2024 outburst of September psi-Cassiopeiids by SonotaCo Network in Japan

Takashi Sekiguchi

Nippon Meteor Society and SonotaCo network, Japan

ts007@mtj.biglobe.ne.jp

On 2024, September 4, a meteor outburst was detected by a video camera network in the United States. Therefore, we also looked into data from Japan's SonotaCo Network and other sources. There were six simultaneous meteors on the same day, and the outburst lasted about eight hours. One of these was recorded with a spectrum and had multiple echoes in radio observations. A weak annual meteor shower was also observed at this time in past data. In addition, when we look into the parent body candidates, we found that there is an asteroid 2010OA101 with a similar orbit.

1 Observations

Six simultaneous meteors have been recorded by video cameras in Japan's SonotaCo Network within the eight hours of the outburst duration (*Figure 1 and 2*). About 20 single station meteors were observed, some of which simultaneously. In addition, one spectrum was captured from the simultaneous meteors for which the orbit was determined. Multiple echoes of this meteor were also observed in radio observations[1].

Figure 1 – SPC meteor on September 4, $12^h51^m22^s$ UTC.

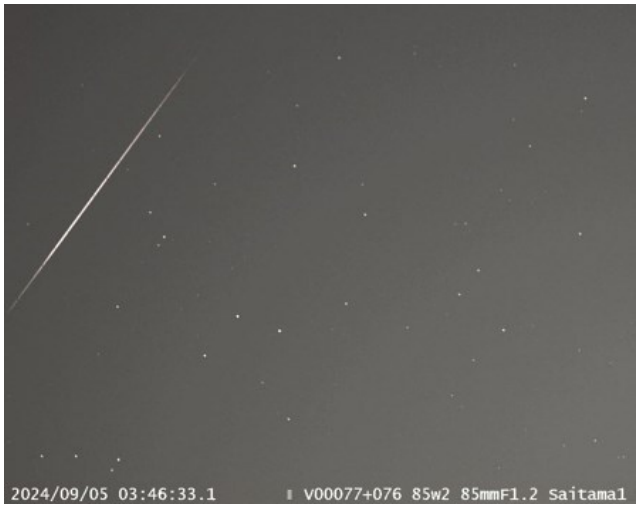

Figure 2 – SPC meteor on September 4, $18^h46^m33^s$ UTC.

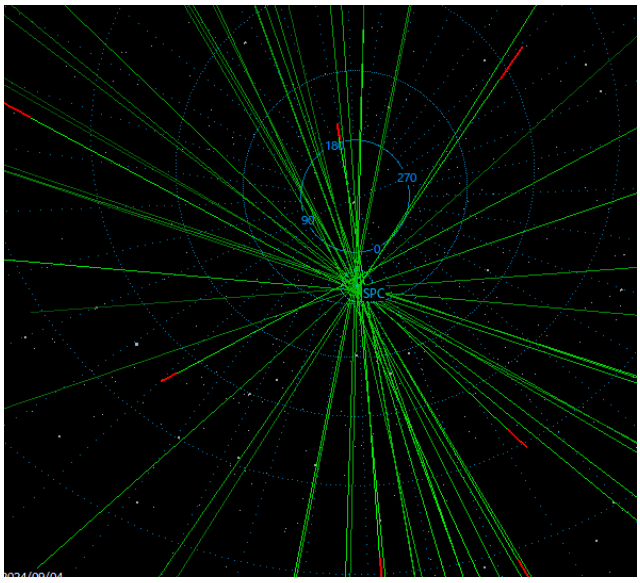

Figure 3 – Single SPC meteors and radiant.

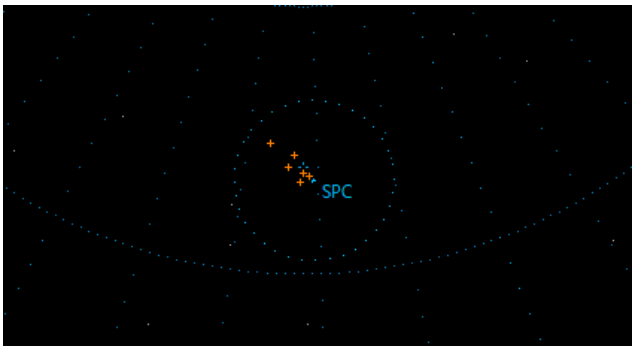

Figure 4 – SPC radiant map 2024, September 4.

2 Results

Similar to the American observation results (Jenniskens and Moskovitz, 2024a; 2024b) the meteor trail map on September 4 (UT) showed a clear cluster of meteors (*Figures 3 and 4*). The orbits from the meteor shower with the triangulated radiant and velocity were selected, and six meteors from this meteor shower were triangulated. The duration of the meteor shower was short. Based on these

[1] https://cgi.iprmo.org/patio/patio.cgi?read=2939&ukey=1

orbits, the meteor shower was active between solar longitudes 162.07 and 162.38 degrees (Equinox J2000), apparently centered at 162.14 degrees, and activity may have continued throughout the night. Detection times on September 4 are listed in *Table 1*. This table shows the orbital elements, geocentric radiant and velocity, and orbital elements for the vernal equinox J2000. The measured radiant was ±1.9degrees in right ascension, ±0.5degrees in declination, and the velocity ±0.4km/. These dispersions are common in meteor triangulations.

