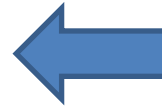
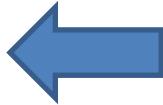


Wahlpflicht-Modul Quantum Materials

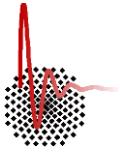
Verschiedene einsemestrige Vorlesungen (2 SWS) mit Übungen (1 SWS) :

- **Superconductivity**
- **Advanced Magnetism**
- **Topological Aspects of Cond. Matter**
- **Low-dimensional materials**



die beliebig kombiniert werden können.

Vertiefung mit unterschiedlichen Spezialvorlesungen / Blockpraktikum (2 SWS) möglich.



Superconductivity (WS 20/21)

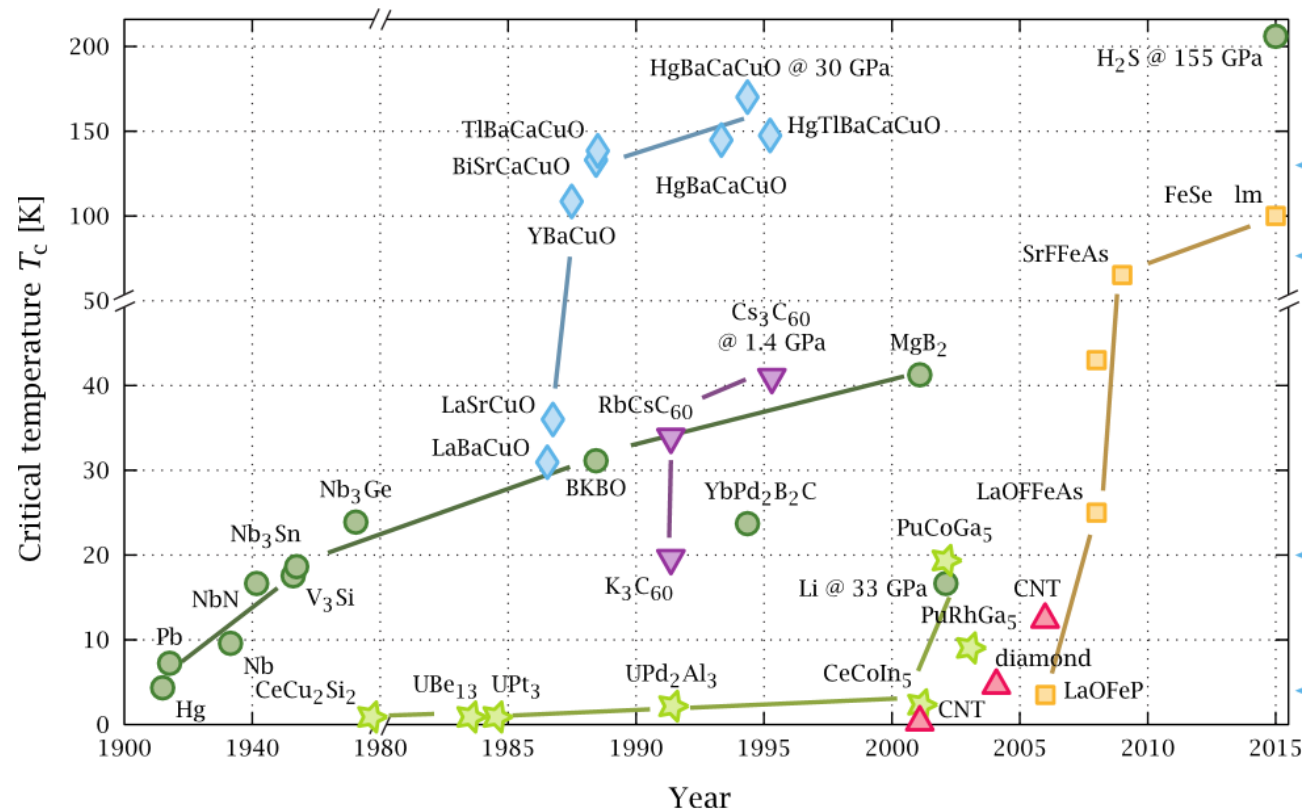
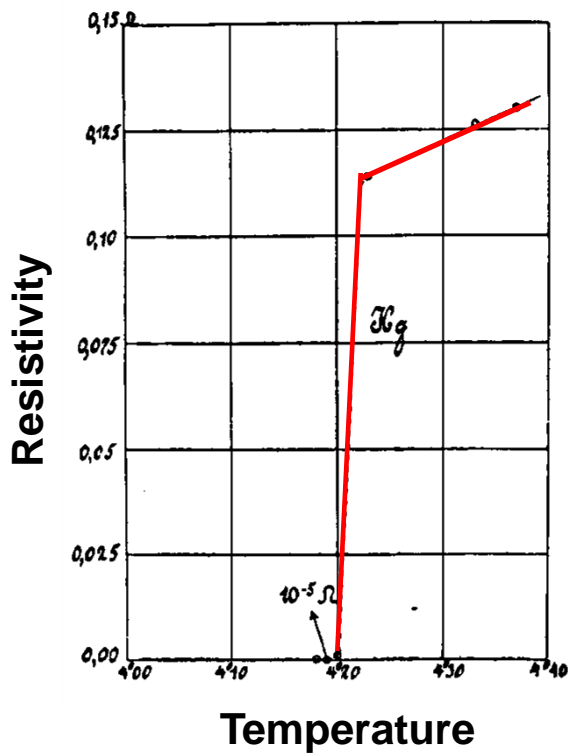


