

# Altermagnetism

A paradigm shift in information technology

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Based on works of the INSPIRE group in *Smejkal et al., Phys. Rev. X, (2022)*

19.09.25

MPA Summer School 2025

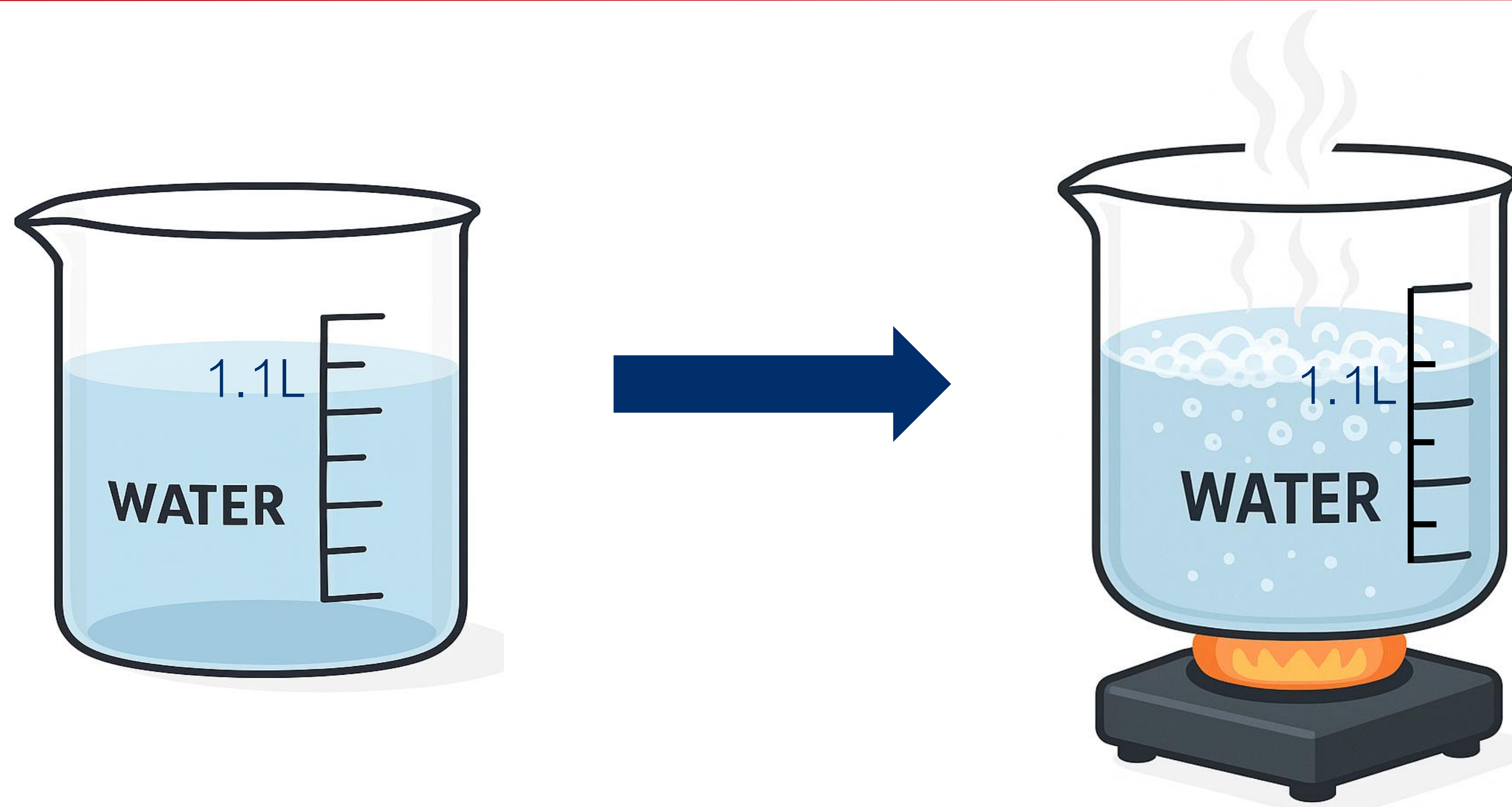




Who has made a Google search today?

Who has made a ChatGPT prompt today?

# Energy consumption of information technology



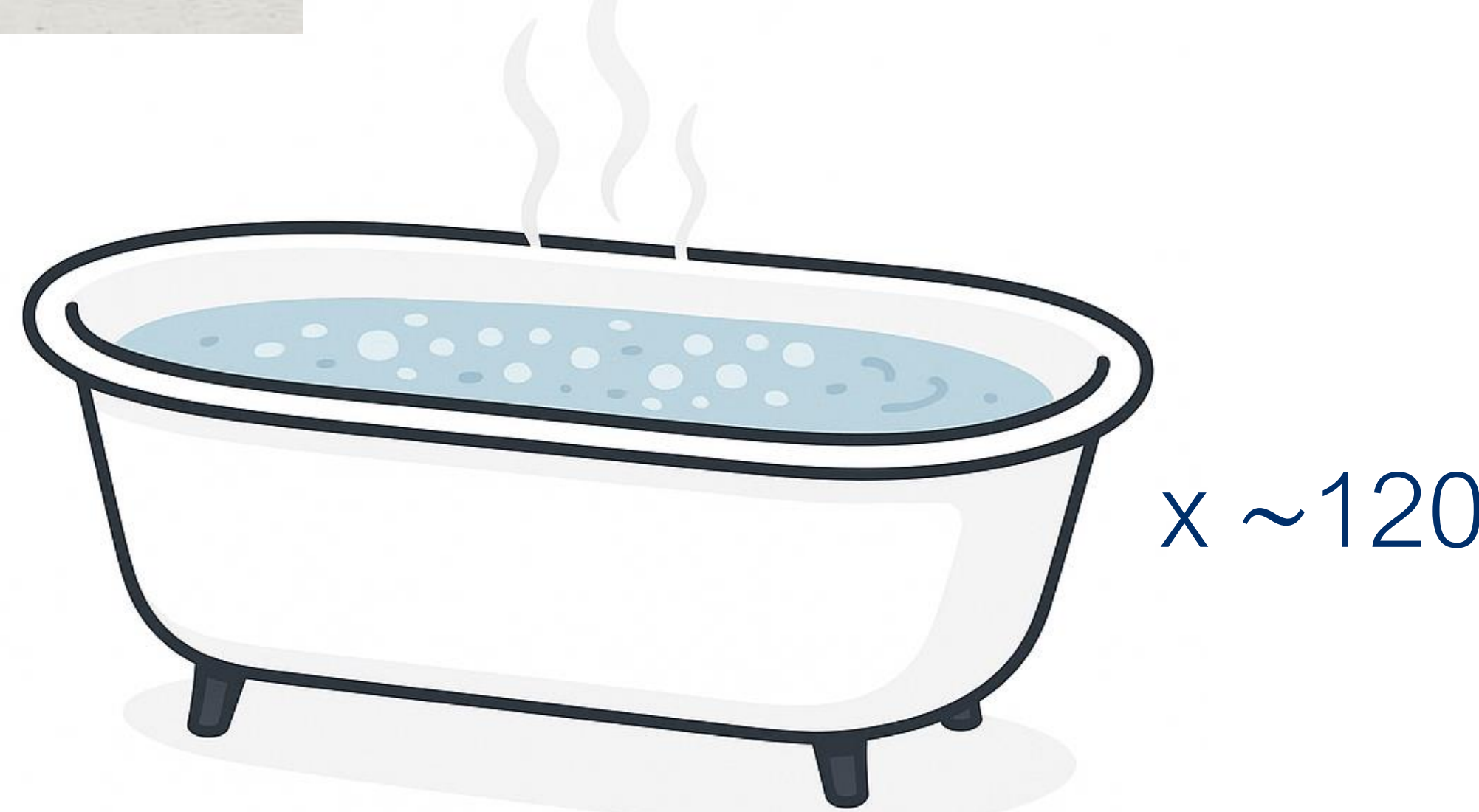
30 Google searches ~ 100 mL boiling water