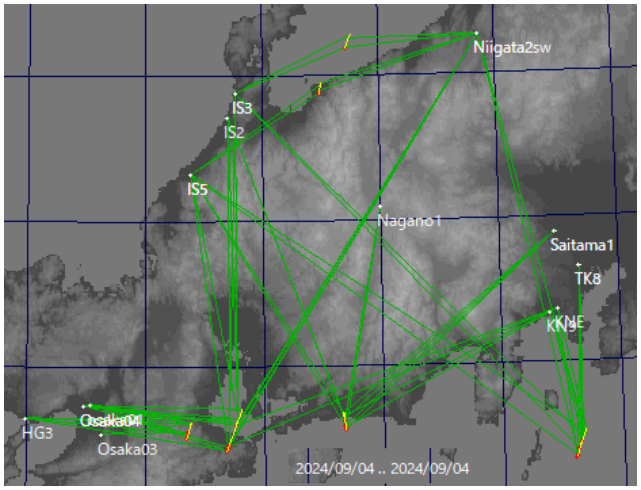

Figure 5 – SPC trajectory map 2024, September 4.

The spectrum obtained from the simultaneous meteor shows early release of sodium, indicating that the meteoroid is fragile (Vojáček et al., 2015). The spectral type is Normal (*Figures 6 and 7*).

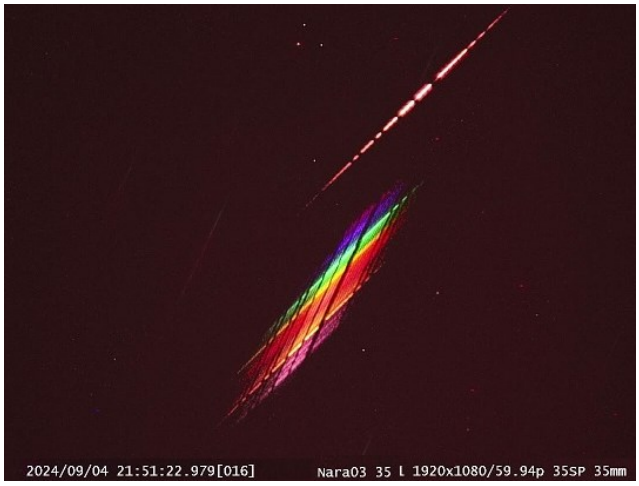

Figure 6 – SPC spectrum of the SPC at $12^h51^m22^s$.

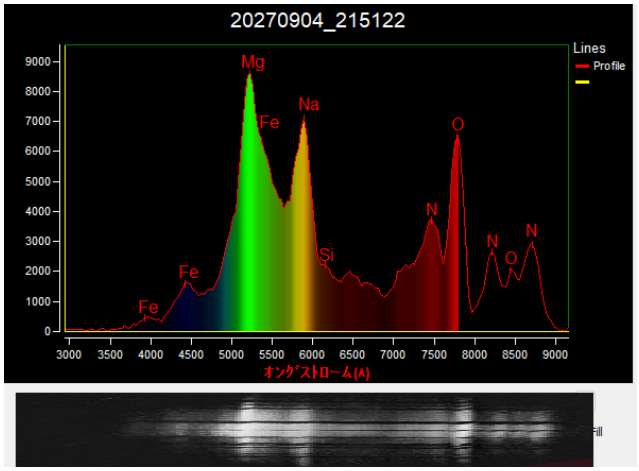

Figure 7 – Spectral analysis results. No sensitivity correction. Spectral type is Normal.

Table 1 – The orbital elements, geocentric radiant and velocity, and other orbital parameters.

