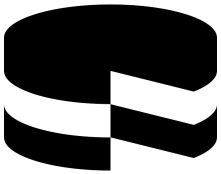
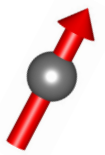
Scattering and its implications

residual resistivity ratio (RRR)



dielectric materials

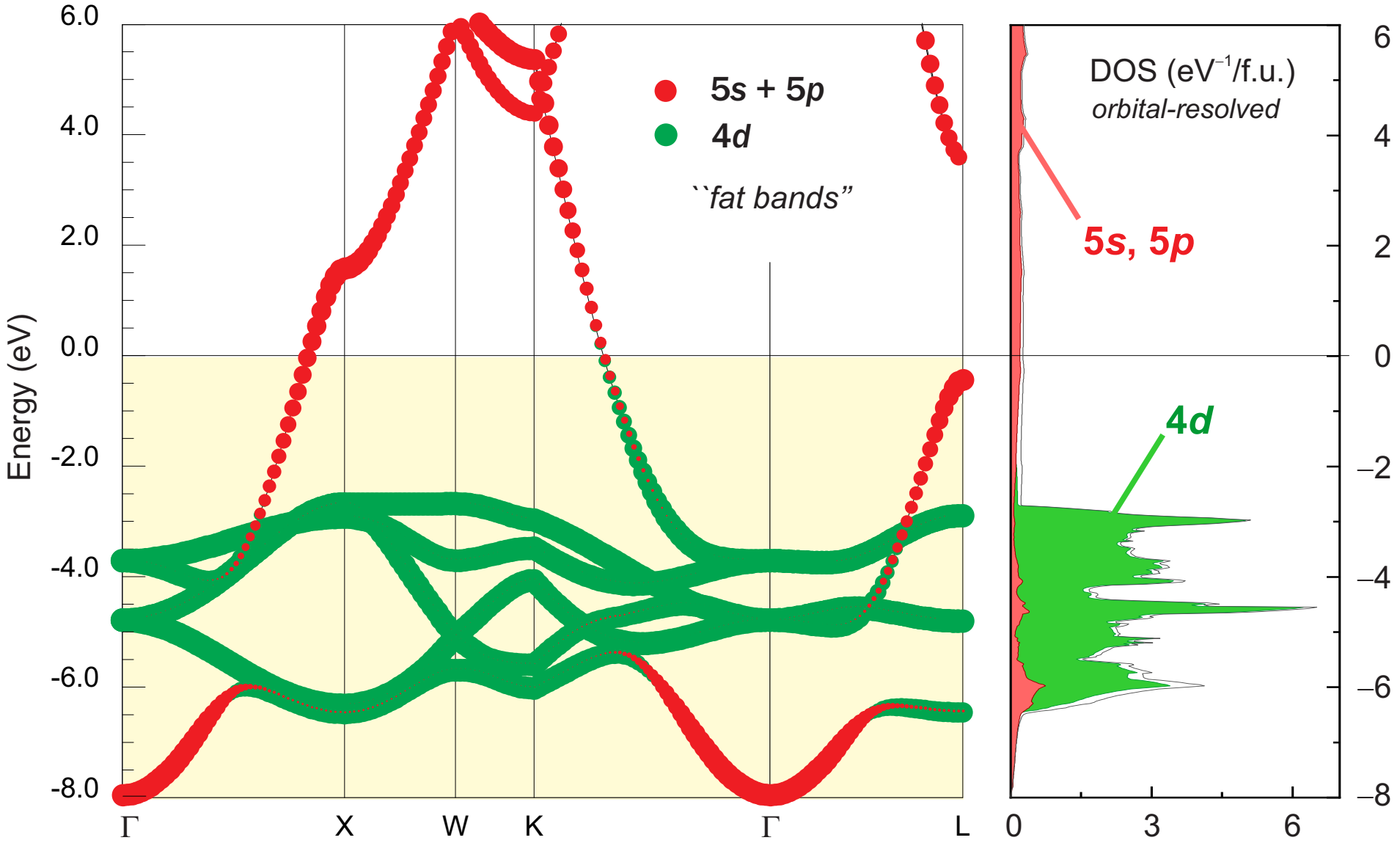
Rudolf Peierls



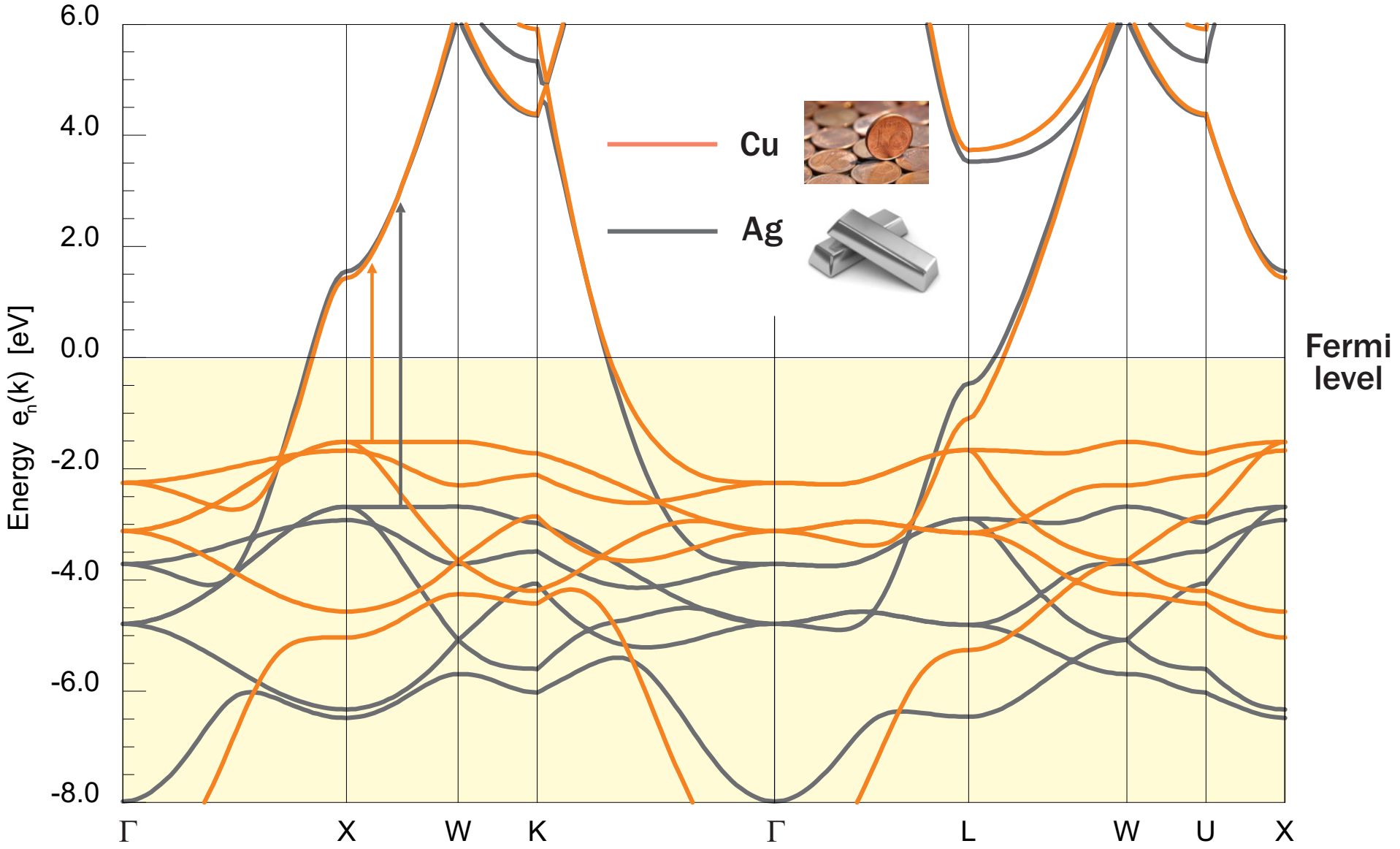
by Alexander Tsirlin, Leipzig University