30 ChatGPT prompt ~ 300 Google searches ~ 1L

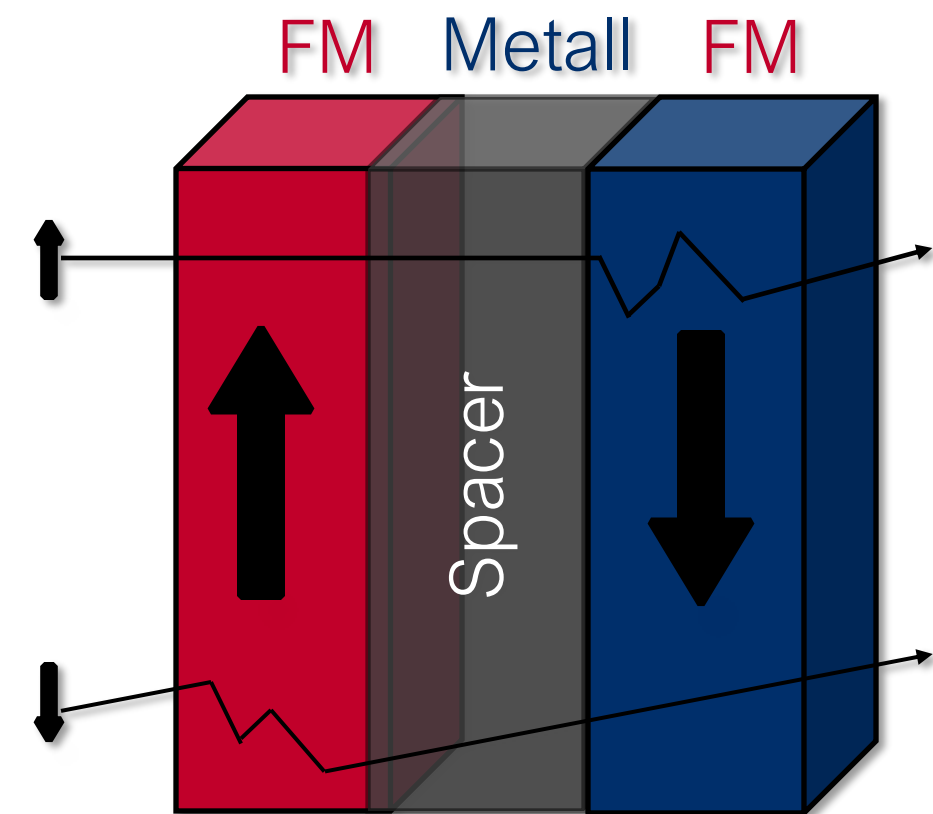
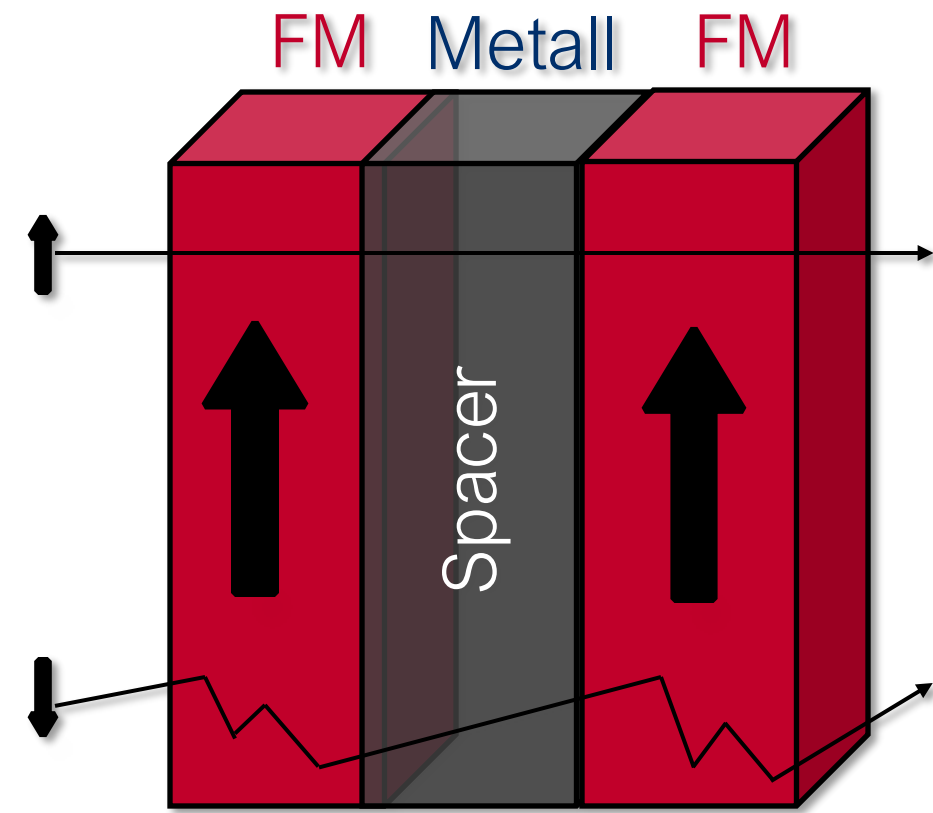
# Energy consumption of information technology



~ 35.000 students/researchers  
Everyone makes equivalent of 10  
ChatGPT requests



## Magnetoresistance (1990's)

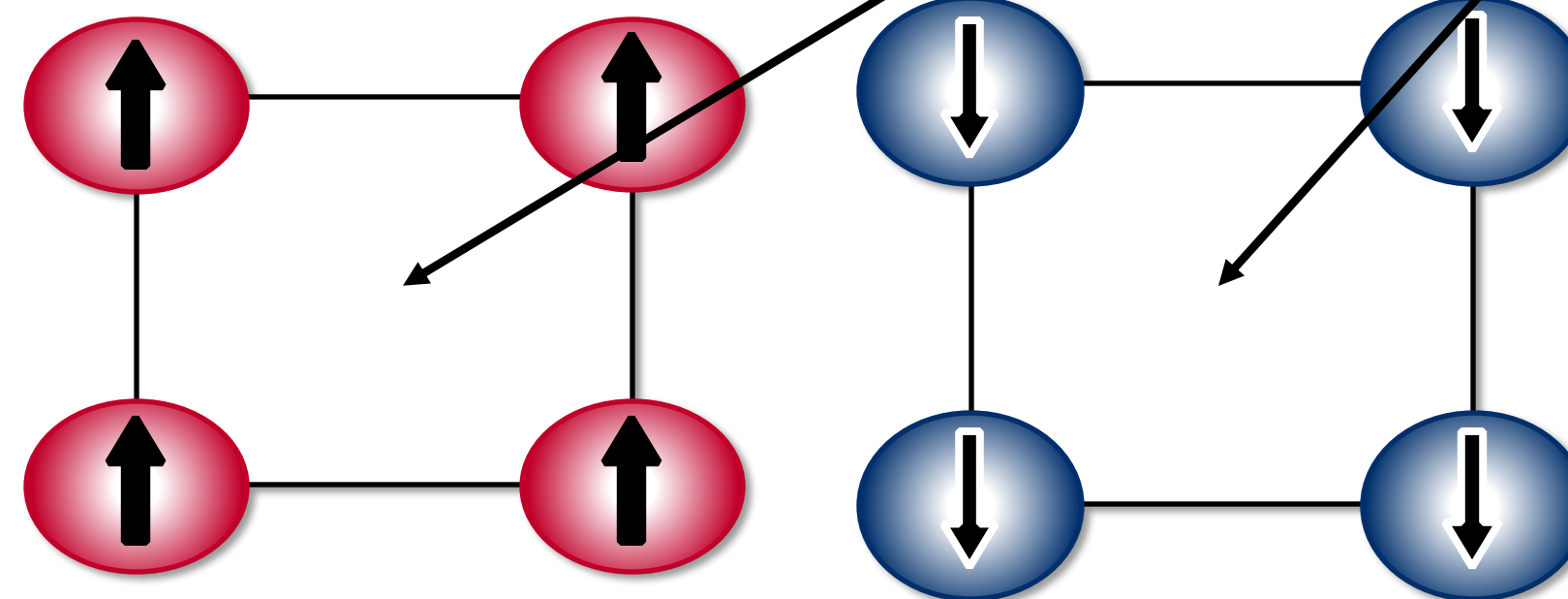
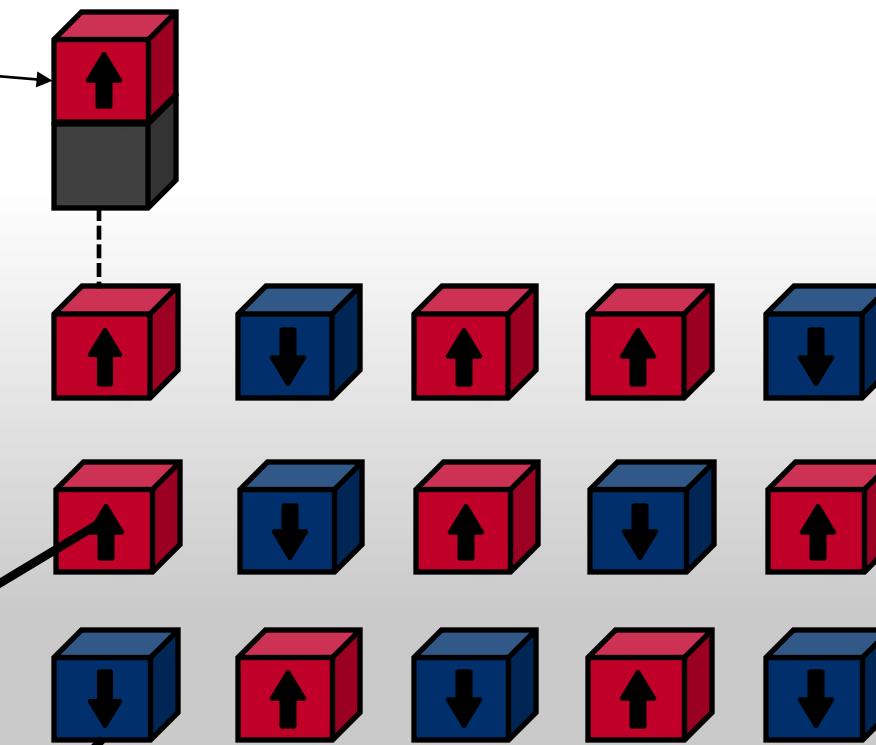


