EPSC Abstracts
Vol. 10, EPSC2015-217, 2015
European Planetary Science Congress 2015

A project to predict meteor showers from all potential parent comets

M. Hajdukova, L. Neslusan, D. Tomko, M. Jakubik and Z. Kanuchova
Astronomical Institute of the Slovak Academy of Scienes, Slovakia, ([ne;dtomko;mjakubik;kanuchova]@ta3.sk; astromia@savba.sk)

Abstract

In this project, new meteor showers associated with known periodic comets have been predicted, new parent bodies associated with known meteor showers have been suggested, and new relationships among the meteor showers that belong to the same complex have been found. Here, we present an overview of our results from the modelling of diverse meteor-shower complexes [1].

1. Introduction

Our modelling of theoretical streams and studying their dynamical evolutions for a suitably long period allows us to reveal alterations in the initial orbital corridors of meteoroid streams which were formed due to gravitational action. For a potential parent comet, we model a stream at the moment of its perihelion passage in a far past, and follow its dynamical evolution until the present. Subsequently, we analyze the orbital characteristics of the parts of the stream that approach the Earth's orbit. The modelled orbits of the stream particles are compared with the orbits of actual photographic, video, and radar meteors from several catalogues. The whole procedure is repeated for several past perihelion passages of the parent comet and allows us to map the whole complex of meteoroid particles released from a parent comet.

2. The modelled meteor-shower complexes

We have so far investigated 13 parent bodies, the theoretical streams of which often split into several filaments, creating meteor-shower complexes.

Meteor-shower complexes of the comet 96P/Machholz (fig. 1) and of the asteroid 2003 EH1 evolved, after a significant time, into almost identical structures [2, 3, 4]. Both the comet and the asteroid could be regarded as parent bodies of four well-known meteor showers: the daytime Arietids, the southern and northern branches of the δ-Aquarids, and Quadrantids. Their possible association to α-Cetids and to the κ-Velids was suggested. Moreover, the investigation showed that a single parent body can associate showers of both kinds, ecliptical and toroidal [3, 4, 5]. The ecliptic-toroidal structure is seen transparently in these models.

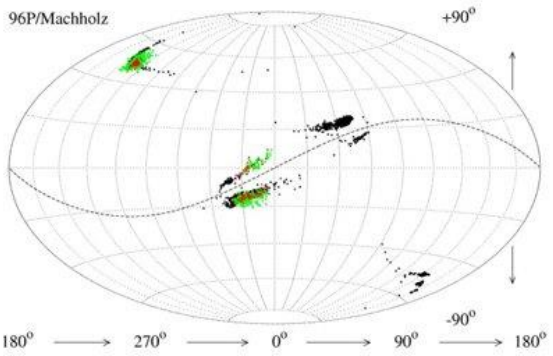

Figure 1: The meteor-shower complex of the comets 96P/Machholz. The radiants calculated from the modeled orbits (black dots) are compared with those of the real meteors from the video (green) and photographic (red) observations. The positions of the radiants in right ascension and declination are shown in the Hammer projection of equatorial coordinates.

The examination of the comet C/1917 F1 Mellish [6] confirmed the generic relationship between the comet and the December Monocerotids, suggested its possible association to the April ρ-Cygnids, and excluded its relation to the November Orionids.

We also modelled the theoretical streams of two comets in orbits situated at a relatively large distance from the orbit of Earth, 126P/1996 P1 and 161P/2004 V2. The analyses showed that parts of the streams cross the Earth's orbit and, eventually, could be observed as meteors, prevailingly on the southern

hemisphere [7]. Another new meteor shower predicted in the southern sky is a result of modelling the stream of the comet 122P/de Vico [8] (fig. 2). Identification with real meteors was negative. However, there seems to be quite a high chance of discovering at least some of them in the future, with an expected increase in observations of the southern hemisphere.