Lecture 26: January 31, 2024

Band structure of silver



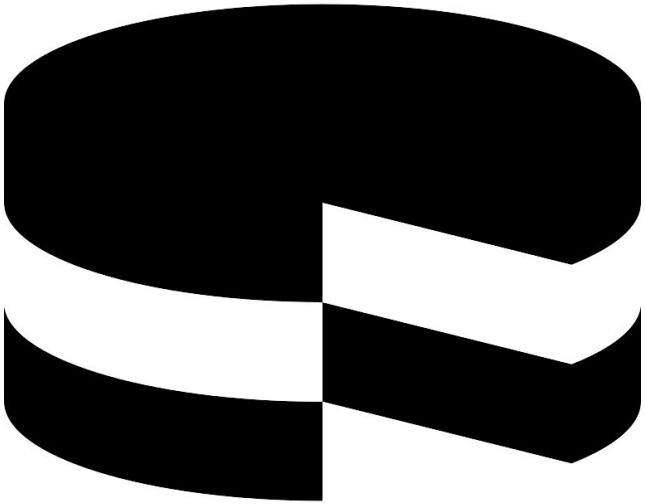
Color of metals



Electrical breakdown

Electrical breakdown

Image credit: U.S. Air Force (public domain)



Material

dielectric materials

Dielectric strength

Substance	Dielectric strength (MV/m) or (Volts/micron)
Helium (relative to nitrogen)[5] [*clarification needed*]	0.15
Air[6]	3
Sulfur hexafluoride[5]	8.5–9.8
Alumina[5]	13.4
Window glass[5]	9.8–13.8
Borosilicate glass[5]	20–40
Silicone oil, mineral oil[5][7]	10–15
Benzene[5]	163
Polystyrene[5]	19.7
Polyethylene[8]	19–160
Neoprene rubber[5]	15.7–26.7
Distilled water[5]	65–70
High vacuum (200 μPa) (field emission limited)[9]	20–40 (depends on electrode shape)
Fused silica[5]	470–670
Waxed paper[10]	40–60
PTFE (Teflon, extruded)[5]	19.7
PTFE (Teflon, insulating film)[5][11]	60–173

Source: Wikipedia

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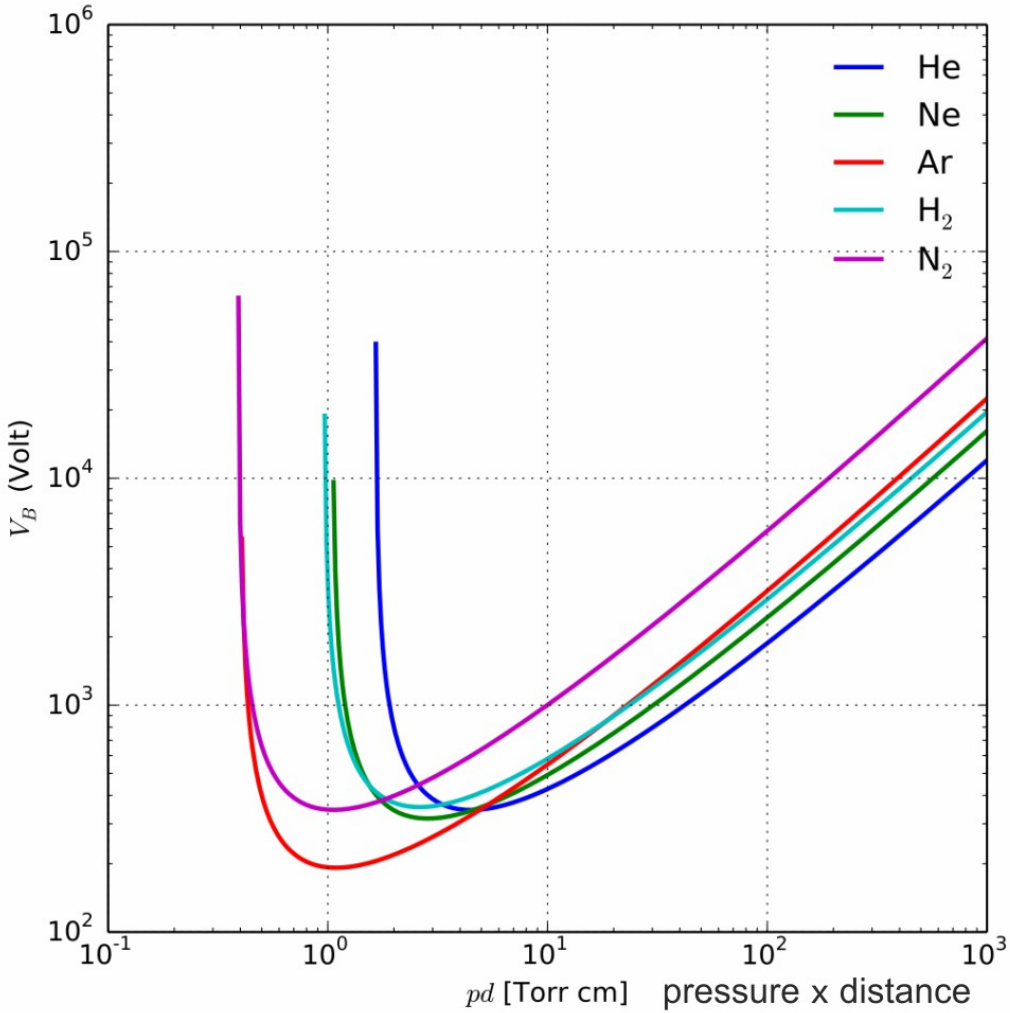


