Meteor science

A possible new meteor shower — η Hydrids

Damir Šegon [1], *Željko Andreić* [2], *Korado Korlević* [3], *Filip Novoselnik* [4,5], *Denis Vida* [4,6] *and Ivica Skokić* [4,7]

The radiant analysis that included orbits from the Croatian Meteor Network Catalogues of Orbits 2007 to 2010 plus the orbits from the SonotaCo catalogues for 2007 to 2011 revealed a possible new Hydrid stream with radiant running parallel to, but distinct from, the σ Hydrids. The stream got a temporary IAU designation 529 EHY and the name η Hydrids. We present here the results of our analysis of the new stream.

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1 Introduction

The Croatian Meteor Network (CMN), which started video meteor observations in 2007, is described in Andreić & Šegon (2010) and Andreić et al. (2010). The catalogues of orbits for 2007 (Šegon et al., 2012), 2008 and 2009 (Korlević et al., 2013) are already published. The catalogue for 2010 is ready for publication.

During 2012 the Croatian Meteor Network did an extensive search for new meteor showers from the SonotaCo (SonotaCo, 2009; SonotaCo, 2012) and the CMN video orbit databases, together containing more than 133 000 single meteor data. The search method consisted of visual checking of radiant plots for each degree of solar longitude, such that each plot covers 3° of solar longitude (i.e., 3° bins centered on the longitude in question). Such single degree plots were then inspected by slide show comparison and by reviewing video files containing certain solar longitude intervals. In this way we were able to detect and separate moving radiants from the sporadic background in a more clear way.

While inspecting plots from 240° to 270° of solar longitude, we were easily able to detect the σ Hydrid (16 HYD) radiant and its daily motion. However, we also saw that there is a separate radiant moving almost parallel to the σ Hydrid one, at about 5–10° to the East. We performed a detailed analysis based on the D-criterion (Southworth & Hawkins, 1963), and found out that very probably there are two different showers, very close to each other. Altogether 120 orbits belonging to this new radiant were identified.

This new shower was reported to the IAU Meteor Data Center and received the preliminary designation 529 EHY — η Hydrids. The file with all individual orbits of the new shower mentioned in this article can be downloaded from the CMN download page:
`http://cmn.rgn.hr/downloads/downloads.html`

2 The η Hydrids

A plot of all radiants for solar longitudes 240–270° in the RA–DEC range of σ Hydrids can be seen in Figure 1. Geocentric velocities are color coded. The σ Hydrid radiant positions are obvious, and the radiant motion can be clearly seen. However, if we take a look at radiants in the range of 254–258° solar longitude, as shown in Figure 2, we can see a group of meteor radiants at approximately RA = 132°, Dec = +2°. For meteors in a circle of diameter 5° around that point (i.e. all meteors having their radiant within 2.5° of that point), we calculated the D-criterion values for each meteor orbit pair. Meteors with the highest number of D-criterion values smaller than 0.15 were then used to calculate an initial mean orbit of this new, at the moment hypothetical, meteor shower. Results using UFOOrbit showed that a fraction of the selected meteors were recognized as members of the σ Hydrid shower (the η Hydrids do not yet exist in the UFOOrbit catalogue), so as a first step we compared their orbits to the reference orbit from the IAU database (Jenniskens, 2006). It turned out that these meteors do not belong to the σ Hydrid

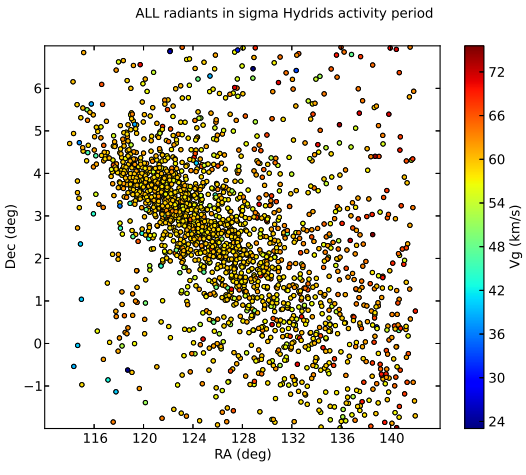

Figure 1 – Plot of all radiants of Hydrids. The geocentric velocity is color coded.

