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Prominence Activity during the 2006 Total Solar Eclipse

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ABSTRACT

During total solar eclipses, we can observe the outer atmospheric layers of the sun (chromosphere and corona). The solar corona extends to several solar radii depending on the sunspot cycle. Basic coronal structures such as polar streamers, helmet type structures were observed during the 2006 total solar eclipse. Our total solar eclipse 2006 observations through both White light corona and H-Alpha filter allowed us to describe coronal structures and Prominence Activity. We found that the solar corona is extended to 4 times of solar radii, the existence different zones of white light corona were shown, moreover, we compared the defined features of solar corona at different observing locations along the track of total solar eclipse 2006. The solar limb activity was studied during both of partial and total eclipse phases by using H-Alpha and white light observations from Salloum, Egypt. We got same prominence activity during partial and total phases of the solar eclipse and recorded three prominences on solar limb. Finally, our processed image in a good agreement with the published processed images was observed from different locations along the track of total eclipse, added, similar magnetic field structure shown in our processed image and published one.

1. INTRODUCTION

Solar atmosphere is mainly composed of three layers: the photosphere, the chromosphere and the corona. We can observe the chromosphere only after starting and before ending total solar eclipse or by certain filters (H-Alpha).

[1] used images with high spatial resolution to show the dark cavities surrounding prominences. They found that a coronal cavity is convincingly seen only in white light, and mentioned that white light high resolution observations are needed to progress to show a clear evidence of cavities.

[2] described the evident stratified structure of the solar corona observed during total solar eclipse March 29, 2006, and found that the most fundamental coronal characteristics (polar plumes, coronal cavities, coronal holes) are seeing in these observations.

[3] compared the defined features of solar corona at six locations along the track of the total solar ec-

lipse 2006; they found that the basic coronal structures were seen in the secured images, moreover, the observed features of solar corona on the processed image is agreement with other processed images from different locations.

[4] used high-resolution movies in 193 Å from Atmospheric Imaging Assembly (AIA) on Solar Dynamic Observatory to show apparent rotation of a prominence observed during a coordinated. They found that the Doppler pattern observed in H-Alpha couldn't be interpreted as rotation of the cool plasma inside tornado. The H-Alpha velocity observations give strong constraints on the possible interpreted of the AIA tornado.

[5] described the white light coronal structure during six total solar eclipses. They found that the white light corona during the 1990, 1999, and 2012 total solar eclipses is symmetric (solar corona at maximum), while white light corona during the 2006, 2008, and 2009 total solar eclipses is asymmetric (solar corona at minimum).

[6] calculated the length of solar prominence during total solar eclipse 2016; they found the real minimum length of prominence in red is 1.05 times longer than green and blue ones, while the real maximum length of prominence in red is 1.08 times longer than blue one, 1.04 times longer than green. Moreover, the intensity in red wavelength is brighter than that of blue and green, 1.37 times to green and 1.23 times to blue.

In this paper, we will show the stratified structure of inner and outer part of white light corona during total solar eclipse 2006 by using our observations from Salloum, Egypt. In addition, we will show and compare the prominence activity in both of our white light and H-Alpha observations. Moreover, we will describe the coronal structure from different locations along the track of total solar eclipse, and we will compare the magnetic field structure our processed and published images.

2. OBSERVATIONS

During total solar eclipse, we can observe solar corona and chromosphere layers; so that total solar eclipse is very important for scientist.

The Egyptian expedition of the solar lab, NRIAG secured a good quality observation sequence of about 314 digital images taken in white light during the partial and total solar eclipse March 2006, using William's top quality optics, Fluoro-star AP FLT-110, Telescope. A high-resolution digital camera, Canon EOS-1ds Mark II, FOV 109 × 2.8 degree (total 17.2 mega pixels) was adapted to the Fluoro telescope. In addition, about 294 digital images have been recorded using Hα filter during the partial phases of the eclipse under test. About 72 pictures of the white light corona with different exposure times were record during the total eclipse. The excellent quality of the observing sequence of about 60 photos of the white light corona has been taken during the total solar eclipse at different exposure times.