Source: Wikipedia; image credit: Krishnavedala

Insulating barrier

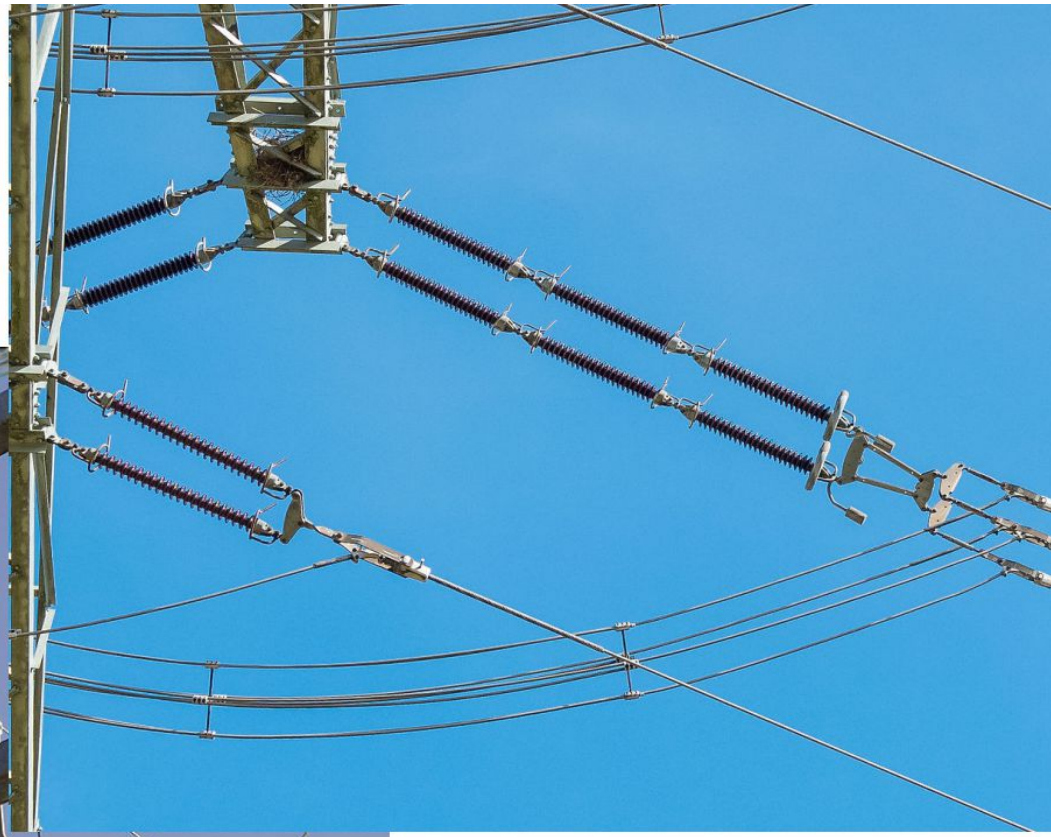
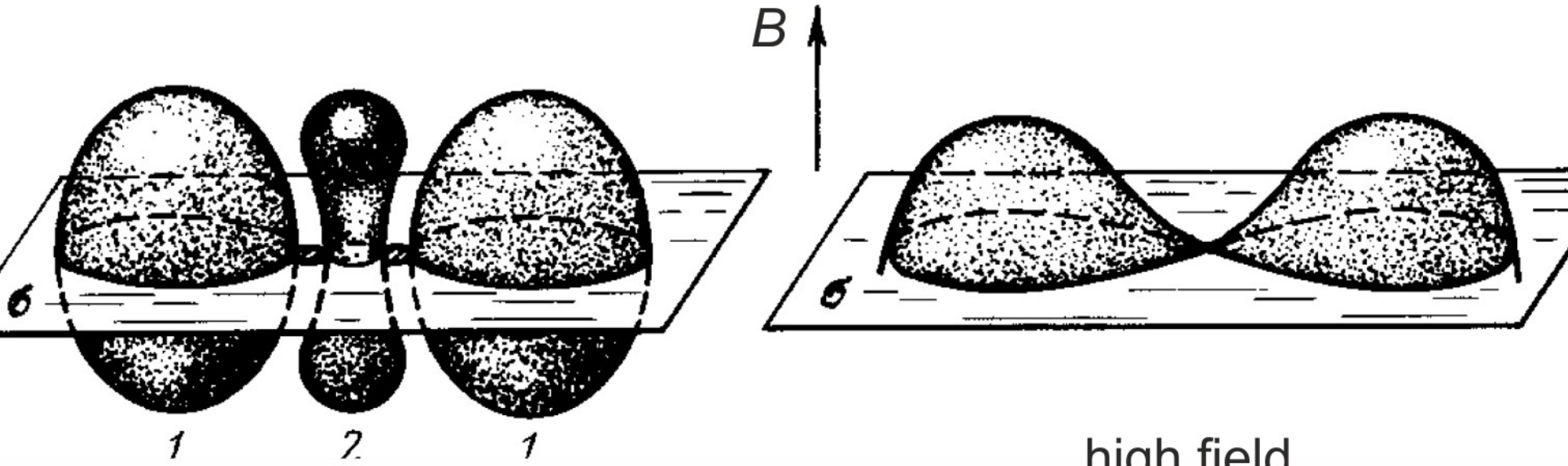


Image credits:
fir0002 and Wolfgang Ellsässer (CC-BY)

Magnetic breakdown

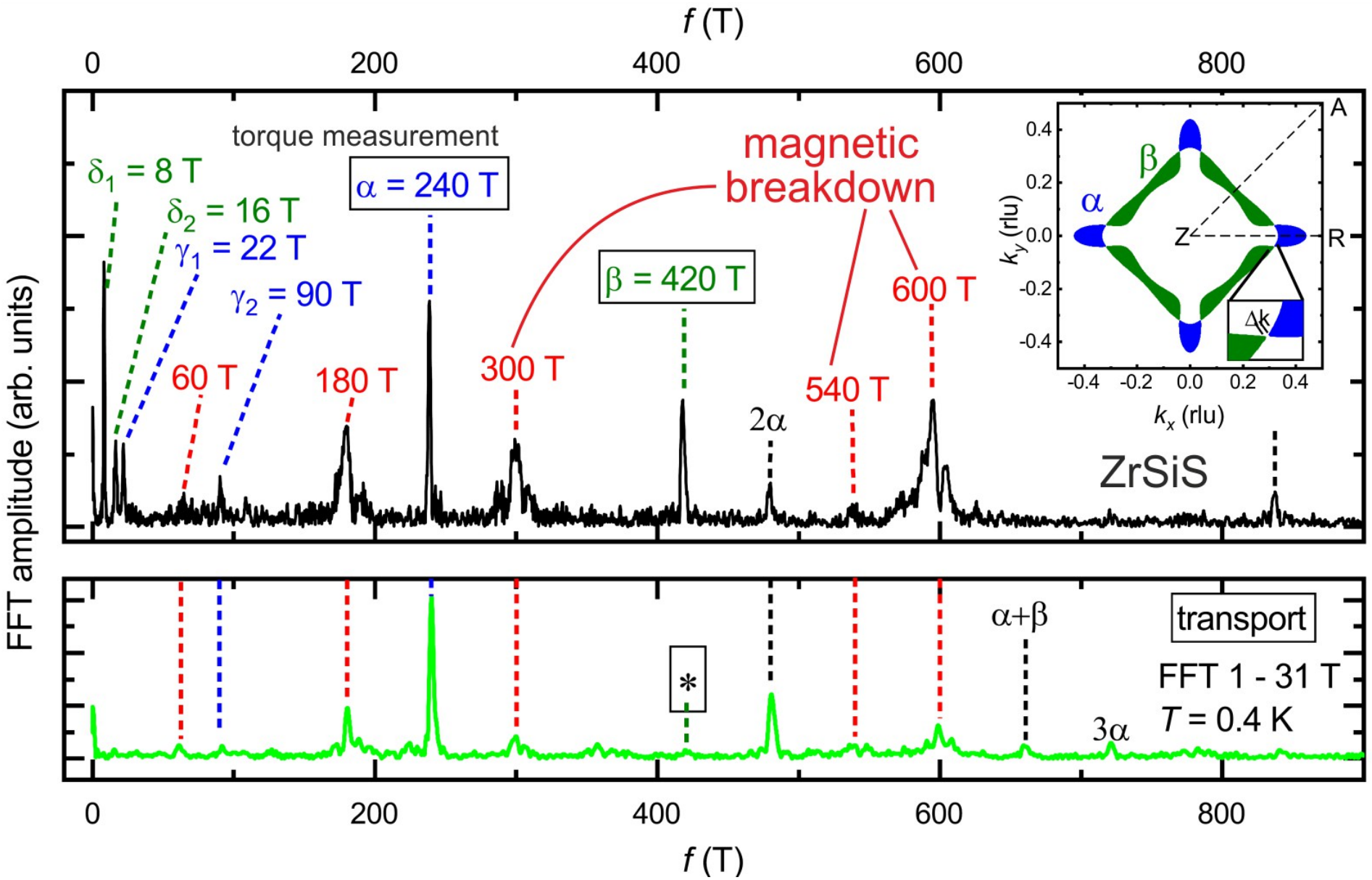


low field

high field
(magnetic breakdown)

