THINK BIG: STATISTICAL MECHANICS I

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(3/16/2010)

Supplementary Material for

PHY 3305 (Modern Physics)

Harris, Ch. 9.1,9.3,J-8

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- Reminders
- Review of last class
  - Superfluidity
- Park your car and win free stuff!
- Reliable predictions and big numbers

REMINDER

- In-class presentation topics:
  - Deadline: FRIDAY!
  - Consult with me and inform me of your ideas

REVIEW

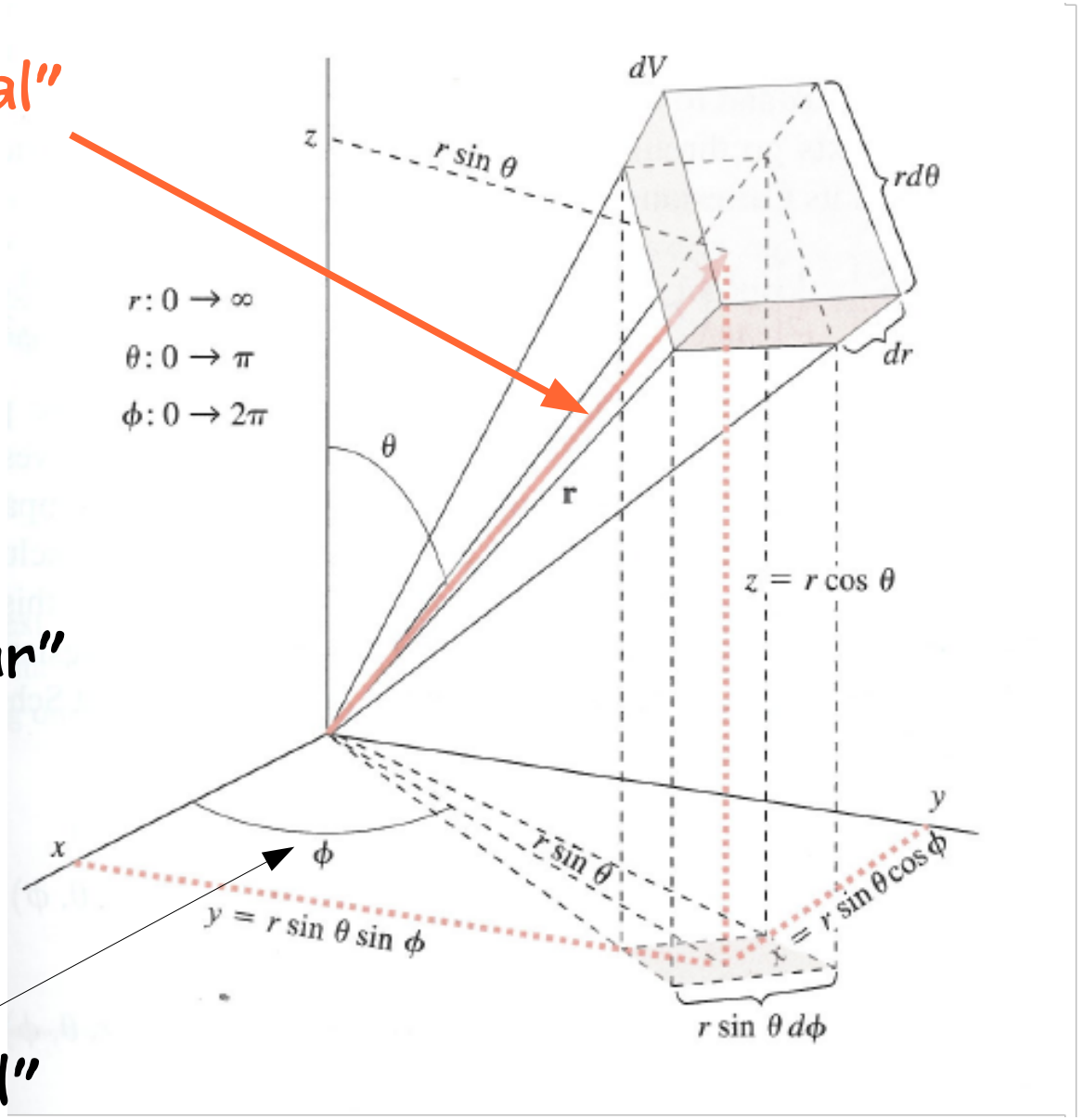
- Review will be more extensive today
  - spin is a key idea going forward
  - let's clear the post-spring-break cobwebs