Our total solar eclipse 20016 observations are unique because:

- We observed the solar eclipse 2006 in both of while light and H-Alpha during total and partial solar eclipse phases respectively. There are no others observed in H-Alpha.
- Our observations shown same solar prominences during partial and total phases of solar eclipse 2006; where we got the prominence during partial phase then got same during totality.
- The most fundamental coronal characteristics (polar plumes, coronal cavities and coronal holes) are seen in our white light solar corona observations, moreover, our solar corona extended to 4 times of solar radii.

A white light corona picture taken by an exposure time 1/3 second (**Figure 1**) relatively indicates the largest recorded extension of the coronal streamers. It is clearly noticeable the existence of different zones in the observed white corona.

Figure 2 shows the inner part of the white corona with exposure time 1/500 sec., we can see the prominences activity on the solar limb. **Figure 3** shows same solar prominences activity on solar limb during partial phase of solar eclipse by using H-Alpha filter, while **Figure 4** shows, the same prominence activity on solar limb during partial and total phases by using H-Alpha and white light observations respectively.

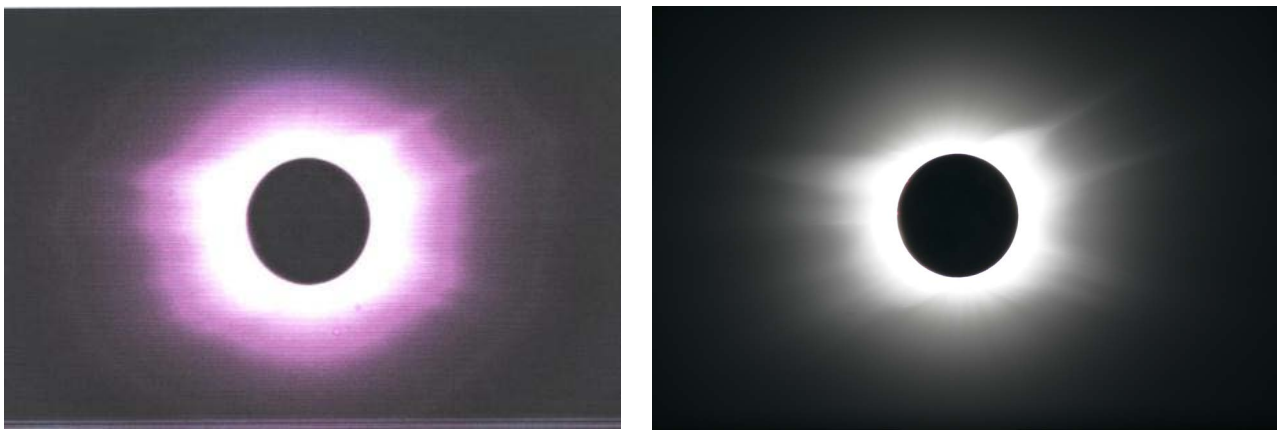

Figure 1. Structures of the white corona taken during solar total eclipse March 29, 2006.

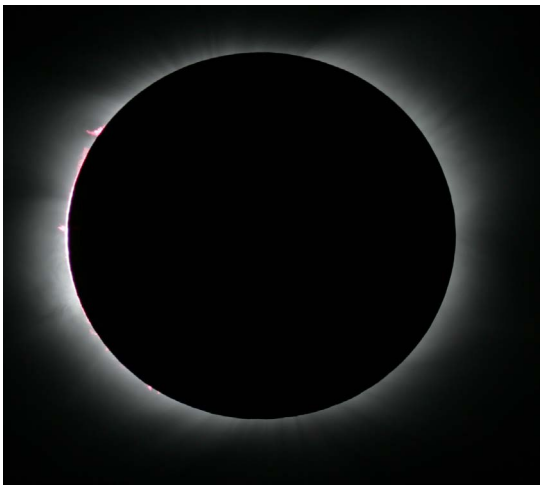

Figure 2. The inner part of the white corona.

