(Ground-based) Observing considerations:

- When is my object visible?
  - Depends on observing location, time of year.
  - Need to define "visible" above the horizon? above a certain altitude?
- Is the moon up or down? How bright is the moon?
  - The moon makes the sky bright, hard to see faint objects.
  - "Dark time" (new moon) can be very competitive
- How many hours is my object visible for? How much observing time do I need?
  - If you need a quick observation (bright object) an hour may be enough
  - If you need very deep observations, you want the object visible for many hours.

### Skycalc (<u>http://www.briancasey.org/artifacts/astro/</u>)

#### Moon Phase Page

Produces an image of the moon for a given date.

#### Astronomical Sky Calendar

The page generates a calendar for the given range of months which contains, for each day, the Julian Date, Sun rise & set times, Moon rise & set times and percent illumination, etc.

#### **Daily Almanac**

Lots of useful information, like sun rise and set, moon phase and position, etc. for a specific date.

#### **Hourly Airmass Tables**

Provides the airmass for a star (or other object) for each hour in a given night.

#### **Object Seasonal Observability**

Lists the rise, set, and transit times for an object on the full and new moons (i.e. bimonthly) over a period of time.

#### **Planetary Positions**

Lists the positions of the major planets for a given date.

# Skycalc (<u>http://www.briancasey.org/artifacts/astro/</u>): When is my object visible?

<b>Object Seasonal Observability</b> by <u>Brian Casey</u> , using <u>Skycalc</u> by John Thorstensen		
<b>Observatory</b> Kitt Peak ~ If "Other" enter:	Choose observatory (or enter location)	
West Longitude (HOURS m s)         North Latitude (d m s)         Actual Elevation (meters)         Actual Elevation (for rise/set)         Effective Elevation (for rise/set)         Site name         Standard Time zone, hours West         Time zone name         Time zone abbrev         Daylight-savings option:         U.S. convention	Important: Skycalc wants coordinates v Be careful to verify you have coordinates properly	vithout colons! e entered
Start Date Year:2022Month:JanuaryDay13End DateYear:2023Month:JanuaryDay13	Choose date ranges	
Stellar Parameters		
Star Name       M87         Right Ascension (hh mm ss)       12 30 00         Declination (dd mm ss)       12 00 00         Epoch (yyyy)       2000         Altitude of twilight sun (degrees)       -18	Enter object information	
Get Observability Table	Click "get observability table"	

### Skycalc (<u>http://www.briancasey.org/artifacts/astro/</u>)

- shows moon phase: F (full) / N (new)
- shows the object's Hour Angle (HA) and airmass (sec.z) at the end of evening twilight, center of the night, and start of morning twilight.
- shows how many hours during the night the object is above (i.e. higher in the sky) an airmass of 3, 2, and 1.5.

We see that M87 is above\* 1.5 airmasses for 6+ hours each night in March and April. But we don't want the moon to interfere with our observations. So we might ask for observing time at the beginning or end of March, to avoid full moon.

\* remember, "above 1.5 airmasses" means "higher in the sky than an airmass of 1.5, or in other words  $\sec(z) < 1.5$ . \*\*\* Seasonal Observability of M87 \*\*\*

RA & dec: 12 30 00.0, 12 00 00, epoch 2000.0 Site long&lat: 7 26 28.0 (h.m.s) West, 31 57 12 North.

Shown: local eve. date, moon phase, hr ang and sec.z at (1) eve. twilight, (2) natural center of night, and (3) morning twilight; then comes number of nighttime hours during which object is at sec.z less than 3, 2, and 1.5. Night (and twilight) is defined by sun altitude < -18.0 degrees.

