MULTI-STATION OBSERVATIONS OF THE 2014 URSID METEOR OUTBURST

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Introduction: Meteor showers are common events that occur several times along the year. They are caused by asteroid or cometary material that encounters the Earth atmosphere. Once detached from their parent body, orbital dynamic processes place the material into an Earth crossing orbit. Comets do suffer severe outgassing when they approach their perihelion and new meteoroids are injected in orbit. As it can take a considerable time after being ejected from the nucleus for cometary meteoroids to disperse away from the nucleus locality, an enhancement is generally to be expected in meteor stream activity at the time when the comet is close to perihelion. What is remarkable about the Ursids is that a much sharper increase in its activity (around 3 times the normal rate) was observed in 1795, 1945 and 1986 [1] and 2000 [2] years when the parent comet, 8P/Tuttle [3], is near aphelion at a heliocentric distance of over 10 AU, so that it will not be outgassing and inserting new meteoroids into the stream at this point.

This singular behaviour was first studied in [2] and an explanation was then suggested. Basically, because of the radiation pressure, some meteor swarms detached from the comet in particular years ended up trapped in a 7:6 resonance with Jupiter. The ratio between the meteoroid period and the comet period (trapped in a 15:13 resonance with Jupiter) becomes roughly fixed and after ~620 years the comet and meteoroids will be exactly out of phase (one at its perihelion, other at its aphelion). The last time this event took place was on December 22nd - 23rd of 2014. A co-joint observation campaign was set between the Spanish Meteor Network (SPMN), and the French Fireball Recovery and Inter-Planetary Observation Network (FRIPON) in order to confirm the previous results.

Results: Despite the local bad weather conditions during the observing nights, we have obtained accurate multi-station and multi-instrument geocentric radiant, atmospheric trajectory and orbit data for 4 Ursid meteors. Our results [4] agree with previous outbursts results in [2], other 2014 outburst reports [5, 6, 7], and computationally simulated predictions [4, 8].

Conclusions: Our results confirm the suggested explanation given by [2]. We found some discrepancies in two of the meteors though. These are attached to the low geocentric velocity of these meteors, which cause some uncertainty in the measurements of the beginning trajectory segment. The membership of these four meteors to the expected dust trails that were to provoke the outburst is discussed. We characterize the origin of the outburst in the dust trail produced by the comet in the year A.D. 1392.

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