Review: Hirohata et al., JMMM, 509 (2020)

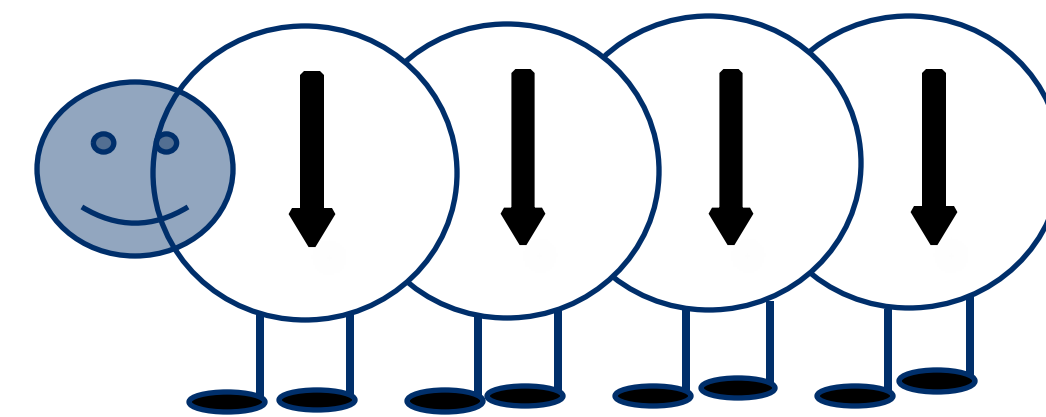
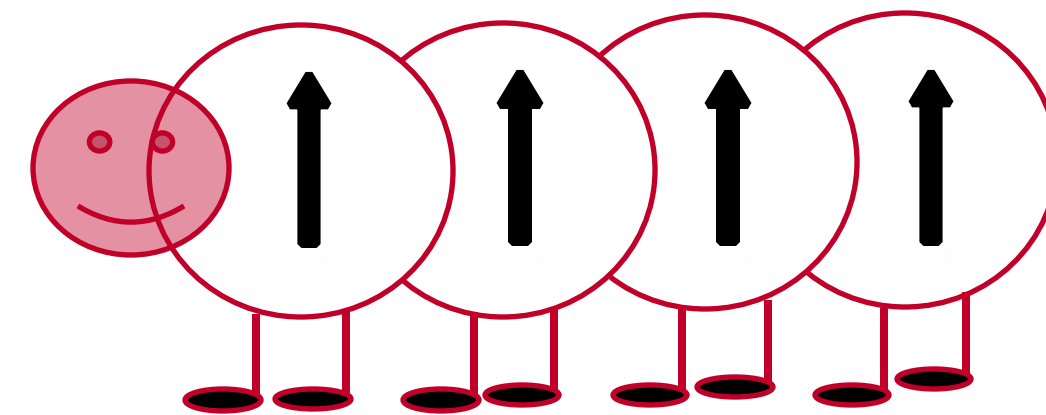
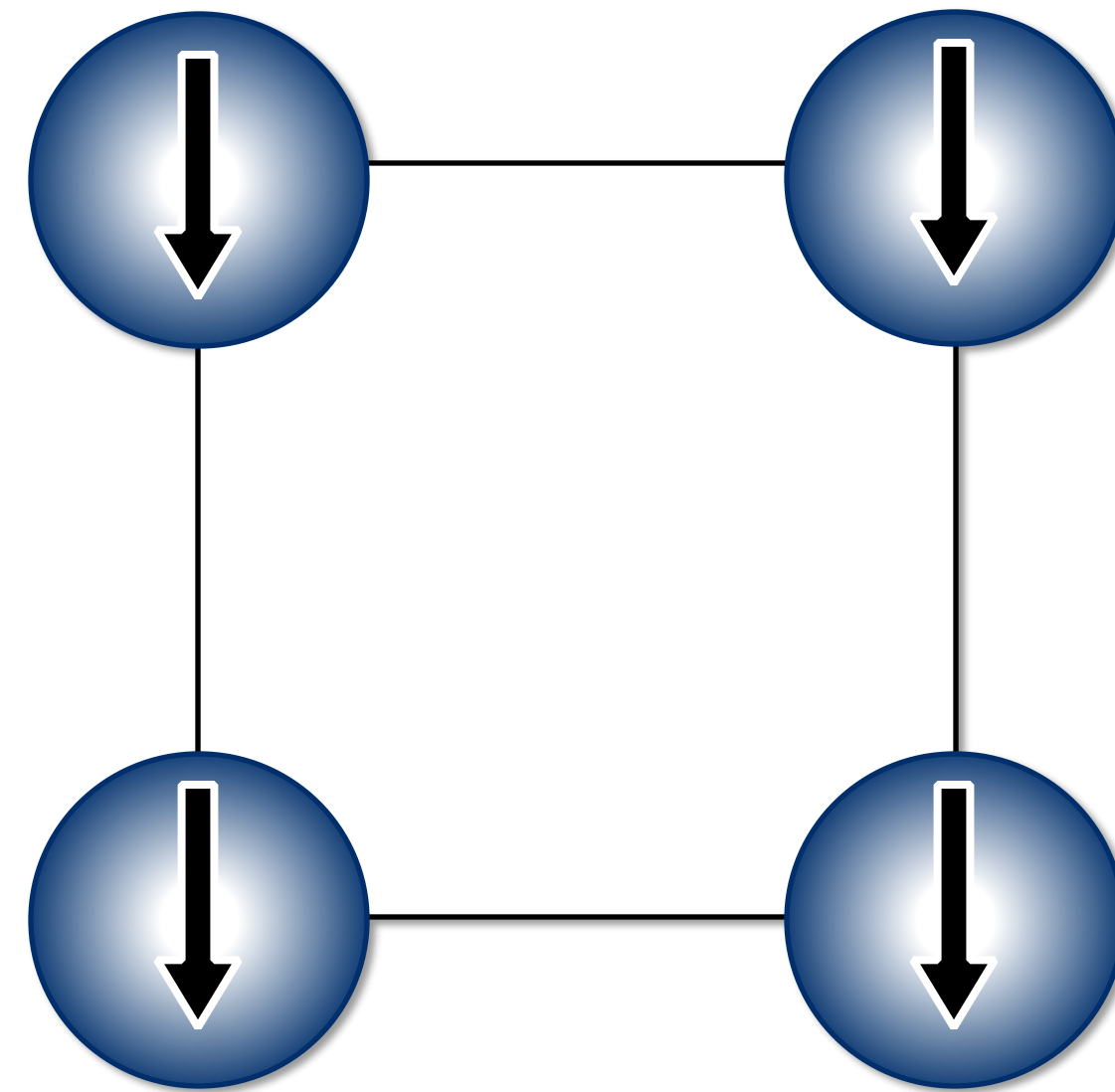


