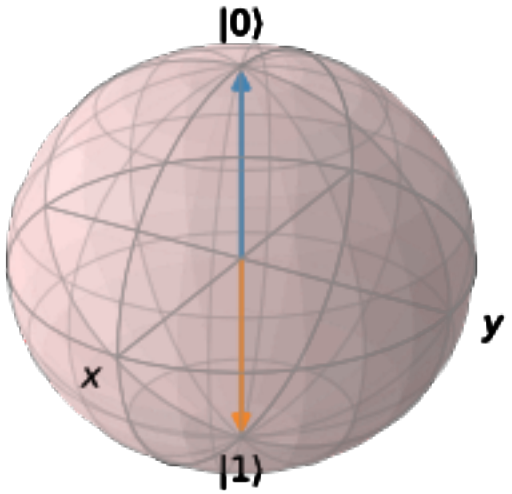
Adriaan Rol

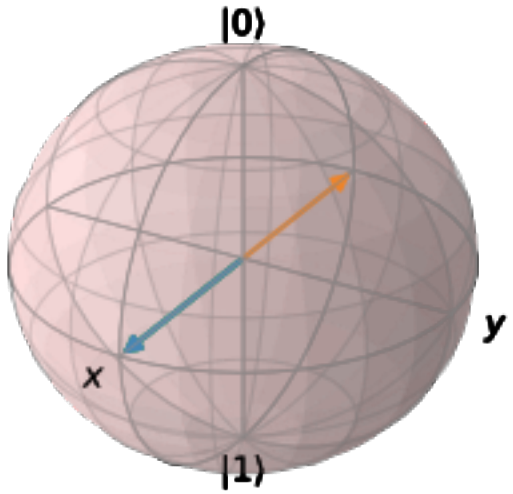
Operations in superconducting qubits: Two-qubit gates

