You will need to observe:

- A binary system with separation between 15" and 60" consisting of two medium-bright stars (m_v < 10)
- A bright (m_v < 6) A-star
- A bright (m_v < 6) M-star
- A spectrophotometric standard star with m_v < 12
- A bright nebula
- A dense star cluster

Your plan needs to include:

- Magnitude estimates in the blue, visual, and red filters
- Optical finder charts with a field of view of 15'

Remember this can be quite tricky for our selection of bright sources; if the DSS doesn't have a good image, we will need to search for alternatives; https://nova.astrometry.net/user_images/location (https://nova.astrometry.net/user_images/location) (Links to an external site.) may be a good option

- Contingency plans for observations in September, October, or November. (Plan for September, but say what changes if you observe in late November instead). Plan to observe from sunset to ~3.5 hours after sunset.
- A planned list of exposures and when you will take them. What CCD images do you need?

Spectrophotometric standard star lists

https://www.eso.org/sci/observing/tools/standards/spectra.html (https://www.eso.org/sci/observing/tools/standards/spectra.html) (Links to an external site.)

https://www.eso.org/sci/observing/tools/standards/spectra/wdstandards.html (https://www.eso.org/sci/observing/tools/standards/spectra/wdstandards.html) (Links to an external site.)

https://mingus.mmto.arizona.edu/~bjw/mmt/spectro_standards.html (https://mingus.mmto.arizona.edu/~bjw/mmt/spectro_standards.html) (Links to an external site.)

https://www.naoj.org/Observing/Instruments/FOCAS/Detail/UsersGuide/Observing/StandardStar/Spe
(https://www.naoj.org/Observing/Instruments/FOCAS/Detail/UsersGuide/Observing/StandardStar/Sp
(Links to an external site.)

https://noirlab.edu/science/observing-noirlab/observing-ctio/Spectrophotometric-Standards (https://noirlab.edu/science/observing-noirlab/observing-ctio/Spectrophotometric-Standards) (Links to an external site.)

Binary star lists:

https://www.astroleague.org/files/u220/DS-MasterObjectList2021.pdf (https://www.astroleague.org/files/u220/DS-MasterObjectList2021.pdf) (Links to an external site.)

http://www.ianridpath.com/binaries.html (http://www.ianridpath.com/binaries.html) (Links to an external site.) (no separations listed)

In [30]:
```
# Libraries
from astropy import coordinates, units
from astropy import units as u # shortcut

from astroquery.simbad import Simbad

from astroplan import Observer
from astroplan import FixedTarget
from astroplan.plots import plot_airmass
from astroplan.plots import plot_finder_image
from astroplan.plots import plot_sky
from astropy.time import Time
from astroquery.vizier import Vizier

import matplotlib.pyplot as plt
```

In [2]:
```
from astropy.utils import iers
iers.conf.IERS_A_URL = 'ftp://cddis.gsfc.nasa.gov/pub/products/iers/finals2000A.a
iers.conf.IERS_A_URL_MIRROR = 'https://datacenter.iers.org/data/9/finals2000A.all
from astroplan import download_IERS_A
download_IERS_A()
```

Setting up time

In [3]:
```
#Campus teaching observatory
CTO = Observer(location=coordinates.EarthLocation(lat=29.643018, lon=-82.349004*u
               timezone='US/Eastern',
               name='University of Florida Campus Teaching Observatory',
              )
CTO
```

Out[3]:
```
<Observer: name='University of Florida Campus Teaching Observatory',
    location (lon, lat, el)=(-82.34900399999998 deg, 29.643018 deg, 30.99999999
950558 m),
    timezone=<DstTzInfo 'US/Eastern' LMT-1 day, 19:04:00 STD>>
```

In [4]:
```
now = Time.now()
now
```

Out[4]:
```
<Time object: scale='utc' format='datetime' value=2022-09-09 16:19:01.373627>
```

In [5]:
```
CTO.sun_set_time(now).iso, CTO.sun_rise_time(now).iso
```

Out[5]:
```
('2022-09-09 23:38:02.606', '2022-09-09 11:14:49.884')
```

```
In [7]: now.to_datetime(timezone=CTO.timezone).isoformat()

Out[7]: '2022-09-09T12:19:01.373627-04:00'
```

```
In [8]: def eastern(time):
            est = time.to_datetime(timezone=CTO.timezone)

            return est.strftime('%H:%M:%S')
```

```
In [9]: (eastern(CTO.sun_set_time(now)), eastern(CTO.sun_rise_time(now)))

Out[9]: ('19:38:02', '07:14:49')
```

Visual Binary

checking rise and set time

```
In [23]: # this uses SESAME
         EtaCrB_coord = coordinates.SkyCoord.from_name('Eta CrB')
         EtaCrB_coord

Out[23]: <SkyCoord (ICRS): (ra, dec) in deg
             (230.80127231, 30.28782502)>
```

```
In [24]: EtaCrB_coord.to_string('hmsdms')

Out[24]: '15h23m12.3053544s +30d17m16.1700864s'
```

```
In [29]: # Is Eta CrB up?
         EtaCrB_target = FixedTarget(EtaCrB_coord, name="Eta CrB")
         CTO.target_is_up(now, EtaCrB_target)

Out[29]: True
```

```
In [27]: # Rise and set time for Eta CrB
         (eastern(CTO.target_rise_time(time=now, target=EtaCrB_target)),
          eastern(CTO.target_set_time(time=now, target=EtaCrB_target)))

Out[27]: ('10:21:38', '00:58:01')
```

Eta CrB has a magnitude of 5.02 and a current separation of 0".38

https://www.webbdeepsky.com/double-stars/object/eta+CrB (https://www.webbdeepsky.com/double-stars/object/eta+CrB) says, "From the current (2009) separation of 0".56 the stars widen to 0".67 in 2014 before closing to 0".38 in 2020 and then widening to 1".0 in 2032."

Magnitude estimates in the blue, visual, and red

filters

In [35]:

```
Simbad.reset_votable_fields()
Simbad.add_votable_fields('flux(R)', 'flux(V)', 'flux(B)')
EtaCrB_simbad = Simbad.query_object('Eta CrB')
EtaCrB_simbad
```

Out[35]: *Table length=1*

MAIN_ID	RA	DEC	RA_PREC	DEC_PREC	COO_ERR_MAJA	COO_ERR_MINA	COO_ERR_A
	"h:m:s"	"d:m:s"			mas	mas	
object	str13	str13	int16	int16	float32	float32	
* eta CrB	15 23 12.3053	+30 17 16.170	9	9	4.310	3.510	

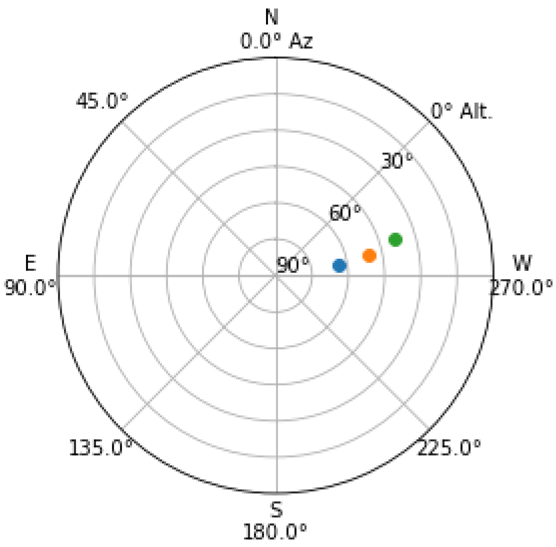
Optical finder charts with a field of view of 15'

In [36]:

```
## Finder chart ##

# where the objects are at sunset
sunset = CTO.sun_set_time(now)

# hour after sunset
onehour_after_sunset = sunset + 1*u.hour
twohours_after_sunset = sunset + 2*u.hour

targets = [EtaCrB_target]
plot_sky(target=targets, observer=CTO, time=sunset)
plot_sky(target=targets, observer=CTO, time=onehour_after_sunset)
plot_sky(target=targets, observer=CTO, time=twohours_after_sunset)
```

