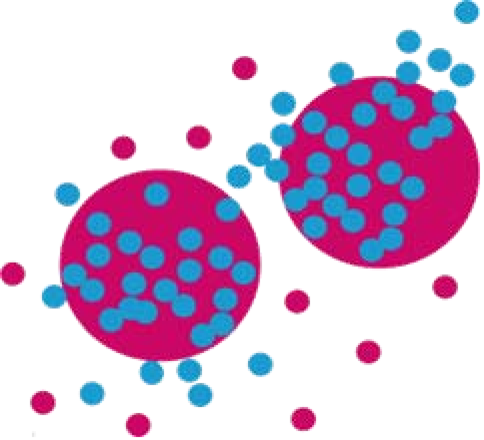


CU Physics Department Colloquium

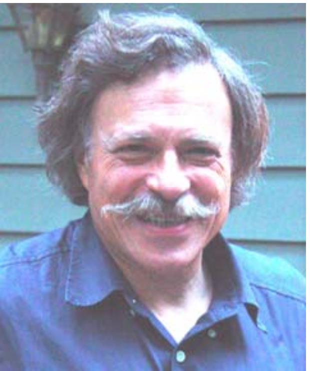
Monday, February 5, 2007 - 4:10 PM - 428 Pupin Hall

Experiments with Colloids and Candies

Packing problems, how densely objects can fill a volume, are among the most ancient and persistent problems in mathematics and science. For equal spheres, it has only recently been proved that the face-centered cubic lattice has the highest possible packing fraction f ~ 0.74. It is also well-known that the corresponding random (amorphous) jammed packings have f ~0.64. The density of packings in lattice and amorphous forms is intimately related to the existence of liquid and crystal phase and is responsible for the melting transition. The densest phase is the thermodynamically stable one. If we could find an object that packs better randomly than crystalline it would never crystallize – an ideal glass.

What about squashed spheres - ellipsoids? They can pack more densely; up to f ~0.68 - 0.71 for spheroids with an aspect ratio close to that of M&M's^Ò Candies, and even approach f ~0.75 for general ellipsoids. We suggest that the higher density relates directly to the higher number of degrees of freedom per particle. We support this claim by measurements of the number of contacts per particle Z, obtaining Z ~10 for our spheroids as compared to Z ~ 6 for spheres. We have also found the ellipsoids can be packed in a crystalline array to a density, f ~.7707 which exceeds the highest previous packing.

Experiments with anisotropic particles and interactions, specific interactions and entropy also illustrate some of the interesting ways that colloids can be made to order, assemble and replicate.



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