SPHERICAL POLAR COORDINATES

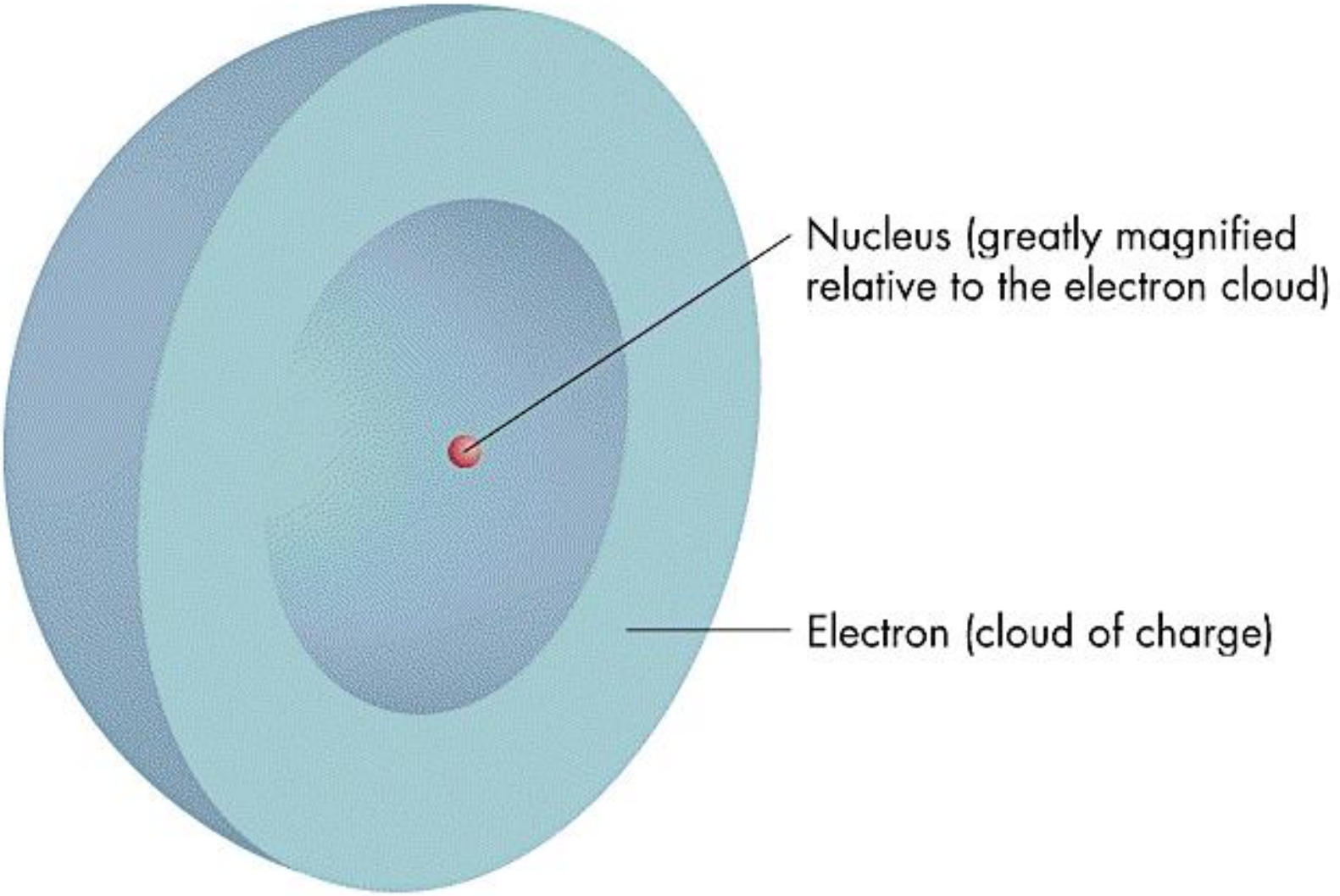
"radial"

"polar"

"azimuthal"

