

Professional-Amateur Collaboration in the Scientific Observations of Total Solar Eclipses

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Abstract. Professional solar scientists and amateur astronomers in Japan have energetically collaborated in observations of total solar eclipses in the last ten years. The collaboration has been producing scientific results, which have been published in refereed journals. Total eclipses have some advantages to involve amateurs in scientific observations, and therefore, the observation of total eclipses is one of the most suitable targets to promote the participation of amateurs in scientific astronomical observations, or citizen science. Furthermore, because astronomers from various nations gather to observe eclipses, it is expected that more extensive collaborations are promoted by an international organization such as IAU. Here we present our collaborative activities in the total solar eclipse observations so far, and we would like to appeal for a wider expansion of such activities.

Keywords. Sun: corona, citizen science

1. Introduction

Observations of total solar eclipses are still scientifically important, because a wide range of the corona can be observed at total eclipses, whereas it is difficult to observe the corona between about $1.2\text{--}2 R_{\odot}$ with the current spaceborne instruments. However, the totality lasts only a couple of minutes at a site, and the good weather conditions are required to obtain high-quality data. Multi-site observations solve these problems, but it is difficult to dispatch many professional expeditions for an eclipse. On the other hand, amateur observers widely spread along the total eclipse path. If they take scientific data, multi-site scientific observations of the corona can be realized. Total solar eclipses are very good chance for amateurs to participate the scientific observations. Professionals and amateurs in Japan have been collaborating in the scientific observations of solar eclipses for ten years, and they have really obtained some scientific results.

2. Results from the Collaboration

Here we present some examples of the scientific results obtained under the professional-amateur collaboration.

During the total solar eclipse on 2012 November 13, an ongoing coronal mass ejection (CME) and a pre-CME loop structure just before the eruption were caught in the height gap of the observation with spaceborne instruments (Hanaoka et al. 2014). We observed this eclipse at two sites, where the totality occurred 35 min apart. The source region of CMEs, where the material and the magnetic field of CMEs were located before the eruption, was revealed to be in this height gap as shown in Figure 1(a). The eclipse

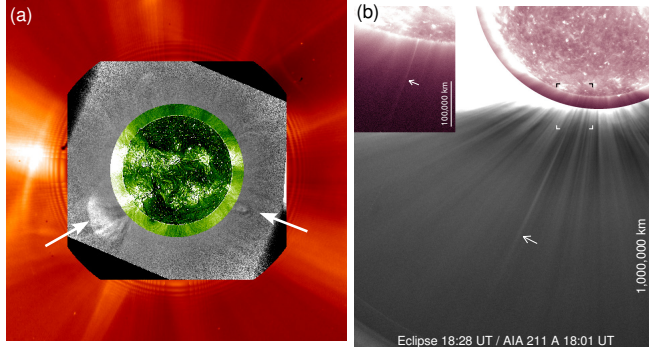


Figure 1. (a) SDO/AIA, eclipse difference, and SOHO/LASCO composite image of the 2012 November 13 eclipse. An ongoing CME and a pre-CME structure are designated by arrows. Both of them are located in the gap between the AIA and the LASCO coverage. (b) An example of coronal jets found at the 2017 August 21 eclipse. At 18:01, the jet appeared in the EUV image, and about 30 min later, it extended more than 1,000,000 km in the eclipse image.

observation shows that this height range is essentially important to study the CME initiation.

During the total solar eclipse on 2017 August 21, we succeeded to obtain a time-series of white-light images of the corona spanning 70 min taken with the observations at seven sites (Hanaoka et al. 2018). From the observational data, six coronal jets, which extend from the solar surface to beyond $2 R_{\odot}$, were found in the polar coronal hole regions. An example of the jets is shown in Figure 1(b). The average apparent speed of the upward ejection is 450 km s^{-1} . Combining with EUV data, we concluded that ordinary polar jets generally reach high altitudes and escape from the Sun as part of the solar wind.

3. Conclusions

Keen amateur astronomers are willing to participate in actual scientific research activity. To involve amateurs in the academic research and promote citizen science is important to extend understanding on natural science outside the academic society. Solar eclipse observations can be carried out with small telescopes. Therefore, solar eclipses are very good chance for amateurs to participate in actual scientific research activity. So far, our collaboration has been only with Japanese amateurs. However, observers from various countries come to observation sites of total solar eclipse. Therefore, total eclipses will be a chance of international professional-amateur collaboration.

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