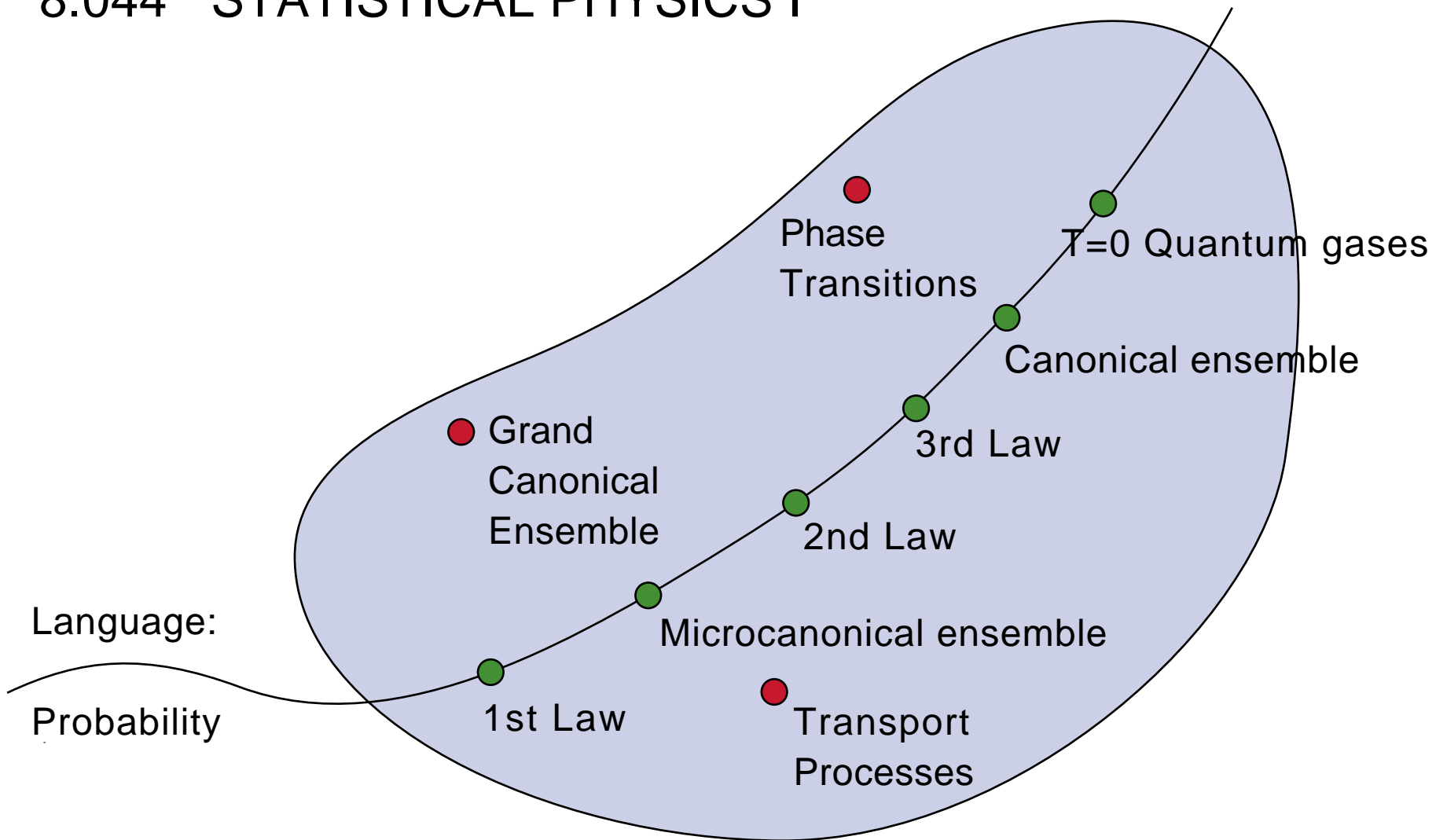


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8.044 Statistical Physics I
Spring 2008

