

# Perseid outburst 2021

P. Jenniskens<sup>1</sup> and K. Miskotte<sup>2</sup>

<sup>1</sup>SETI Institute, 189 Bernardo Ave, Mountain View, CA 94043, USA

pjenniskens@seti.org

<sup>2</sup>Dutch Meteor Society

k.miskotte@upcmail.nl

An unexpected outburst of Perseids was detected by low-light video observations on August 14, 2021. The outburst peaked at solar longitude  $141.474 \pm 0.005$  degrees (equinox J2000.0) and the activity profile had a Full-Width-at-Half-Maximum of 0.08 degrees solar longitude and a peak rate of  $ZHR = 130 \pm 20$  per hour above the normal  $\sim 45$  per hour annual Perseid activity. The Perseids had a steeper magnitude size distribution index than the normal annual shower component. The activity profile is similar to that derived from visual and forward meteor scatter observations. This activity may be related to the earlier smaller enhancements observed in 2018 and 2019.

## 1 Introduction

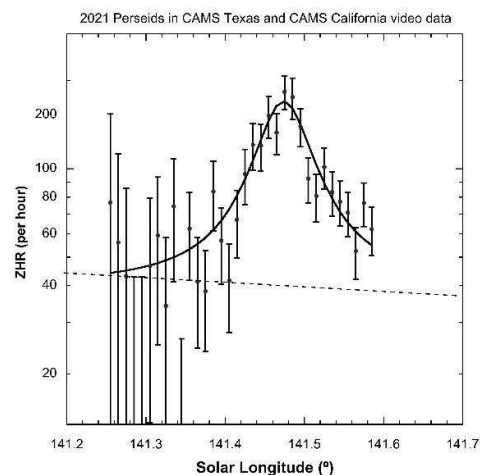
In 2018, visual observers reported a narrow peak of Perseid shower activity around solar longitude  $140.95^\circ$ , about  $\sim 30$  hours after the traditional Perseid maximum, with a peak of about  $ZHR = 25$  per hour above the normal Perseid activity of  $ZHR \sim 45$  per hour at that time (Miskotte 2019). In 2019, a similar peak was recorded by forward meteor scatter observations collected by the International Project for Radio Meteor Observation. That year, the outburst peaked at solar longitude  $141.02^\circ$  with a peak  $ZHR \sim 30$  per hour above normal activity (Miskotte 2020a; 2020b). Here, we report the detection of a more significant outburst on August 14, 2021 (Jenniskens, 2021). This outburst was not anticipated from known 109P/Swift-Tuttle dust trail encounters

## 2 CAMS low-light video observations

The Perseids are best observed from the northern hemisphere. The 2021 outburst happened between 6h and 12h UTC on August 14, 2021, at a time best suited to the CAMS video-based meteoroid orbit survey networks in the United States. The networks triangulated meteors using low-light video cameras and determined the meteor's radiant and speed in a continuous night time surveillance. The weather was mostly clear for networks in Texas (coordinated by W. Cooney and including D. Selle, F. Cyrway and J. Brewer) and California (P. Jenniskens, D. Samuels, J. Albers, E. Eglund, B. Grigsby and J. Wray). CAMS Mid-Atlantic (coordinated by P. Gural), CAMS Florida (A. Howell), CAMS Arkansas (L. Juneau) and LO-CAMS in Arizona (N. Moskovitz) also observed some of the meteors under partial clear skies (c.f. CAMS-website<sup>2</sup> for date of August 14).

Early results from the new CAMS Texas network in mostly clear skies and the CAMS California network in clear skies

show an activity profile with peak Zenith Hourly Rate  $ZHR = 130 \pm 20$  per hour on top of normal  $ZHR = 40\text{--}45$  per hour annual Perseid activity (*Figure 1*). The Full-Width-at-Half-Maximum of the fitted Lorentzian profile is  $0.08 \pm 0.01$  degrees solar longitude. The peak occurred at solar longitude  $141.474 \pm 0.005$  degrees (equinox J2000.0), corresponding to 8.2<sup>h</sup> UTC on August 14. The combined magnitude distribution index was  $3.59 \pm 0.36$ , compared to  $2.94 \pm 0.04$  for the annual component in other years at this solar longitude.



*Figure 1* – 2021 Perseid rates according to CAMS Texas and CAMS California video data. The vertical scale is logarithmic. The dashed line is the level of normal annual Perseid activity.

## 3 Comparison to other observations

Pierre Martin, visually observing from Ottawa, Canada, reports “*I just witnessed very strong Perseids activity Aug 13/14 06-09 UT. Multiples Perseids per minute with many bursts. Sometimes 3-4 in a second. Much busier than previous night but I had a great sky mag 6.7. Was this an*

<sup>2</sup><http://cams.seti.org/FDL/>

unexpected outburst? I've never seen so many Perseids a full day after the normal peak. I think the rate might have been as high as 300/hr but I'll know more when I listen to the tape. Average brightness, perhaps a bit below average. There was a very large number of mag 4 and 5 meteors but still good numbers of +1s and 0s. Brightest we're -3". Starting at 6<sup>h</sup> UTC. He observed until 9<sup>h</sup> UTC, under clear skies with star limiting magnitude 6.7. From his 5-minute interval counts, we calculated a peak ZHR = 210 ± 20 per hour at solar longitude 141.474 ± 0.005 deg. The visually observed meteors follow the video data profile well (Figure 2).

