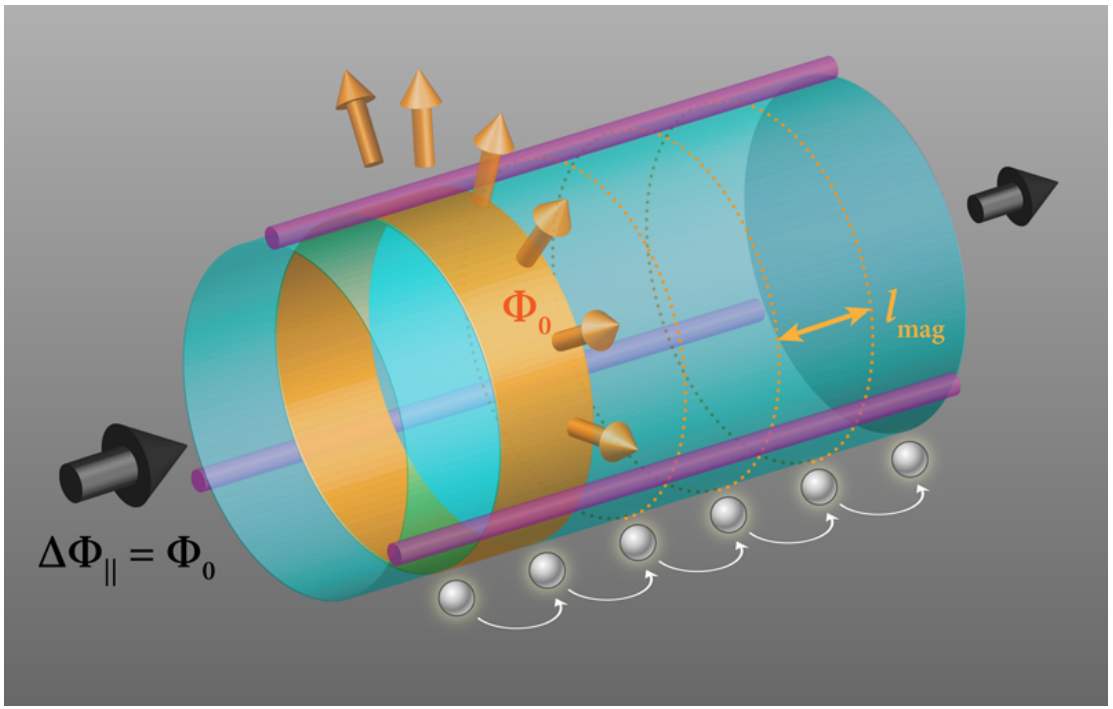
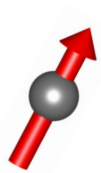
Quantum Hall effect, now anomalous

