4CF13-2013-000199

Abstract for an Invited Paper
for the 4CF13 Meeting of
the American Physical Society

The Chelyabinsk Airburst: Observations and Models

MARK BOSLOUGH, Sandia Natl Labs

On Feb. 15, 2013, an asteroid exploded about 40 km SSW of the Russian city of Chelyabinsk. It caused many injuries and widespread blast damage, but also yielded a plethora of data from security and dashboard cameras. Combined with seismic, infrasound, and satellite records, this serendipitous source provides a means to determine the projectile size and entry parameters and develop a self-consistent model. Analysis of video with subsequent on-site stellar calibrations enabled precise estimates of entry velocity (19 km/s), angle (17 deg) and altitude of peak brightness (29 km). The inferred pre-entry diameter was $\sim$ 20 m with a mass of $\sim$ 1200 tonnes. Satellite sensors recorded a radiated energy consistent with a total energy of $\sim$ 450 kilotons. The shallow entry angle led to an extended, near-horizontal, linear explosion. The blast was distributed over a large area, and was much weaker than it would be for a steep entry. The orientation also led to different phenomena than expected for a more vertical entry. There was no ballistic plume as calculated for Tunguska ($\sim$ 35 deg). Instead, buoyant instabilities grew into mushroom clouds and bifurcated the trail into two contra-rotating vortices. This event also suggests that the risk from airbursts is greater than previously thought.