· 例子: 狸想气体				
$E = \sum_{i=1}^{\infty} \frac{\overline{P}_i^{2,*}}{2m}$				
复防止的配级是离散的,但而短河隔至小时,可以先	5通短.			
对左绍条件:KBT>>AE				
计屏蔽分函数:				
$Z = \int \frac{\prod\limits_{i=1}^{N} \alpha^{3} p_{i} \alpha^{3} q_{i}}{h^{3m} N!} \cdot e^{-\beta^{3} \cdot \sum\limits_{i=1}^{N} \frac{\overline{p}_{i}^{2}}{2^{3m}}}$				
$= \frac{\sqrt{N}}{N!  n^{\frac{2}{3}N}} \cdot \left[ \int dp \cdot e^{-\int e^{-\frac{p^2}{24m}}} \right]^{\frac{3}{3}N}$				
$= \frac{\sqrt{N}}{N!  N^{3N}} \cdot \left(\frac{2 \lambda M}{\beta}\right)^{\frac{2N}{N}} = \frac{\sqrt{N}}{N!  \lambda_{1}^{3N}}  ,  \lambda_{1} := \frac{h}{\sqrt{2 \lambda m k_{0}^{2}}}$	· 弘攽长.			
院蠢颖复路上数价异多高密针异 ∑να(E)·e <sup>-pe</sup> ! 虫 这里Λ(E) 芝窖闹予濯漏瓶兔。	茄客用 {Pi.913 たEをG	6出采。		
$\{nZ = N \cdot ln\left(\frac{V}{h^{\frac{2}{3}}} \cdot \left(\frac{2Nm}{6}\right)^{\frac{3}{2}}\right) - N lnN + N$				
$= N \cdot \ln \left( \frac{V}{N} \left( \frac{2\lambda m}{\beta R^2} \right)^{N_0} \right) + N.$ 並为多量:				
(E)=-26 InZ=-N·(-芝皮)= 3NKsT				
$P = \frac{1}{\beta^2} \frac{3}{\delta^2} \ln Z = \frac{N}{\beta} \cdot \frac{1}{V} = \frac{N k e^T}{V} \Rightarrow pV = N k e^T$	<del>1</del> .			
$S = k_{\theta}(\ln z - \beta \frac{\partial}{\partial \beta} \ln z)$				
$= Nk_{B} \left[ \ln \left( \frac{V}{N} \left( \frac{22M}{\beta h^{2}} \right)^{3/9} \right) + \frac{5}{2} \right].$				
• 彻子:二阶级子说				
伊辛诺体 Oi=±1. {Oi3in				
ME EL = - MBOL.				
ZMZ $E = \sum_{i=1}^{L} \Sigma_i = -\mu E \sum_{i=1}^{L} \sigma_i$				
$Z=\sum\limits_{\{\Sigma_i\}}e^{-eta\sum\limits_{i=1}^{K}E_i}$ (对ฬ扬河派性基形)				
$= \sum_{\{\sigma_i\}} e^{\beta_i \mu B} \sum_{i=1}^{\infty} \sigma_i$				
= 〒 THE PARTS (这一多是才包对 2~1及本部	恢复成Nf2政而独)			
$= \frac{N}{N} \left( \sum_{\sigma_{i}=0} e^{\beta \mu B \sigma_{i}} \right) = \left[ 2 \cosh(\beta \mu B) \right]^{N}.$				
lnZ= N·ln(2cosh(βμΒ))				
在力学生:				
$E = -\frac{\partial}{\partial \beta} \ln Z = -N_{\mu}B \cdot \tanh(\beta \mu B)$				
= - NMB :				
$= N \cdot \frac{(-\mu_B) \cdot e^{-(-\beta\mu_B)} + (\mu_B) \cdot e^{-\beta\mu_B}}{e^{-(-\beta\mu_B)} + e^{-(\beta\mu_B)}}$	(B)			
= N-(5).				
八中:(87为年广自旋的年均预量.				
