HeatWatch:

Improving 3D NAND Flash Memory Device Reliability by Exploiting Self-Recovery and Temperature Awareness

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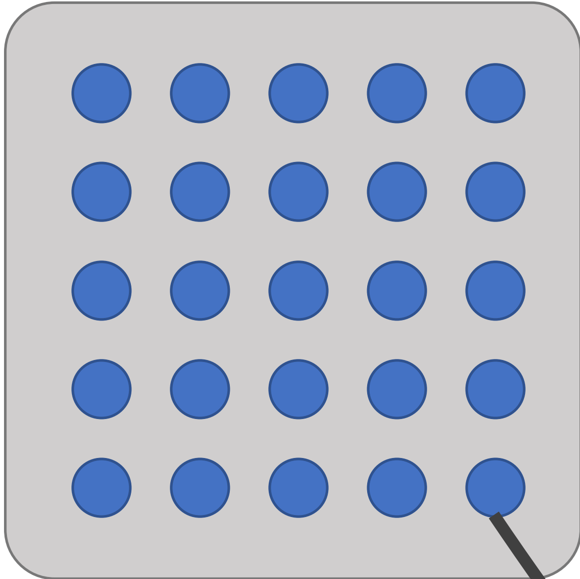
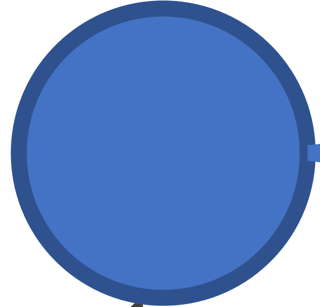
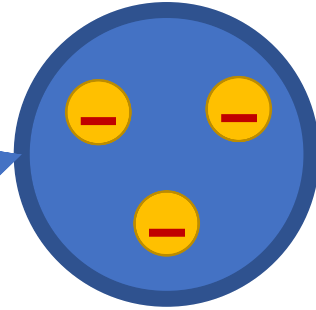
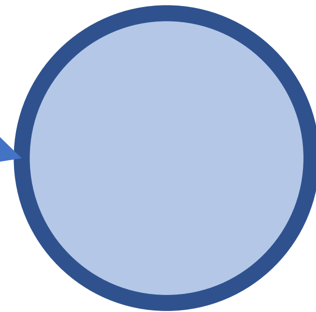

NAND Flash Memory

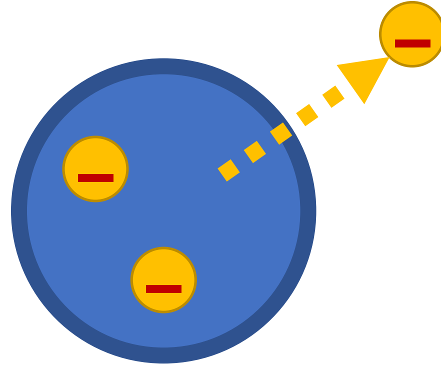

Flash Cell

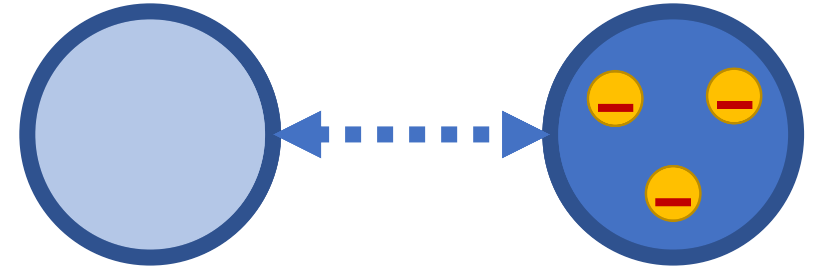

Higher Voltage State
Data Value = 0

Read Reference Voltage


Lower Voltage State
Data Value = 1

Flash Reliability and Lifetime Factor





1. Retention Loss Speed

2. Program variation

Physical Phenomenon

Self-Recovery Effect

Temperature Effect

Our Contributions

3D NAND Flash Characterization

First experimental characterization

Real 3D NAND chips

Self-recovery slows down retention loss by: **40%**

High temperature increases program variation by: **21%**

URT Model

A new comprehensive model that **unifies** 4 most significant effects that affect flash reliability

Prediction error rate: **4.9%**

HeatWatch

A new mechanism that **adapts** read reference voltage to **access pattern and temperature**

Improves flash lifetime by: **3.85x**

Memory/Storage overhead: **<1.6MB**

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Session 6A – Tuesday 11:20 AM

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Paper download link:
http://yixinluo.com/index_files/heatwatch_hpca18.pdf