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Maria Teresa Lago, ed.

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COMMISSION F1 **METEORS, METEORITES AND INTERPLANETARY DUST**

METEORES, METEORITES ET POUSSIERE INTERPLANETAIRE

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COMMISSION F1 WORKING GROUP

Div. F / Commission F1 WG1 **Meteor Shower Nomenclature**

TRIENNIAL REPORT 2021-2024

1. Introduction

Commission F1 of the IAU has historically been the international focal point of the meteor community. In 1992, the first of what would become the Meteoroids conferences was held in Slovakia. After meetings in 1994 and 1998, the meetings became a triennial meeting organized by the Organizing Committee of what was then Commission 22, and continues to be organized by Commission F1. This has historically been the primary gathering of meteor scientists. The Commission also periodically summarizes the state of research in the community, most recently with the book Meteoroids: Sources of meteors on Earth and Beyond, published in 2019. The Commission fosters scientific cooperation not only among different nationalities, but also links scientific communities; obviously meteors, meteorites and dust, but also the comet and asteroid communities.

2. Developments within the past triennium

2.1. *Meteoroids 2022*

The latest instance of the triennial Meteoroids meeting was hosted by NASA's Meteoroid Environment Office from Huntsville, Alabama, USA, from June 13 to 17, 2022. Because of the lingering danger posed by the pandemic, the conference was for the first time held entirely online. Talks were prerecorded, and sessions (which were shortened to accommodate as many time zones as possible) consisted of short summaries and question time. Poster sessions were held in a virtual environment to allow free discussions among participants. There were 126 presenters at the meeting, in addition to participants who did not submit talks or posters. Attendance was particularly good among scientists with less access to funding, since the registration cost was very low, and was waived entirely where it was an impediment to attendance. Invited talks at the meeting covered the connections between comets, asteroids and meteor showers; improvements in observational techniques; and advances in dynamical modelling. Practical considerations, such as the

effect of meteoroids on spacecraft, and planetary defence from large impactors, were also discussed. The proceedings of the meeting, with additional papers in the scope of the Commission, are being published in a special issue of Planetary and Space Science, with members of the F1 Organizing Committee serving as guest editors.

2.2. *Working Group on Meteor Shower Nomenclature*

The Working Group on Meteor Shower Nomenclature has been working on major and minor issues surrounding the naming of newly found meteor showers. One major issue faced by the group is the explosion of new showers discovered with optical and radar observations, which has reached nearly a thousand. Most of these new showers are on the Working List in the Meteor Data Centre. Showers are moved to the more restrictive Established Shower List when further observations confirm their existence. The Group has changed the naming convention for non-established showers to avoid name duplication, and has reworked the criteria for moving a shower from the working list to the established list. While refining these new, badly needed procedures, the group is also working on issues of meteor showers with northern and southern branches, meteor showers which are embedded in sporadic sources, how to deal with duplicate discoveries, and inconsistent orbital calculations in shower catalogues.

2.3. *Science developments*

One major area of interest in the past three years has been pre-atmospheric detection of large meteoroids, which have then been observed. This first occurred in 2008 in Tunisia (Jenniskens & Shaddad 2010), but no meteor observations were deliberately carried out for events of this kind until 2022, when asteroid 2022 WJ1 impacted the atmosphere over Ontario, Canada and was observed by a handful of notified observers. In 2023, 2023 CX1 was widely observed over the UK and France when it impacted about 7 hours after being discovered (Vida et al. 2023).

On a similar note, two new predicted meteor showers were observed during the triennium. The Arids from Comet 15P/Finlay were observed for the second time (Jenniskens et al. 2021), and there was a first observation of the lambda-Sculptorids from Comet 46P/Wirtanen (Vida et al. 2024a). The showers were observed by the GMN and CAMS optical meteor networks, and the SAAMER meteor radar. An outburst of the established τ Herculid shower, caused by a breakup of comet 73P/Schwassmann-Wachmann 3 in 1995, was also observed in 2022 (Koten et al. 2023).

Fireball and meteor networks, like the EN, DFN, SOMN, SPMN and others, continue to expand and provide ever increasing amounts of data. Large data sets have recently allowed large scale population studies of meteoroid physical properties, which can be linked to their origins (e.g. Borovička et al. 2022).

Progress on the determination of meteoroid masses from observed light is being made on many fronts. Many studies are being done with Earth-observing satellites designed for lightning mapping, which observe the oxygen line at 777 nm. Spectra of bright fireballs have recently been used to determine the efficiency in this narrow bandpass (Vojaček et al. 2023). Luminous efficiencies of faint meteors have been determined from high-resolution meteor observations and used to calculate physical properties of Orionid meteors (Vida et al. 2023b). Lab experiments continue to make advances, for example the work of Tarnecki et al. (2023), who looked at the relationship between luminous efficiency and speed with a dust accelerator. Meteorite ablation has also be done in the lab to determine luminous efficiencies (Loehle et al. 2024).

Dynamical modelling, in addition to predicting new meteor showers and modelling meteor shower outbursts (e.g. Egal et al. 2023), can address the problem of the dust

environment in near Earth space and the influx of interplanetary material on the Earth. Pokorný et al. (2024) developed a new model of collisions in the zodiacal cloud which produced good fits to dust and meteor measurements.

3. Conclusion and future plans

The Commission is already preparing for the next major event of the coming triennium: our Meteoroids 2025 conference in Perth, Australia. Members of the F1 Organizing Committee, with other members nominated by the Committee, will serve as the Scientific Organizing Committee for the meeting. The meeting will be held adjacent to the annual meeting of the Meteoritical Society, which will foster communication between the meteor and meteorite communities. The Meteor Shower Nomenclature Working Group will continue to deal with the issues of rapidly increasing amounts of meteor shower data and historical inaccuracies in the records. We look forward to the next three years of rapid developments in meteor science.

Margaret Campbell-Brown
President of the Commission

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