

Equilibrium Statistical Mechanics: A khuhhawnna

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Thuhmahruai

Phyics-ah, Kinetic Theory of gas khan hmasawnna tam tak a pe a. Thil (system) tam tak a hrilhfiah a. Tin, atomic scale ang zawng pawhin Drude model (hei pawh hi Kinetic Theory of gas hrin chhuah tho a ni) khan a hun lai chuan thil tam tak a hrilhfiah a. Mahse duhthusam lohna tam tak a nei. Chu'ng zingah chuan *electronic mean square velocity* an chawh chhuah kha a let za dawnin a tlem a. Tin, *specific heat* (volume pangngai rengah), drude model hmanga an chawh chhuah pawh kha 100 laiin a tam leh thung. Chuvang chuan *mathematical concept* hran daih – statistical mechanics hi, atom tam tak awmkhawmna nihna (property) zirna atan mamawh a nih avangin miin an lo hmang uar ta a ni.

Thupuiah lut nghal ang

Kan chhehvela kan thil hmuh tam tak leh physics zirlaibua calculation kan tih tam zawkah hian atom tam tak an awm a. Entirnan: cubic meter khatah hian 10^{28} atom an awm thei a. Physics tawngkam chuan hetiang thil(system) hi *large system* tih a ni thin a. Atom awmzat khi a tam hem hem khawp mai. Drude model khan atom pakhat energy kha a thlur deuh bik tawp a, mahse atom te kha an in kaihnawih (interact) vek mai si a. Chumi avang chuan a dikna tak kan hmu thei ngai dawn lo a ni. An energy a ni emaw engpawhnise an zavai hnathawh avanga lo chhuak chu chhutchhuah kan tum zawk dawn a ni. Chuti ang zawnga calculation tih chu *Statistical mechanics* hmanga zirchianna chu a ni a. He *mathematical concept* hmang hian thil nihphung chu kan bihchiang (generalize) thin zawk a lo ni.

Han sawi chho zel ila

System pakhat: Luma pangngai (*constant T*), hmunluah zawng pangngai(*constant V*) leh chakzawng pangngai (*Constant Energy= 3E*) lo nei ta ila. Volume constant kan neih avangin Energy pawh a hrang (quantize) dawn tihna a ni a. Chu chu a hnuia diagram – ah hian ka entir a.

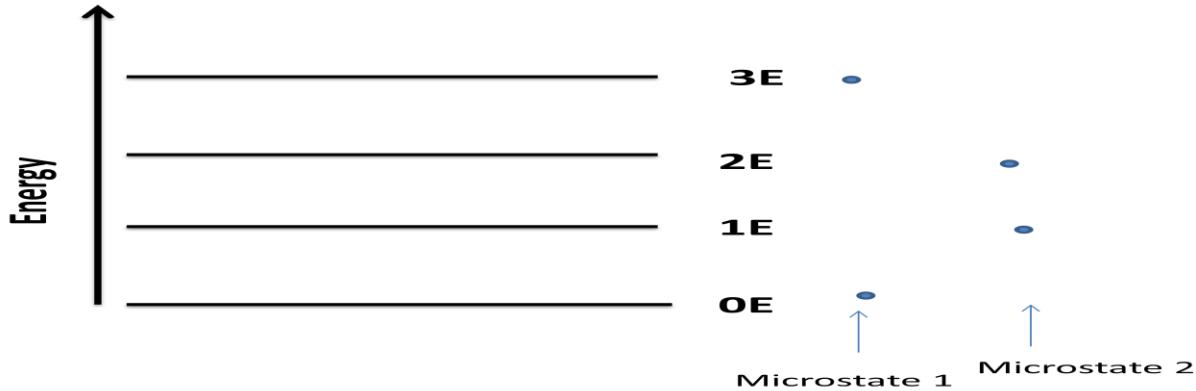


Figure 1: Energy state particle 2 tan

Chuan tunah hian particle (*atom*) awm zat chu 2 emaw 3 emaw 4 emaw lekah lo ngai chhin ta ila. A nih chuan particle ho khian a chunga energy khi an nei dawn tihna a lo ni a. Tin, *Temperature, Volume* leh *Energy* inang reng, danglam ngai lovin state a hrinchhuah kha *thermodynamics* takin *Macrostate* kan ti thin bawk kha a ni a. Partilce 2 chu han la ta ila. A chunga energy an neih khi han hmehbel bawk ta ila, state kan neih hran zawng zawnga kha microstate an tih kha a ni leh a. Chumi awmzia chu microstate khan macrostate a siam tihna a lo ni. A nih chuan particle pakhat kha enrgy 3E nei ta se pakhat zawk chuan enrgy 0E a nei dawn tihna a ni a, chu chu microstate chu a ni. Tin, hetiang lo pawh hian tihdan a awm leh a. Particle pakhat khan energy 2E nei ta sela a dang chuan 1E a nei veleh thung a. Hei pawh hi microstate pakhat dang a ni leh tihna a ni, a chunga diagramah khian chiang takin kan ziak a.

