Comet, Asteroid and Meteor Section Special Bulletin

Possible outburst of Andromedid meteors 2 December 2023

Background

The Andromedids meteor shower are the remnants of Comet 3D/Biela. The parent comet was first discovered by Montaigne in 1772 (Kronk 1999). It was observed again in 1805 by Jean Louis Pons, and became a naked eye object late in that year. In 1826 the comet was observed by Wilhelm von Biela, who determined the orbit of the comet, which subsequently became known as Biela's Comet. The comet returned in 1832 as predicted, was missed in 1839, but was again seen in 1846, when the nucleus was seen to have split into two fragments. The comet was seen for the last time in 1852 at which time it was seen to continue to disintegrate, and despite searches has never been seen since.

The Andromedid meteor shower is associated with comet 3D/Biela. While the meteor shower has been known since 1798, it became well known for the outbursts of 1872 and 1885, when Zenithal Hourly Rates (ZHR) were estimated to have reached 6000 - 8000 per hour. Following these intense outbursts, the shower has produced weak activity, mostly less than a few meteors per hour. In 2011, there was enhanced activity between 3-5 December when the ZHR reached 50 per hour (Wiegert et al 2013). Meteors radiated from R.A. +18.2°, Decl. +57.5°, and were shown to have been from particles ejected from the comet in its 1649 return. Based on the 2011 activity, further outbursts were predicted for 2018, 2023 and 2036. Activity was predicted in 2018, though lower than the 2011 rates, but nothing untoward was seen. However activity was observed on 28 November 2021 (Rendtel 2022). Enhanced activity is again possible in 2023, as outlined further in this Bulletin. Will any activity be seen? We will only know by going out and observing for potential meteors from Biela's comet.

Predictions for possible enhanced activity in 2023 and visibility from Southern Africa

According to the IMO Meteor Shower Calendar (Rendtel 2022), there may be possible activity of slow meteors from a radiant at R.A. 29° (01h56m), Decl. +47°, centred around 19hUT (21h SAST) on 2 December 2023, again from meteors released from Comet 3D/Biela in 1649. Rates may be as high as four times those in 2011, so ZHR ~200 per hour. These meteors enter the atmosphere with velocity 17 km/sec, and so will appear to be very slow moving.

Despite being a northern hemisphere shower, the radiant is nevertheless suitable for observation from Southern Africa. The position of the radiant is shown in Figure 1 and the altitude for different times is given for Johannesburg and Cape Town in Table 1. The radiant is already high enough to observe immediately after darkness falls, and culminates at 21h20 for Johannesburg, at altitude 16.7°. Conditions for Cape Town are less favourable, with culmination at 22h00, when the radiant will be only 9° above the northern horizon. After these times the radiant will become lower, setting for Cape Town at around 1 am local time, and for Johannesburg about 18 minutes later. If any outburst occurs around this time, we may be treated to a shower of long pathed meteors as they appear to come off the horizon, grazing the upper layers of the atmosphere and burning out behind our heads! Those who remember the Perseids outburst of 1993 will no doubt recall the spectacular appearance of those meteors on the morning of 12 August, when for three hours before dawn long-pathed Perseids streaked across the sky!

At the time of predicted activity the Moon will be 71% illuminated and rises after 23h00 SAST. Once it rises, its light will wash out any fainter meteors, effectively reducing the number of meteors seen.

