Single Impurity Electronics for Quantum Computing
Anisotropic Hyperfine Interaction (AHF)

Challenge / Objective:

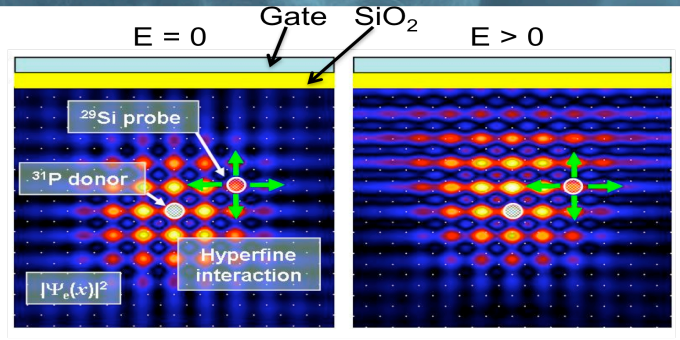
- Can a single impurity donor wavefunction(wf) be experimentally mapped?

Approach:

- Indirectly probe wfs by measuring anisotropic hyperfine (AHF) tensor components.
- Use Si-29 as a single probe atom or a sample of probe atoms
- Calculate donor wfs in realistic geometries and electric fields
- Propose experiment:
  Distort wf by electric fields and interfaces
  => distort AHF
  => measure AHF based on lattice symmetries
  => map the wavefunction

Results / Impact:

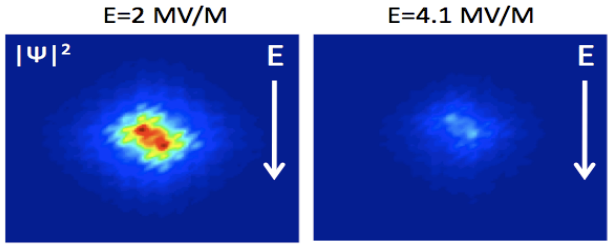
- Demonstrated numerical stability of AHF calculation through semi-analytic comparison (toy wavefunctions)
- Demonstrated distortion of tight binding wavefunctions and toy wfs of different symmetries produce signature AHF maps.
- Preparing a full journal publications



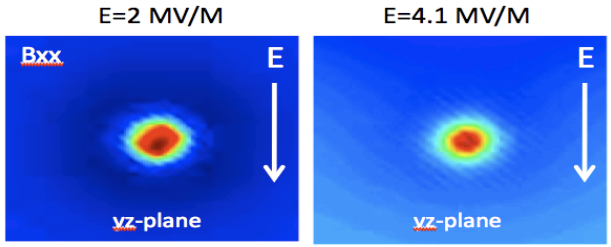
Magnetic Dipolar (super hyperfine) Interaction

$$A_{ij} = \gamma_I \gamma_S \hbar^2 \left(\frac{8\pi}{3} |\Psi(0)|^2 \delta_{ij} + \left\langle \Psi \left| \frac{3x_i x_j - r^2 \delta_{ij}}{r^5} \right| \Psi \right\rangle \right)$$

ENDOR Experiments can measure A_{ij} --> Indirect measure of WF



Hyperfine Map



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