Sources of dephasing in Si/SiGe quantum dots

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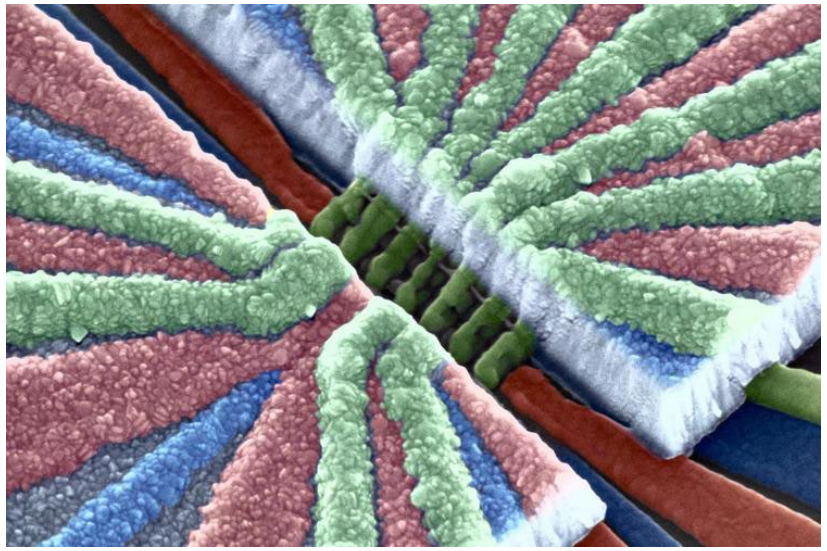
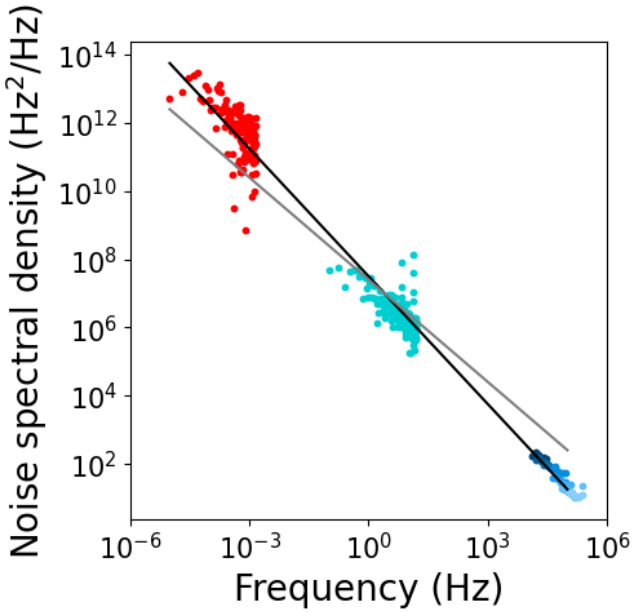
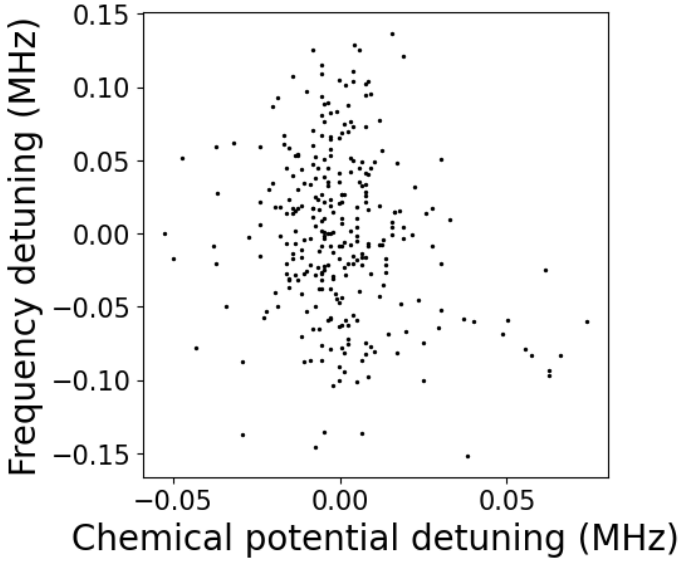


