

Meteor science

Confirmation of the delta Mensids (IAU#130, DME)

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The CAMS New Zealand video meteor orbit survey detected a high southern declination meteor shower that was previously reported from radar and visual observations. This detection now confirms the delta Mensids (#130, DME) in the IAU Working List. The shower is most active between March 17–22, around the spring equinox.

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During the routine reduction of CAMS New Zealand data from 2016 March (Jenniskens et al., 2016), a high declination meteor shower was detected that stands out well in sun-centered ecliptic radiant coordinates (Figure 1). The shower was also detected in 2015. 15 orbits cluster in time between solar longitude 353° and 6°, around the spring equinox. 11 of those meteors occurred between 357° and 2° solar longitude (March 17–22). Orbits are listed in Table 1.

Checking against the IAU Working List (Jopek et al., 2016) shows that the shower is known as IAU#130, the delta Mensids (DME), active from March 13 to March 21, in agreement with the time interval found here. Kronk (2014) gives a brief history. The shower was first reported by Gartrell (1972) from radar observations in Adelaide in 1969. His showers 3.04 and 3.05 with 11 and 10 measured trajectories, respectively, had a radiant at RA = 51°, Dec = −81°, $V_{\text{inf}} = 34$ km/s and RA = 50°, Dec = −78°, $V_{\text{inf}} = 38$ km/s, respectively, in good agreement with our video observations. Gartrell & Elford (1975) reported that the radar was in operation in the period March 16–22, with average activity centered on March 18 and 19, respectively. Visual observers have occasionally reported activity from this area during March 14–21, with a peak rate of 1–2 meteors per hour (Kronk, 2014).

This is the same shower as the beta Tucanids (#108, BTU), based on the source information given in Jenniskens (2006), who also pointed to McIntosh (1935) for a record of visual observations. However, the period of activity given for the BTU (Feb 27 – March 02) is earlier than derived from our observations, and the proposed parent body C/1976 D1 (Bradfield) would produce meteors earlier in the month (Table 1). Hence, the name beta Tucanids (#108, BTU) is best reserved for meteors from comet Bradfield.

Median radiant position and orbital elements from CAMS data are given in Table 1. The shower has a prograde 56°9′-inclined orbit with a Halley-comet like semi-major axis $a = 4.2$ AU. This appears to be dynamically evolved dust from a Halley-type parent comet

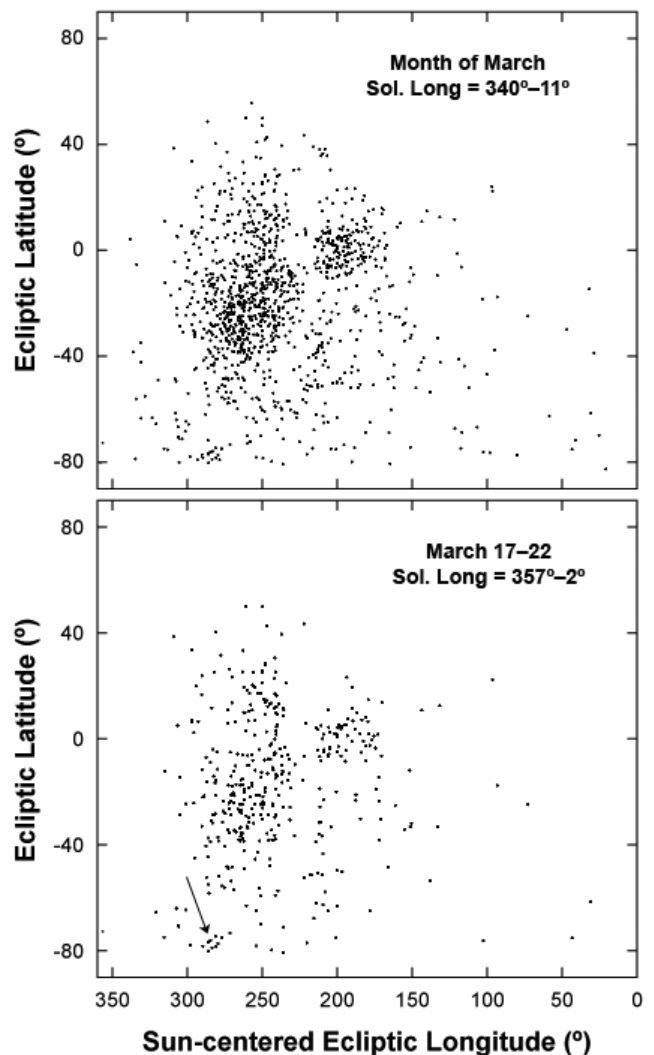


Figure 1 – Radiant distribution in sun-centered ecliptic coordinates for meteors detected in the month of March (left) and during the March 17–22 time interval (right). Arrow points to the newly confirmed delta Mensids.

contributing to the toroidal source. Specular radar observations often measure a shorter semi-major axis, in part because speed is measured downrange. Gartrell (1972) derived a shorter $a = 2.13$ AU orbit.

