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Packing Nonspherical Particles: All Shapes Are Not Created Equal[1]

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Over the past decade there has been increasing interest in the effects of particle shape on the characteristics of dense particle packings, since deviations from sphericity can lead to more realistic models of granular media, nanostructured materials, and tissue architecture. It is clear the that the broken rotational symmetry of a nonspherical particle is a crucial aspect in determining its resulting packing characteristics, but given the infinite variety of possible shapes (ellipsoids, superballs, regular and irregular polyhedra, etc.) it is desirable to formulate packing organizing principles based the particle shape. Such principles are beginning to be elucidated; see Refs. 1 and 2 and references therein. Depending upon whether the particle has central symmetry, inequivalent principle axes, and smooth or flat surfaces, we can describe the nature of its densest packing (which is typically periodic) as well as its disordered jammed states (which may or may not be isostatic). Changing the shape of a particle can dramatically alter its packing attributes. This tunability capability via particle shape could be used to tailor many-particle systems (e.g., colloids and granular media) to have designed crystal, liquid and glassy states.

[1] S. Torquato and F. H. Stillinger, "Jammed Hard-Particle Packings: From Kepler to Bernal and Beyond," *Rev. Modern Phys.* **82**, 2633 (2010).
[2] Y. Jiao and S. Torquato, Communication: "A Packing of Truncated Tetrahedra That Nearly Fills All of Space and its Melting Properties," *J. Chem. Phys.* **135**, 151101 (2011).

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