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LETTER

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Spin–orbit qubit in a semiconductor nanowire

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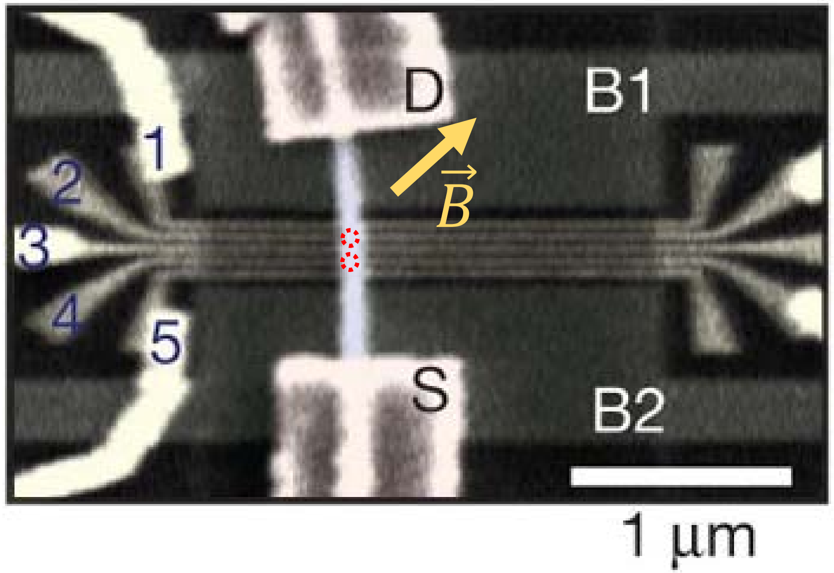
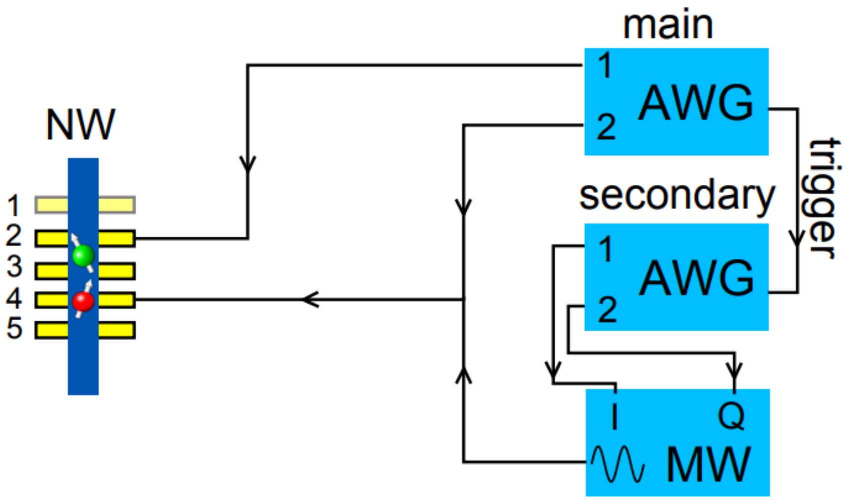
Device architecture





- undoped silicon substrates
- 5 ‘finger’ gates (Ti-Au):
  - 2 and 3 to tune the dot
  - 1, 3 and 5 to tune tunnel barriers
- InAs nanowires (50 < diameter < 80 nm)
- 2 wide gates B1 and B2 (+50 nm Si_3N_4 insulator) underneath to enhance the conductance of the NW
- He^3 refrigerator at T = 300 mK
- Inplane magnetic field (~45° to the NW)
- 2 AWG + 1 wave vector source: manipulate the Qubit