Gartrell (1972) identified what might be the parent body: comet C/1804 E1 (Pons). The comet was only seen between March 7 and April 1 of that year, when it moved from near the equator at Libra into Bootes. The sparse observations suggested a long semi-major

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Table 1 – Trajectory and lightcurve data of delta Mensids from CAMS data. λ_{\odot} = solar longitude (J2000); RA_{∞} and Dec_{∞} are the Right Ascension and Declination of the apparent radiant; V_{∞} is the apparent entry speed; a_1 and a_2 are deceleration parameters (Jenniskens et al., 2011); H_b and H_e are the beginning and end height; M_v is the absolute visual magnitude (for a distance of 100 km); F is the shape parameter of the light curve, being 0 when peaking at the beginning and 1 when peaking at the end; and Q is the convergence angle of planes between station and meteor.

Date	Time (UT)	λ_{\odot} ($^{\circ}$)	RA_{∞} ($^{\circ}$)	Dec_{∞} ($^{\circ}$)	V_{∞} (km/s)	a_1 (km/s)	a_2 (1/s)	H_b (km)	H_e (km)	M_v (mag.)	F ($^{\circ}$)	Q
2015/3/14	12 ^h 56 ^m 57 ^s	353.42	81.2	−79.8	32.7	0.037	0.362	107.8	80.7	1.4	0.37	14.2
2015/3/17	17 ^h 36 ^m 06 ^s	356.60	72.9	−81.6	37.2	0.722	0.169	103.6	87.5	0.9	0.76	39.8
2016/3/17	15 ^h 51 ^m 49 ^s	357.27	74.5	−80.9	35.2	0.000	0.120	102.8	93.9	1.8	0.94	31.3
2016/3/17	17 ^h 17 ^m 22 ^s	357.33	64.3	−78.4	32.0	0.210	0.274	102.2	97.3	2.0	0.25	79.1
2016/3/18	12 ^h 39 ^m 32 ^s	358.13	84.4	−78.1	38.9	0.027	5.992	102.7	83.9	−0.5	0.46	50.0
2016/3/19	13 ^h 02 ^m 36 ^s	359.14	79.6	−78.7	30.4	0.004	0.614	99.0	82.8	−0.3	0.51	16.6
2016/3/19	13 ^h 14 ^m 50 ^s	359.15	85.4	−80.0	36.7	0.037	0.036	105.0	88.7	0.9	0.90	37.3
2015/3/20	11 ^h 07 ^m 37 ^s	359.32	79.8	−81.7	36.0	0.034	0.114	104.7	90.5	1.2	0.54	33.5
2016/3/20	08 ^h 19 ^m 12 ^s	359.94	93.9	−82.6	36.8	0.034	0.325	103.3	88.7	0.9	0.70	36.2
2016/3/20	10 ^h 20 ^m 08 ^s	0.02	78.1	−79.8	34.5	0.155	3.660	104.3	95.8	2.3	0.54	77.5
2016/3/21	11 ^h 03 ^m 28 ^s	1.05	84.4	−81.6	36.5	0.018	0.100	105.9	91.4	0.1	0.67	35.1
2016/3/21	12 ^h 21 ^m 14 ^s	1.10	83.7	−78.6	37.7	0.020	9.643	106.8	87.7	1.0	0.75	40.3
2016/3/21	15 ^h 19 ^m 36 ^s	1.22	81.0	−77.8	31.5	0.001	4.975	109.2	85.6	2.3	0.87	46.5
2015/3/24	16 ^h 19 ^m 42 ^s	3.50	68.7	−77.2	36.1	0.014	0.135	107.1	86.2	−0.3	0.41	35.7
2015/3/26	15 ^h 53 ^m 03 ^s	5.47	65.8	−79.1	39.7	1.417	1.816	101.2	86.9	−0.8	0.27	4.6

Table 1 – (continued) – Geocentric radiant and orbital elements. RA, Dec, and V are now corrected for Earth’s rotation and gravitational attraction. q = perihelion distance; a = semi-major axis; e = eccentricity, i = inclination, ω = argument of perihelion, Ω = node, Π = longitude of perihelion (J2000).