Physics Reports 98, 189 (1983)

Magnetic breakdown

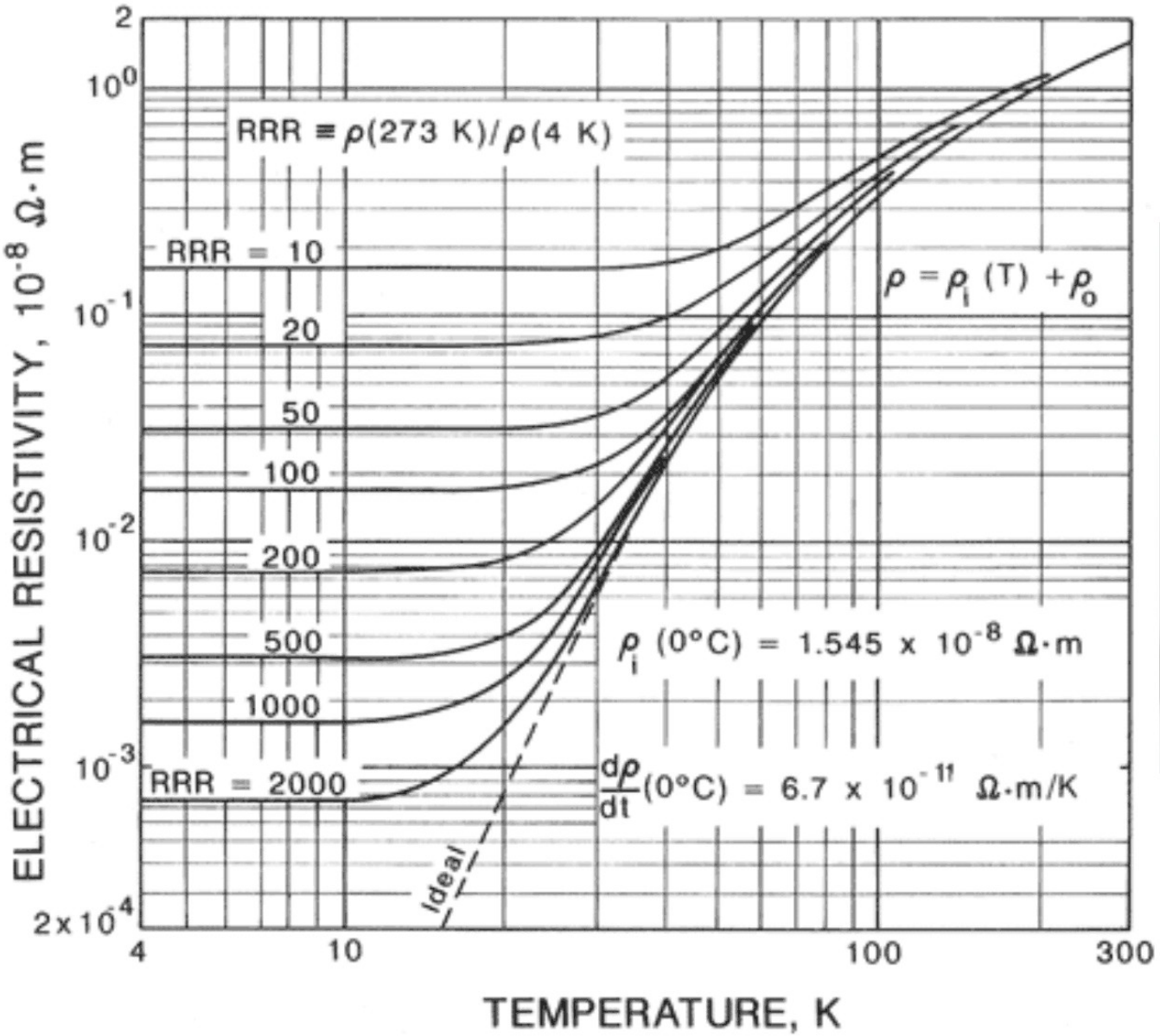


Phys. Rev. Research 2, 023217 (2020)

Experimental technique

residual resistivity ratio (RRR)

