FALL AREA CALCULATION AND ASSOCIATION OF METEOR ORBITS WITH PARENT BODIES: A CASE STUDY USING THE MOFID NETWORK FOR TAGHZOUT METEORITE FALL MOROCCO.

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Introduction: The MOFID (Moroccan Observatory for Fireball Detection) network is designed for computing meteor orbits to predict meteorite falls and establish parent body associations. It is a part of the GFN (Global Fireball Network) conducted by Perth University. It was initiated and created in 2014 after the Meteoritical Society meeting held in Casablanca

Fireball Observations and Reduction: On 2021-08-06T21:12:14Z, a bright fireball was observed by a fireball camera from the MOFID network in Ifrane (Morocco), as well as from three distant viewpoints (>300 km) in Spain: two cameras of the Southwestern Europe Meteor Network (Calar Alto and Sierra Nevada) and a casual photograph in Puerto de las Palomas. These four viewpoints were used to reconstruct the trajectory of the bolide, visible from 84 down to 25 km altitude. Dynamic modeling of the deceleration showed that a kilo-sized meteorite had survived entry [1, 2]. Owing to the shallow entry angle (29°) and the positional uncertainty, the total search area predicted by the dark flight and wind modeling [3] was 18 km² (5 km² at 1σ confidence level). This relatively large area, compounded with the steepness of the terrain (~800 m of elevation variation in the zone), made this fall not an ideal candidate for a dedicated search, but fortunately, a unique piece of meteorite was found in the 1σ search area, it is the Taghzout fall [4]. Weighing 2.1 kg, this main mass found was larger than the nominal dynamical estimate (that assumed spherical shape with ordinary chondrite density), however, the angular shape of the meteorite found largely explains the discrepancy due to the higher frontal area per unit of mass. Preliminary orbit inferred from the camera data points to the inner main belt, and can be fed to near-Earth space by multiple source regions (including the 3:1 mean-motion resonance with Jupiter or the ν6) [5]: semi-major axis 2.216 ± 0.014 AU, eccentricity 0.604 ± 0.003, and inclination 3.79 ± 0.01°.

Taghzout meteorite fall parent body: This study focuses on identifying the parent body of the Taghzout fireball meteor through orbit comparisons with known asteroids and comets. We initially explored different threshold values of the D-criterion but ultimately opted to consider other parameters. Our analysis involved examining the association between the meteor and potential parent bodies, taking into account radiant difference, geocentric velocity, solar longitude, and angular distance between radiants. Additionally, a variable velocity threshold was used. This analysis was conducted using a dataset of orbital and physical parameters from the JPL Small Body Database and implemented through a program developed in previous work [6]. Results revealed a significant association between the Taghzout meteor and the 2016 PQ asteroid, corroborated by consistent orbit similarities and adherence to specified threshold criteria. The 2016 PQ asteroid, a member of the Near-Earth Object (NEO) Apollo group, exhibits a close orbital proximity to Earth, further supporting the validity of the association. This study demonstrates the efficacy of the MOFID network in identifying parent bodies of meteors and contributes to our understanding of celestial dynamics and meteorite origins. It shows the importance of the camera networks to help recover potential meteorite falls as well as learning more about meteorites' parent bodies, their orbits, and trajectories since the ejection moment.

References:

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