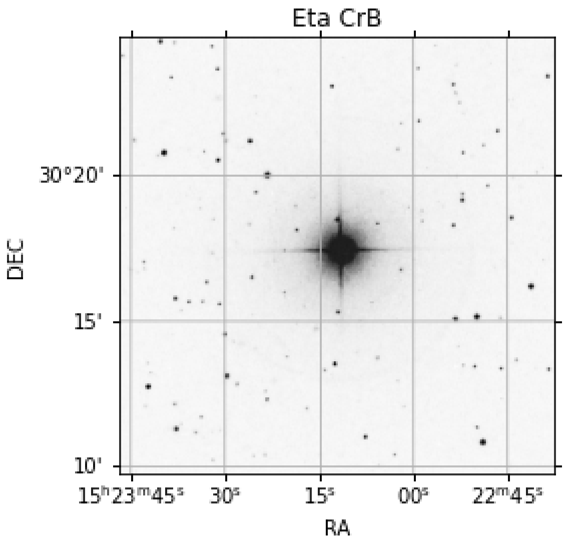
Out[36]:

```
<PolarAxesSubplot:>
```



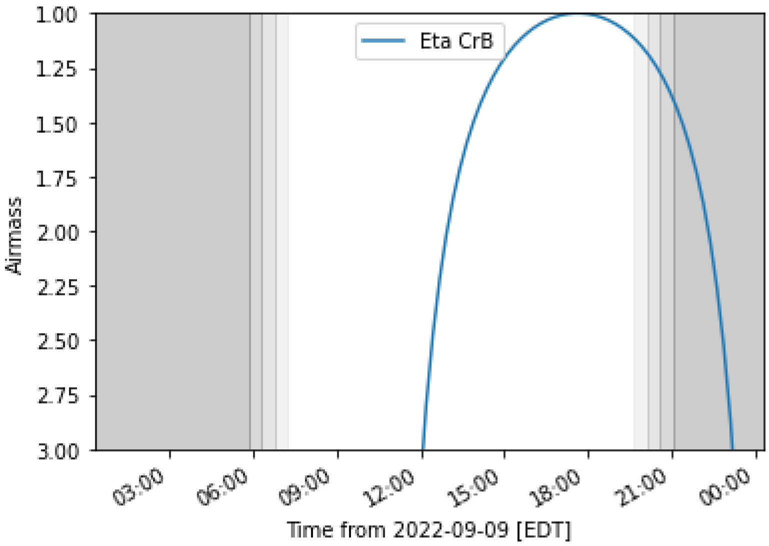
In [37]:

```
## sky chart Eta CrB ##
ax, hdu = plot_finder_image(EtaCrB_target, survey='DSS', fov_radius=15*u.arcmin)
```



In [44]:

```
# airmass/altitude plot
plot_airmass([EtaCrB_target],
             observer=CTO,
             time=now.to_datetime(timezone=CTO.timezone),
             use_local_tz=True,
             brightness_shading=True)

plt.legend(loc='best')
plt.show()
```



Contingency

Sabik, will be visible throughout semester

A bright (m_v < 6) A-star

In [45]:
```
ald_coord = coordinates.SkyCoord.from_name('Alderamin')
ald_coord
```

Out[45]:
```
<SkyCoord (ICRS): (ra, dec) in deg
    (319.6448847, 62.58557446)>
```

In [46]:
```
ald_coord.to_string('hmsdms')
```

Out[46]:
```
'21h18m34.77232728s +62d35m08.0680704s'
```

In [51]:
```
ald_target = FixedTarget(ald_coord, name="Alderamin")
CTO.target_is_up(now, ald_target)
```

Out[51]:
```
True
```

In [52]:
```
(eastern(CTO.target_rise_time(time=now, target=ald_target)),
 eastern(CTO.target_set_time(time=now,  target=ald_target)))
```

```
---------------------------------------------------------------------------
ValueError                                Traceback (most recent call last)
<ipython-input-52-ea4b7695c29b> in <module>
----> 1 (eastern(CTO.target_rise_time(time=now, target=ald_target)),
      2  eastern(CTO.target_set_time(time=now,  target=ald_target)))

<ipython-input-8-dd43bd415693> in eastern(time)
      1 def eastern(time):
----> 2     est = time.to_datetime(timezone=CTO.timezone)
      3 
      4     return est.strftime('%H:%M:%S')

~\AppData\Roaming\Python\Python38\site-packages\astropy\time\core.py in to_date
time(self, timezone)
   2114         # had an **kwargs part that was just passed on to _time.
   2115         tm = self.replicate(format='datetime')
-> 2116         return tm._shaped_like_input(tm._time.to_value(timezone))
   2117 
   2118     to_datetime.__doc__ = TimeDatetime.to_value.__doc__

~\AppData\Roaming\Python\Python38\site-packages\astropy\time\formats.py in to_v
alue(self, timezone, parent, out_subfmt)
   1020                                 .format((iy, im, id, ihr, imin, isec,
 ifracsec)))
   1021             if timezone is not None:
-> 1022                 out[...] = datetime.datetime(iy, im, id, ihr, imin, ise
c, ifracsec,
   1023                                              tzinfo=TimezoneInfo()).ast
imezone(timezone)
   1024             else:

ValueError: year -4713 is out of range
```

The above code results in errors, meaning it does not set nor rise.

Magnitude estimates in the blue, visual, and red filters

In [54]:

```
Simbad.reset_votable_fields()
Simbad.add_votable_fields('flux(R)', 'flux(V)', 'flux(B)')
ald_simbad = Simbad.query_object('Alderamin')
ald_simbad
```

Out[54]: *Table length=1*

MAIN_ID	RA	DEC	RA_PREC	DEC_PREC	COO_ERR_MAJA	COO_ERR_MINA	COO_ERR_A
	"h:m:s"	"d:m:s"			mas	mas	
object	str13	str13	int16	int16	float32	float32	
* alf Cep	21 18 34.7723	+62 35 08.068	9	9	0.790	0.790	

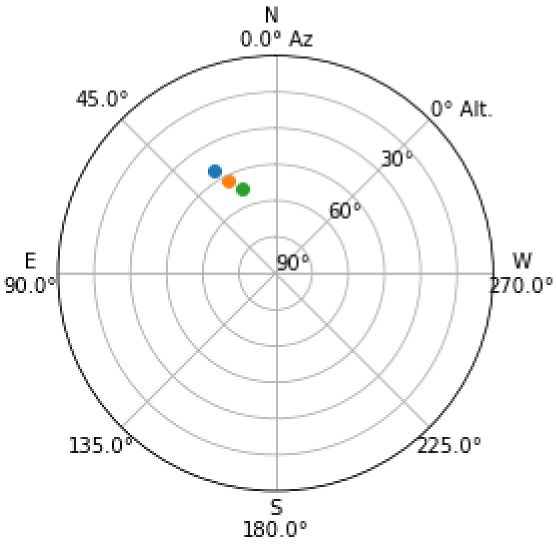
Plots

In [55]:

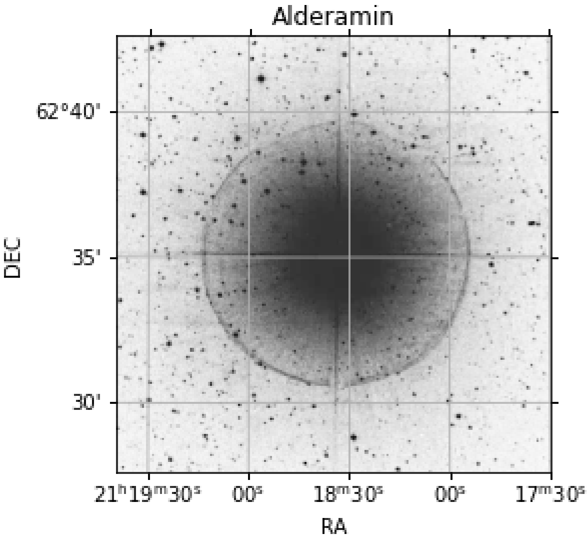
```
targets = [ald_target]
plot_sky(target=targets, observer=CTO, time=sunset)
plot_sky(target=targets, observer=CTO, time=onehour_after_sunset)
plot_sky(target=targets, observer=CTO, time=twohours_after_sunset)
```

