













































Presenter

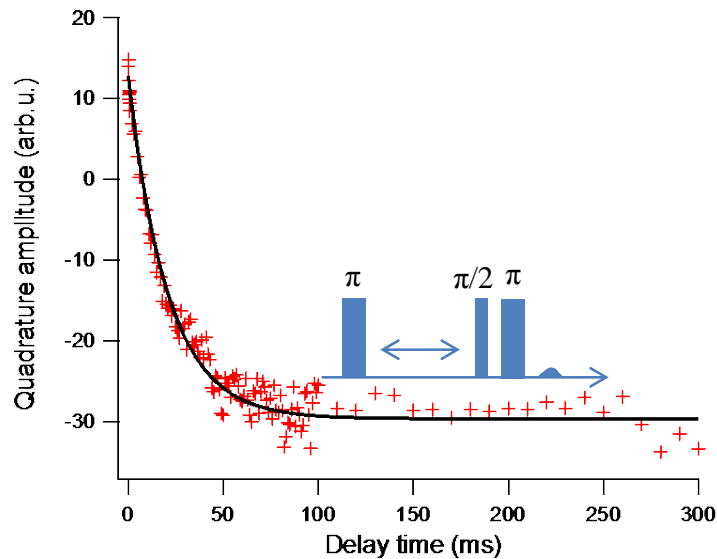
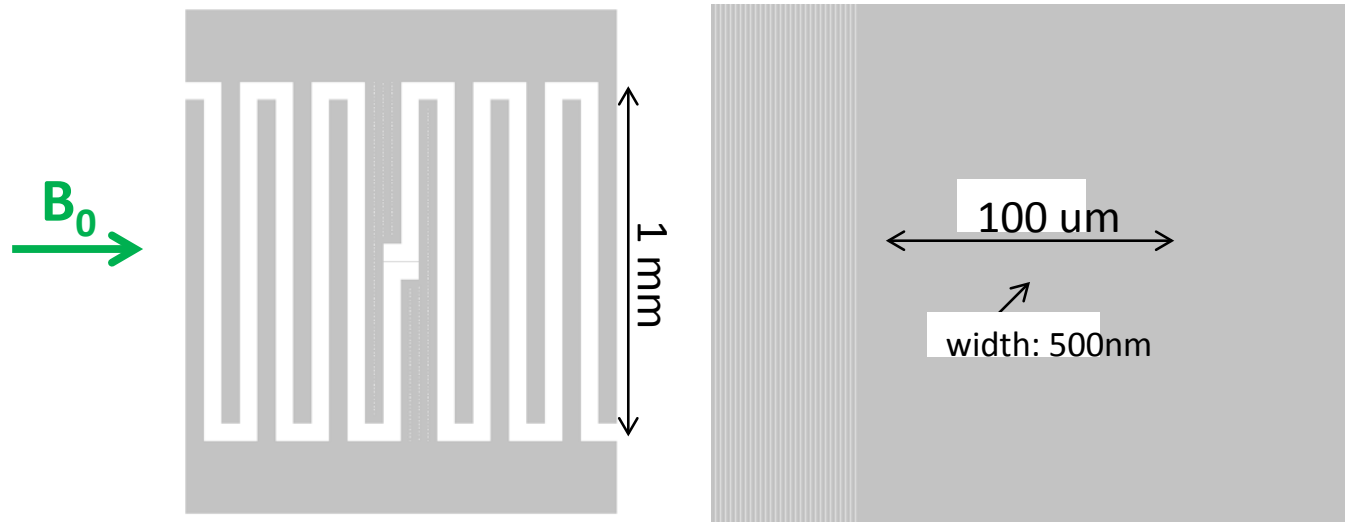
For characterizing the sensitivity, we perform a Hahn echo experiment by applying a Pi pulse some time after a Pi/2 pulse.

Spins are found at different frequencies, which is well explained by the stress in the material due to the aluminum deposited on top of the substrate.





