we examined 136 emerging ARs, focusing on the evolution of their magnetic helicity and magnetic energy during the emergence phase. Based on the relation between helicity accumulation and magnetic flux evolution, we found that these emerging ARs can be categorized into three types: Type-I, Type-II and Type-III, accounting for 52.2\%, 25\%, and 22.8\% of the total number, respectively. Type-I ARs exhibit a synchronous increase in both the magnetic flux and magnetic helicity, while magnetic helicity in Type-II ARs displays a lag of increase behind the magnetic flux. Type-III ARs show obvious helicity injections of opposite signs. Significantly, 90\% of the flare-productive ARs (flare index ≥ 6) were identified as Type-I ARs, suggesting that this type of ARs has a higher potential to become flare-productive. In contrast, Type-II and Type-III ARs exhibit the low likelihood of becoming active. Our statistical analysis also revealed that Type-I ARs accumulate more magnetic helicity and energy, far beyond those in Type-II and Type-III ARs. Moreover, it is observed that flare-productive ARs consistently accmulate a significant amount of helicity and energy during their emergence phase. These findings provide valuable insights into the flux emergence phenomena, offering promising possibilities for early-stage predictions of solar eruptions.

Primary authors: SUN, Zheng (Peking University); CHEN, Yajie (Peking University); Dr ZHANG, Mei (National Astronomical Observatories, China); Dr WANG, Quan (National Astronomical Observatories, China); Dr YANG, Shangbin (National Astronomical Observatories, China)

Co-authors: TIAN, Hui (Peking University); Dr LI, Ting (National Astronomical Observatories, China)

Session Classification: Coffee break and poster session 1

Track Classification: Energy and mass transfer throughout the solar atmosphere and structures within