Exercise 1, TFY4235 Computational physics

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Introduction

The goal of this exercise is to simulate particles as flat, hard disks in a square, 2D container. This is done with a event-driven simulation, as described in the exercise [1]. This is implemented in Python, using the built-in library heapq. The simulation is used to first tested with scenarios we know the outcome of, then used to demonstrate the Maxwell-Boltzmann distribution and to investigate the effect of a large, heavy disk hitting a large number of small, inert particles.

Implementation

The main engine of the code is the function `run_loop()` in `utillities.py`. It follows the algorithm, as laid out in [1], using the objects:

- `particles`, a numpy array with the position and velocity of all the particles.
- `collisions`, a priority queue containing the time of the collision, the index of the particle(s) involved, and the type of collision it is.
- `last_collided`, a list of when each particle was involved in a collision.

To be expanded ...

Tests

Several functions were developed to test the accuracy of the simulation. First, one particle, starting at in the middle of the box, all the way to the left, and with a velocity with at 45° to the x-axis should move in a titled rectangle. With $\xi = 1$ it should also conserve energy.

References

[1] TFY4235 Computational Physics Exercise 1, 2021. Institutt for fysikk.

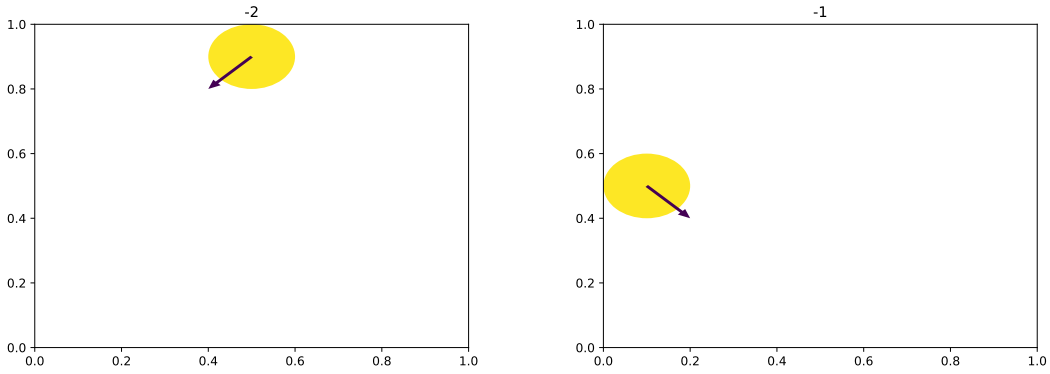

Figure 1: One ball being simulated. after 10000 steps, it still follows a regular pattern.