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# Magnetic Skyrmions

and their application potential

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(idw) Nachrichten
Informationsdienst Wissenschaft
Pressemitteilungen von über 1.000 Wissenschaftseinrichtungen

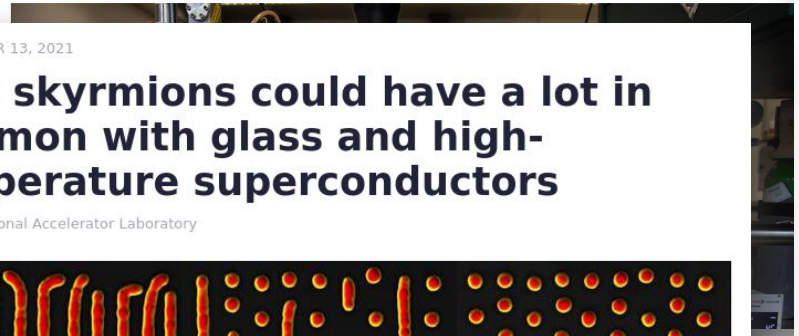
1 Sperrfristmeldung (idw)

Technik & Industrie | Gesellschaft & Kultur | Gesundheit | Umwelt & Leben | Wirtschaft & Politik | Fachunabhängig

21. Dezember 2020, 11:53

Forschungsergebnisse

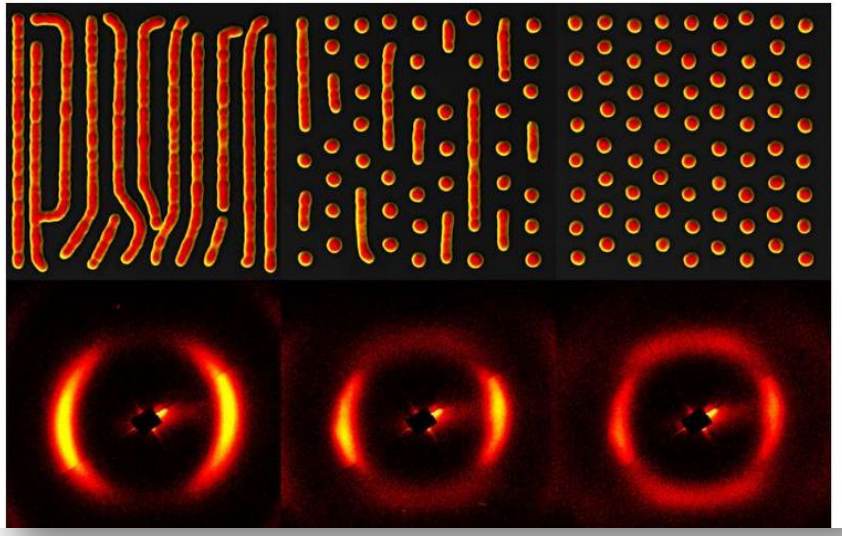
# Skyrmionen – Grundlage für eine vollkommen neue Computerarchitektur?



OCTOBER 13, 2021

# Why skyrmions could have a lot in common with glass and high-temperature superconductors

by SLAC National Accelerator Laboratory



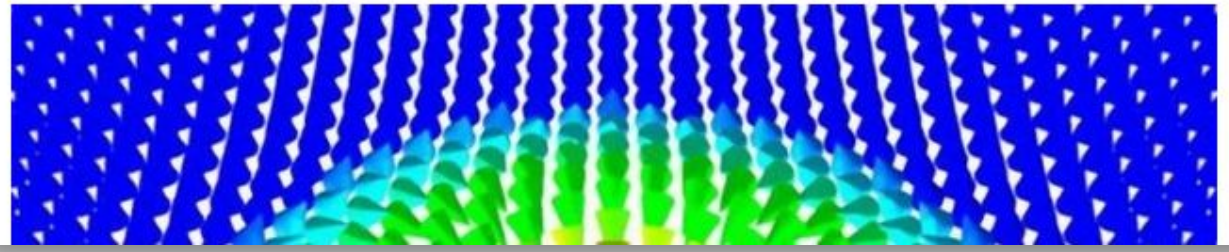
28.10.2020 | Materialentwicklung | Im Fokus | Onlineartikel

# Mit Skyrmionen ist zu rechnen

Autor: Dieter Beste

16:30 Min. Lesedauer

Die Existenz magnetischer Skyrmione als teilchenartige Objekte konnte 2013 nachgewiesen werden. Da sie eine hohe Stabilität gegenüber äußeren Einflüssen zeigen, sind sie vielversprechende Kandidaten für künftige Datenspeicher.



# A UNIFIED FIELD THEORY OF MESONS AND BARYONS

T. H. R. SKYRME †
*A.E.R.E., Harwell, England*

Received 29 September 1961

# Skyrmion Lattice in a Chiral Magnet

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*To whom correspondence should be addressed; E-mail: christian.pfleiderer@frm2.tum.de.