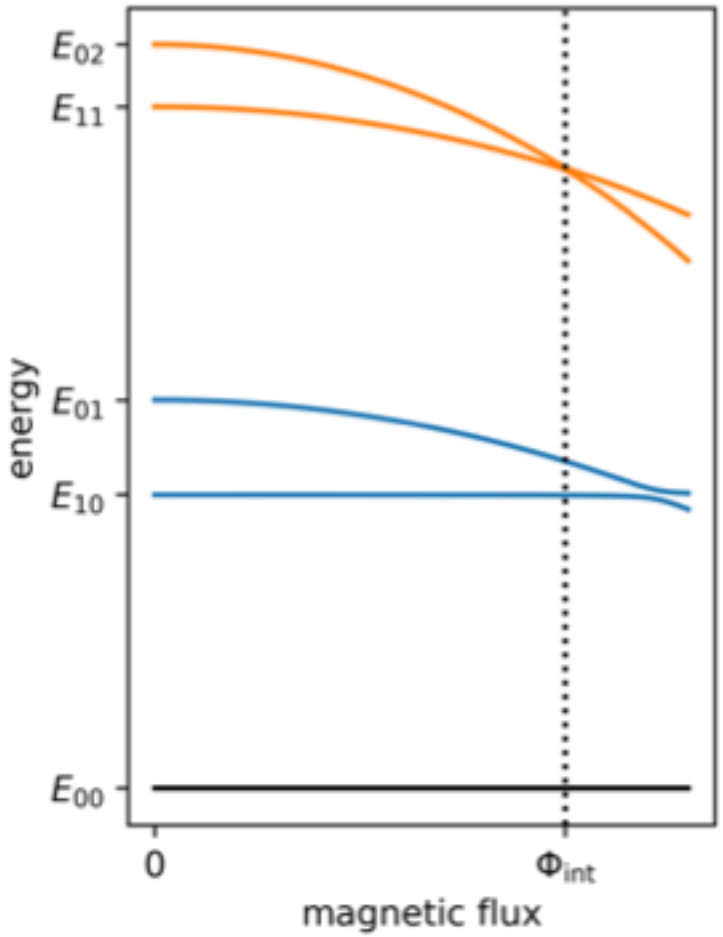
Conditional-phase gate

Control: q_C



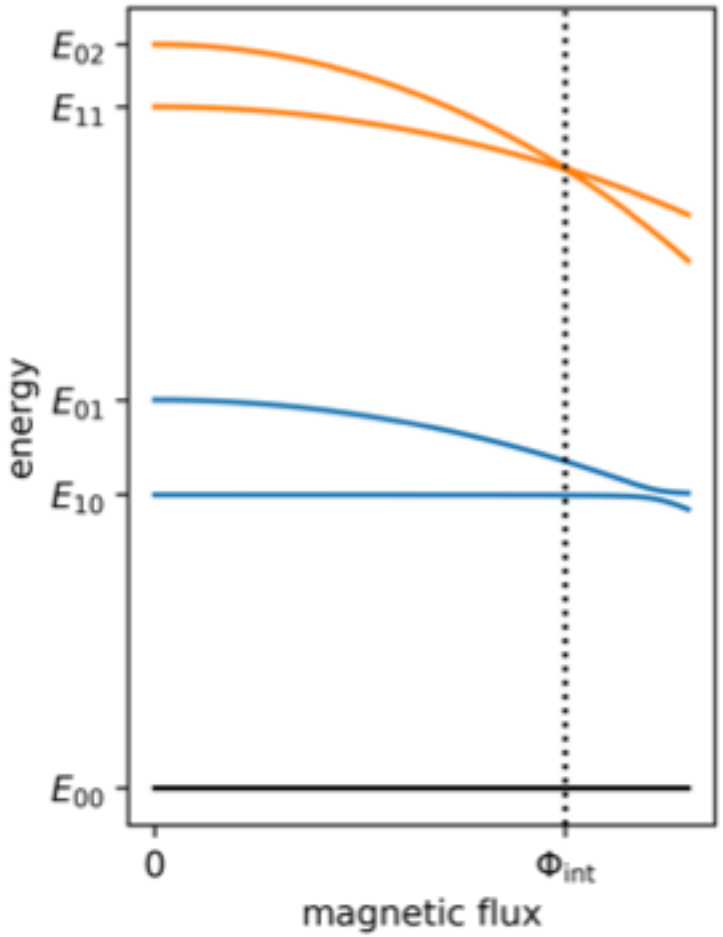
Target: q_T



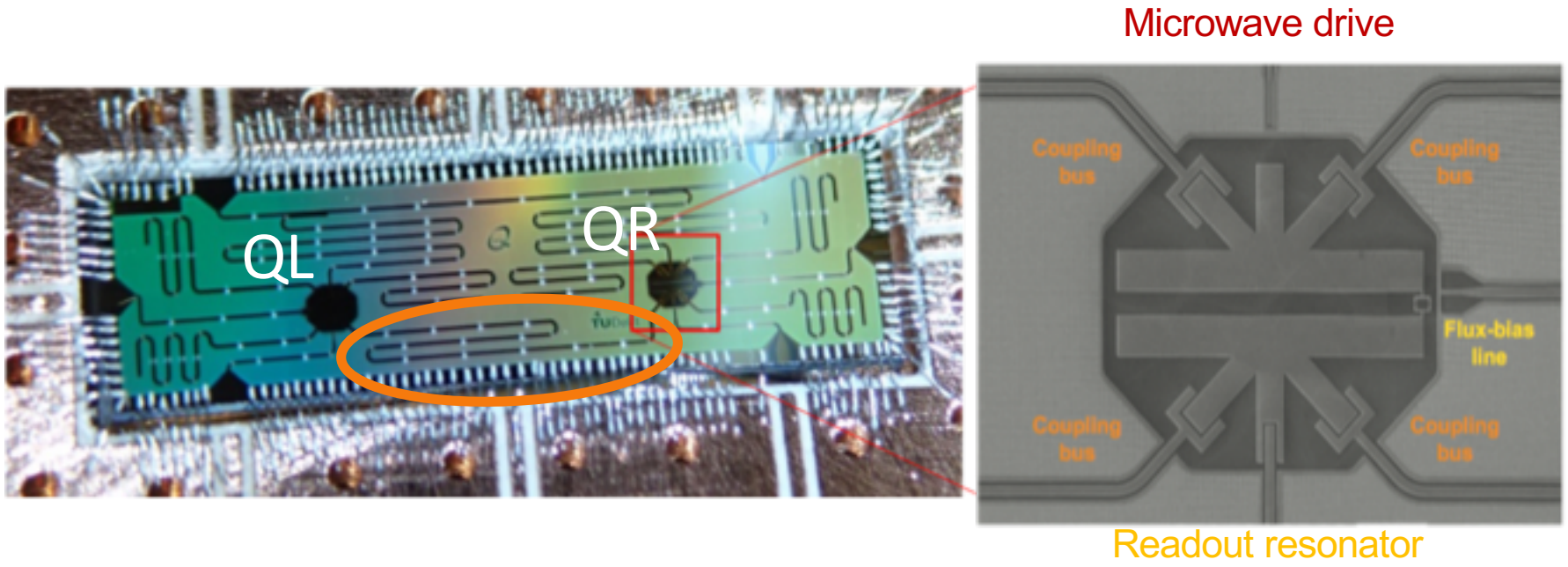


Conditional-phase gate