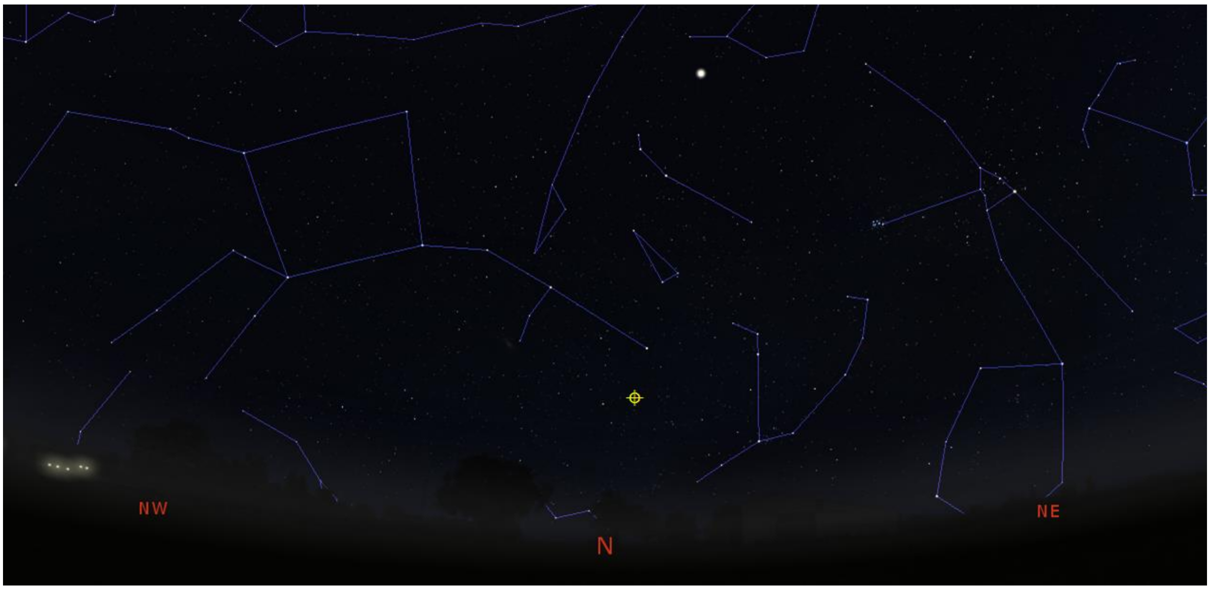

Figure 1 View looking north from Johannesburg at 21h00 SAST on 2 December. Radiant position of the Andromedids is shown as a yellow target. Bright object at the top is Jupiter, which will then be magnitude -2.8. The Hyades and Pleiades clusters in Taurus are above right.

Time SAST	Johannesburg		Cape Town	
	Az	Alt	Az	Alt
20h00	14.0	14.6	--	--
21h00	3.7	16.7	10.3	7.8
22h00	353.0	16.3	359.9	9.0
23h00	343.0	13.5	349.8	7.8
00h00	333.5	8.9	339.9	4.6
01h00	326.3	2.0	331.2	-0.1
02h00	320.0	-6.5	--	--

Table 1 Radiant azimuth and altitude for 2 December

What does ZHR 200 look like for Southern African conditions?
The Zenithal Hourly Rate (ZHR) is the number of meteors that can be expected to be seen when the radiant is at the zenith and magnitude 6.5 stars are visible to the naked eye. Rates under brighter skies or where the radiant is lower in the sky will consequently be lower. So how many meteors could you expect to see from urban Southern African locations?

The ZHR is calculated using the equation (1):

$$ZHR = N \,.\, F \,.\, r^{(6.5-LM)} \,/\, T_{eff} .\, \sin(h) \qquad (1)$$

where;

N	= number of shower meteors observed
F	= factor correcting for obscuration by clouds etc.
r	= population index
h	= mean altitude of radiant above horizon
LM	= limiting magnitude
Teff	= observing time in hours corrected for breaks

We can transpose equation (1) to give N, which is the number of meteors that could be expected under the conditions of an observer. For example, for an observer in Johannesburg, assuming an outburst of ZHR = 200 at the predicted time, the radiant altitude would be h = 16.7°. I can expect a naked eye limiting magnitude LM = 5.5 from my location. Assuming I observe for one hour (T = 1.0) with no clouds (F=1.0) and with r = 2.5 (medium brightness meteors) and inserting these conditions into equation (1) and solving for N we get an expected rate of 23 meteors per hour. Even if the meteors are fainter than average (r = 3.0), then N is 19 per hour. That's certainly worthwhile spending time to see if any outburst occurs. If nothing occurs then that is also an important observation, and helps constrain the modelling of the meteor stream.

What observations are required?

No specific equipment is required apart from the naked eye. Lay back on a reclining chair facing north, allow your eyes to become dark adapted for quarter or half an hour before you start your watch, and then gaze at the sky for a period and make a note of the meteors you see. If the path can be traced back to the target symbol in Figure 1 then note it as AND (Andromedid). If the path cannot be traced back to the radiant, then it is not an Andromedid meteor, but either sporadic or member of another shower, for example the Taurids or Geminids which are both active at the same time. If you can then identify these meteors seen from other showers, or if not, just refer to them as SPO. In any event enjoy the show!

For more advanced observers, record the times of start and end of each period, limiting magnitude (LM) at start and end of each period, identity of any meteors seen, and an estimate of the magnitude of each meteor seen. You can pick your own suitable stars with which to compare the magnitude. Once done let me have the data and I will do the analysis and magnitude distributions, and submit these to the IMO for inclusion in the Visual Meteor Database.

Definitely observe on 2 December, starting straight after dark, and observe until around 1 am. Stagger observing periods as you need, taking breaks as and when you like, but always recording the start and end of each watch. Observing periods should ideally be broken up into 30 minute periods. Since there is some uncertainty in what will or will not happen, observe also the preceding and following nights if possible.

References

- Rendtel, J. (2022), 2023 Meteor Shower Calendar, International Meteor Organization, IMO INFO(3-22), edited by Juergen Rendtel.
- Kronk. G. W. (1999), Cometography, Vol. 1. Cambridge: Cambridge University Press.
- Wiegert, P. A., Brown, P. G., Weryk, R. J. and Wong, D. K. (2013), The Return of The Andromedids Meteor Shower, The Astronomical Journal, 145, pp70-81.