[1]Astronomical Society Istra Pula, Park Monte Zaro 2, 52100 Pula, Croatia; and Višnjan Science and Education Center, Istarska 5, 51463 Višnjan, Croatia. Email: damir.segon@pu.htnet.hr
[2]University of Zagreb, Faculty of Mining, Geology and Petroleum Engineering, Pierottijeva 6, 10000 Zagreb, Croatia. Email: zandreic@rgn.hr
[3]Višnjan Science and Education Center, Istarska 5, 51463 Višnjan, Croatia. Email: korado@astro.hr
[4]Astronomical Society "Anonymus", B. Radića 34, 31550 Valpovo, Croatia and Faculty of Electrical Engineering, University of Osijek, Kneza Trpimira 2B, 31000 Osijek, Croatia.
[5]Email: novoselnikf@gmail.com
[6]Email: denis.vida@gmail.com
[7]Email: ivica.skokic@gmail.com

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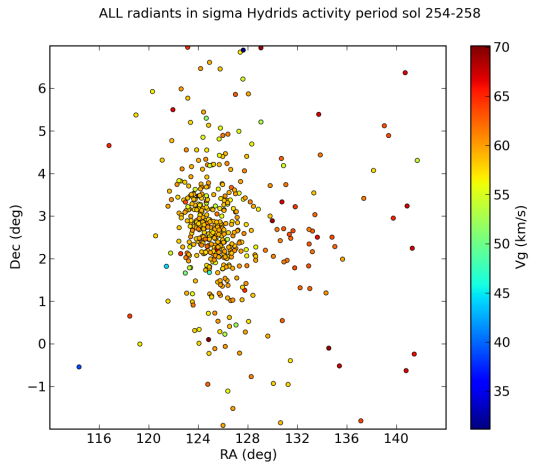

Figure 2 – Plot of Hydrid radiants in the range of 254° to 258° solar longitude. The geocentric velocity is color coded.

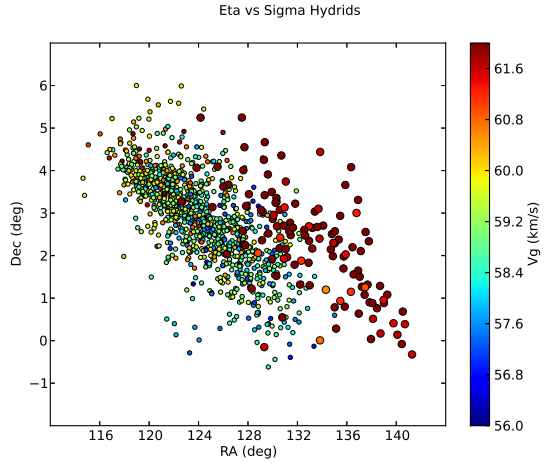

Figure 3 – Plot of Hydrid radiants in equatorial coordinates. The geocentric velocity is color coded. The η Hydrids are labeled by larger circles.

shower, since their D-criterion value surpasses the value of 0.15 (typically more than 0.35).

In order to check the σ Hydrids' orbital parameters and see if there is a significant difference between the two groups of meteors in a more accurate way, we calculated mean orbital parameters for the σ Hydrid shower from all available SonotaCo and CMN datasets and then repeated the D-criterion calculations with the new σ Hydrid mean orbit. This new mean orbit was derived from 1051 σ Hydrid meteors satisfying a D-criterion below 0.15 and is presented in Table 1. The D-criterion values calculated from this σ Hydrid mean orbit and meteors in the hypothetical new shower show that there is a significant difference between these two groups of radiants. After an iterative search for meteors satisfying the new shower's mean orbital parameters by the D-criterion being less than 0.15, we have found 120 meteor orbits. Mean orbital parameters of these 120 meteors are also shown in Table 1. The resulting D-criterion value for these two mean orbits is 0.38, confirming that we have a very probable new shower finding. An RA–DEC comparison plot of σ Hydrids and new shower radiants is presented in Figure 3. The members of the new shower η Hydrids are drawn with larger circles.

Table 1 – The newly calculated mean orbit of the σ Hydrids, compared to the mean orbit of the η Hydrids.

parameter	σ Hydrids	η Hydrids
$\lambda_\odot$ (°)	245–265	244–267
$\lambda_\odot$ max. (°)	254.6	256.9
RA (°)	124.0 ± 3.5	132.9 ± 4.2
DEC (°)	2.9 ± 1.9	2.3 ± 1.2
daily motion in RA (°)	+0.83	+0.79
daily motion in DEC (°)	−0.18	−0.16
v_g (km/s)	59.0 ± 1.0	62.5 ± 0.8
a (AU)	20	15
q (AU)	0.259 ± 0.023	0.383 ± 0.032
e	0.987 ± 0.023	0.974 ± 0.030
ω (peri) (°)	119.0 ± 3.4	103.8 ± 4.0
Ω (node) (°)	74.6 ± 4.1	76.9 ± 5.2
i (°)	129.5 ± 2.3	142.8 ± 2.3

Now the difference in radiant positions is a bit more clearly seen, due to v_g being properly color coded – but the observed difference in radiant positions is small, less than 10°. In order to enhance differences in orbital parameters, we are presenting plots showing that fact in the best way. In Figure 4, the argument of perihelion versus ascending node is presented, with v_g color coded. Two groups of orbits are clearly separated. In Figure 5, the argument of perihelion versus inclination has been plotted, again with v_g color coded. There is a clear separation between the two groups of orbits. Finally, the ascending node versus perihelion distance can been seen in Figure 6, and again the two sets of orbits show a significant difference.

