

THE MASON GULLY METEORITE FALL IN SW AUSTRALIA: FIREBALL TRAJECTORY, LUMINOSITY, DYNAMICS, ORBIT AND IMPACT POSITION FROM PHOTOGRAPHIC RECORDS.

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Introduction: We report a new instrumentally recorded meteorite fall, named Mason Gully, which was recorded by the Desert Fireball Network (DFN), an ambitious project dedicated to mapping of fireballs over the remote area of the Nullarbor Region of SW Australia, a very suitable place for meteorite recoveries [1]. This is the second case of such successful recovery after Bunburra Rockhole, the major milestone of this project [2,3].

Results and discussion: The reported meteorite fall occurred over SW Australia on April 13th, 2010 at 10^h36^m12.7^s ± 0.1^s UT (maximum brightness). The fireball designated DN130410 was recorded photographically and photoelectrically by two automated fireball observatories (DFO) on two eastern stations of the DFN. Its luminous trajectory started at an altitude of 83.46 km and after a 73.8 km long flight terminated at an altitude of 23.84 km. The angle of the atmospheric trajectory to the Earth's surface was 53.9°. The object, with initial mass of about 40 kg, entered the atmosphere with a very low speed of 14.53 km/s, and during a 6.0 second long flight decelerated to the terminal speed of 4.1 km/s, when the fireball brightness decreased below the sensitivity limit of both DFOs. The maximum absolute (100 km distance) brightness of -9.4 magnitude was reached in a short flare at an altitude of 35.8 km. The observed light curve and deceleration was used for modeling of meteoroid atmospheric fragmentation. The initial meteoroid before its collision with Earth orbited the Sun on a very low inclined orbit (Fig. 1) defined by the following parameters: semimajor axis (AU): 2.470 ± 0.004; eccentricity: 0.6023 ± 0.0007; perihelion distance (AU): 0.98240 ± 0.00007; aphelion distance (AU): 3.958 ± 0.008; argument of perihelion (°): 18.95 ± 0.03; longitude of ascending node (°): 203.2112; inclination (°): 0.832 ± 0.013; period (years): 3.882 ± 0.009. All angular elements are given in J2000 equinox. This is one of the most precise orbits ever calculated for a meteorite dropping fireball. The computation of the dark flight and determination of impact position was complicated by very strong lateral stratospheric winds reaching 45 m/s, shifting the resulting impact position for the meteorite of the recovered size (25 g) by about 6 km aside!

In spite of this unfavorable fact the meteorite was found up to 150 meters from the predicted site. Mason Gully has been classified as an H5 ordinary chondrite, with minimal weathering, due to its short terrestrial exposure age in an area of low precipitation [4]. This case along with the Bunburra Rockhole meteorite clearly show that this project in the remote and hostile environment of the Australian desert is meaningful, and that these observations can bring data of fundamental value to solar system research. We also proved the correctness of our observational and computational methods and models.

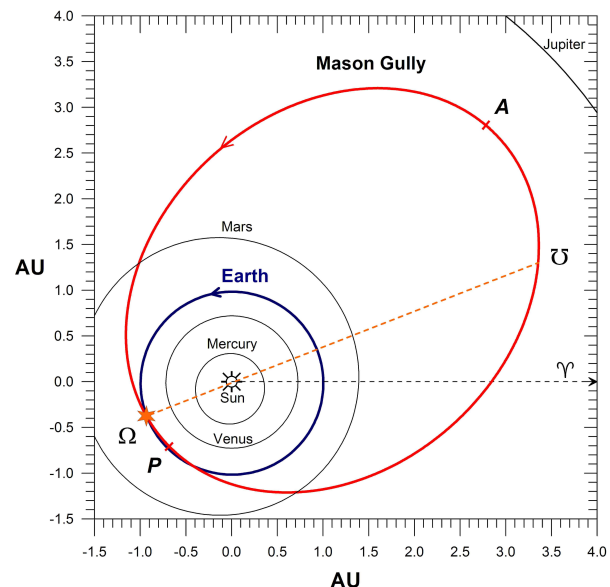


Fig. 1. Orbit of Mason Gully (MG) projected on the plane of the ecliptic. Orbits of planets are plotted as well. MG had a typical Apollo-type orbit with aphelion in the outer main belt of asteroids.

References: [1] Bland P. A. et al. (2006) *Meteoritics & Planet. Sci.* 41:5197. [2] Bland P.A. et al. (2009) *Science* 325: 1525. [3] Spurný P. et al. (2012), *Meteoritics & Planet. Sci.*, 47, 163-185. [4] Towner M. C. et al. (2011) *Meteoritics & Planet. Sci.* 46, Abstract #5124.