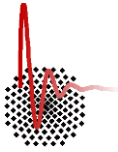
Vanishing resistivity

In 1911 Heike Kamerlingh Onnes first observed the vanishing resistance of Hg [Leiden Communications **124c** (1911)]

2020: $T_c \sim 260$ K
LaH₁₀, 200 GPa

2020: $T_c \sim 160$ K
ambient pressure





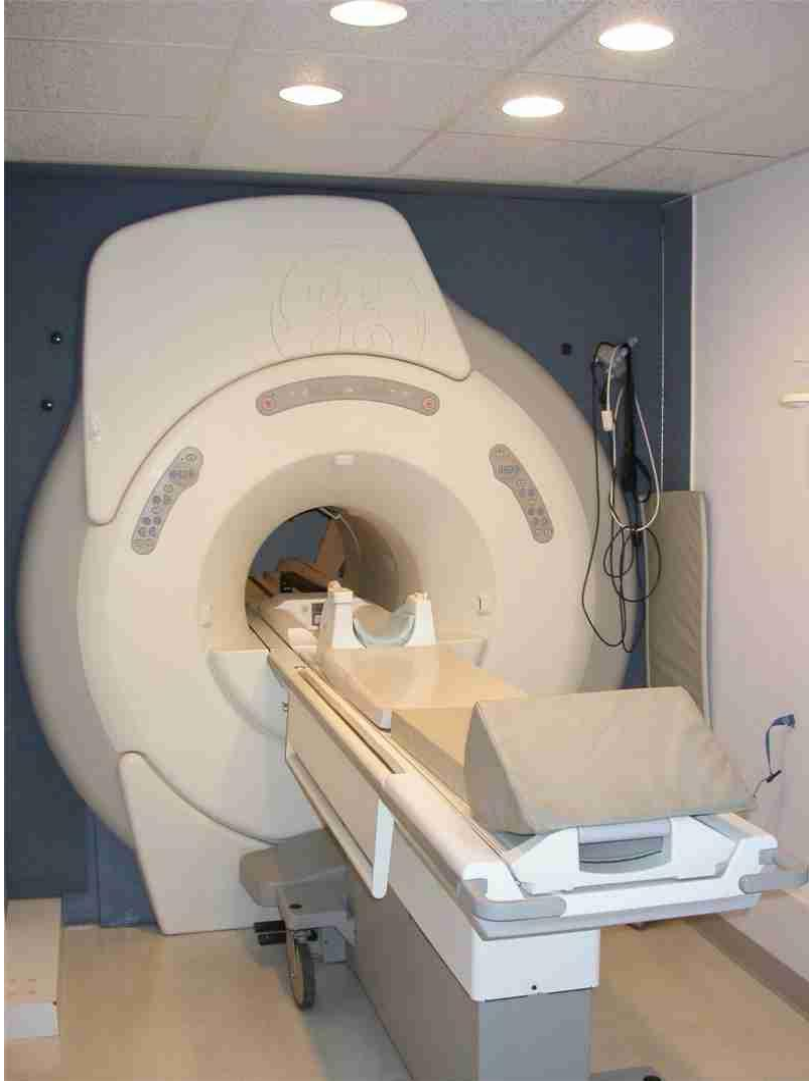
Superconductivity: applications

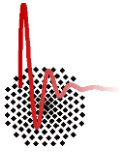
Current:

- **magnets for magnetic resonance tomography**
- **power transmission (short distances)**
- **magnets for particle accelerators and other research (e.g. SQUIDs)**

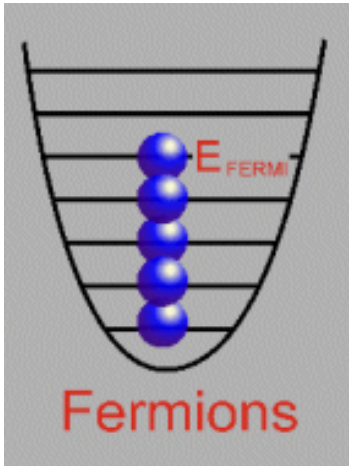
Potential:

- **levitating trains**
- **long-distances power transmission**
- ...

