Expectation Values

Consider an ensemble of microscopic systems prepared in the same initial state $|A\rangle$. Suppose a measurement of the observable $|\xi'\rangle$ is made on each system. We know that each measurement yields the value $|\xi'\rangle$ with probability $|P(\xi')\rangle$. What is the mean value of the measurement? This quantity, which is generally referred to as the expectation value of $|\xi'\rangle$, is given by

$$\langle\xi\rangle = \sum_{\xi'} \xi' |P(\xi')\rangle = \sum_{\xi'} \xi' |\langle A|\xi\rangle|^2$$

which reduces to

$$\langle\xi\rangle = |\langle A|\xi\rangle|^2$$

with the aid of Eq. (54).

Consider the identity operator, 1. All states are eigenstates of this operator with the eigenvalue unity. Thus, the expectation value of this operator is always unity: i.e.,

$$\langle\mid A\rangle = \langle\mid A\rangle$$

for all $|\langle A|\rangle\rangle$. Note that it is only possible to normalize a given ket $|\langle A|\rangle\rangle$ such that Eq. (60) is satisfied because of the more general property (21) of the norm. This property depends on the particular correspondence (16), that we adopted earlier, between the elements of a ket space and those of its dual bra space.

Outside Links

- [http://mysbfiles.stonybrook.edu/~klikharev/511-512/F08-S09/Ch4.pdf](http://mysbfiles.stonybrook.edu/~klikharev/511-512/F08-S09/Ch4.pdf)
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