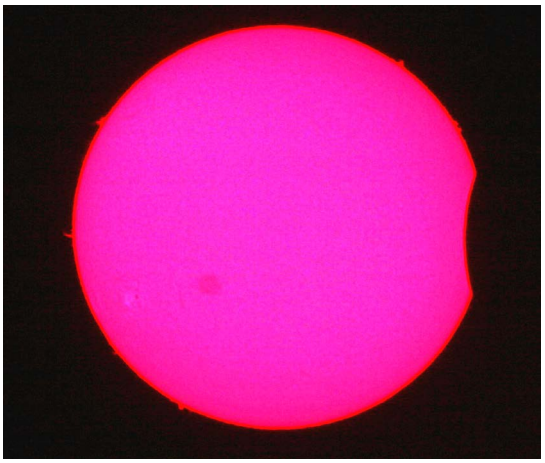

Figure 3. The Hα image during partial phase of total solar eclipse 2006.

Figure 5 shows our processed image of the white light corona (left) during total solar eclipse 2006, the python software was use to process this image.

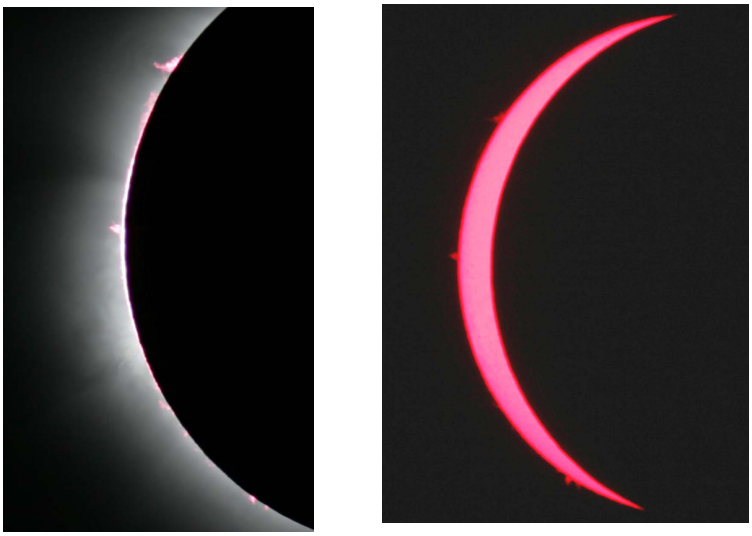

Figure 4. Same prominences activity in both white light (left) and H-Alpha (right) images during total and partial phases of solar eclipse 2006 respectively.

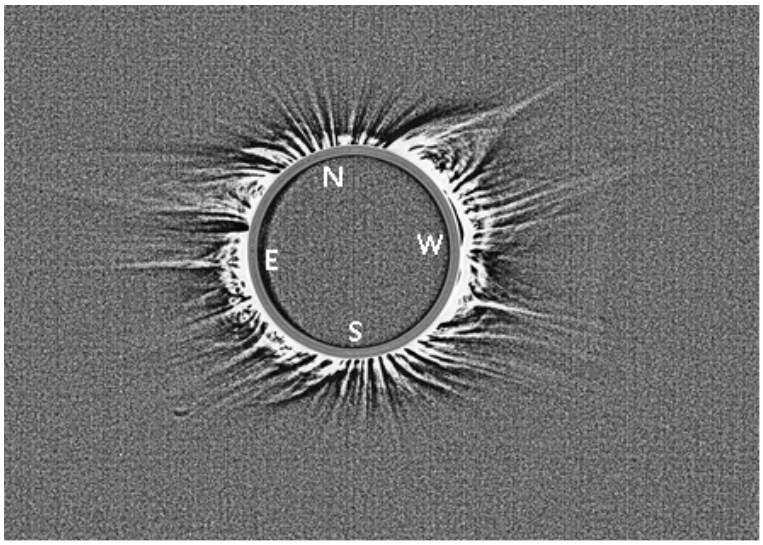

Figure 5. Our processed image of the white light corona during total eclipse 2006.

