Quantum-Dot Cellular Automata (QCA)

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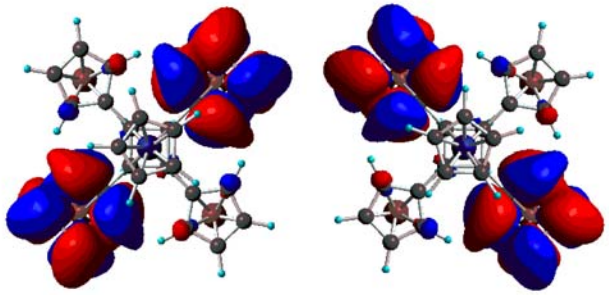
QCA

- Objective: a switching device that gets **better** as it gets smaller
- Computing paradigm based on electronic charge configuration rather than current switching
- A better approach to molecular electronics?
- Takes full advantage of molecular scales



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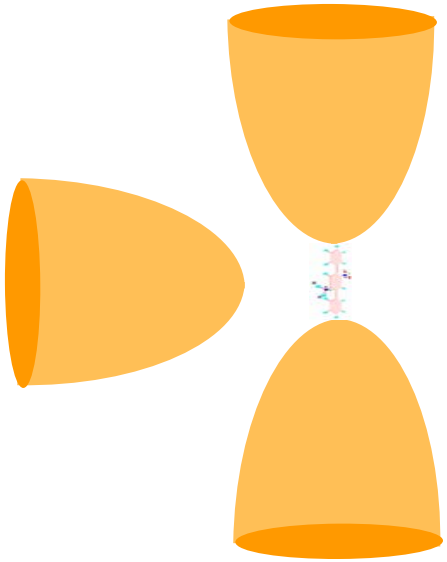
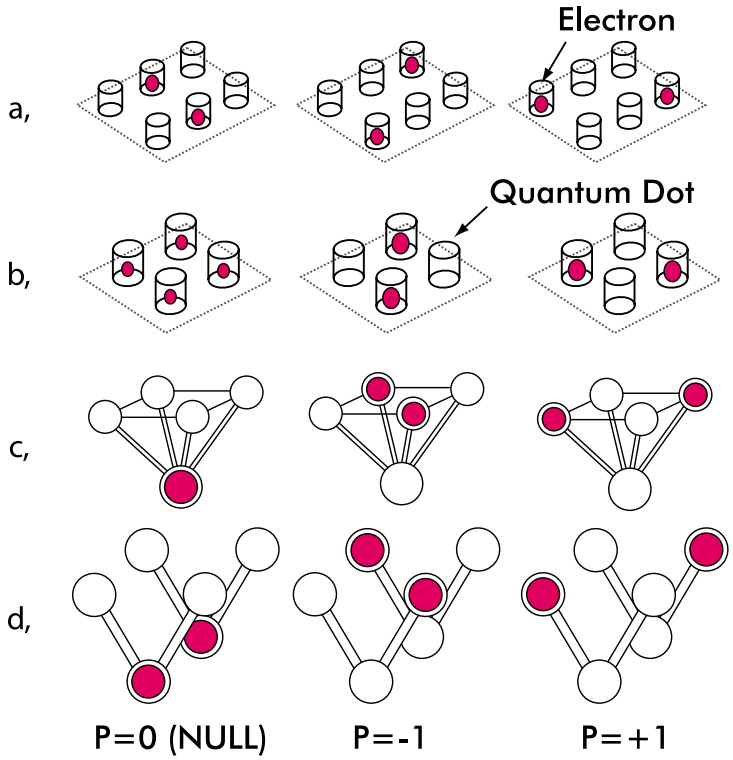
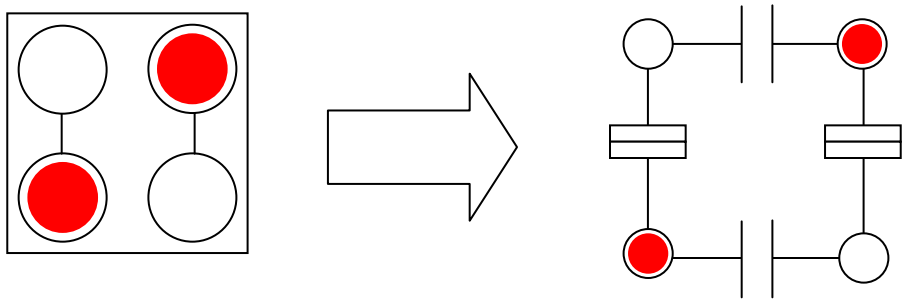


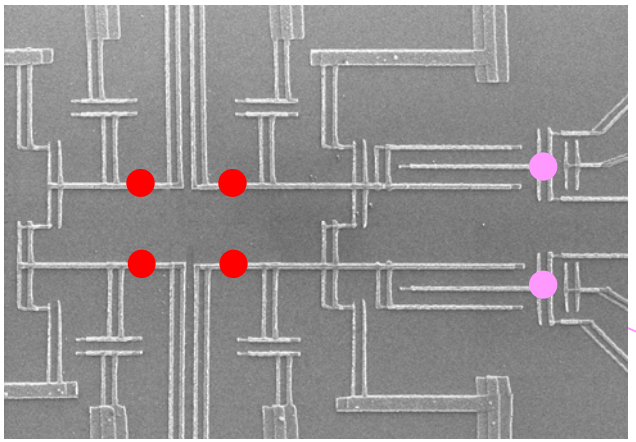
Where is the benefit of small?



