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# On the Utility of Orbital Bolide Observatories for Characterizing the Impactor Population

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An analysis for a conceptual space borne bolide observatory is presented with a mission to characterize the small near-Earth asteroid and comet populations. Specifically, we investigate the utility and feasibility of orbital narrow-band spectroscopy. The informed selection of wavelength ranges has the potential to provide diagnostics with respect to impactor properties such as meteorite class and composition.

The discovery of meteoroid impacts in the data stream of the Geostationary Lightning Mapper (GLM) [1] has demonstrated that space borne observations can achieve statistically significant quantities of bolide light curves – as of the time of this writing, over 8000 bolide events have been catalogued since 2017, or just over 1000 bolide events per year based on data from two geostationary satellites.

The GLM instrument is a high frame rate imager that uses a narrow bandpass filter centered over the 777nm neutral oxygen emission line. It was initially assumed that the instrument detected only magnitude -14 and brighter fireballs in a regime where meter-sized asteroid impacts dominate. Recent advances in the detailed simulation of bolide emission spectra [2] has enabled the investigation of specific spectroscopic features of bolide luminosity. Figure 1 shows an example of a simulated spectrum compared with observation for the well-known Benesov bolide. Spectra such as these allow for analysis of specific instrument configurations. The simulations suggest that majority of the energy detected in the

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GLM passband originates from dissociated, atmospheric oxygen (as opposed to vaporized meteoritic oxides). Many of the GLM detected bolides are now understood to be cometary in origin, -7 magnitude and brighter, and belong to meteor showers.

With cometary fireballs in reach of space borne sensors, this makes it possible to determine the composition of potentially hazardous comets, even those that have not yet been discovered. Space borne observations can uniquely measure the elemental abundance of carbon – whose emission lines are absorbed in the lower atmosphere before they can reach a ground-based observer – as well as measurement of other elements. This, in turn, can provide insights into cometary formation dynamics.

A space borne bolide observatory can also probe the composition of small asteroids while they are impacting, and measure the fraction of carbonaceous chondrites among the population of small Earth impactors. It is understood that atmospheric entry results in a strong bias in class statistics for recovered meteorites, with the carbonaceous meteorites underrepresented in the meteorite population due to the presumed fagility of their parent meteoroids. Diagnostic bolide spectroscopy could enable better constraints on the abundance of carbon in the impactor population, facilitating better risk assessments which account for their reduced strength.

This presentation will provide details on the approach for generating simulated spectra, as well as for how those data are synthesized into useful bolometric quantities. Then, we apply this approach to specific events from the GLM data stream. Finally, we propose some concepts for future orbital bolide observation missions which could enable a paradigmatic shift in our understanding of the impactor population

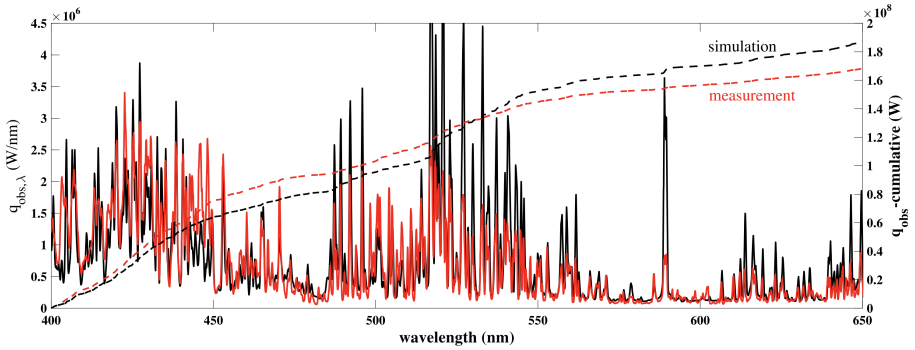


**Figure 1: Comparison of a simulated spectrum with observation for the Benesov bolide [2].**

**Comments:**

*(Could also be in Impact Effects and Consequences session, Poster preferred but can do Oral if better for the program)*

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