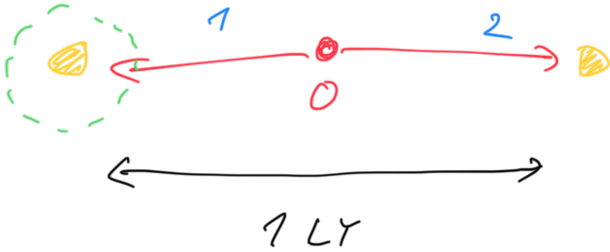
Kvantové 'povídání'

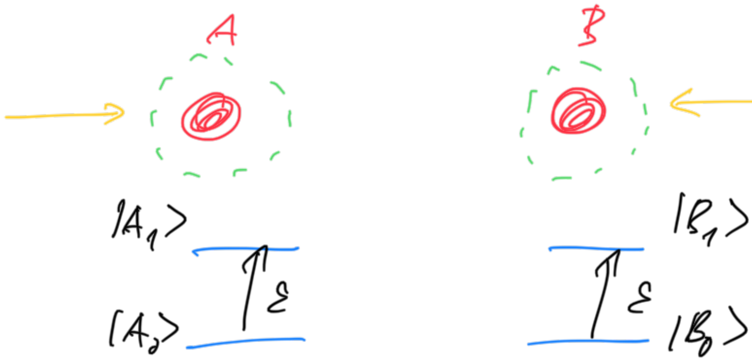
$$|\psi_1\rangle \,,\quad |\psi_2\rangle$$

$$\boxed{|\psi\rangle = a|\psi_1\rangle + b|\psi_2\rangle} \qquad a = b = \frac{1}{\sqrt{2}}$$

$$|\psi_1\rangle \equiv |1_\uparrow\rangle|2_\downarrow\rangle$$

$$|\psi_2\rangle \equiv |1_\downarrow\rangle|2_\uparrow\rangle$$





$$H = H_A + H_B + H_I$$

$$\boxed{|\psi_0\rangle = |A_1\rangle|B_0\rangle}$$

$$H_I = \Theta(t - t_0)\,\Theta(-[t - (t_0 + \Delta t)])\,\varepsilon \times \Big(|A_0\rangle|B_1\rangle\langle A_1|\langle B_0| + |A_1\rangle|B_0\rangle\langle A_0|\langle B_1|\Big)$$

$$\frac{\partial}{\partial t}|\psi\rangle = -\frac{i}{\hbar} H|\psi\rangle \;;\quad \Delta t < \frac{\hbar}{\varepsilon}$$

$$= -\frac{i}{\hbar} H_I |\Psi\rangle$$

$$|\Psi(t)\rangle = |\Psi(t_0)\rangle - \frac{i}{\hbar}\int_{t_0}^{t} d\tau\, H_I |\Psi(\tau)\rangle$$

$$|\Psi(t_0+\Delta t)\rangle = |\Psi(t_0)\rangle - \frac{i}{\hbar} H_I \Delta t\, |\Psi(t_0)\rangle$$

$$\boxed{|\Psi(t_0+\Delta t)\rangle = \frac{1}{N}\Big(|A_1\rangle|B_0\rangle - \frac{i}{\hbar}\Delta t\, \xi\, |A_0\rangle|B_1\rangle\Big)}$$

Provázání je běžným výsledkem interakce

Vznik klasických stavů – dekoherence

$$|\Psi\rangle = a|\Psi_1\rangle + b|\Psi_2\rangle$$

$$|\Psi\rangle|\phi\rangle = \big(a|\Psi_1\rangle + b|\Psi_2\rangle\big)|\phi\rangle$$

$$\rightarrow a|\Psi_1\rangle|\phi_1\rangle + b|\Psi_2\rangle|\phi_2\rangle$$

$$\hat{W} = |\Psi\rangle\langle\Psi| \otimes |\phi\rangle\langle\phi|$$

$$\hat{\rho} = tr_{env}\{\hat{W}\} = \begin{pmatrix} |a|^2 & a^* b \\ a b^* & |b|^2 \end{pmatrix}$$

$$\hat{\rho} = tr_{env}\big(|\varphi\rangle\langle\varphi|\big) =$$

$$= Tr_{env}\Big\{\big(a|\Psi_1\rangle|\phi_1\rangle + b|\Psi_2\rangle|\phi_2\rangle\big)\big(a^*\langle\Psi_1|\langle\phi_1| + b^*\langle\Psi_2|\langle\phi_2|\big)\Big\}$$

$$= \mathrm{Tr}_{env}\Big\{ |a|^2 |\psi_1\rangle\langle\psi_1|\, \underline{|\phi_1\rangle\langle\phi_1|}$$

$$+ |b|^2 |\psi_2\rangle\langle\psi_2|\, \underline{|\phi_2\rangle\langle\phi_2|}$$

$$+ a^* b\, |\psi_2\rangle\langle\psi_1|\, |\phi_2\rangle\langle\phi_1|$$

$$+ h.c. \Big\}$$

$$\sum_n \langle n|\phi_1\rangle\langle\phi_2|n\rangle$$

$$= \sum_n \langle\phi_1|n\rangle\langle n|\phi_1\rangle$$

$$= \langle\phi_1|\phi_1\rangle = 1$$

$$= |a|^2 |\psi_1\rangle\langle\psi_1| + |b|^2 |\psi_2\rangle\langle\psi_2| + a^* b\, |\psi_2\rangle\langle\psi_1| \times \langle\phi_1|\phi_2\rangle + h.c.$$

$$\approx 0$$

$$= \begin{pmatrix} |a|^2 & 0 \\ 0 & |b|^2 \end{pmatrix}$$