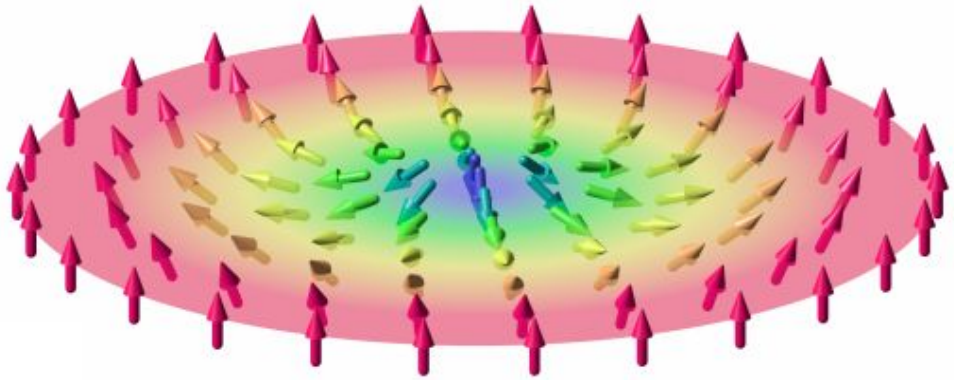
February 11, 2009

# What is a Skyrmion?

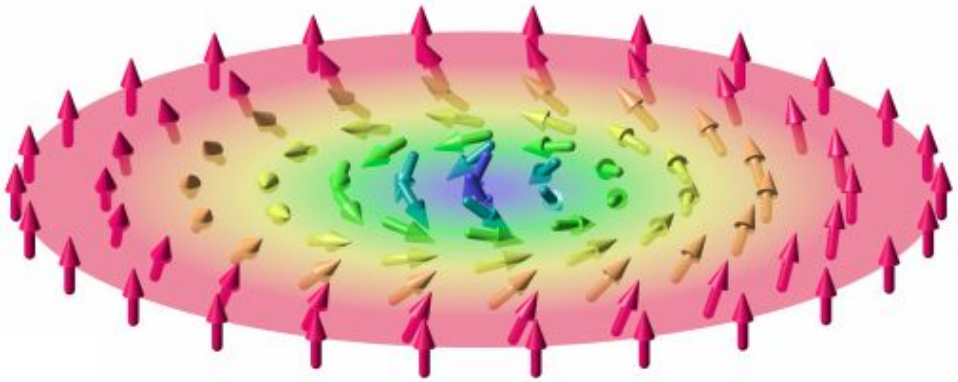


$$E_{ex} = J \cdot (\mathbf{S}_1 \cdot \mathbf{S}_2)$$

$$E_{DM} = -\mathbf{D}_{12} \cdot (\mathbf{S}_1 \times \mathbf{S}_2)$$



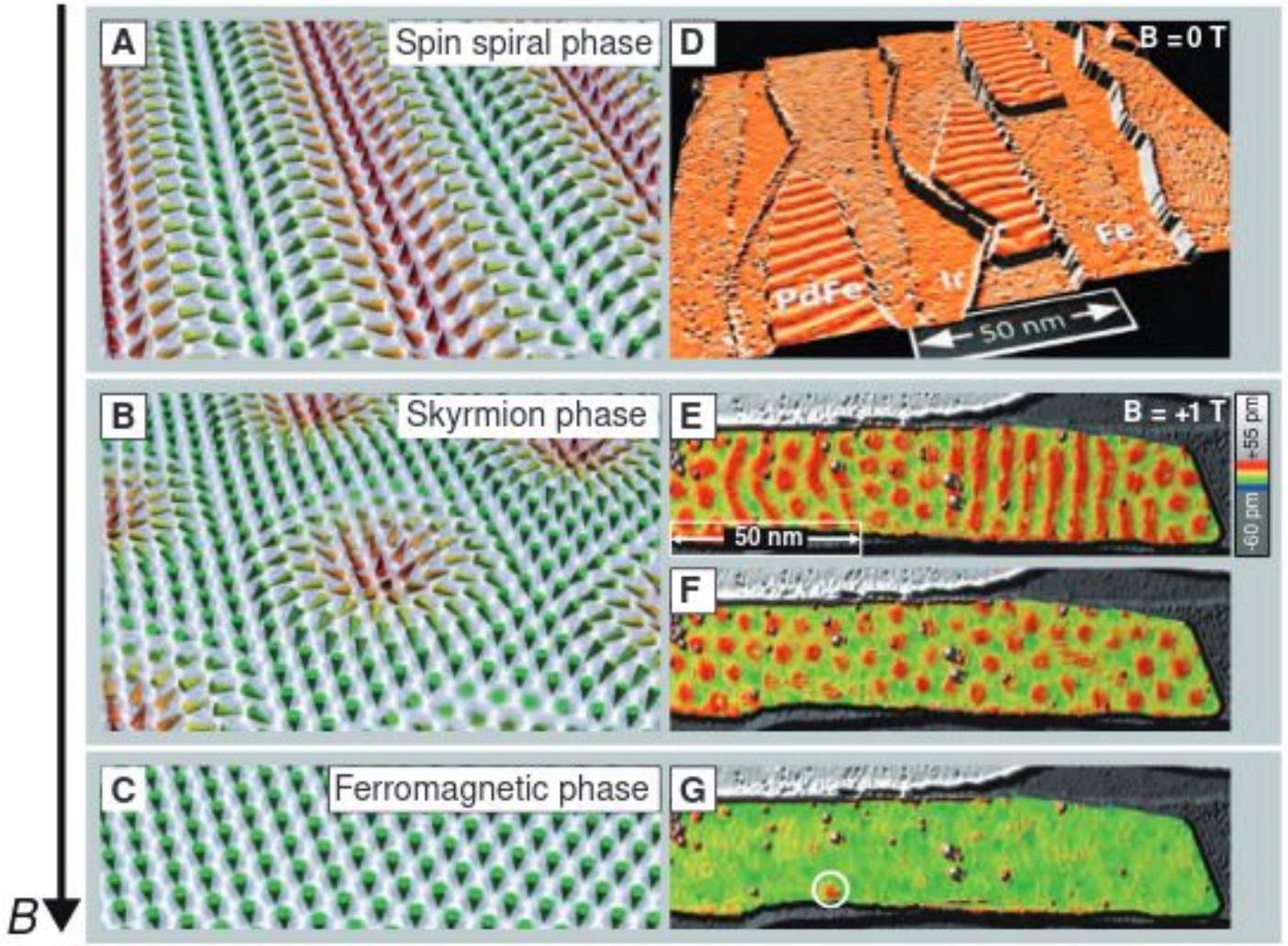
