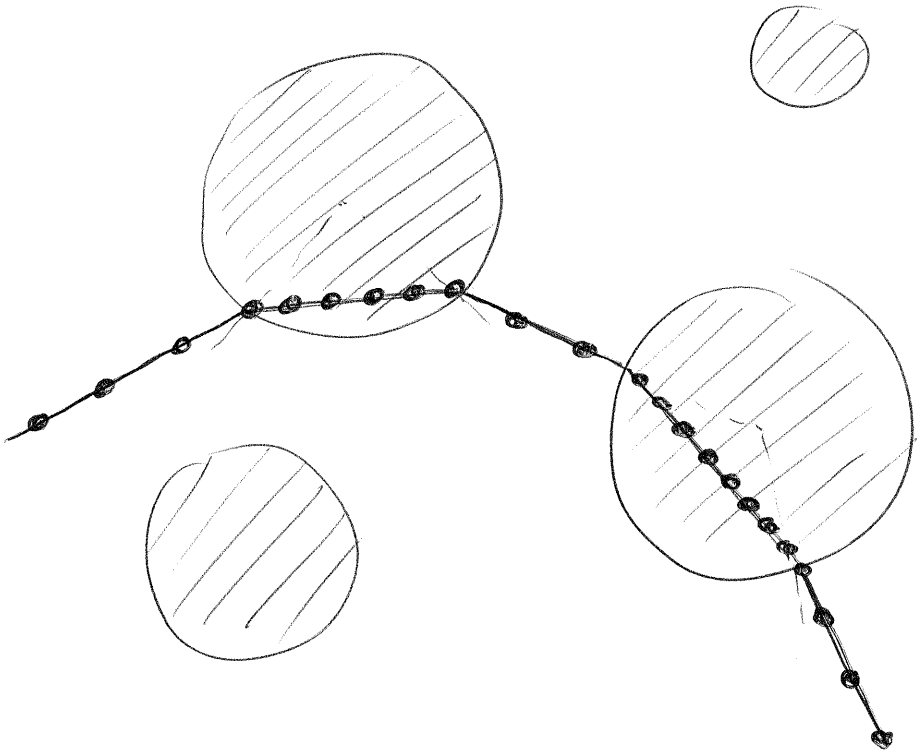
Lecture 33

The different position and velocity states a system can take, given constraints such as the walls of the box or the conserved energy of a gas, we will refer to as "microstates". When asking about the "macrostate", e.g. density, pressure, etc., we usually find ourselves interested in counting microstates. This comes about from the following which we state as a hypothesis even though it can be shown (with difficulty) to follow from the laws of mechanics in simple systems (Sinai's billiards) or (more easily) in quantum mechanics.

"ergodic hypothesis": Over the course of time, a mechanical system will visit all the available microstates with equal frequency.

To convey the power of this hypothesis we will consider a very simple mechanical system involving just one particle moving in a two-dimensional potential that takes only two values. The regions of high potential are circles to simplify the analysis in mechanics, but can be any shape without

changing the conclusions.



Use Snell's law to work out trajectory

inside circles: high potential, low speed v_1

outside circles: low potential, high speed v_2

Question: What is the relative rate the particle visits position states inside vs. outside the circles?