Out[55]:

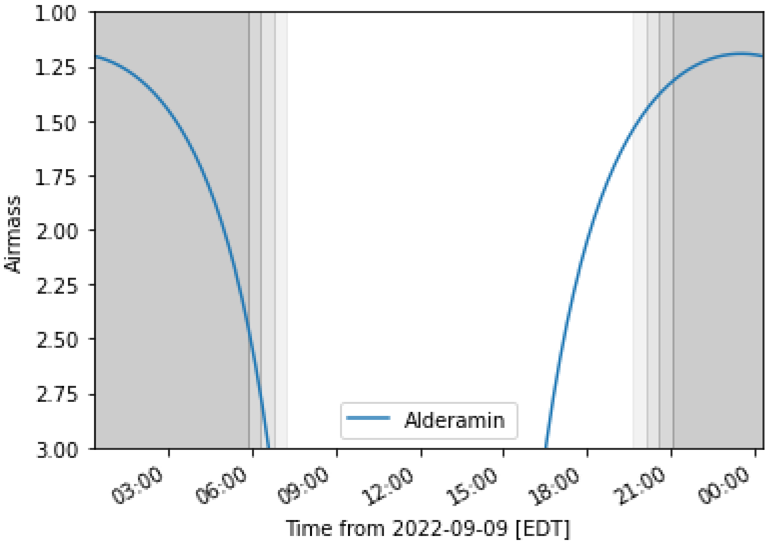
```
<PolarAxesSubplot:>
```



In [134]:
```
## sky chart Alderamin ##
ax, hdu = plot_finder_image(ald_target, survey='DSS', fov_radius=15*u.arcmin)
```



In [57]:
```
# airmass/altitude plot
plot_airmass([ald_target],
             observer=CTO,
             time=now.to_datetime(timezone=CTO.timezone),
             use_local_tz=True,
             brightness_shading=True)

plt.legend(loc='best')
plt.show()
```



Contingency

None needed, this star is visible throughout the semester

A bright (m_v < 6) M-star

In [127]:

```
bar_coord = coordinates.SkyCoord.from_name("Barnard's Star")
bar_coord
```

Out[127]:

```
<SkyCoord (ICRS): (ra, dec) in deg
    (269.45207696, 4.69336497)>
```

In [128]:

```
bar_coord.to_string('hmsdms')
```

Out[128]:

```
'17h57m48.49847007s +04d41m36.11387968s'
```

In [129]:

```
bar_target = FixedTarget(bar_coord, name="Barnard's Star")
CTO.target_is_up(now, bar_target)
```

Out[129]:

```
False
```

In [130]:

```
# Rise and set time for Proxima Centauri
(eastern(CTO.target_rise_time(time=now, target=bar_target)),
 eastern(CTO.target_set_time(time=now,  target=bar_target)))
```

Out[130]:

```
('14:02:32', '02:25:52')
```

Magnitude M5.5 Ve

Magnitude estimates in the blue, visual, and red filters

In [131]:

```
Simbad.reset_votable_fields()
Simbad.add_votable_fields('flux(R)', 'flux(V)', 'flux(B)')
bar_simbad = Simbad.query_object("Barnard's Star")
bar_simbad
```

Out[131]:

Table length=1

MAIN_ID	RA	DEC	RA_PREC	DEC_PREC	COO_ERR_MAJA	COO_ERR_MINA	COO_ERR_A
	"h:m:s"	"d:m:s"			mas	mas	
object	str13	str13	int16	int16	float32	float32	
NAME Barnard's star	17 57 48.4984	+04 41 36.113	14	14	0.026	0.029	

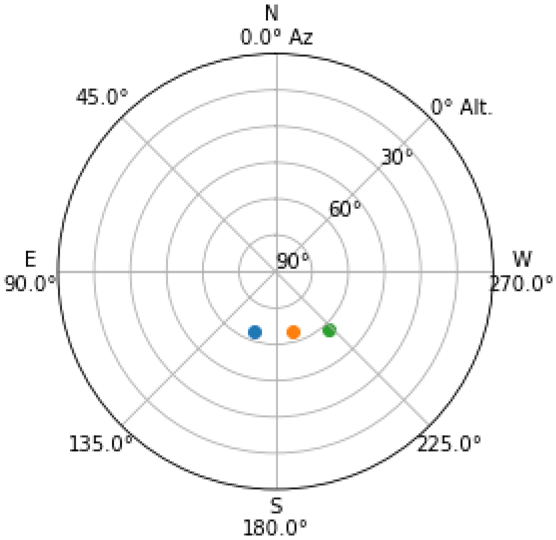
Plots

In [132]:

```
targets = [bar_target]
plot_sky(target=targets, observer=CTO, time=sunset)
plot_sky(target=targets, observer=CTO, time=onehour_after_sunset)
plot_sky(target=targets, observer=CTO, time=twohours_after_sunset)
```

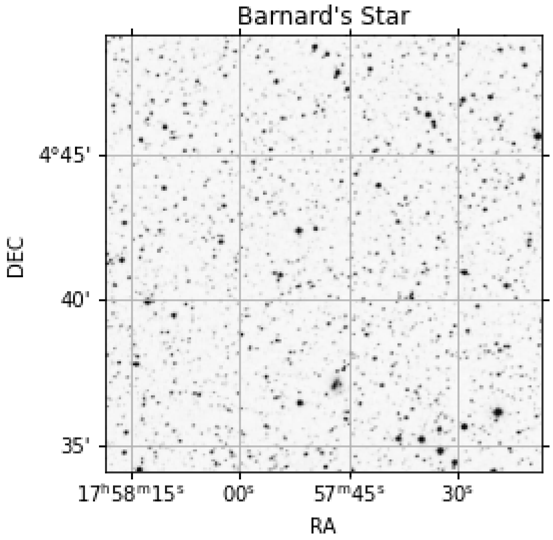
Out[132]:

```
<PolarAxesSubplot:>
```



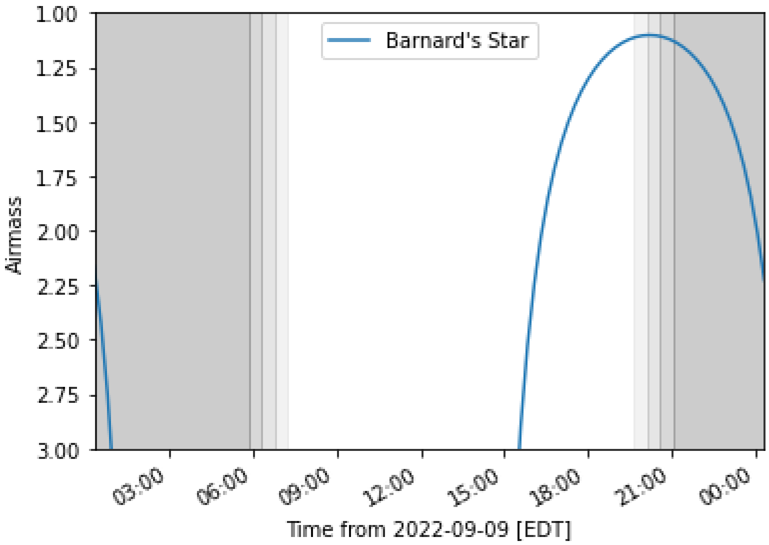
In [135]:

```
## sky chart Barnard's Star ##
ax, hdu = plot_finder_image(bar_target, survey='DSS', fov_radius=15*u.arcmin)
```