Néel Skyrmion



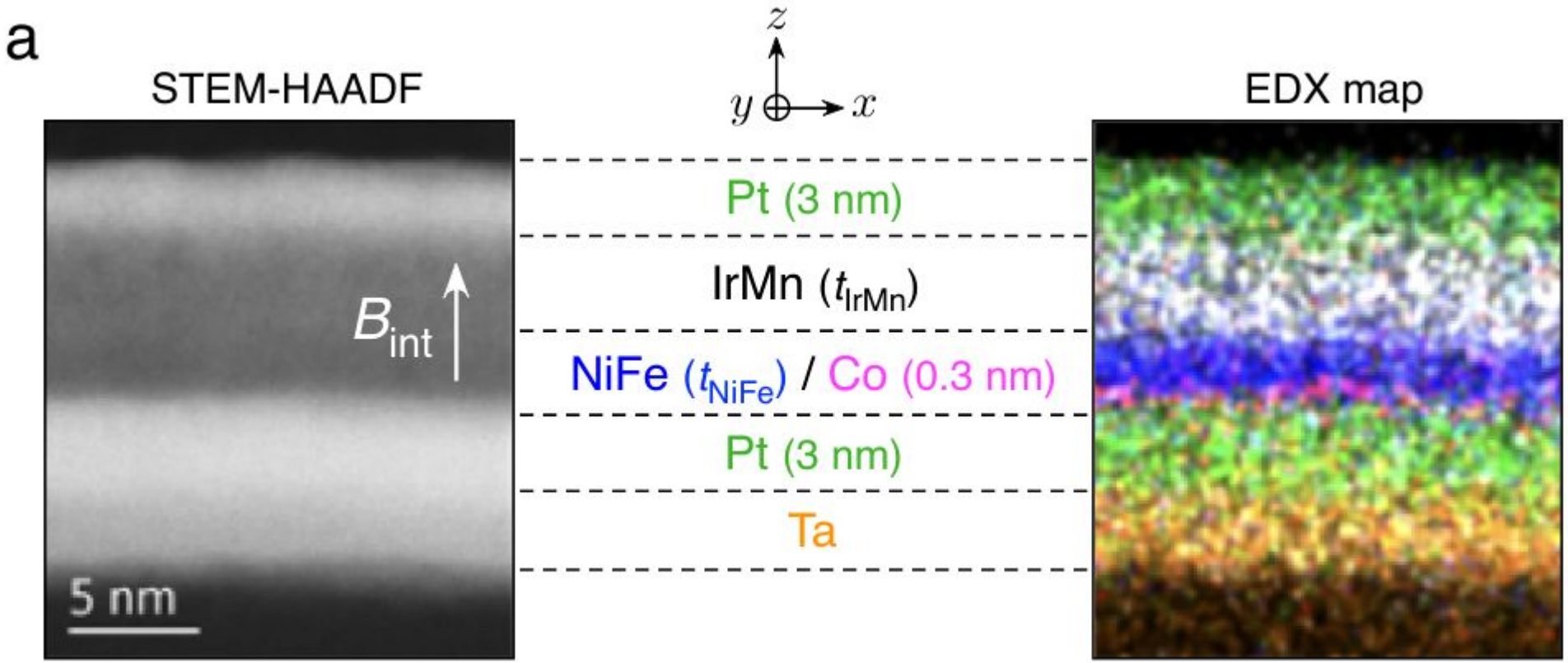
Bloch Skyrmion

# Stability of Skyrmions



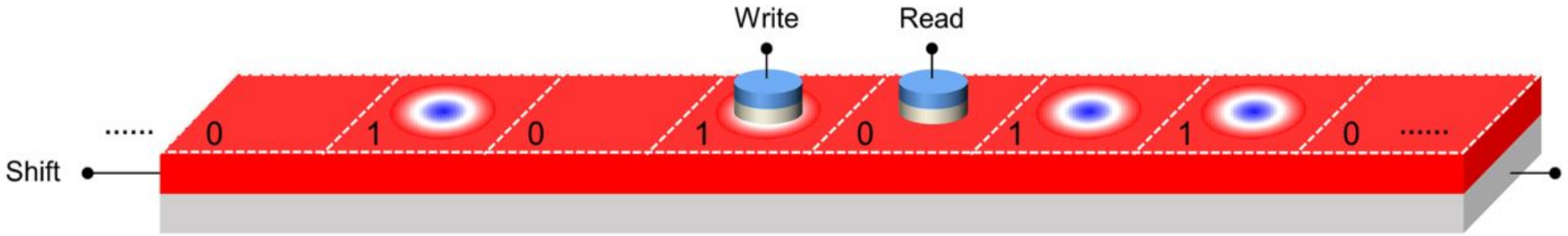


# Stability of Skyrmions



# Racetrack Memory





# How to compute?

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Have a stable Platform