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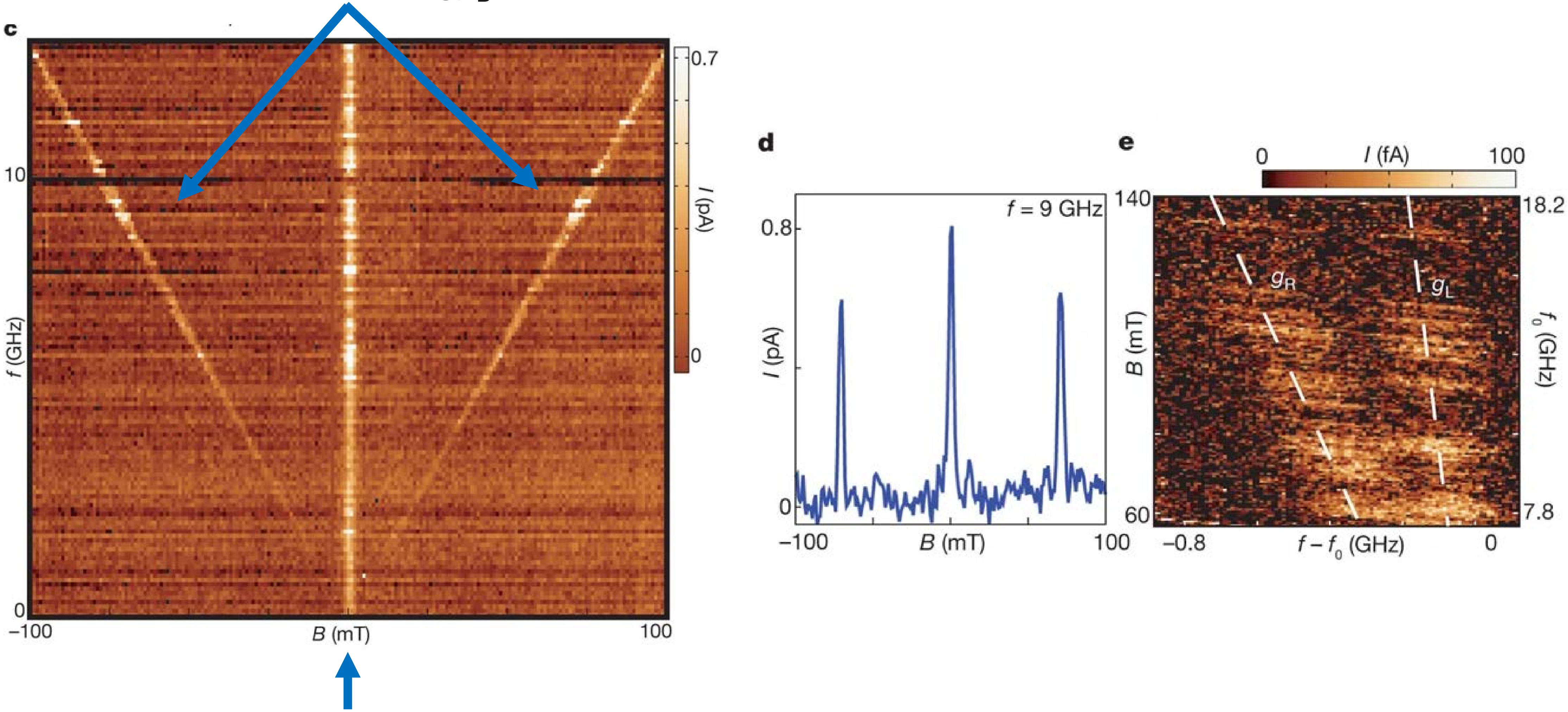
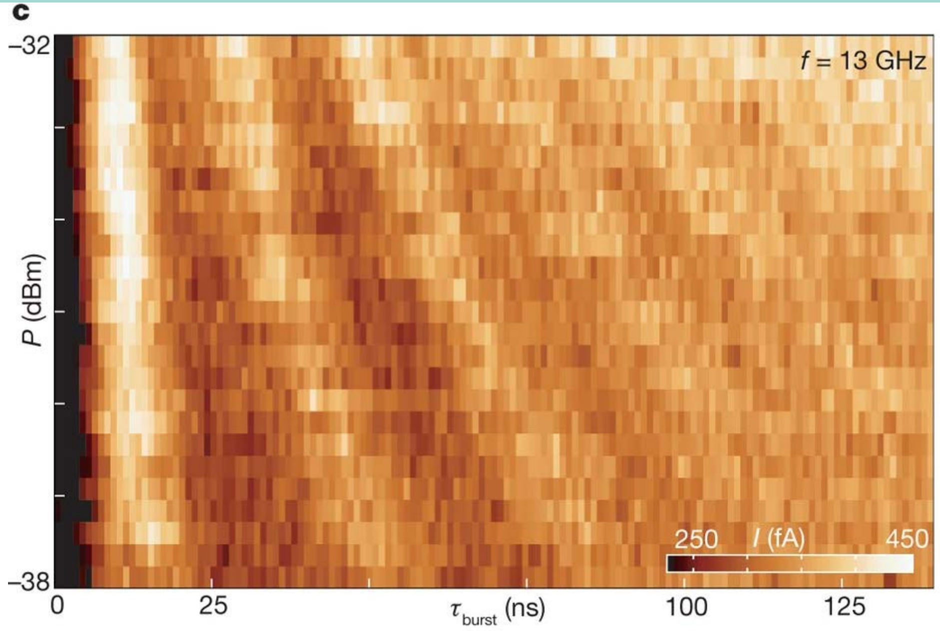
Electric-dipole spin resonance