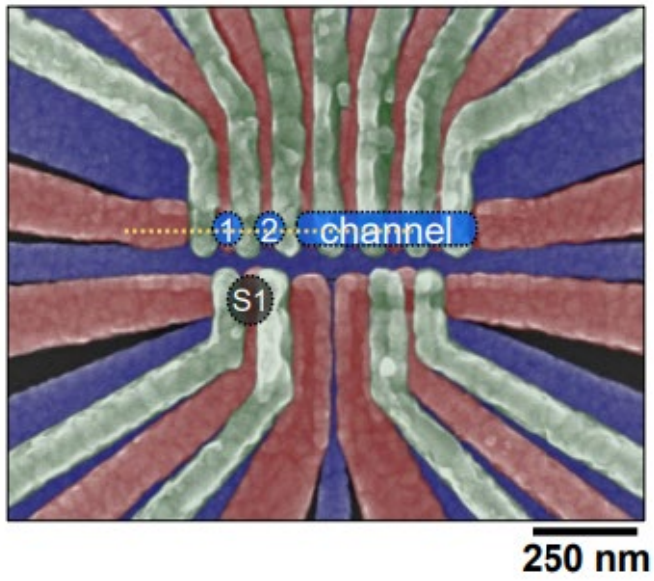
Outline

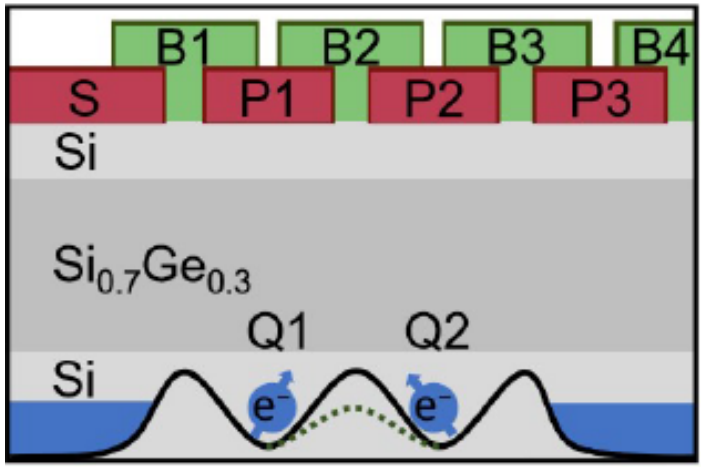
- Spectroscopy using dynamical decoupling, Ramsey, sensor dot
- Demonstrate 1/f charge noise environment across 12 decades
- **Observe lack of correlation between dot electrochemical potential detuning and frequency detuning**



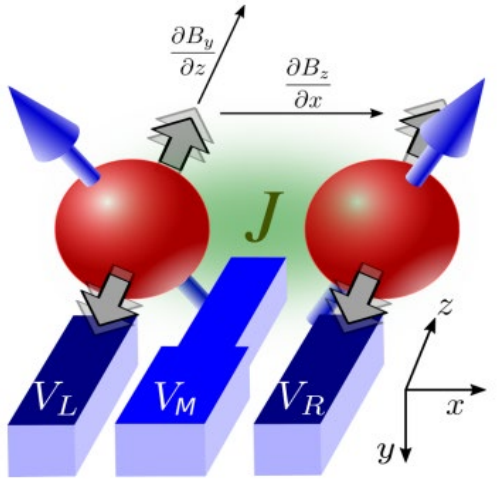


Si/SiGe spin qubits

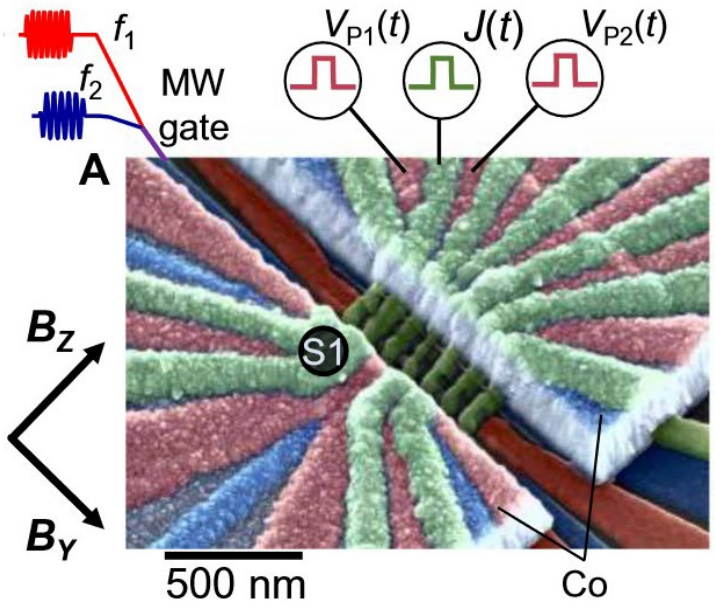




Mills *et al.*, Sci. Adv. (2022)