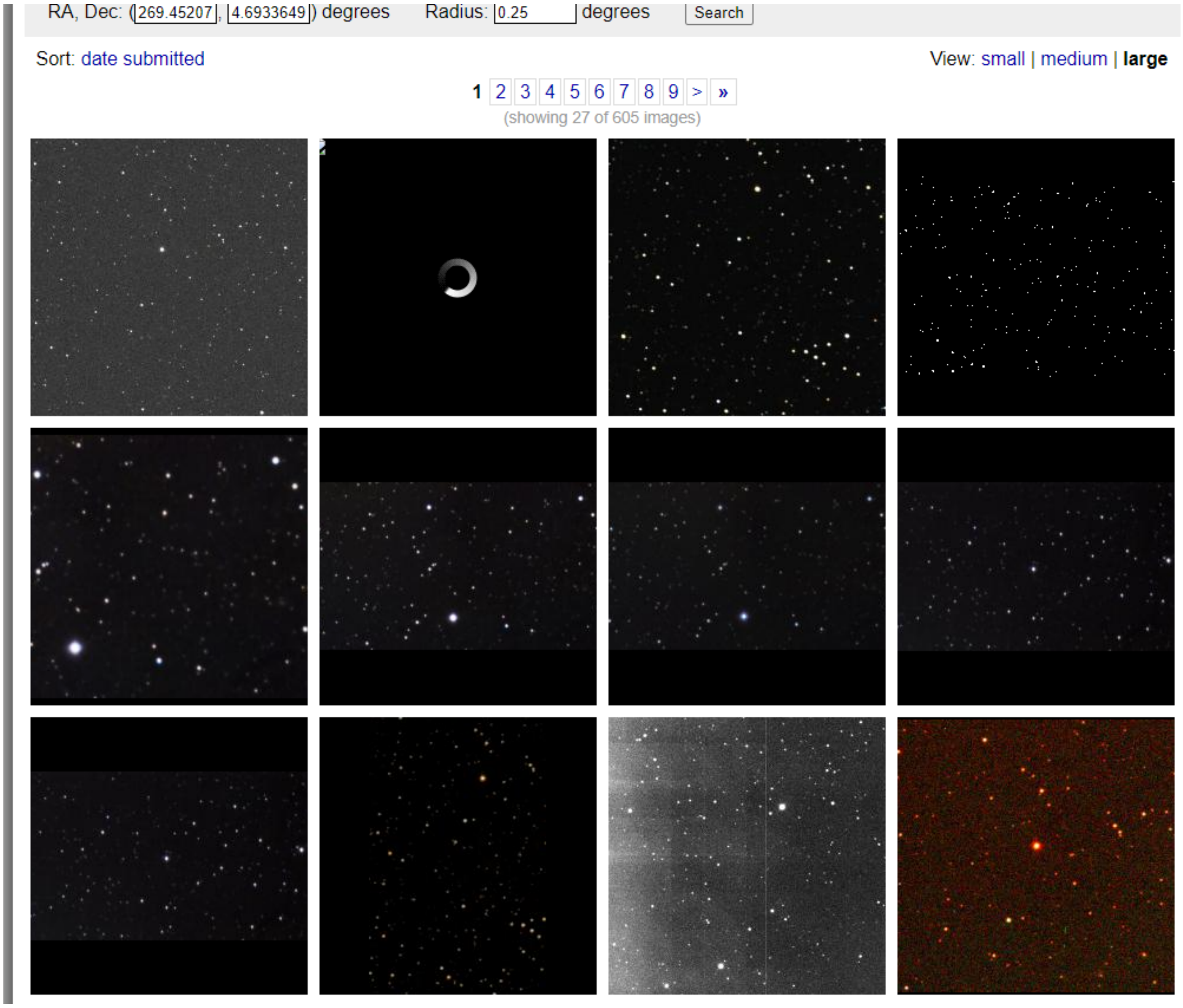


In [136]:

```
# airmass/altitude plot
plot_airmass([bar_target],
             observer=CTO,
             time=now.to_datetime(timezone=CTO.timezone),
             use_local_tz=True,
             brightness_shading=True)

plt.legend(loc='best')
plt.show()
```



[https://nova.astrometry.net/user_images/location?thumbnail_size=&sort=&calibrated=on&ra=269.45207696&dec=4.69336497&radius=0.25 (https://nova.astrometry.net/user_images/location?thumbnail_size=&sort=&calibrated=on&ra=269.45207696&dec=4.69336497&radius=0.25)](https://nova.astrometry.net/user_images/location?thumbnail_size=&sort=&calibrated=on&ra=269.45207696&dec=4.69336497&radius=0.25)



RA, Dec: (269.45207, 4.6933649) degrees Radius: 0.25 degrees

Sort: date submitted

View: small | medium | large

(showing 27 of 605 images)

A spectrophotometric standard star with m_v < 12

In [179]:
```
vega_coord = coordinates.SkyCoord.from_name("Alpha Lyr") #HZ 44
vega_coord
```

Out[179]:
```
<SkyCoord (ICRS): (ra, dec) in deg
    (279.23473479, 38.78368896)>
```

In [180]:
```
vega_coord.to_string('hmsdms')
```

Out[180]:
```
'18h36m56.33634888s +38d47m01.2802416s'
```

In [181]:
```
vega_target = FixedTarget(vega_coord, name="Alpha Lyr")
CTO.target_is_up(now, vega_target)
```

Out[181]:
```
False
```

In [182]:
```
# Rise and set time for Proxima Centauri
(eastern(CTO.target_rise_time(time=now, target=vega_target)),
 eastern(CTO.target_set_time(time=now,  target=vega_target)))
```

Out[182]:
```
('13:03:13', '04:42:31')
```

Magnitude estimates in the blue, visual, and red filters

In [183]:
```
Simbad.reset_votable_fields()
Simbad.add_votable_fields('flux(R)', 'flux(V)', 'flux(B)')
vega_simbad = Simbad.query_object("Barnard's Star")
vega_simbad
```

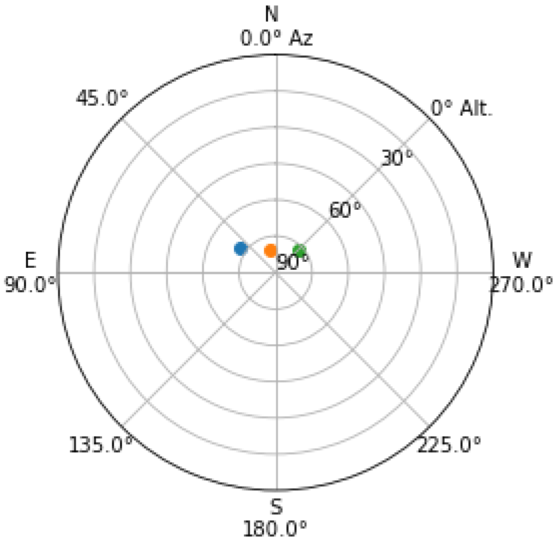
Out[183]: *Table length=1*

MAIN_ID	RA	DEC	RA_PREC	DEC_PREC	COO_ERR_MAJA	COO_ERR_MINA	COO_ERR_A
	"h:m:s"	"d:m:s"			mas	mas	
object	str13	str13	int16	int16	float32	float32	
NAME Barnard's star	17 57 48.4984	+04 41 36.113	14	14	0.026	0.029	