Increasing sensitivity with narrower wire



$$T_1 = 21 \text{ ms}$$

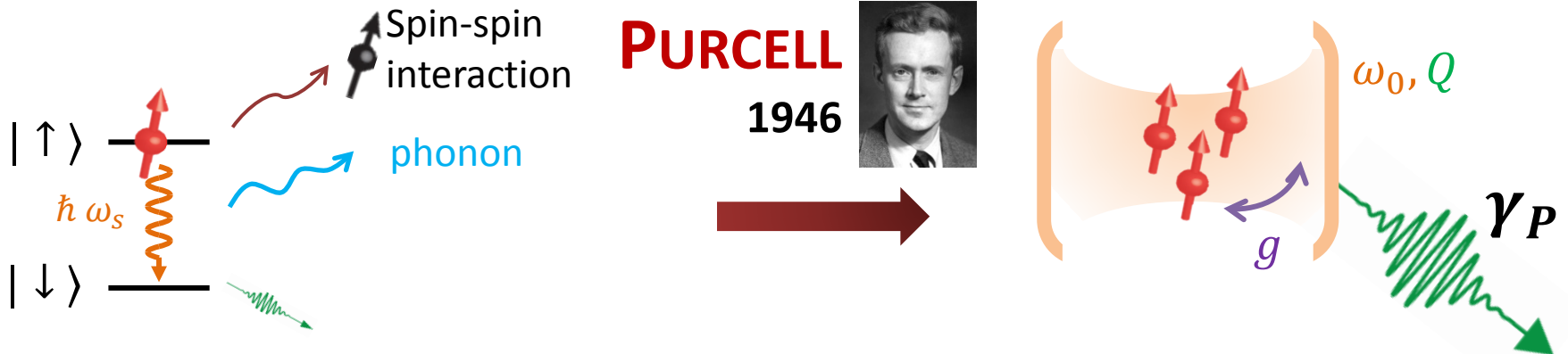
$$g/2\pi = 440 \text{ Hz}$$

$$N_{min} = 300 \text{ spins}$$

$$\text{Sensitivity : } 65 \text{ spins } / \sqrt{\text{Hz}}$$

S. Probst et al., in preparation (2017)

Controlling relaxation: by spontaneous emission



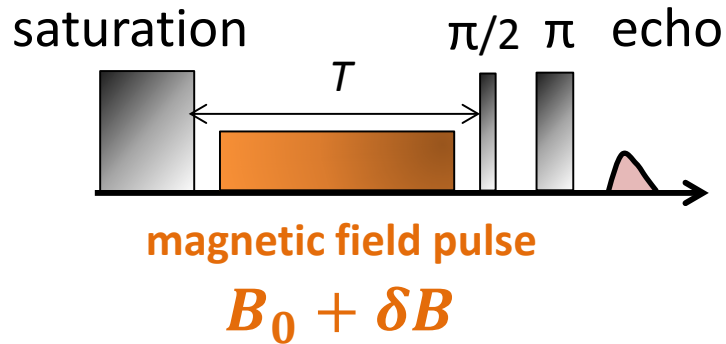
Photon in free space
 ≈ 10000 years !

$$\gamma_P = \frac{4Qg^2}{\omega_0} \frac{1}{1 + 4Q^2 \left[\frac{\omega_s - \omega_0}{\omega_0} \right]^2}$$

- For $T_1 \approx \gamma_P^{-1}$: need small mode volume, high Q cavity
- Allows to shorten T_1 on-demand : accelerate spin thermalization