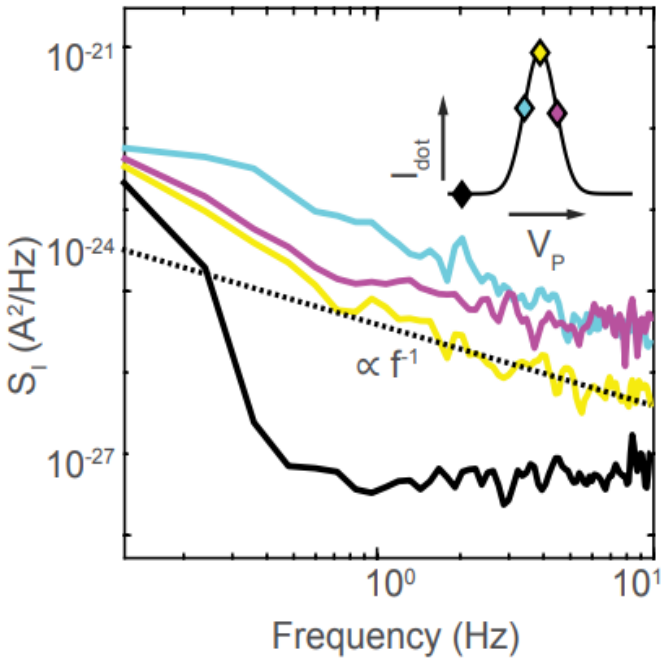
Russ *et. al.*, Phys. Rev. B (2018)



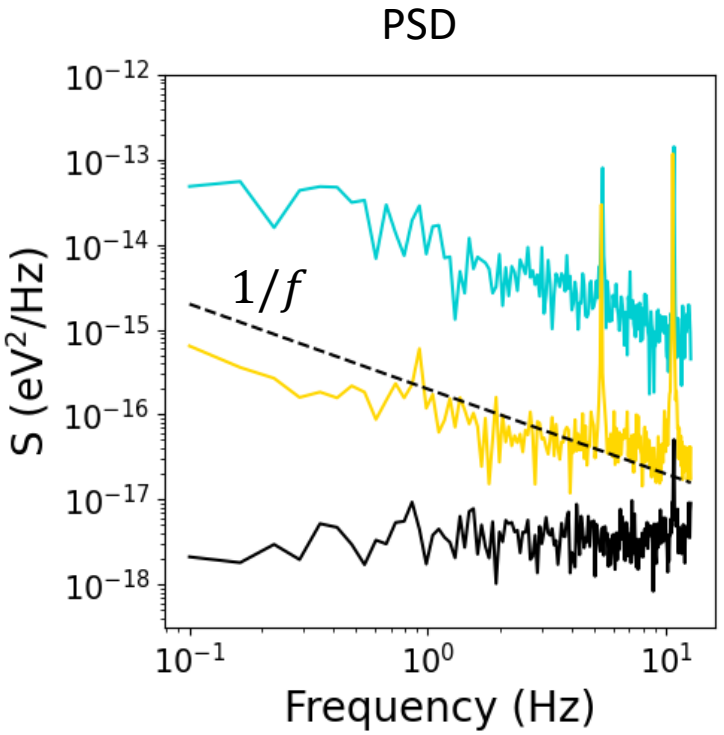
- Field gradient, ESR, EDSR control
- 2-qubit exchange coupling
- Achieved 1- and 2-qubit fidelities >99%
- $T_2^*(T_2) = 1.7(23)\mu s, 2.3(102)\mu s$ for Q1,Q2
- Significantly lower hyperfine coupling compared to GaAs

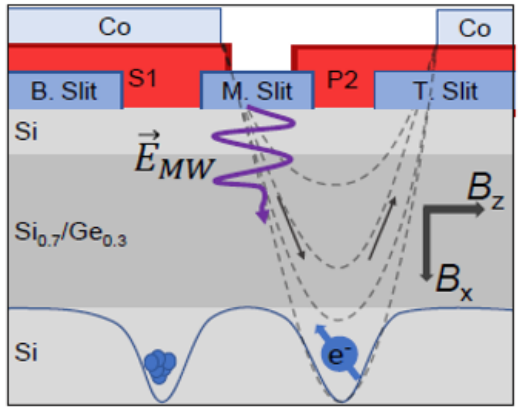
^{28}Si/SiGe heterostructure provided by HRL Laboratories, LLC