RRR: electrical conductivity

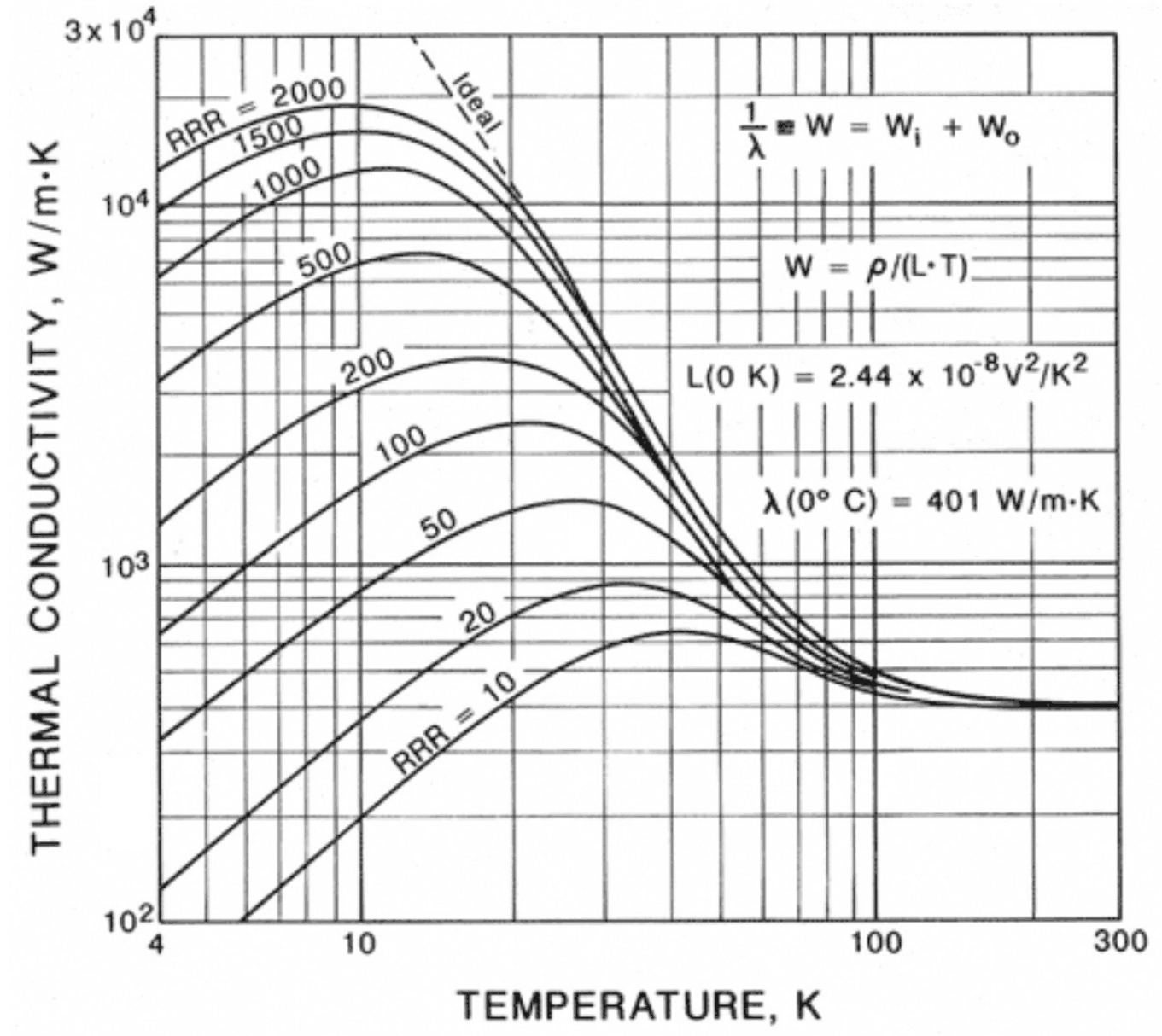


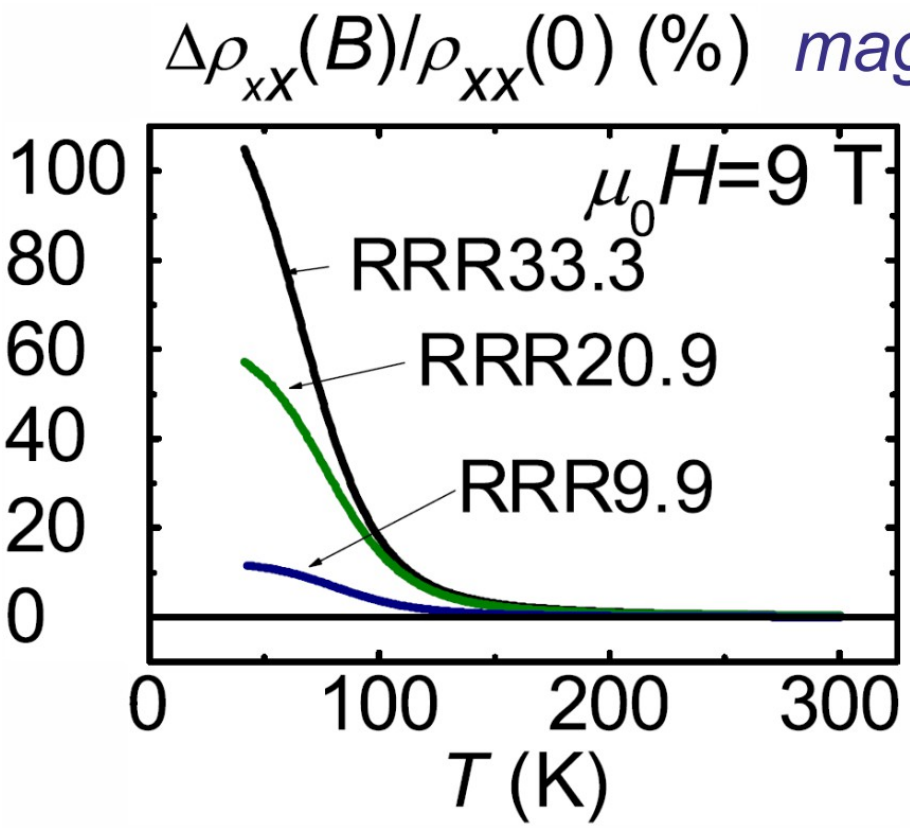
copper

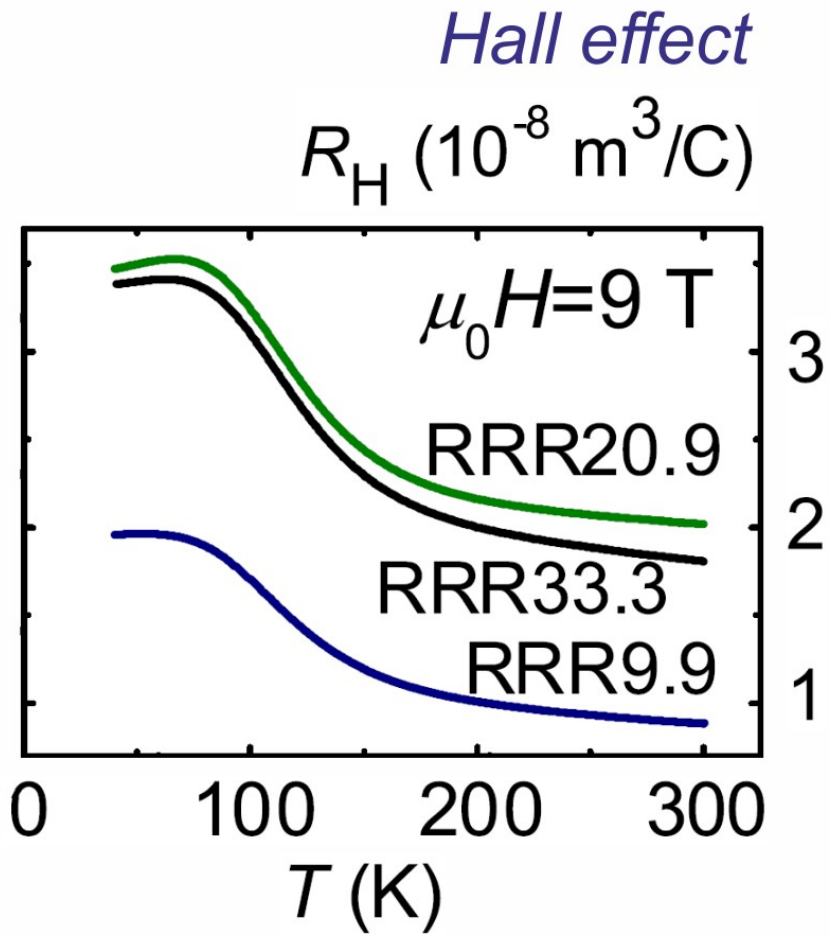
Image credits: Copper Development Association and Sjöhistoriska museet (CC-BY-SA)