(E) = P+E++P-E-,				
$P_{\pm} = \frac{e^{\mp \beta \mu B}}{z} \qquad z_{:=} e^{\beta \mu B} + e^{-\beta \mu B} \qquad \boxed{48}$	由度配分函数.			
· 泛急: 迳而乍倒子,都是N乍名相互作用的自由在!				
逐种代况下: E= Ž εί.				
$Z = \sum_{\{\epsilon_i\}} e^{-\beta \sum_{i=1}^{\infty} \epsilon_i} = \prod_{i=1}^{n} \left( \sum_{\epsilon_i} e^{-\beta \sum_{i=1}^{n} \epsilon_i} \right) = \sum_{i=1}^{n} \left( \sum_{\epsilon_i} e^{-\beta \sum_{i=1}^{n} \epsilon_i} \right)$	βε: )			
= z^. ⇒ 体8年%面2分五效,另至耳面由床之职!				

「附置与年初配置・(Stoppy Language)"  (E) E*、 為多語近?  着 E 仍 維護:〈E') - 〈E)*、 (記介 〈E') $_{c}$ ( $_{c}$ ( $_{c}$ ( $_{c}$ ) $_{c}$						
着 E 的 排稿: 〈E'〉-〈E〉'、〈 $(? C - 2)$ 〈 $(E) = -\frac{\partial}{\partial R} \ln Z$ . $\frac{\partial^2}{\partial R^2} \ln Z = \frac{\partial}{\partial R} \left(\frac{1}{2} \frac{\partial}{\partial R} Z\right)$ $= \frac{1}{2} \frac{\partial^2}{\partial R^2} 2 - \frac{1}{2^2} \left(\frac{\partial^2}{\partial R} Z\right)^2$ $= \langle E^2 \rangle - \langle E \rangle^2$ $\Rightarrow \langle E^2 \rangle = \frac{\partial^2}{\partial R^2} \ln Z$ $= -\frac{\partial \langle E \rangle}{\partial R}  \left(\frac{\partial}{\partial R} = \frac{\partial}{\partial T} \frac{\partial T}{\partial R} = -k_B T^* \frac{\partial}{\partial T}\right)$ $= k_B T^* \cdot \frac{\partial \langle E \rangle}{\partial T} = k_B T^* C_V \propto N$ .  相对排稿: $\frac{\langle E^2 \rangle}{\langle E \rangle} \sim \frac{\sqrt{N}}{N} = \frac{1}{N} \rightarrow 0 \cdot N \rightarrow \infty$ .  证据等後計事中, $Z \cdot \partial^n$ "移位运输",是"发现"的生成运输, $L_D Z \cdot E_D \cap D_Z$ "中心证", 证证证证						
$\langle E \rangle = -\frac{\partial}{\partial g} \ln Z$ . $\frac{\partial^2}{\partial g^2} \ln Z = \frac{\partial}{\partial g} \left( \frac{1}{2} \frac{\partial}{\partial g} Z \right)$ $= \frac{1}{2} \frac{\partial^2}{\partial g^2} Z - \frac{1}{2^2} \left( \frac{\partial Z}{\partial g} Z \right)^2$ $= \langle E^2 \rangle - \langle E \rangle^2$ $\Rightarrow \langle E^2 \rangle = \frac{\partial^2}{\partial g^2} \ln Z$ $= -\frac{\partial \langle E \rangle}{\partial g} \left( \frac{\partial}{\partial g} = \frac{\partial}{\partial T} \frac{\partial T}{\partial g} = -k_B T^2 \frac{\partial}{\partial T} \right)$ $= k_B T^2 \cdot \frac{\partial \langle E \rangle}{\partial T} = k_B T^2 C_C \propto N$ .  Apply (E) $\sim \sqrt{N} = \frac{1}{\sqrt{N}} \rightarrow 0$ . $N \rightarrow \infty$ .  无证纸等键计 事中, $Z \rightarrow W$ 指征函数", $\mathcal{L}_{C} W$ 证"码主成函数", $L_{D} Z \pm K W$ 是"中小延", 证据证						
