Long-Term Datasets for the Understanding of Solar and Stellar Magnetic Cycles
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The coronal green line monitoring: a traditional but powerful tool for coronal physics

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Abstract. The particular environment with high temperature and low plasma density in the corona results to the formation of some forbidden emission lines, in which the well-known green line at 530.3 nm has been utilized to diagnose the corona for a few decades. For the green line, besides its contribution on revealing the long-term coronal cycles as well as their relationship to the other solar phenomena, it is also helpful to detect limb coronal waves and ejections originated from the lower corona which seems not to be paid close attention to. Suggestions are presented that we not only need to keep the green line observation as a routine task for current coronagraph observations, but need to develop larger coronagraphs with advanced technology.

Keywords. Corona, magnetic fields, sunspots, emission lines.

1. Background and current situation

The coronal green line in the optical part of spectrum, Fe XIV 530.3 nm, is being popularly used in ground-based coronagraph observations covering a few solar cycles (Badalyan *et al.* 2001, Sýkora 1992a, 1992b, Sakurai 1998, 2004, Sakurai & Suematsu 2002). Its strong brightness and high sensitivity to magnetic field on the photosphere are helpful to study the evolution of coronal magnetic field and plasma density. Using the observations from 530.3 nm and the other coronal lines, people can study the cycle relation between the corona and the sunspot number, as well as the detailed eruption process occurring in coronal environment. Although the coronal brightness distribution of 530.3 nm is thought closely related to the magnetic field on the photosphere from below, a careful comparison by Bludova (2005) shows the complicated relationship between them and a simple one-to-one correspondence may not work for the relation between the sunspot size and the green line brightness above it on short time scale. Sometimes, different coronal emission lines could present their asymmetry of coronal intensity distribution in the opposite sense, and the correlation between sunspot numbers and the green coronal intensity north-south asymmetry seems not perfect (e.g., Ozguc & Ucer, 1987). The asymmetry of different solar indices provides an important clue to understanding subphotospheric dynamics and solar dynamo action. Moreover, different coronal emission lines, including the famous red line and the green line, can show different local structures for coronal magnetic fields (e.g., Habbal *et al.* 2010). Significant temporal shift in the coronal manifestation of the magnetic flux asymmetry relative to the photosphere is noticed and the shift can be explained by the delayed coronal evolution in responding to the magnetic flux emergence (Sýkora & Rybák 2010).

Currently, the number of ground-based coronagraph stations has been very few in the world, which causes the critical problem how to keep the long-term green line observations

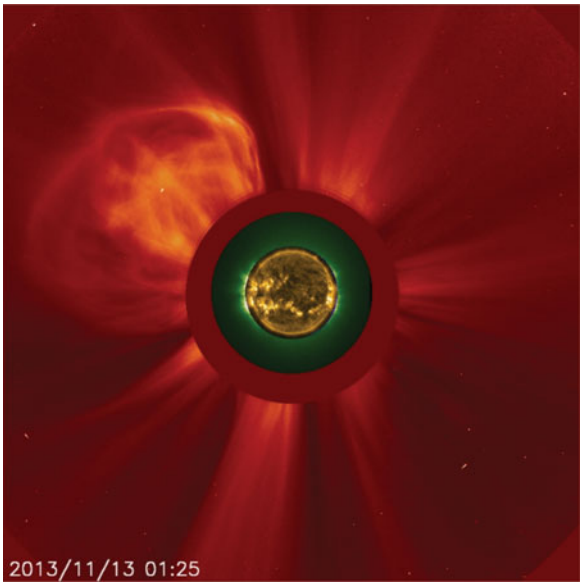

Figure 1. A composite coronal image with large field of view including solar full disk (AIA/SDO, 171 Å), inner corona (Lijiang, 530.3 nm) and outer corona (C2/LASCO, white light wavelength).

with enough data. A new coronagraph station has been built at Lijiang Station ($26^o41.7'$ N, $100^o1.8'$ E, alt. 3200 m) and one Norikura 10-cm coronagraph (Ichimoto *et al.* 1999) has been relocated in Lijiang successfully to continue working at 530.3 nm wavelength. In Figure 1, the inserted data in green is shown for its field of view.

2. Future prospects and conclusion

Although the maintenance and running of a ground-based coronagraph station is hard due to the high altitudes and sometimes shortage of funding, more and more scientists have realized that keeping the long-term and high-resolution for coronal observations is critical for better understanding solar cycles as well as stellar coronal physics. A site survey project (11533009 NSFC) has been supported aiming to find excellent sites in western China to build large coronagraphs (Liu *et al.* 2016).

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