Birth of a Bipolar Active Region in a Small Coronal Hole

Mitzi Adams¹, Navdeep K. Panesar², Ronald Moore³, Robert Woolley⁴


We report on the emergence of an anemone active region in a very small coronal hole (about 120'' across), beginning at approximately 19:00 UT on March 3, 2016. The emergence was initially observed by an amateur astronomer (AV) in an H-alpha movie from the Global Oscillations Network Group (GONG), it attracted the attention of the observer because there was no active region at the site of the emergence. To examine the region in detail, we use data from the Solar Dynamics Observatory (SDO), provided by the Atmospheric Imaging Assembly (AIA) in wavelengths 171, 193, 211, and 304, 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 with the LabMATE computer software. The data used in this study have been downloaded from the LASCO CME Explorer, SDO, and HMI websites. The observed data were analyzed using python and sunpy. Problems encountered included:

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
3. When animating a cube, the color bar "bounces" due to different scaling of each image.
4. When plotting an image (ipython), as long as plot window is up, the command line is not available.
5. When plotting a Sunpy data cube, the title appears twice.
6. This fix is a part of number four:

To experienced matplotlib/sunpy users, but not to new ones. Our suggestion is, if it doesn't work after, try positioning the

norm for each frame of the animation. Since we did not find this to be obvious we list the actual code that does this here:

```
hdulist = fits.open(filepath, memmap=False)
```

Make this change to the line that opens the FITS file:

```
Copy fits.py --> mv fits.py to fits.sav
```

The system keeps the file open for the lifetime of the array. Currently Sunpy does not provide a
data are stored on disk. Thus, the system keeps the file open for the lifetime of the array. Currently Sunpy does not provide a

means to override this default. An ugly solution is to increase the number of files that the system can open. Another almost as

ugly solution is to modify the sunpy/io/fits.py source code (as shown below), adding the "memmap=False" parameter to the

fits.open call.

Summary/Results:

1. The flux-emergence rate over ten minutes was 7.86 x 10⁴ Mx/s.
2. The magnetic "bubble" increased in size from approximately 20'' x 20'' to 40'' x 40'' from 2016
3. Flux emergence begins between 17:30 UT and 18:44 UT, followed by brightening in AIA 304
4. Too many open files
5. When animating a cube, the color bar "bounces" due to different scaling of each image.
6. When plotting an image (ipython), as long as plot window is up, the command line is not available.
7. Removing the title for animated plots (with intent to use something else)

```
plt.show()
plt.colorbar()
plt.title('SDO Composite Plot')
mp4=derotated.plot(interval=100,annotate=False)
plt.ylabel('Y-position [arcsec]')
plt.xlabel('X-position [arcsec]')
```

```
mp4=derotated.plot(interval=100)
plt.grid(b=False)
```

```
hdulist = fits.open(filepath, memmap=False)
```

```
Copy fits.py --> mv fits.py to fits.sav
```

In contrast, From Vemareddy, et al. (2015) the rate of positive flux emergence over four days from

```
Mx/s, suggesting that for larger
```

```
1. The flux-emergence rate over ten minutes was 7.86 x 10⁴ Mx/s.
2. The magnetic "bubble" increased in size from approximately 20'' x 20'' to 40'' x 40'' from 2016
3. Flux emergence begins between 17:30 UT and 18:44 UT, followed by brightening in AIA 304
4. Too many open files
5. When animating a cube, the color bar "bounces" due to different scaling of each image.
6. When plotting an image (ipython), as long as plot window is up, the command line is not available.
7. Removing the title for animated plots (with intent to use something else)

```
plt.show()
plt.colorbar()
plt.title('SDO Composite Plot')
mp4=derotated.plot(interval=100,annotate=False)
plt.ylabel('Y-position [arcsec]')
plt.xlabel('X-position [arcsec]')
```

```
mp4=derotated.plot(interval=100)
plt.grid(b=False)
```

```
hdulist = fits.open(filepath, memmap=False)
```

```
Copy fits.py --> mv fits.py to fits.sav
```