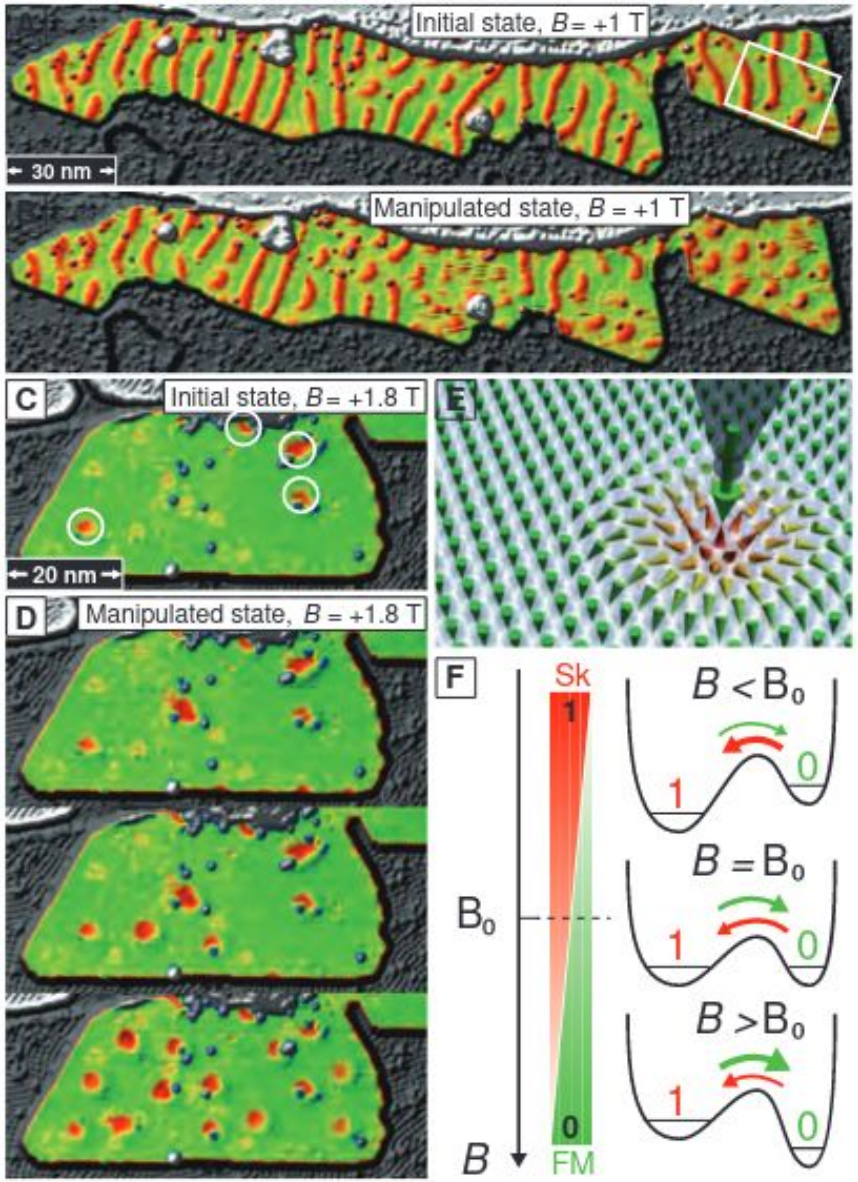
Write and delete data in Storage

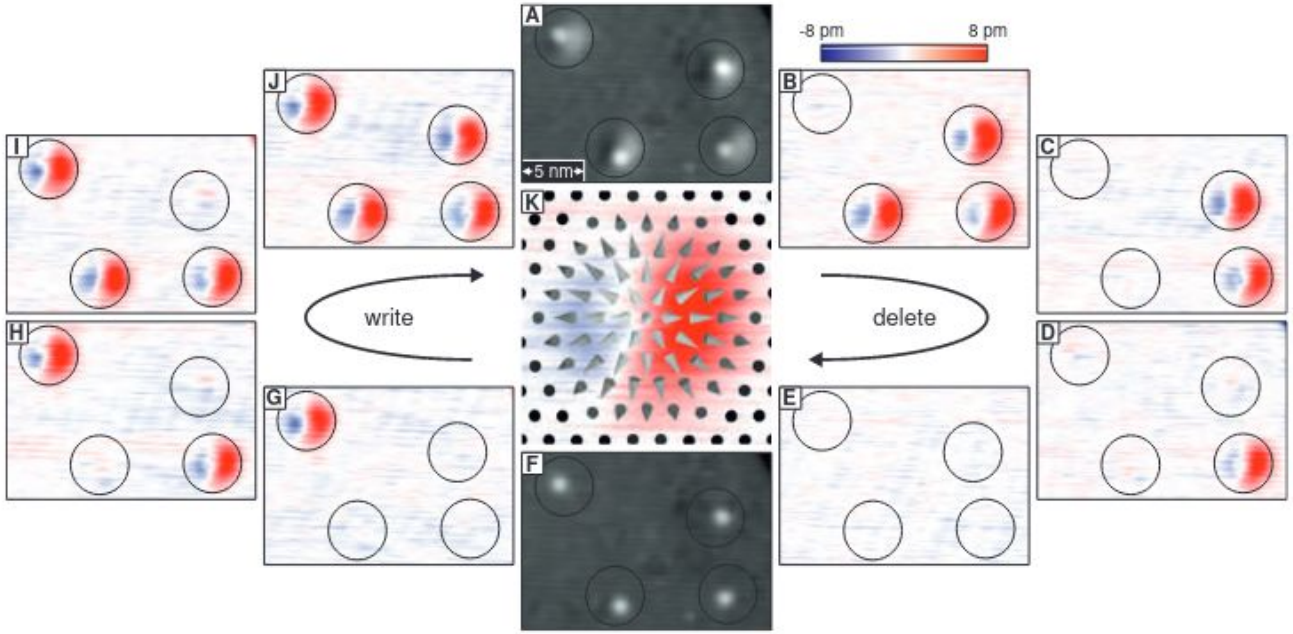
Read data from Storage

Move data

Manipulate data -> Logical gates

# How to write and delete data



# How to read data

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## Imaging