3. RESULTS AND DISCUSSIONS

Our white light observations during total phase showing that the relatively indicate the largest recorded extension of white light corona as shown in Figure 1, moreover, we can notice that the existence of different zones in white light corona observations (see Figure 1). The detected zones of the white corona clearly show the shape and extension of solar corona arising from scattered sunlight by fast electrons.

In Figure 1, we cannot see the inner part of solar corona, while we can see it in Figure 2, where we can see most of inner part of solar corona. Prominence activity appears on solar limb through inner part of solar corona during total phase of solar eclipse. Prominence activity also observed during partial phase of solar eclipse on same place of solar limb as shown in Figure 3.

We can noticed that same limb on Figure 2 and Figure 3; where we can see same prominence activity

on the left side, where H-Alpha image during partial phase taken before white light image during total phase.

Same excellent solar prominence activity given in both observations during partial and total phases of solar eclipse by using H-Alpha filter and white light observations respectively, so that we can noticed that there are same three solar prominences activity in **Figure 4**, first one near northern solar pole, second near solar equator, and third near southern pole of the sun.

Our processed image of solar corona during total eclipse 2006 is shown in **Figure 5**, where we used Python processing program to can get this processed image. Our processed image shown that the basic coronal structures such as polar plumes at both north and south solar poles, moreover, we can see a south border of helmet streamers near large coronal holes at the southern hemisphere. Added we can noticed that the open magnetic field lines at northern and southern poles, also there is also a good closed magnetic field lines at the north-west side, south-west and near the equator. Finally, we can see open magnetic field lines at east north side.

We compared our processed image with those published processed images taken from different locations on track of solar eclipse 2006 (Niger, Libya, Greece, and Turkey) (see **Figure 6**). We find that our processed image and published images has same observed features of solar corona, such as same polar plumes, helmet streamers rays, and prominences activity in all observations. We have to notice that our processed image is composed of one white corona image during solar eclipse 2006, while other published processed images are composed of many white corona images, and our processed image shown similar coronal structure. It was describe in more details on our previous published paper [3].

[7] used our white light observations to applied a numerical processing method to can get a processed image of solar corona during total solar eclipse 2006 (**Figure 7**), where it is composed of 60 white light corona images. Our processed image in a good agreement with published one by [7], where both have same open magnetic field lines at northern and southern poles. In addition, similarity of closed magnetic field lines near to equator of the sun.

