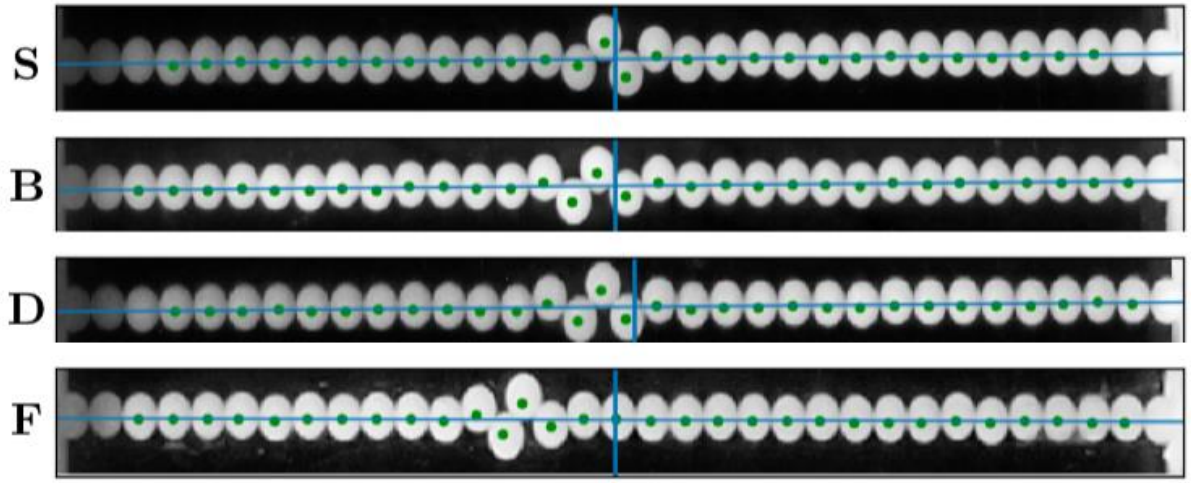
Equilibrium configurations of hard spheres in a cylindrical harmonic potential

J. Winkelmann[1], A. Mughal[2], D. Weaire[1] and S. Hutzler[1]

1 School of Physics, Trinity College Dublin, The University of Dublin, Ireland
2 Department of Mathematics, Aberystwyth University, Wales, U.K.

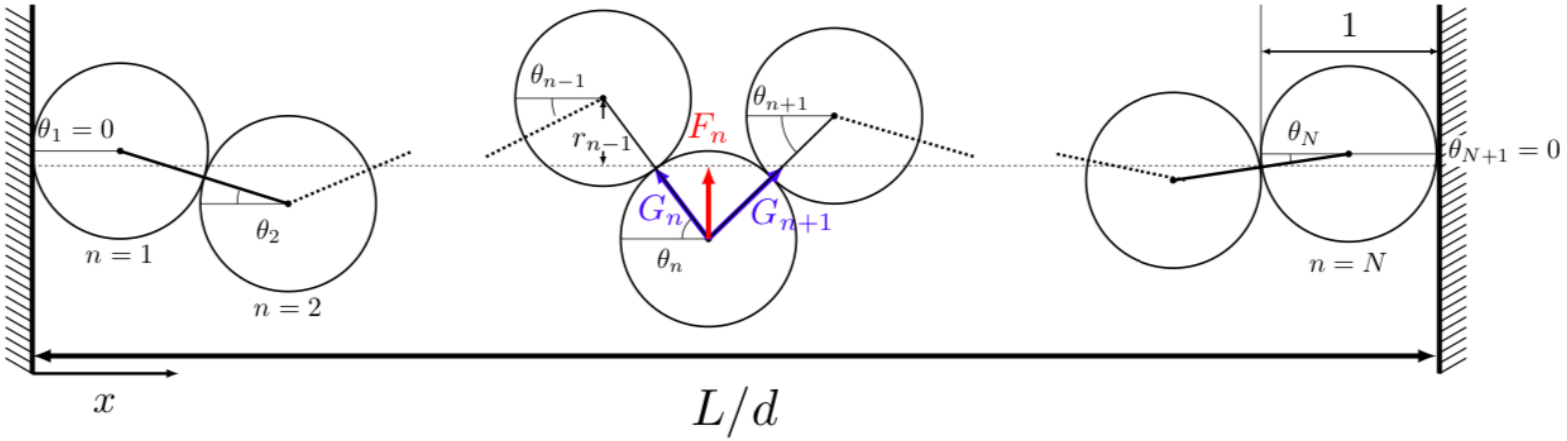


L = tube length
d = sphere diameter
N = Number of spheres

A line of hard spheres confined by a transverse harmonic potential, with hard walls at its ends, exhibits a variety of buckled structures as it is compressed longitudinally.

The types of structures observed depends on the compression, which we define as

$$\Delta = (Nd - L)/d = N - L/d$$



"Shooting Method"

$$\theta_{n+1} = \arctan\left(\frac{F_n}{G_0} - \tan\theta_n\right),$$

$$F_{n+1} = \sin\left[\arctan\left(\frac{F_n}{G_0} - \tan\theta_n\right)\right] - F_n$$