Our search for a main body of the new shower has not returned any possible candidate.

The mean daily motion of the radiant can be described with Equations (1) and (2), and the daily motion of the σ Hydrids by Equations (3) and (4):

$$\text{RA} = 0.79(\lambda_\odot - 256\overset{\circ}{.}9) + 132\overset{\circ}{.}9 \quad (1)$$

$$\text{DEC} = -0.16(\lambda_\odot - 256\overset{\circ}{.}9) + 2\overset{\circ}{.}3 \quad (2)$$

$$\text{RA} = 0.83(\lambda_\odot - 254\overset{\circ}{.}6) + 124\overset{\circ}{.}0 \quad (3)$$

$$\text{DEC} = -0.18(\lambda_\odot - 254\overset{\circ}{.}6) + 2\overset{\circ}{.}9 \quad (4)$$

Finally we checked the IMO Million Meteors pages (IMO, 2012), and found out that the η Hydrid radiant has been detected during the last analysis, too. A very well fitting radiant has been found on two solar longitudes (257° and 258°), with maximal relative strength for $\lambda_\odot = 257°$, corresponding to the mean solar longitude of the activity period found by this analysis.

3 Conclusion

A new shower, running parallel to the σ Hydrids was found in the combined CMN-SonotaCo datatset. The new shower was named η Hydrids. Its radiant is about 9° away from the radiant of the σ Hydrids, running parallel to it and closing up at a rate of $0\overset{\circ}{.}04$ and $0\overset{\circ}{.}02$ per solar longitude degree in RA and Dec respectively. Both radiants are active between November 26 and December 18, with maximum activity around December 8. Moreover, they show almost the same daily motion. The mean orbit of the η Hydrids is similar to the mean

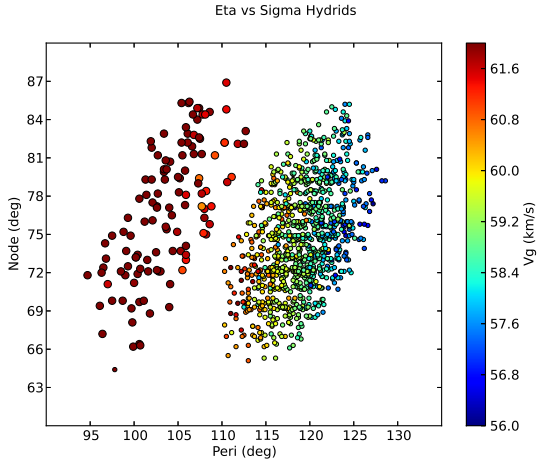

Figure 4 – Plot of longitude of ascending node versus argument of perihelion.

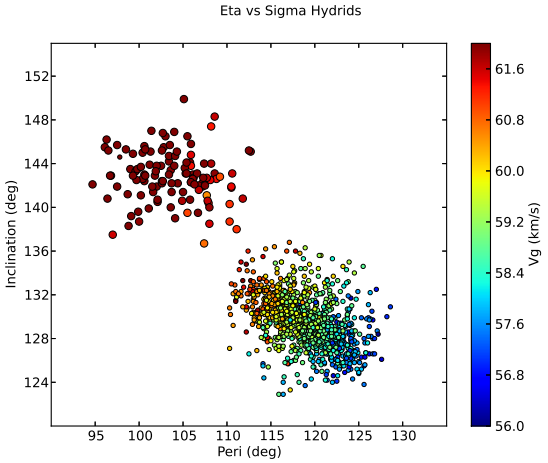

Figure 5 – Plot of inclination versus argument of perihelion.

orbit of the σ Hydrids, having slightly larger perihelion distance and about 3.5 km/s larger geocentric velocity. The D_{SH} for the two mean orbits is 0.38 confirming that the two showers are not identical. However, the similarity of orbital elements indicates that they may be related.

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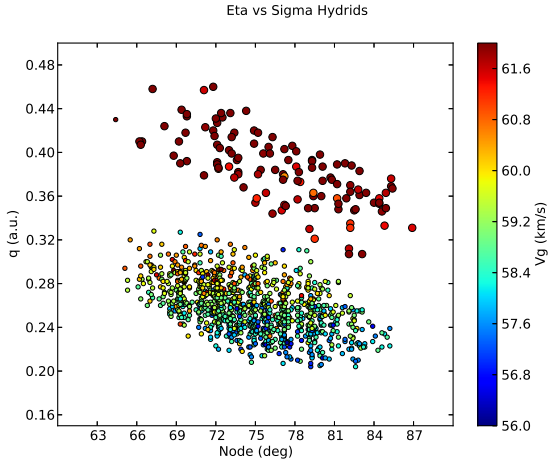

Figure 6 – Plot of perihelion distance versus ascending node.

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