Chern number and Chern insulator

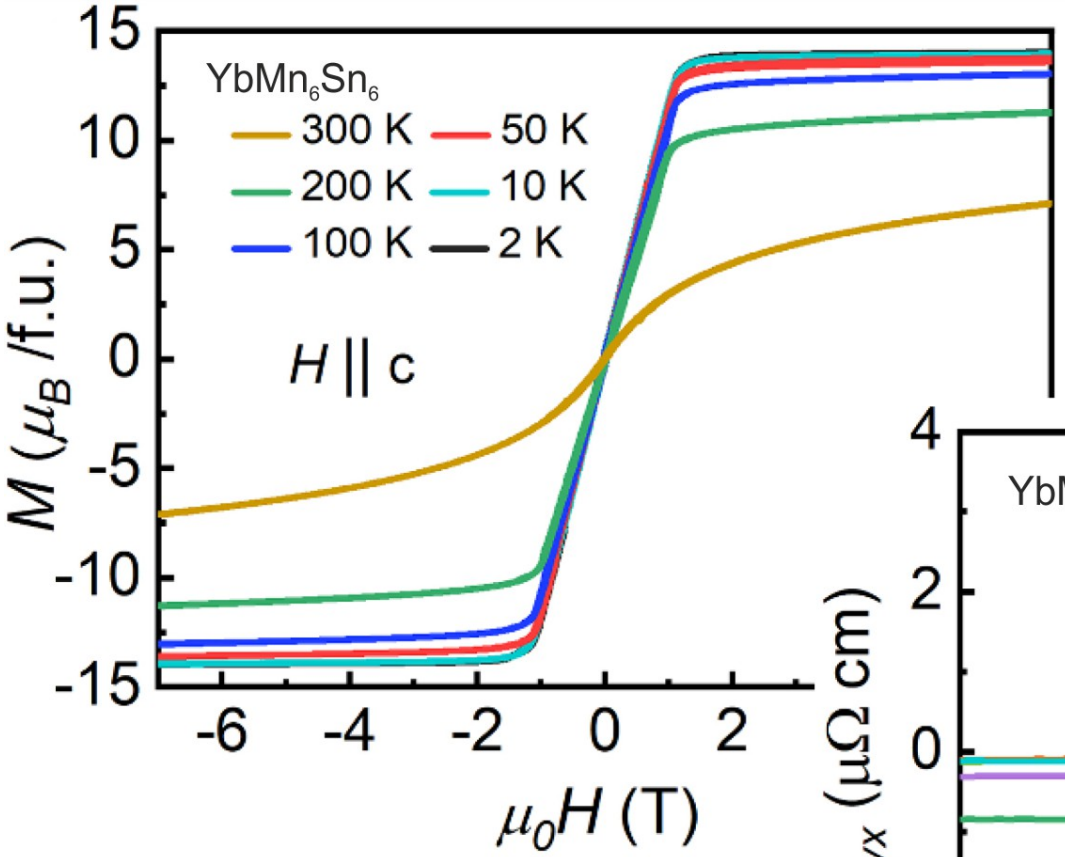


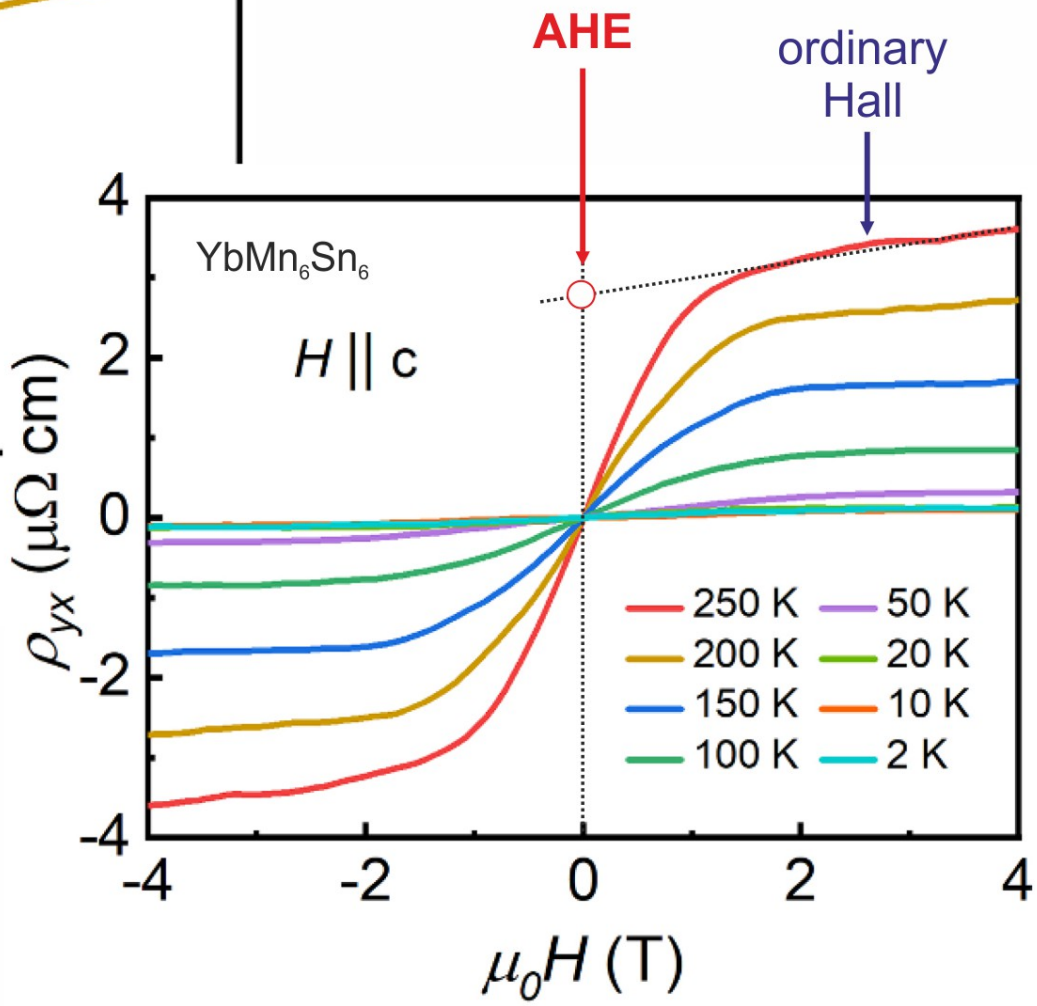


by Alexander Tsirlin, Leipzig University

Lecture 7: November 11, 2024

Anomalous Hall effect (AHE)