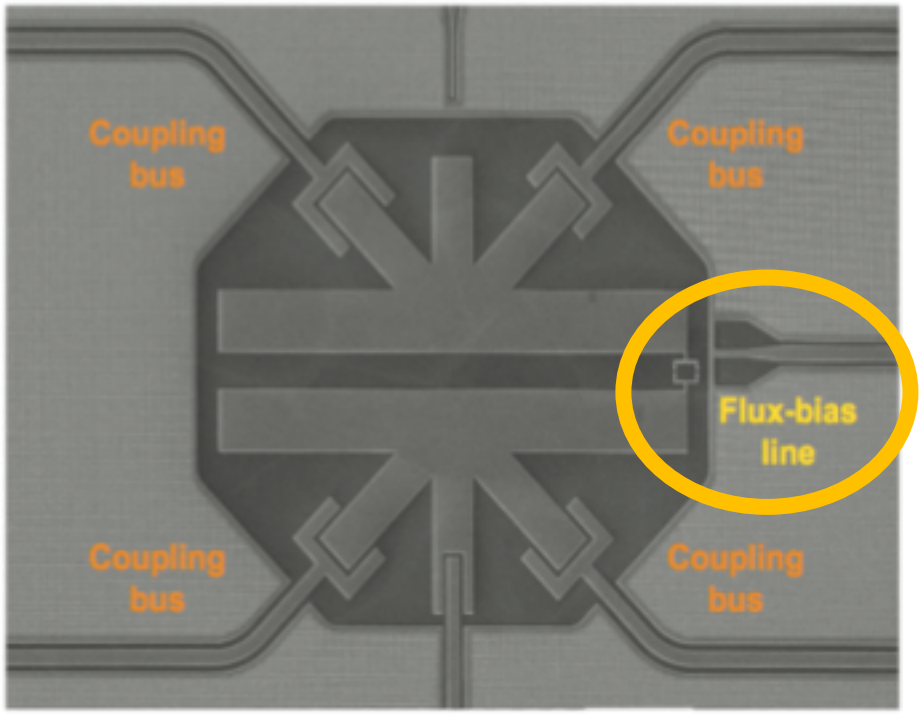
- Resonator mediated coupling
- Flux control and acquiring phase
- Conditional phase and minimizing leakage
- Experimental challenges in performing high fidelity gates

