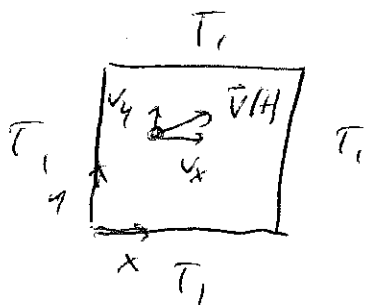


Lec 2

Version 2 ①

I | Plausibility argument for postulate 1 (= the prob. of observing a macroscale system in any one of its available microstates is uniform)

A) CONSIDER A SINGLE PARTICLE (no rotational inertia, no electronic energy states to deal with) in a box having isothermal walls:



B) Assume that the ptcl's ^{nominal} energy remains "fixed" near E_1 and assume that

Lec 2 (2)
 Vers. 2

due to our inability to maintain walls perfectly isothermal and/or due to uncertainty in our measurements of the instantaneous velocity, the ptcl. K.E. (@ any t) satisfies;

$$E_1 - \frac{\Delta E}{2} \leq \frac{1}{2} m (v_x^2 + v_y^2) \leq E_1 + \frac{\Delta E}{2} \quad (2.1)$$

C) Represent (2.1) Graphically;

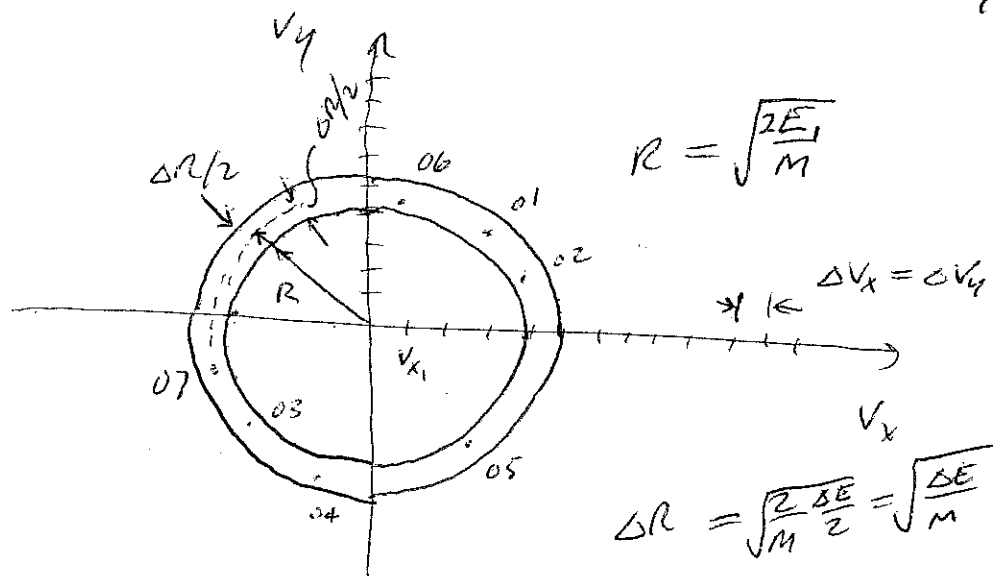


Fig 4

Lec. 2 (3)

Ver 2

NOTE 1: the results of
7 different exp.
observations of
the ptcl's velocity, obtained
at 7 different instants $t_1, t_2, \dots, t_7$,
are shown as of three
or (o = observation),

NOTE 2 From Fig 1, ^{Postulate 1} ~~it~~ seems
eminently ~~pl~~ plausible;
there's no physical reason
to expect that a given
observation of this system's
instantaneous microstate --
represented by $[v_x(t), v_y(t)]$ --
will ~~be~~ not be uniformly
distributed around the
annulus.

