

MA T H E M A T I C A L P H Y S I C S S E M I N A R

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Proving Increasing Disorder and Randomness via Fourier Analysis: On the Foundations of the Second Law of Thermodynamics

Abstract

We study the time evolution of a large Newtonian system (large point billiard system bouncing around in a box container), starting from any explicit “order” (e.g., all point billiards start from the same point, or they are all in the left side half of the box, or the set of starting points forms a regular grid, etc.), and prove quantitative theorems that support the Second Law. We show quantitative results describing how the initial “order” of any explicit starting position, with a typical velocity distribution, grows into increasing “disorder” (in the form of increasing uniformity in the whole box) and exhibits increasing “randomness”.