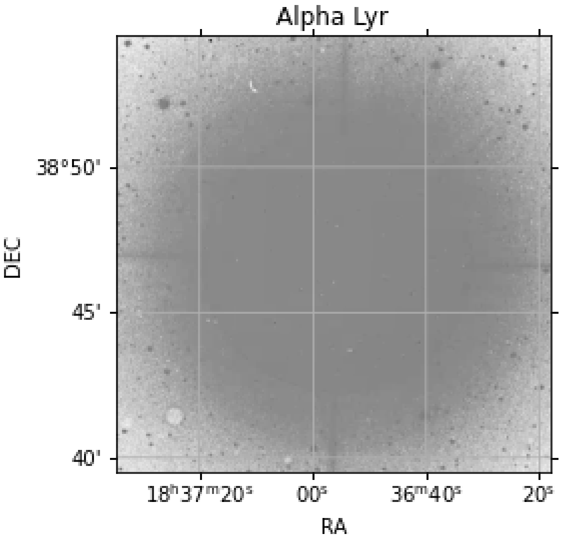
Plots

In [184]:
```
targets = [vega_target]
plot_sky(target=targets, observer=CTO, time=sunset)
plot_sky(target=targets, observer=CTO, time=onehour_after_sunset)
plot_sky(target=targets, observer=CTO, time=twohours_after_sunset)
```

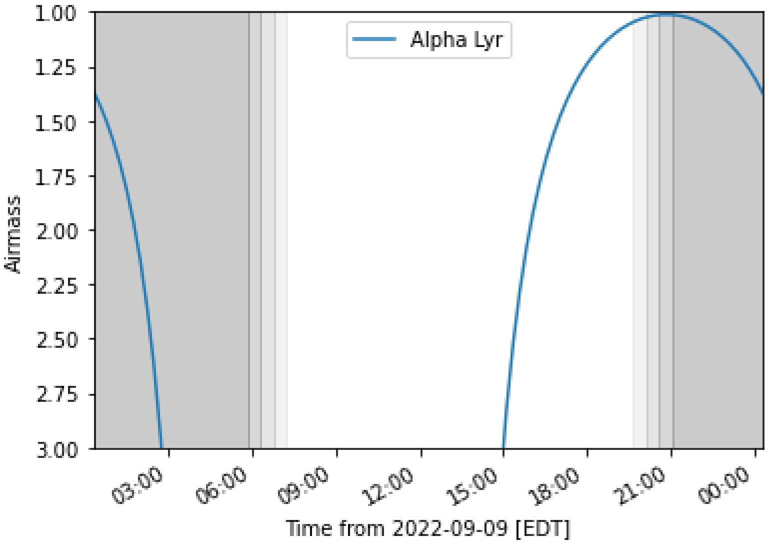
Out[184]:
```
<PolarAxesSubplot:>
```



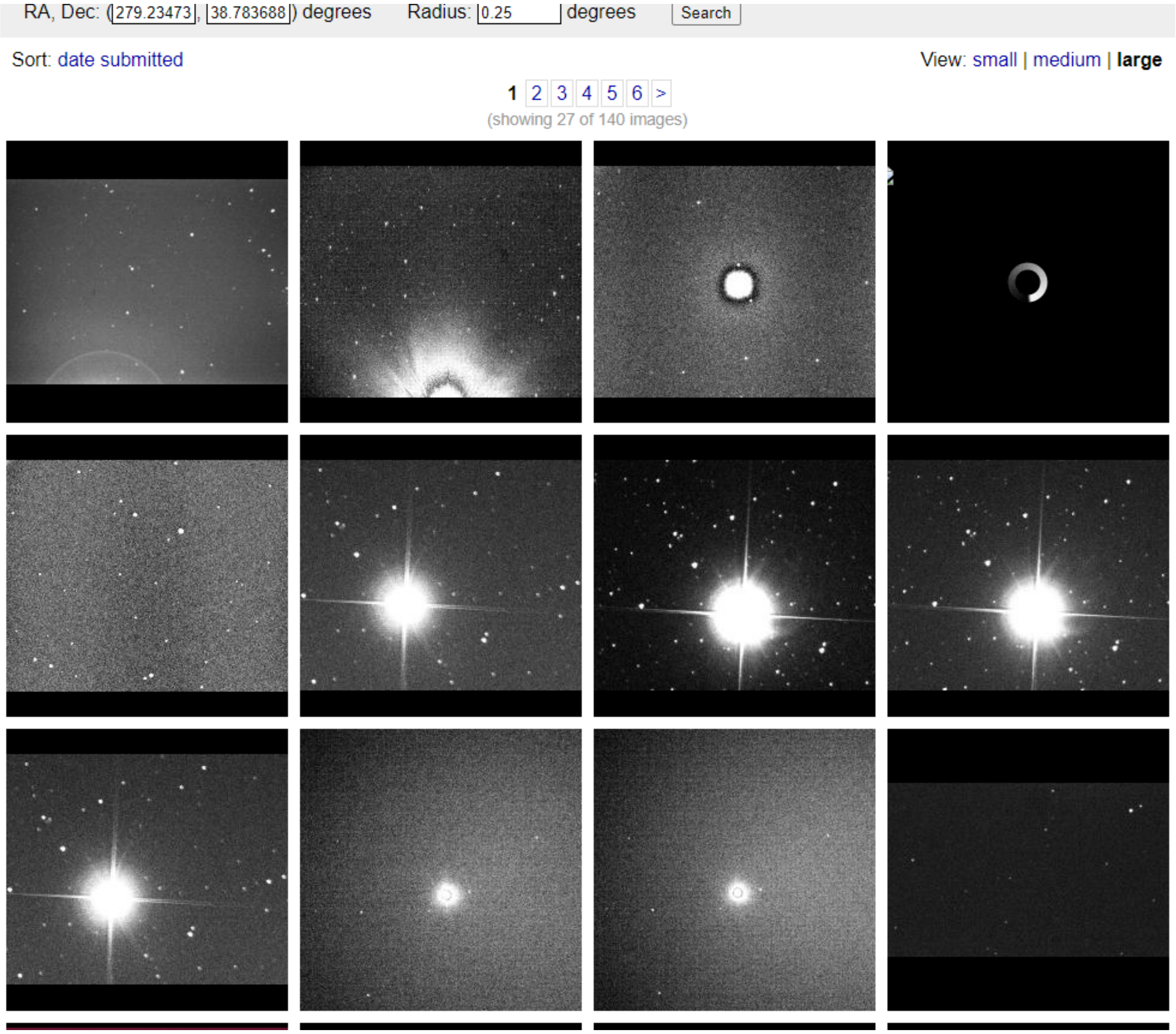
In [185]:
```
## sky chart Vega ##
ax, hdu = plot_finder_image(vega_target, survey='DSS', fov_radius=15*u.arcmin)
```



In [186]:
```
# airmass/altitude plot
plot_airmass([vega_target],
             observer=CTO,
             time=now.to_datetime(timezone=CTO.timezone),
             use_local_tz=True,
             brightness_shading=True)

plt.legend(loc='best')
plt.show()
```



https://nova.astrometry.net/user_images/location?thumbnail_size=&sort=&calibrated=on&ra=279.23473479&dec=38.78368896&radius=0.25 (https://nova.astrometry.net/user_images/location?thumbnail_size=&sort=&calibrated=on&ra=279.23473479&dec=38.78368896&radius=0.25)



RA, Dec: (279.23473, 38.783688) degrees Radius: 0.25 degrees Search

Sort: date submitted

View: small | medium | large

1 2 3 4 5 6 >

(showing 27 of 140 images)

A bright nebula

```
In [192]: naneb_coord = coordinates.SkyCoord.from_name("North America Nebula")
          naneb_coord
```

```
Out[192]: <SkyCoord (ICRS): (ra, dec) in deg
              (314.6958, 44.33)>
```

```
In [193]: naneb_coord.to_string('hmsdms')
```

```
Out[193]: '20h58m46.992s +44d19m48s'
```

```
In [194]: naneb_target = FixedTarget(naneb_coord, name="North America Nebula")
          CTO.target_is_up(now, naneb_target)
```

```
Out[194]: False
```

In [195]:

```
# Rise and set time for Proxima Centauri
(eastern(CTO.target_rise_time(time=now, target=naneb_target)),
 eastern(CTO.target_set_time(time=now,  target=naneb_target)))
```

