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Mean-field theory of random close packings of axisymmetric particles LIN BO, Levich Institute and Physics Department, City College of New York, and The Graduate Center, CUNY, ADRIAN BAULE, Levich Institute, City College of New York, and School of Mathematical Sciences, Queen Mary University of London, ROMAIN MARI, LOUIS PORTAL, Levich Institute, City College of New York, HERNAN MAKSE, Levich Institute and Physics Department, City College of New York — Finding the optimal random packing of non-spherical particles is an open problem with great significance in a broad range of scientific and engineering fields. So far, this search has been performed only empirically on a case-by-case basis, in particular, for shapes like dimers, spherocylinders and ellipsoids of revolution. Here, we present a mean-field formalism to estimate the packing density of axisymmetric non-spherical particles. We derive an analytic continuation from the sphere that provides a phase diagram predicting that, for the same coordination number, the density of monodisperse random packings follows the sequence of increasing packing fractions: spheres $<$ oblate ellipsoids $<$ prolate ellipsoids $<$ dimers $<$ spherocylinders. We find the maximal packing densities of 73.1% for spherocylinders and 70.7% for dimers, in good agreement with the largest densities found in simulations. Moreover, we find a packing density of 73.6% for lens-shaped particles, representing the densest random packing of the axisymmetric objects studied so far.

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