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The remarkable similarity of the orbit of C/2023 P1 Nishimura and the σ Hydrid meteor shower

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Examination of meteor orbits from multiple publicly available databases when tested with D criteria reveal that many σ Hydrid meteors have orbits associated with that of the recently discovered C/2023 P1 Nishimura.

1 Introduction

CBET 5285[1] announced that a suspect comet had been confirmed as a true comet and gave particulars of its preliminary orbit. The orbit is a highly inclined one and thus suited for testing with D criteria with respect to orbital association with other objects as greatly inclined orbits usually follow a more random distribution such that "distance parameter" statistical testing is applicable. Meteor orbits from the following multiple publicly available databases, BRAMON, CAMS, CMN, EDMOND, GMN, SonotaCo and UKMON (in alphabetical order with source locations noted in the Acknowledgment section below) were tested against this preliminary orbit with both the Southworth and Hawkins (1963) and Jopek (1993) D criteria giving many matches to the meteor orbits with the orbit radiants and Solar Longitudes of the latter having a strong similarity to those of the σ Hydrid shower (McCrosky and Posen, 1961).

However, due to the then short orbital arc an elliptical orbit did not become available until later, and the present paper uses the currently latest updated elements based on 421 observations over a 17-day arc as published on August 28th 2023 in MPEC-Q150[2] and on August 29th 2023 in CBET 5290[3]. It should be noted that particulars of the shower noted in the latter are based on calculations of the current comet orbit as performed by Ye Quanzhi whilst the shower particulars in this paper are taken from the mean of the meteor orbits.

2 Results

The orbital elements for C/2023 P1 as per MPEC-Q150 as well as the mean elements derived from the analysis using both Jopek (D_J) and Southworth and Hawkins (D_{SH}) criteria are given in *Table 1*. For D_J 671 meteor orbits matched with values of 0.100 or less whilst 129 match for of 0.085 or less, the minimum value being 0.066. For D_{SH} a much larger number of 5456 meteors matched for their suggested threshold value of 0.150 or less with 2101 being of a value of 0.100 or less and the smallest value being 0.043. This discrepancy in scale can be explained in that Jopek (1993) states a tighter restriction upon assessing perihelia to make the search for new showers more rigorous relative to Southworth and Hawkins (1963). Here we have an established rather than new shower, albeit little mentioned in the literature.

It will be noted that the match with mean radiant positions and Solar Longitudes from the two criteria has an offset of a handful of degrees from literature values. The current orbital elements give the comet a period of about 500 years which is ample time for perturbational and YORP effects to have modified the orbits of the meteoroids somewhat, however such an analysis is beyond the remit of this paper. C/2023 P1 also has a quite small perihelion and at the time of writing it is also not clear whether nearer perihelion on 17th–18th September 2023 if there will be any outbursts or jets associated with the comet, however any dust ejected from the comet, which already sports a dust tail, will also be subject to fairly high levels of radiation pressure at perihelia.

The mean date of the meteors from these data from over the spread of the past 15 years is December 2nd (non-leap years).

Table 1 – Parameters for C/2023 P1 and for σ Hydrid meteors via both D_J and D_{SH}.

	RA (°)	DEC (°)	λ_O (°).	v_g (km/s)	q (AU)	e	i (°)	ω (°)	Ω (°)
C/2023 P1	126-134	0-3	252.9	58–59	0.22516	0.99636	132.464	116.289	66.843
D_J mean	119.8	4.5	249.871	59.2	0.25426	0.98861	131.035	119.541	69.868
D_{SH} mean	121.2	3.8	251.111	59.1	0.26200	0.98383	130.390	118.791	71.109

[1] http://www.cbat.eps.harvard.edu/iau/cbet/005200/CBET005285.txt
[2] https://minorplanetcenter.net/mpec/K23/K23QF0.html
[3] http://www.cbat.eps.harvard.edu/iau/cbet/005200/CBET005290.txt

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3 Conclusion

Examination of a large number of archival meteor orbits derived from multi-station surveys reveal that C/2023 P1 Nishimura is either the parent Comet for the σ Hydrid meteor shower or is at least strongly associated with any unknown parent comet that it has possibly disassociated from. When the mean orbital elements of the meteor orbits as seeded via the comet orbit are derived there is a slight offset in Solar Longitude and radiant position relative to the usual published values, however these are usually derived via radiant clustering algorithms, not D criteria between large numbers of orbits, which can be polluted via sporadic false positives. Nevertheless, there is a related very small but real offset in perihelion between meteor orbits and the comet orbit which may or may not be due to dispersion of meteoroids since the comet's last apparition roughly half a millennium ago.

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The Minor Planet Center at the Harvard and Smithsonian Center for Astrophysics. The data sources and outline can be found online for the CAMS project[4], for GMN[5] , for SonotaCo[6], for UKMON[7]. Details of the EDMOND and some BRAMON data can be found online[8] . The URL of the orbital archives for the data from CMN, the Croatian Meteor Network, prior to its archiving its data with larger networks, could not be found.

References

Jopek T. J. (1993). "Remarks on the meteor orbital similarity D-criterion". *Icarus*, **106**, 603–607.

McCrosky R. E. and Posen A. (1961). "Orbital Elements of Photographic Meteors". *Smithson. Contrib. Astrophys.*, **4**,15–84.

Southworth R. R. and Hawkins G. S. (1963). "Statistics of meteor streams". *Smithson. Contrib. Astrophys.*, **7**, 261–286.

[4] http://cams.seti.org/
[5] https://globalmeteornetwork.org/data/
[6] https://www.astro.sk/iaumdcDB/home/PDA/SNMv3
[7] https://archive.ukmeteornetwork.co.uk/
[8] https://fmph.uniba.sk/en/microsites/daa/division-of-astronomy-and-astrophysics/research/meteors/edmond/

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