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Possible new meteor shower detected from CMN and SonotaCo data

Denis Vida\textsuperscript{1,2}, Filip Novoselnik\textsuperscript{1,2}, Željko Andreić\textsuperscript{3}, Damir Šegon\textsuperscript{4,5}, Korado Korlević\textsuperscript{3}, Filip Matijević\textsuperscript{6}, Džan Jašarević\textsuperscript{7}, Anton Perkov\textsuperscript{4} and Ciobanu Tudor\textsuperscript{8}

\textsuperscript{1} Astronomical Society “Anonymus”, B. Radića 34, HR-31550 Valpovo, Croatia
denis.vida@gmail.com and filip.novoselnik@gmail.com
\textsuperscript{2} Faculty of Electrical Engineering, University of Osijek,
Kneza Trpimira 2B, HR-31000 Osijek, Croatia
\textsuperscript{3} University of Zagreb, Faculty of Mining, Geology and Petroleum Engineering,
Pierottijeva 6, HR-10000 Zagreb, Croatia
zandreic@rgn.hr
\textsuperscript{4} Astronomical Society Istra Pula, Park Monte Zaro 2, HR-52100 Pula, Croatia
damir.segon@pu.htnet.hr and tonivic@net.hr
\textsuperscript{5} Višnjan Science and Education Center, Istarska 5, HR-51463 Višnjan, Croatia
korado@astro.hr
\textsuperscript{6} Vladimir Prelog Science School, Vukovarska 269, HR-10000 Zagreb, Croatia
filipmatijevi96@gmail.com
\textsuperscript{7} Astronomical Society “Orion” Sarajevo,
Maršala Tita 12, BIH-71000 Sarajevo, Bosnia and Herzegovina
jasarevic.dzan@gmail.com
\textsuperscript{8} International Computer High School of Bucharest,
Mihai Bravu Street No. 428, Sector 3, RO-030328 Bucharest, Romania
tudor_ciobanu@ymail.com

The Croatian Meteor Network was started in 2007, and, since then, 19,055 orbits were obtained. A new meteor shower was detected using CMN and SonotaCo data. Basic orbital and activity data of this shower are described and discussed.

1 Introduction

Early 2012, the Croatian Meteor Network (CMN) was able to overcome a major obstacle. Software was developed for time synchronization between different stations. Before, the absence of such software prevented the calculation of high-precision orbits. Four years worth of data (2007–2010) were processed using the new software. For this period, 19,055 orbits have been acquired. It was decided to start searching for hitherto unknown meteoroid streams. The methods used and the first results are presented and discussed in this paper.

2 Croatian Meteor Network

The CMN was started in 2007 by a group of enthusiasts led by Damir Šegon. Since then, the CMN has grown into a large video meteor network with currently over 30 operational cameras (Andreić and Šegon, 2010; Andreić et al., 2010). The entire airspace over Croatia is currently covered by at least two cameras (Figure 1). The network uses 1004× surveillance cameras for night-sky imaging. They are built around a Sony 1/3' EXView HAD CCD chip, and achieve a sensitivity of 3 mLux with an f/1.2 objective lens. They provide black and white images at standard 25 frames per second, which allows for simple coupling with a PC: almost any frame-grabber PC card or PC-TV card works with this camera. Readily available 4 mm f/1.2 objective lenses are used on most cameras. They provide a good compromise between sensitivity (the faintest meteors recorded with this objective are around magnitude +3.5) and image scale (which in this case is around 10' per pixel). The image reduction procedure is described in detail by Vida and Novoselnik (2011).