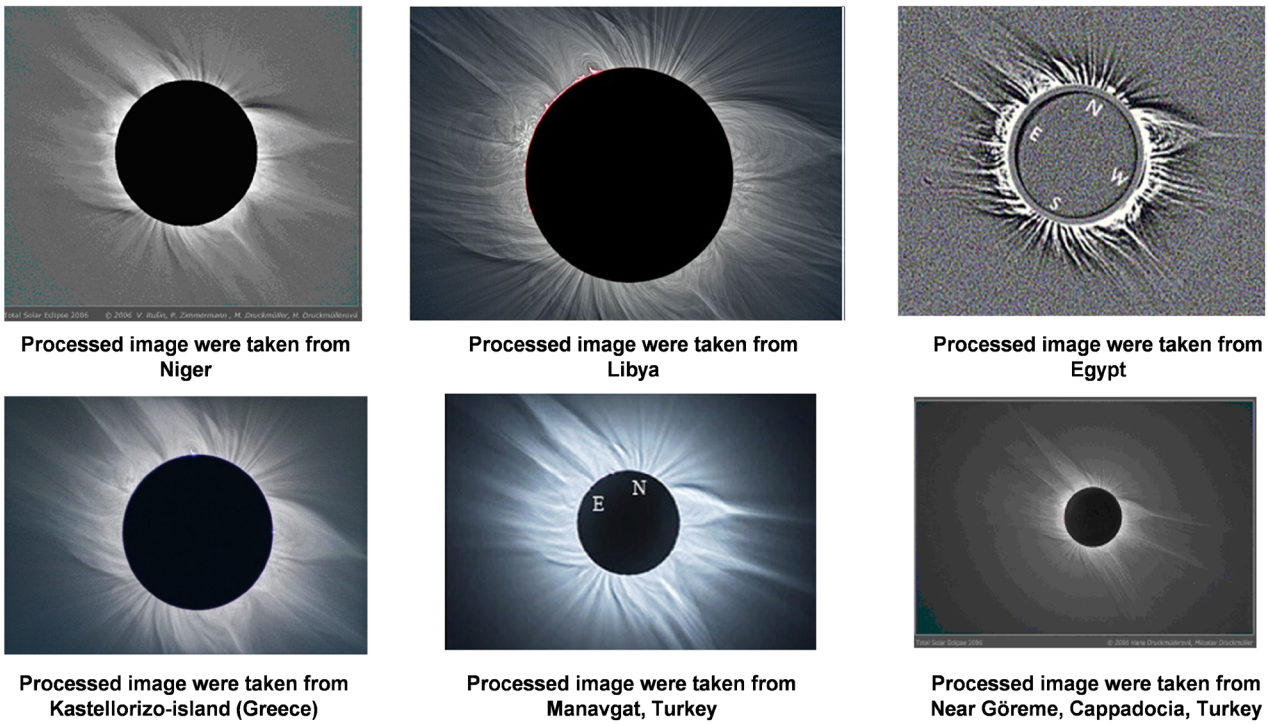

Figure 6. The processed images of the white light corona taken from six locations along the track of total solar eclipse 2006.

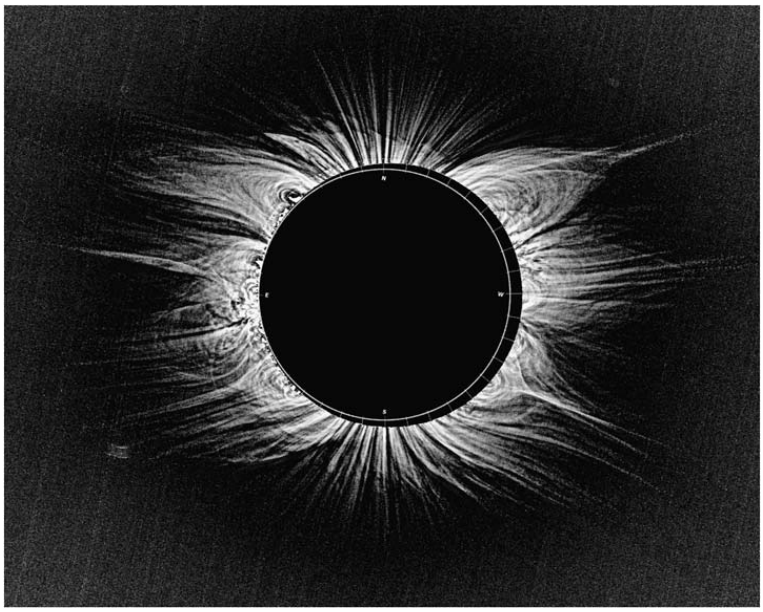

Figure 7. Processed image of the white-light corona from 29 March 2006 observed at Al Sallum, Egypt [7].

4. CONCLUSIONS

Largest recorded extension and the existence different zones of white light corona are shown by our observations during total solar eclipse 2006. The shape and extension of solar corona arising from scattered sun light by fast electrons.

Same prominences activity is observed during partial and total phases of solar eclipse 2006 by H-Alpha and white light observations respectively.

Three prominences activity is observed during solar eclipse 2006, first one appeared near northern pole, second appeared near the equator of the sun, and third appeared near southern pole.

Basic coronal structures such as polar plumes, dome-shaped structures, and helmet streamers type structures are seen in our processed image, moreover, polar plumes are seen at north and south poles, also we can see prominence activity at northeast side.

Our processed image of white light corona is in a good agreement with published processed images from different locations along the track.

Our processed image is in a good coincident with published one by [7]. In both images, we can notice similar open magnetic field lines at northern and southern poles, closed magnetic field lines at west north side, west south and near the equator. We can see open magnetic field lines at east north side.

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