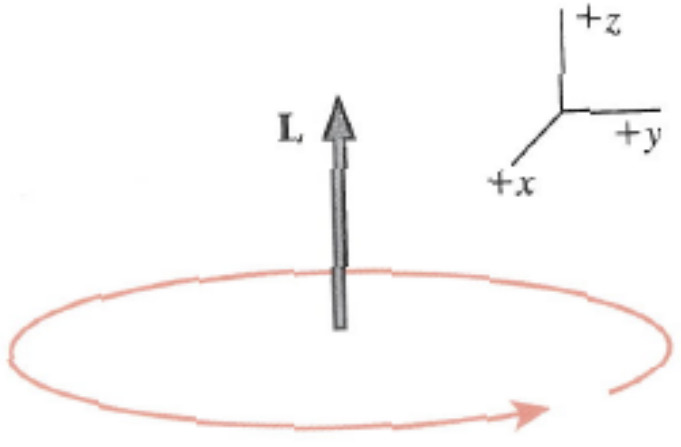


THE HYDROGEN ATOM



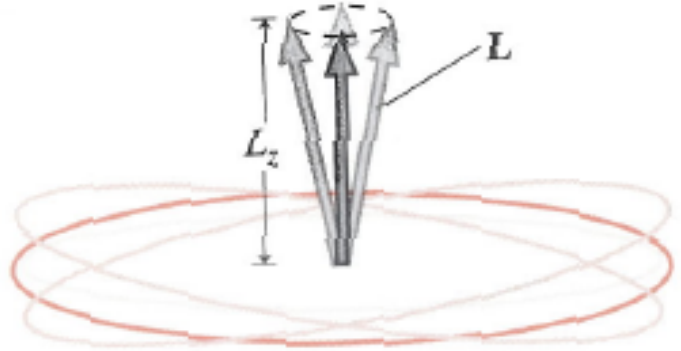
Cross section of a hydrogen atom

VISUALIZING L, L_z QUANTIZATION



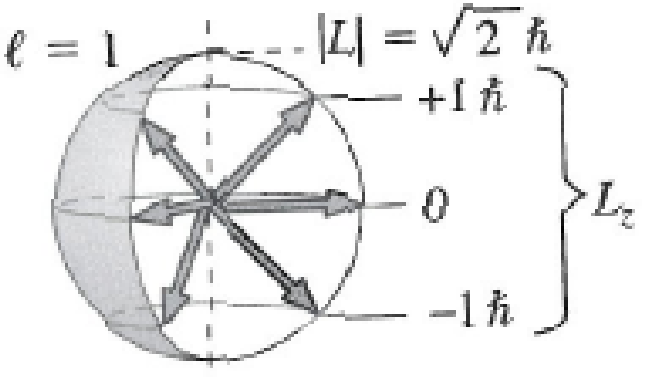
Impossible