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8.044 STATISTICAL PHYSICS I

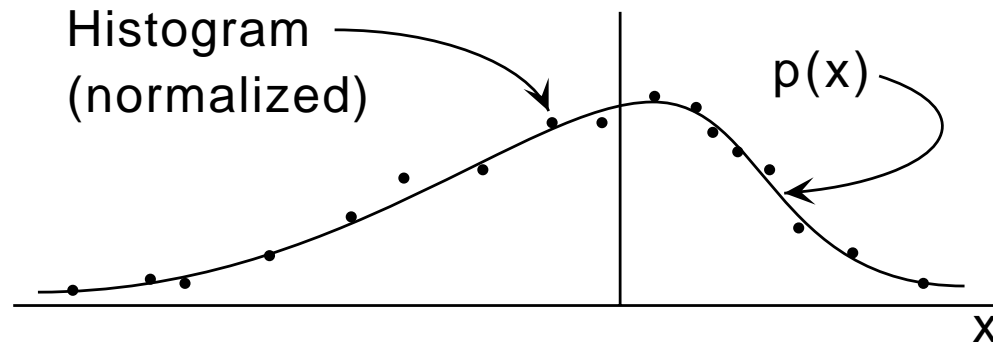


PROBABILITY

Random variable (ignorance and/or QM)

Continuous, discrete, or mixed

Probability density: $p(x) \leftrightarrow p_x(\zeta)$



$$\text{PROB}(\zeta \leq x < \zeta + d\zeta) = p_x(\zeta)d\zeta$$

$$\Rightarrow p_x(\zeta) \geq 0,$$

$$\int_{-\infty}^{\infty} p_x(\zeta) d\zeta = 1,$$

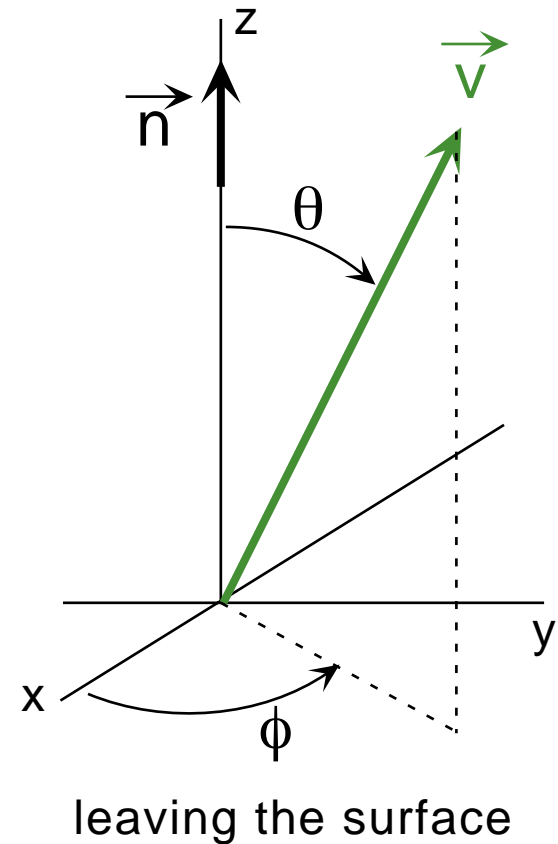
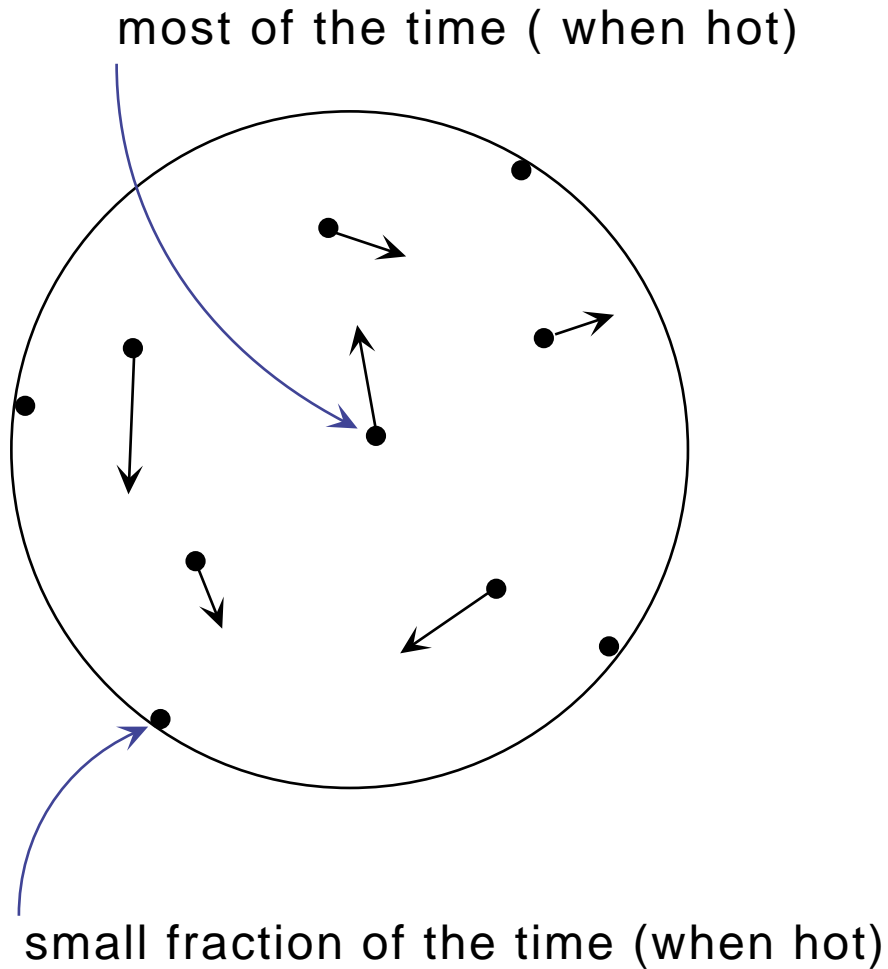
$$\text{PROB}(a \leq x < b) = \int_a^b p_x(\zeta) d\zeta$$

