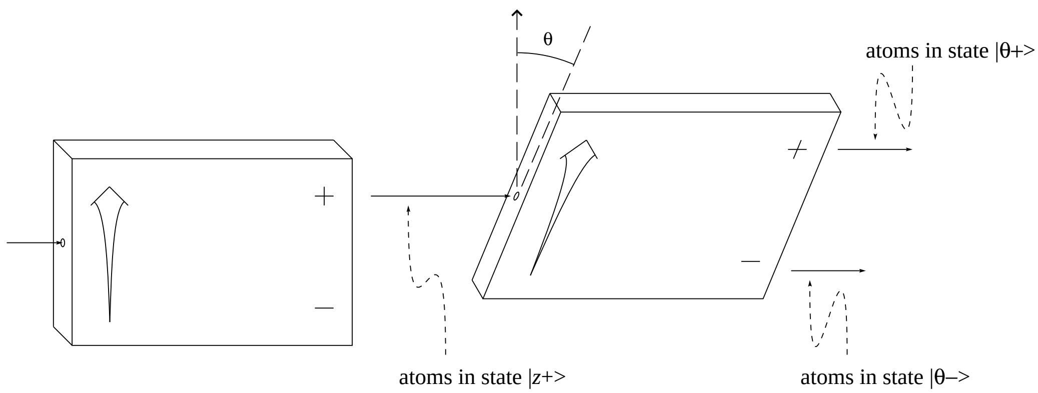
Terms Concerning Quantum States

Just as the symbol for a vector is identified as such by a decoration, namely $\vec{r}$ or $\mathbf{r}$, so the symbol for a quantum state is identified by a decoration, namely $|A\rangle$. For example $|z+\rangle$, $|z-\rangle$, $|y+\rangle$, $|y-\rangle$, $|\theta+\rangle$, $|\theta-\rangle$. In terms of our diagrams we have



For atoms in state $|z+\rangle$, the probability of measuring μ_θ and finding $\mu_\theta = +\mu_B$ is $\cos^2(\theta/2)$. We say "The projection probability from $|z+\rangle$ to $|\theta+\rangle$ is $\cos^2(\theta/2)$." This situation is frequently, but incorrectly, described as "The probability that an atom in state $|z+\rangle$ is in state $|\theta+\rangle$ is $\cos^2(\theta/2)$."

If the projection probability from $|A\rangle$ to $|B\rangle$ is zero, and vice versa, the two states are *orthogonal*. (For example, $|z+\rangle$ and $|z-\rangle$ are orthogonal, whereas $|z+\rangle$ and $|y-\rangle$ are not.)

Given a set of states $\{|A\rangle, |B\rangle, \ldots, |N\rangle\}$, this set is said to be *complete* if an atom in *any* state is analyzed into one state of this set. In other words, it is complete if

$$\sum_{i=A}^{N} (\text{projection probability from any given state to } |i\rangle) = 1.$$

(For example, the set $\{|\theta+\rangle, |\theta-\rangle\}$ is complete.)