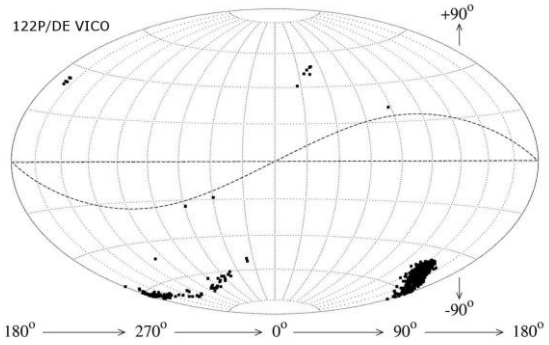

Figure 2: Radiants of a new meteor-shower, associated with the comet 122P/de Vico, which is predicted in the southern hemisphere.

Currently, we are dealing with the complex of asteroid 3200 Phaethon, which is the parent body of the well-known major shower Geminids and also of the daytime Sextantids. It appears that the particles released from the Phaethon cannot exactly evolve to the orbits of observed Geminids if we take into account only the gravitational action of the Sun and the planets. Their dynamical evolution is most probably significantly influenced also by non-gravitational effects (Poynting-Robertson drag).

3. Summary and Conclusions

In this project, we have investigated more than ten parent bodies. The examination is based on the modelling of a theoretical stream for several moments of the perihelion passages of a parent body in the distant past, monitoring its orbital evolution up to the present, selecting that part of the stream which approached the Earth's orbit, and comparing the characteristics of this part with the corresponding observed meteor shower. New meteor showers, mainly in the southern hemisphere, were predicted and new parent bodies of meteor showers, resp. new relationships between observed showers, were suggested. Moreover, it was shown that a single parent body can associate multiple showers, and that a shower can be associated to multiple parent bodies. The shower radiants of all meteor-shower complexes that were examined are distributed on the sky symmetrically with respect to the Earth's apex.

Acknowledgements

The work was also supported, by the VEGA - the Slovak Grant Agency for Science, grants No. 2/0031/14 and 1/0225/14 and by the Slovak Research and Development Agency under the contract No. APVV-0517-12.

References

[1] Neslušan, L., Hajduková, M., jr. Tomko, D., Kaňuchová, Z., and Jakubík, M.: The prediction of meteor showers of all potential parent comets, Proceedings of the IMC, edited by J.-L. Raul and P. Roggemans, International Meteor Organization, 139-145, Giron, 2014.

[2] Kaňuchová, Z. and Neslušan, L.: The parent bodies of the Quadrantid meteoroid stream, A&A 470, 1123, 2007.

[3] Neslušan, L., Kaňuchová, Z., and Tomko, D.: The meteor-shower complex of 96P/Machholz revisited, A&A 551, 14 2013 a.

[4] Neslušan, L., Hajduková, M., jr., and Jakubík, M.: Meteor-shower complex of asteroid 2003 EH1 compared with that of comet 96P/Machholz, A&A 560, A47, 2013 b.

[5] Neslušan, L., Kaňuchová, Z., and Tomko, D.: Ecliptic-toroidal structure of the meteor complex, in Proceedings of the Astronomical Conference held at A. M. University, Poznan, Poland, eds. T. J. Jopek, F. J. M. Rietmeijer, J. Watanabe, I.P. Williams, A.M. University Press, 235–242, 2014.

[6] Neslušan, L. and Hajduková, M., jr.: The meteor-shower complex of comet C/1917 (Mellish), A&A, 566, A33, p. 1-9, 2014.

[7] Tomko, D. and Neslušan, L.: Search for New Parent Bodies of Meteoroid Streams Among Comets. I. Showers of Comets 126P/1996 P1 and 161P/2004 V2 with Radiants on Southern Sky, EM&P 108, 123, 2012.

[8] Tomko, D.: Prediction of meteor shower associated with Comet 122P/de Vico, CAOSP 44, 33, 2014.