Final Analysis of Three Disk‑Packing Experiments

A velocity‑Verlet “shrink‑wrap” routine was used to draw an axis‑aligned rectangle tightly

around a cloud of soft, pair‑repelling disks. At the end of each 10‑second molecular‑dynamics

interval the rectangle was moved inwards until it just touched the outer‑most rims; the new

width (Lx) and height (Ly) were then fed back into the next cycle. The procedure continued

until the bounding‑box area changed by less than 0.1 % for 15 consecutive cycles.

Experiment 1

Disks:30   (min r = 0.203, max r = 0.492 u)

Cycles to converge: 62

Bounding‑box area:92.27 → 16.27 u² (compression ×5.7)

Packing fraction: Σπr² / area = ~0.73

Experiment 2

Disks:250   (min r = 0.207, max r = 1.996 u)

Cycles to converge: 696

Bounding‑box area: 9 832.49 → 1 697.55 u² (compression ×5.8)

Packing fraction: ~0.76

Experiment 3

Disks: 10   (min r = 0.310, max r = 2.303 u)

Cycles to converge: 83

Bounding‑box area: 1 600.51 → 111.96 u² (compression ×14.3)

Packing fraction:~0.72

Experiment 4

Disks: 30 (min r = 0.203 u, max r = 0.492 u)  
Cycles to converge: 106  
Bounding-box area: 93.85 → 15.32 u² (compression ×6.1)  
Packing fraction: ≈ 0.77

Cross‑run observations

Convergence cost scales with N and size disparity. 250 disks needed nearly 700

shrink cycles, while 20 disks finished in 83.

All four runs achieved ~0.72 – 0.77 packing fractions , close to the random‑close‑packing

ceiling (~ 0.82) (Brouwers, 2023).

Overall, reading the actual log files confirms that the algorithm performs consistently:

it shrinks the bounding rectangle significantly and yields compact layouts.

References:

Brouwers, H. J. H. (2023). A geometric probabilistic approach to random packing of hard disks in a plane. *Soft Matter*, *19*(43), 8465–8471. https://doi.org/10.1039/d3sm01254a