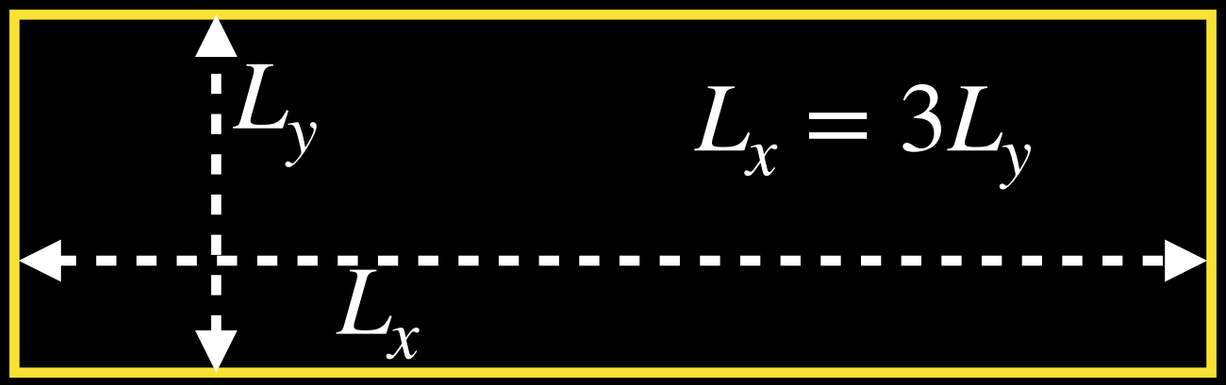
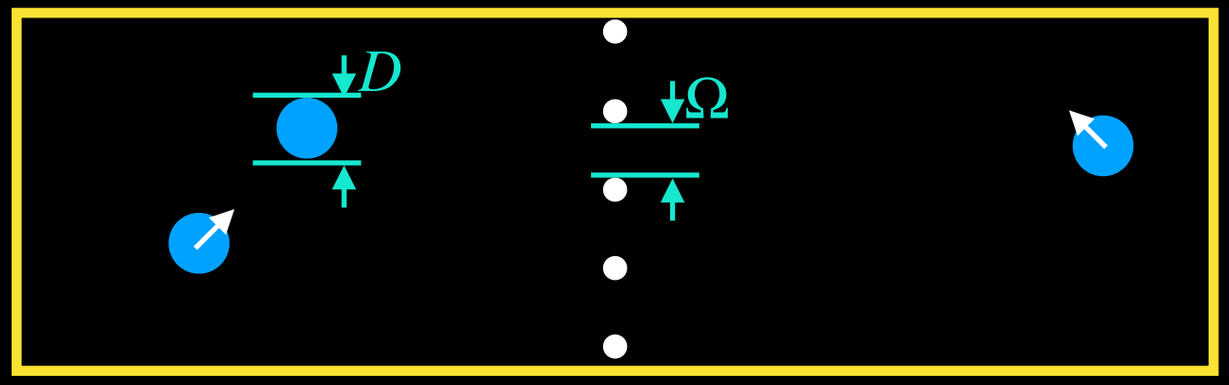
Project 4) Velocity filter

Choose an elongated box as shown in the picture below.



Place a vertical chain of infinitely heavy, but small particles inside the box (white particles in the following figure). The gap between those particles Ω should be variable.



We consider that those heavy particles do not move $v_x = v_y = 0$, but they interact with the other particles via elastic collisions.

Task: Chose an initial configuration, where all blue particles are on the right side of the white particle chain. Measure the time to reach the equilibrium steady state (equal density on right and left side) as a function of the particle spacing Ω. What it the minimal Ω to reach equal densities on the right and left? (You know the theoretical value, but does this value exists in practice ?)

Note: It is not necessary, that one and the same code does everything. You can write several codes, which do one specific measurement.

Project 4)

Now we consider that the white particles are very very heavy compared to the blue particles, i.e. a collision with a blue particle should not change the velocity of the white particles. However, white particles interact with each other and with the walls via elastic collisions.

Furthermore, for the white particles we consider the case $v_x = 0$ at all times, but $v_y \neq 0$. This means Ω is now a function of time.

We consider, that at $t = 0$, white particles are arranged just as shown under b). We can imagine different scenarios for the initialization of the velocities $v_{y,i}(t = 0)$ of the WHITE particles:

- $v_{y,i}(t = 0) = const$
- $v_{y,1}(t = 0) = +c$, $v_{y,2}(t = 0) = -c$, $v_{y,3}(t = 0) = +c$, $v_{y,4}(t = 0) = -c$, ...
- $v_{y,i}(t = 0) = random$

(Take care! Adapt your initial condition, such that you don't have two events at the same time. A little epsilon difference in the spacing or in the velocities might be helpful.)
How does this choice influence the time to reach the steady state, i.e. equal density of blue particles on both sides of the white particle chain.

In the blue particle system: What is the average speed of a blue particle which manages to cross the barrier? How does this compares to the temperature of the system?