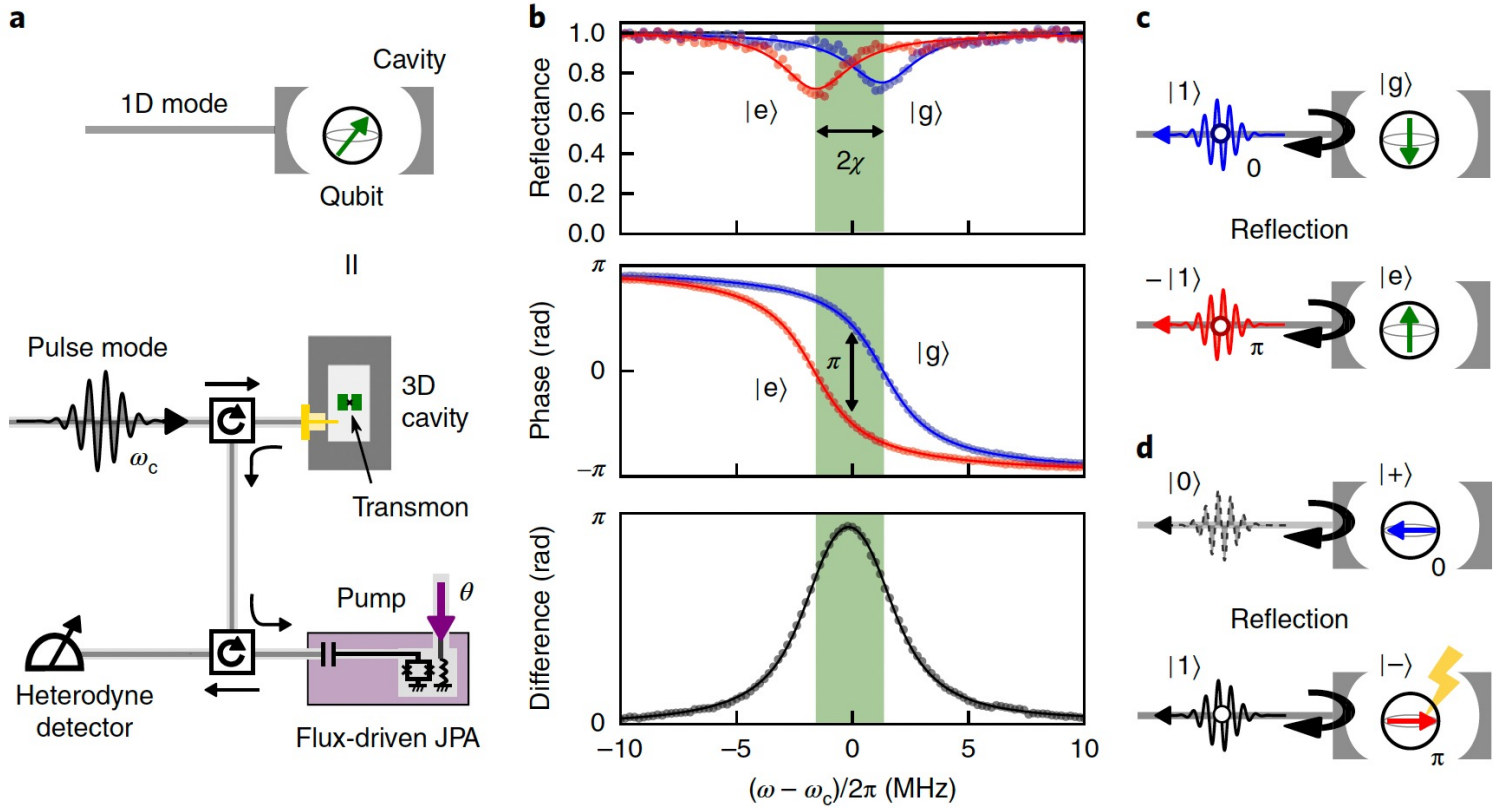
Two Qubits Single Photon Detector

C Gatti

Kono et al. Scheme

Dark count rate $R = \frac{p(1|0)}{T_2} \approx \frac{1\%}{26\ \mu s} = 385\ Hz$



Need to match dispersive shift with resonator width!

