









II BSc (Physics)  
DEPARTMENT  
SCIENCE

Max. Probable Speed & The most Probable Speed

Average Speed: The average speed  $\bar{c}$  is the speed of all the particles divided by the total number of particles.

$$\bar{c} = \frac{\int_0^\infty c \, dn}{n} = \frac{\int_0^\infty c \left( \frac{m}{2\pi kT} \right)^{3/2} \exp(-mc^2/2kT) c^2 dc}{n}$$
$$= \left( \frac{m}{2\pi kT} \right)^{3/2} \int_0^\infty c^3 e^{-mc^2/2kT} dc$$
$$= \left( \frac{m}{2\pi kT} \right)^{3/2} \frac{1}{2kT} \left[ \int_0^\infty c^2 e^{-mc^2/2kT} dc \right]$$
$$= \frac{\sqrt{m}}{\sqrt{2\pi kT}} \frac{\sqrt{2kT}}{\sqrt{m}} = \sqrt{\frac{2kT}{\pi m}}$$


(MPCs)

### RMS Speed:-

The square of mean speed is given by

$$\begin{aligned} \bar{c}^2 &= \frac{1}{n} \int_0^\infty n c^2 e^{-\frac{m c^2}{2kT}} dc \\ &= \frac{1}{n} \int_0^\infty n \left( \frac{m}{2\pi kT} \right)^{3/2} c^4 \exp\left(-\frac{m c^2}{2kT}\right) dc \\ &= 4\pi \left( \frac{m}{2\pi kT} \right)^{3/2} \int_0^\infty c^4 \exp\left(-\frac{m c^2}{2kT}\right) dc = \frac{3}{2} \left( \frac{2kT}{m} \right) \end{aligned}$$

Now  $\bar{c}^2 = \frac{3}{2} \frac{2kT}{m}$   
Further  $C_{rms} = \sqrt{\bar{c}^2} = \sqrt{\frac{3kT}{m}}$

Average Speeds: The average speed  $\bar{c}$  is the speed of all