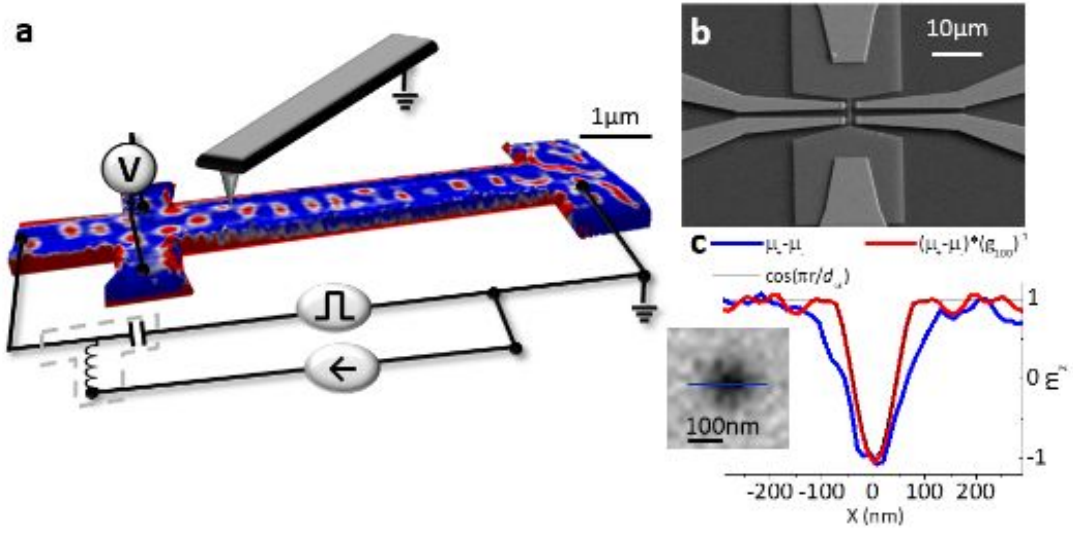
- **S**pin **P**olarized **S**canning **T**ransmission **M**icroscopy
- X-ray
- etc.

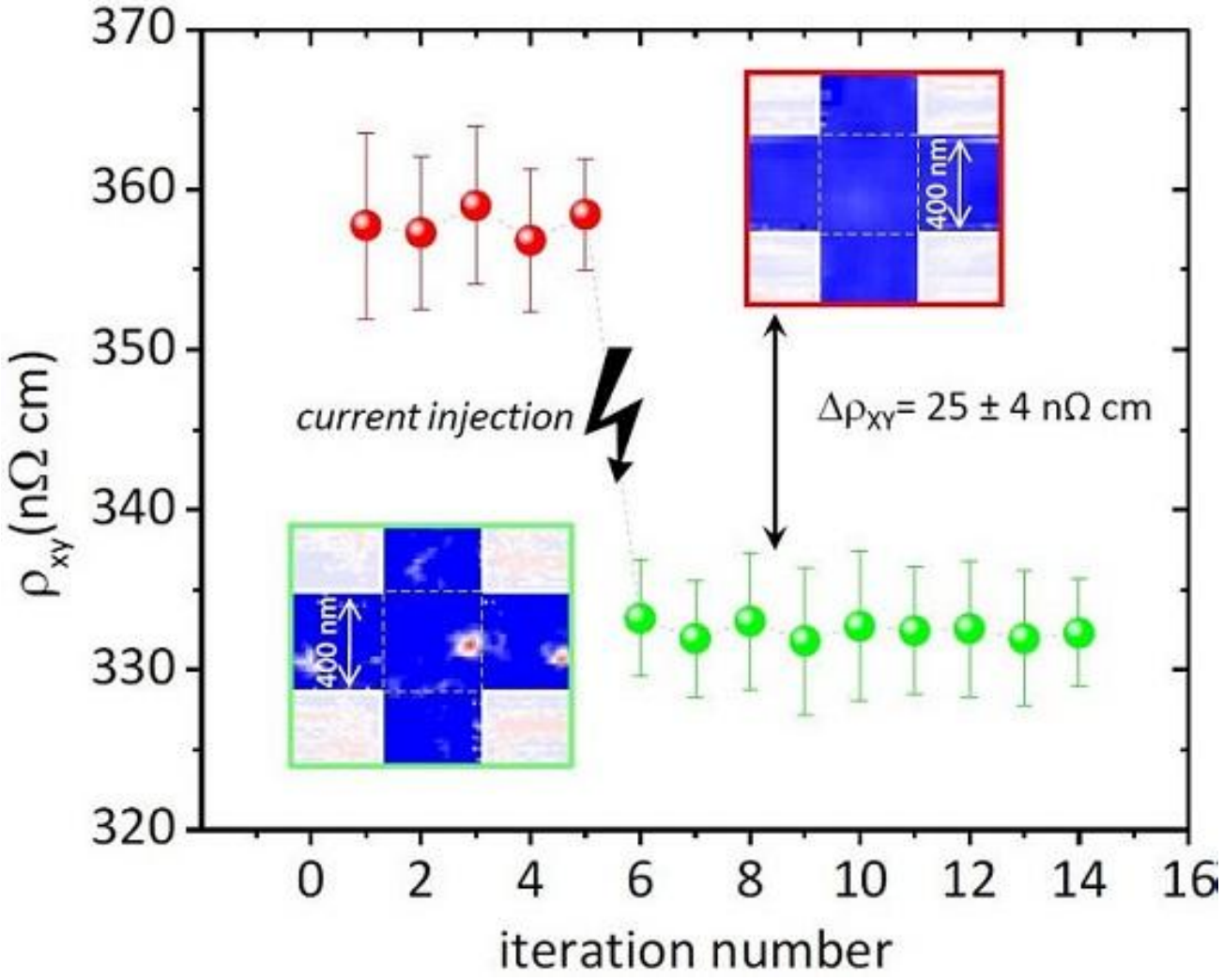
## Electrical

- **M**agnetic **T**ransfer **J**unction
- **T**opological **H**all **R**esistivity
- etc.

