# RECENT PROBABLE METEORITE FALLS OBSERVED BY THE SOUTHERN ONTARIO METEOR NETWORK.

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**Introduction:** Since its inception in 2004, the Southern Ontario Meteor Network's (SOMN) array of digital all-sky cameras has monitored southern Ontario, Canada for modestly bright (-2 mag and brighter) meteors. Although designed principlly to simultaneously observe meteors across the multiple sensor-suite of SOMN (optical, radar, infrasound, seismic, VLF), occasionally a fireball is detected that potentially may produce meteorites. To date, such events occur on average once per year over the small region covered by the network. Here we present the reduction and orbital data for these potential meteorite-producing events.

**Instruments:** Individual camera stations are composed of "off-the-shelf" HAD CCD security cameras with 1.6 – 3.4 mm f/1.4 fish-eye lenses, running at standard interlaced video rates (~30 fps). Meteor detection is controlled by each camera's operating software, while simultaneous events are evaluated by a central server, correlating events according to the observation time. Station time calibrations are achieved via local GPS receiver or by Network Time Protocol (NTP)[1].

**Identification and Reduction:** Probable meteorite falls are identified using several criteria: (1) Meteor duration (>2 sec.) (2) Sustained brightness: <-6 mag. (3) Observed deceleration. (4) Initial meteor velocity (<25 km/s). (5) Terminal altitude (<35 km). If these conditions are met the meteor is selected for further reduction and darkflight calculations. Assuming a linear meteor trajectory[2], the trajectory and velocity of the meteor is determined by least squares minimization of the distances between camera sight lines and the trial meteor position as a function of time assuming the model of: $x(t) = x_o + v_o t + A\exp(kt)$, introduced by Whipple[3]. Darkflight modeling of potential meteorites to the surface is computed using the method of Ceplecha[4], the meteor's radiant, and observed meteorological conditions for the event day as measured by UARS[5] from the last observed meteor position.

**Recent Meteorite Falls:** In ~4 yrs. of operation, six events have been identified as probable meteorite falls. In addition several of these events have also been observed by radar and/or infrasonically.

*20060305 – Kincardine.* $M_{\text{initial}}$: 11.6 ± 1.3 kg, Probable $M_{\text{fall}}$: 100–300 g. Fall region: Lake Huron coastline and local farmland.

*20060405 – Hamilton.* $M_{\text{initial}}$: 6.8 kg, Probable $M_{\text{fall}}$: <100 g. Fall region: Local farmland and southern city limits.

*20061223 – Tobermory.* $M_{\text{initial}}$: >146 kg, Probable $M_{\text{fall}}$: >1 kg. Fall region: Lake Huron.

*20080306 – Pointe au Baril.* $M_{\text{initial}}$: 53-123 kg, Probable $M_{\text{fall}}$: ~1 kg. Fall region: Georgian Bay and nearby coastline.

*20080314 – Dunnville.* $M_{\text{initial}}$: >2.6 kg, Probable $M_{\text{fall}}$: ~50 g. Fall region: Local farmland.

*20080325 – Sarnia.* $M_{\text{initial}}$: 3.5 – 14.7 kg, Probable $M_{\text{fall}}$: ~100 g. Fall region: Lake Huron.

**Meteorite Orbits and Implications:** Although to date no meteorites have been recovered from these falls, their orbits have been determined. While most are typical Apollo-type orbits, similar to those already associated with meteorites falls[6][7][8], others surprisingly are not. The 20080306 and 20080314 initial orbits are potentially unusual, having low inclinations and aphelia between 5-6 AU, beyond the orbit of Jupiter. Further analysis is ongoing as large orbital uncertainities remain due to initial velocities. Nevertheless, the orbits appear to be dynamically related with a $D' = 0.064$[9]. Such low D' have been found for other probable meteorite producing events observed by the MORP and PN meteor networks, suggesting the existance of meteorite producing streams[10]. These proposed streams, however, do no match these unusual orbits. If meteorites are recovered from these events, not only will this provide new meteorite orbits, but also a greater understanding to the origins of meteorites, challenging our current understanding of meteorite source regions.

**References:** [1] Weryk R. J. et al. (2007) *EMP*, doi 10.1007/s11038-007-9183-1, 1–6. [2] Borovička J. (1990) *Bull. Astro. Inst. Czech.*, **41**, 391–396. [3] Whipple F. L. et al. (1961) *Smith. Contib. Astro.*, **4**, 97-129. [4] Ceplecha Z. (1980) *Bull. Astro. Inst. Czech.*, **38**, 222–234. [5] Swinbank R. and O’Neil A. A. (1994) Mon. Weath. Rev., **122**, 686–702. [6] Ceplecha Z. (1961) *Bull. Astro. Inst. Czech.*, **12**, 21–47. [7] McCrosky R.E. et al. (1971) *JGR*, **76**, 4090–4108. [8] Halliday I. et al. (1981) Meteorit., **16**, 153–170. [9] Drummond J.D. (2000) *Icarus*, **146**, 453–475. [10] Halliday I. et al. (1990) *Meteorit.*, **25**, 93–99.