

Abstract

Presently, research of meteoroid composition relies almost exclusively on the analysis of meteor emission spectra. Considering the common origin of asteroidal meteoroids and meteorites, such analysis can be advanced by incorporating experimentally obtained meteorite emission spectra into a unified methodology for meteoroid composition estimation. This work introduces a framework based on diagnostic features extracted from emission spectra of meteorite samples of diverse composition and demonstrates its applicability to both individual meteors and large datasets. Applied to the AMOS (All-sky Meteor Orbit System) spectral database, the framework enabled the identification of promising candidates for nearly all major chondrite groups, two achondrites, and five iron meteoroids, and revealed spectra whose atypical properties warrant further modelling. The framework's suitability for large dataset analysis was further demonstrated through hierarchical clustering analysis. Dynamical information, including orbital parameters and the P_E criterion, was incorporated to support the identification of meteoroids with potential carbonaceous origin. Finally, multi-station spectral observations were analysed to assess how observational geometry, instrumental characteristics, and processing procedures influence extracted relative-intensity ratios, underscoring the need to account for these effects in compositional studies. Overall, this work establishes an approach that integrates laboratory data, spectral diagnostics, dynamical constraints, and observational constraints, providing a foundation for a robust meteoroid composition estimation based on the relative intensities extracted from meteor spectra.

Keywords: meteoroids, meteors, meteorites, spectroscopy, emission spectra, AMOS