

# Feynman and Hibbs problem 5-4

Suppose the wave function for a system is  $\psi(x)$  at time  $t_a$ . Suppose further that the behavior of the system described by the kernel  $K(x_b, t_b, x_a, t_a)$  for motions in the interval  $t_b \geq t \geq t_a$ . Show that the probability that the system is found to be in state  $\chi(x)$  at time  $t_b$  is given by the square of the integral

$$\int_{-\infty}^{\infty} \int_{-\infty}^{\infty} \chi^*(x_b) K(x_b, t_b, x_a, t_a) \psi(x_a) dx_a dx_b \quad (1)$$

We call this integral the “transition amplitude” to go from state  $\psi(x)$  to state  $\chi(x)$ .

From equation (3.42)

$$\psi(x_b, t_b) = \int_{-\infty}^{\infty} K(x_b, t_b, x_a, t_a) \psi(x_a, t_a) dx_a$$

Hence the integral over  $x_a$  in (1) becomes  $\psi(x_b)$ .

$$\int_{-\infty}^{\infty} \chi^*(x_b) \psi(x_b) dx_b$$

Then by equation (5.32)

$$P(\chi) = \left| \int_{-\infty}^{\infty} \chi^*(x_b) \psi(x_b) dx_b \right|^2$$