Date (UT)	04/09/2024	04/09/2024	04/09/2024	04/09/2024	04/09/2024	04/09/2024	Average	SD
Time (UT)	$11^h06^m39^s$	$12^h12^m58^s$	$12^h51^m22^s$	$14^h31^m08^s$	$16^h02^m00^s$	$18^h46^m33^s$		
$\lambda_\odot$ (°)	162.07	162.12	162.14	162.21	162.27	162.38	162.198	±0.114
α_g (°)	22.45	24.02	22.00	21.15	26.67	23.12	23.23	±1.944
δ_g (°)	73.45	74.00	73.81	73.69	74.86	74.43	74.04	±0.522
v_g (°)	45.03	45.89	45.53	45.56	45.11	44.68	45.30	±0.44
a (AU)	3.08	3.71	3.60	3.71	3.10	3.04	3.37	±0.33
q (AU)	0.987	0.992	0.989	0.987	0.997	0.991	0.991	±0.004
e	0.679	0.733	0.725	0.734	0.679	0.674	0.704	±0.029
ω (°)	198.72	196.00	197.46	198.08	193.72	196.60	196.76	±1.785
Ω (°)	162.07	162.12	162.14	162.21	162.27	162.38	162.20	±0.114
$\imath$ (°)	82.01	82.87	82.21	82.10	82.14	81.27	82.10	±0.512
Mag_A	–1.8	–1.7	–2.4	0.7	–0.1	–1.2	–1.1	
Dur. (s)	0.3	0.5	0.9	0.4	0.3	0.4	0.5	
H_b (km)	98.1	107.3	115.8	106.2	105.6	105.3	106.4	
H_e (km)	90.9	93.0	87.3	93.9	95.9	89.8	91.8	
L (km)	12.5	23.7	44.6	17.1	12.5	20.3	21.8	
T_j	1.85	1.54	1.60	1.56	1.83	1.88	1.71	±0.16
λ_Π	344.77	344.16	344.58	344.78	344.18	344.97	344.57	±0.336
β_Π	–18.5	–15.9	–17.3	–17.9	–13.6	–16.4	–16.6	±1.762
D_{SH}	0.05	0.05	0.05	0.06	0.07	0.06	0.04	±0.01

Table 2 – Comparing CAMS orbit data and the parent body candidate orbital elements.

	N	$\lambda_\odot$ (°)	α_g (°)	δ_g (°)	v_g (km/s)	a (AU)	q (AU)	e	ω (°)	Ω (°)	ι (°)	T_j	λ_Π (°)	β_Π (°)	D_{SH}
CAMS2024	13	162.104	20.6	73.5	46.4	5.3	0.987	0.812	197.8	162.07	82.4	1.15	344.5	-17.64	0.12
CAMS2014	11	162.11	25.6	73.7	45.9	3.33	0.992	0.702	195.8	162.4	83.5	1.71	344.23	-15.7	0.03
Parent body 2010OA101						4.5	1.38	0.693	197.87	161.29	82.1	1.29	343.1	-17.78	0.39
RVO 9/4			26.1	72.6	46.2	3.22	0.989	0.693	197.9	161.9	84.4	1.72	343.71	-17.81	0.04

I tried to find a parent body candidate from the orbital elements. When I calculated it with RVO at the observation time, it came up as a candidate. there was an asteroid 2010OA101 with a similar orbit. See *Table 2 and Figure 8*.

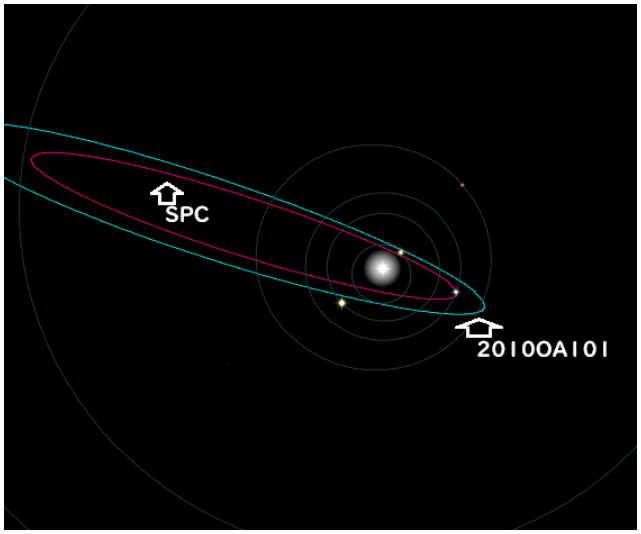

Figure 8 – Comparing the orbits of the SPC meteoroid stream with the possible parent body 2010OA101.

The meteoroid stream and the suggested parent body have a very large offset in space, the Southworth&Hawkins criterion with 0.39 raises doubts if there is an association. However, the high inclination, unusual for minor planets and other parameters show these orbits are remarkably parallel although at a large distance. This object may be an inactive cometary body and then the meteoroids encountered by Earth could be outliers of a dust trail barely intersecting with the Earth orbit. It would require an in-depth long-term orbit modelling to find out what the origin could be, but most likely this is a cometary meteoroid stream that may cause surprise outbursts in the future.

Acknowledgment

We would like to thank the SonotaCo network for providing the orbit calculation data for this study. We would also like to thank Paul Roggemans for his proofreading and advice.

References

Vojáček V., Borovička J., Koten P., Spurný P., Štork R. (2015). "Catalogue of representative meteor spectra". *Astronomy & Astrophysics*, **580**, A67, 1–31.

Jenniskens P., Moskovitz N. (2024a). Meteor shower outburst with radiant in Cassiopeia. CBET 5442. Ed. D. W. E. Green. IAU Central Bureau for Astronomical Telegrams. 1 pp.

Jenniskens P., Moskovitz N. (2024b). "2024 outburst of September psi-Cassiopeiids". *eMetN*, **9**, this issue.