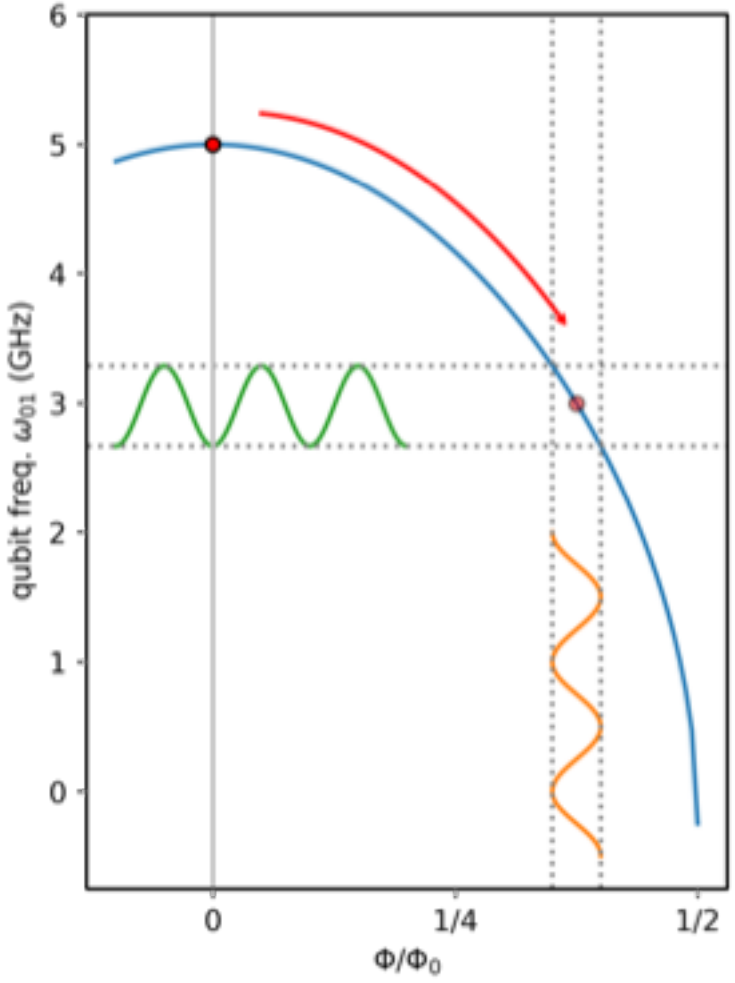


Resonator mediated coupling

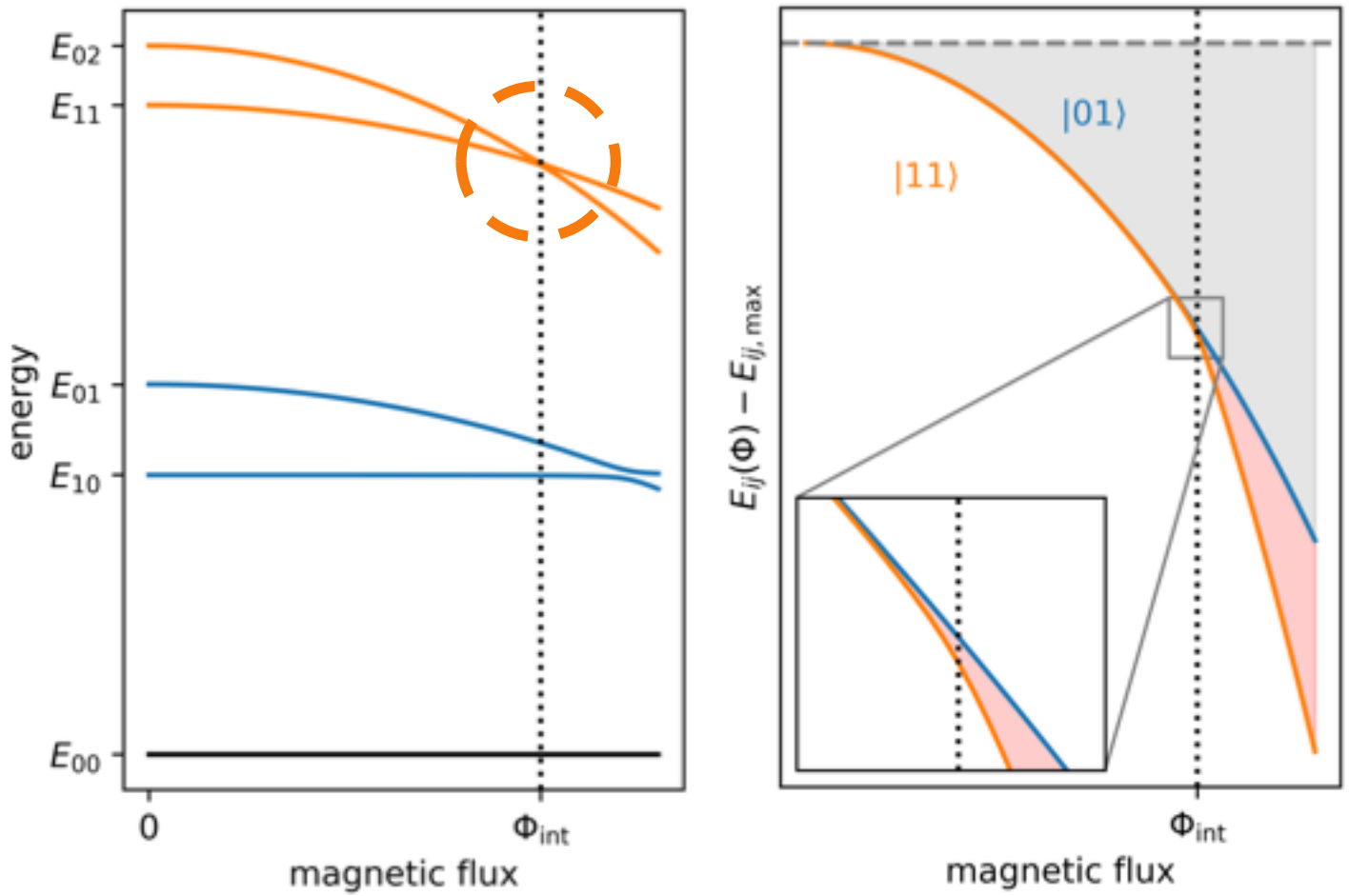


Flux control





Conditional phase



Pulse shaping techniques

