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Confocal measurements of emulsions leading to a statistical model for frictionless, polydisperse packings

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We use confocal microscopy to image a frictionless, polydisperse emulsion in 3D. Using a deconvolution technique we determine the position and radius of every droplet. This information allows us to calculate the network of nearest neighbors and the local packing fraction around each droplet. Additionally, we exploit an enhanced fluorescence at the points of droplet contacts to determine the contact network. Based on our observations we build a simple statistical model in which the complexity of the global packing is distilled into a local stochastic process. We show that, locally, the packing problem may be reduced to the random assembly of nearest neighbors, followed by a random choice of contacts among them. Our model is based on only two parameters, the available solid angle around each particle and the ratio of contacts to neighbors, which are both directly obtained from experiments. We find that this "granocentric" view captures the essential properties of the polydisperse emulsion packing, ranging from the microscopic distributions of nearest neighbours and contacts to local density fluctuations and all the way to the global packing density. This model suggests a general principle of organization for random packing.