Date	Time	λ_{\odot} ($^{\circ}$)	RA_g ($^{\circ}$)	Dec_g ($^{\circ}$)	V_g (km/s)	q (AU)	$1/a$ (1/AU)	e	i ($^{\circ}$)	ω ($^{\circ}$)	Ω ($^{\circ}$)	Π ($^{\circ}$)
2015/3/14	12 ^h 56 ^m 57 ^s	353.42	73.9	−78.7	30.8	0.987	0.366	0.638	51.9	348.8	173.4	162.2
2015/3/17	17 ^h 36 ^m 06 ^s	356.60	75.9	−80.2	35.5	0.991	0.143	0.858	58.0	352.5	176.6	169.1
2016/3/17	15 ^h 51 ^m 49 ^s	357.27	73.5	−79.2	33.5	0.990	0.238	0.764	55.4	351.3	177.3	168.5
2016/3/17	17 ^h 17 ^m 22 ^s	357.33	67.2	−76.4	30.0	0.985	0.353	0.652	50.3	346.9	177.3	164.2
2016/3/18	12 ^h 39 ^m 32 ^s	358.13	79.7	−77.3	37.3	0.993	−0.099	1.099	58.0	354.5	178.1	172.6
2016/3/19	13 ^h 02 ^m 36 ^s	359.14	72.7	−77.1	28.4	0.990	0.457	0.548	48.7	349.4	179.1	168.5
2016/3/19	13 ^h 14 ^m 50 ^s	359.15	79.8	−79.0	35.1	0.994	0.127	0.873	56.9	354.7	179.1	173.8
2015/3/20	11 ^h 07 ^m 37 ^s	359.32	71.4	−81.2	34.3	0.992	0.272	0.730	57.5	352.2	179.3	171.5
2016/3/20	08 ^h 19 ^m 12 ^s	359.94	86.4	−83.3	35.1	0.996	0.292	0.709	59.5	357.3	179.9	177.3
2016/3/20	10 ^h 20 ^m 08 ^s	0.02	70.2	−79.5	32.7	0.991	0.310	0.693	55.0	351.0	180.0	171.0
2016/3/21	11 ^h 03 ^m 28 ^s	1.05	75.9	−81.2	34.8	0.994	0.235	0.766	58.1	354.6	181.0	175.6
2016/3/21	12 ^h 21 ^m 14 ^s	1.10	78.6	−77.8	36.1	0.994	0.015	0.985	57.3	354.9	181.1	176.0
2016/3/21	15 ^h 19 ^m 36 ^s	1.22	78.3	−75.7	29.5	0.993	0.342	0.660	49.3	353.0	181.2	174.2
2015/3/24	16 ^h 19 ^m 42 ^s	3.50	69.9	−75.5	34.4	0.991	0.069	0.931	54.7	351.2	183.5	174.7
2015/3/26	15 ^h 53 ^m 03 ^s	5.47	67.2	−77.7	38.1	0.993	−0.085	1.085	59.8	352.7	185.5	178.2
<median>		356.60	73.9	−78.7	34.4	0.992	0.238	0.764	56.9	352.5	179.3	172.6
C/1804 E1 (Pons)		358.31	34.4	−73.2	34.9	1.071	0.000	1.000	56.5	332.0	179.5	151.5
C/1976 D1 (Bradfield)		340.4	12.8	−63.5	32.9	0.848	0.007	0.994	46.8	313.0	160.8	113.8

axis $a > 10$ AU. The calculated parabolic orbit has a perihelion distance $q = 1.071$ AU just outside of Earth’s orbit, inclination $i = 56^{\circ}45$, and node $\Omega = 179^{\circ}53$ (J2000). The longitude of perihelion ($151^{\circ}48$) is 21° from that observed for the meteoroids. The theoretical radiant is also $9^{\circ}5$ from the observed radiant position. Perhaps this reflects the dynamical evolution needed to cross Earth’s orbit. If this was a Halley-type comet, it should have returned to perihelion at least once since

1804. Without further study, this association remains in doubt.

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