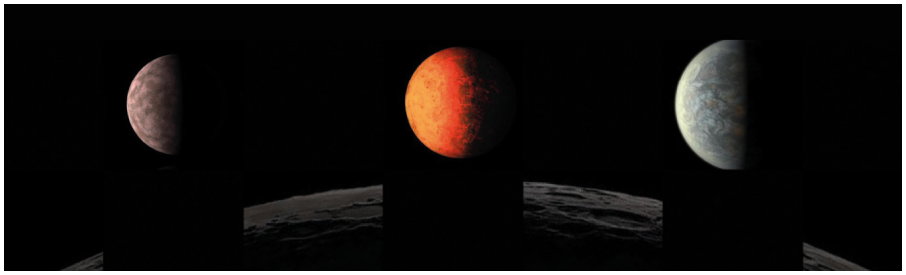

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A new method to evaluate the impact of spectral resolution and irradiation on spectral feature detectability

Friday 24 October 2025 12:30 (1 hour)

Space weathering is a fundamental process that alters the surfaces of airless planetary bodies, modifying their optical, structural and chemical properties, complicating remote compositional interpretation. To support optimized spectral band selection, especially for low-cost CubeSat instruments, the influence of instrumental resolution and irradiation on peak detectability in meteorite spectra was evaluated.

Spectral coarsening was simulated with a C++ code by convolving laboratory reflectance spectra with a Gaussian line spread function. The Gaussian kernel width was set by the desired full-width at half maximum (FWHM), and downsampling was applied at half the FWHM to satisfy the Nyquist criterion. This process was done to smooth the spectrum and reduce the number of data points, replicating the spectra recorded with a lower resolution spectrometer. Peak visibility was quantified using peak area and height within fixed spectral windows centered on known mineral features. The peak area was calculated via trapezoidal approximation, and peak height was defined as the difference between the peak maximum and a flat baseline.

A peak was classified as undetectable when either its area dropped below 25% or its height below 30% of the original value. To statistically characterize resolution thresholds for spectral degradation, Kaplan–Meier survival analysis was applied. Peaks were grouped by mineral type, and the disappearance of a peak was treated as the event in the analysis. The resulting Kaplan-Meier graphs indicate how feature visibility declines with increasing spectral coarsening, and help determine the lowest resolution to detect important mineral features.First results showed that irradiation accelerates peak loss, though major bands of feldspar, pyroxene, and spinel remain detectable at moderate resolution. These findings could define practical limits for mineral identification and guide the design of low-cost IR instruments.

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