Out[195]:

```
('14:58:10', '07:30:36')
```

Magnitude estimates in the blue, visual, and red filters

In [196]:

```
Simbad.reset_votable_fields()
Simbad.add_votable_fields('flux(R)', 'flux(V)', 'flux(B)')
naneb_simbad = Simbad.query_object("North America Nebula")
naneb_simbad
```

Out[196]:

Table length=1

MAIN_ID	RA	DEC	RA_PREC	DEC_PREC	COO_ERR_MAJA	COO_ERR_MINA	COO_ERR_A
	"h:m:s"	"d:m:s"			mas	mas	
object	str13	str13	int16	int16	float32	float32	
NGC 7000	20 58 47	+44 19.8	4	4	--	--	

Visual magnitude of 4 - from google search

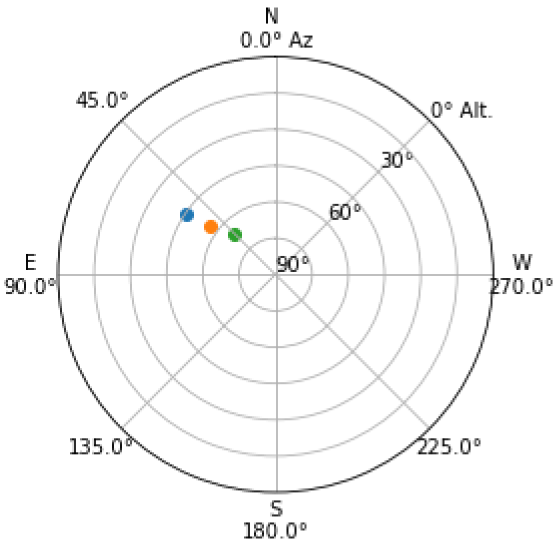
Plots

In [200]:

```
targets = [naneb_target]
plot_sky(target=targets, observer=CTO, time=sunset)
plot_sky(target=targets, observer=CTO, time=onehour_after_sunset)
plot_sky(target=targets, observer=CTO, time=twohours_after_sunset)
```

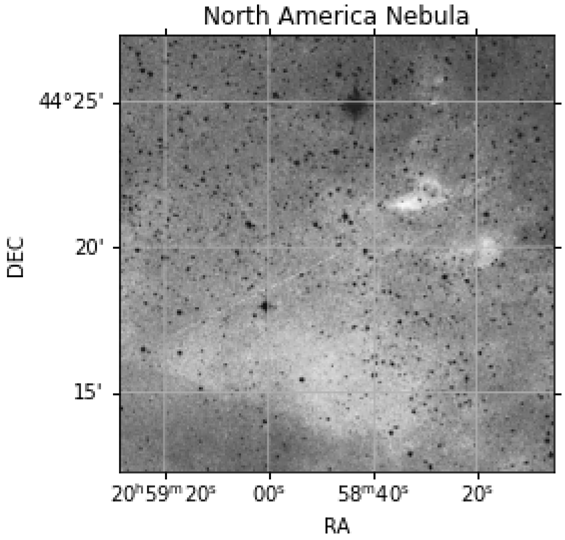
Out[200]:

```
<PolarAxesSubplot:>
```

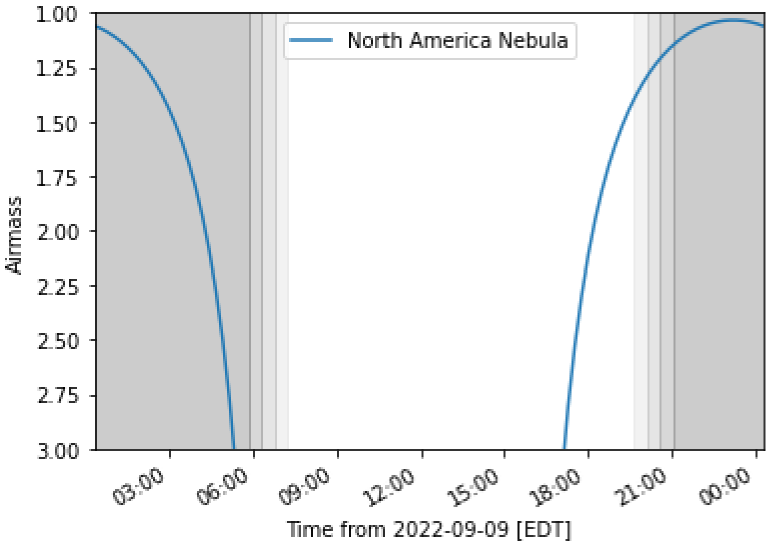


In [201]:

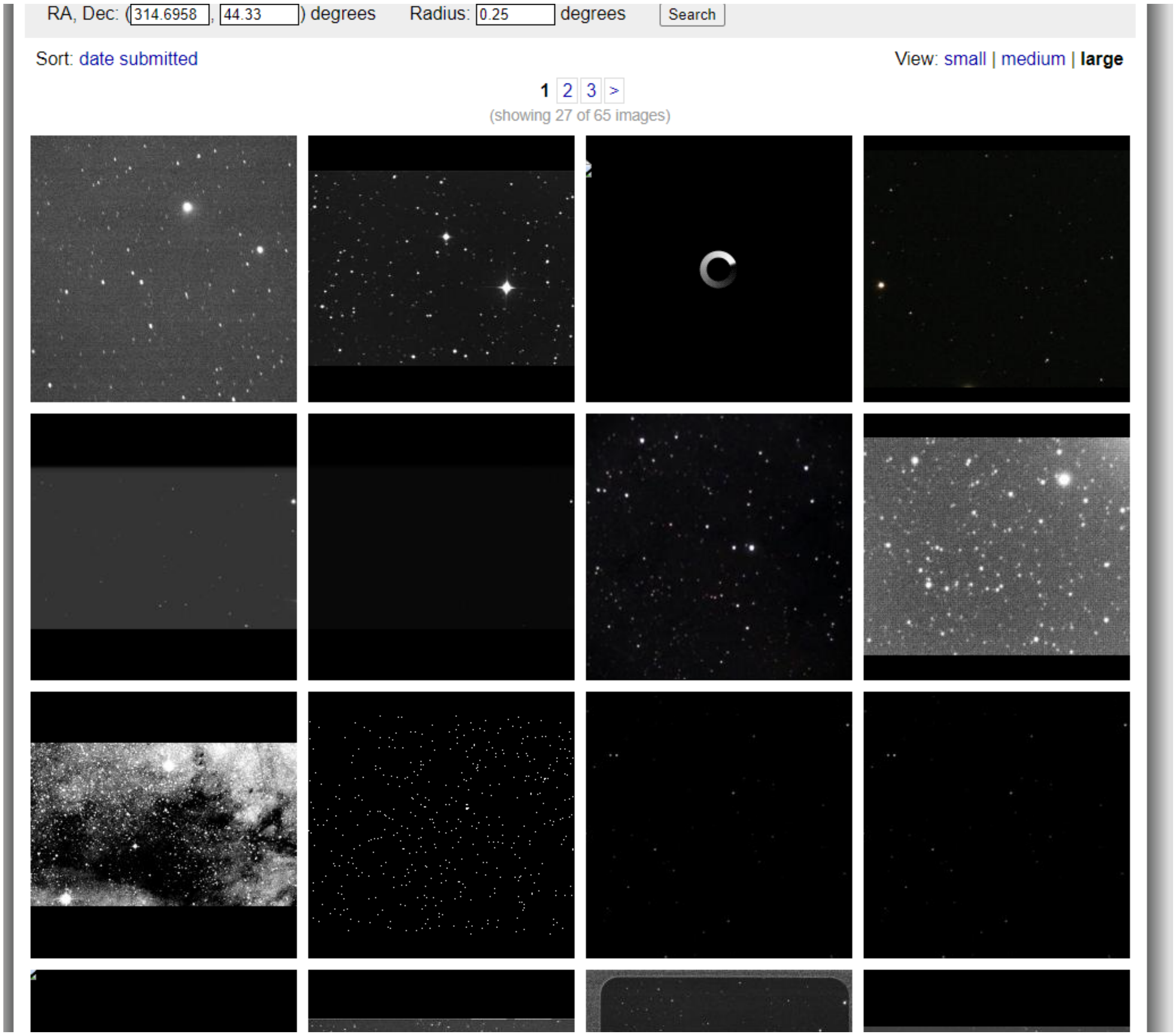
```
## sky chart North America Nebula ##
ax, hdu = plot_finder_image(naneb_target, survey='DSS', fov_radius=15*u.arcmin)
```



