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COMMISSION F1 **WG Meteor Shower Nomenclature (MSN-WG)**

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TRIENNIAL REPORT 2018-2021

1. Introduction

The Commission F1 Working Group on Meteor Shower Nomenclature (MSN–WG) is a functional working group in IAU Commission F1 with the task to assemble a descriptive list of established meteor showers that can receive official names during the next IAU General Assembly (IAU Information Bulletin 99, 2007, p. 60). The task aims to uniquely identify all existing meteor showers and establish unique names, in order to keep the literature transparent. That literature includes observations of meteor showers, the search for associations between meteor showers and their parent bodies in the Near Earth Object population, and the dynamical studies of meteoroid streams that address their origin and their future satellite impact hazard. The MSN–WG works from a Working List of Meteor Showers maintained by the Meteor Data Center in Poznan (Jopek & Kanuchova, 2017). Working closely with the Meteor Data Center, the MSN–WG formulates nomenclature guidelines and provides arbitration in proposed meteor shower names.

2. Developments within the past triennium

At the start of the triennium, the Working List contained 563 meteor shower names (Janches, 2018). Because some showers have since been removed, the highest assigned number was 796. At the time of writing this report, there were 836 meteor showers, a 48% increase, and the highest number assigned is 1049. Work on at least 50 other new meteor showers is ongoing and publication in the Working List is pending publication of that work. The list of Established Meteor Showers remains at 112 and work on new additions is being prepared for the upcoming IAU General Assembly.

In the new triennium, there were no additional issues with the naming itself. However, new guidelines were adopted in 2019 to help clean up the current list by enabling the Meteor Data Center to remove additional meteor showers from the Working List. Because the names are present in the literature, they are not fully removed but posted into a List of Removed Showers. Since then, the showers that belong in the List of Removed Showers have been moved there. It was found that some explanation for a move needs to be added to the shower entries. For example, whether or not the December Leonis Minorids (IAU shower 32) should be in the List of Removed Showers was debated in the Working Group,

because it is a duplicate name that still is used widely (official name is Comae Berenicids, IAU shower 20).

At the 2019 Meteoroids conference, it was also adopted to include lookup tables to the database in order to describe the dispersion of the streams in time (solar longitude), radiant coordinates (sun-centered ecliptic coordinates) and speed (geocentric speed). This concept of lookup tables (Jenniskens, 2018) is gradually being implemented and they are now standard in the submission of new shower names. The lookup tables address the need to codify how wide a distribution of orbits were considered to belong to a given meteoroid stream. This is expected to help avoid duplicates. Until now, only the average solar longitude, geocentric equatorial radiant coordinates and geocentric speed were listed in the Working List.

The amateur meteor community actively assisted the MSN–WG by publishing on issues with the Working List entries (Koseki, 2018, 2019a–c, 2020a–e, 2021a–b) and expanded on a better description of listed showers (e.g., Roggemans, 2019, 2020; Roggemans et al., 2020; Cooper, 2021). Amateur–professional collaborations are a pillar of our community, both helping to improve our nomenclature (e.g., Vaubaillon, 2020; Roggemans, 2020).

New meteor datasets came from low-light video work in the NASA's All-sky Fireball Network (Kingery et al., 2020; Ehlert & Erskine Blaauw, 2020) and from radar observations by Hissar Observatory (Narziev et al., 2018). More datasets are expected to become available now funding agencies demand that underlaying data on published results are made public.

The past triennium saw much work on the meteor showers in the southern hemisphere. The Southern Argentine Agile MEteor Radar (SAAMER) expanded and published on unusual meteor showers (Janches et al., 2020a,b; Bruzzone et al., 2021) and on a comparisson of radar and low-light video observations (Jenniskens et al., 2018; Bruzzone et al., 2020). The analysis of low-light video camera triangulated meteors by new groups in Brasil also produced many newly proposed showers (de Sousa Trindade et al., 2019, Amaral et al., 2018, 2020). The All-Sky Meteor Orbit System (AMOS) measured orbits and spectra using intensified cameras (Toth et al., 2018). The CAMS (Cameras for Allsky Meteor Surveillance) network was expanded on the southern hemisphere, making meteor shower monitoring for the first time feasible. Since 2018, regular CBET telegrams were issued, and reports were made to eMeteorNews, to inform the public of unusual meteor shower events (Jenniskens et al., 2018; Jenniskens, 2019; Jenniskens, 2019a–c; Sato & Jenniskens, 2020; Jenniskens, 2020a–h; Jenniskens & Cooper, 2020; Jenniskens et al., 2020a–h; Jenniskens, 2021a–c).

The COVID-19 pandemic did not significantly impact the production of new meteoroid orbits and unusual meteor showers were reported about once a month in 2020. Most were announced via CBET telegrams, one in Astrophysical Journal Letters (Janches et al., 2020). In all cases, the Meteor Data Center (T.J. Jopek) provided rapid feedback on naming requests to expedite the announcements.

Williams et al. (2019), and other chapters in the book "Meteoroids: Sources of meteors on Earth and beyond", provide a review of the field up to 2018. With more meteor showers being detected since, the searches for parent bodies are slowly progressing since (e.g., Ye, 2018; Dumitru, 2018; Kokhirova et al., 2018; Guennoun et al., 2019; Ieva et al., 2019; Hajdukova & Neslusan, 2019, 2020, 2021; Greaves, 2020a,b; Kasuga & Jewitt, 2019; Sergienko et al., 2020; Jopek, 2020; Neslusan & Hajdukova, 2018, 2020), as is the modeling of meteor streams (e.g., Moorhead, 2019; Moorhead et al., 2019; Egal et al., 2020; Lyytinen & Jenniskens, 2020). With regret we learned that Esko Lyytinen passed in late 2020. He will be missed.

3. Closing remarks

The MSN–WG is a functional Working Group because its task is continuous. The number of meteor showers added to the Working List of Meteor Showers is growing yearly and is expected to do so in the near future. The Global Meteor Network has come online in 2018 (Vida et al., 2019), which will greatly expand the triangulation of meteors by video cameras. The new EISCAT 3D radar network is also expected to come online soon and measure meteoroid orbits (e.g., Schult et al., 2020; Stamm et al., 2021). New algorithms are being developed to detect meteor showers in the data (e.g., de Cicco et al., 2018; Peng et al., 2020). Many early entries are not statistically significant clusters of similar meteoroid orbits that did not originate from the same parent body. The list also contains many duplicates, aside from proposed shower components. The technologies of video and radar observations of meteor showers, and improved methods for data reduction (e.g. Gural, 2020; Vida et al., 2020; Mazur et al., 2020; Vida et al., 2021; Peña–Asensio et al., 2021), are now producing the number of orbits that make it possible to identify which showers exist, and which do not. In doing so, they push the horizon deeper and detect fainter showers that in the future may be confirmed.

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