Approximation to the diffraction limit of three-dimensional shapes using the scaling approach

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A scaling approach for understanding features such as power laws and cross over points of the light scattered in the diffraction or $m \to 1$ limit, where m is the relative index of refraction, is presented. The scaling approach is a semi-quantitative approach to describing the behavior of the structure factor of an arbitrary collection of scatterers, be it a dense three-dimensional particle, fractal aggregate or a collection of scatterers within a scattering volume [1,2]. The focus here will be on single three-dimensional orientationally averaged homogenous particles. In the scaling approach instead of considering the particle itself as being rotated, it is instead the scattering wave vector q that can take on all possible directions. Instead of being a vector, q can be thought of as a spherical region with radius q^{-1}. We show that for three-dimensional shapes such as hexagonal columns, spheroids, cylinders, and square columns the average behavior, power laws, and cross over points of the structure factor can be described by a single parameter ϵ which is the aspect ratio of the shape.

References

[1] Oh, C., and Sorensen, C. M., 1999: Scaling approach for the structure factor of a generalized system of scatterers. *J. Nanoparticle Res.* **1**, 369–377.

[2] Sorensen, C. M., Oh, C., Schmidt, P. W., and Rieker, T. P., 1998: Scaling description of the structure factor of fractal soot composites. *Phys. Rev. E* **58**, 4666–4672.

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