VIVEKANANDA COLLEGE
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NAAC ACCREDITED 'A' GRADE

Topic: Calculation of Density of States (https://www.youtube.com/watch?v=vQXlmf0EaHk)

Course Title: Statistical Mechanics

Paper: PHY 423

Unit: 2

Semester: 2

Name of the Teacher: Arvind Pan

Name of the Department: Physics PG

Density of States (DOS) $\Rightarrow g(\epsilon) = \frac{4\pi p^{f-1} dp/d\epsilon}{(2\pi\hbar)^f}$ $\quad f=3$

For free particle: $g(\epsilon) = \frac{1}{(2\pi\hbar)^3} 4\pi (2m\epsilon) \left(\frac{2m}{\epsilon}\right)^{1/2} \epsilon^{-1/2}$

$= \frac{2\pi}{(2\pi)^3 \hbar^3} (2m)^{3/2} \epsilon^{1/2} = \frac{1}{4\pi^2} \frac{(2m)^{3/2}}{\hbar^3} \epsilon^{1/2}$

For rel. particle: $g(\epsilon) = \frac{1}{2\pi^2 \hbar^3} \cdot \left(\frac{\epsilon^2 - m^2c^4}{c^2}\right) \cdot \frac{\epsilon/c}{(\epsilon^2 - m^2c^4)^{1/2}}$

Ultra rel-particle: $= \frac{1}{2\pi^2 (\hbar c)^3} \epsilon (\epsilon^2 - m^2c^4)^{1/2}$

$g(\epsilon) = \frac{1}{2\pi^2 \hbar^3} \frac{\epsilon^2}{c^2} \cdot \frac{1}{c} = \frac{\epsilon^2}{2\pi^2 (\hbar c)^3}$

DOS $g(\epsilon)$	Cases	dispersion relation	$p-\epsilon$ relation dispersion relation
$\frac{1}{4\pi^2} \frac{(2m)^{3/2}}{\hbar^3} \epsilon^{1/2}$	free particle	$\epsilon = p^2/2m$	$\frac{dp}{d\epsilon} = \left(\frac{m}{2}\right)^{1/2} \epsilon^{-1/2}$
$\frac{1}{2\pi^2} \frac{\epsilon(\epsilon^2 - m^2c^4)^{1/2}}{(\hbar c)^3}$	rel. parti	$\epsilon = \sqrt{p^2c^2 + m^2c^4}$	$\frac{dp}{d\epsilon} = \frac{\epsilon/c}{(\epsilon^2 - m^2c^4)^{1/2}}$
$\frac{1}{2\pi^2} \frac{\epsilon^2}{(\hbar c)^3}$	Ultra Relativistic	$\epsilon = pc$	$\frac{1}{c}$

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