Meteor showers in review

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Introduction

Since the last Meteoroids meeting in Poznan in 2013, several exceptional meteor showers have occurred. A large number of newly detected meteor showers have been reported. Progress has been made in understanding meteor showers and the sporadic background. Many questions remain. In this invited review, I will highlight some of the advances and reflect on outstanding problems.

Showers on other planets

The close encounter of comet C/2013 A1 Siding Spring to Mars on October 19, 2014, [1] resulted in the detection of a metal atom layer high in the Martian atmosphere [2]. Closer to home, lunar impact flashes [3] and LADEE's periodically dusty lunar atmosphere [4] were attributed to the effect of meteoroid streams.

Meteor shower outbursts

Some exceptional meteor showers in recent years were predicted, others came quite unexpected. In 2013, the September epsilon Perseids had a strong return [5]. On April 7, 2014, an outburst of April alpha Capricorinids was reported [6]. The strong 2014 kappa Cygnids were found to be meteoroids in resonant orbits [7].

In 2015, a new Chi Cygnids meteor shower was detected, active for much of the month of September [8]. The most delighting surprise was the Volantids, a southern hemisphere shower that was active on New Year's eve, 2015, and the first two days of the new year [9].

The May 24, 2014, encounter with comet 209P/Linear was predicted and produced a meteor shower called the Camelopardalids, rich in faint meteors [10]. Low escape velocities suggested these meteoroids just barely escaped from the comet nucleus [11]. The lack of bright meteors was attributed to meteoroids falling apart in the interplanetary medium [12].

Similar predictions were made ahead of the close March 2016 approach of mostly dormant comet 252P/Linear and its fragment P/2016 BA14 (PANSTARRS). By the time of the Meteoroids 2016 meeting, results will be known.

Meteoroid stream dynamics

The status of meteoroid stream modeling is still in its infancy. No models are established, while many fail to explain even the most basic features of the observed meteor showers. The age and formation mechanism of the core of the Quadrantid meteoroid stream was studied [13] and ought to be one of the easier problems to solve. Combining models and observations confirmed that the Daytime Arietids were too wide to have been created during the Marsden Sungrazer breakup [14]. Predictions were made for 1-revolution dust trail encounters from long period comets, including possible activity from C/2015 D4 (Borisov), 12P/Brooks, and Comet 15P/Finlay.

The number of known showers reported to the IAU Meteor Data Center has grown dramatically. Several new surveys are now reporting their results [e.g., 12]. The southern hemisphere is now also being mapped [e.g., 5].

Sporadic meteors

The sporadic background at visual magnitudes was found to be fundamentally different from that detected by the CMOR and AMOR radars [12]. The visible meteors appear to be relatively recently released meteoroids. Most matter originates in comet disintegrations. These meteoroids disappear, presumably by falling apart into smaller grains, on a timescale of 100-10,000 years. Some Poynting-Robbertson evolved larger grains are found to survive for several million years in the zodiacal cloud.

The short semi-major axis of radar-detected apex-source meteors remains a mystery and the nature of the toroidal complex is debated [12]. The relevance of meteor showers from rubble-pile asteroids is also a hot topic [15, 16].

References

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