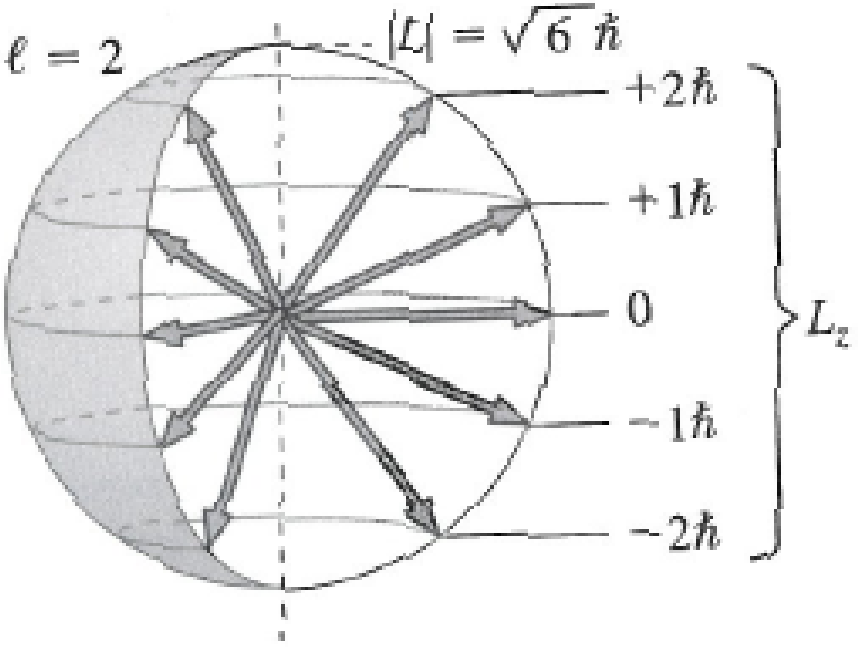
$z = 0$
$p_z = 0$



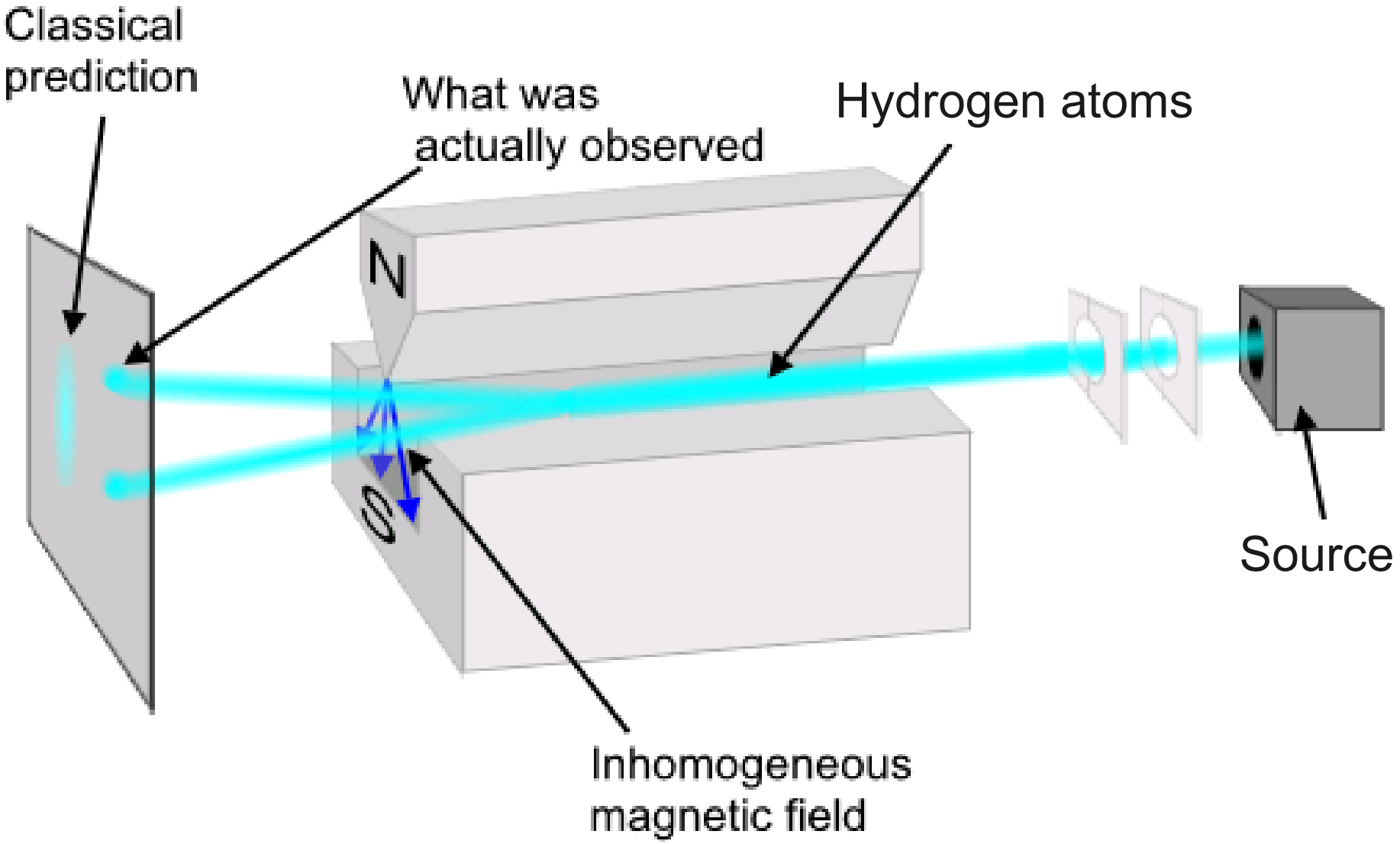
Possible

$\Delta z \neq 0$
$\Delta p_z \neq 0$





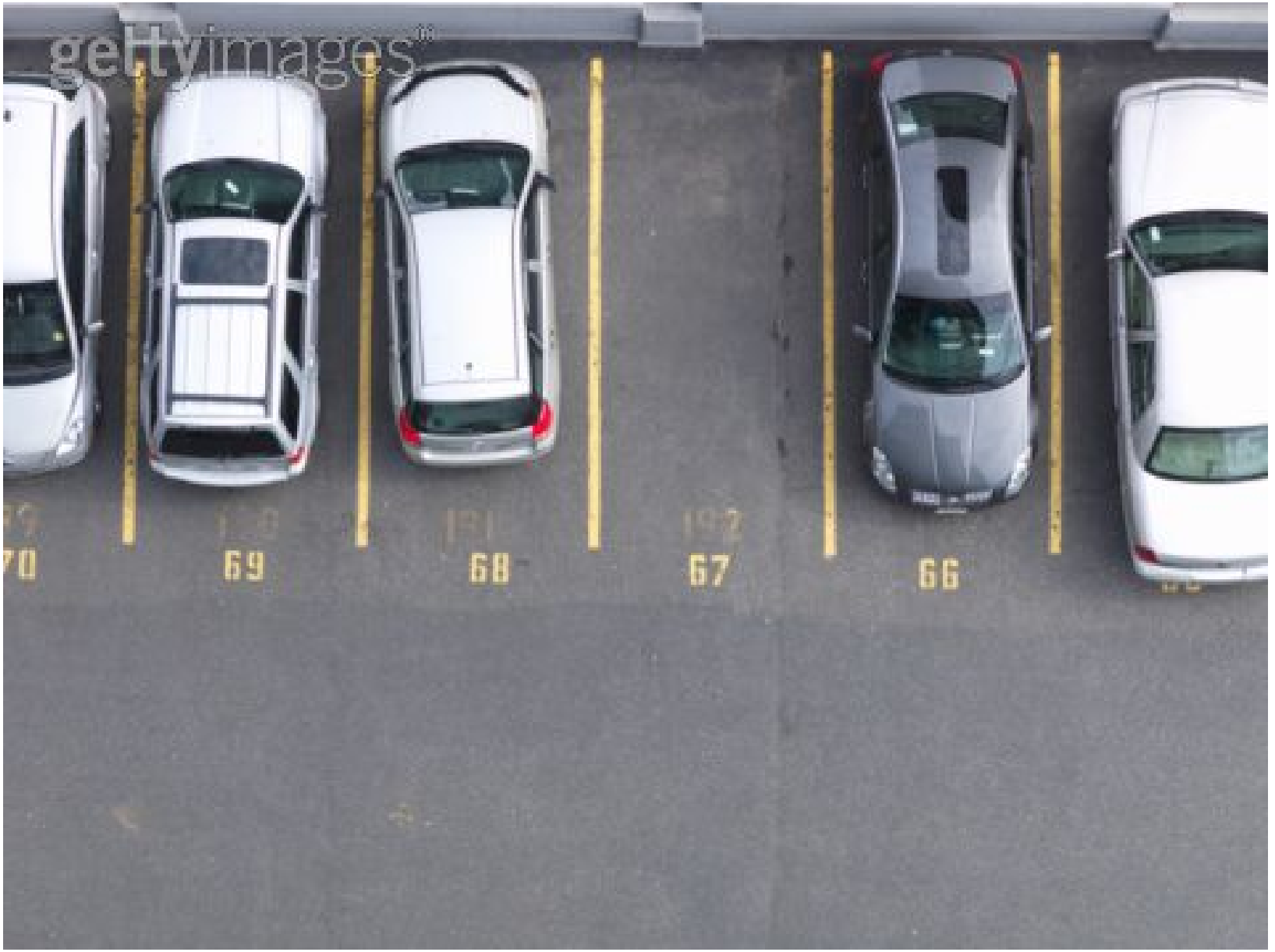
STERN-GERLACH EXPERIMENT