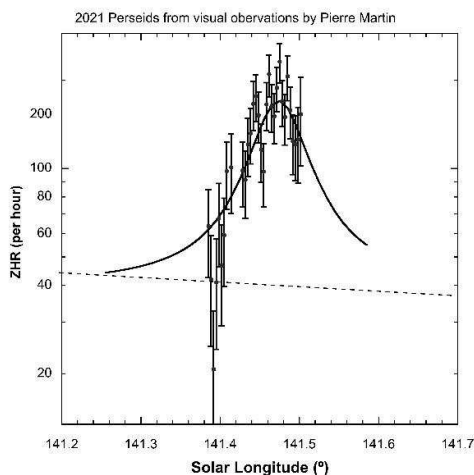


Figure 2 – 2021 Perseids from visual observations by Pierre Martin.

This also confirms radio forward meteor scatter observations posted by H. Ogawa of the International Project for Radio Meteor Observation<sup>3</sup> (Figure 3). A compilation of rates from 49 observers in 14 countries saw

the detection count increase above normal levels after 6.4<sup>h</sup> UTC (141.40 deg solar longitude), and peak at about 8.8<sup>h</sup> UTC (141.49 deg) at a level of 3 times the Perseid peak level, before declining to normal levels at 12.5<sup>h</sup> UTC (141.65 deg solar longitude). Combined Zenith hourly rates peaked around ZHR = 210 per hour<sup>4</sup>, in good agreement.

The outburst cannot be identified yet with a known dust trail crossing from 109P/Swift-Tuttle. On the other hand, the width of the outburst is similar to that of past Perseid Filament returns (Jenniskens, 2006). The Filament is thought to be an accumulation of dust in mean-motion resonances from many past returns. That could perhaps mean that this dust was directed into Earth's path this year. These observations may help better understand the origin and evolution of that dust component.

### References

Jenniskens P. (2006). "Meteor Showers and their Parent Comets". Cambridge University Press, Cambridge, UK, 790 pp.

Jenniskens P. (2021). "Perseid meteor shower outburst 2021". CBET 5016, 2021 August 14, editor D.W.E. Green.

Miskotte K. (2019). "Perseids 2018: an analysis of the visual data". *eMetN*, 4, 135–142.

Miskotte K., Vandeputte M.(2020a). "Perseids 2019. Another peak around solar longitude 141.0°?". *eMetN*, 5, 25–29.

Miskotte K. (2020b). "Perseids 2020: again, enhanced Perseid activity around solar longitude 141°?" *eMetN*, 5, 395–397.

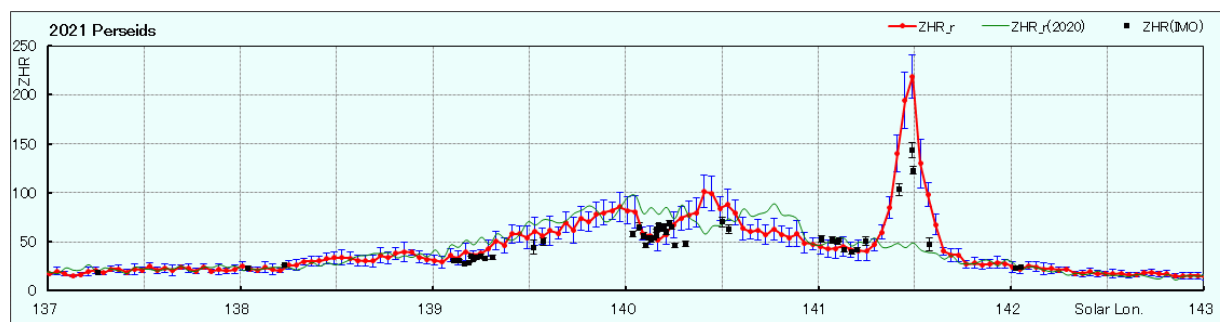


Figure 3 – ZHR<sub>r</sub> presented by Hirofumi Sugimoto.  $ZHR_r = CHR_r * 1/\sin(h)$  ( $h$ : radiant elevation), (excluding  $h < 20^\circ$ ).  $CHR_r$  is the number of meteors with the sporadics being subtracted from the total. The sporadic meteor activity is calculated from the past data during a period of 10 days.

<sup>3</sup> <https://www.iprmo.org/flash/perseids-2021.html>

<sup>4</sup> <http://www5f.biglobe.ne.jp/~hro/Flash/2021/PER/index-e.htm>