THE MORÁVKA METEORITE FALL: FIREBALL TRAJECTORY ORBIT AND FRAGMENTATION FROM VIDEO RECORDS. J. Borovicka, P. Spurný and Z. Ceplecha, Astronomical Institute of the Academy of Sciences, 251 65 Ondrejov Observatory, The Czech Republic, e-mail: borovic@asu.cas.cz

Introduction: The Morávka meteorite fall occurred in the northeastern part of the Czech Republic on May 6, 2000, 11:52 GMT [1]. The first meteorite (214 g) was collected immediately after the fall, two other pieces (329 g and 91 g) were found in the following weeks. The meteorites were classified by P. Jakeš as ordinary chondrites of type H5. They are quite compact with density of 3.59 ± 0.05 g/cm^3 and low porosity, showing only fine cracks.

The very bright fireball preceding the fall was witnessed by thousands of people on blue sky one hour after local noon. Three people were fortunate enough to capture part of the fireball path on video. From these records we were able to determine the fireball trajectory, velocity, and orbit and to study extensive fragmentation which occurred during the atmospheric entry (see the figure extracted from video taken by J. Mišák). Satellites on the Earth orbit also recorded the fireball. Ten seismic stations located in close vicinity of the fireball path registered sonic booms and infrasounds were recorded on one station in Germany.

Trajectory, orbit and mass: The fireball entered the atmosphere with a velocity of 22.5 ± 0.5 km/s and followed nearly southern direction (azimuth $175.5 \pm 0.5°$) with a slope of $20.4 \pm 0.2°$. The first video record started at height of 45.7 km. After extensive fragmentation and deceleration, the last piece of nominal mass of 18 kg ceased to be visible at a height of 21.2 km when it was decelerated to 3.7 km/s. Several other meteorites of the masses of 2–9 kg and numerous smaller pieces are predicted to have fallen in a mountainous, forested terrain.

Using the satellite data on fireball radiative energy [2], the pre-atmospheric mass of the meteoroid was estimated to 2000 kg, corresponding to a diameter of 1 meter. The heliocentric orbit is notable by a high inclination, $i = 32.2 \pm 0.8°$. The other orbital elements are $a = 1.85 \pm 0.05$ AU, $e = 0.47 \pm 0.03$, $q = 0.9823 \pm 0.0012$ AU, $Q = 2.7 \pm 0.2$ AU, $\Omega = 46.2580°$, $\omega = 203.5 \pm 1.0°$.

Fragmentation: The first break-up must have occurred at heights above 50 km under a low dynamic pressure (<0.5 MPa). About a dozen of primary fragments of mass up to 200 kg were formed. Taking the strength of the meteorites into account, the reason of this disintegration is not obvious.

Even the strongest primary fragments disrupted again to smaller pieces at heights around 30 km, under the pressure of 5 MPa. This seems to be the limit of material strength caused by internal cracks. Fifteen fragmentation events were studied in more detail. No complete pulverization of a fragment was observed. At least 10% of original mass always survived as macroscopic fragment. On the other hand, some part of mass was always lost. A quiet separation into two or more pieces, which together would form the original mass, was not observed. Fragmentation products gained a velocity to the side up to 300 m/s in some cases.

References: [1] Borovicka J. et al. (2000) *Meteoritics & Planet. Sci., 35*, A31. [2] DoD Press Release 20-003 (October 30, 2000)

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