RRR: thermal conductivity

copper

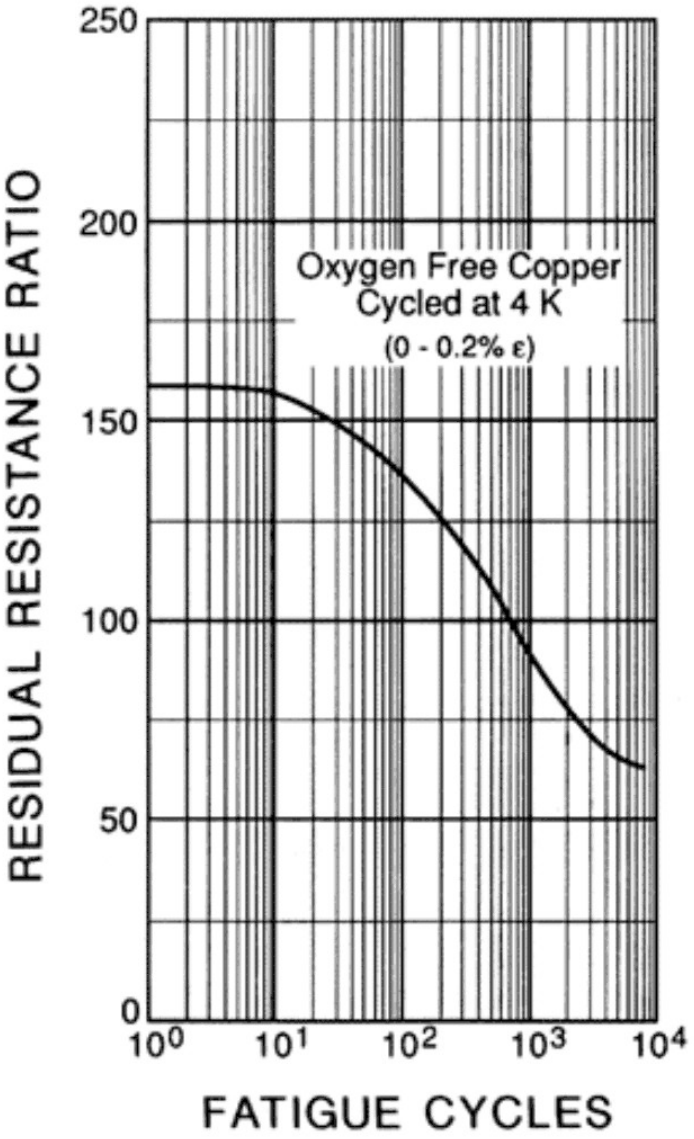






Phys. Rev. Lett. 101, 067001 (2008)

RRR: mechanical tests



Thermal conductivity of metals

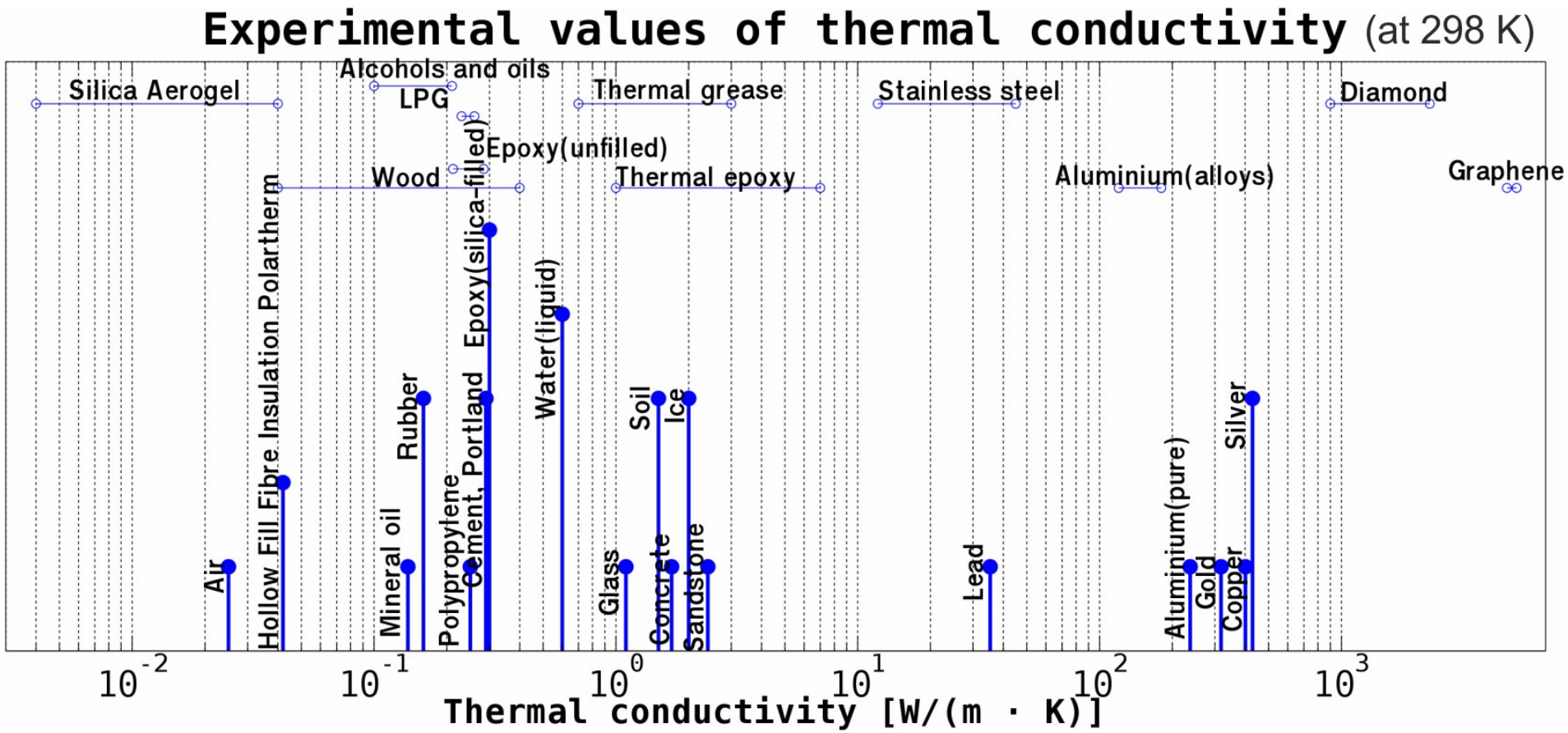


Image credits: Grzegorz Knor (public domain)