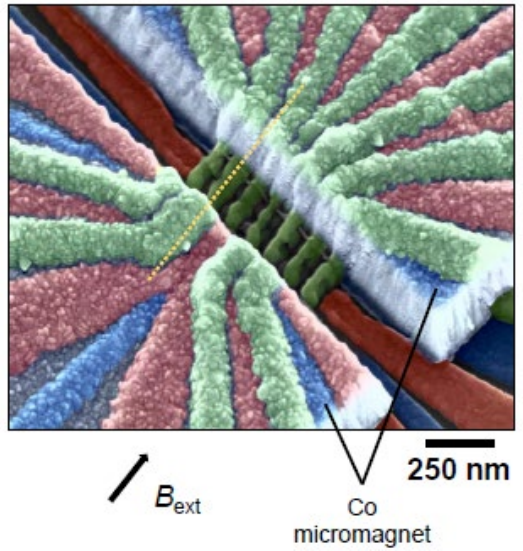
Sensor dot spectroscopy



Connors *et al.*, Phys. Rev. B (2020)



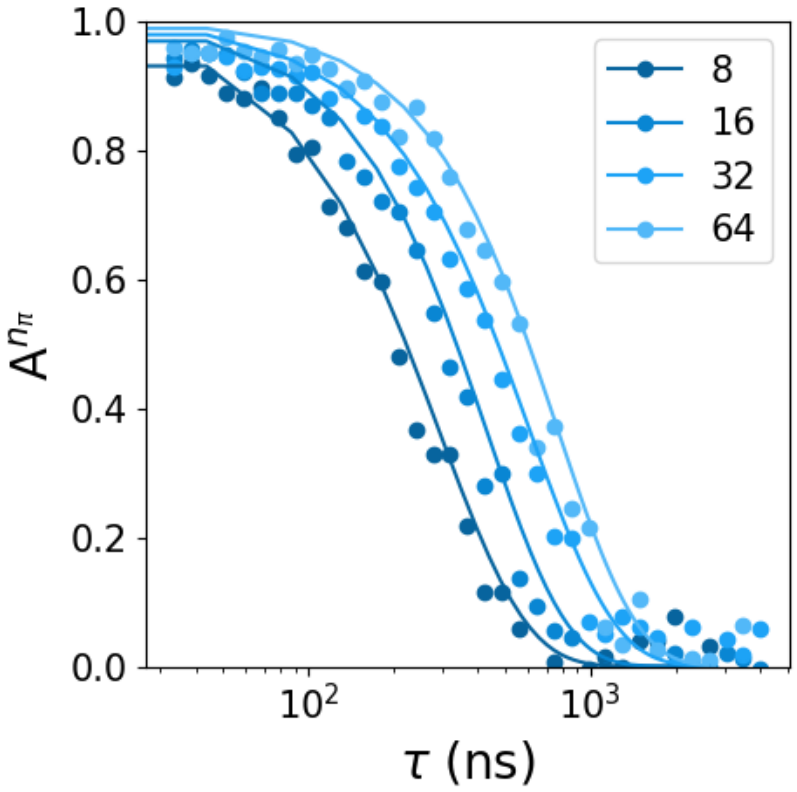


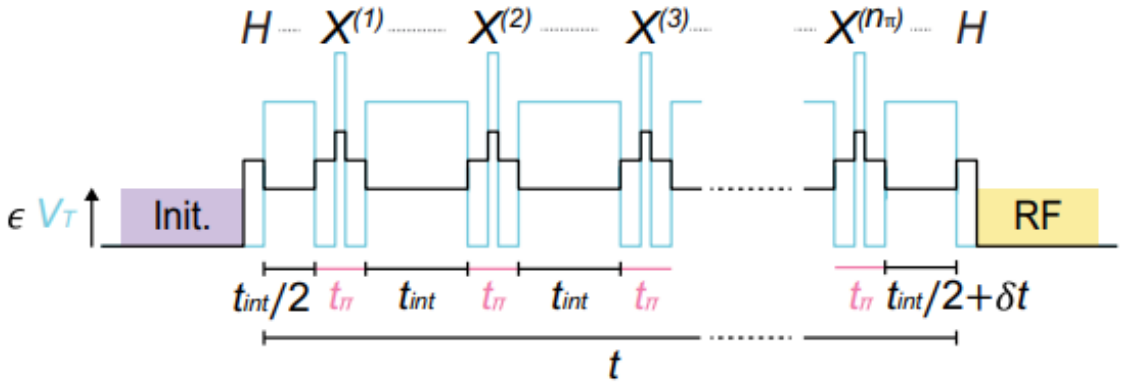


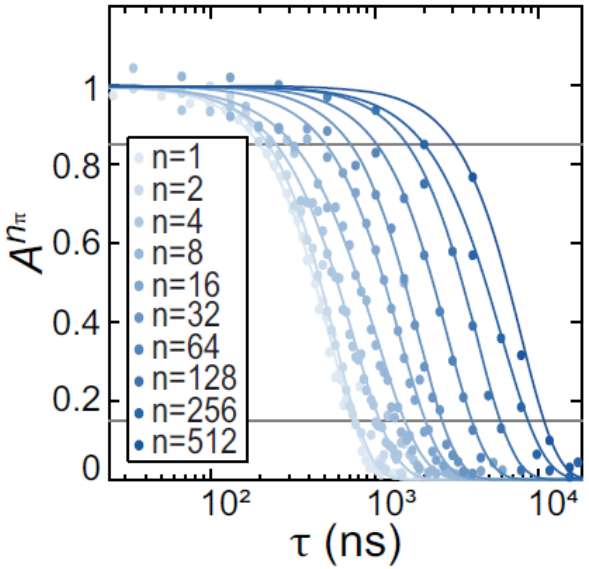