Date (eve)	moon	(	eve		cent			morn		<pre>night hrs@sec.z:</pre>		
		HA	sec.z	HA	4	sec.z	H	A	sec.z	<3	<2	<1.5
2022 Jan 17	F	-9 55	down	-4 3	30	2.3	0	55	1.1	5.9	5.0	4.1
2022 Jan 31	N	-8 49	down	-3 3	32	1.6	1	45	1.2	6.7	5.9	4.9
2022 Feb 15	F	-7 38	down	-2 3	32	1.3	2	34	1.3	7.5	6.7	5.7
2022 Mar 1	N	-6 33	down	-1 3	39	1.2	3	15	1.5	8.2	7.4	6.4
2022 Mar 17	F	-5 18	3.8	-0 4	40	1.1	3	58	1.9	8.9	8.1	6.4
2022 Mar 31	N	-4 11	2.0	0 3	11	1.1	4	34	2.4	8.7	8.2	6.4
2022 Apr 15	F	-2 59	1.4	1 (	06	1.1	5	12	3.5	7.9	7.1	6.2
2022 Apr 30	N	-1 46	1.2	2 (	03	1.2	5	51	7.1	6.7	5.9	4.9
2022 May 15	F	-0 32	1.1	3 (	01	1.4	6	34	down	5.5	4.6	3.7
2022 May 29	N	0 36	1.1	3 5	58	1.9	7	18	down	4.3	3.5	2.6
2022 Jun 13	F	1 45	1.2	4 5	59	3.1	8	13	down	3.2	2.4	1.4
2022 Jun 28	N	2 48	1.4	6 (	02	9.8	9	16	down	2.2	1.3	0.4
2022 Jul 12	F	3 39	1.7	6 5	59	down	10	20	down	1.3	0.5	0.0
2022 Jul 27	N	4 26	2.3	7 5	59	down	11	33	down	0.5	0.0	0.0
2022 Aug 11	F	5 08	3.4	8 5	57	down	-11	14	down	0.0	0.0	0.0
2022 Aug 26	N	5 47	6.4	9 5	53	down	-10	01	down	0.0	0.0	0.0
2022 Sep 9	F	6 22	33.4	10 4	43	down	-8	55	down	0.0	0.0	0.0
2022 Sep 25	N	7 02	down	11 4	41	down	-7	41	down	0.0	0.0	0.0
2022 Oct 9	F	7 39	down	-11 2	29	down	-6	36	down	0.0	0.0	0.0
2022 Oct 24	N	8 22	down	-10 3	32	down	-5	27	4.4	0.0	0.0	0.0
2022 Nov 7	F	9 07	down	-9 3	38	down	-4	21	2.2	0.6	0.0	0.0
2022 Nov 23	N	10 03	down	-8 3	32	down	-3	06	1.5	1.8	1.0	0.1
2022 Dec 7	F	10 59	down	-7 3	31	down	-2	01	1.2	2.9	2.1	1.2
2022 Dec 22	N -	-11 57	down	-6 2	25	52.8	-0	53	1.1	4.1	3.2	2.3
2023 Jan 6	F -	-10 48	down	-5 3	19	3.9	0	11	1.1	5.1	4.3	3.4
2023 Jan 21	N	-9 38	down	-4 3	14	2.1	1	09	1.1	6.1	5.3	4.3

## Skycalc (<u>http://www.briancasey.org/artifacts/astro/</u>): What are the conditions on a particular night?

Hourly Airmass Table by <u>Brian Casey</u> , using <u>Skycalc</u> by John Thorstensen	
Observatory Kitt Peak ~	Choose observatory (or enter location)
West Longitude (HOURS m s)	
North Latitude (d m s)	
Actual Elevation (meters)	
Effective Elevation (for rise/set)	
Site name	
Standard Time zone, hours West	
Time zone name	
Time zone abbrev	
Daylight-savings option: U.S. convention ~	
Date Year: 2022 Month: March V Day 24 V	Choose date
Stellar Parameters	
Pight Ascension (hh mm ss) 12 20 00	
Declination (dd mm ss) 12 30 00	Enter object information
Epoch (www) 2000	
Altitude of twilight sun (degrees) 18	
Antitude of twinght sun (degrees) -18	
Get Airmass Table	Click "get airmass table"

- Shows moon phase (half lit)
- Shows local time at observatory, universal time, local sidereal time
- Shows Hour Angle (HA) and airmass (secz) of the object over the course of the night.
- Show altitude of Sun and Moon

So on this night, if we wanted to observe with the object above and altitude of 1.5 airmasses and no moon:

- Start at about 9:30pm (above secz=1.5)
- End at about 3:00am (moonrise)

## Hourly Airmass Table for M87 for Mar 24, 2022

\*\*\* Hourly airmass for M87 \*\*\*

Epoch 2000.00: RA 12 30 00.0, dec 12 00 00 Epoch 2022.23: RA 12 31 07.5, dec 11 52 38

At midnight: UT date 2022 Mar 25, Moon 0.49 illum, 95 degr from obj

Loca	ເ ປ	T LMST	HA	secz	par.angl.	SunAlt	MoonAlt
19 0	0 2	00 6 44	-5 47	6.485	-59.0	-4.9	
20 0	0 3 0 4	00         7         44           00         8         44	-4 47 -3 47	2.719	-60.1 -59.3	-1/.4	
22 0 23 0	0 5 0 6	00 9 44 00 10 44	-2 47 -1 47	1.373 1.176	-55.5 -46.5		
00	0 7	00 11 44	-0 47	1.085	-26.3		
2 0	0 9	00         12         45           00         13         45	1 14	1.115	37.3		-0.5
3040	$   \begin{array}{ccc}     0 & 10 \\     0 & 11   \end{array} $	001445001545	2 14 3 14	1.247 1.517	51.5 57.7		9.3 17.8
50 60	0 12 0 13	001645001745	4 14 5 14	2.088 3.658	59.9 59.8	 -5.8	24.6 29.0