In [202]:
```
# airmass/altitude plot
plot_airmass([naneb_target],
             observer=CTO,
             time=now.to_datetime(timezone=CTO.timezone),
             use_local_tz=True,
             brightness_shading=True)

plt.legend(loc='best')
plt.show()
```



https://nova.astrometry.net/user_images/location?thumbnail_size=&sort=&calibrated=on&ra=314.6958&dec=44.33&radius=0.25 (https://nova.astrometry.net/user_images/location?thumbnail_size=&sort=&calibrated=on&ra=314.6958&dec=44.33&radius=0.25)



RA, Dec: (314.6958, 44.33) degrees Radius: 0.25 degrees Search

Sort: date submitted

View: small | medium | large

1 2 3 >

(showing 27 of 65 images)

Contingency

None neeved, visible throughout semester

A dense star cluster

In [248]:
```
arch_coord = coordinates.SkyCoord.from_name("Arches Cluster")
arch_coord
```

Out[248]:
```
<SkyCoord (ICRS): (ra, dec) in deg
    (266.46042, -28.82444)>
```

In [249]:
```
arch_coord.to_string('hmsdms')
```

Out[249]:
```
'17h45m50.5008s -28d49m27.984s'
```

In [250]:
```
arch_target = FixedTarget(arch_coord, name="Arches Cluster")
CTO.target_is_up(now, arch_target)
```

Out[250]:
```
False
```

In [251]:
```
# Rise and set time for Proxima Centauri
(eastern(CTO.target_rise_time(time=now, target=arch_target)),
 eastern(CTO.target_set_time(time=now,  target=arch_target)))
```

Out[251]:
```
('15:14:26', '00:50:43')
```

Magnitude estimates in the blue, visual, and red filters

In [252]:
```
Simbad.reset_votable_fields()
Simbad.add_votable_fields('flux(R)', 'flux(V)', 'flux(B)')
arch_simbad = Simbad.query_object("Arches Cluster")
arch_simbad
```

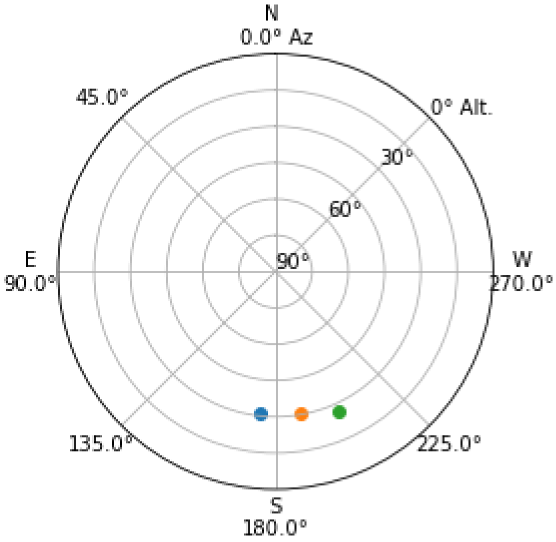
Out[252]: *Table length=1*

MAIN_ID	RA	DEC	RA_PREC	DEC_PREC	COO_ERR_MAJA	COO_ERR_MINA	COO_ERR_A
	"h:m:s"	"d:m:s"			mas	mas	
object	str13	str13	int16	int16	float32	float32	
NAME Arches Cluster	17 45 50.5	-28 49 28	5	5	--	--	

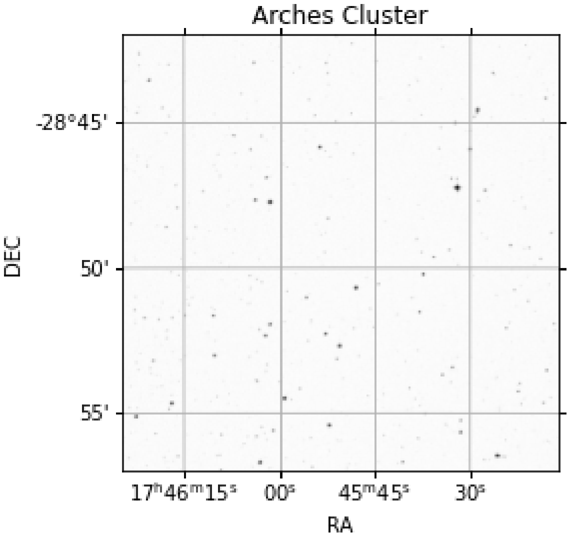
Plots

In [253]:
```
targets = [arch_target]
plot_sky(target=targets, observer=CTO, time=sunset)
plot_sky(target=targets, observer=CTO, time=onehour_after_sunset)
plot_sky(target=targets, observer=CTO, time=twohours_after_sunset)
```