Mills *et al.*, Sci. Adv. (2022)

Spectroscopy using dynamical decoupling

CPMG



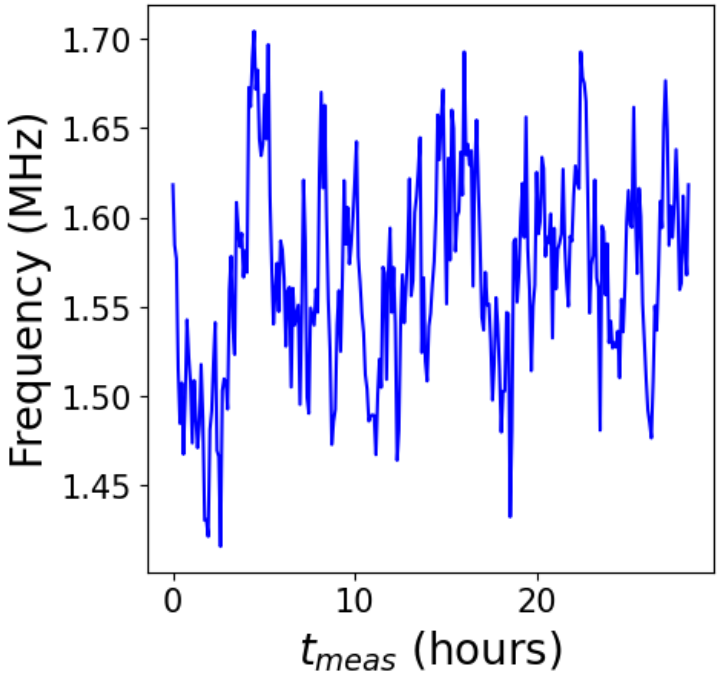




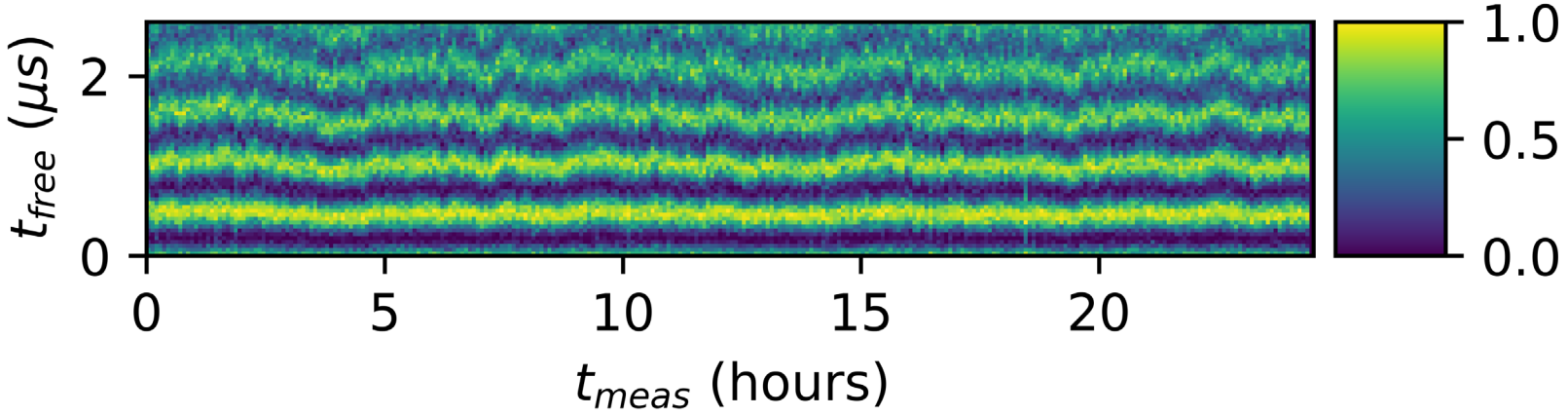
Connors *et. al.*, Nature (2023)