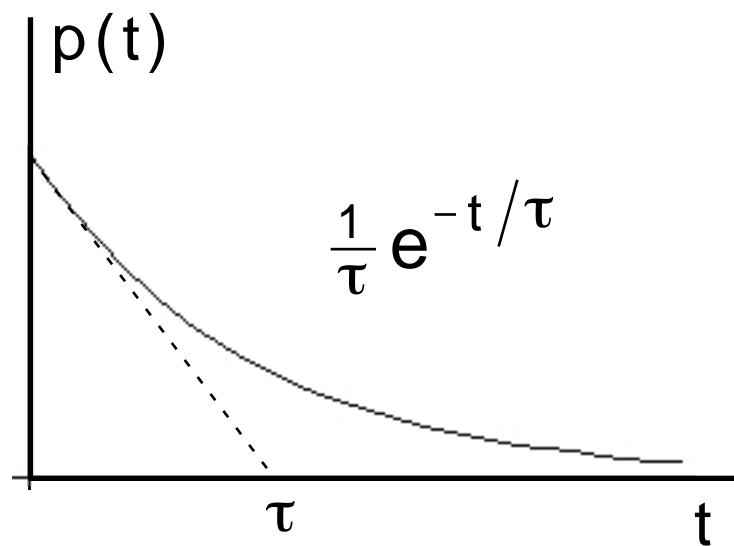
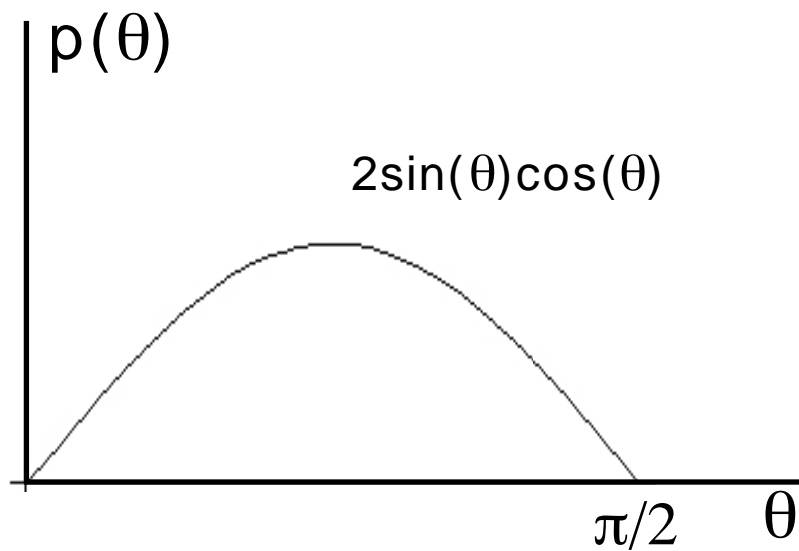
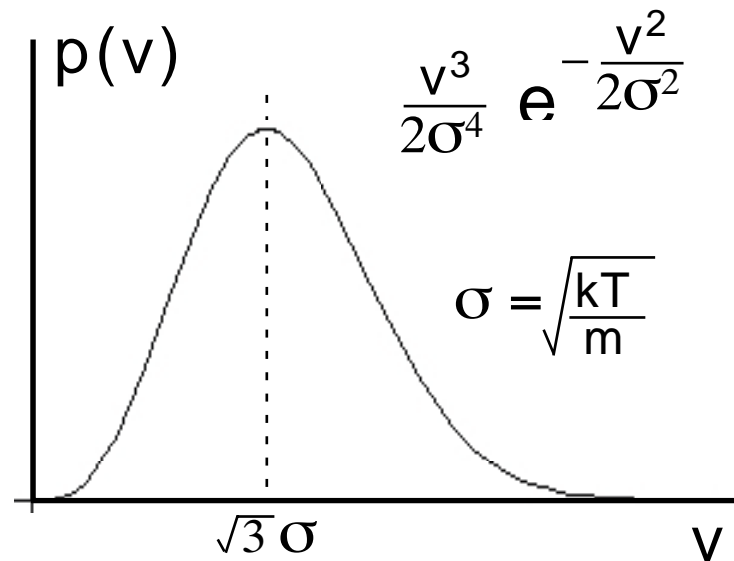
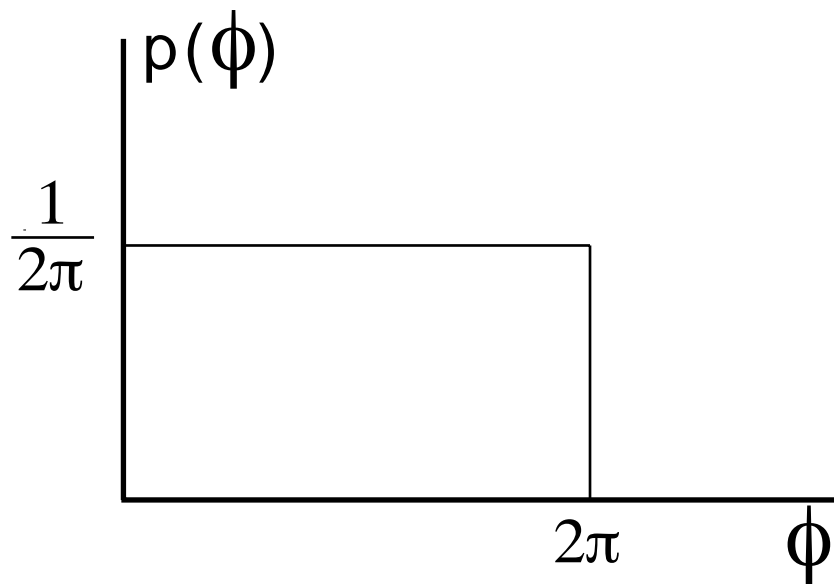
Cumulative probability:

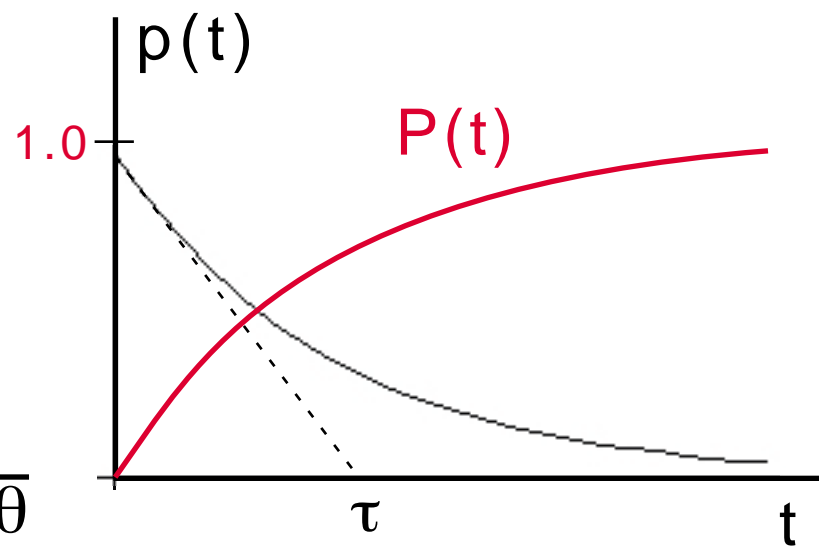
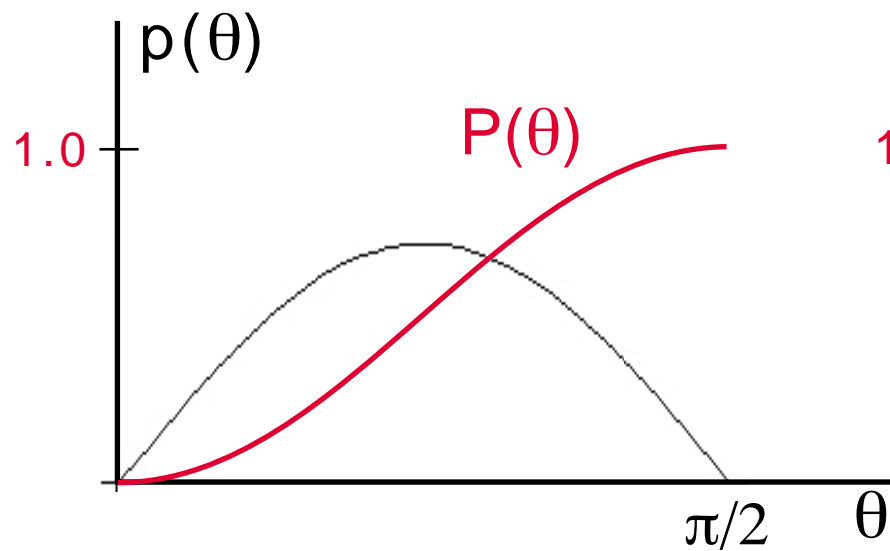
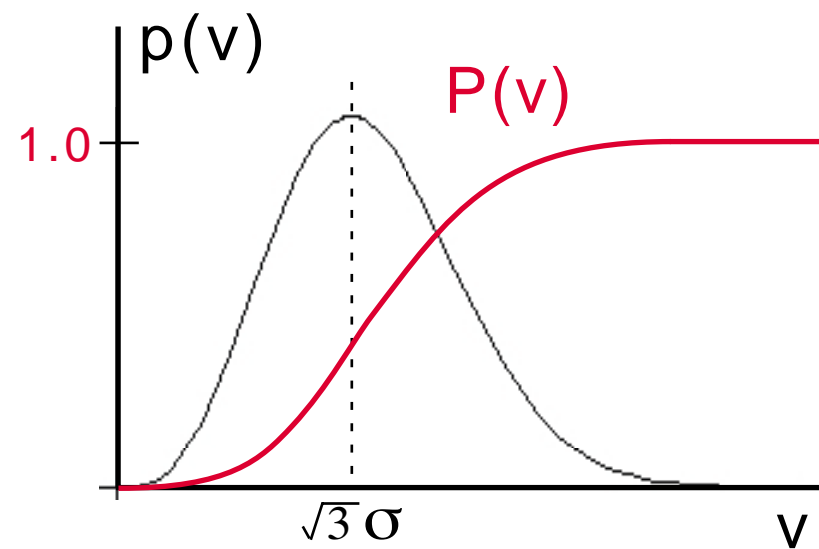