Sawi tawh angin kan system ngaiantuah khian energy 3E chauh a neih avangin particle pahnithe khan an energy chan belhbawm kha 3E a nih ngei ngei a ngai tlat a. Thil pakhat leh chu particlete khi thleng (swap) pawh ni ila microstate khat a ni reng dawn bawk a ni. Amaherawhchu particle kan tih khi a hriathran theih (distinguishable) an nih avangin state pahnih erawh an nei ang. Mathematics takin microstate khatah energy an neih kual dan chu heti ang hian factorial hmangin kan ziak thei a:

$$\text{Microstate (1 leh 2)in Energy neih theih dan} = \frac{2!}{1!1!} = 2 \dots \dots \dots \quad (1)$$

Tin, microstate pakhat zawk energy 2E leh 1E nei pawh khan khitiang tho khian energy a neih theih zat chu pahnih a ni a. Classical Probability hmangin microstate pakhata an awm theihna chance khi 50% ve ve a ni a. Chumi awmzia chu energy 3E leh 0E awm theihna chance chu 50% a ni a, chutiang bawkin energy 2E leh 1E awm theihna chance pawh 50% tho a ni bawk.

Sawifiah chhunzawm zel ang

Tunah hian particle 3 nei leh ta ila. Engtin nge energy kan neih kual theih han en leh chhin phawt teh ang: a hmasa berah chuan energy 3E pakhat nei leh energy 0E pahnihin a neihin a ni a, a dang lehah chuan particle pakhat khan 2E nei se, a a dangin1E nei leh a pathumnaain 0E nei leh

selā, tin atawp berah chuan energy 1E theuh an neihin a dik chiah dawn bawk a. A hnuaiā diagram hi en ta ila:

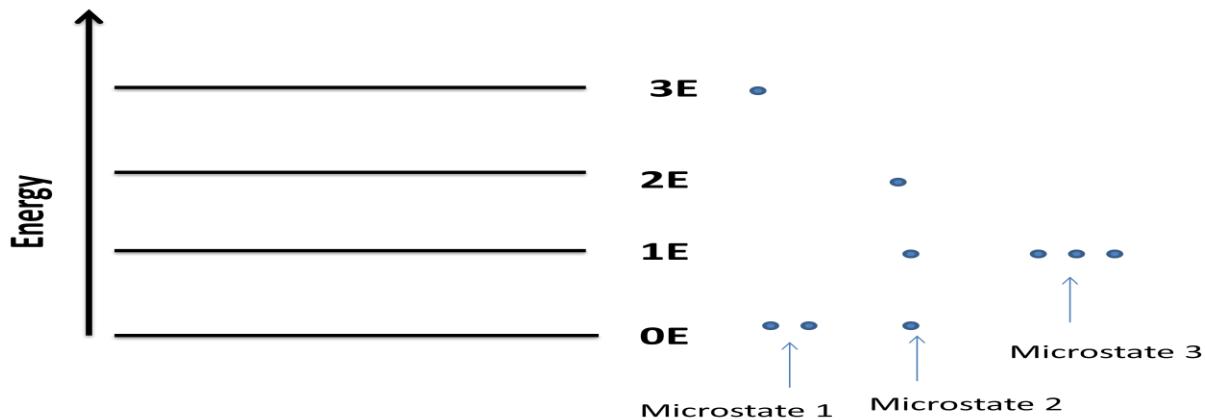


Figure 2: Energy state particle 3 tan

Mathematics takin microstate tinin engtin nge energy an neih theih dan han entir leh ila:

$$\text{Microstate 1 in Energy neih theih dan} = \frac{3!}{1!2!} = 3 \dots \dots \dots \quad (2)$$

$$\text{Microstate 2 in Energy neih theih dan} = \frac{3!}{1!1!1!} = 6 \dots \dots \dots \quad (3)$$

$$\text{Microstate 3 in Energy neih theih dan} = \frac{3!}{3!} = 1 \dots \dots \dots \quad (4)$$

Classical probability hmangin micorstate 1 hian state a neih theina chance chu 30% a ni a, microstate 2 chuan 60%, tin microstate 3 erawh chuan 10% chauh a nei thung a. A nih chuan particle a tam pauh leh a buai (complicate) tulh tulh tihna a lo ni. Microstate 2 khian energy neih theina chance a ngah ber tihna a ni.