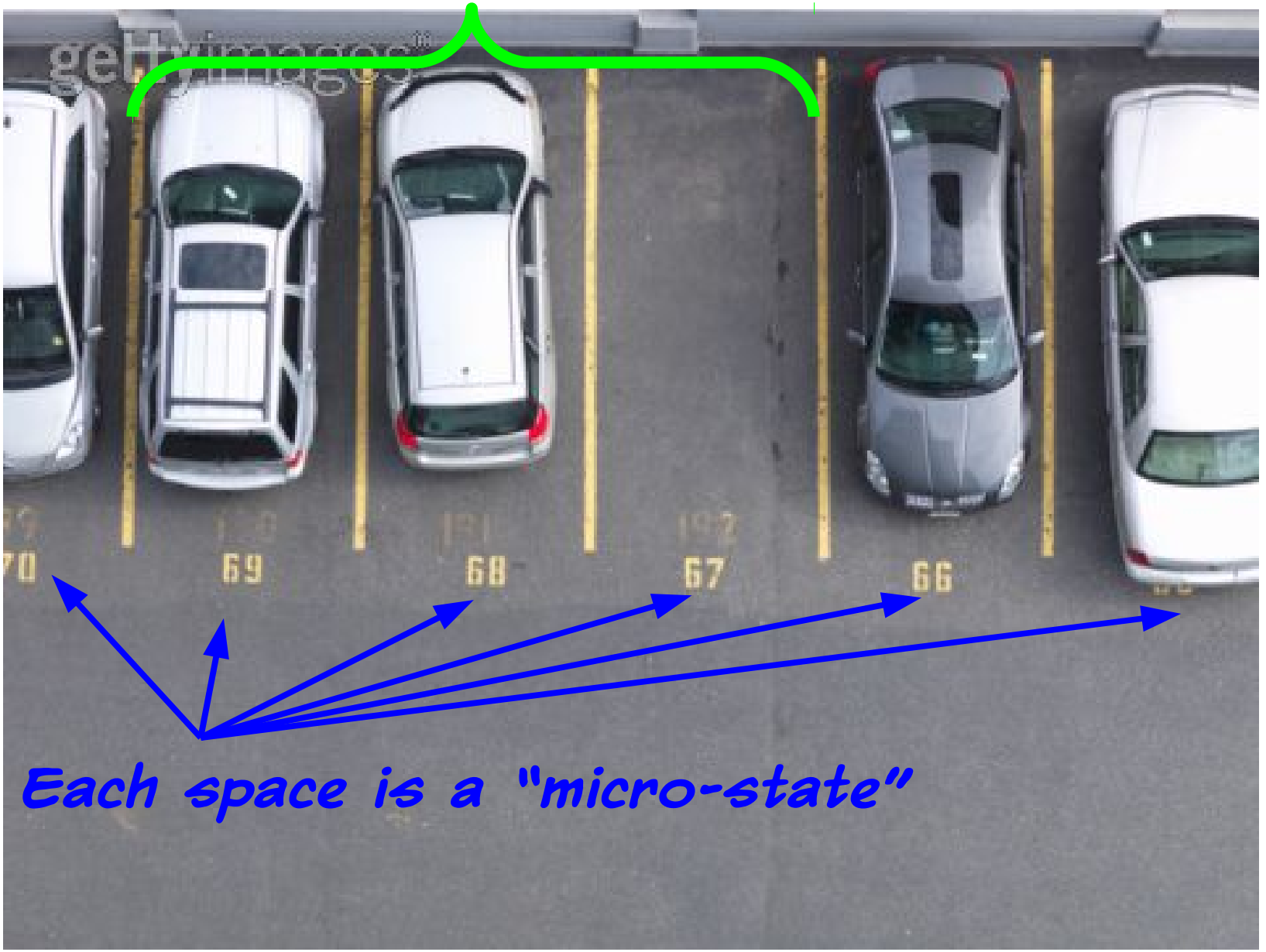
BOSONS AND SUPERFLUIDITY

http://www.youtube.com/watch?v=2Z6LJbwxBZI

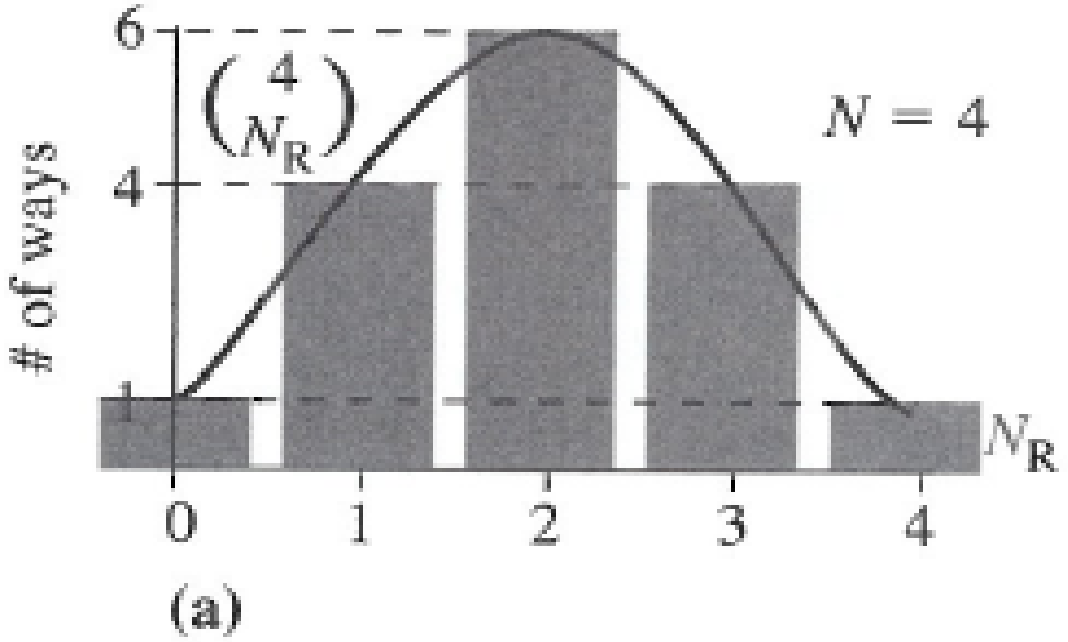
PARK YOUR CAR, WIN FREE COUPONS!

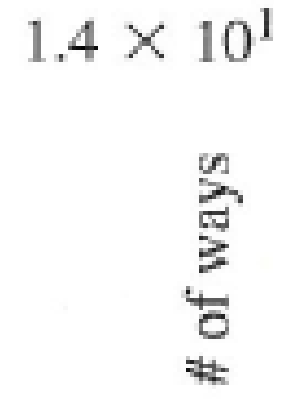