<https://www.gcsecs.com/magnetic-hard-disk-drive.html>

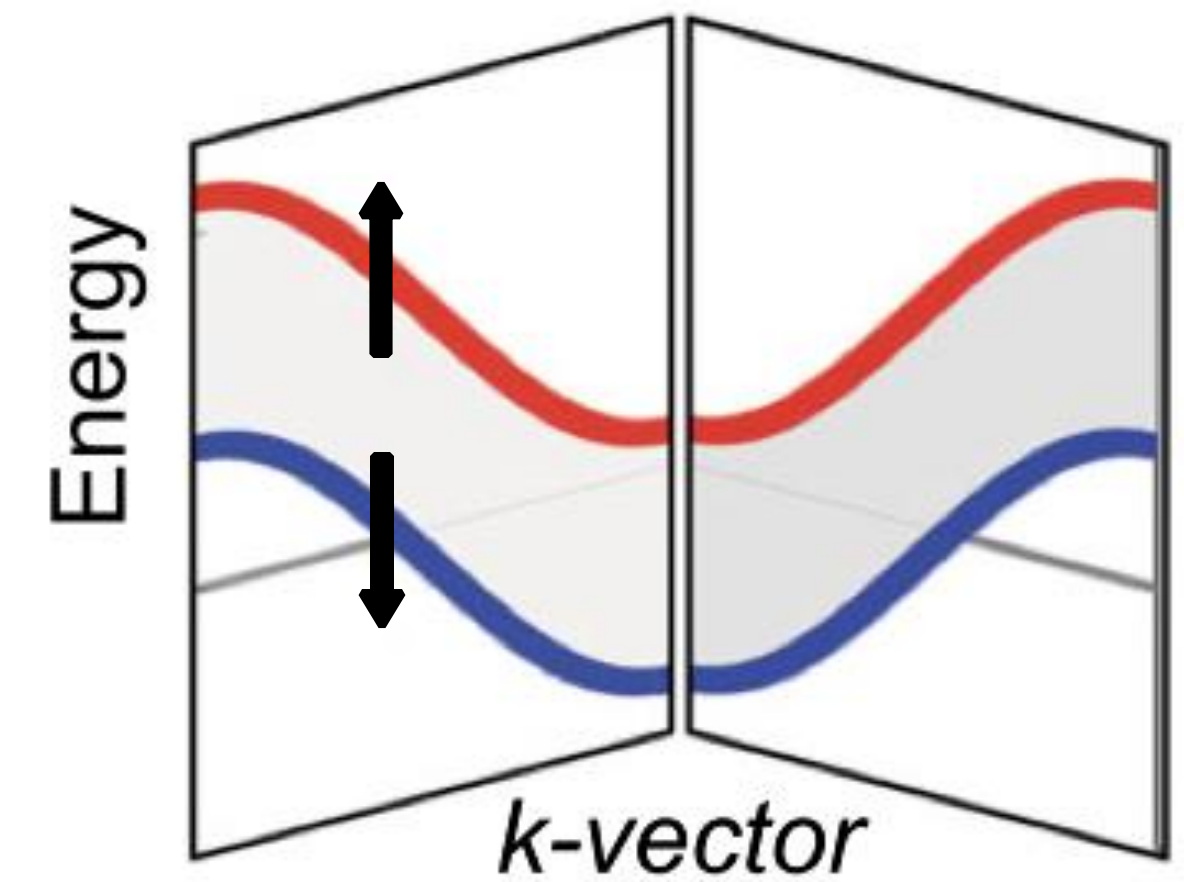
Read head

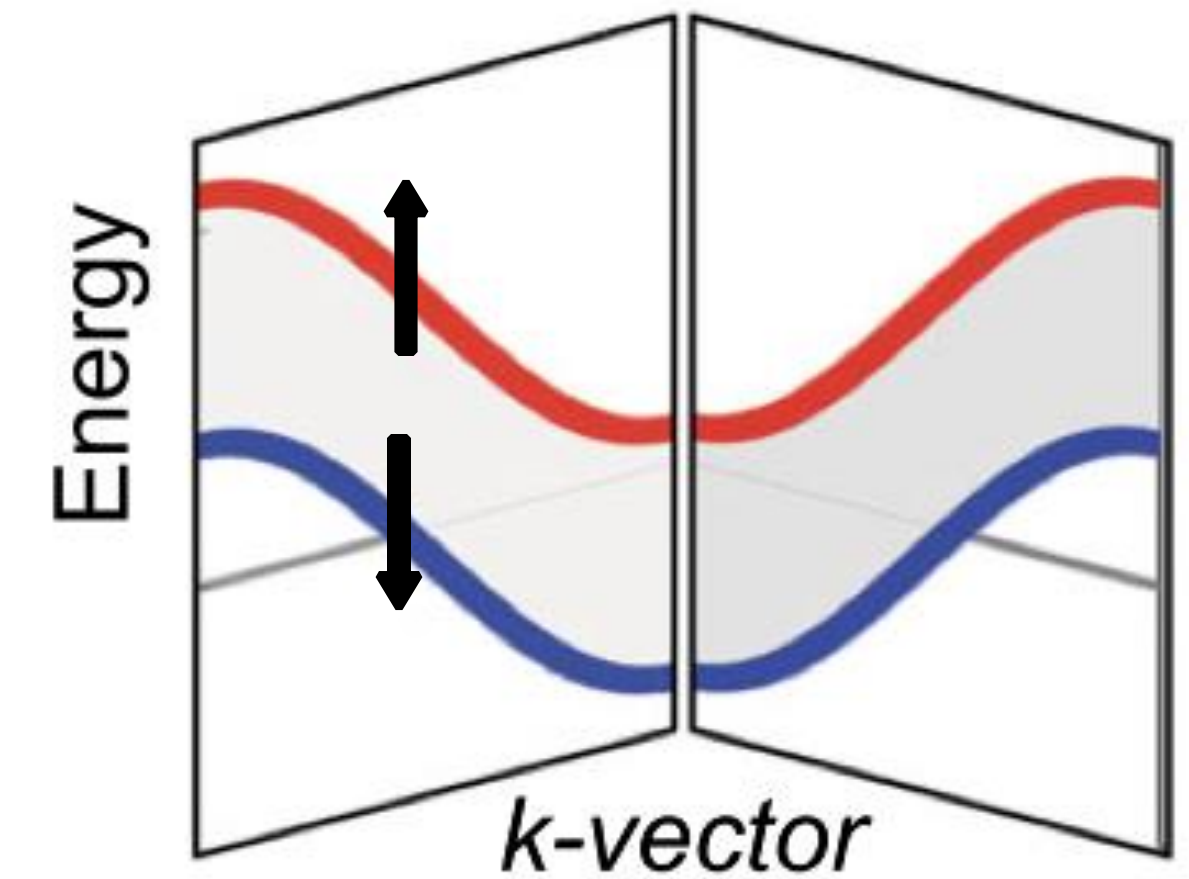
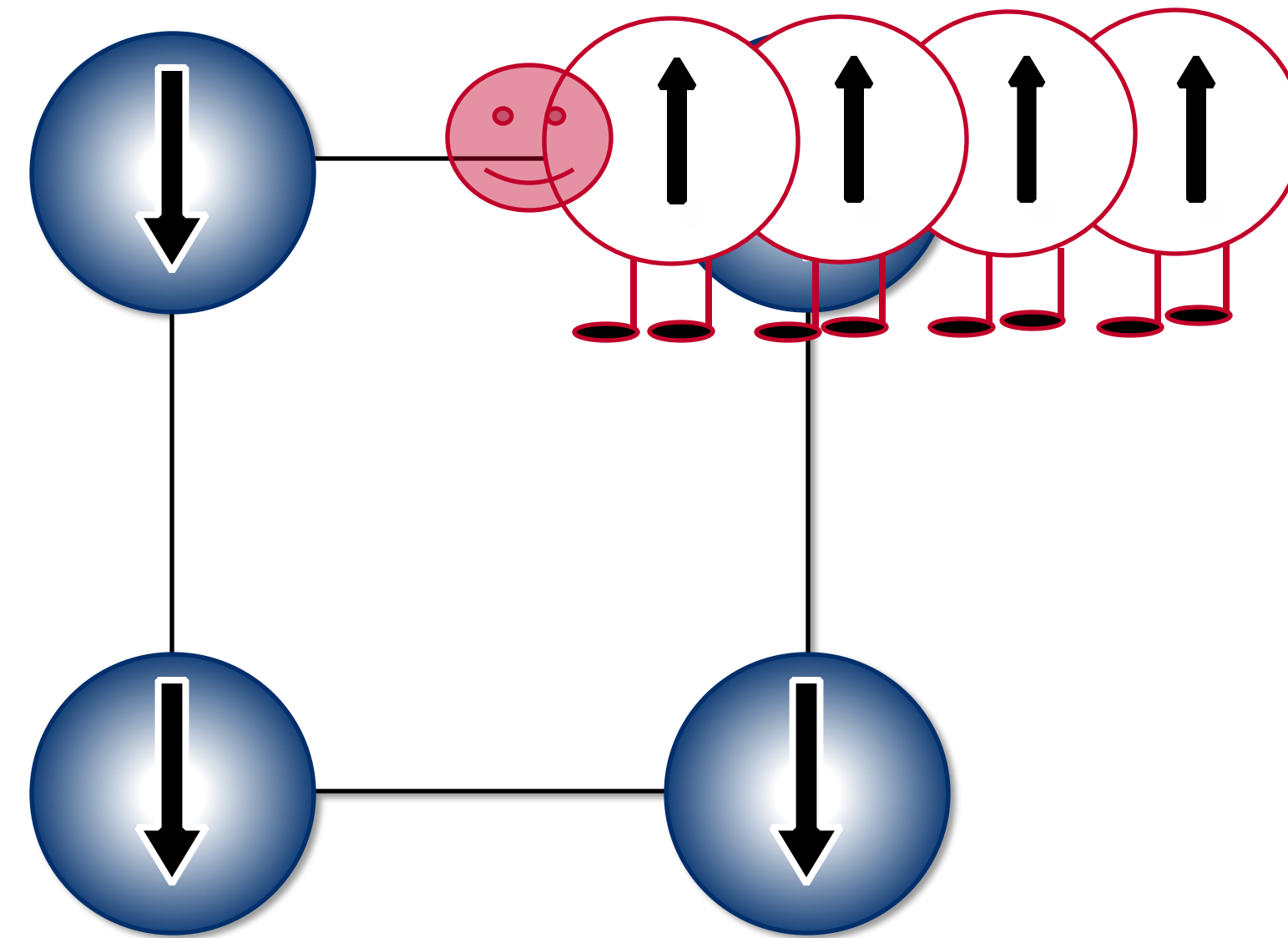


Relies on  
Ferromagnets!

