



Maryland All-Sky Network

Nick Riley | nriley02@umd.edu
Science, Discovery, and the Universe
Computer Science

Mentor: Elizabeth Warner | warnerem@astro.umd.edu



MASN Project

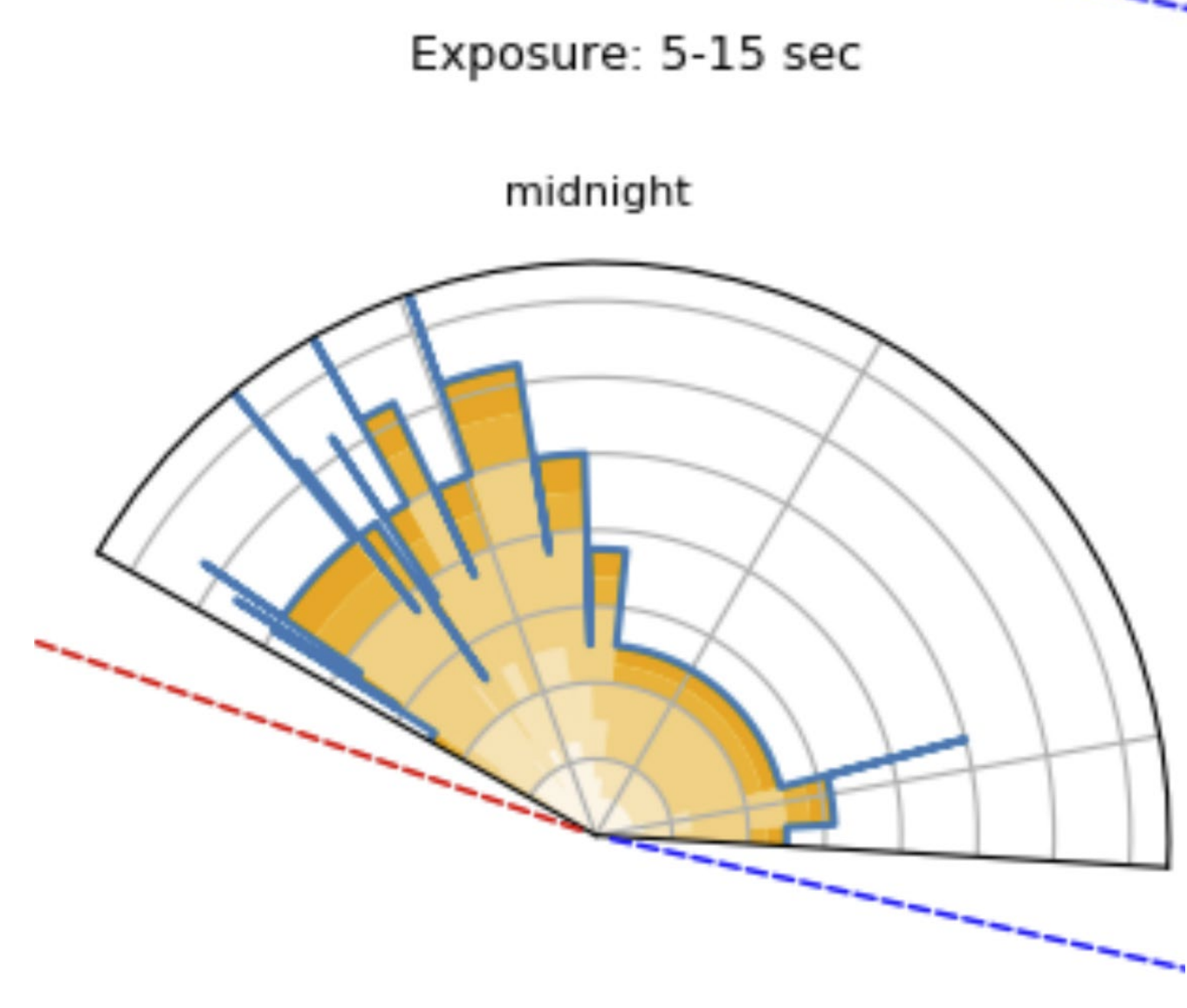
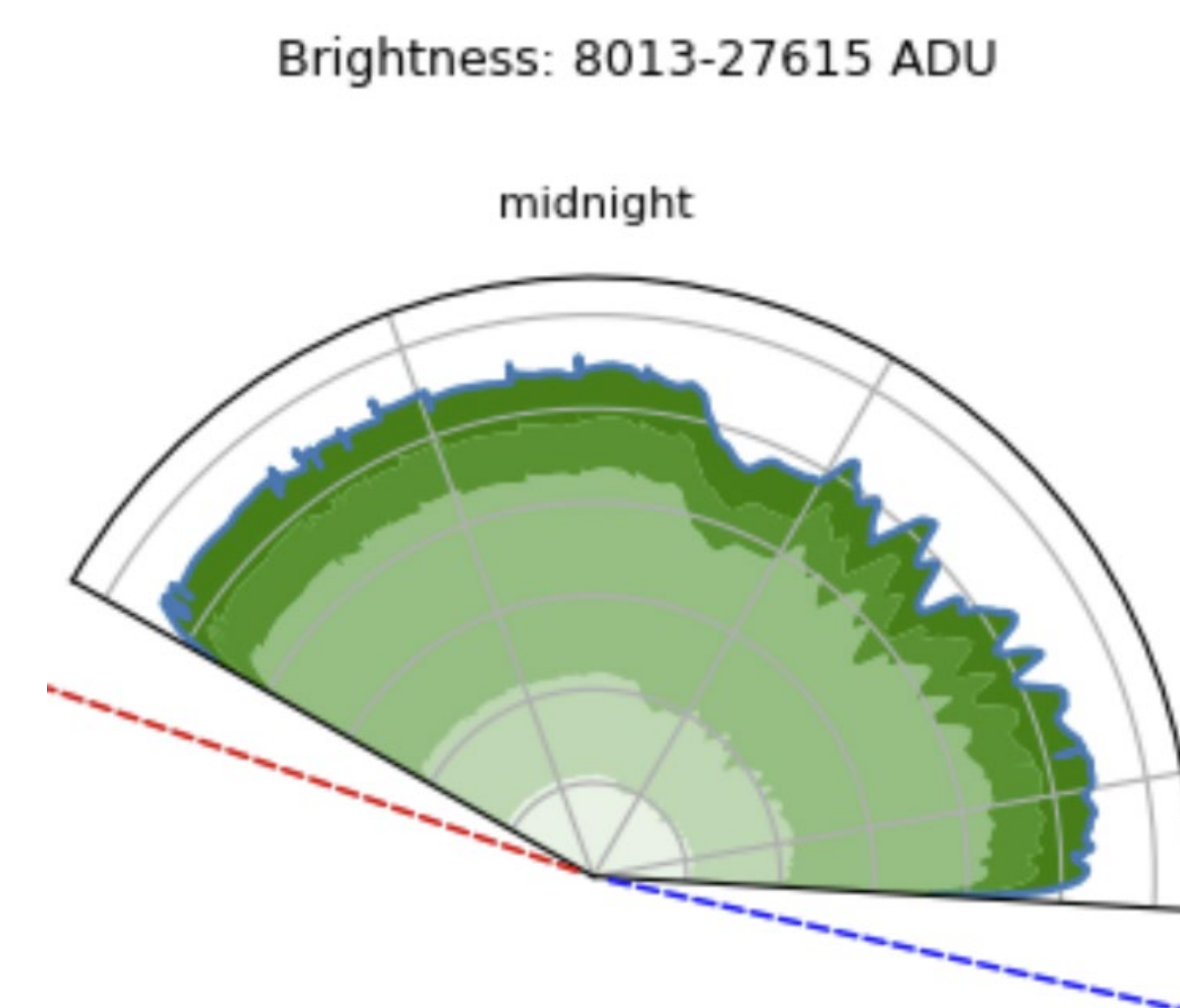
Maryland All-Sky Network (MASN) is a part of the University Maryland's Astronomy department. It is an expandable array of observatories that takes images of the night sky. For my capstone I helped work on some of the scripts that help visualize the data for a given night.