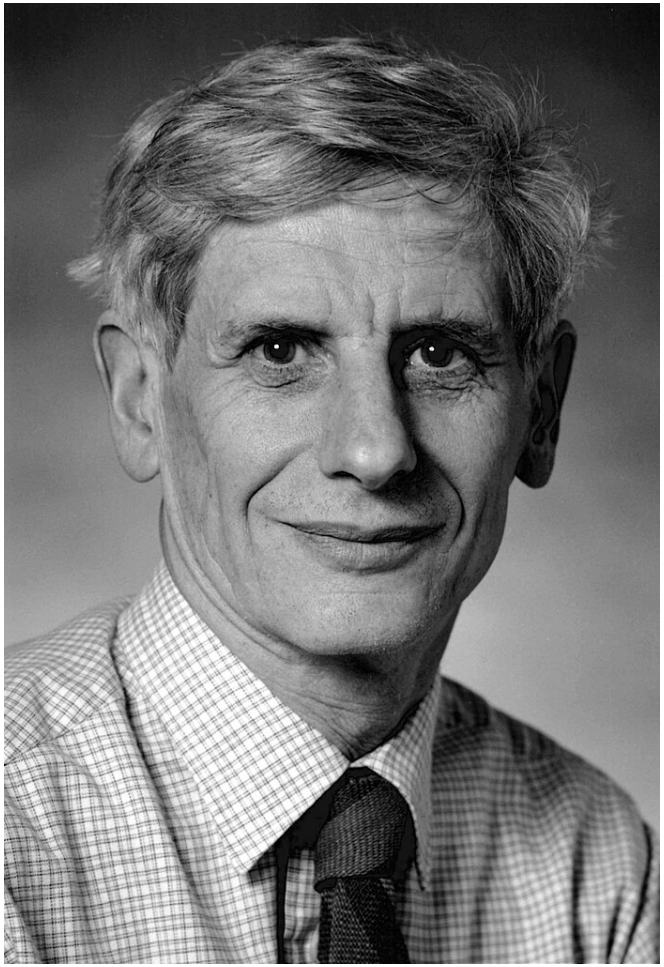


3D: not quantized

2D: possibly quantized (Chern number)

J. Phys.: Condens. Matter 36, 315701 (2024)

Nobel prize in physics 2016



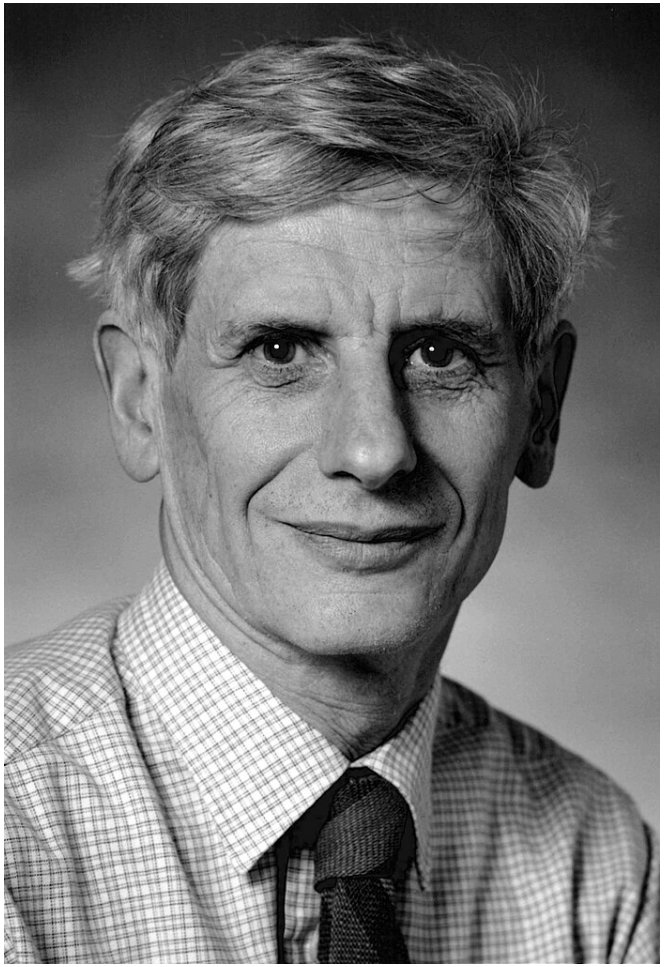
David Thouless
1934–2019

F. Duncan Haldane
born 1951

Third awardee: Michael Kosterlitz

Image credits: Mary Levin and Bengt Nyman (CC-BY)