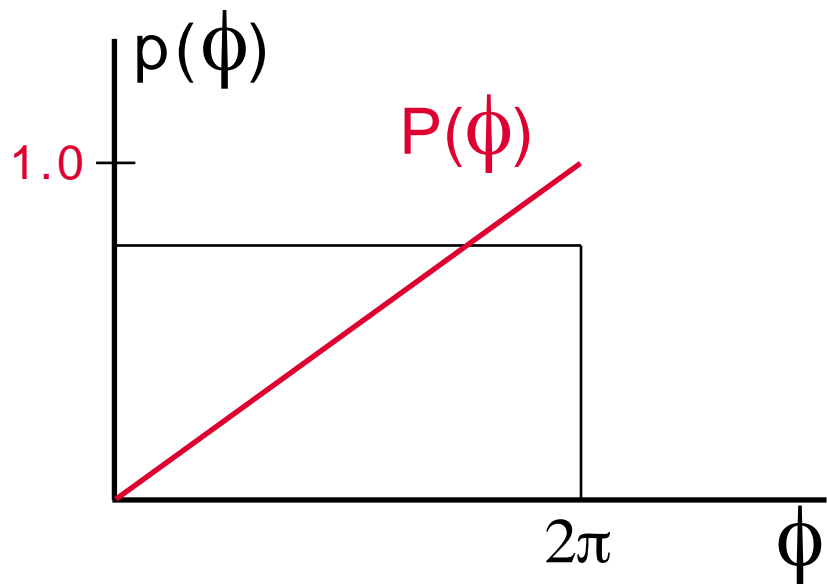
$$P_x(\zeta) \equiv \int_{-\infty}^{\zeta} p_x(\zeta') d\zeta' \Rightarrow p_x(\zeta) = \frac{d}{d\zeta} P_x(\zeta)$$