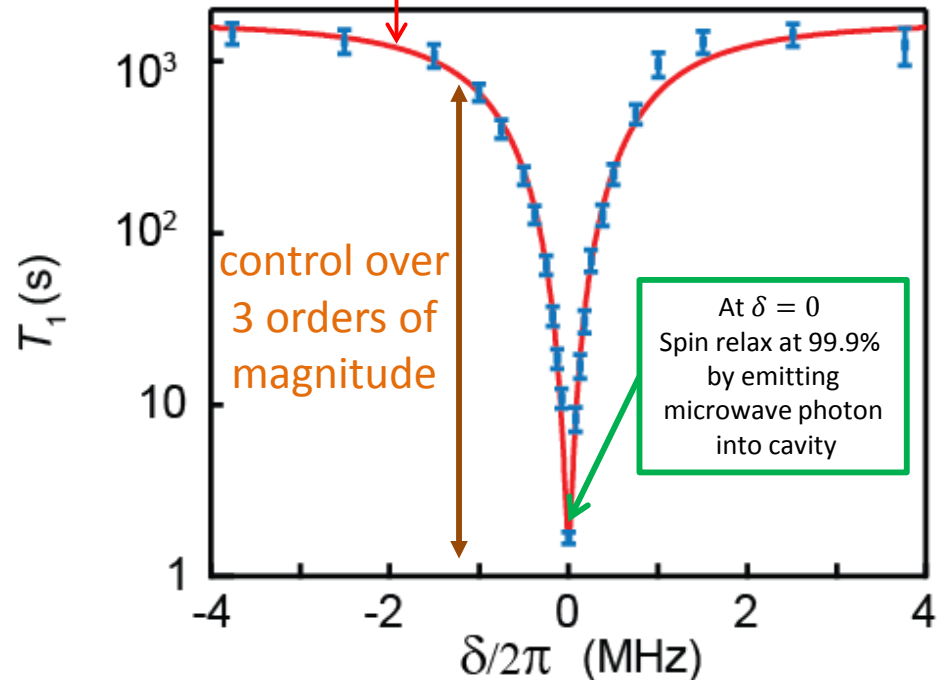
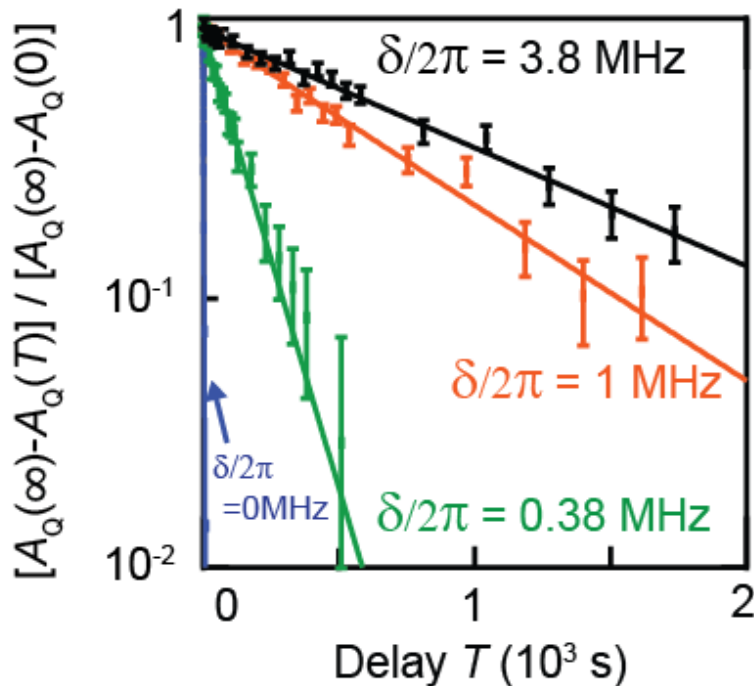


Spin relaxation control by δ -tuning



Spins detuned during T from cavity by $\delta = \delta B \left| \frac{\partial \omega_s}{\partial B} \right|$

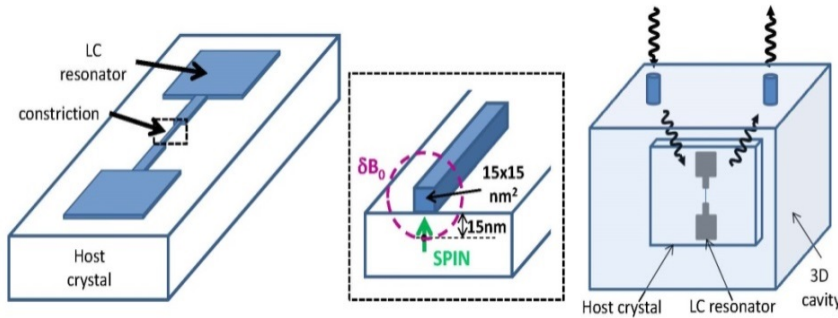
$$\gamma_P = \frac{\gamma_P(\omega_s = \omega_0)}{1 + 4Q^2 \left[\frac{\delta}{\omega_0} \right]^2}$$