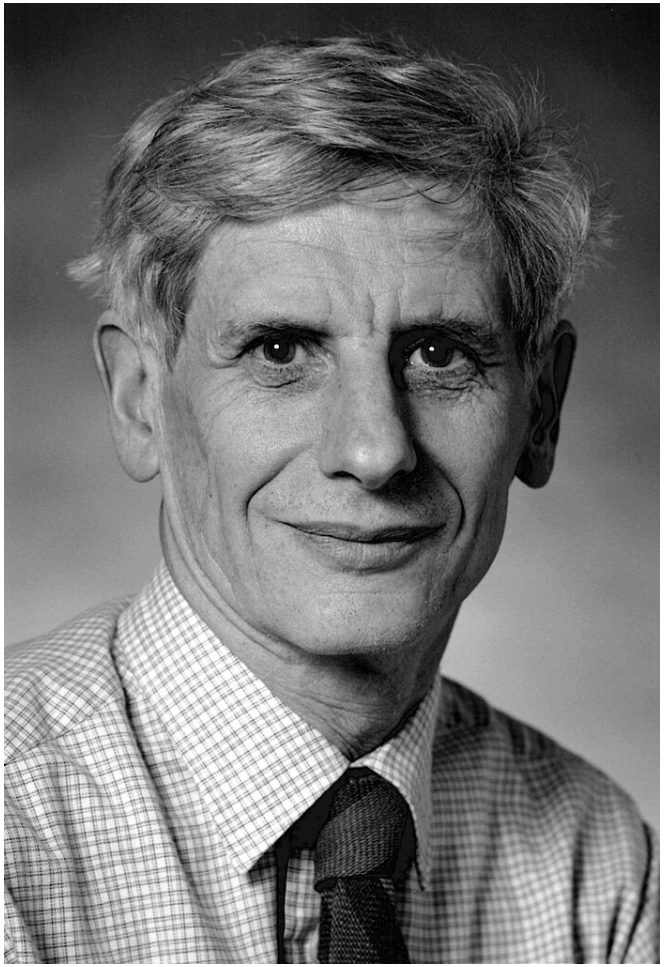
Thouless pump



David Thouless
1934–2019

Image credits: Mary Levin and Ewok Slayer (CC-BY)

Thouless pump

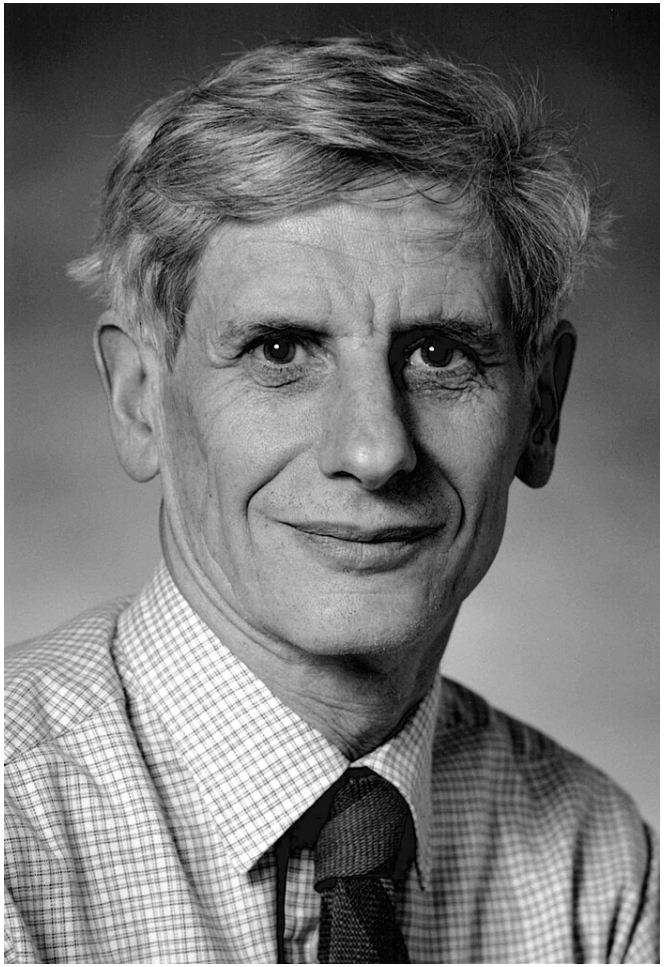


David Thouless
1934–2019

Archimedian screw

Image credits: Mary Levin and Frank Vincentz (CC-BY)