$\frac{\partial^{2}}{\partial \beta^{2}} \ln 2 = \frac{\partial}{\partial \beta} \left( \frac{1}{2} \frac{\partial}{\partial \beta} 2 \right)$ $= \frac{1}{2} \frac{\partial^{2}}{\partial \beta^{2}} 2 - \frac{1}{2^{2}} \left( \frac{\partial 2}{\partial \beta} \right)^{2}$ $= \langle E^{2} \rangle - \langle E \rangle^{2}$ $\Rightarrow \langle E^{2} \rangle_{c} = \frac{\partial^{2}}{\partial \beta^{2}} \ln 2$ $= -\frac{\partial \langle E^{2} \rangle}{\partial \beta^{2}} \left( \frac{\partial}{\partial \beta} = \frac{\partial}{\partial T} \frac{\partial T}{\partial \beta} = -k_{B} T^{2} \frac{\partial}{\partial T} \right)$ $= k_{B} T^{3} \cdot \frac{\partial \langle E^{2} \rangle}{\partial T} = k_{B} T^{3} C_{c} \propto N.$ April (E) $\sim \sqrt{N} = \frac{1}{\sqrt{N}} \rightarrow 0 \cdot N \rightarrow \infty$ .  2. the first the law of th						
$ = \frac{1}{Z} \frac{\partial^{2}}{\partial \beta^{2}} 2 - \frac{1}{Z^{2}} \left( \frac{\partial 2}{\partial \beta} \right)^{2} $ $ = \langle E^{2} \rangle - \langle E \rangle^{2} $ $ \Rightarrow \langle E^{2} \rangle_{c} = \frac{\partial^{2}}{\partial \beta^{2}} \ln 2 $ $ = -\frac{\partial \langle E \rangle}{\partial \beta} = \left( \frac{\partial}{\partial \beta} = \frac{\partial}{\partial \gamma} \frac{\partial T}{\partial \beta} = -k_{B} T^{2} \frac{\partial}{\partial \gamma} \right) $ $ = k_{B} T^{2} \cdot \frac{\partial \langle E \rangle}{\partial T} = k_{B} T^{2} C_{c} \propto N. $ $ = \frac{1}{2} \frac{\partial \langle E \rangle}{\partial \beta^{2}} = \frac{1}{2} \frac{\partial \langle E \rangle}{\partial \gamma} = \frac$						
$= \langle E^2 \rangle - \langle E \rangle^2$ $\Rightarrow \langle E^3 \rangle_c = \frac{\partial^2}{\partial \beta^2} \ln 2$ $= -\frac{\partial \langle E \rangle}{\partial \beta} \qquad \left( \frac{\partial}{\partial \beta} = \frac{\partial}{\partial T} \frac{\partial T}{\partial \beta} = -k_B T^2 \frac{\partial}{\partial T} \right)$ $= k_B T^2 \cdot \frac{\partial \langle E \rangle}{\partial T} = k_B T^2 C_V \propto N.$ 相对继统: $\frac{\sqrt{\langle E' \rangle_c}}{\langle E \rangle} \sim \frac{\sqrt{N}}{N} = \frac{1}{\sqrt{N}} \rightarrow 0 . N \rightarrow \infty.$ 记机算统计当中, Z 为"拐拉马敌", 是"笔"仍生成马敌。 $l_D$ Z 主成仍是"中心范"。						
