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ATMOSPHERIC BREAKUP BEHAVIOUR OF 2022 WJ_1

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ABSTRACT

Small near-Earth asteroid 2022 WJ_1 was discovered by the Catalina Sky Survey shortly before 5 UT on Nov 19, 2022. Images over the next few hours confirmed an impact would occur over Southern Ontario, Canada near 08:26 UT (03:26 local time). 2022 WJ_1 is only the sixth asteroid detected and recognized before impact and the first where local observers were alerted in advance, providing a rare opportunity to witness a predicted NEO impact in the form of a fireball in Earth's atmosphere. Even more fortuitously, the fireball ground track of 2022 WJ_1 was near the middle of the

Western Meteor Physics Group's optical and radar network comprising nearly two dozen stations spread over Southern Ontario, Canada. As a result, the fireball associated with the impact of 2022 WJ_1 was captured by more than half a dozen low resolution video and high resolution dedicated all sky fireball cameras. Additionally, the head echo of the fireball was registered on three frequencies of the Canadian Meteor Orbit Radar, while the acoustic shock was detected by several nearby infrasound microphones co-located with seismic stations. The fireball was first detected moving at 14 km/s at an altitude of 83.2 km, just north of the city of London, Ontario. It ended its luminous flight 14 seconds later at an altitude of 21.5 km over land NE of the town of Beamsville, less than 1 km south of the shoreline of Lake Ontario. Doppler radar records from the NEXRAD KBUF station located ~60 km away show likely meteorite-debris related returns 2-5 minutes after the fireball. These doppler returns, together with darkflight modelling, confirm that most of the meteorite fall occurred in Lake Ontario. At least one large fragment and some smaller material likely made landfall. From infrasound records of the period at maximum amplitude an approximate source energy of 0.01-0.02 kt TNT equivalent is found, corresponding to an initial mass of 400-800 kg and body of diameter 0.60-0.75 m for chondritic bulk densities. For its measured H magnitude of 33.6, this diameter produces an albedo of 0.14 ± 0.02. Details of the fireball luminous flight, model fits to its ablation behaviour and comparison of the in-atmosphere and telescopic orbit will be presented.

Figure 1. Global Fireball Observatory image of the fireball produced by the 2022 WJ_1 entry as taken from directly under the flight path less than 100 km from the endpoint.

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Comments:

(Alternative session: NEO Discovery; Oral preferred - attractive video materials will be shown)