Thouless pump

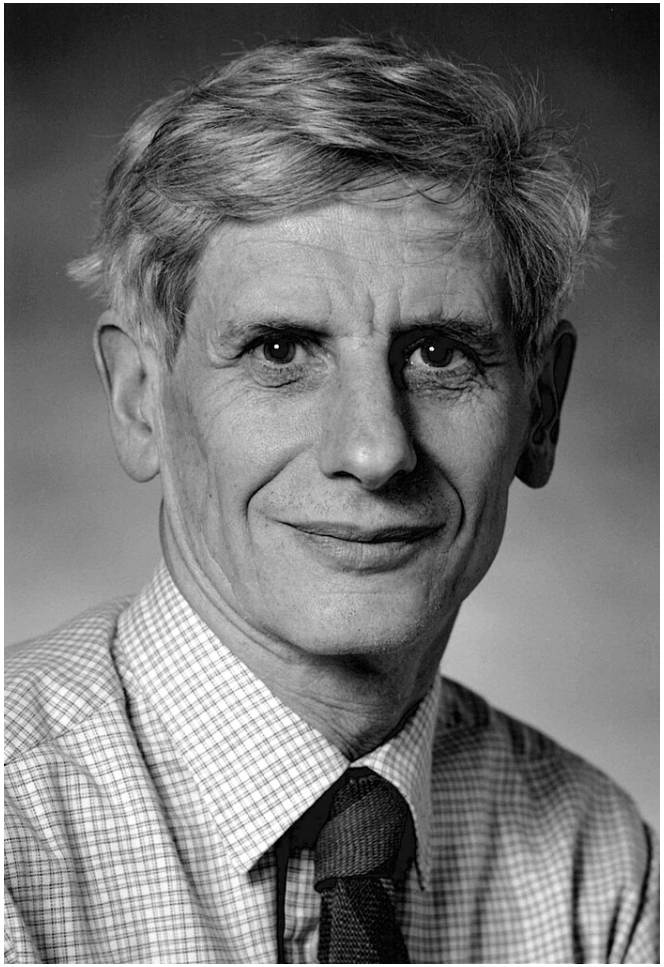


David Thouless
1934–2019

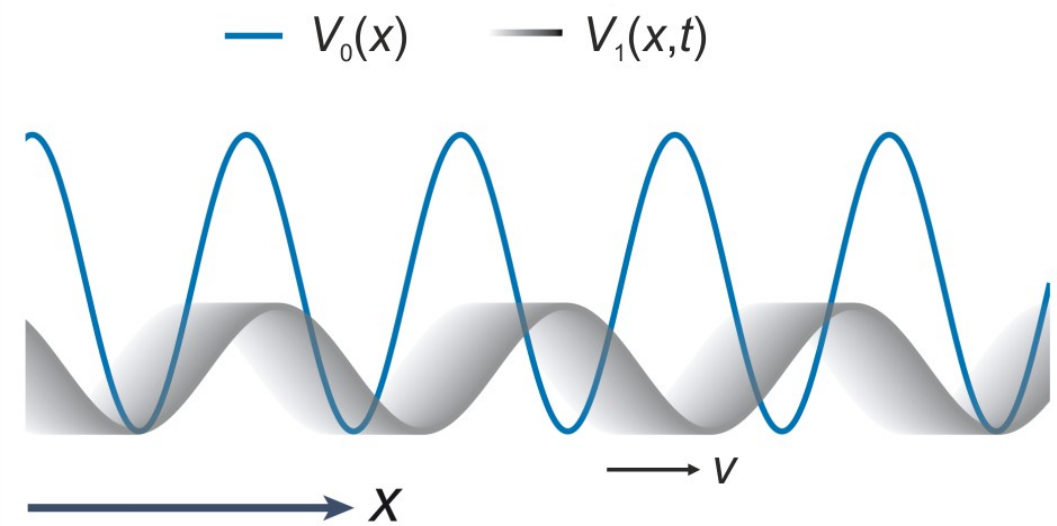
somewhere in Netherlands...

Image credits: Mary Levin and S.J. de Waard (CC-BY)