Frequency detuning using Ramsey

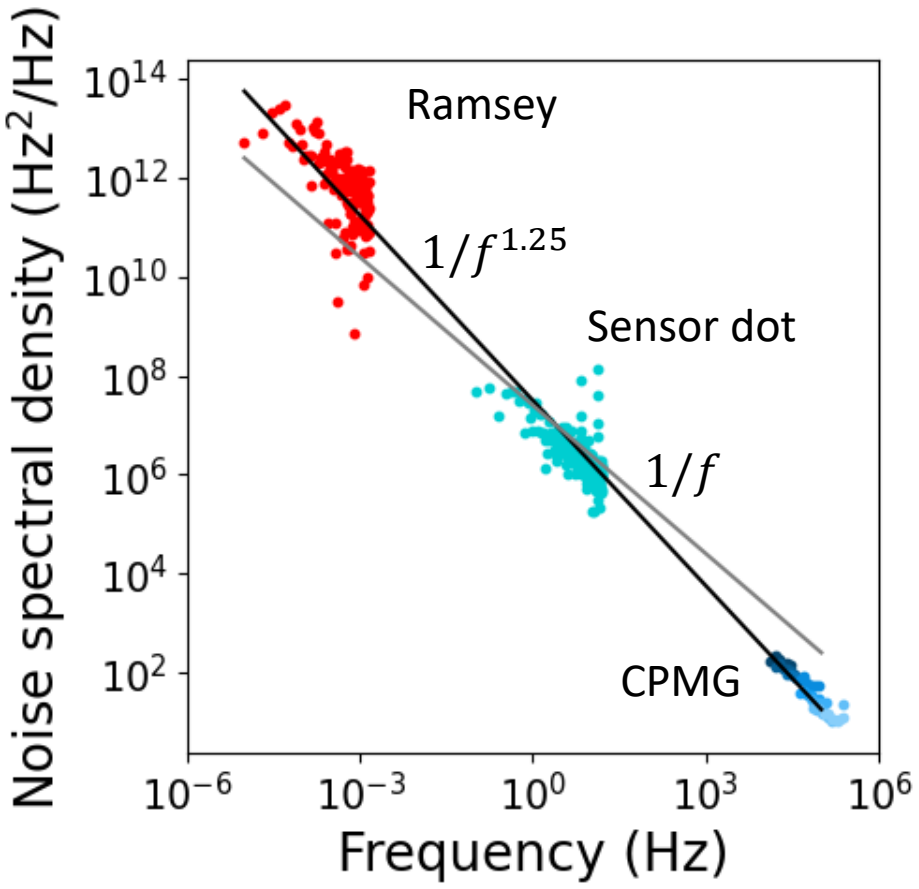
Implied frequency detuning

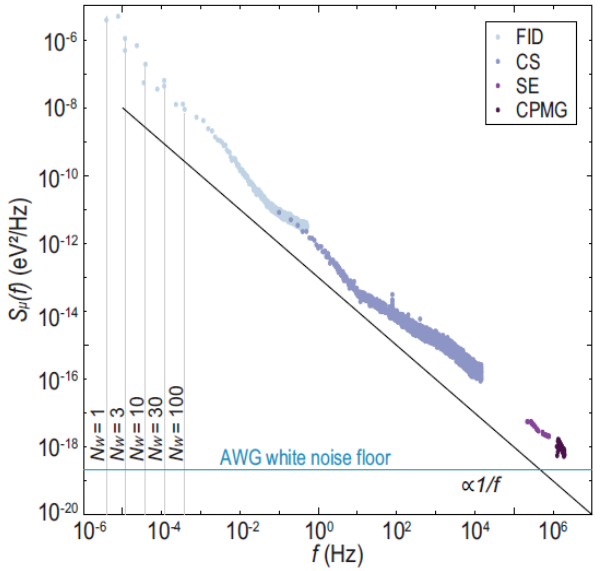


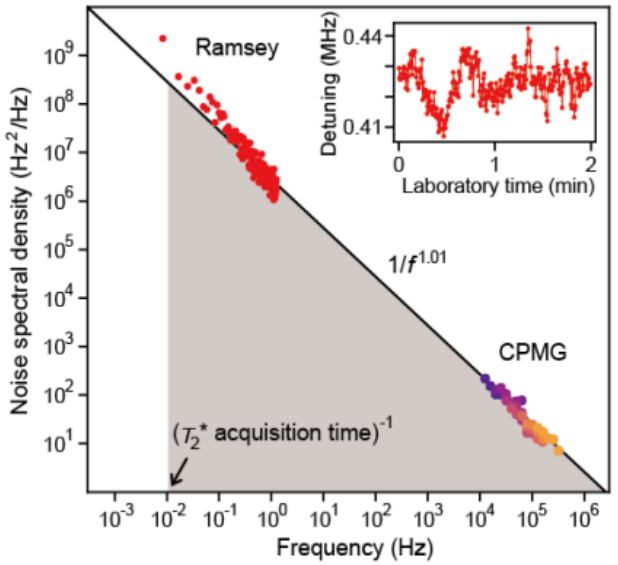
Long Ramsey experiment



Dot noise spectrum