Fourier series in the frame of the interaction:

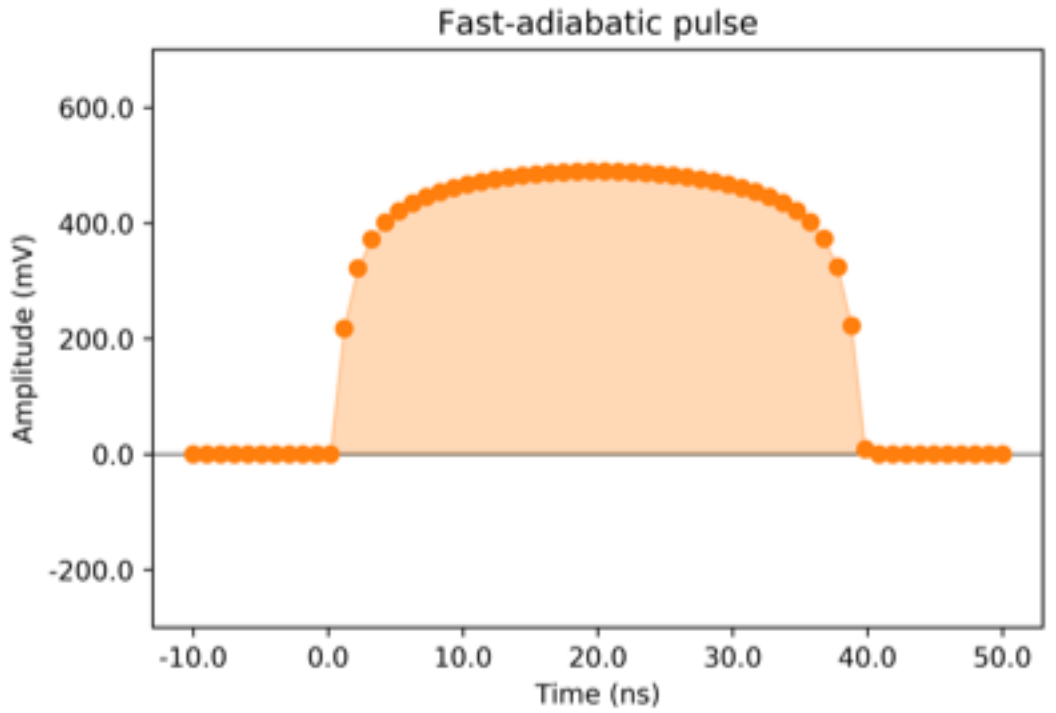
$$\theta = \theta_i + \sum_{n=1,2,\ldots,n_m} \lambda_n (1 - \cos(2\pi n t / t_p))$$