Thermal conductivity of metals

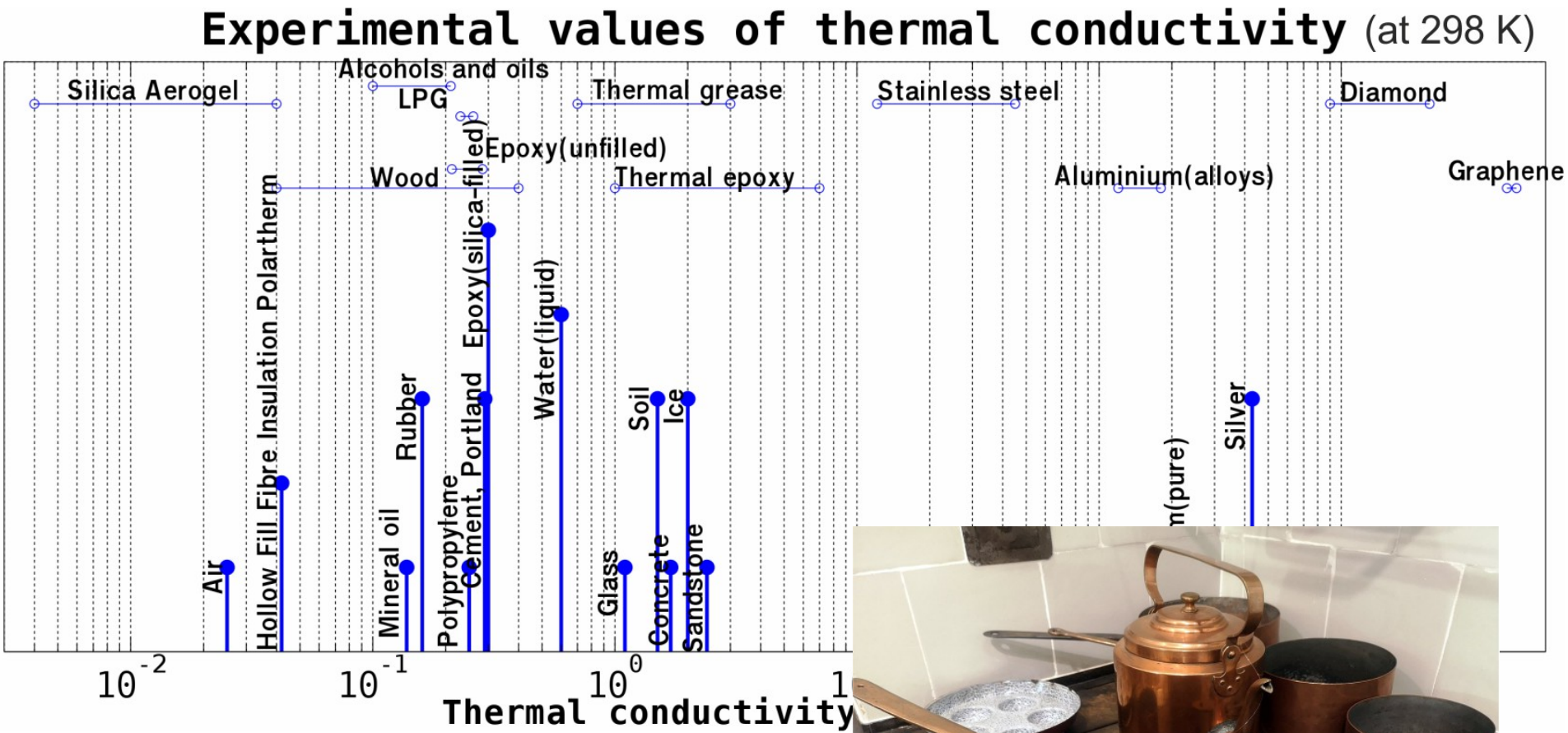


Image credits: Grzegorz Knor (public domain); freefoodphotos and Silar (CC-BY-SA)

Thermal conductivity of metals

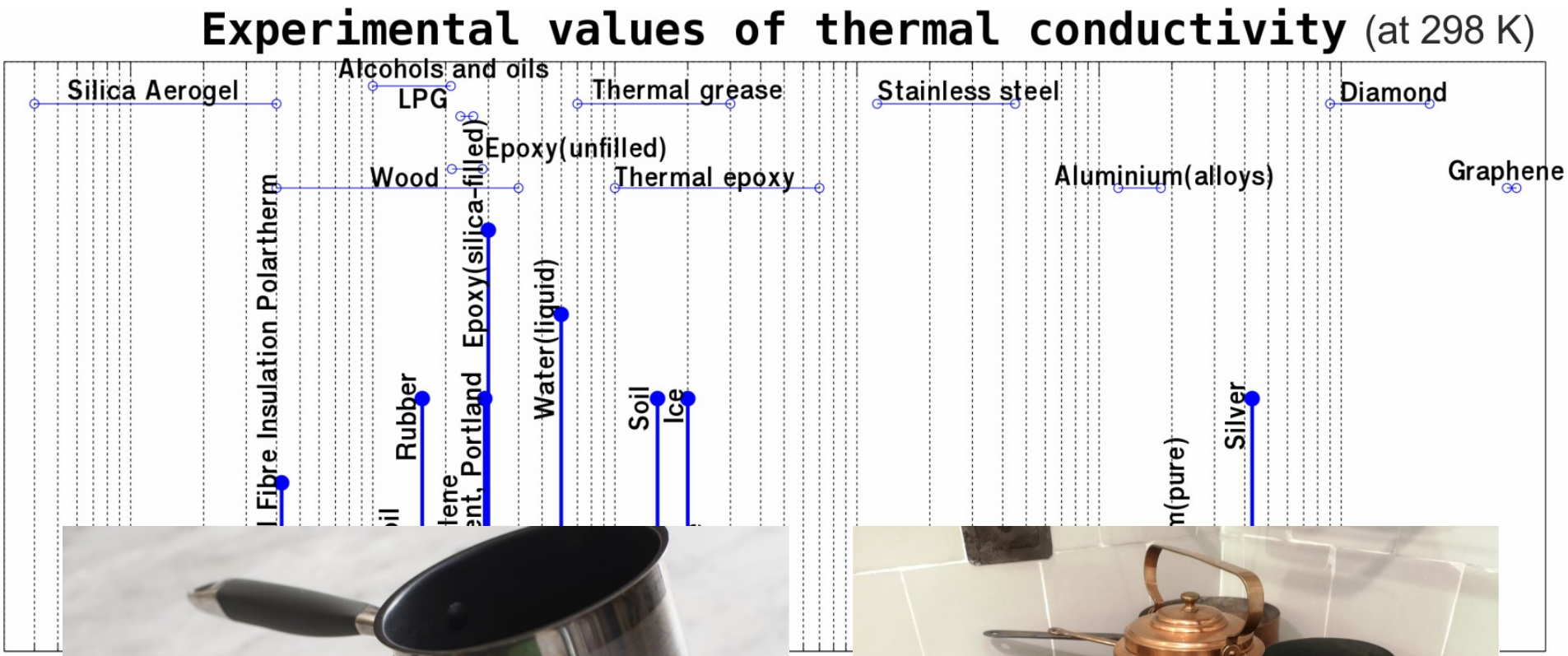


Image credits: Grzegorz Knor (public domain); freefoodphotos and Silar (CC-BY-SA)

Person

Rudolf Peierls

- 1925–28: studied physics in Berlin and Munich
- 1929: PhD in Leipzig (supervised by Heisenberg)
- 1930–32: Pauli's assistant in Zürich
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- from 1935: works in Cambridge, then Birmingham

