Birth of a Bipolar Active Region in a Small Coronal Hole


We report on the emergence of an anemone active region in a very small coronal hole (about 120” across), beginning at approximately 18:00 UT on March 3, 2015. The emergence was initially observed by an amateur astronomer [1] in an H-alpha movie from the Global Oscillation Network Group (GONG). It attracted the attention of the observer because there was no active region at the site of the emergence and the system was in a region of negative polarity. The emergence was further observed by the Solar Dynamics Observatory (SDO), provided by the Atmospheric Imaging Assembly (AIA) in wavelength 193, 171, 131, and 304 Å and with the Helioseismic and Magnetic Imager (HMI). Data analysis and calibration activities such as scaling rotation so that north is up, and removal of solar rotation are accomplished using Sunpy (version 0.7.1) [2]. No data from the Extreme Ultraviolet Imaging Telescope [3] were used in this analysis. The Sun was observed throughout this period with a 195 aperture field defined by the center of the emerging region.

From start to finish, data were analyzed using python and sunpy. Problems encountered include:

1. Too many open files
2. Sunpy provides no way to set the plotting min and max values for the entire cube. However, it is possible to manually set the values for the entire cube.
3. Sunpy does not provide a way to set the plotting min and max values for the entire cube. However, it is possible to manually set the values for the entire cube.
4. When animating a cube, the color bar “bounces” due to different scaling of each image.
5. When plotting an animated data cube, you can set annotate=False which removes this title. (Alas, this also gets rid of the position of plt.grid is important, if plt.grid appears after a derotation line, many errors are displayed on the terminal and no plot appears.
6. When plotting a Sunpy data cube, the title appears twice.
7. The matplotlib default is to wait after each plot. To change the default just type “pylab” at the ipython prompt.

Data were analyzed using python and sunpy. Problems encountered include:

1. Sunpy provides no way to set the plotting min and max values for the entire cube. However, it is possible to manually set the values for the entire cube.
2. Sunpy does not provide a way to set the plotting min and max values for the entire cube. However, it is possible to manually set the values for the entire cube.
3. Sunpy does not provide a way to set the plotting min and max values for the entire cube. However, it is possible to manually set the values for the entire cube.
4. When animating a cube, the color bar “bounces” due to different scaling of each image.
5. When plotting an animated data cube, you can set annotate=False which removes this title. (Alas, this also gets rid of the position of plt.grid is important, if plt.grid appears after a derotation line, many errors are displayed on the terminal and no plot appears.
6. When plotting a Sunpy data cube, the title appears twice.
7. The matplotlib default is to wait after each plot. To change the default just type “pylab” at the ipython prompt.
8. When animating a cube, the color bar “bounces” due to different scaling of each image.
9. When plotting an animated data cube, you can set annotate=False which removes this title. (Alas, this also gets rid of the position of plt.grid is important, if plt.grid appears after a derotation line, many errors are displayed on the terminal and no plot appears.
10. When plotting a Sunpy data cube, the title appears twice.
11. The matplotlib default is to wait after each plot. To change the default just type “pylab” at the ipython prompt.

Data were analyzed using python and sunpy. Problems encountered include:

1. Too many open files
2. Sunpy provides no way to set the plotting min and max values for the entire cube. However, it is possible to manually set the values for the entire cube.
3. Sunpy does not provide a way to set the plotting min and max values for the entire cube. However, it is possible to manually set the values for the entire cube.
4. When animating a cube, the color bar “bounces” due to different scaling of each image.
5. When plotting an animated data cube, you can set annotate=False which removes this title. (Alas, this also gets rid of the position of plt.grid is important, if plt.grid appears after a derotation line, many errors are displayed on the terminal and no plot appears.
6. When plotting a Sunpy data cube, the title appears twice.
7. The matplotlib default is to wait after each plot. To change the default just type “pylab” at the ipython prompt.

Problems encountered include:

1. Too many open files
2. Sunpy provides no way to set the plotting min and max values for the entire cube. However, it is possible to manually set the values for the entire cube.
3. Sunpy does not provide a way to set the plotting min and max values for the entire cube. However, it is possible to manually set the values for the entire cube.
4. When animating a cube, the color bar “bounces” due to different scaling of each image.
5. When plotting an animated data cube, you can set annotate=False which removes this title. (Alas, this also gets rid of the position of plt.grid is important, if plt.grid appears after a derotation line, many errors are displayed on the terminal and no plot appears.
6. When plotting a Sunpy data cube, the title appears twice.
7. The matplotlib default is to wait after each plot. To change the default just type “pylab” at the ipython prompt.

**Summary/Results:**

1. The flux-emergence rate over ten minutes was 7.86 x 10^14 Mx/s. In contrast, Frommert et al. [4] report a peak flux emergence over four days from NOAA 11158, a region that produced an X.2 flare, for 4.4 x 10^14 Mx/s, suggesting that for larger regions, the flux rate will be higher.
2. The magnetic “bubble” increased in size from approximately 20” x 20” to 40” x 40” from 2015-03-04 18:44 UT to 2016-03-04 02:55, 8 hours 11 minutes.
3. Flux emergence begins between 17:30 UT and 18:44 UT, followed by brightening in AIA 304 (~19:12 UT), 193 (~19:30 UT), and 94 (~20:00 UT) Angstroms.
4. This work is a preliminary analysis of flux emergence and development of an active region in a unique open-magnetic-field environment.

**References:**