Partilce pali tan han ngaihtuah leh chhin ila. Hei hi chu diagram chauhin microstate tinte'n energy state an neih theih dan chu entir tawh mai ila:

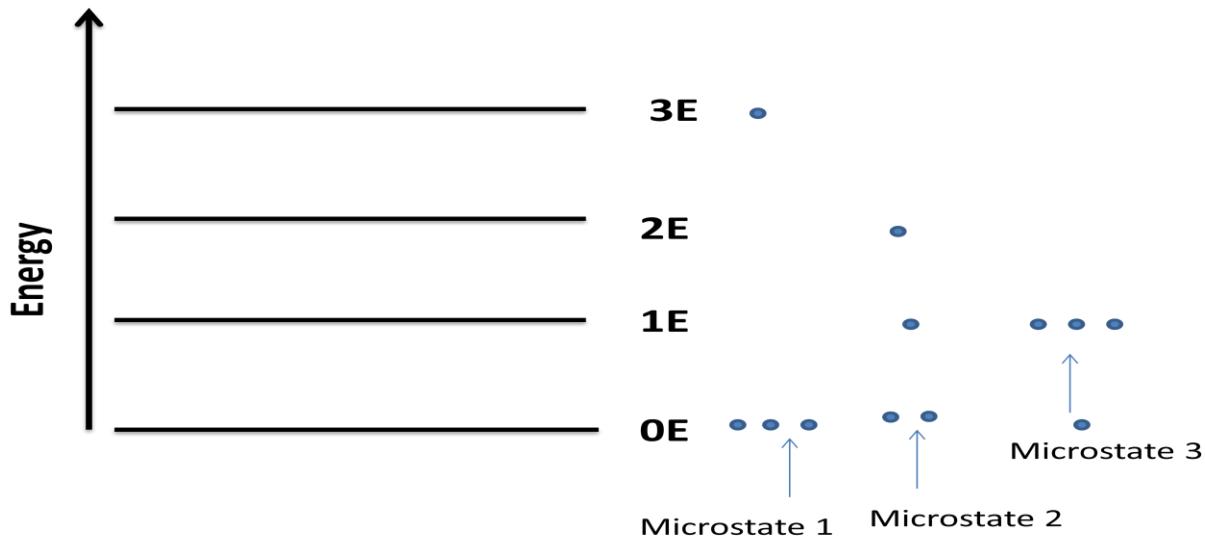


Figure 3: Energy state particle 4 tan

Tin, energy state an neih theih dan pawh hetiang hian a ni a:

$$\text{Microstate 1 in Energy neih theih dan} = \frac{4!}{1!3!} = 4 \dots \dots \dots \quad (5)$$

$$\text{Microstate 2 in Energy neih theih dan} = \frac{4!}{1!2!} = 12 \dots \dots \dots \quad (6)$$

$$\text{Microstate 3 in Energy neih theih dan} = \frac{4!}{3!1!} = 4 \dots \dots \dots \quad (7)$$

A nih chuan classical probability hmang bawkin microstate 1, microstate 2 leh microstate 3 te hian state neih theihna chance 20%, 60% leh 20% tihna a lo ni. A hmasa berah particle pahnih chauh kan ngaihtuah kha chuan energy state an neih theihna chance kha 50% ve ve a ni a. Mahse particle a tam zel khan microstate thenkhat chuan energy state neihna chance an neih sang bik a lo ni. Particle tam zawk kan ngaihtuah phei chuan microstate khatin energy state a neih theihna chance kha a sang filawr zel a, tin microstate chhunga energy state a neih theih dan pawh a sang lawr lak zel dawn tihna a lo ni. A tira kan sawi cubic meter khat biala 10^{28} atom nei thei system tan phei chuan microstate chungnung fal bik awm dawn tihna a lo ni.

Titawp leh phawt mai ang

A sei viau hian miin an chhiar tha duh lo ang tih a hlauhawm riau mai a. Chuvang chuan ka rek bung mai dawn. Mahse chiang tako ka ziah duh chu: system zir chian nana statistical mechanics kan hman reng reng hian particle a tam poh leh state khat awm theihna a sang filawr tulh tulh a. A chunga ka sawi ang khian cubic meter khata 10^{28} atom awm thinah phei chuan state awm thei sang berin state dangte aia a awm theihna chance hi a sang filawr lak a. Chu state chu statistical

mechanics chuan equilibrium state tiin a pawm a ni. A nih chuan particle 3 tan equilibrium state chu microstate 2 a ni anga chutiang zelin particle 4 tan pawh equilibrium state chu microstate 2 a ni dawn tihna a lo ni. Remchang hmasa berah Fermi – Dirac statistics te, Maxwell Boltzmann Statistics te pawh kan la sawiho dawn nia. Mahse he concept hi kan theihngilh loh a ngai ang.