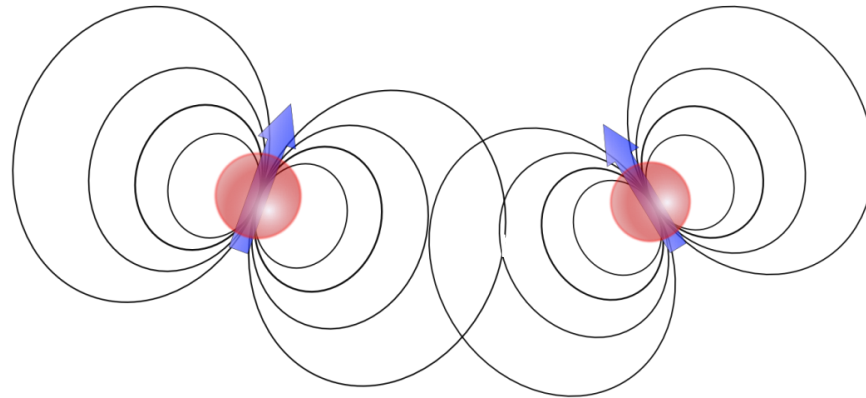Electronic Spins

$$H_{spin-spin} = \hbar\xi\left(3(\hat{r}\cdot\vec{\sigma})_1(\hat{r}\cdot\vec{\sigma})_2 - \sum_{k=x,y,z}\sigma_{k,1}\sigma_{k,2}\right)$$

$$\xi/2\pi = \frac{13}{(r/1\mu m)^3} \quad mHz$$

- Results in entanglement
- Was never directly measured: dominated by exchange interaction
- If measured with high precision: search for anomalous spin forces
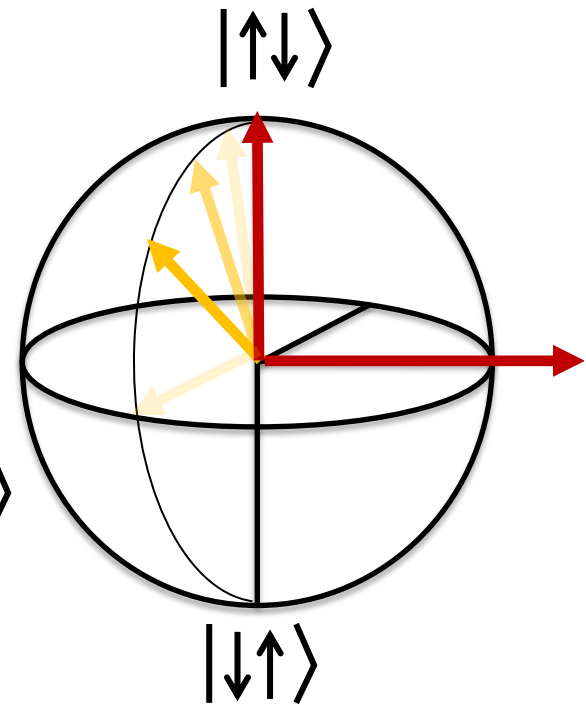
Spin-Spin eigenstates:

$$|\Psi+\rangle = (|\uparrow\downarrow\rangle + |\downarrow\uparrow\rangle)/\sqrt{2}$$

$$|\Psi-\rangle = (|\uparrow\downarrow\rangle - |\downarrow\uparrow\rangle)/\sqrt{2}$$
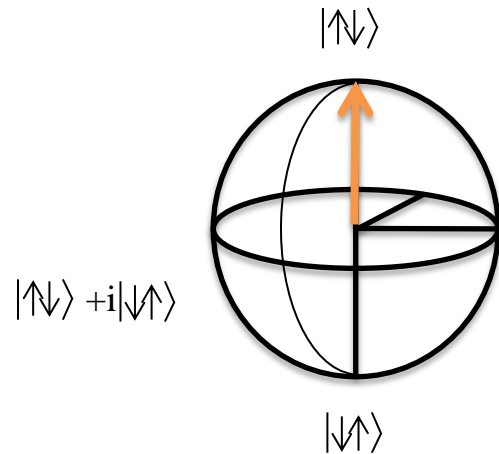

2.4 µm

$|\uparrow\downarrow\rangle$

$|\uparrow\downarrow\rangle + i\,|\downarrow\uparrow\rangle$

$|\downarrow\uparrow\rangle$

- $\Delta E = 4\xi = 3.8\ mHz \approx 200 \times 10^{-15}\ °K \approx 20 \times 10^{-18}\ eV$

- B-field spins apply on each other 130 fT; 10^6 < than noise

Spontaneously entangled spins

After 0.1 seconds

After 15 seconds