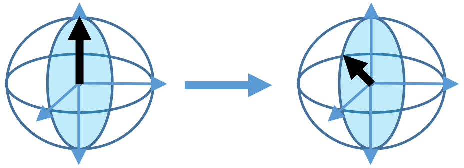
SOC $f = g\mu_B B/h$

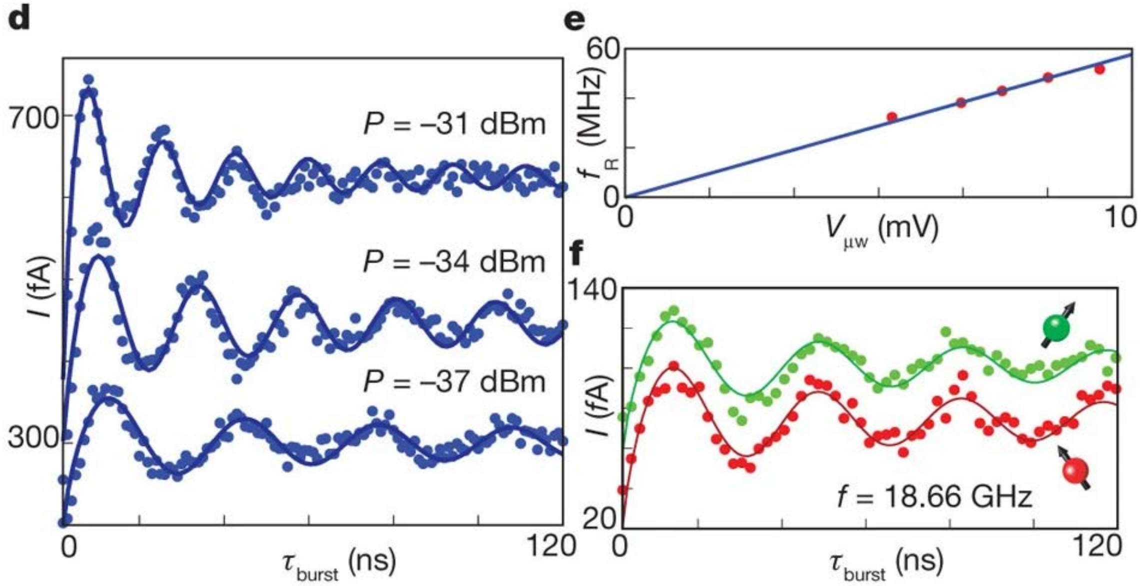