— END Plausibility arg for —
Postulate 1

lec. 2 (4)
vers. 2

NOTE 3: From Fig 2, we observe that the number of microstates, Ω , each represented by $[v_x(t), v_y(t)]$ available to the system at a given energy, E , increases w/ E :
proof:

a) $dA = 2\pi R \Delta R$

$$\boxed{dA = 2\pi \sqrt{\frac{2E}{m}} \sqrt{\frac{\Delta E}{m}}} \quad (4.1)$$

(+) since our system uncertainty, ΔE , and ptcl mass, m , are fixed, (4.1) shows that $dA \uparrow$ w/ system energy, E .

b) Since the number of microstates, avail. to
 $\Omega = \Omega(E, N=1, V=V_{Box})$

Let 2 (5)
10/12

Our system is
roughly proportional to
the area, dA , (by simple
inspection of Fig. 1), we
HAVE :

$$\Omega(E, N=1, V_{ex}) \propto \sqrt{E} \cdot \sqrt{\Delta E}$$

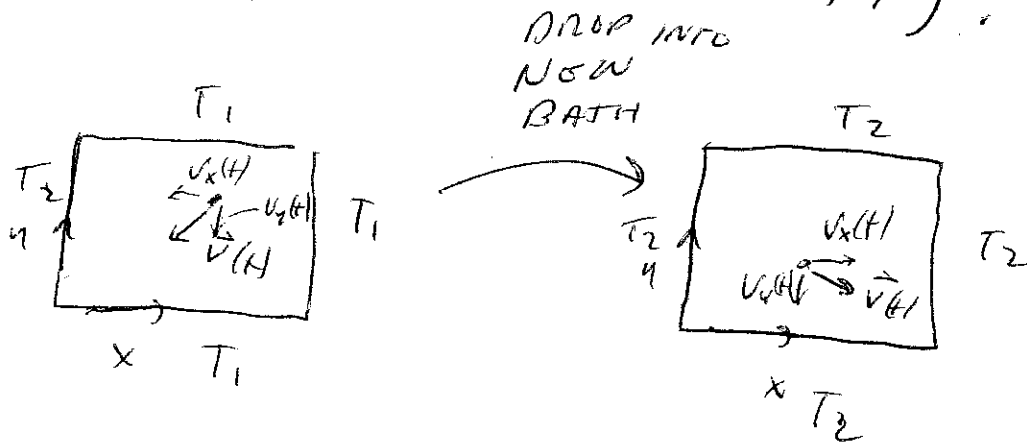
ie., $\Omega \propto E$

end proof

II) PLausibility argument
that supporting Postulate
2 (= AS A ^{scale} MACROSYSTEM
approaches equilibrium,
the no. of microstates, Ω ,
available to the system
goes to a maximum)