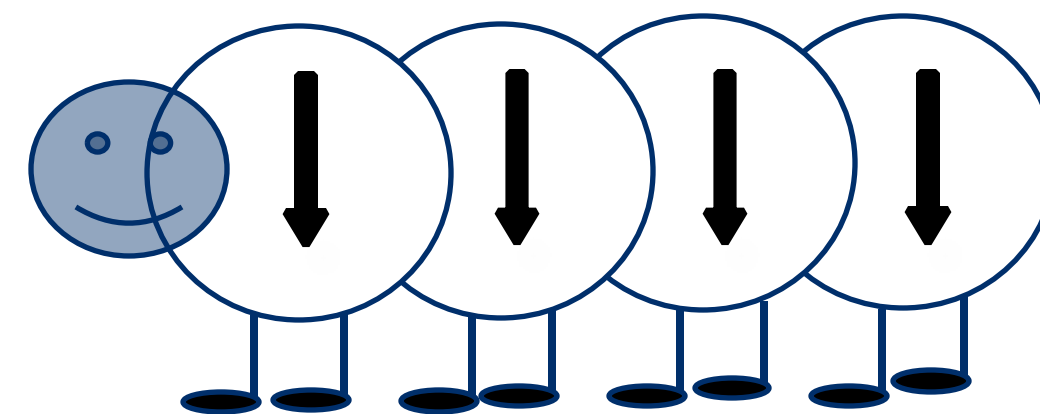


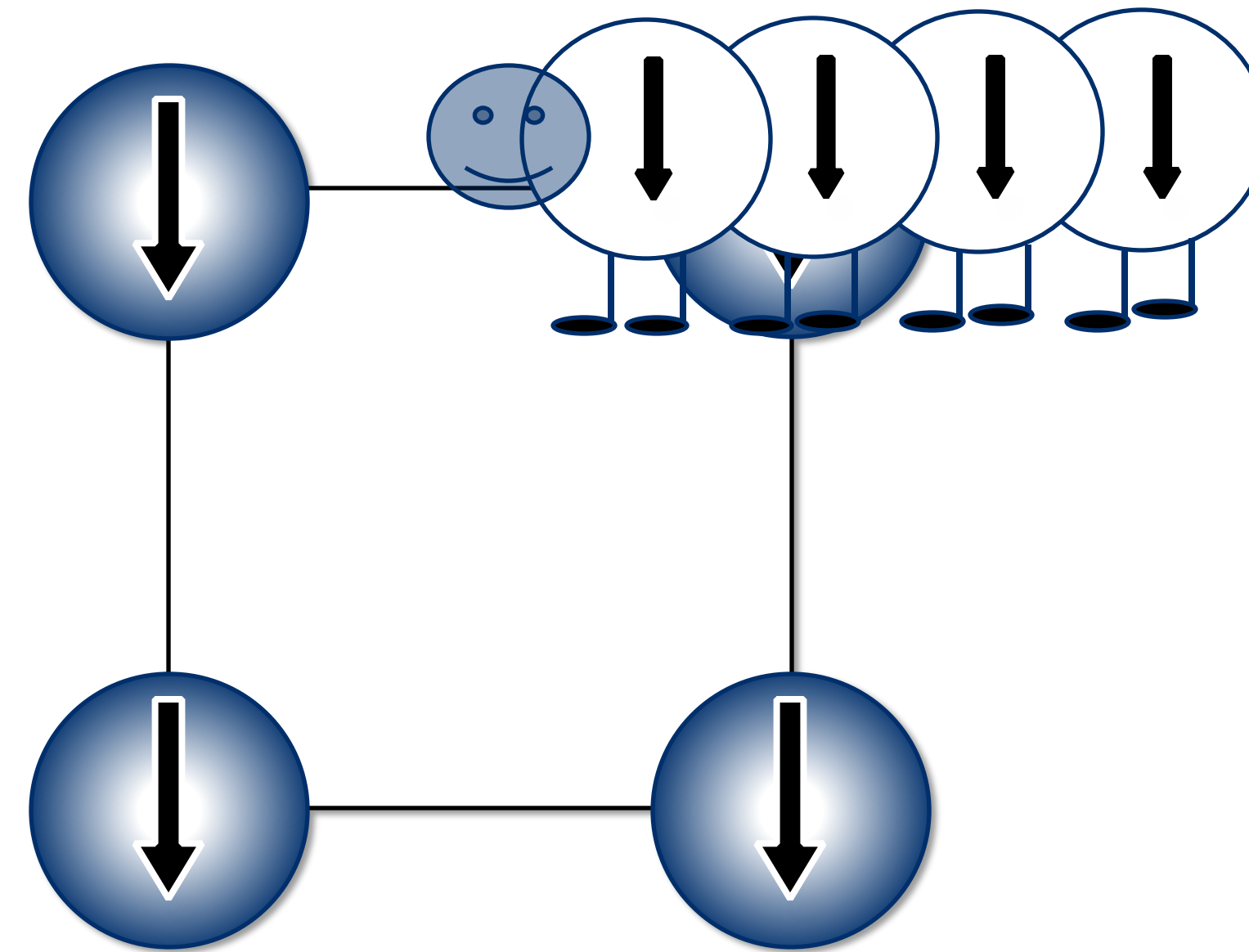
- stray fields (scalability)
- GHz dynamics (to slow!)
- + strong read out