$= \langle E^2 \rangle - \langle E \rangle^2$ $\Rightarrow \langle E^3 \rangle_c = \frac{\partial^2}{\partial \beta^2} \ln 2$ $= -\frac{\partial \langle E \rangle}{\partial \beta} \qquad \left( \frac{\partial}{\partial \beta} = \frac{\partial}{\partial T} \frac{\partial T}{\partial \beta} = -k_B T^2 \frac{\partial}{\partial T} \right)$ $= k_B T^2 \cdot \frac{\partial \langle E \rangle}{\partial T} = k_B T^2 C_V \propto N.$ 相对继统: $\frac{\sqrt{\langle E' \rangle_c}}{\langle E \rangle} \sim \frac{\sqrt{N}}{N} = \frac{1}{\sqrt{N}} \rightarrow 0 . N \rightarrow \infty.$ 记机算统计当中, Z 为"拐拉马敌", 是"笔"仍生成马敌。 $l_D$ Z 主成仍是"中心范"。						
$\Rightarrow \langle E^{2} \rangle_{c} = \frac{3^{2}}{2\beta^{2}} \ln 2$ $= -\frac{3\langle E \rangle}{3\beta} \qquad \left( \frac{\partial}{\partial \beta} = \frac{\partial}{\partial T} = \frac{\partial}{\partial T} = -k_{0}T^{2} \frac{\partial}{\partial T} \right)$ $= k_{0}T^{2} \cdot \frac{\partial \langle E \rangle}{\partial T} = k_{0}T^{2}C_{v} \propto N.$ April 1977						
$=-\frac{\partial(E)}{\partial\beta} \qquad \left(\frac{\partial}{\partial\beta} = \frac{\partial}{\partial T} \frac{\partial T}{\partial\beta} = -k_B T^2 \frac{\partial}{\partial T}\right)$ $= k_B T^* \cdot \frac{\partial \langle E \rangle}{\partial T} = k_B T^2 C_V \propto N.$ 相对辨為: $\frac{\langle \overline{KE} \rangle_C}{\langle E \rangle} \sim \frac{\sqrt{N}}{N} = \frac{1}{\sqrt{N}} \rightarrow 0$ . $N \rightarrow \infty$ .  记识年统计当中, 飞为"拐拉马敌",是"这"仍生成马敌,几尺生成仍是"中心"还						
= kaT* <u>d<e< u=""><sup>2</sup>/<sub>2T</sub> = kaT<sup>2</sup>C<sub>V</sub></e<></u>						
插竹腰鹨;√(E)>2 ~ √N = √n → 0 · N→∞。 无概等统计当中, 乙为"铅红函效",是"延"仍生成函数,ln乙生成仍是"中山延"。 征缓末:						
无极幸统计当中, 乙为"好红马饺", 堤 "矩" 稻生戏马效、ln乙生成稻是"中山延", 征役术。						
无极幸统计当中, 乙为"好红马饺", 堤 "矩" 稻生戏马效、ln乙生成稻是"中山延", 征役术。						
<b>建设式</b> :						
(Tm) , m/d/m,						
$(E^n)_c = (-1)^n (\frac{2}{7^n})^n \ln Z \propto N$ . $IZ = \sum_n e^{-\beta E_n}$ 私概算统计中 <u>疑的生成函数</u> (增强系数) 有相同的数式 $]$						
中心极限处理:						
对于以作档主同分布的P通机建量 {x,3。(x;约均值为0.方差为1)						
$X = \sum_{i=1}^{N} x_i,  \langle X \rangle = N \cdot \langle x \rangle.$						
$\langle X^2 \rangle_c = N \langle x^2 \rangle_c$						
<x">; = N.<x">;</x"></x">						
$P(y) \simeq \frac{1}{\sqrt{22. \frac{\langle x^2 \rangle_c}{N}}} \cdot e^{-\frac{(y - \langle x_2 \rangle)^2}{2. \frac{\langle x_2 \rangle_c}{N}}}$						
[尧]星仍江州用荆了"好性孟叔",按以是说:把 c <sup>in f</sup> 居开,勃更所推0 顶是 - f ⇔ N - x2. N→の可只构造-项3] 【和2哥付铊的" • 勒马取舍" 征相似!]						