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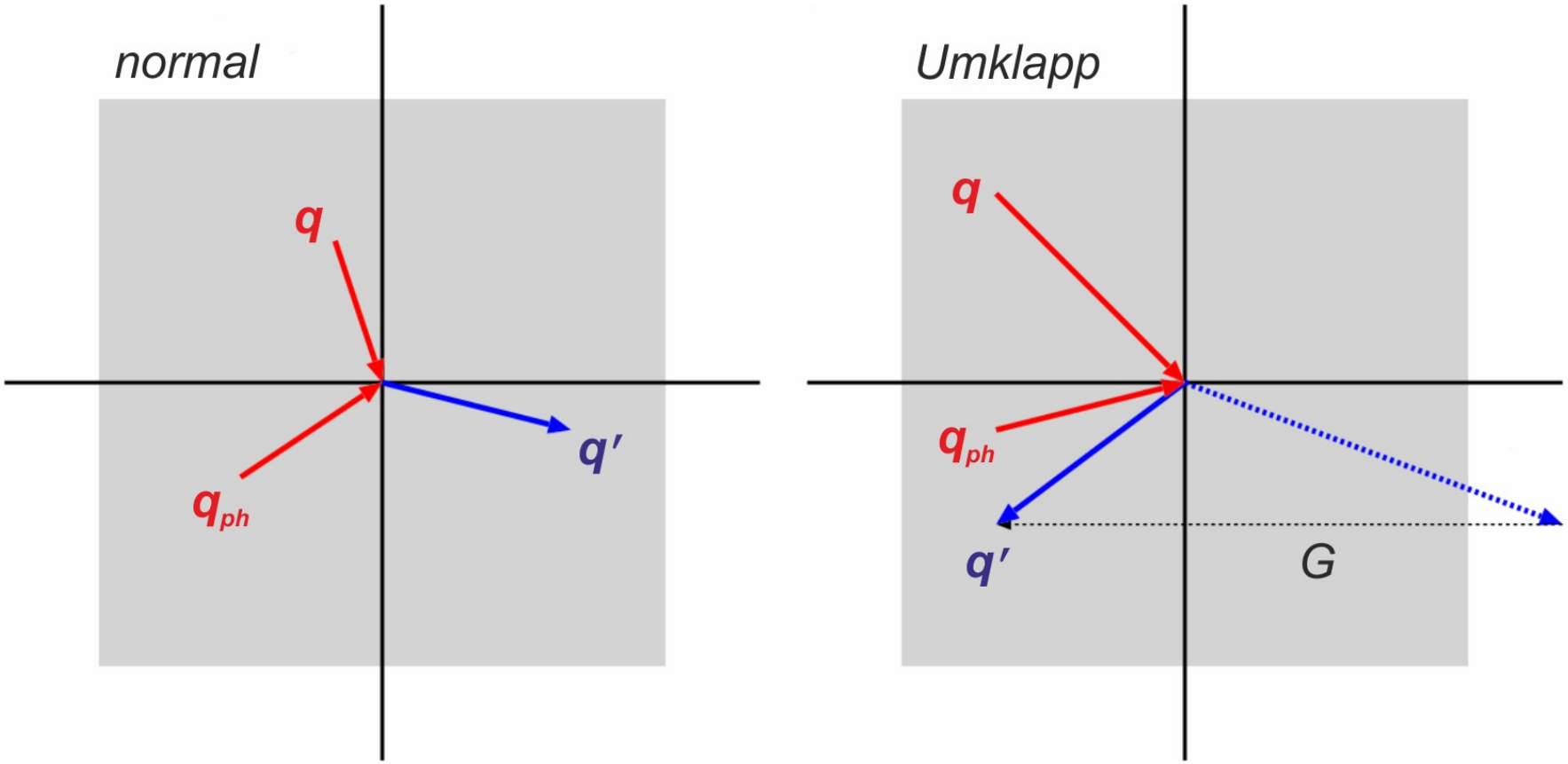
"a major player in the drama of the eruption of nuclear physics into world affairs"

Rudolf Peierls
1907–1995

Types of scattering



"I used the German term *Umklapp* (flip-over) and this rather ugly word has remained in use..."

Image credits: Daniel Schwen (CC-BY-SA) and Schnurhaus (fair use)

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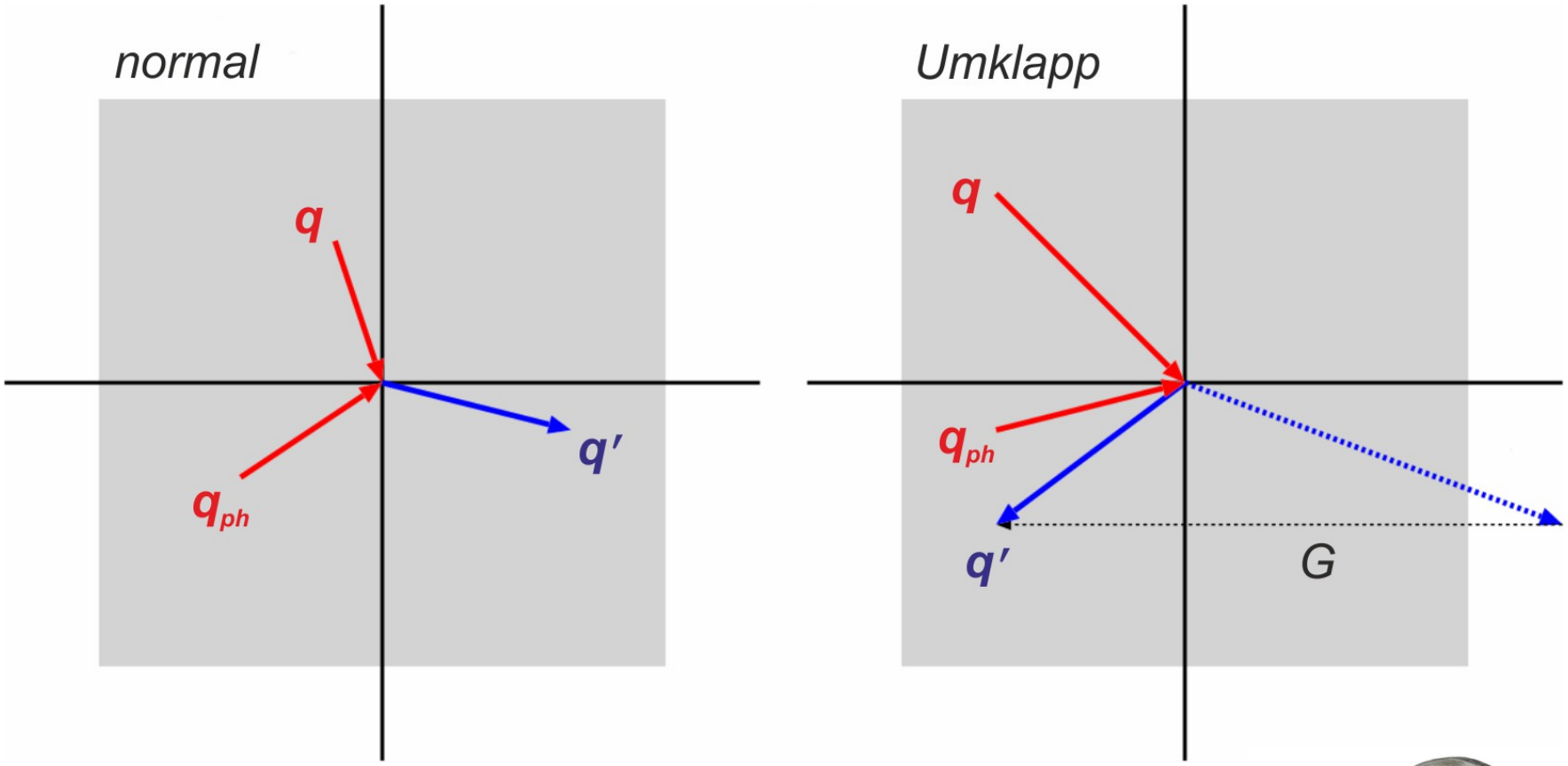

"I used the German term *Umklapp* (flip-over) and this rather ugly word has remained in use..."

"His many papers on electrons in metals have now passed so deeply into the literature that it is hard to identify his contribution"

Image credits: Daniel Schwen (CC-BY-SA) and Schnurhaus (fair use)