Either $p_x(\zeta)$ or $P_x(\zeta)$ completely specifies the RV x .

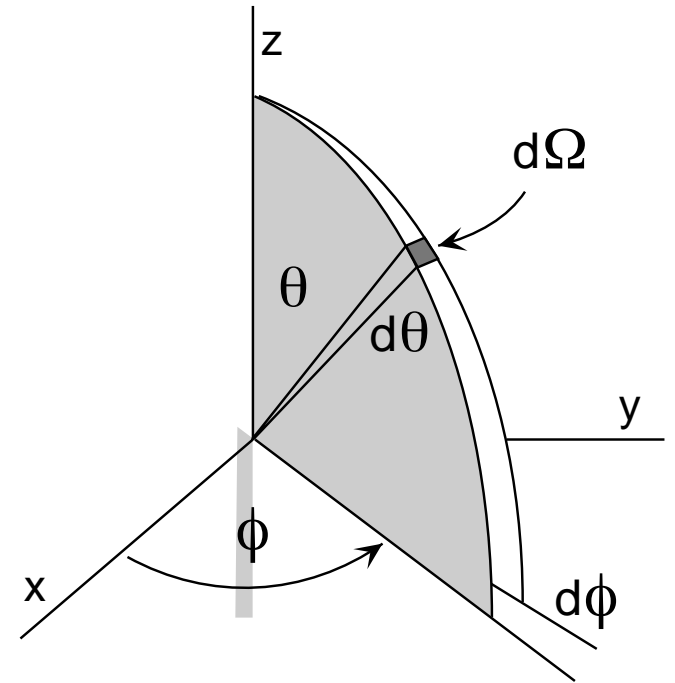
Example Physical adsorption of a gas







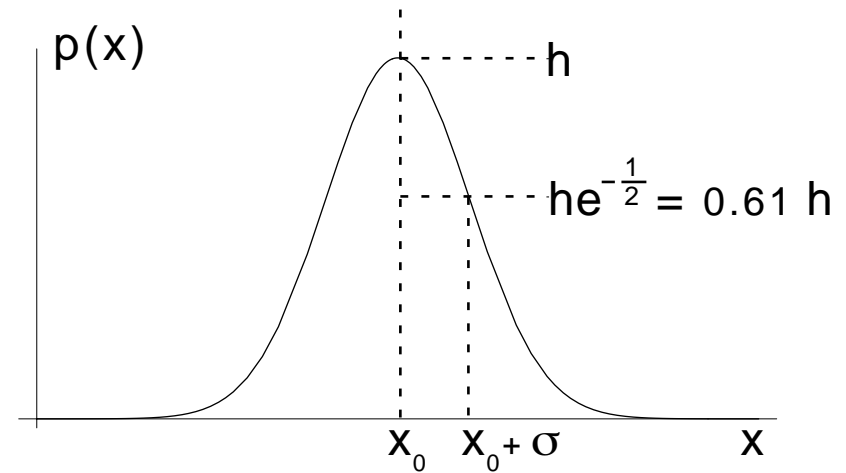
$$\begin{aligned}
 \text{PROB} &= p(\theta)d\theta p(\phi)d\phi \\
 &= 2 \sin(\theta) \cos(\theta)d\theta(1/2\pi)d\phi \\
 d\Omega &= \sin(\theta)d\theta d\phi
 \end{aligned}$$



$$\text{PROB}/d\Omega = (1/\pi) \cos(\theta)$$

Gaussian density (memorize)

$$p(x) = \frac{1}{\sqrt{2\pi\sigma^2}} e^{-\frac{(x-x_0)^2}{2\sigma^2}}$$



2 parameters