Thouless pump



David Thouless
1934–2019

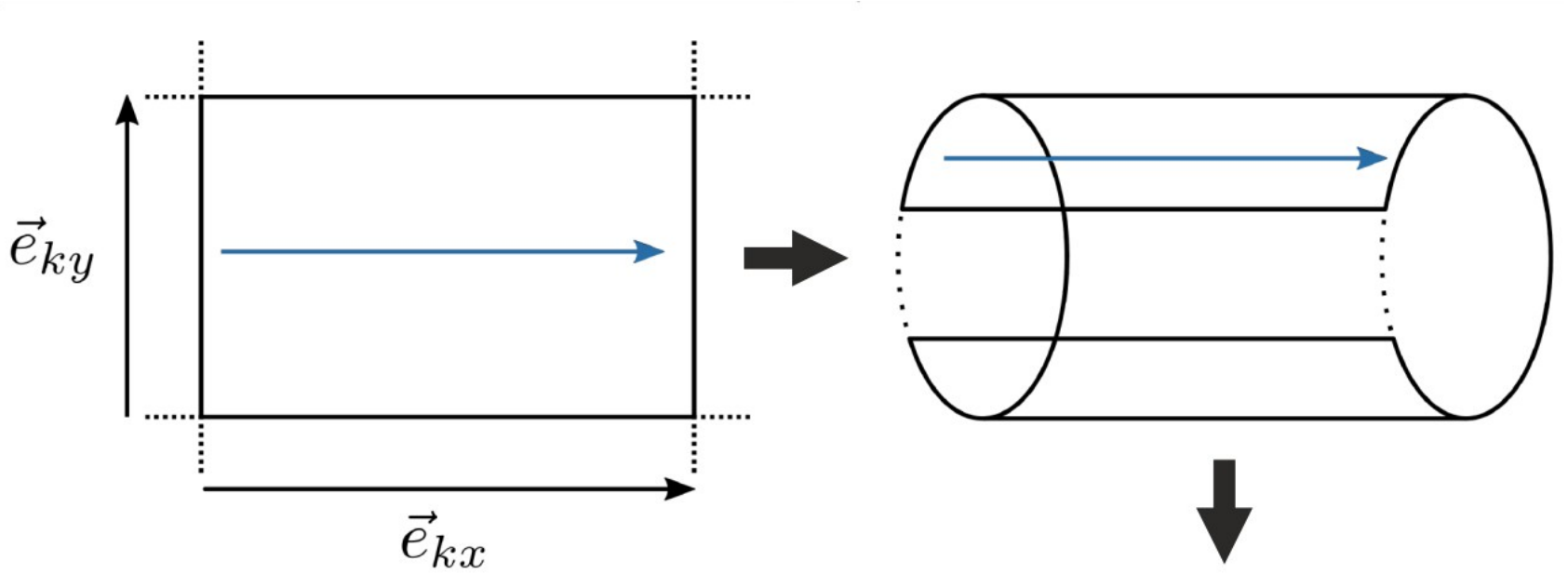


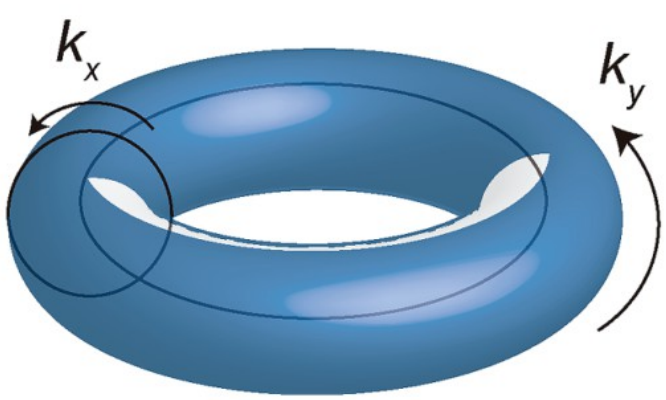
Nature Rev. Phys. 5, 87 (2023)

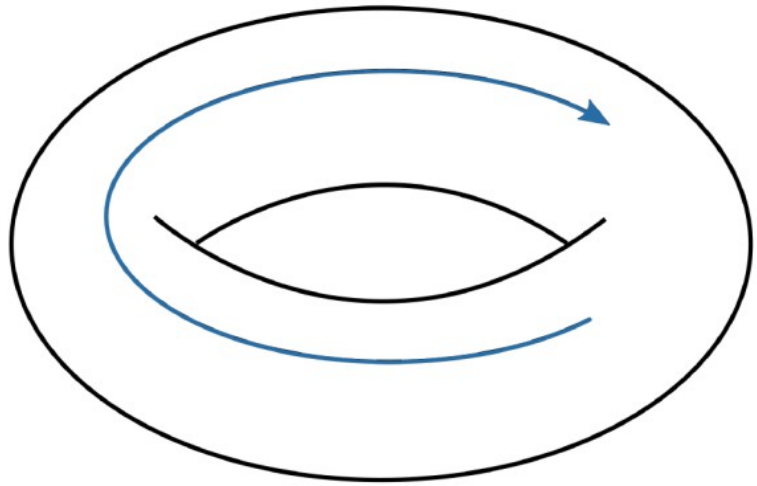
Experimental realization in cold atoms:
Nature Phys. **12**, 296 and 350 (2016)

or ask Johannes Deiglmayr and Inti Sodemann
(arXiv:2406.08551)

Everything is torus!