レ マー・ウェイトに 40 - 有名と与えた会 - 子もス階(水): ]						

 $\langle X^n \rangle_c = \langle (X - \langle X \rangle)^n \rangle$  $= \left\langle \sum_{k>0}^{n} \binom{n}{k} \times^{k} (-(\times 7)^{n-k} \right\rangle$  $= \sum_{k=n}^{n} {n \choose k} \langle \chi^{k} \rangle (-1)^{n-k} \langle \chi^{n-k} \rangle$ 後 X的均值为0 ⇒中心発 = < x7. (x") & N?  $p(E_n) = \frac{e^{-\beta E_n}}{Z}$ 4= 2xi < x"> x N. f(x).  $F(t) = \int_{-a}^{+a} f(x)e^{itx} dx$ (y) = N.(x) (E) = \frac{1}{2} \Sigma Ene-pEn <42 = 0 = 1 - 3 2 F(+) \( \int\_{-a}^{+a} (-ix)^n f(x) e^{-itx} dx \) (y,)= < = (x;-(x)))  $= N (x^2) + N (x^2)^2 - 2N (x^2)^2$ (E<sup>2</sup>) = Σ(En - (E))<sup>2</sup>e<sup>-βEn</sup>  $= N \left( \zeta \chi^2 7 - \zeta \chi^7 r \right) \propto N.$  $\overline{F^{(n)}(0)} = (-i)^n \langle x \rangle_n$  $\langle E \rangle = \int \Omega(E) dE \cdot e^{-\beta E} \cdot \frac{1}{Z}$ 九阶等. (∑ (x; -<x>)<sup>™</sup> 7 F(B) = \[ \frac{\sigma(E)}{2} e^{-\beta E} dE  $= N \cdot \left(\sum_{k>0}^{n} (-1)^{n-k} \langle x^k \rangle^{\langle x \rangle^{n-k}}\right)$ 3.兔全天至比, 丝征相低,  $(\ell_{y}(t) = \int_{-\infty}^{\infty} f(y) e^{-ity} dy$ 屋职→系职. μ=0. σ=1. E.  $\psi_{E(t)} = \int f(E) e^{iEt} \alpha t$ . Gauss: \ \ e^{\frac{x^2}{2}}e^{-itx}dx  $(f_{x}(t)) = \int_{-\infty}^{+\infty} f(x) e^{-itx} dx.$   $(f_{x}(t)) = \int_{-\infty}^{+\infty} f(x) e^{-itx} dx.$ = \int e - \frac{1}{2} \quad \text{dx e} - \frac{1}{2}  $f(x) dx = f(\frac{2}{N}) d(\frac{2}{N})$   $f(y) = f(x_1) * f(x_2) * \cdots * f(x - \sum x_1)$ => (eg)+) = e-2 > f(×)= N.f(x)  $(\varphi_{2}(k)) = \int_{-\infty}^{\infty} \frac{f(x)}{f(x)} e^{-i\tau \frac{x}{N}} dx \qquad (\varphi_{3}(k)) = (\varphi_{x}(k))^{n}$   $(\varphi_{x}(k)) = \int_{-\infty}^{\infty} \frac{f(x)}{f(x)} e^{-i\tau \frac{x}{N}} dx \qquad (\varphi_{x}(k)) = (\varphi_{x}(k))^{n}$ - 100 (x+i+60)2 - 100 ( (4x(t))"  $\left(1-\frac{t^2}{2N^2}\right)^N \rightarrow \left(e^{-\frac{t^2}{2N^2}}\right)^N \Rightarrow \sigma = \frac{1}{\sqrt{N}}, \ \sigma^2 = \frac{1}{N}.$  $\int \left(1-it\frac{x}{N}-\frac{1}{2}t^2\frac{x^2}{N^2}+O(\frac{1}{N^2})\right)f(x)dx$  $= 1 - \frac{1}{2} t^{2} \cdot \frac{1}{N^{2}} \sigma^{2} = 1 - \frac{t^{2}}{2N^{2}} + O(\frac{1}{N^{2}})$ > y ~ e - ± N y~e-~望e··/ o(小)