A collection of spaces that achieves the same outcome (e.g. the same coupon winners) is a "macro-state"



RELIABLE PREDICTIONS





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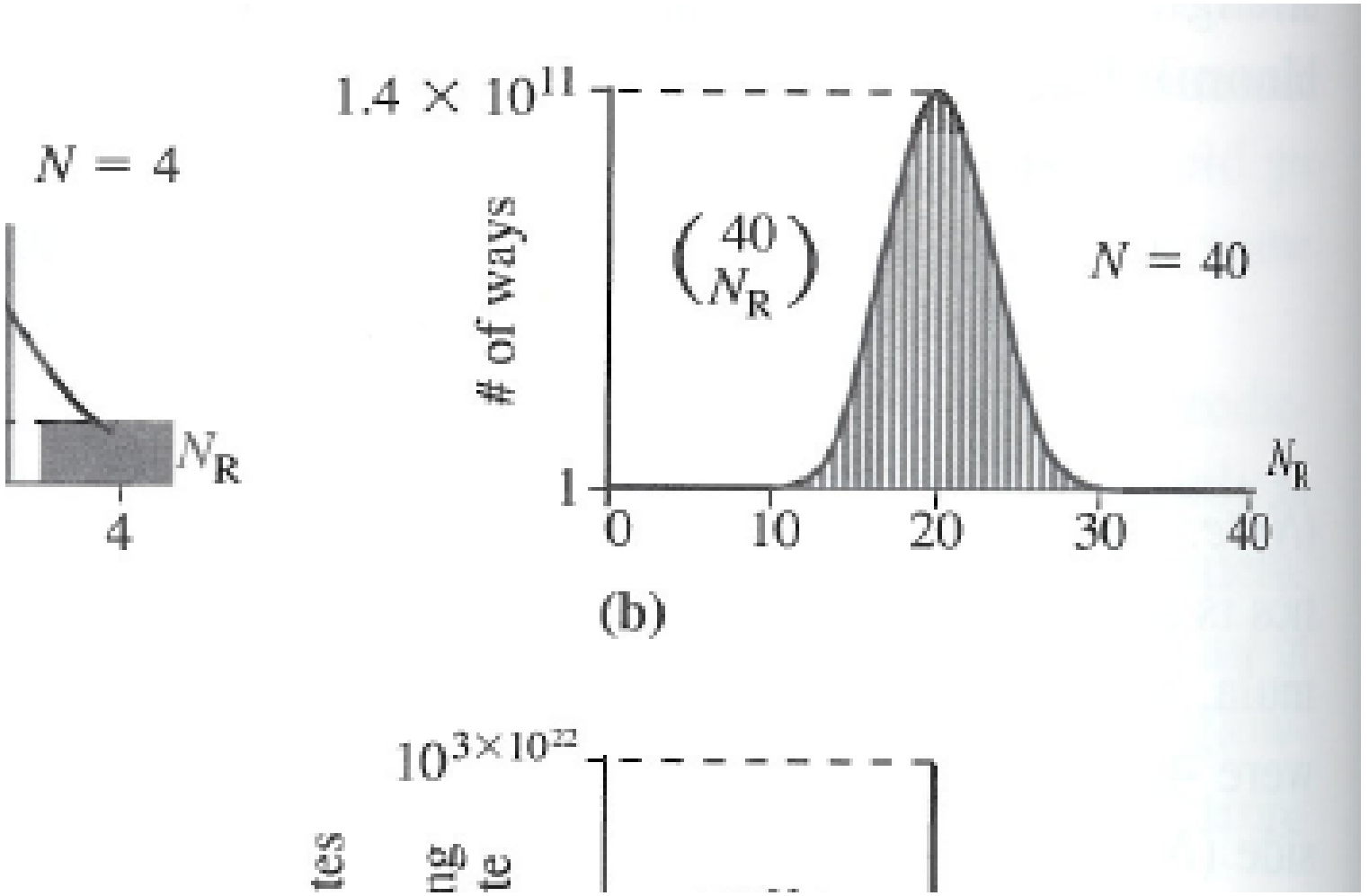