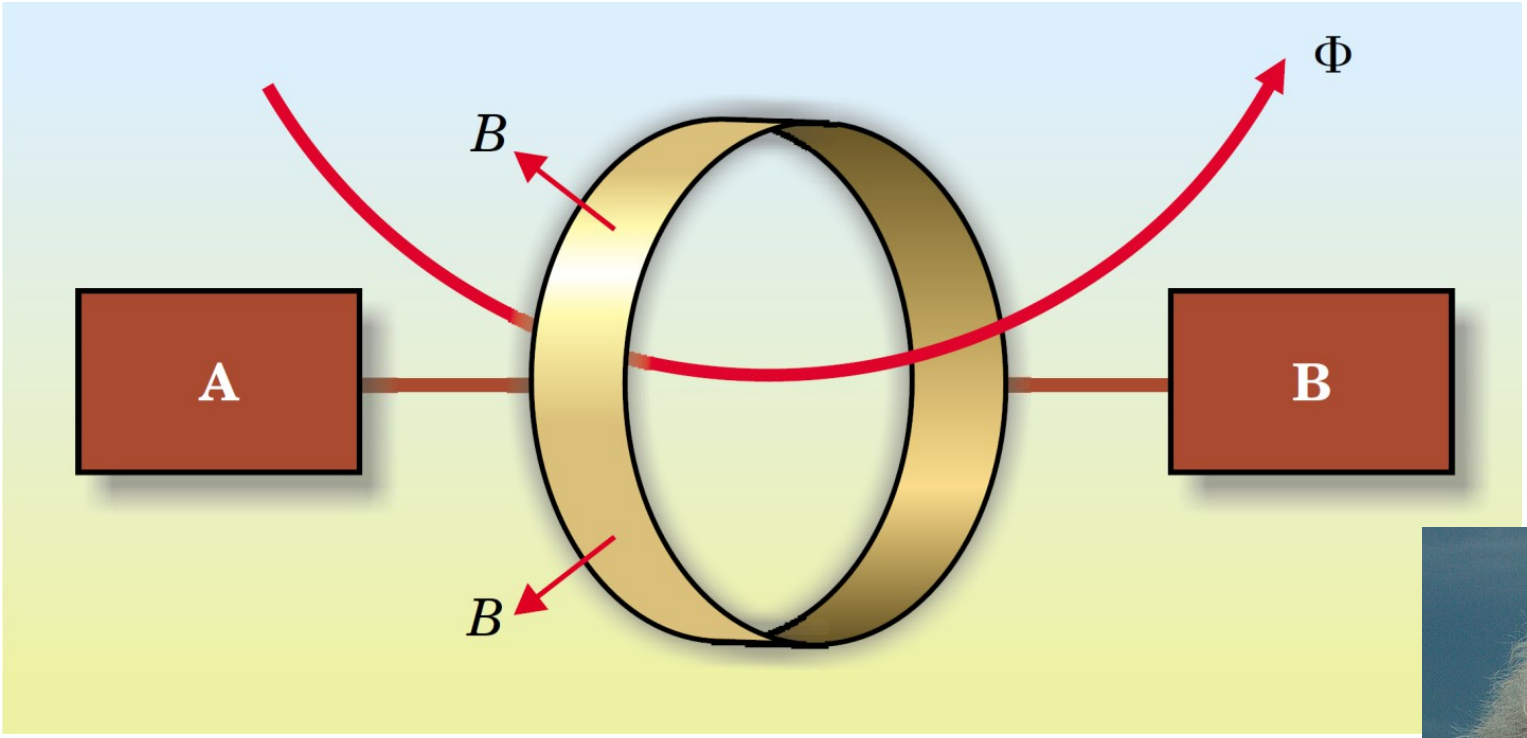






arXiv:2407.10464 and J. Appl. Phys. 128, 191101 (2020)

Laughlin pump



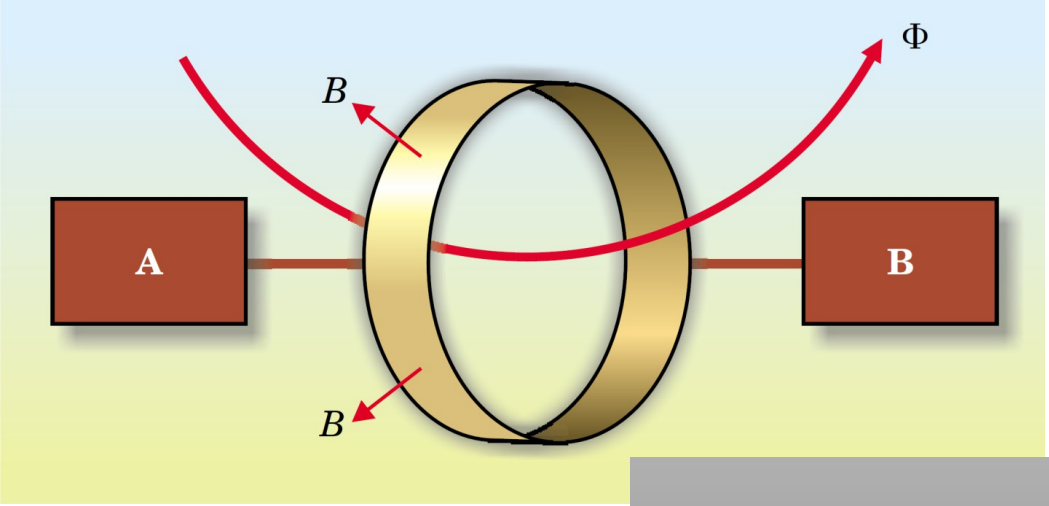
Robert Laughlin

born 1950

Nobel prize in physics 1998
(fractional quantum Hall effect)