# Topological Hall Resistivity

$$\rho^{\mathrm{THE}} = P \cdot R_0' \cdot (n_{\mathrm{sk}} \cdot \Phi_0)$$



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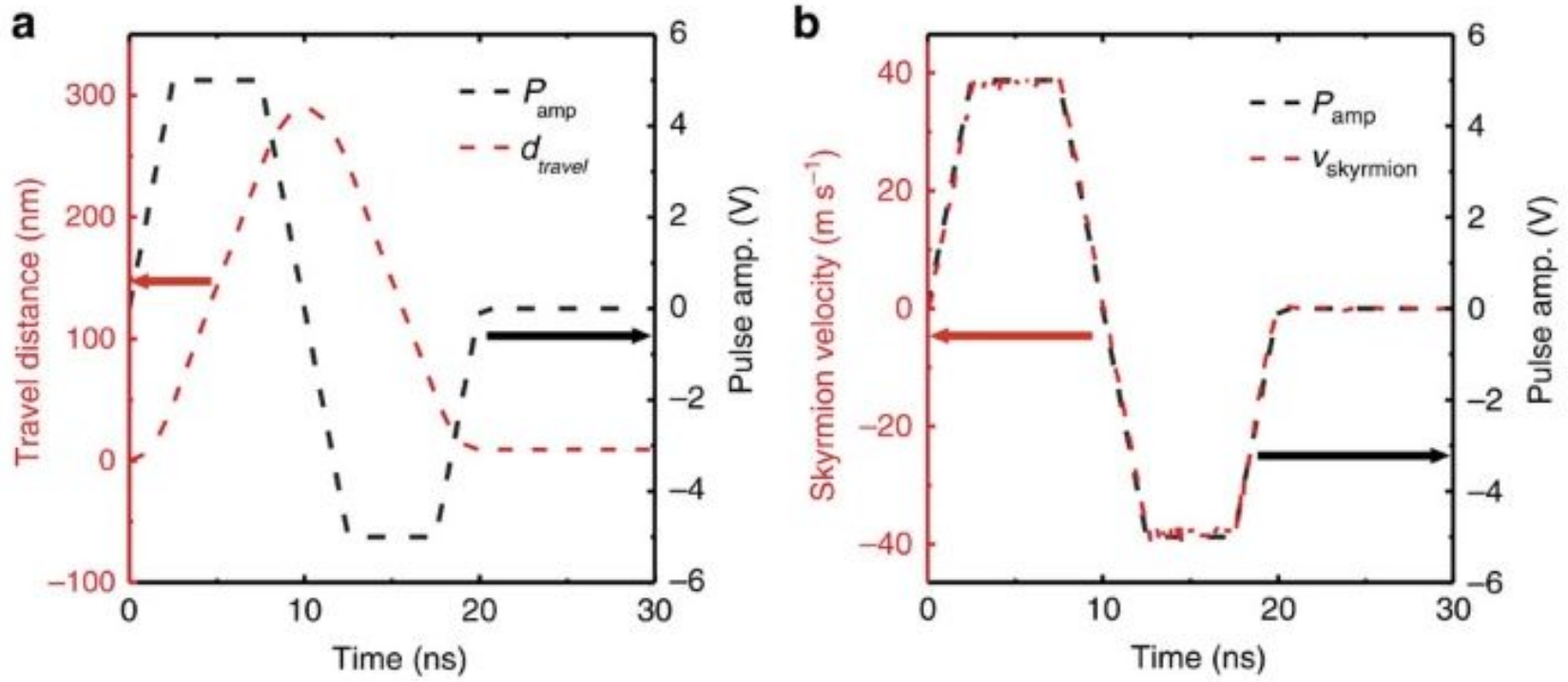
# How to move data / Skyrmions