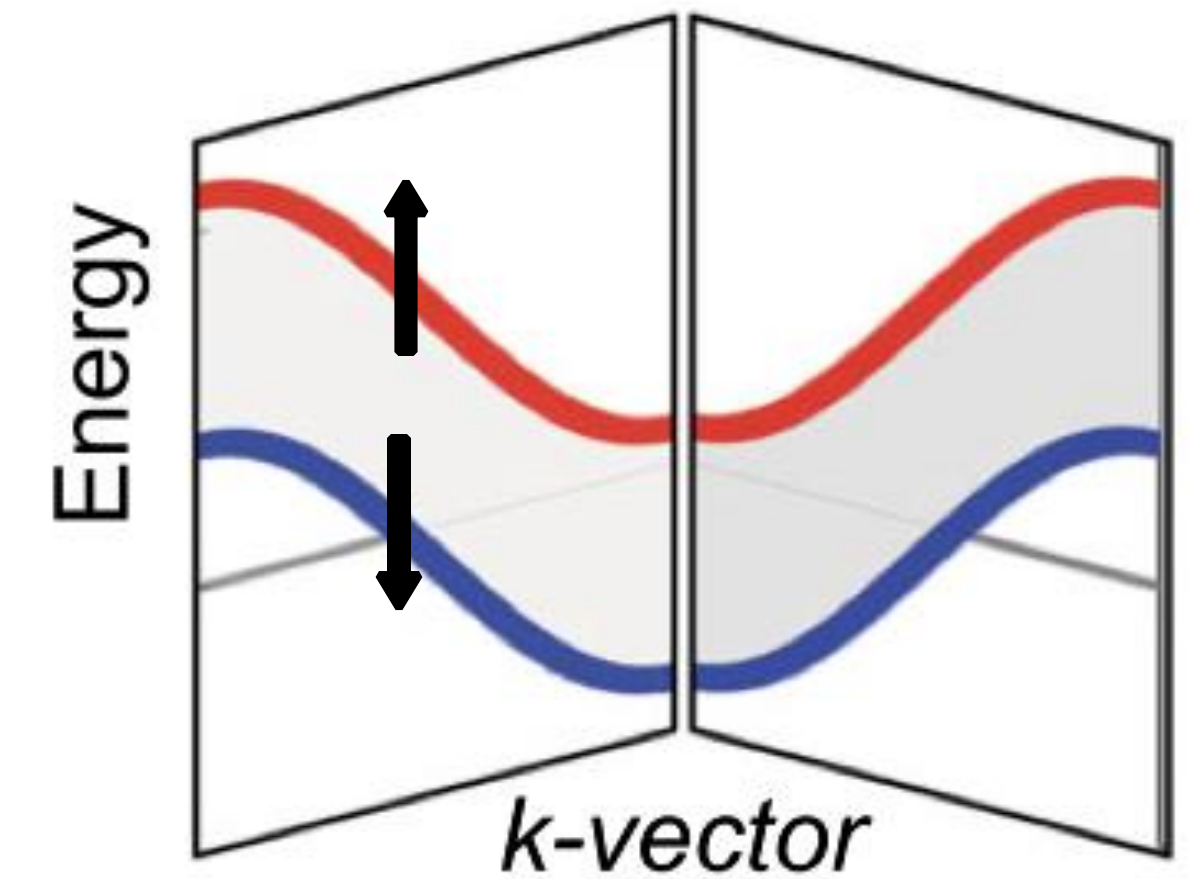


- stray fields (scalability)
- GHz dynamics
- + strong read out

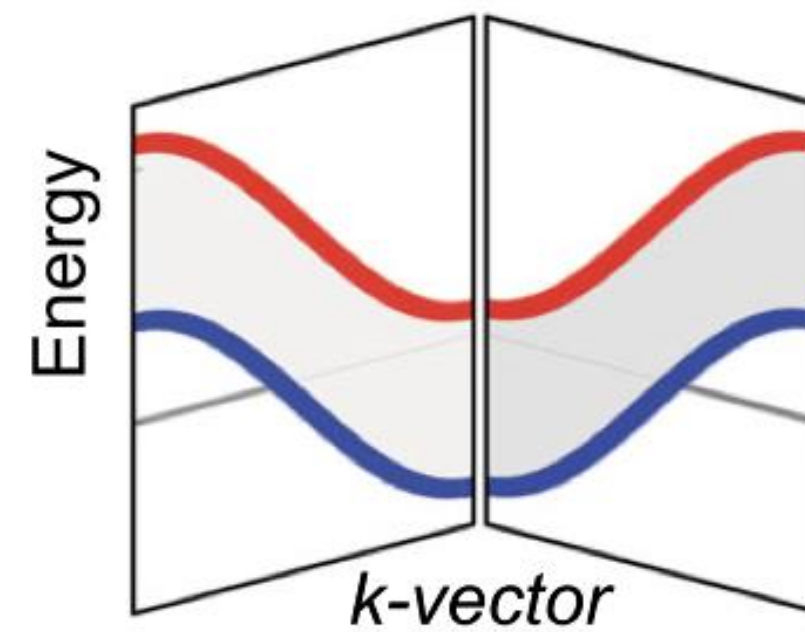




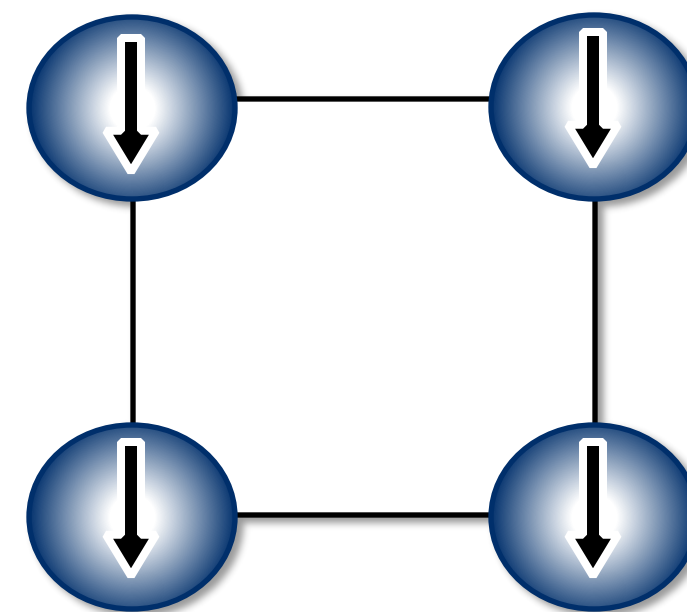
- stray fields (scalability)
- GHz dynamics
- + strong read out



