# Optical properties of elongated conducting grains

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Extremely elongated, conducting dust particles (also known as metallic 'needles' or 'whiskers') are seen in carbonaceous chondrites and in samples brought back from the Itokawa asteroid. Their formation in protostellar nebulae and subsequent injection into the interstellar medium have been demonstrated, both experimentally and theoretically. Metallic needles have been suggested to explain a wide variety of astrophysical phenomena, ranging from the mid-infrared interstellar extinction at $\sim$ 3–8μm to the thermalization of starlight to generate the cosmic microwave background. To validate (or invalidate) these suggestions, an accurate knowledge of the optics (e.g. the amplitude and the wavelength dependence of the absorption cross sections) of metallic needles is crucial. Here we calculate the absorption cross sections of iron needles of various aspect ratios over a wide wavelength range, by exploiting the discrete dipole approximation, the most powerful technique for rigorously calculating the optics of irregular or nonspherical grains. Our calculations support the earlier findings that the antenna theory and the Rayleigh approximation, which are often taken to approximate the optical properties of metallic needles, are indeed inapplicable.