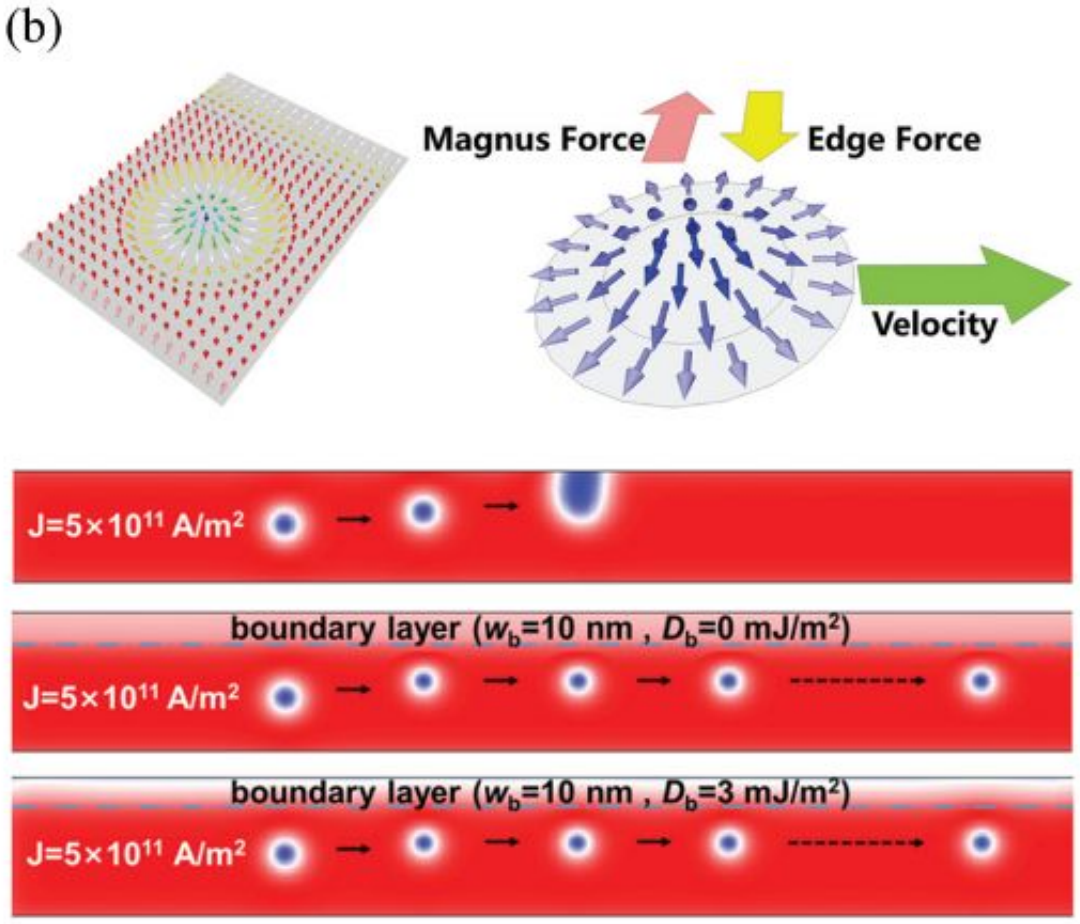


$$\mathbf{F} = \mathbf{G} \times \mathbf{v} + \alpha \mathbf{D} \cdot \mathbf{v} + \mathbf{F}_{spin}$$