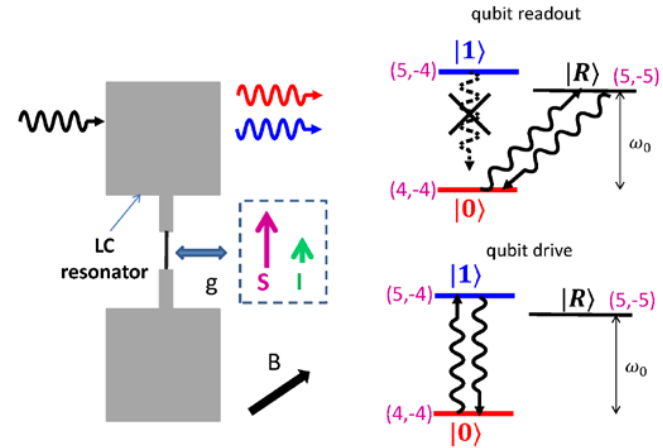


The nuclear spin route : next elements

Increasing the spin-resonator coupling

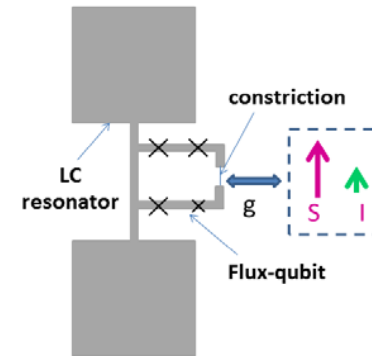


Nuclear spin readout

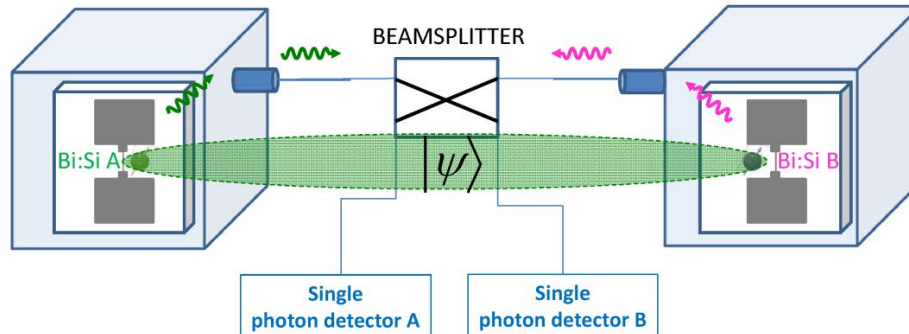


Achieving strong coupling

Coupling scales as zero-point current fluctuations



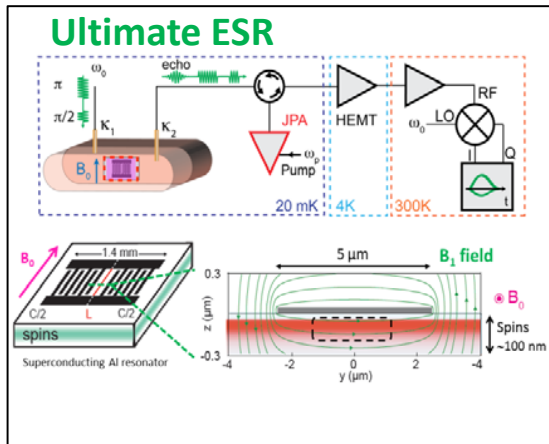
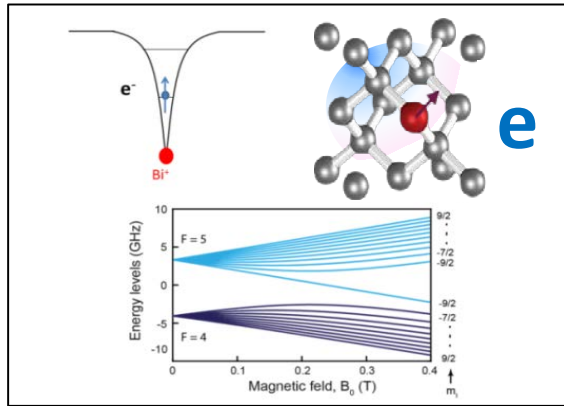
Entangling qubits for making a two qubit gate





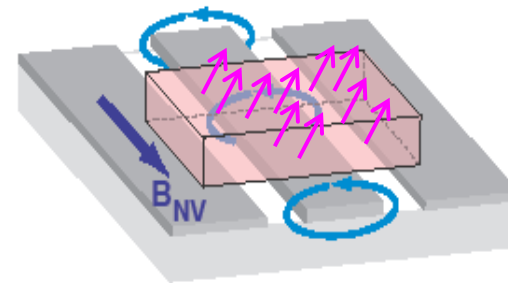
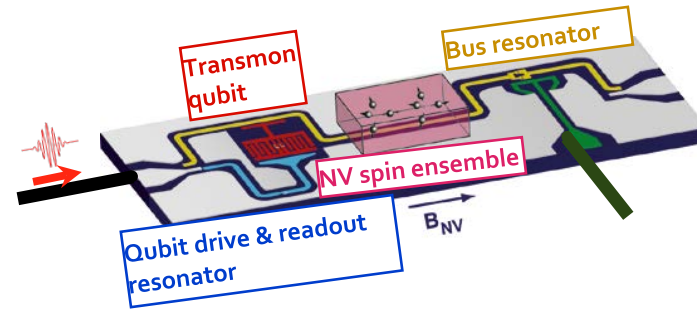
QIP research based on spins

Spin project



Huge sensitivity gain:
 Bienfait et al., Nature Nano 11, 253 (2016)
Single spin sensitivity within reach