Hyperfine

Rabbi

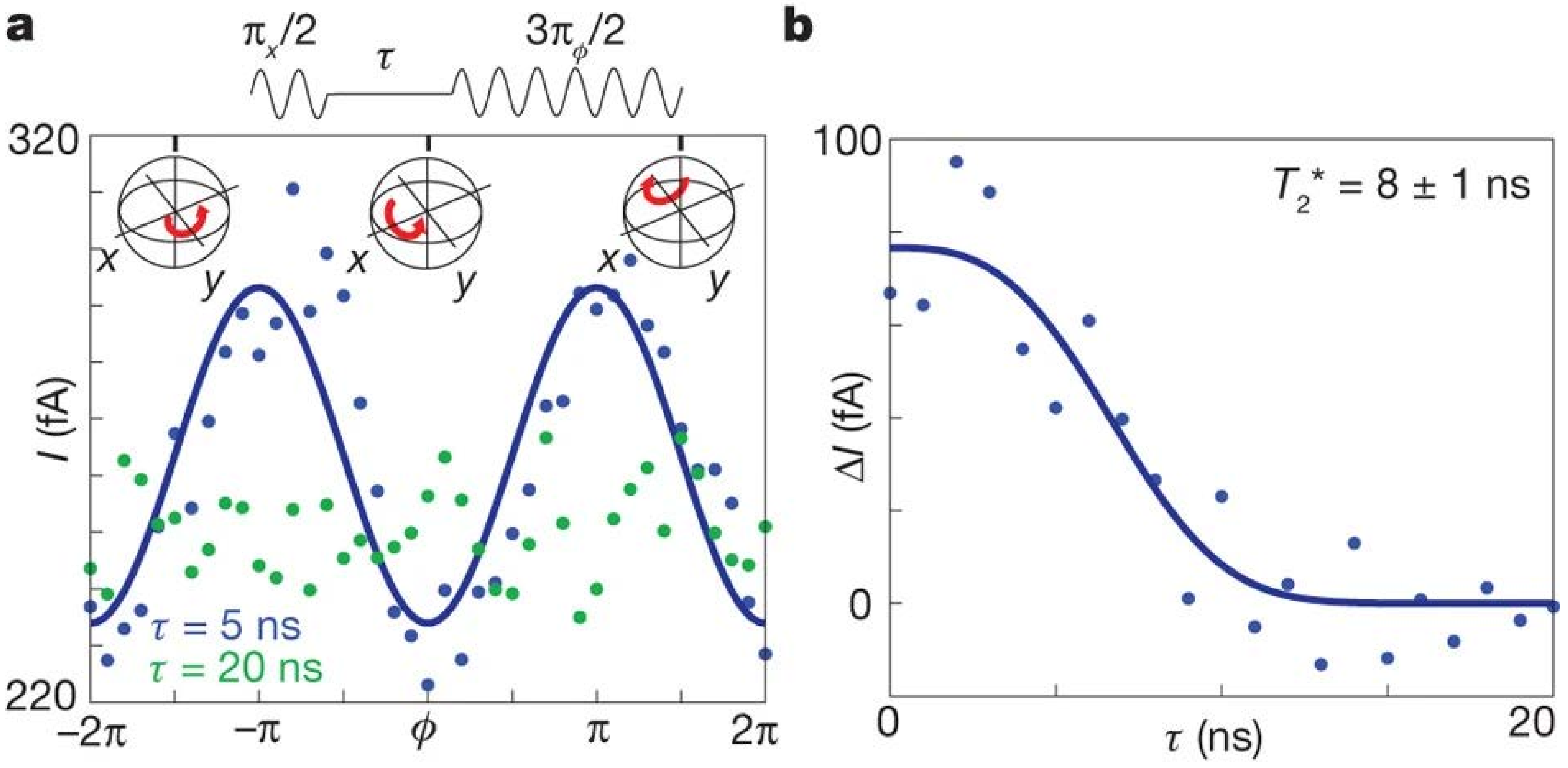






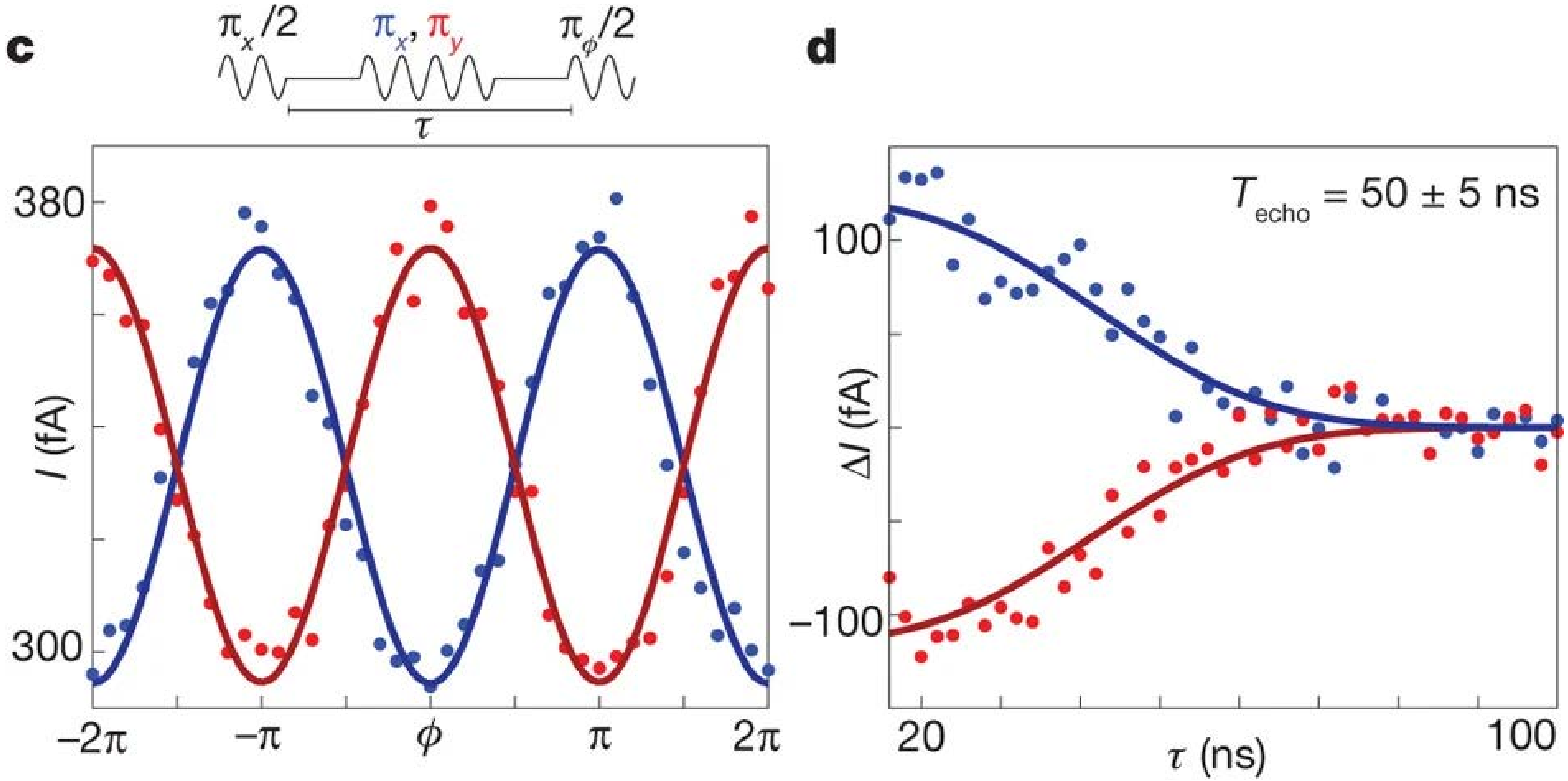
- f_R up to 58 ± 2 MHz (achieved at f = 13 GHz)
- $f_R \propto \sqrt{P}$
- Two dots have different f_R