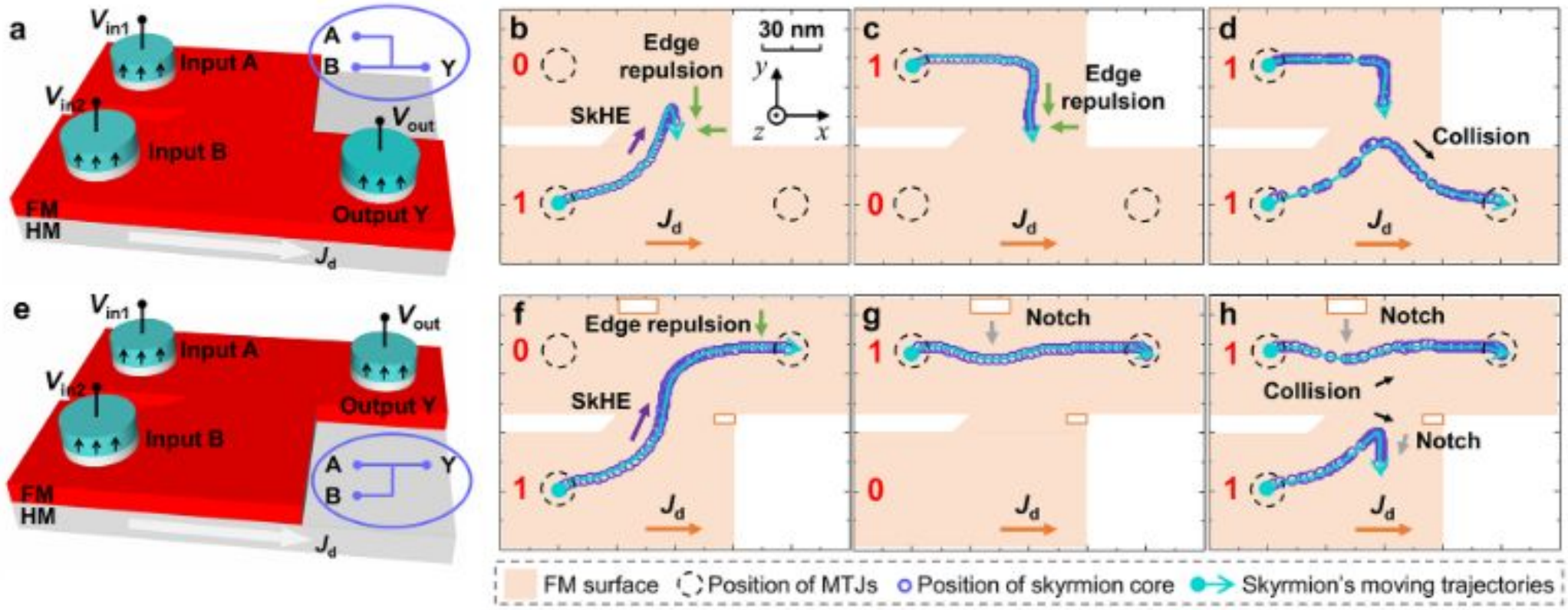


# Skyrmion Hall effect

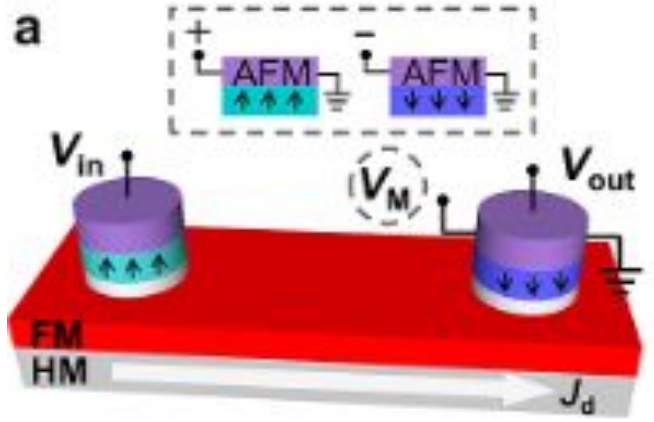


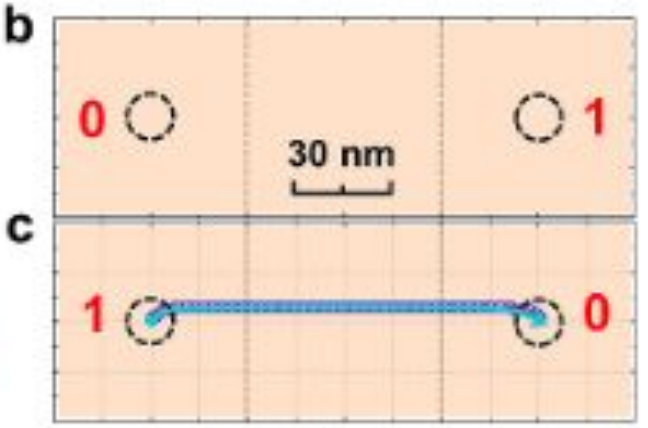


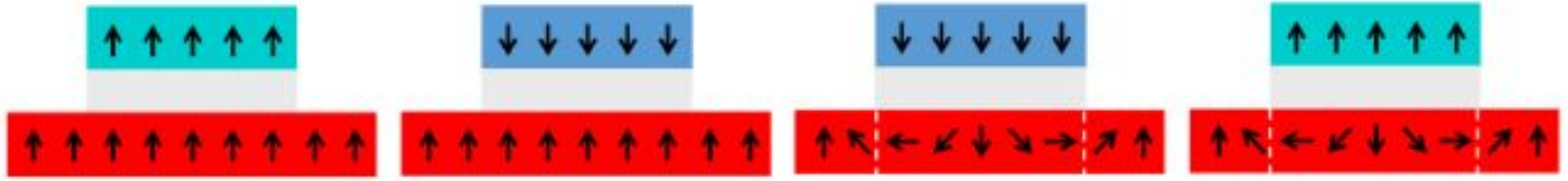
# Logical gates



# NOT

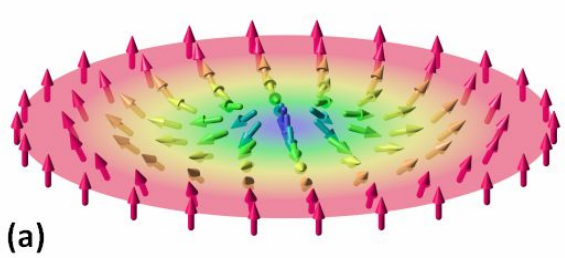


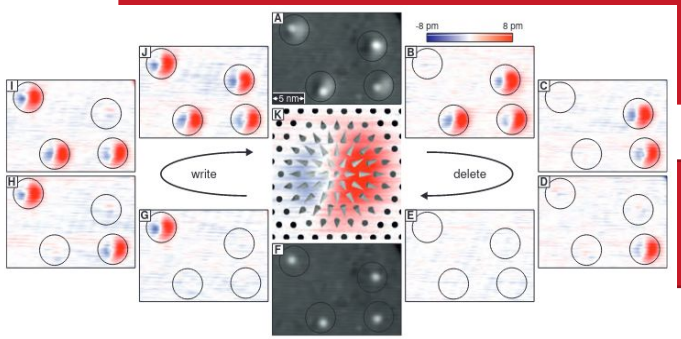

| MTJ |  | | | |
|---|---|---|---|---|
| **State** | P | AP | Quasi-P | Quasi-AP |
| ***θ*** | 0° | 180° | 37° | 143° |
| **TMR** | 0% | 100% | 10.6% | 67.8% |
| **R** | LRS | HRS | LRS | HRS |
| **Data** | 0 | 1 | 0 | 1 |
| **Sk** | w/o | w/o | w/ | w/ |

# Outlook

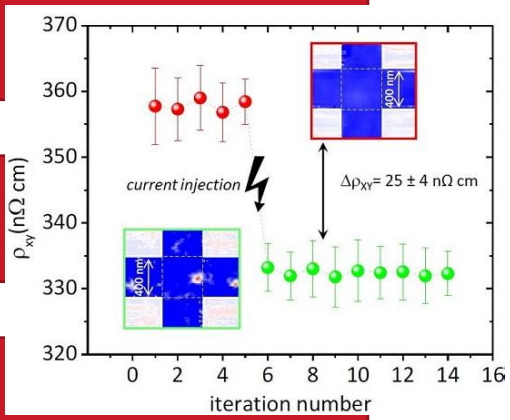




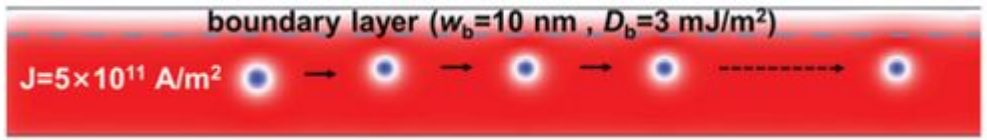

Have a stable Platform




Write and delete data in Storage

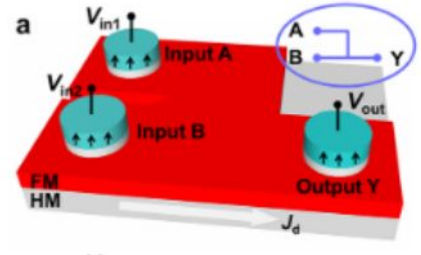



Read data from Storage




Move data

Manipulate data -> Logical gates



Questions?

# Literature

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