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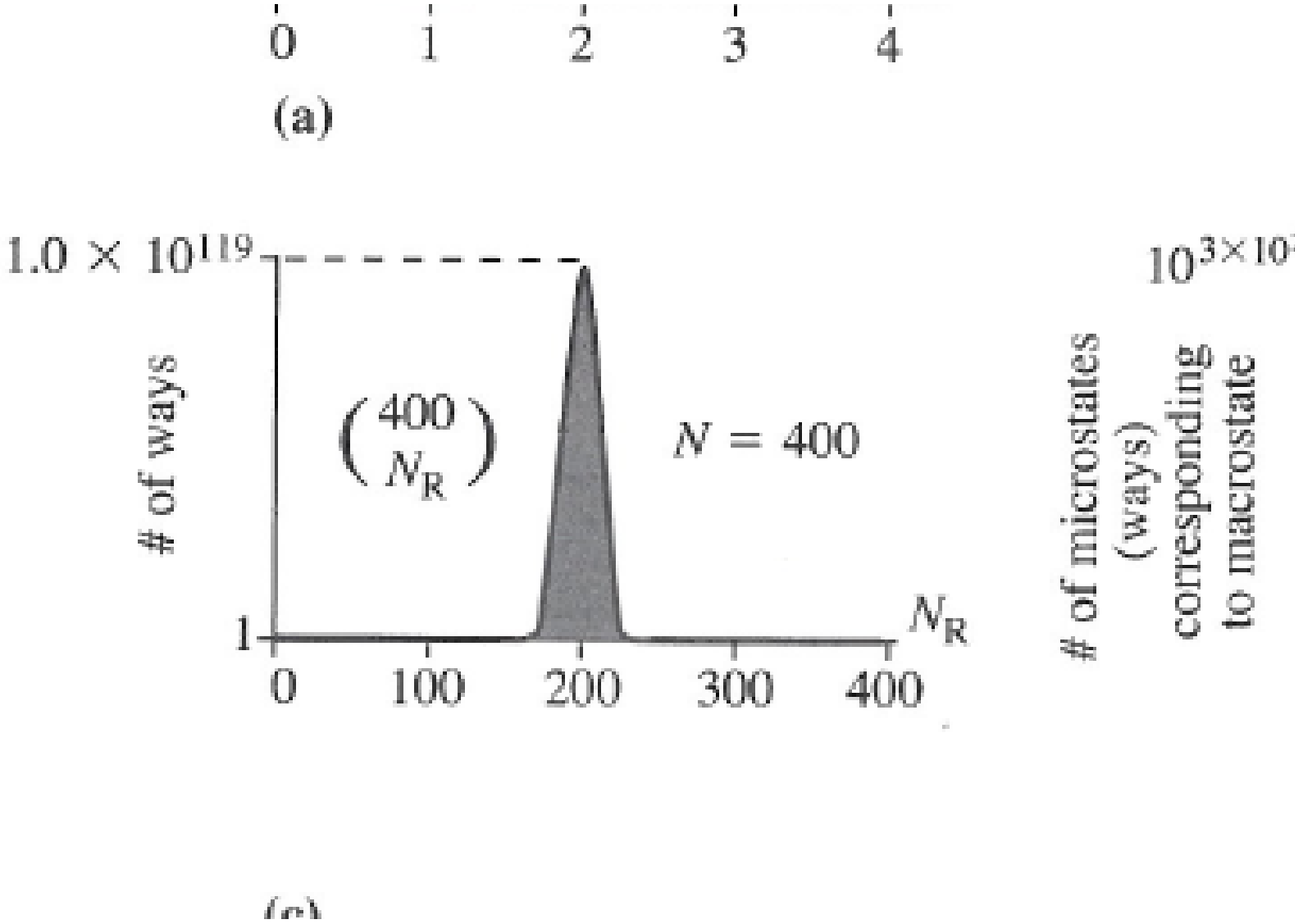

