

Hard Disk Gas

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1 Problem

We discussed a hard sphere gas. For this question consider a 2D hard **disk** gas.

1.1 Part 1

Derive an expression for the entropy of a hard disk gas. The N hard disks of radius r are in an $L \times L$ box.

1.2 Part 2

Derive an equation of state for the gas.

1.3 Part 3

Modify the provided code to simulate a gas of hard disks.

1.4 Part 4

Write a subroutine to calculate the temperature at incremental times. Comment on the temperature fluctuations. Why does the gas behave this way.

1.5 Part 5

How many disks should you use? How many time steps should you measure over? What size box did you use? What disk radius? What mass?

If the simulation is done at room temperature with particles which have atomic weight of $40g/mol$ and radii of 4\AA , what is the time in seconds between your measurements?

2 Part 6

What is the pressure? Compare this to the theoretical value you derived in Part. 2.

2.1 Part 6

Over many time steps, measure the speed distribution and the density distribution (in one direction).