

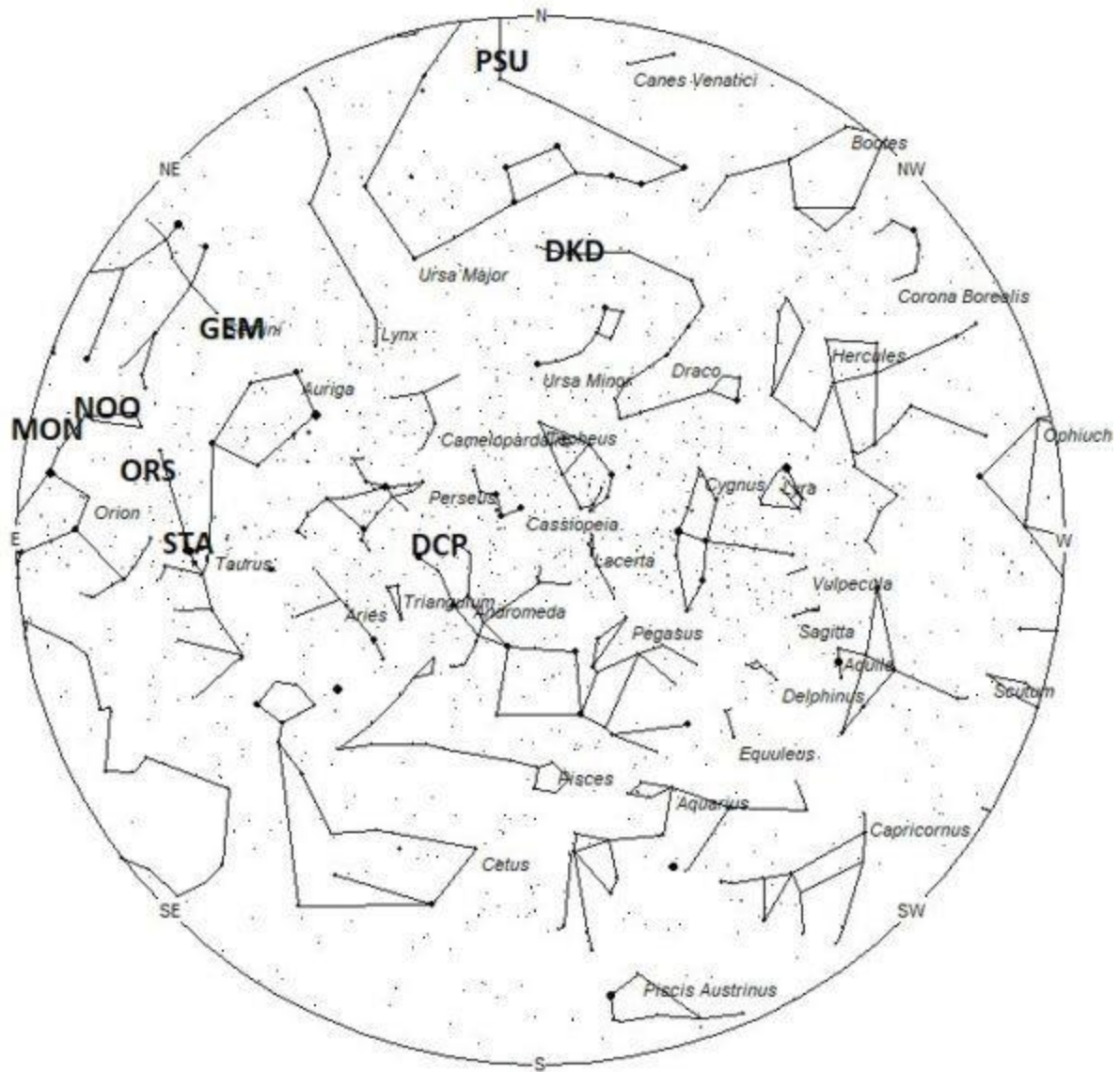
Meteor Activity Outlook for December 2-8, 2023

No matter where you live, the first half of December provides some of the best meteor activity of the year. In the Northern Hemisphere the sporadic rates are still strong plus you can also count on strong activity from the Geminids, which peak on December 14th. There are also several minor sources that add a few meteors each hour. All these centers of activity are located high in the sky during the early morning hours this time of year. Much of the activity mentioned above can also be seen from the Southern Hemisphere. While the sporadic rates are not as strong as those seen from the north, they are stronger than the previous months and heading for a maximum in February. The warm, but short summer nights south of the equator make for some great viewing as long as the moon does not interfere.

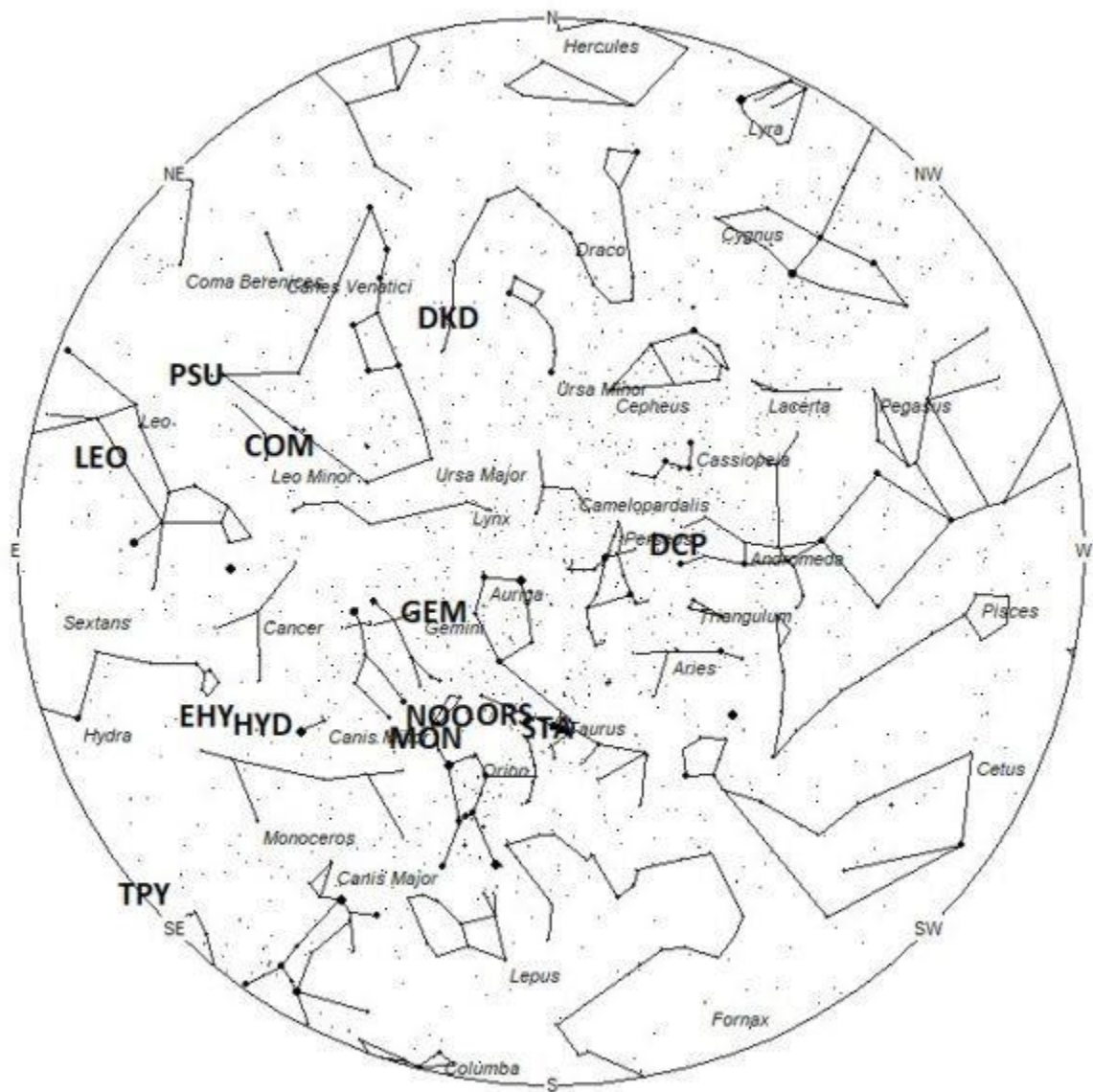
During this period, the moon reaches its last quarter phase on Tuesday December 5th. On that night the moon will be located 90 degrees west of the sun and will rise between midnight and 01:00. This weekend the waning gibbous moon will rise during the late evening hours, effectively spoiling the sky for the remainder of the night. As the week progresses the moon will become less of a factor as its phase wanes. The estimated total hourly rates for evening observers this weekend should be near 3 as seen from mid-northern latitudes (45N) and 2 as seen from tropical southern locations (25S). For morning observers, the estimated total hourly rates should be near 14 as seen from mid-northern latitudes (45N) and 8 as seen from tropical southern locations (25S). Rates are reduced due to moonlight. The actual rates seen will also depend on factors such as personal light and motion perception, local weather conditions, alertness, and experience in watching meteor activity. Note that the hourly rates listed below are estimates as viewed from dark sky sites away from urban light sources. Observers viewing from urban areas will see less activity as only the brighter meteors will be visible from such locations.

The radiant (the area of the sky where meteors appear to shoot from) positions and rates listed below are exact for Saturday night/Sunday morning December 2/3. These positions do not change greatly day to day so the listed coordinates may be used during this entire period. Most star atlases (available at science stores and planetariums) will provide maps with grid lines of the celestial coordinates so that you may find out exactly where these positions are located in the sky. I have also included charts of the sky that display the radiant positions for evening, midnight, and morning. The center of each chart is the sky directly overhead at the appropriate hour. These charts are oriented for facing south but can be used for any direction by rotating the charts to the desired direction. A planisphere or computer planetarium program is also useful in showing the sky at any time of night on any date of the year. Activity from each radiant is best seen when it is positioned highest in the sky, either due north or south along the meridian, depending on your latitude. Radiants that rise after midnight will not reach their highest point in the sky until daylight. For these radiants, it is best to view them during the last few hours before dawn. It must be remembered that meteor activity is rarely seen at its radiant position. Rather they shoot outwards from the radiant, so it is best to center your field of view so that the radiant lies toward the edge and not the center. Viewing there will allow you to easily trace the path of each meteor back to the radiant (if it is a shower member) or in another direction if it is sporadic. Meteor activity is not seen from

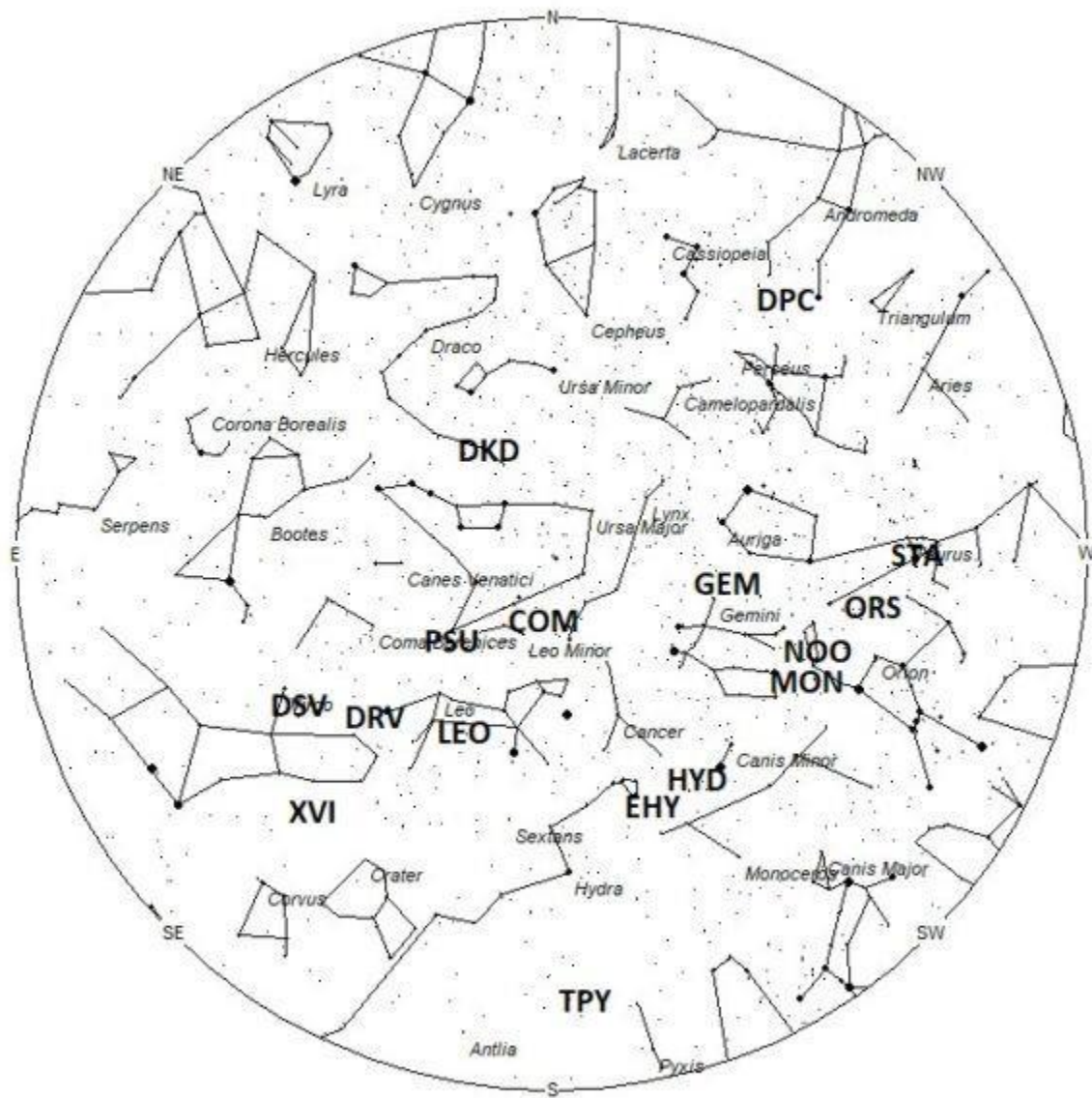
radiants that are located far below the horizon. The positions below are listed in a west to east manner in order of right ascension (celestial longitude). The positions listed first are located further west therefore are accessible earlier in the night while those listed further down the list rise later in the night.



Radiant Positions at 7pm Local Standard Time



Radiant Positions at Midnight Local Standard Time



Radiant Positions at 5am Local Standard Time

These sources of meteoric activity are expected to be active this week

The **December Phoenicids (PHO)** are a periodic shower that rarely produces noticeable activity. The only impressive display produced so far by this shower occurred in 1956 when ZHR's were near 100. The normal range for these meteors is from November 28 through December 9 with a peak on December 2nd. The radiant at maximum is located at 01:12 (018) -53. This position lies in southern Phoenix, 5 degrees south of the 3rd magnitude star known as beta Phoenicis. For those viewing from the northern tropics southward, this position also lies 7 degrees northwest of the bright 1st magnitude star known as Achernar (alpha Eridani). This area of the sky is best placed in the southern sky as soon as evening twilight ends. These meteors are best seen from the southern hemisphere where the radiant lies much higher in the sky. For those viewing from the northern hemisphere, only those in the northern tropics have any real chance of seeing activity from this source. At only 18 km/sec. the Phoenicids produce extremely slow meteors.

The **December phi Cassiopeiids (DPC)** are the classical return of the Andromedids and the radiant that was active prior to the breakup of comet 3D/Biela in the 1840's. This source is active from November 28 through December 10th. Maximum activity is expected to occur on December 2nd when the radiant is located at 01:56 (029) +47. This area of the sky is located 5 degrees northwest of the 2nd magnitude double star known as Almach (gamma Andromedae A). This position is also close to the border with Cassiopeia and in some years the radiant lies in Cassiopeia, hence the name of phi Cassiopeiids. These meteors are best seen near 2100 (9pm) LST by looking toward the northern sky. Meteors from the December phi Cassiopeiids strike the atmosphere at 17km/sec., which would produce meteors of very slow velocity. A minor outburst of faint meteors is predicted near 19:00 UT, which favors Europe, Northern Africa and western Asia. No matter your location we urge you to check the sky on the evening of December 2nd for any of this activity.

The last of the **Southern Taurids (STA)** are expected this week from a radiant located at 04:37 (069) +16. This area of the sky is located in central Taurus, near the spot occupied by the 1st magnitude orange star known as Aldebaran (alpha Tauri). To best see these meteors, one should face southward near 23:00. Maximum activity was on November 7th so rates at this time should be less than 1 no matter your location. With an entry velocity of 20 km/sec., the average STA meteor would be of medium-slow velocity.

The **Southern chi Orionids (ORS)** are usually included in the totals of the Southern Taurids, as the two radiants are separated by only 5 degrees. Careful study of this area of the sky can separate these two showers. These meteors are active from November 14 through December 16, with maximum activity occurring on December 2nd. The radiant is currently located at 05:19 (80) +18, which lies in central Taurus, 4 degrees southwest of the 3rd magnitude star known as Tianguan (zeta Tauri A). This radiant is best placed in the southern sky near midnight LST, when it lies on the meridian and is located highest in the sky. Rates at this time should be near 1 per hour no matter your location. With an entry velocity of 26 km/sec., the average ORS meteor would be of medium-slow velocity.

The **November Orionids (NOO)** are active from November 13 through December 12, with maximum activity occurring on November 30th. The radiant is currently located at 06:14 (094) +15. This area of the sky lies in northeastern Orion, 1 degree north of the 4th magnitude star known

as xi Orionis. This radiant is best placed in the sky near 0100 LST, when it lies highest above the southern horizon. Rates should be near 1 per hour no matter your location. With an entry velocity of 42 km/sec., most activity from this radiant would be of medium speed.

The **Monocerotids (MON)** are active this week from a radiant located at 06:22 (096) +09. This area of the sky is located in northeastern Orion, 5 degrees northeast of the 1st magnitude orange star known as Betelgeuse (alpha Orionis). This position is 5 degrees away from the NOO radiant so care must be taken to differentiate between these two showers. This radiant best placed near 0100 LST, when it lies highest in the southern sky. Rates should be near 1 per hour no matter your location. With an entry velocity of 43 km/sec., most activity from this radiant would be of medium speed. This shower is active from November 23rd through December 24th, with maximum activity occurring on December 11th.

The **Geminids (GEM)** are active from November 19th through December 24th, peaking on December 14th. The Geminid radiant is currently located at 06:48 (102) +34. This area of the sky lies in northern Gemini, 2 degrees west of the 4th magnitude star known as theta Geminorum. These meteors are best seen near 02:00 LST, when the radiant lies highest in the southern sky. Rates are expected to be near 1 per hour this weekend, increasing to 5 per hour by the end of next week. With an entry velocity of 33km/sec, most of these meteors would appear to possess a medium velocity.

The **sigma Hydrids (HYD)** are active from a radiant located at 08:02 (121) +04. This area of the sky is located in southeastern Canis Minor, 4 degrees southeast of the zero-magnitude star known as Procyon (alpha Canis Minoris). These meteors are active from November 24 through January 7th, with maximum activity occurring on December 7th. The activity profile is not smooth as there are several minor peaks of activity throughout the activity period. We will highlight these as they occur. To best see these meteors, face toward the south during the last couple of hours prior to dawn. With an entry velocity of 59km/sec, most of these meteors would appear swift. Expect to see 1 per hour no matter your location.

The **Puppis-Velids (PUP)** are a vast complex of weak radiants located in the constellations of Puppis and Vela. Visual plots and photographic studies have revealed many radiants in this area during November and December. The combined strength of these radiants can produce a ZHR of 10. Actual hourly rates will be much less unless you happen to be observing from the deep Southern Hemisphere. Activity from this source begins around December 1st. The center of this activity is currently located at 08:10 (122) -45. This position lies in western Vela, 2 degrees northeast of the 2nd magnitude star known as gamma Velorum. Peak rates occur near December 7. These meteors are best seen near 0300 LST when the radiant lies highest in the southern sky. Observers located in the southern hemisphere have an advantage viewing this shower as the radiant will rise higher into their sky allowing more activity to be seen. Since the radiant lies low in the south for most northern hemisphere observers, meteors seen from north of the equator tend to be long in length and long-lasting. At 40 km/sec. the Puppis-Velids produce meteors of average velocity. Note: these are also listed as the “e Velids” from several sources.

The **eta Hydrids (EHY)** were recently discovered by members of the Croatian Meteor Network. This radiant is active from November 26 through January 1st with maximum activity occurring on

December 12th. The radiant is currently located at 08:36 (129) +03, which places it in extreme western Hydra, 1 degree southwest of the 4th magnitude star known as sigma Hydrae. This position is close to that of the sigma Hydrids so care must be taken to separate the two sources. These meteors are best seen near 0400 LST when the radiant lies highest above the southern horizon. Current rates should be less than 1 per hour no matter your location. With an entry velocity of 62 km/sec., most activity from this radiant would be of swift speed.

The **theta Pyxidids (TPY)** consist of two weak showers that peak two weeks apart. The early version is active from November 26 through December 6, with maximum occurring on December 1st. The radiant is currently located at 09:20 (140) -26. This area of the sky is located in western Hydra, 8 degrees northeast of the 4th magnitude star known as gamma Pyxidis. These meteors are best seen near 0500 LST when the radiant lies highest in the southern sky. At 60 km/sec. the theta Pyxids would produce mostly swift meteors.

The **Comae Berenicids (COM)** are a long duration shower active from December 5th through February 4th. Maximum activity occurs on December 16th. The radiant is currently located at 09:44 (146) +37, which places it in Leo Minor, 6 degrees west of the 4th magnitude star known as beta Leonis Minoris. These meteors would be best seen near 05:00 LST, when the radiant lies highest in the eastern sky. Current rates would be near 1 per hour as seen from the northern hemisphere and less than one as seen from south of the equator. At 63km/sec., these meteors would produce mostly swift meteors.

The **Leonids (LEO)** are still active from November 3rd to December 2nd with maximum activity occurring on November 18th. The radiant is currently located at 10:52 (163) +15. This position lies in central Leo, 4 degrees southwest of the 3rd magnitude star known as Chertan (theta Leonis). The Leonid radiant is best placed in the northeastern sky during the last hour before morning twilight when the radiant lies highest in the eastern sky. Leonids may be seen from the southern hemisphere, but the viewing conditions are not quite as favorable as those north of the equator. Current rates are expected to be less than 1 per hour no matter your location. With an entry velocity of 71 km/sec., most activity from this radiant would be swift.

The **psi Ursa Majorids (PSU)** were discovered by observers in Japan using data from SonotaCo. This shower is active from November 29-December 11 with maximum activity occurring on December 4th. The radiant is currently located at 11:15 (161) +44. This position lies in southern Ursa Major, 2 degrees southeast of the third magnitude star known as psi Ursae Majoris. This area of the sky is best placed during the last hour before dawn, when it lies highest above the northern horizon in a dark sky. Current hourly rates would most likely be near one per hour as seen from the Northern Hemisphere and less than 1 as seen from south of the equator. At 61km/sec., the average psi Ursa Majorid meteor would be swift.

The **December rho Virginids (DRV)** are active from November 29 through December 22 with peak rates occurring near December 5th. The current radiant location is at 12:17 (184) +13, which places it in northwestern Virgo, 6 degrees southeast of the 2nd magnitude star known as Denebola (beta Leonis). Current hourly rates would be less than 1 no matter your location. These meteors are best seen during the last dark hour before dawn, when the radiant lies highest above the eastern

horizon in a dark sky. At 68 km/sec. the December rho Virginids would produce mostly swift meteors.

The **December chi Virginids (XVI)** are another shower discovered in Japan by observers using data from SonotaCo. This source is active from November 26 through December 30 with maximum occurring on December 12th. The radiant is currently located at 12:17 (184) -07, which places it in southwestern Virgo, 6 degrees south of the 4th magnitude star known as Zaniah (eta Virginis A). Hourly rates should be less than 1 no matter your location. These meteors are best seen during the last dark hour before dawn, when the radiant lies highest above the eastern horizon in a dark sky. At 68 km/sec. the December chi Virginids would produce mostly swift meteors.

The **December kappa Draconids (DKD)** were discovered by SonotaCo during studies of new radiants in 2008-09. This shower is active from November 29 through December 13 with maximum activity occurring on December 3rd. The radiant is currently located at 12:32 (188) +70. This position lies in extreme western Draco, near the spot occupied by the 4th magnitude star known as kappa Draconis. While the radiant lies above the horizon all night for most of the northern hemisphere, it is best placed during the last hour before dawn, when it lies highest above the northern horizon in a dark sky. Rates could reach 1 per hour on the morning of the 3rd. Away from that morning I would expect hourly rates of less than 1. Due to the high northerly declination of the radiant these meteors are not visible from most of the southern hemisphere. At 43km/sec., the average December kappa Draconid meteor would be of medium velocity.

The **December sigma Virginids (DSV)** is a source of long duration discovered by John Greaves using the data from SonotaCo. This source is active from November 26 through January 24 with peak rates occur near December 21st. The current radiant location is at 12:49 (192) +09, which places it in northwestern Virgo, 3 degrees southwest of the 3rd magnitude star known as Vindemiatrix (epsilon Virginis). Current hourly rates would be less than 1 no matter your location. These meteors are best seen during the last dark hour before dawn, when the radiant lies highest above the eastern horizon in a dark sky. At 66 km/sec. the December Sigma Virginids would produce mostly swift meteors.

Sporadic meteors are those meteors that cannot be associated with any known meteor shower. All meteor showers are evolving and disperse over time to the point where they are no longer recognizable. Away from the peaks of the major annual showers, these sporadic meteors make up the bulk of the activity seen each night. As seen from the mid-Northern Hemisphere (45N) one would expect to see during this period approximately 8 sporadic meteors per hour during the last hour before dawn as seen from rural observing sites. Evening rates would be near 2 per hour. As seen from the tropical Southern latitudes (25S), morning rates would be near 5 per hour as seen from rural observing sites and 1 per hour during the evening hours. Locations between these two extremes would see activity between these listed figures. Rates are reduced due to moonlight.

You can keep track of the activity of these meteor showers as well as those beyond the limits of visual observing by visiting the [NASA Meteor Shower Portal](#). You can move the sky globe to see different areas of the sky. Colored dots indicate shower meteors while white dots indicate sporadic (random) activity. The large orange disk indicates the position of the sun so little activity will be seen in that area of the sky.

The list below offers the information in tabular form of the showers that I feel are within reach of the visual observer to discern. Hourly rates are often less than 1 but noting parameters such as the duration, radiant distance and the elevation of each meteor, one can compute the probability of shower association. Most showers discovered by video means have rates less than 1 meteor per **night** away from maximum, so the showers listed in these articles are not as weak as they seem. Rates and positions are exact for Saturday night/Sunday morning.

SHOWER	DATE OF MAXIMUM ACTIVITY	CELESTIAL POSITION	ENTRY VELOCITY	CULMINATION	HOURLY RATE	CLASS
		RA (RA in Deg.) DEC	Km/Sec	Local Standard Time	North- South	
December Phoenicids (PHO)	Dec 02	01:12 (018) -53	18	20:00	<1 – <1	III
December phi Cassiopeiids (DPC)	Dec 02	01:56 (029) +47	17	21:00	<1 – <1	III
Southern Taurids (STA)	Nov 07	04:37 (069) +16	20	23:00	<1 – <1	II
Southern chi Orionids (ORS)	Dec 02	05:19 (080) +18	26	00:00	<1 – <1	IV
November Orionids (NOO)	Nov 30	06:14 (094) +15	42	01:00	1 – 1	II
Monocerotids (MON)	Dec 11	06:22 (096) +09	43	02:00	1 – 1	II
Geminids (GEM)	Dec 14	06:48 (102) +34	33	02:00	1 – <1	I
sigma Hydrids (HYD)	Dec 07	08:02 (121) +04	59	03:00	1 – 1	II
Puppis-Velids (PUP)	Dec 07	08:10 (122) -45	40	03:00	<1 – 1	II
eta Hydrids (EHY)	Dec 12	08:36 (129) +03	62	04:00	<1- <1	IV
theta Pyxidids (TPY)	Dec 01	09:20 (140) -26	60	05:00	<1 – <1	IV

Comae Berenids (COM)	Dec 16	09:44 (146) +37	63	06:00	<1 – <1	II
Leonids (LEO)	Nov 18	10:52 (163) +15	71	06:00	<1 – <1	I
psi Ursa Majorids (PSU)	Dec 04	11:15 (161) +44	61	06:00	<1 – <1	IV
December rho Virginids (DRV)	Dec 05	12:17 (184) +13	68	07:00	<1 – 1	IV
December chi Virginids (XVI)	Dec 12	12:17 (184) -07	68	07:00	<1- <1	IV
December kappa Draconids (DKD)	Dec 03	12:32 (188) +70	43	08:00	<1 – <1	IV
December rho Virginids (DRV)	Dec 05	12:49 (192) +09	66	08:00	<1 – <1	IV

Class Explanation: A scale to group meteor showers by their intensity:

- **Class I:** the strongest annual showers with Zenith Hourly Rates normally ten or better.
- **Class II:** reliable minor showers with ZHR's normally two to ten.
- **Class III:** showers that do not provide annual activity. These showers are rarely active yet have the potential to produce a major display on occasion.
- **Class IV:** weak minor showers with ZHR's rarely exceeding two. The study of these showers is best left to experienced observers who use plotting and angular velocity estimates to determine shower association. These weak showers are also good targets for video and photographic work. Observers with less experience are urged to limit their shower associations to showers with a rating of I to III.