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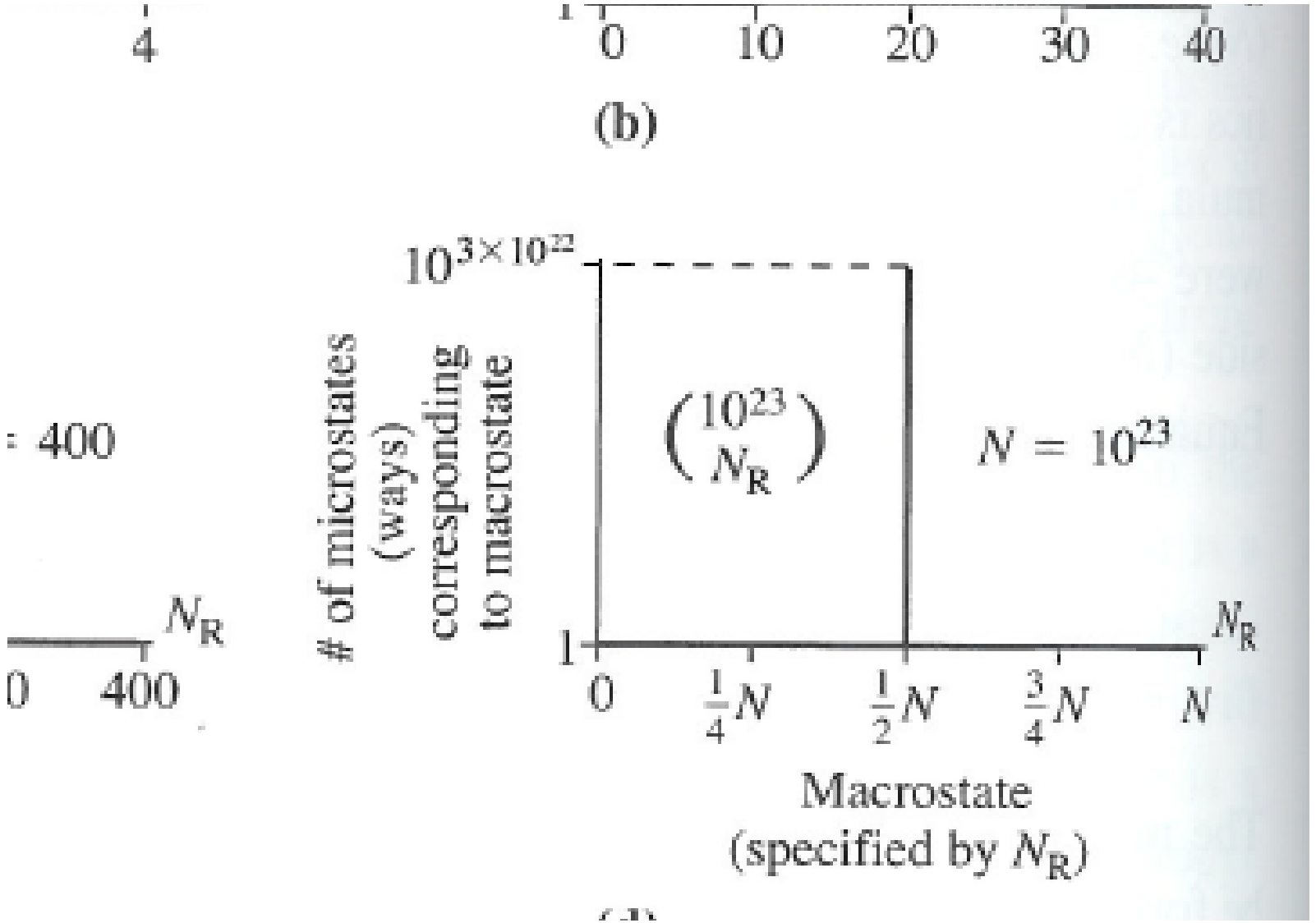

ROADMAP

- Statistical Mechanics
  - or, "what happens when a bunch of particles do stuff"
- Solid-state physics
  - quantum mechanics and the structure of atomic matter
- Nuclear physics
  - quantum mechanics and the structure of the atomic nucleus
- Particle physics
  - quantum mechanics, relativity, and the fundamental structure of the universe

NEXT TIME

- Statistical Mechanics II
  - The Boltzmann Distribution
  - Classical Averages
  - Quantum Distributions
- Reading: Harris Ch. 9.3-9.5