High energy  
consumption through  
data storage



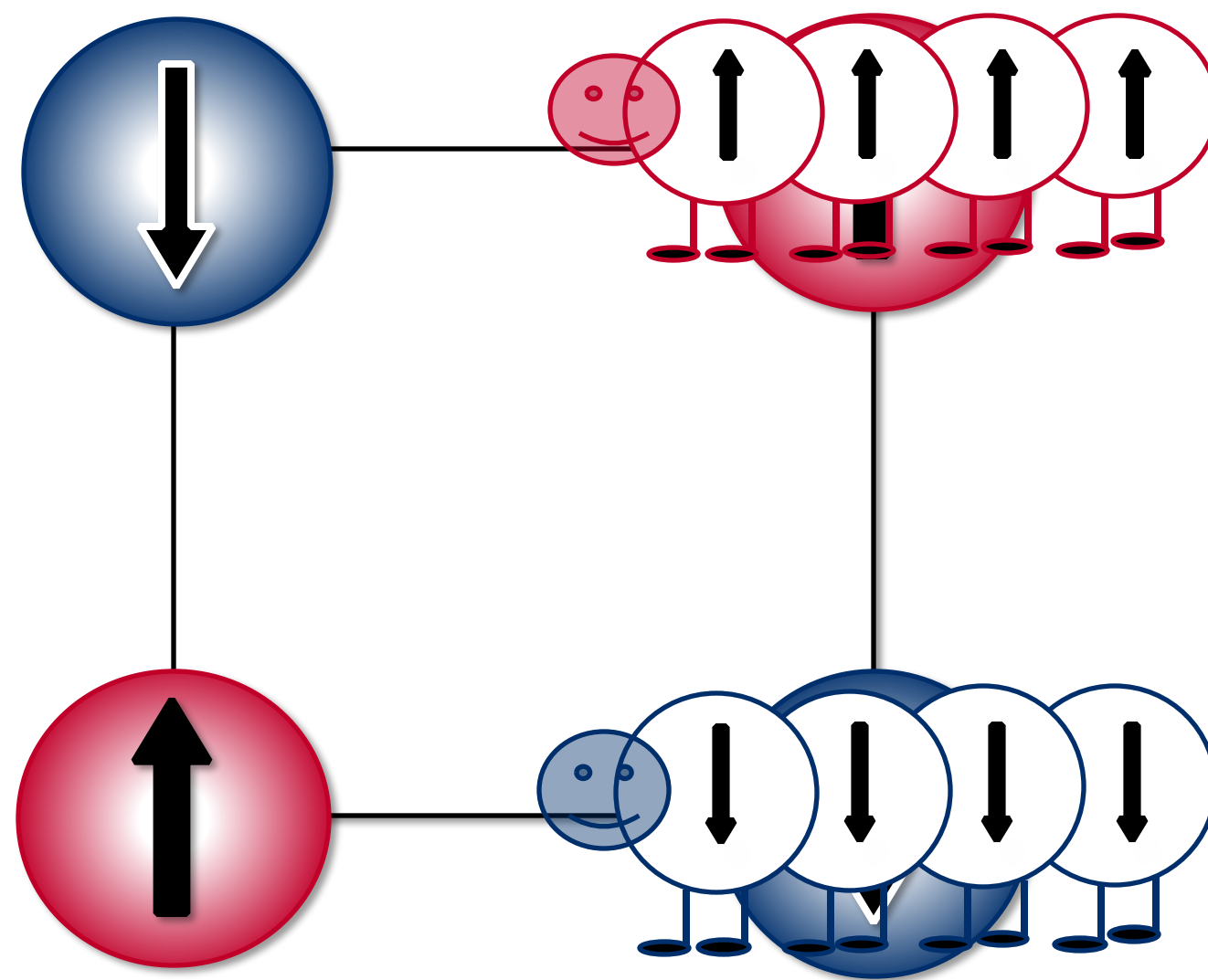
Relies on  
ferromagnets



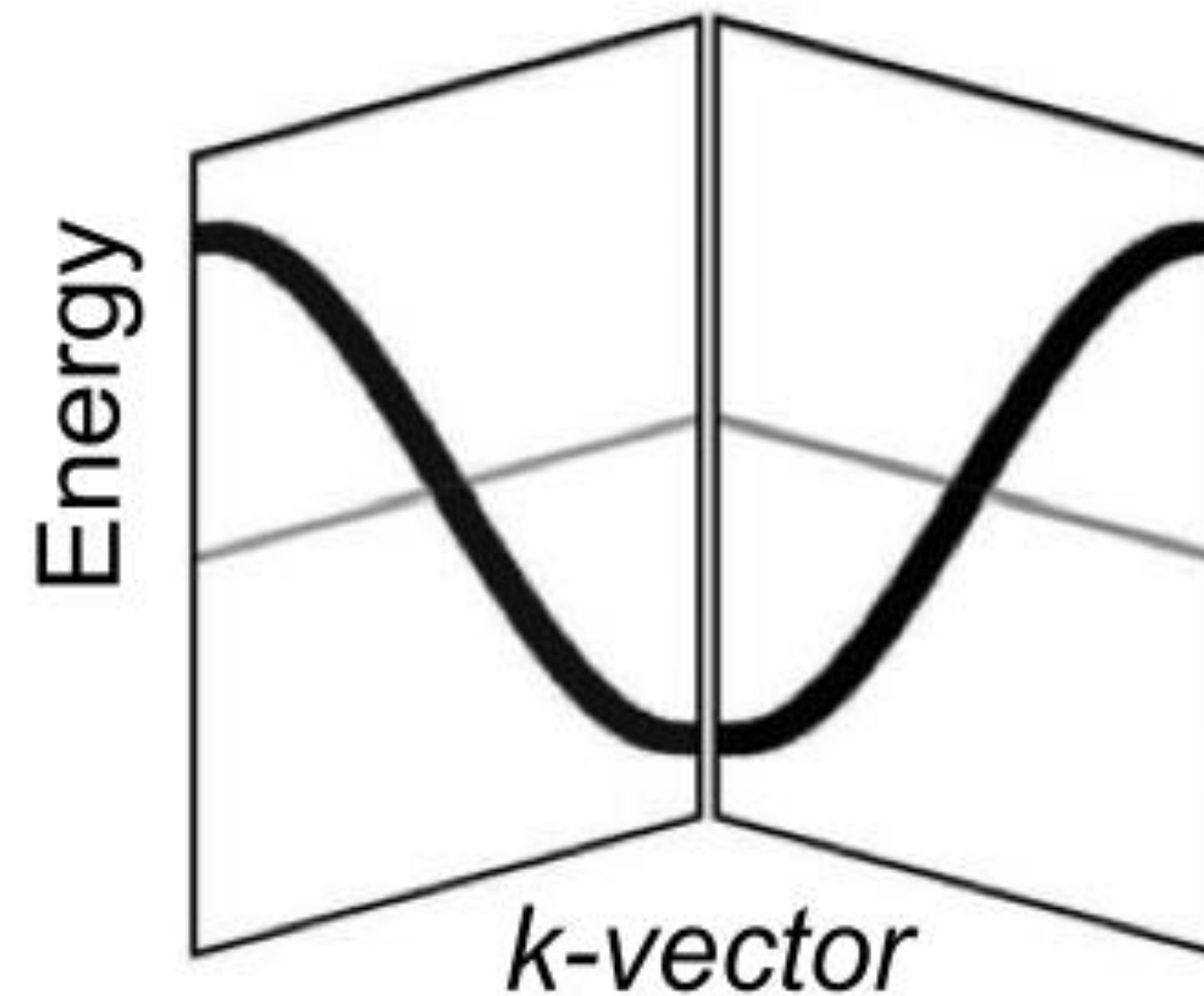
High read-out *through magnetization*

Slow dynamics/Low  
scalability *through magnetization*

# Lets try and drop the *magnetization*



Antiferromagnet



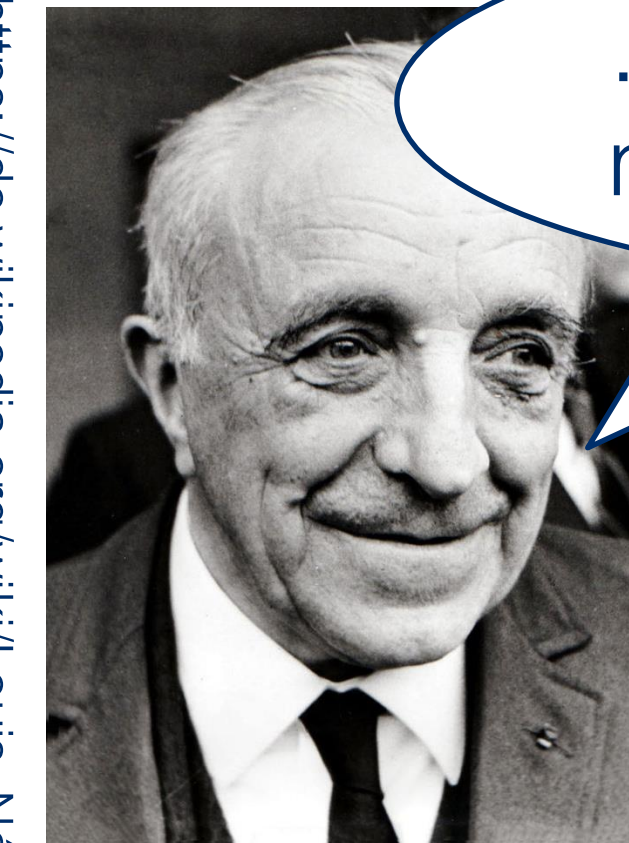
- Weak read out (!!!)

+ High scalability

+ 1000x faster dynamics

reading/writing

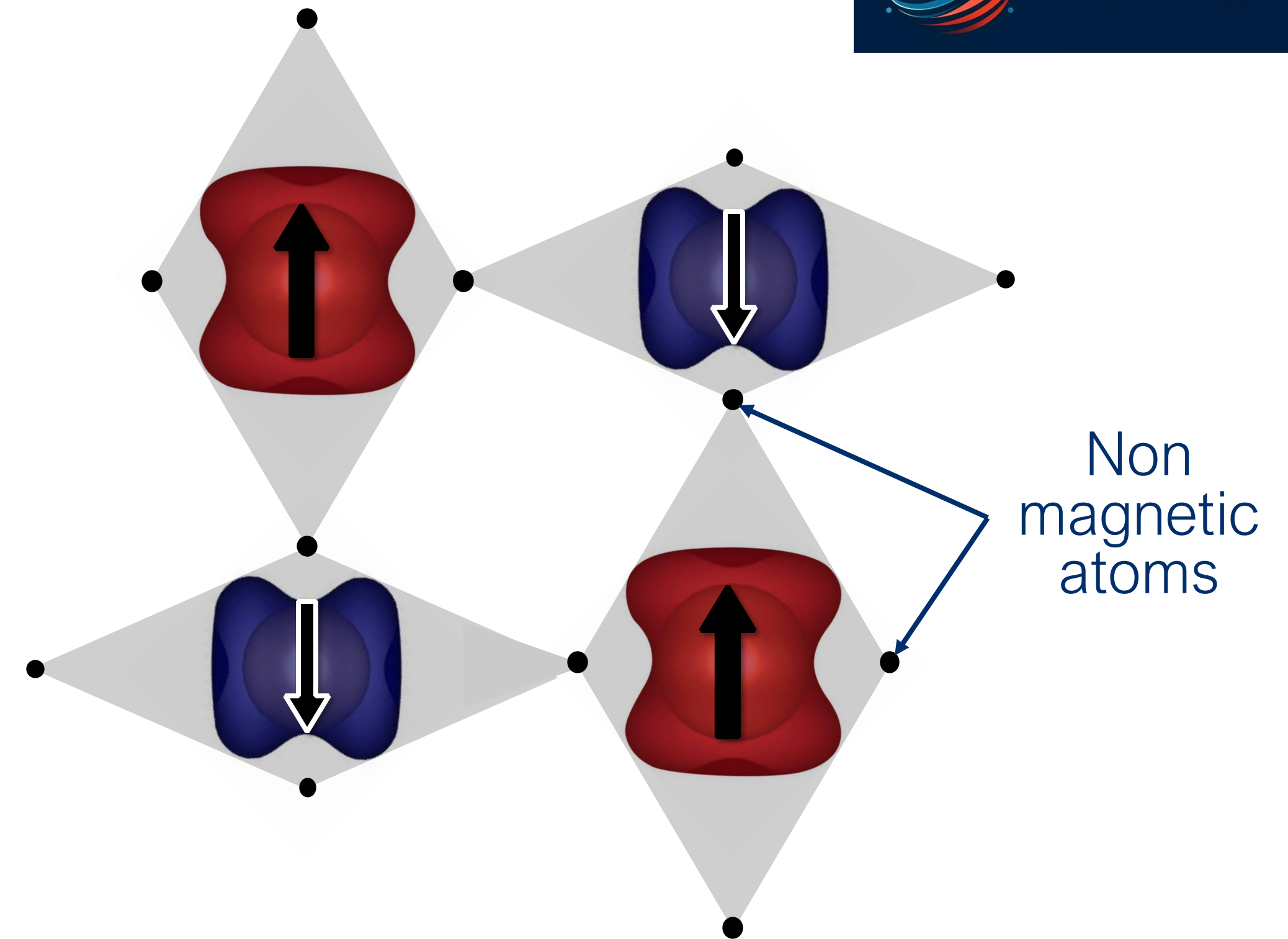
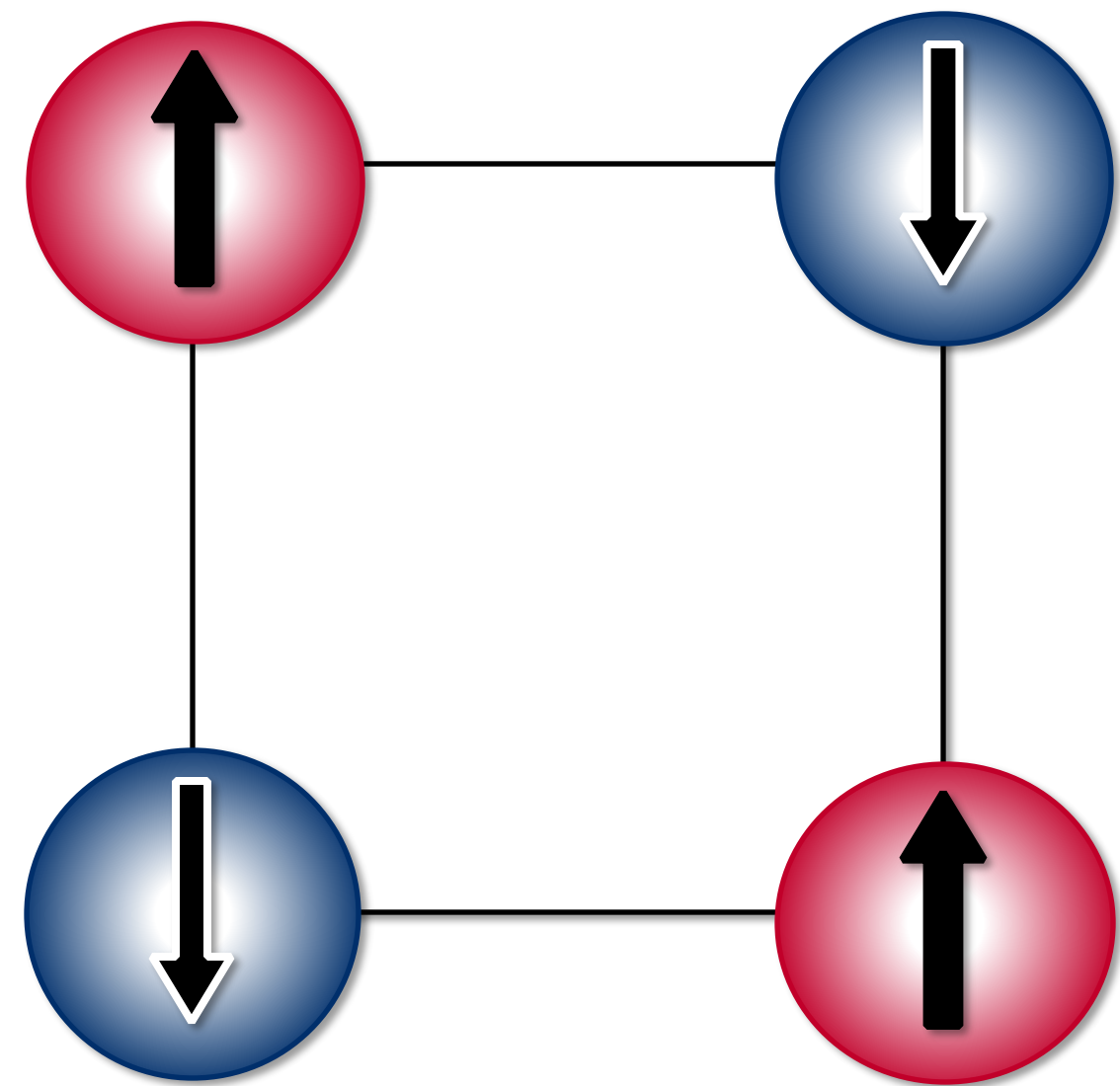
[https://de.wikipedia.org/wiki/Louis\\_Néel](https://de.wikipedia.org/wiki/Louis_Néel)