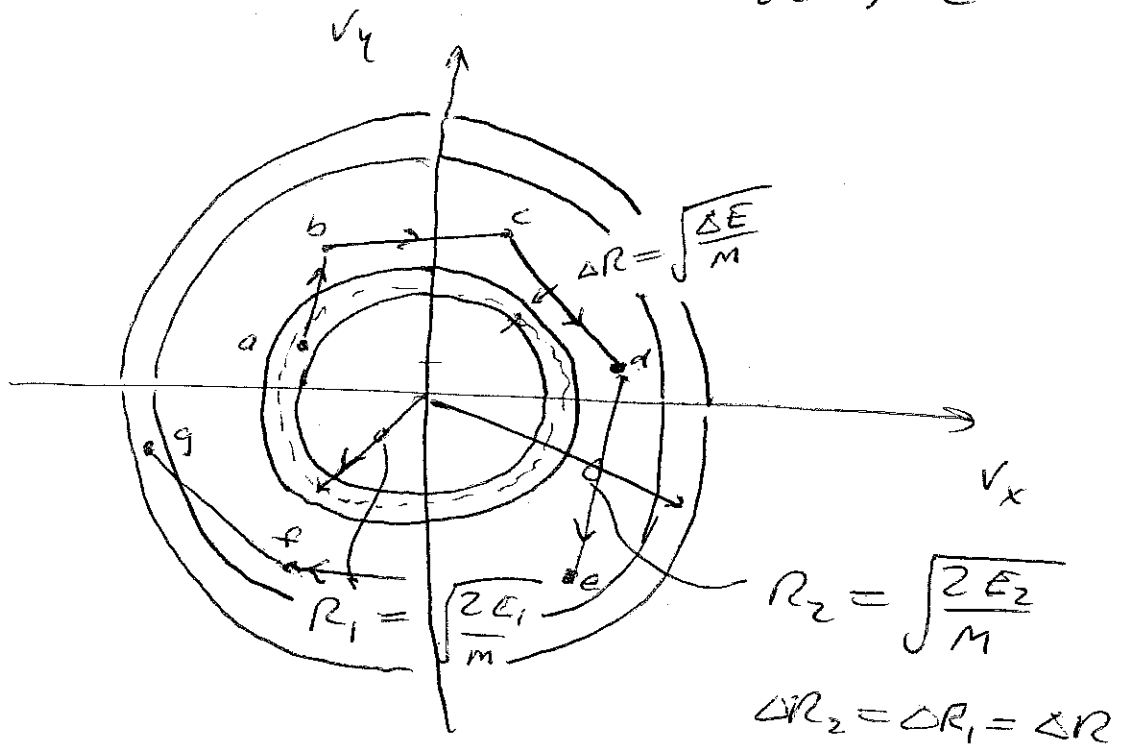
Lec. 2 (6)
Vers. 2

A) CONSIDER SAME
EXPERIMENT, BUT NOW
WE DROP THE BOX
INTO A ^{LARGE} BATH AT
 T_2 (where, for concreteness,
 $T_2 > T_1$; similar arg. can
be used for $T_2 < T_1$):



B) Represent the equilibration
process graphically:

Lec 2
 vers 2 ②



NOTE 1 - The 'path' $a \rightarrow b \rightarrow c \rightarrow d \rightarrow e \rightarrow f \rightarrow g$ represents / corresponds to

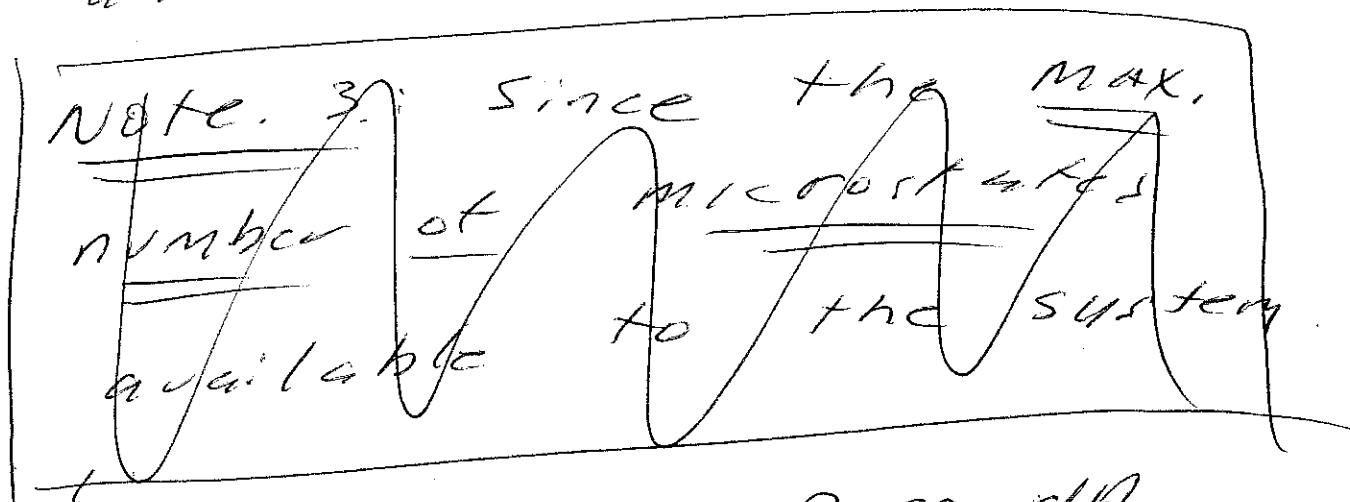
7 sequential observations of the ptcl's instantaneous velocity.

The number of collisions between the ptcl. and the box between any 2 measurements is variable. NOTE TWO the "radius" of each

lec 2
vers 2 (8)

Measurement is increasing.

Note 2: Eventually, as the particle reaches thermal equilibrium it remains stuck in the outer annulus.



Note 3: i) Since $\Omega \propto dA$, and thus Ω ,
and ii) since $dA \propto \frac{1}{E}$,
Both $\propto \frac{1}{E}$, and iii)
Both $\propto \frac{1}{E}$,
Since the EQUILIBRIUM state
for our ptcl. lies anywhere
w/in the outer annulus,
then we've shown that post,
2 is plausible $\Rightarrow$ ~~that~~

Lecl 2 (9)
JCS

The number of microstates
avail to the system
has definitely gone to
its maximum.