Two Qubit Scheme

0 - Initial state

$$|Q_1Q_2\rangle_{\overline{\gamma}} = |0\rangle \times |0\rangle$$

1 - Prepare the qubits in 0+1 state

$$|Q_1Q_2\rangle = \frac{1}{2}(|0\rangle + |1\rangle) \times (|0\rangle + |1\rangle)$$

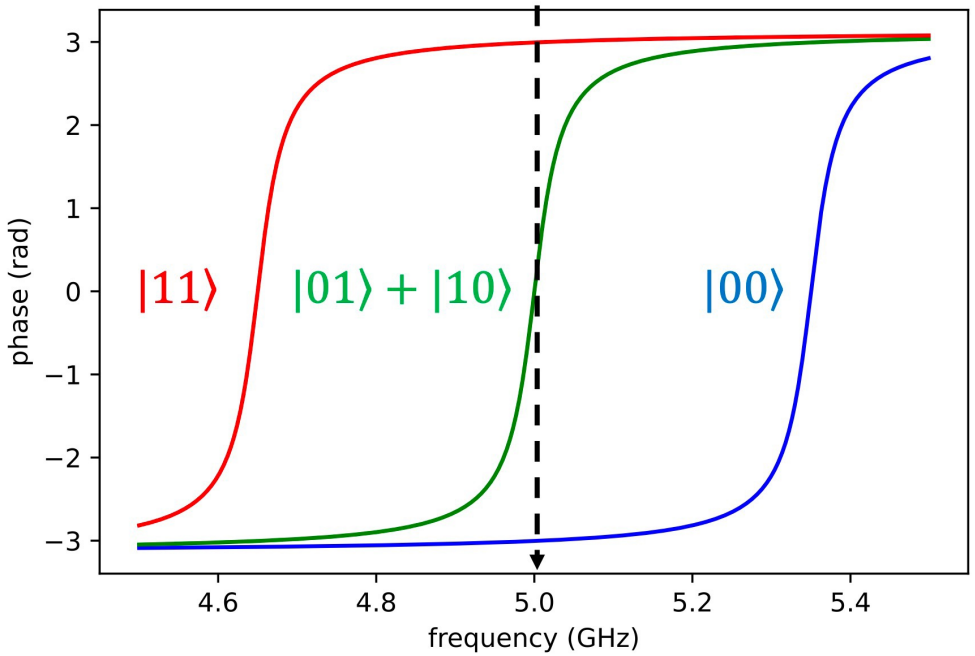
2a - If no photons arrives, nothing happens. Complete Ramsey cycle

$$|Q_1Q_2\rangle_{\overline{\gamma}} = |0\rangle \times |0\rangle$$

2b - If instead a photon arrives

$$\begin{aligned} |Q_1Q_2\rangle_{\gamma} &= \frac{1}{2}\left(e^{-i\pi}|00\rangle + |10\rangle + |01\rangle + e^{i\pi}|11\rangle\right) \\ &= \frac{-1}{2}(|00\rangle - |10\rangle - |01\rangle + |11\rangle) \\ &= -\frac{1}{2}(|0\rangle - |1\rangle) \times (|0\rangle - |1\rangle) \end{aligned}$$

$2\chi \gg \Gamma_c$



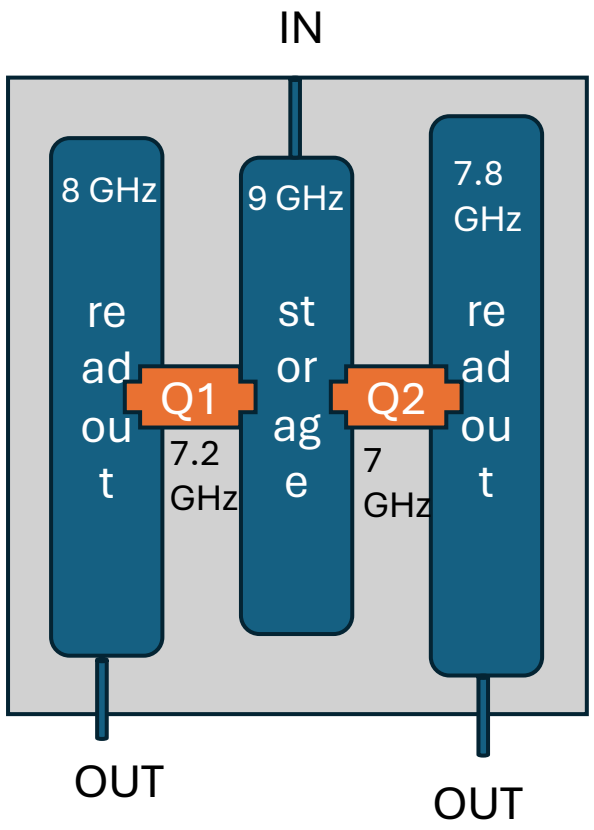
3 - Completing the Ramsey cycle

$$|Q_1Q_2\rangle_{\gamma} = |1\rangle \times |1\rangle$$

Dark count rate

$$R = \frac{p(1|0)^2}{T_2/2} \approx \frac{2\times10^{-4}}{26\ \mu s} = 8\ Hz$$

Two Qubit Scheme



Similar design in 2D

- Define parameters (Qutip simulation)
- 2D and 3D design
- Design of qubit-cavity couplings
- Fabrication
- Storage cavity tuning