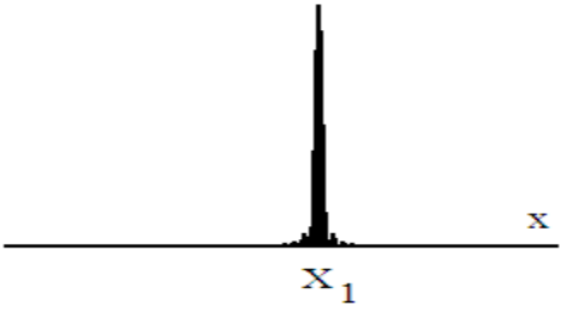
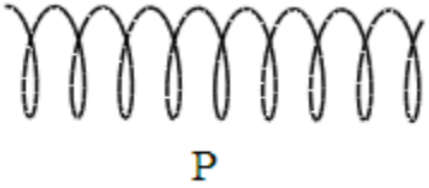
1.22: Relationship Between the Coordinate and Momentum Representations

A quon has position x_1 : $|x_1\rangle$

Coordinate space $\Leftrightarrow$ Fourier Transform $\Leftrightarrow$ Momentum space

$$\langle x|x_1\rangle = \delta(x - x_1) = \underset{\int\langle x|p\rangle\langle p|x_1\rangle dp}{\overset{\int\langle p|x\rangle\langle x|x_1\rangle dx}{\rightleftharpoons}} \langle p|x_1\rangle = \exp\left(-\frac{ipx_1}{\hbar}\right)$$

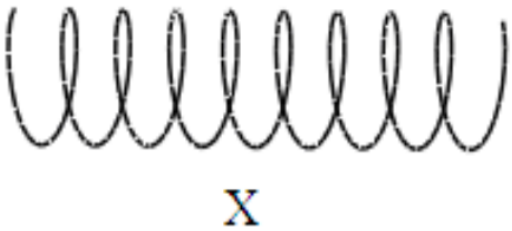


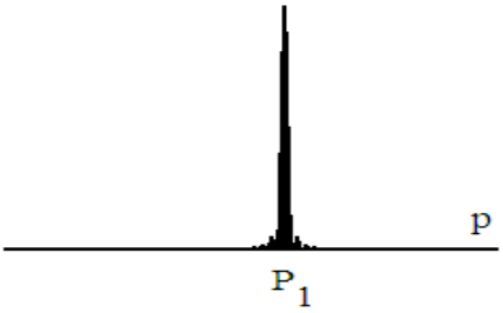


A quon has momentum p_1 : $|p_1\rangle$

Coordinate space $\Leftrightarrow$ Fourier Transform $\Leftrightarrow$ Momentum space

$$\langle x|p_1\rangle = \exp\left(\frac{ip_1x}{\hbar}\right) \underset{\int\langle x|p\rangle\langle p|p_1\rangle dp}{\overset{\int\langle p|x\rangle\langle x|p_1\rangle dx}{\rightleftharpoons}} \langle p|p_1\rangle = \delta(p - p_1)$$





Please note the important role that the coordinate and momentum completeness relations play in these transformations.

$$\int |x\rangle\langle x|dx = 1 \quad \text{and} \quad \int |p\rangle\langle p|dp = 1$$