Figure 1 – Sky coverage at 100 km height at the end of 2011.
3 Finding unknown meteor streams

We first combined our data sets with those of Sono-
taCo\textsuperscript{1}. After that, meteors belonging to known streams were excluded and the remaining meteors were plotted on a map of the sky. During plotting, the geocentric velocities of individual meteors were color-coded. Each day (solar longitude) had its own plot. These sky maps where visually searched for groups of dots of the same color. The exact position on the sky map and the range of solar longitudes were marked. After that, the data were run through our software called SELECTED\textsuperscript{RANGEFILTER}, which extracts orbital elements of meteors within the parameter range defined. The next step was to find the correlation of each meteor to every other meteor in this reduced data set. For that purpose, PYSTREAM\textsuperscript{FINDER} was used. This software compared each meteor to all other meteors to find orbital similarities using the D-criterion. We required the value of $D_{SH}$ to be lower than 0.15. The literature describes different versions of the D-criterion method, but we implemented the original one (Southworth and Hawkins, 1963).

4 Results

After filtering out antihelion and other known sources, we were left with several potential candidates for the new streams. Among them, we have chosen the most promising one to be studied first, and the results of this study are presented in this paper.

A total of 23 orbits (13 CMN and 10 SonotaCo) are possibly belonging to the new stream. The shower is active from $\lambda_\odot = 145^\circ$ to $\lambda_\odot = 153^\circ$. Mean orbital elements are given in Table 1. One can notice that they are similar to those of the Southern $\delta$ Aquariids (SDA) meteoroid stream, especially in eccentricity, perihelion distance, and geocentric velocity.

The consistency of velocities can be seen in Figure 2. All velocities are in the range from 33 to 41 km/s. The radiants span from $\alpha = 355^\circ$ to $\alpha = 365^\circ$ in right ascension and from $\delta = -04^\circ$ to $\delta = -10^\circ$ in declination.

Orbits are quite consistent, too, and close to each other, as can be seen in Figure 3.

4.1 Southern $\delta$ Aquariids

After completing the data reduction process including detection, astrometry, and photometry, the results were stored in a .csv file with all data required for orbit analysis. A total of 268 Southern $\delta$ Aquariid (SDA) orbits were found in the combined dataset for the 2007–2009 period. UFO\textsuperscript{ORBIT} software of SonotaCo was used for orbit visualization and analysis. (UFO\textsuperscript{ORBIT} settings were: $Q1, Gm = 2$, $dV = 15$, $GD > 10$). Southern $\delta$ Aquariid activity was detected from $\lambda_\odot = 119^\circ$ to $\lambda_\odot = 144^\circ$. Mean orbital elements for this shower obtained from the orbits obtained are also given in Table 1.

4.2 Comparison of the new stream and SDA

The duration of the Southern $\delta$ Aquariid meteor shower covers the period from July 12 to August 19. They are shown in Figure 4 as gray orbits. The first meteors from our new stream appear on August 20 and last until September 8. The new stream is plotted in black on Figure 4. At first sight, some correlation seems to exist between both streams. The new stream appears to be a continuation of the Southern $\delta$ Aquariids, with similar (but not equal) orbital parameters.

To investigate further the reality of this apparent correlation, the right ascension/declination plot is shown in Figure 5. Southern $\delta$ Aquariid radiants are plotted in gray. They range from $\alpha = 332^\circ$ to $\alpha = 355^\circ$ in right ascension and from $\delta = -04^\circ$ to $\delta = -10^\circ$ in declination. At the end of the Southern $\delta$ Aquariids’ activity

\textsuperscript{1}Simultaneously observed meteor data sets SNM2007, SNM2008, and SNM2009; http://sonotaco.jp/doc/SNM/.
period, the new stream continues at almost exactly the same coordinates (black radiants) to end at $\alpha = 365^\circ$ and $\delta = -04^\circ$.

6 Conclusion

A possible new meteor stream is discovered which may be related to the Southern $\delta$ Aquariids. Based on the D-criterion, however, it is clear that these two are different meteoroid streams. Nevertheless, our data reveal that the new stream is continuation of the Southern $\delta$ Aquariids, with similar, but not identical, orbits. Further analysis and observations are needed to refine this conclusion. In October 2012, the new stream was registered with the IAU MPC under the name August $\iota$ Cetids and code 0505 AIC.

References