Ramsey



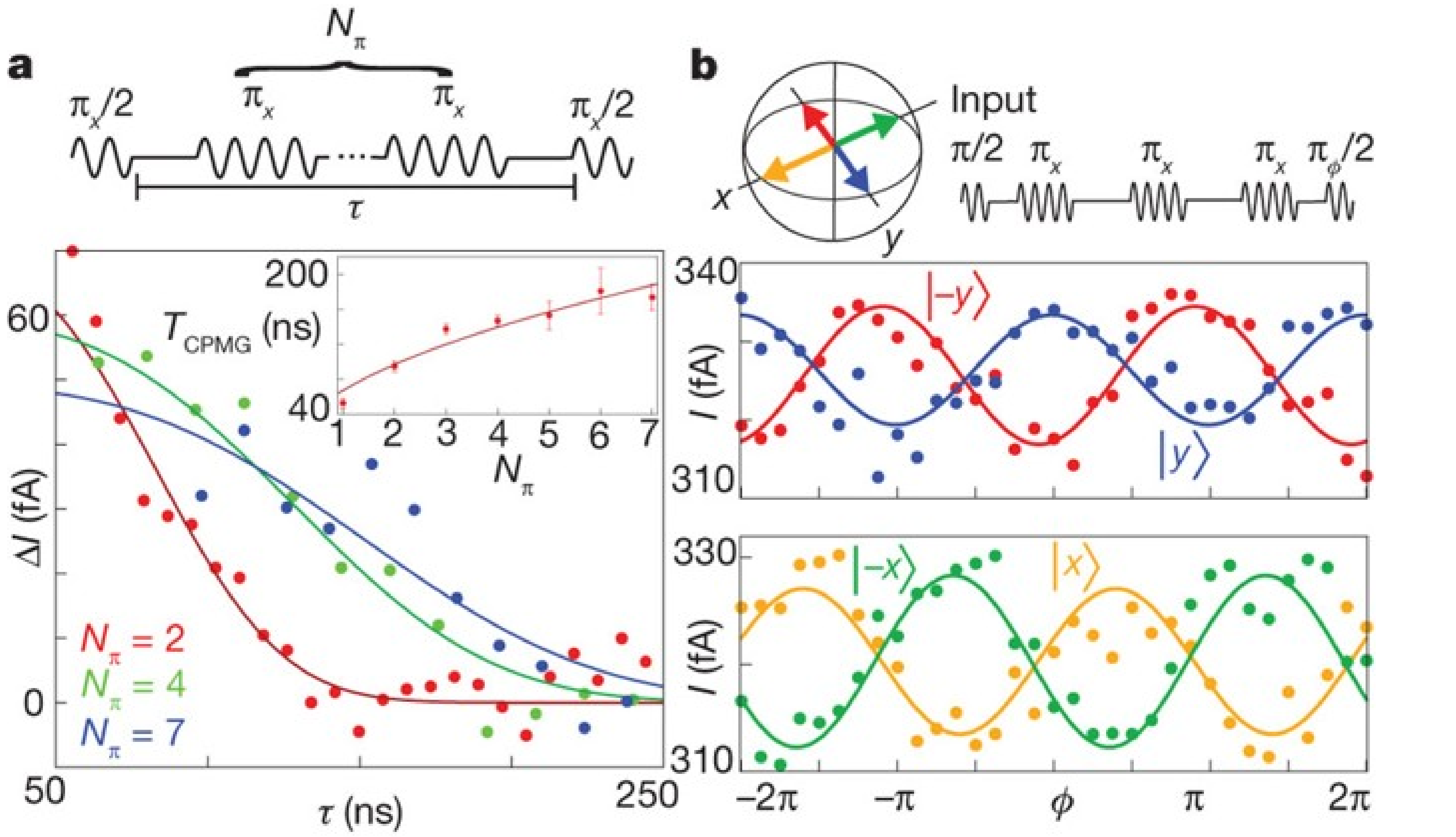
a
$\pi_x/2$
τ
$3\pi_\phi/2$
320
220
I (fA)
x
y
τ = 5 ns
τ = 20 ns
−2π
−π
ϕ
π
2π
b
100
0
ΔI (fA)
T_2^* = 8 ± 1 ns
0
20
τ (ns)

Han echo



- T_{echo} = 50 ns > T_2^* = 5 ns but still low (explain by a faster nuclear spin fluctuations caused by the large nuclear spin of indium, *I* = 9/2)

CPMG dynamical-decoupling pulse sequences



Conclusion

- Using NW => Strong SOC => fast rabbi
- Small T_{echo} (~50ns) but improved with CPMG
- T_{echo} could be improve using nuclear spin state

Thanks

Thank you for your attention!