$$\theta_f - \theta_i = 2 \sum_{n\mathrm{odd}} \lambda_n$$

Frame transformations:

$$\theta \rightarrow \omega_q$$

$$\omega_q \rightarrow V$$



J.M. Martinis and M.R. Geller Phys. Rev. A 90, 022307 (2014)

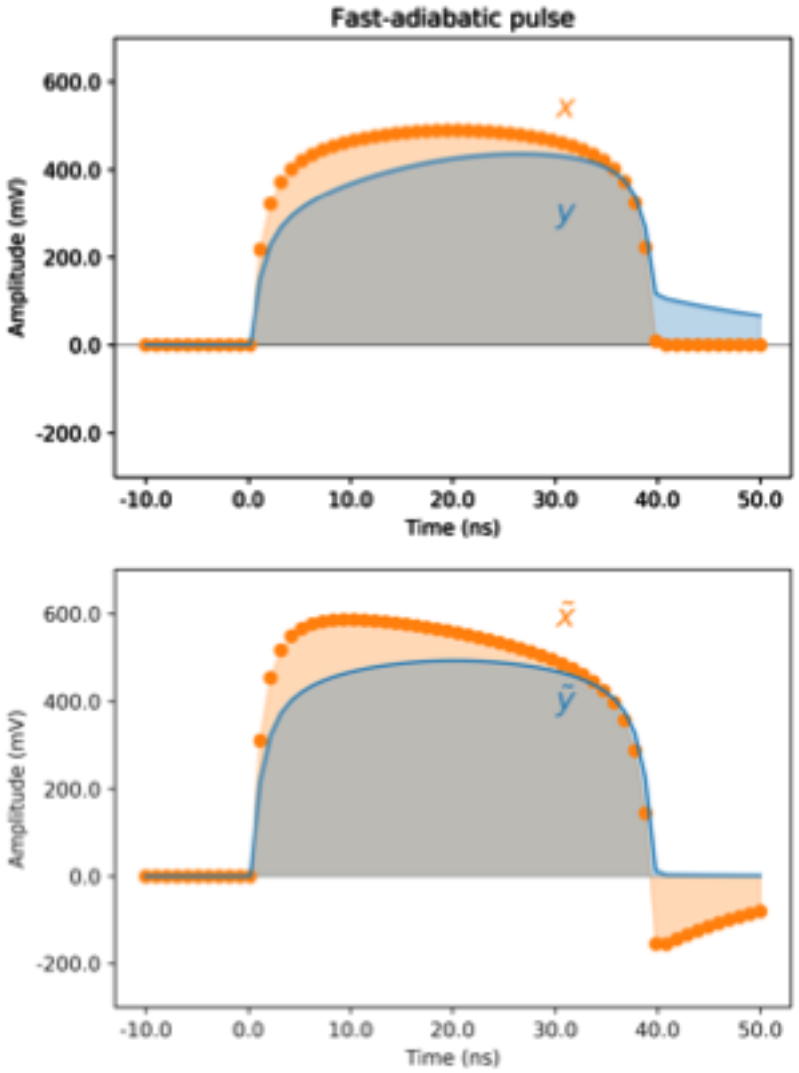
Experimental challenges

Causes of distortions

- AWG response
- Impedance mismatch
- Cables (skin effect)
- Filters (bias-tee)
- On-chip response

Key challenges

- Measuring distortions (in the fridge)
- Correcting distortions
- Mitigating the effect of distortions



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