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The meteor detected system and lunar impact observations in Taiwan

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Abstract

Taiwan Meteor Detection System (TMDS) is a joint platform under a collaborative development among National Dong-Hwa University (NDHU), National Central University (NCU) and Taipei Astronomical Museum (TAM). The TMDS aims to scope meteor events in the sky surrounding Taiwan and performs successive analyses of recorded events. Currently, four observing stations including Lulin, Kenting, Yang Ming Shan National park and Fushoushan, were constructed. From July 2016 to April 2019, the TMDS has detected about ten thousand events. But only a few hundred multi-station orbits are precisely determined and some of them are associated with the parent body (i.e. comet 109P/Swift–Tuttle and (3200) Phaethon). In addition to meteor observations, we also attended the worldwide campaign of lunar impact observations and reported our results during Geminid meteor shower in 2017 and 2018.

1. Introduction

A meteor occurs when a meteoroid (comet debris or asteroid fragment) strikes Earth's atmosphere at high speed. Intense heat is created by the compression of the air ahead of the meteoroid, which usually causes the object to burn up in the atmosphere, creating the white "shooting star" that we are all familiar with. Taiwan Meteor Detection System (TMDS), which is an interdisciplinary project dedicated to study these meteoroids streams and the interaction of these particles of interplanetary matter with Earth's atmosphere. TMDS located in different places in Taiwan employ a high-sensitivity CCD video cameras to monitor the night sky. The fist two of these stations were setup at Hutain elementary school located in Yang-Ming-Shan National Park, and Lulin observatory in 2016, and two more stations were setup at Kenting observatory in 2017 and Fushoushan Farm in 2018. Over ten thousand meteor trails have been registered from 2016 to 2019 but only a few percentage can be used to determine the orbits due to the bad weather in Northern (Hutain) and Southern (Kenting) Taiwan. In this work, we focus on the detected orbits and use D_{SH} criterion to find out which parent body is related to especially in known meteor showers (i.e. Perseids-August, and Geminids-December).

2. Observations

2.1 TMDS

The TMDS started operation in August 2015 after Hutain site setup. So far, over ten thousand meteor trails have been detected and about one hundred events can be used to determine the orbits. Three cameras are also endowed with holographic diffraction gratings (600 grooves per millimeter) for obtaining meteor spectra. Because the calibration to the spectra is still undergoing, we therefore focus on the results of the orbits analysis.

2.2 Lunar impact system

Our 2017 and 2018 lunar impact flashes monitoring campaign was conducted at Lulin Observatory, where two identical 0.40m and 0.20m Schmidt-Cassegrain telescopes manufactured by Celestron (Table 1) were employed to monitor the same part of the night side of the Moon. Two telescopes were used in order to have duplicity of impact flash detections to distinguish true impact flashes from noise or cosmic ray hits in the detectors. This is the usual procedure that we follow to detect impact flashes unambiguously.

3. Results

The triangulation method was applied to calculate the positions and velocities of simultaneously detected meteors. With the position and velocity components of individual meteors, the meteor orbits can be determined. With Dsh criterion, we present results

for selected cases in Figure 1 and Table 1.

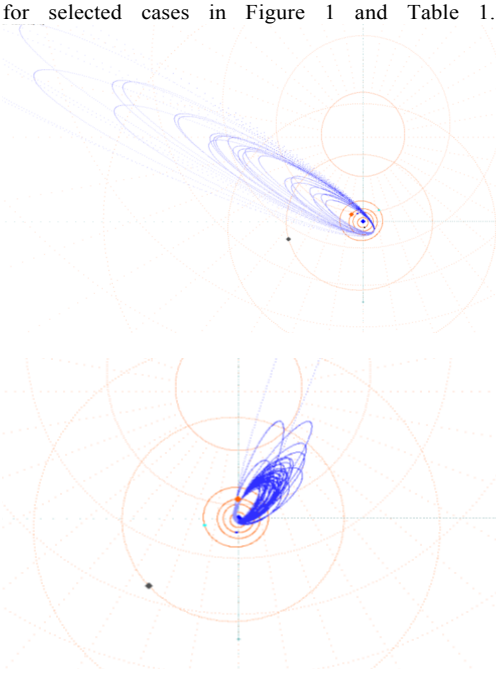

Figure 1. The detected orbits of the Perseids (up-panel) and Geminid (lower-panel) meteor shower in 2017 and 2018.

Table 1: Associated orbit of known parent body and detected meteors by using Southworth-Hawkins criterion (D_{SH}).

	Parent body	Max Ds_h	Min D_{sh}
Gemind	3200 Phaethon	0.19	0.02
Perseids	109P Swift-Tuttle	0.20	0.02

During the Geminid meteor shower in December 2017, we fortunately found a plausible candidate lunar impact flash (Figure 2) in one telescope (SLT) on Dec. 15.89 UT, 2017 at selenographic longitude 44.50 degrees and latitude 2.09 degrees. The flash lasted for 0.033 s and the brightness is 5.77 mag. using the field star for comparison.

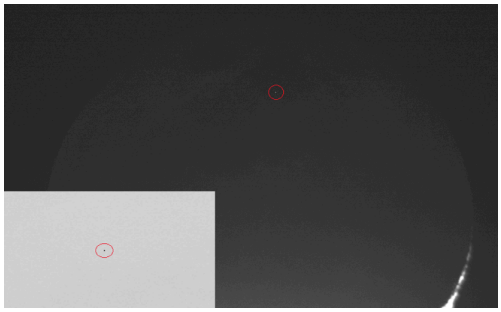

Figure 2 A plausible candidate lunar impact flash in late-December of 2017.

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