Statistical Study of the Magnetic Field Orientation in Solar Filaments

HANAOKA, Yoichiro, SAKURAI, Takashi
(NAOJ)

We have been carrying out full-Sun, full-Stokes spectropolarimetric observations using the He I 1083.0 nm line since 2010. The He I 1083.0 linear polarization signals of solar filaments show the magnetic field in filaments. Figure 1 shows a filament observed in Hα and in He I 1083.0. The linear polarization signals in panel (b) is approximately parallel to the fine structures seen in the Hα image in panel (a), and they are almost aligned. We can define the average direction of the magnetic field, and it deviates clockwise with respect to the filament axis.

We have carried out a statistical study of the average orientation of the magnetic field in filaments with respect to their axes for 438 samples [1]. Figure 2 shows the relation between the latitude and the deviation of the average magnetic field of filament samples. This figure show a clear hemispheric tendency; most filaments in the northern (southern) hemisphere show the clockwise (counterclockwise) deviation of the average magnetic field direction. The deviation angles of the magnetic field from the axes have the peak around 10–30° (the light-green belts in Figure 2). Such a hemispheric tendency has been studied for the chirality of the fine structures in filaments and the magnetic field in prominences, and our results are consistent with them. Therefore, our results confirm the hemispheric tendency of the filament magnetic fileds with the direct measurements of the magnetic field in filaments for the first time.

There is an interesting feature in the filaments which violate the hemispheric tendency; the alignment of the background magnetic field of such filaments is in many cases opposite to that of active regions following the Hale-Nicholson law.

A filament is considered to be located at the bottom of a magnetic flux rope, which often erupts into the interplanetary space as a part of a coronal mass ejection (CME). Therefore, our observation of the filament magnetic field can be used to predict the magnetic field of CME flux ropes, which is the key to investigate their impact to the geomagnetic field.

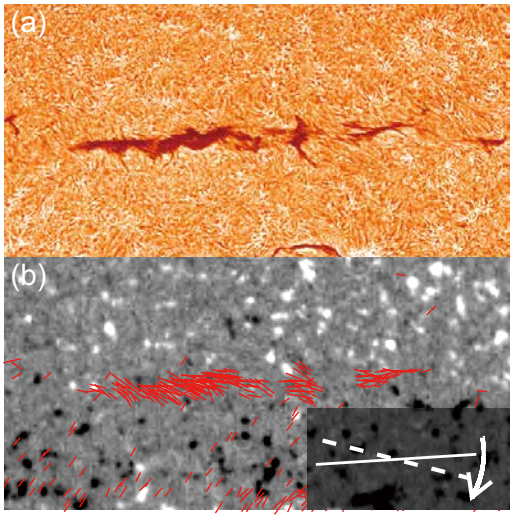

Figure 1: A filament (located in the northern hemisphere) observed on 2014 November 23. The celestial north is to the top. (a) Hα image of the filament and (b) the linear polarization signals (> 0.1 %) represented by red lines drawn on the photospheric magnetogram. At the lower-right corner, the approximate direction of the axis of the filament is shown with a solid line, and the average direction of the linear polarization signals is shown with a dashed line.

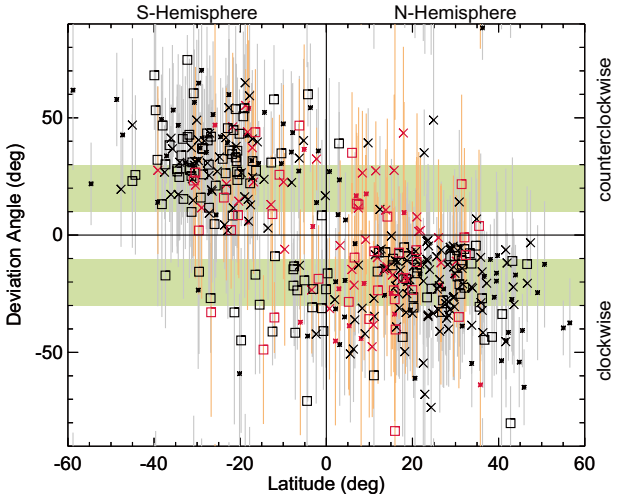

Figure 2: The relation between the latitude of the filaments and their average deviation angle. Black symbols represent filaments in the quiet areas, and red symbols represent those in the active areas. The cross symbols correspond to the filaments with the preceding positive polarity, and the box symbols correspond to the filaments with the preceding negative polarity. The dots show the filaments where the alignment of the polarity cannot be defined clearly. The vertical lines are error bars.

Reference

[1] Hanaoka, Y., Sakurai, T.: 2017, *ApJ*, **851**, 130.