Louis Néel

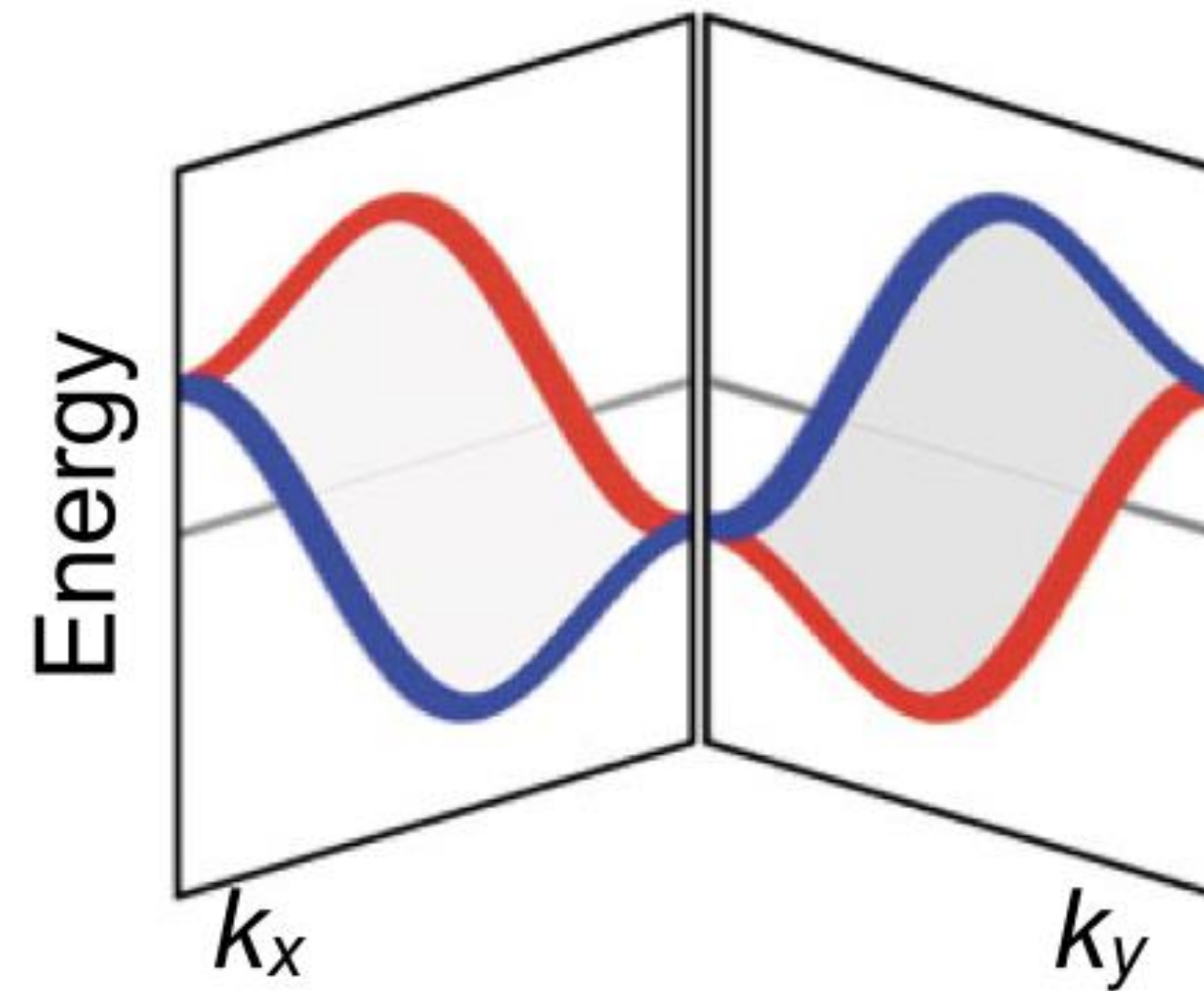
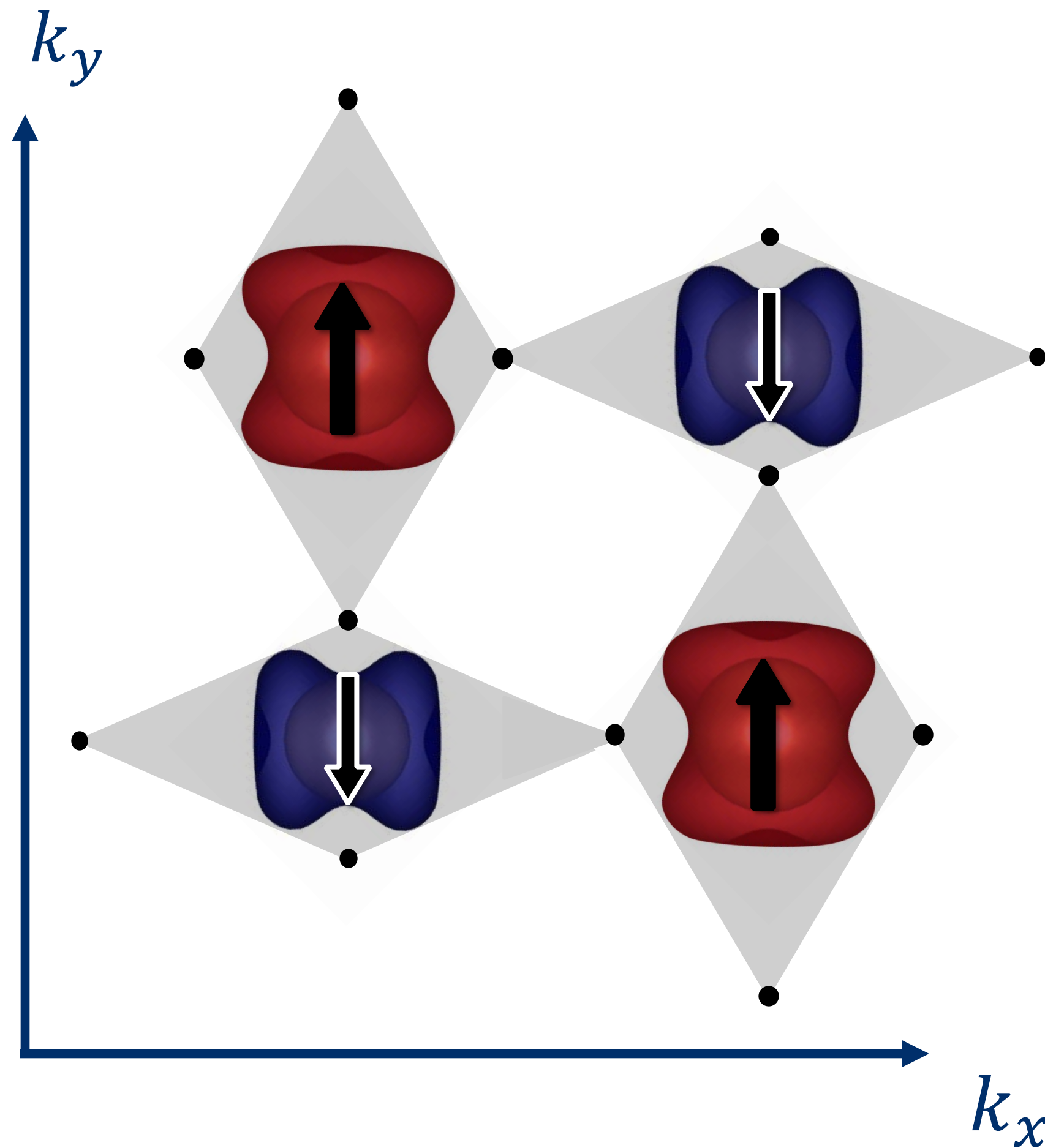
.... interesting but of no practical use....

# The solution hidden in plain sight



Neglect non-magnetic atoms

Non magnetic atoms deform  
spin density



Smejkal et al., Phys. Rev. X, (2022)

- + High scalability
- + Ultra fast (THz) dynamics
- + High read out signal
- + Novel features
- + Abundant materials