Fabricated QCA Devices



Metal-dot QCA implementation



Al/AlO_x on SiO_2

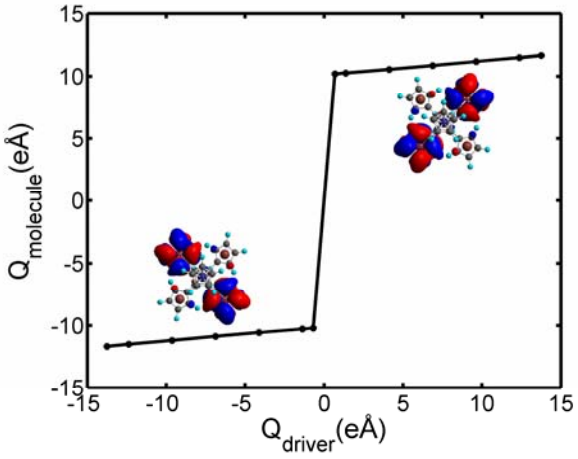
electrometers

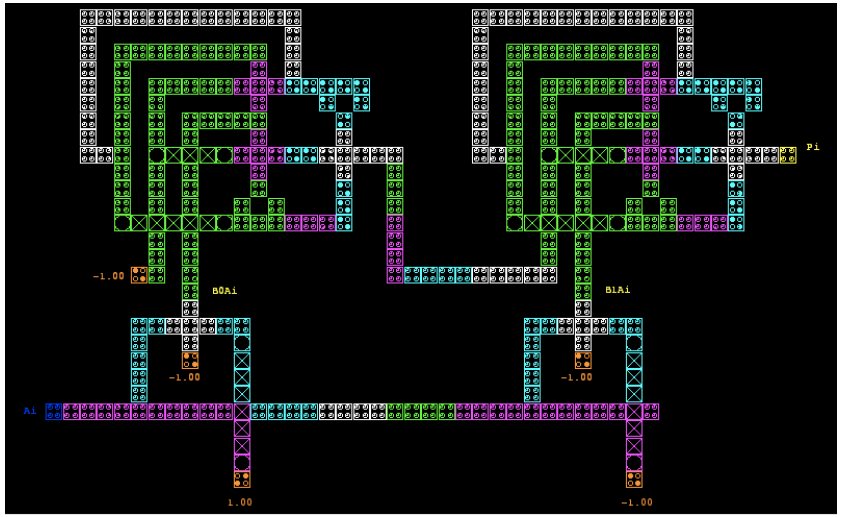
"dot" = metal island

70-300 mK

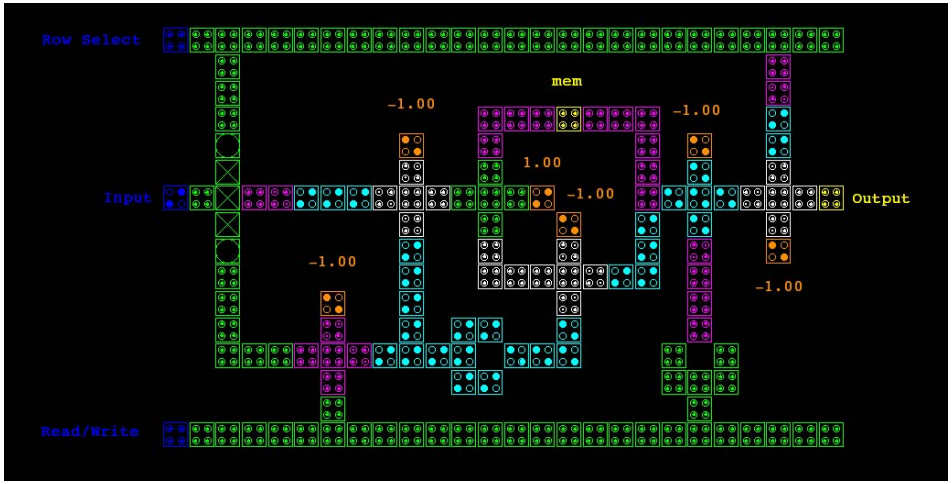
QCA

- Nonlinear charge interaction between cells
- Circuits are created with arrays of cells
- Many standard circuits have already been designed





Multiplier



Memory Cell

Our Research Objectives

- Develop experimental platforms for QCA based on 2DEG, metal-island, and SOI.
  - Require mK characterization
  - Require nm lithography
- Develop simulation and design tools based on these results.
- Develop architectures which take full-advantage of the unique properties of QCA.