A multimode hybrid memory for sc qubits



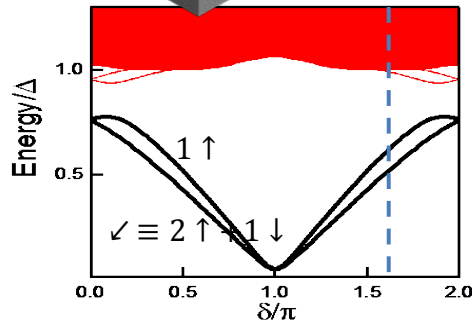
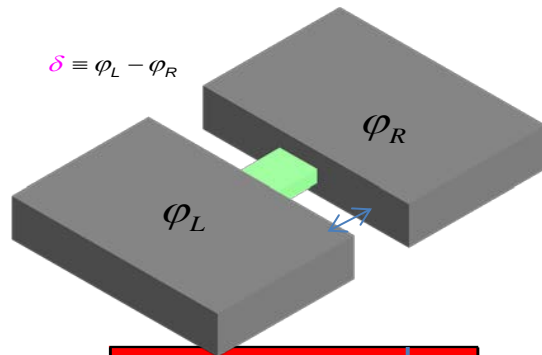
Proof of principle demonstrated

Kubo et al., PRL 107, 220501 (2011)
 Julsgaard et al., PRL 110, 047001 (2013)
 Grèzes et al., PRX 4, 021049 (2014)
 Grèzes et al., CRAS 167, 693 (2017)

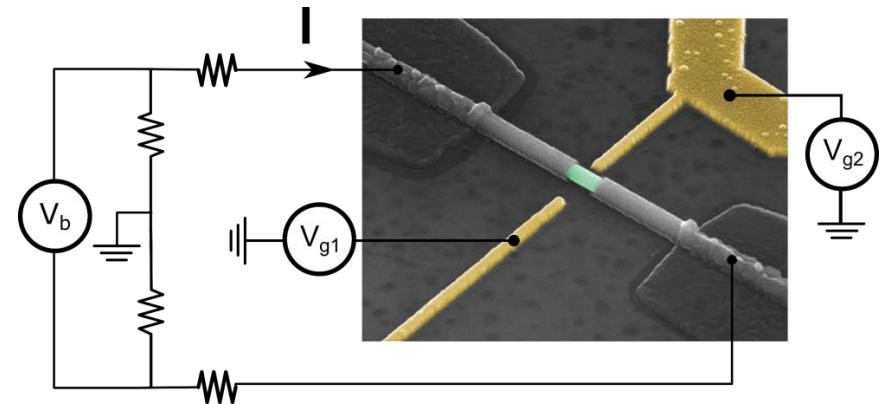
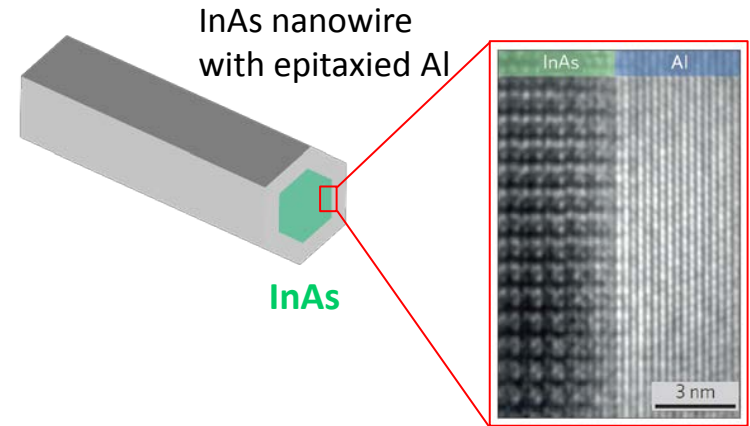
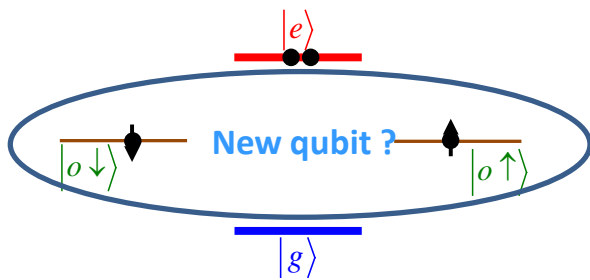


SC challengers : spin qubits in proximitized InAs wires ?

Rashba spin-orbit coupling
 weak link



Tight-binding calculation



Goffman et al., arXiv 1706.09150
 to appear in NJP.