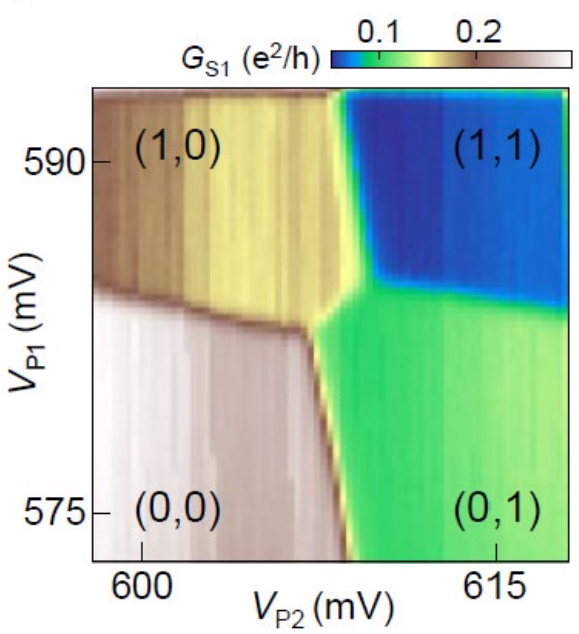


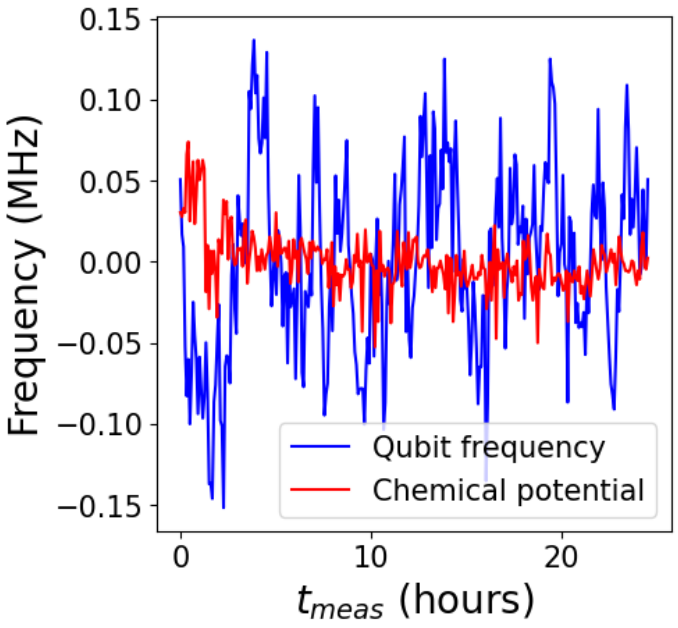


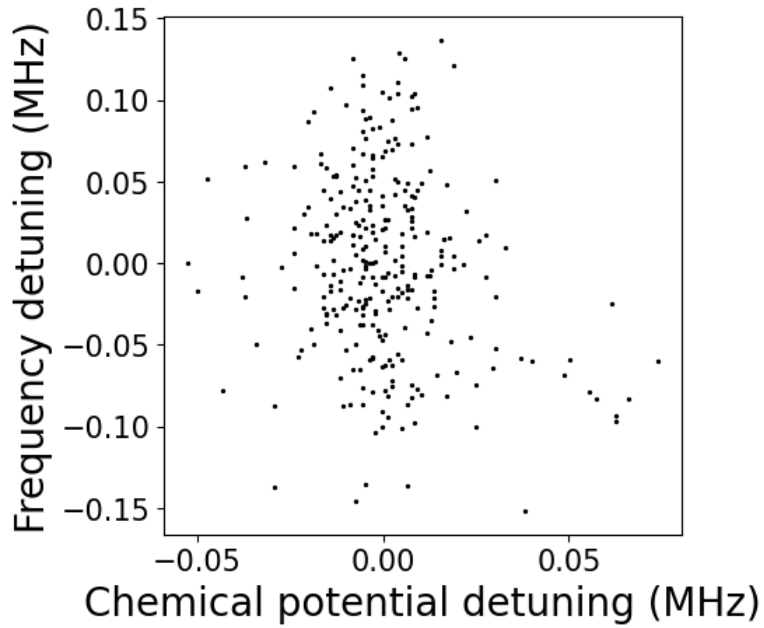


Connors *et. al.*, Nature (2023)

Dot electrochemical potential



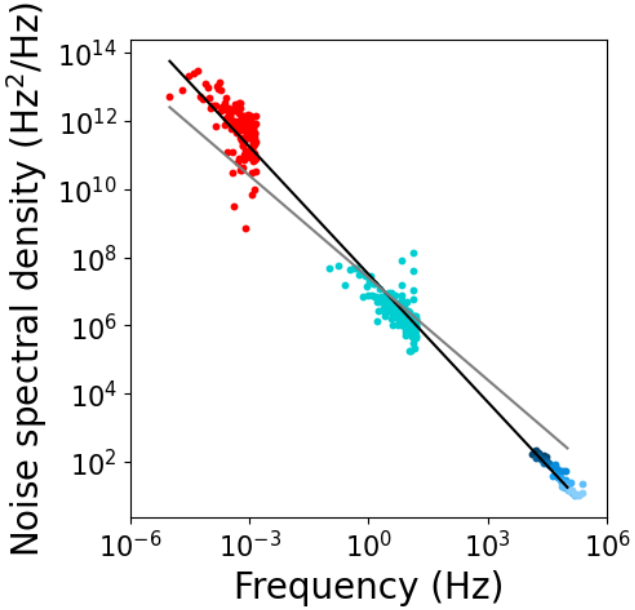


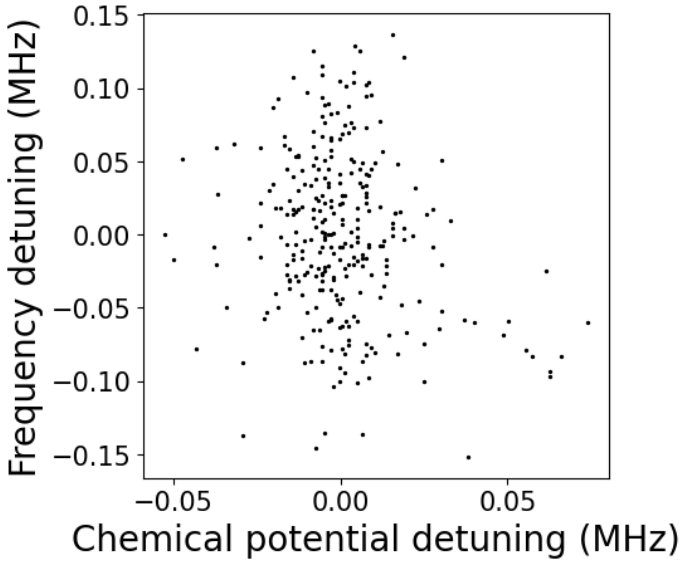


No correlation

Results

- Demonstrate 1/f noise spectrum across 12 decades using sensor dot, CPMG, Ramsey
- **No correlation between dot electrochemical potential and frequency detuning**





Backup slides

Sensor dot conductance peak