Each night thousands of photos are taken by the observatory, and each photo contains important data. An example of that tabular data is pictured below.

TIME	BRIGHTNESS	EXPTIME	MOON ILLUM %	FILENAME
0	19.9725	17624.0	5.0	0.411676 2021-09-... 25Z.fits
1	19.9749	17641.0	5.0	0.411676 2021-09-... 67Z.fits
2	19.9772	17544.0	5.0	0.411676 2021-09-... 08Z.fits
3	19.9795	17391.0	5.0	0.411676 2021-09-... 79Z.fits
4	19.9819	17228.0	5.0	0.411676 2021-09-... 09Z.fits
...
3650	6.2056	25633.0	5.0	0.411676 2021-09-... 07Z.fits

Image taken by me during testing

Example SkyTab Diagrams



Images taken by me during testing

SkyTab Images

A night's images are in the form of FITS files which contain information in the header of each file. As there are thousands of images in a night, we want to visualize some of the data in a meaningful way. We visualize this with Python which plots meaningful data from the night including:

- Exposure time
- Brightness
- A moon phase visualization
- Sunrise and sunset
- Night sky clarity

The graphs on the left are two plots on the SkyTab diagrams. On the top is the brightness graph which helps visualize the clarity of the night sky. The bottom is the exposure graph. The red and blue lines indicate sunset and sunrise times, respectively.

Future

An issue remains with the switch from fixed to variable exposure. The switch allows for improved image clarity at the cost of causing brightness values to be more constant, negatively affecting the visualization of night sky clarity from the SkyTab brightness graph.

Solving this will likely be down to producing a function to normalize the brightness values graphed based on exposure time.

```
# also get the sunset/sunrise, the UMD Observatory, where MASN1 is,
# closest observatory that astropy gives us
# MASN1 Coords: +39.0021 (N), -76.9560 (W), ele = 50m
location = EarthLocation.from_geodetic(-76.9560*u.deg, 39.0021*u.deg, 50*u.m)
UMD_obs = Observer(location = location, name = "UMD_obs", timezone = "US/Eastern")

sunset = "(0.iso)".format(UMD_obs.sun_set_time(t, which = 'nearest')).split(' ')
sunrise = "(0.iso)".format(UMD_obs.sun_rise_time(t, which = 'nearest')).split(' ')

# checking for daylight savings for both sunrise and sunset
# clock change: summer = EDT = UTC - 4, is_dst = True
# winter = EST = UTC - 5, is_dst = False
ss = [int(x) for x in sunset[0].split('-')]
sr = [int(x) for x in sunrise[0].split('-')]
sunset_dst = is_dst(datetime.datetime(ss[0],ss[1],ss[2]), timeZone)
sunrise_dst = is_dst(datetime.datetime(sr[0],sr[1],sr[2]), timeZone)

# x is the sunset hour difference from UTC to local time (EST)
# y is the sunrise hour difference from UTC to local time (EST)
x,y = 5,5
if sunset_dst:
    x = 4
if sunrise_dst:
    y = 4

# split the time up. It comes back in UTC, so change it to EST,
# that is, subtract x (5 or 4 depending on timezone),
# make sure it does not go negative
ss = sunset[1].split(':')
sr = sunrise[1].split(':')
if int(ss[0]) - x < 0:
    ss[0] = int(ss[0]) + 24 - x
else:
    ss[0] = int(ss[0]) - x
sunset = float(ss[0]) + float(ss[1])/60 + float(ss[2])/3600
if int(sr[0]) - y < 0:
    sr[0] = int(sr[0]) + 24 - y
else:
    sr[0] = int(sr[0]) - y
sunrise = float(sr[0]) + float(sr[1])/60 + float(sr[2])/3600
```

Portion of SkyStats.py

Learned Skills

Throughout the capstone there are various new tools and libraries that I was introduced and familiarized to during work. These include:

- Python
- Git
- Python Libraries
 - Matplotlib
 - Numpy
 - Astropy
 - Astroplan

Acknowledgements

I would like to thank Elizabeth Warner and Dr. Peter Teuben, who were the mentors and project leaders.