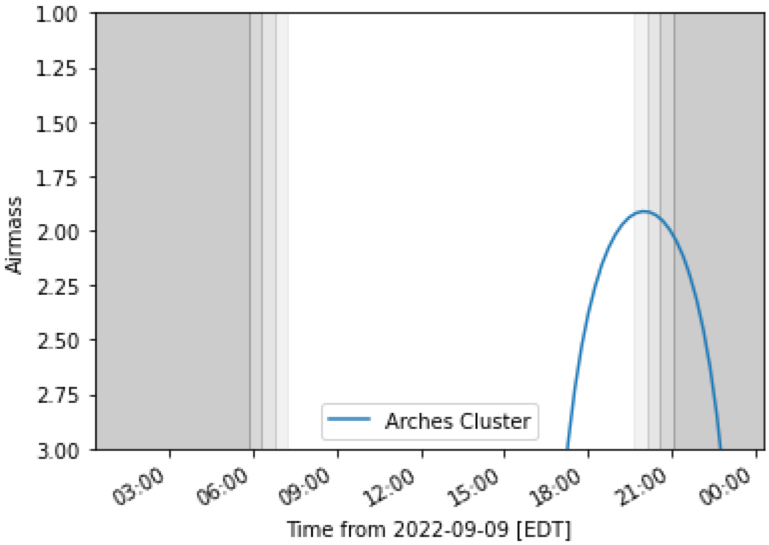
Out[253]:
```
<PolarAxesSubplot:>
```



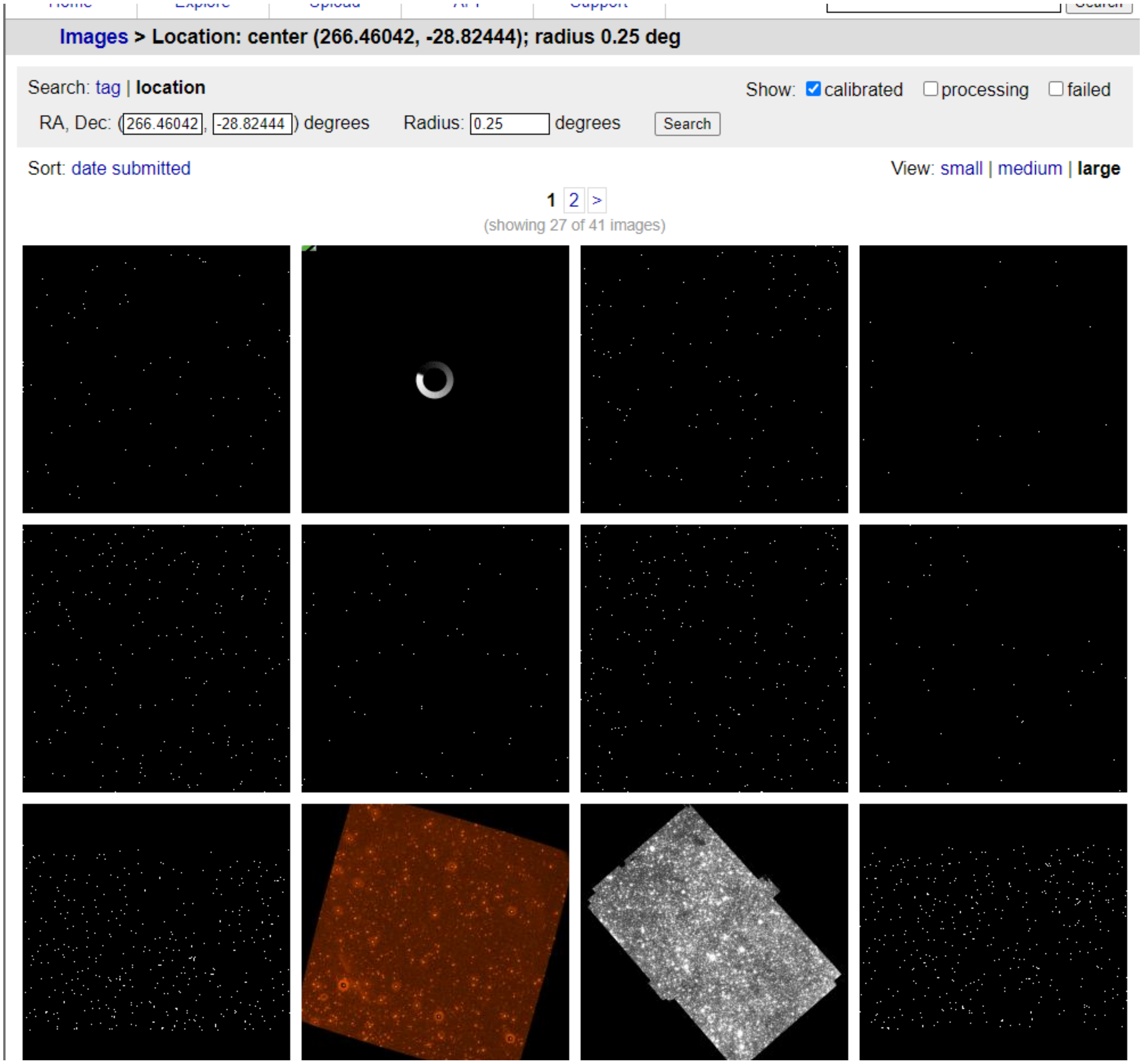
In [254]:
```
## sky chart Barnard's Star ##
ax, hdu = plot_finder_image(arch_target, survey='DSS', fov_radius=15*u.arcmin)
```



In [255]:
```
# airmass/altitude plot
plot_airmass([arch_target],
             observer=CTO,
             time=now.to_datetime(timezone=CTO.timezone),
             use_local_tz=True,
             brightness_shading=True)

plt.legend(loc='best')
plt.show()
```



[https://nova.astrometry.net/user_images/location?thumbnail_size=&sort=&calibrated=on&ra=266.46042&dec=-28.82444&radius=0.25 (https://nova.astrometry.net/user_images/location?thumbnail_size=&sort=&calibrated=on&ra=266.46042&dec=-28.82444&radius=0.25)](https://nova.astrometry.net/user_images/location?thumbnail_size=&sort=&calibrated=on&ra=266.46042&dec=-28.82444&radius=0.25)



Images > Location: center (266.46042, -28.82444); radius 0.25 deg

Search: tag | **location**

Show: ☑ calibrated □ processing □ failed

RA, Dec: (266.46042, -28.82444) degrees Radius: 0.25 degrees

Sort: date submitted

View: small | medium | **large**

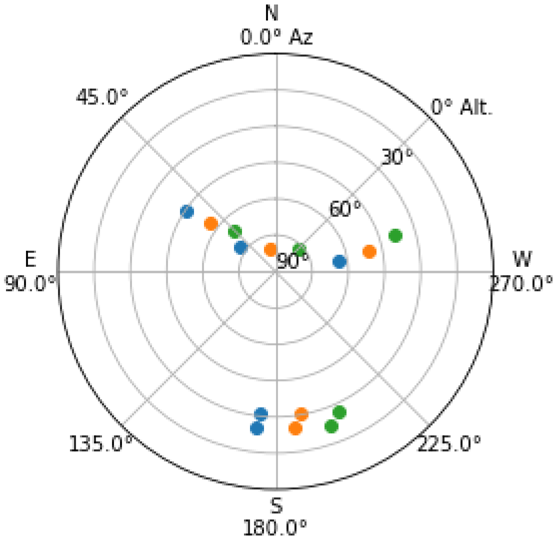
(showing 27 of 41 images)

Contingency

None neeved, visible throughout semester

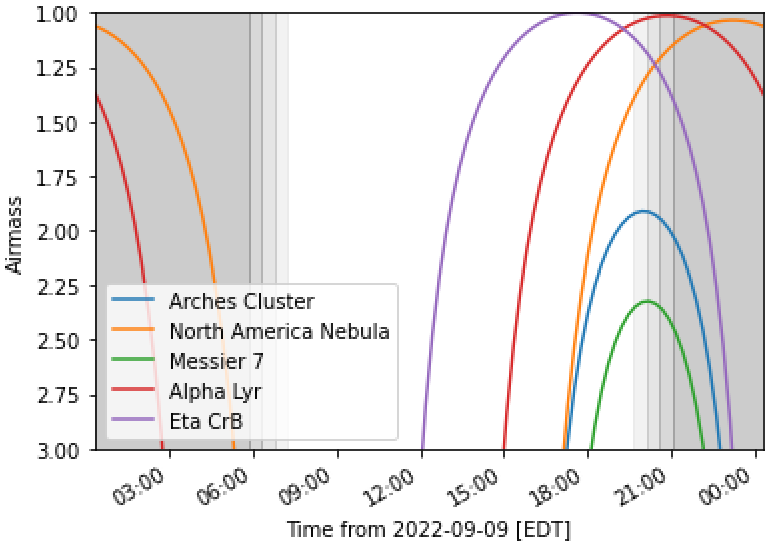
In [256]:
```
targets = [arch_target,naneb_target,vega_target,bar_target,EtaCrB_target]
plot_sky(target=targets, observer=CTO, time=sunset)
plot_sky(target=targets, observer=CTO, time=onehour_after_sunset)
plot_sky(target=targets, observer=CTO, time=twohours_after_sunset)
```

Out[256]:
```
<PolarAxesSubplot:>
```



In [257]:

```
# airmass/altitude plot
plot_airmass(targets,
             observer=CTO,
             time=now.to_datetime(timezone=CTO.timezone),
             use_local_tz=True,
             brightness_shading=True)

plt.legend(loc='best')
plt.show()
```



Exposure plan

1. 6 pm to 7 pm Set up at CTO before twilight
2. 7 pm to 8 pm Begin taking flat/dark/bright/twilight images as the sun is setting
3. 8 pm to 8:30 pm After twilights, align telescope on three known objects
4. 8:40 pm Messier 7
   - ten exposures each at 1s and 10 s long. Longer exposure times if needed
5. 9:10 pm Arches Cluster
   - ten exposures each at 1s and 10 s long. Longer exposure times if needed
6. 10 pm Eta CrB
   - ten exposures each at 1s and 10 s long. Longer exposure times if needed
7. 10:30 pm Alpha Lyr
   - ten 0.4 s exposures
8. 11 pm North America Nebula
   - ten exposures each at 10 s, 30 s,and 1 min long exposure
9. 11:30 pm Break down equipment

In [ ]: