# Likely alpha Monocerotids (AMO#246) outburst on the morning of November 22, 2019

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There is a good chance to observe a short-lived outburst of the alpha Monocerotids in the morning of the night 2019 November 21–22. Observers are encouraged to watch for possible alpha Monocerotids in the last hours of the night, from 4h15m UT onwards. If an outburst takes place it is likely to be centered around 4h50m UT with a duration of 15 up to 40 minutes maximum.

## 1 Introduction

A very short outburst for the alpha Monocerotids (AMO#246) is likely on 2019 November 22, at $04^h50^m$ UT at the morning sky over Europe (Jenniskens and Lyytinen, 2019a). This outburst is caused by the dust released by a long period comet, but the comet itself is still unknown. The orbital data is listed in *Table 1*.

*Table 1* – The alpha Monocerotids (AMO#246) data listed by the Meteor Data Center in the IAU working list of meteor showers.

| | Dutch Meteor Society (2001) | Jenniskens et al. (2016) |
|---|---|---|
| $\lambda_\odot$ | 239.3° | 239.0° |
| $\alpha_g$ | 117.1° | 116.8° |
| $\delta_g$ | +0.8° | +0.9° |
| $v_g$ | 63 km/s | 63.0 km/s |
| $a$ | ~500 A.U. | 500.00 A.U. |
| $q$ | 0.488 A.U. | 0.488 A.U. |
| $e$ | 0.999 | 0.999 |
| $\omega$ | 90.66° | 90.7° |
| $\Omega$ | 59.322° | 59.3° |
| $i$ | 134.13° | 134.1° |

## 2 AMO#246 history

This shower has previously produced four outbursts, in 1925, 1935, 1985 and 1995, of which 1995 was already predicted and the photographic observations revealed the exact radiant. This is important for modeling.

Because it is a long period one revolution orbit, you do not even need to know the orbital period. This is valid when the period is long enough, e.g. at least about 300 years. The period should also not be too long, for instance more than 1000 years, because then the dust trail would have been stretched too long and so diluted that it could have hardly caused any outbursts as strong as these we had before. The 1925 and 1935 outbursts reached even the level of a meteor storm with ZHRs of over 1000. In 1985 and 1995 the activity reached a level with ZHRs of about 700 and 400.

This dust trail exists for such a long time near the Earth's orbit that it can produce outbursts, for at least decades, and in this case probably for a few centuries. The width of the trail is just very narrow. The half-width is approximately the same as the distance from the center of the Earth to the geostationary satellite orbit.

The perturbations by the planets, in total, amount to about a few million kilometers so that at sometimes the trail gets close enough to the Earth. The forecast for a possible outburst was published in 2002 (Lyytinen and Jenniskens, 2003). The data concerning the alpha Monocerotids (AMO#246) has been reproduced in *Table 2*.

*Table 2* – Predicted close approaches for the alpha Monocerotids (AMO#246) dust trail.

| Date (UT) | Distance (A.U.) | $\lambda_\odot$ (J2000) | Comment |
|---|---|---|---|
| 2019-11-22, 04h52m | –0.00036 | 239.306 | Far |
| 2043-11-22, 10h58m | –0.00008 | | |

The possible 2019 outburst has a calculated “miss-distance” of –0.00036 which can be commented as “far”. At such a distance the author estimates that only a weaker outburst could be produced. The trail situation for the calculation model has been fitted to agree exactly for the year 1995. As such, it is also well suited to fit with the previous outbursts.

However, I now reviewed the situation and I think it is likely possible that it could have a somewhat shorter orbital period, maybe about 600 years (somewhat shorter for the comet than for these meteors). Next, I have averaged the different outbursts and eventually putting more weight on the former outbursts because these had higher ZHRs.

As a result, I find the prediction to be more favorable for this year. I could estimate the miss-distance as –0.0002 AU, but in this case, there would be an uncertainty of something like ±0.0002 (possible everything from zero to that value in the table of the Icarus paper).

It could produce a ZHR value of maybe only about a hundred to even storm level (with a ZHR of more than 1000). However, because the radiant is not very high and also because of the possible twilight, the actual counts will be of course well below this level. In Helsinki, the Sun rises a little less than two hours later, so the twilight somewhat disturbs. The Moon is also present at the sky, but already as a crescent, so this may not disturb significant more than the twilight.

While checking, I got the time for the outburst 2 minutes earlier than in the Icarus paper (Lyytinen and Jenniskens, 2003), e.g. $04^h50^m$, even though the solar longitude became 0.002° larger now. This was valid for the center of the Earth. Because people in Europe are at the morning side and on the north side, we are a few minutes ahead of that. Otherwise, this would not be in error for many minutes. The location of the trail is more accurate in the direction of the Earth's motion than in the ecliptic perpendicular to the orbit.

Anyone who is going to try to observe should not be late at all. The strongest maximum would fit in about 15 minutes, or maybe a little bit less. It will be almost completely over in about 40 minutes. I recommend starting the observations at the latest at $04^h30^m$ and if you don't want to miss any meteor, then start no later than at $4^h15^m$.

Another point in regard with the fairly large number of prediction lines in the table in the Icarus paper (Lyytinen and Jenniskens, 2003) is that quite a few are observed in only one outburst while assumed to be likely of long-period. Looking at the IAU database for a couple of the showers it seems that these have already been observed and that these had no long period.

As for the outburst of the DPA#120, linked to C/1907 G1 (Grigg-Mellish), it was the first time such event was observed for this comet. Although the outburst was rather weak, it was distinct enough. Earlier this year we got a new unlisted case, the 15 Bootids (FBO#923), confirmed by camera observations for a long time and known for its weak annual activity (Jenniskens, 2019b; Johannink, 2019).

Other observed meteor showers of this type are the Lyrids (LYR#006) and the Aurigids (AUR#206), for which the parent comets are known. The outburst for the latter happened in 2007 (Atreya and Christou, 2009) and was first predicted by Lyytinen and Jenniskens (2003) and later brought back to the attention of meteor observers in a separate paper (Jenniskens and Vaubaillon, 2007). While for the September epsilon Perseids (SPE#208) and the October Camelopardalids (OCT#281), the trail appears to be either wider than usual or did not yet had the best hit.

## References

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