Princip superpozice

Může-li se systém nacházet ve stavu $|\psi_1\rangle$ a $|\psi_2\rangle$, může se také nacházet ve stavu

$$|\psi\rangle = c_1|\psi_1\rangle + c_2|\psi_2\rangle$$

kde c_n jsou komplexní koeficienty.

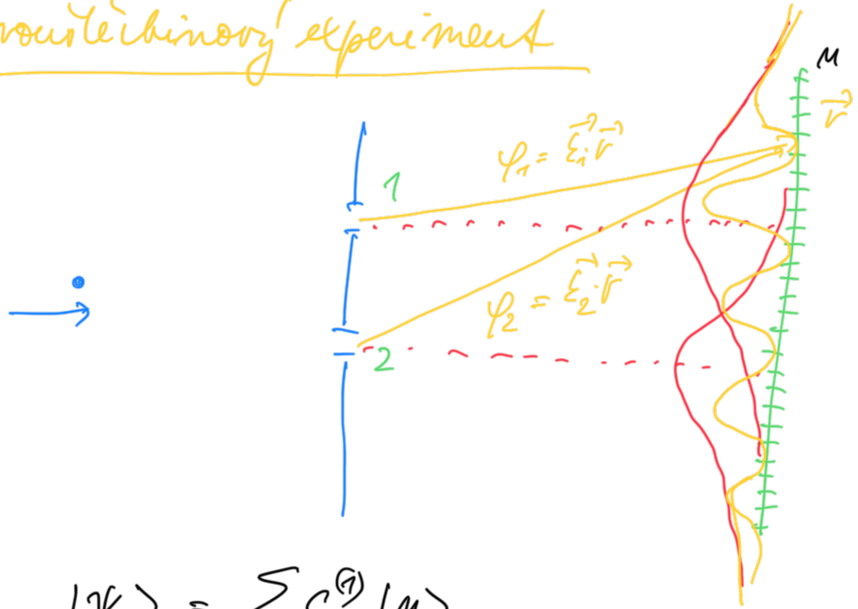
Příklad:

$$\langle \vec{r}_1|\psi_1\rangle = c_1 \frac{1}{\sqrt{2\pi\hbar}} e^{\frac{i}{\hbar}\vec{p}_1\cdot\vec{r}_1} + c_2 \frac{1}{\sqrt{2\pi\hbar}} e^{\frac{i}{\hbar}\vec{p}_2\cdot\vec{r}_1}$$

$$\langle \vec{r}_1|\langle\vec{r}_2|\psi_2\rangle = c_1 \frac{1}{2\pi\hbar} e^{\frac{i}{\hbar}\vec{p}_1\cdot\vec{r}_1} e^{\frac{i}{\hbar}\vec{p}_2\cdot\vec{r}_2} + c_2 \frac{1}{2\pi\hbar} \left(e^{\frac{i}{\hbar}\vec{p}_1\cdot\vec{r}_2} + e^{\frac{i}{\hbar}\vec{p}_2\cdot\vec{r}_1}\right)$$

$$\xleftarrow{\;p_1\;} \qquad \xrightarrow{\;p_2\;}$$

Dvouštěrbinový experiment



$$\Delta\varphi = (\vec{\xi}_1 - \vec{\xi}_2)\cdot\vec{r}$$

$$|\psi_1\rangle = \sum_n c_n^{(1)}|n\rangle$$

$$|\psi_2\rangle = \sum_n c_n^{(2)}|n\rangle$$

$$|\psi\rangle = \frac{1}{\sqrt{2}}\left(|\psi_1\rangle + |\psi_2\rangle\right)$$

$$P_n = |\langle n|\psi\rangle|^2 = \frac{1}{2}\left(\langle\psi_1| + \langle\psi_2|\right)|n\rangle\langle n|\left(|\psi_1\rangle + |\psi_2\rangle\right)$$

$$= \frac{1}{2}\Big(\underbrace{\langle\psi_1|n\rangle\langle n|\psi_1\rangle}_{P_1^{(n)}} + \underbrace{\langle\psi_2|n\rangle\langle n|\psi_2\rangle}_{P_2^{(n)}}$$

$$+ \langle\psi_1|n\rangle\langle n|\psi_2\rangle + \langle\psi_2|n\rangle\langle n|\psi_1\rangle\Big)$$

$$= \frac{1}{2}\left(P_1^{(n)} + P_2^{(n)} + 2\,\mathrm{Re}\, c_n^{(1)*} c_n^{(2)}\right)$$

interferenční člen

$$c_n^{(1)} = \langle n|\psi_1\rangle$$

$$c_n^{(2)} = \langle n|\psi_2\rangle$$