

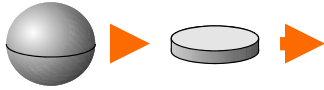
# Moving Planar Catoms

## Electromagnetic Prototype Modules for Claytronics

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- 2D cross-sections of 3D spherical catoms



- Enable us to study using electromagnets for cooperative movement
- Latest revision adds IR communication, plus magnet robustness to go  $>360^\circ$
- What limits us from scaling down?  
1) electronics size, 2) magnet fabrication

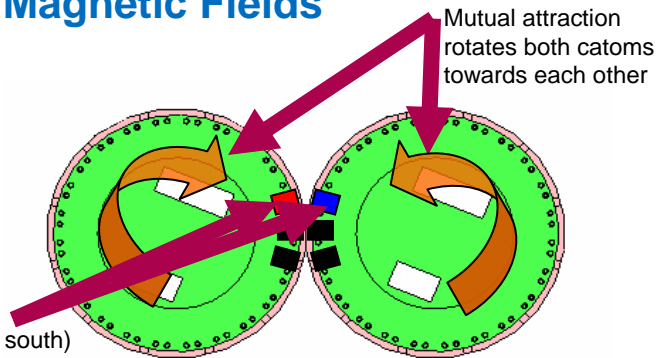


Pairs of Catoms from prototypes 7 through 2 (left to right)

## Locomotion Through Coordinated Magnetic Fields

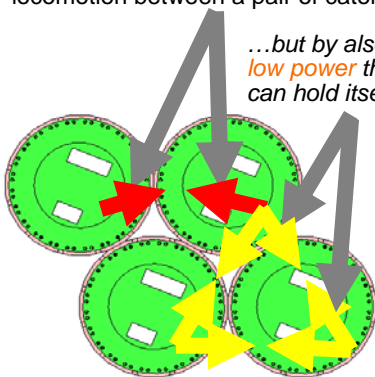
- Neighbor's cooperation required to move
- All catom movement is relative – with only 2 catoms each spins an equal/opposite angle
- With more catoms, a rotor catom will move across the (mostly) stationary ensemble

Energizing close but not yet touching electromagnets with opposite fields (north, south) creates a powerful attractive force



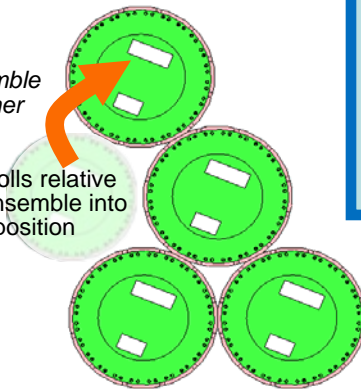
## Movement in a Larger Group of Catoms

Using high power induces relative locomotion between a pair of catoms



...but by also using low power the ensemble can hold itself together

Catom rolls relative to the ensemble into its new position



### Successes

- Moving robots without moving parts
- Uninterrupted, complete rotation ( $>360^\circ$ ) of two catoms [new!]
- Bolt-together design for increased reliability [new!]
- IR communications hardware [new!]