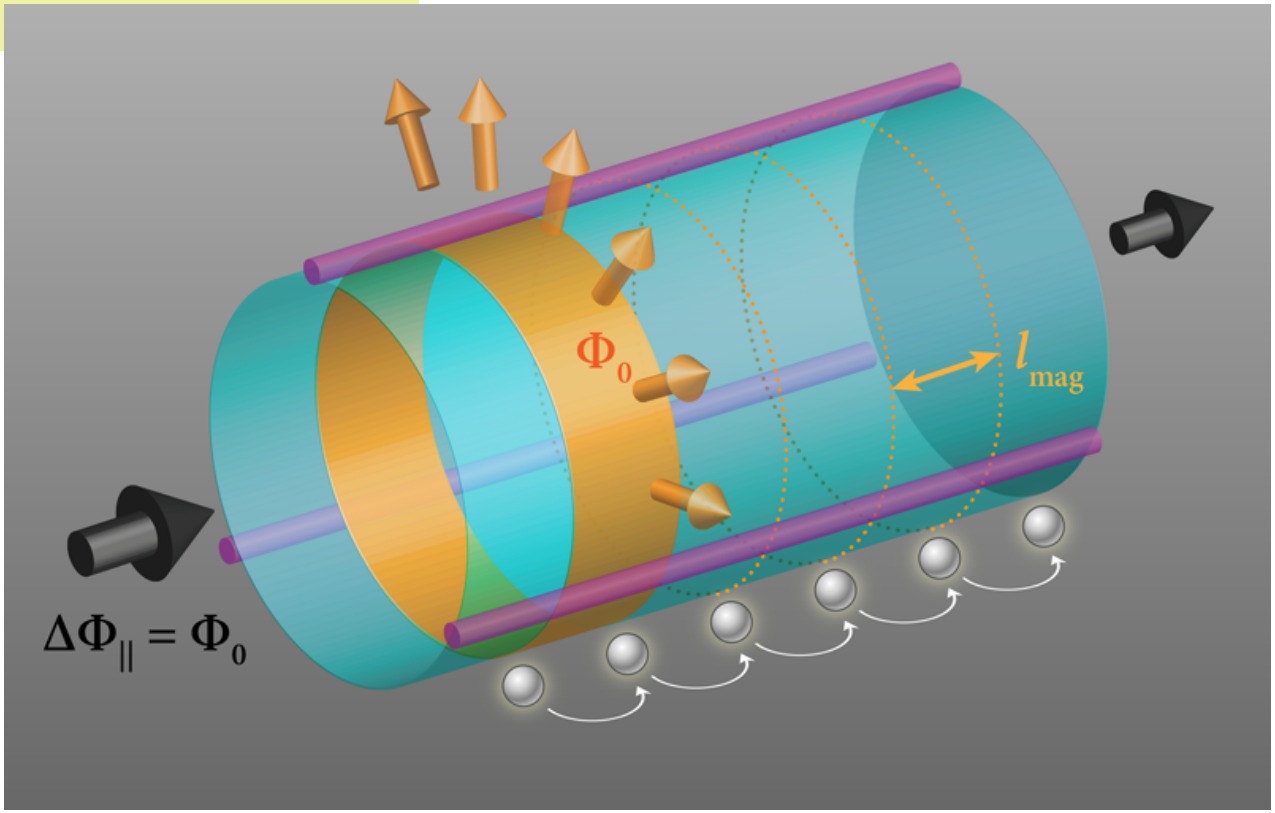
Image credits: Markus Pössel (CC-BY) and Phys. Today 56(8), 38 (2003)

Laughlin pump



Experimental realization in cold atoms:
Phys. Rev. Lett. **128**, 173202 (2022)

in solid-state setting:
Nature Phys. **19**, 333 (2023)



Phys. Today 56(8), 38 (2003)
Physics 15, 61 (2022)

Quantized Hall Conductance in a Two-Dimensional Periodic Potential

D. J. Thouless, M. Kohmoto,[a] M. P. Nightingale, and M. den Nijs
Department of Physics, University of Washington, Seattle, Washington 98195
(Received 30 April 1982)

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$C = 0$

$C = 1$

$C = 2$

$C = 3$