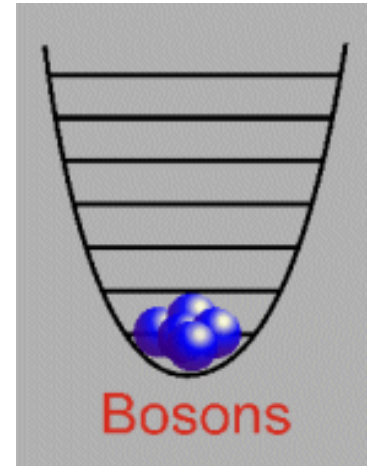




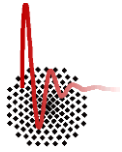
Electrons form a Bose condensate



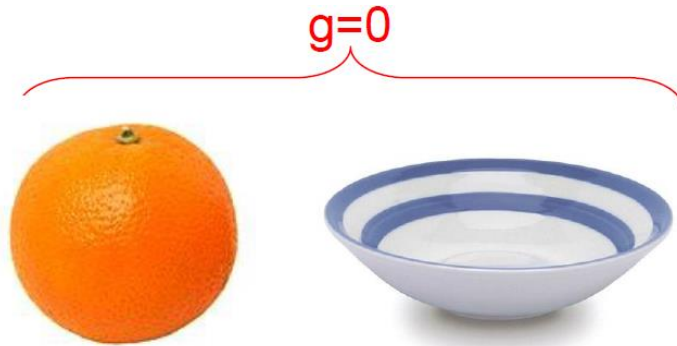
2 electrons bound together
and form **Copper pairs**,
which are bosons



Bardeen–Cooper–Schrieffer (BCS) theory:
the first microscopic theory of superconductivity (1957)

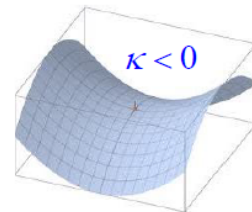
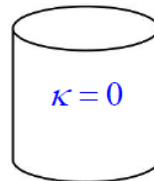
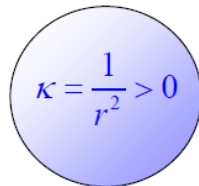


Topological aspects of solid state physics (SS 2021)



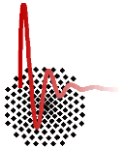
Topological numbers (invariants) **g** – genus

$$\kappa = \frac{1}{r_1 r_2}$$



Gauss Bonnet Theorem : $\int_S \kappa dA = 4\pi(1 - g)$

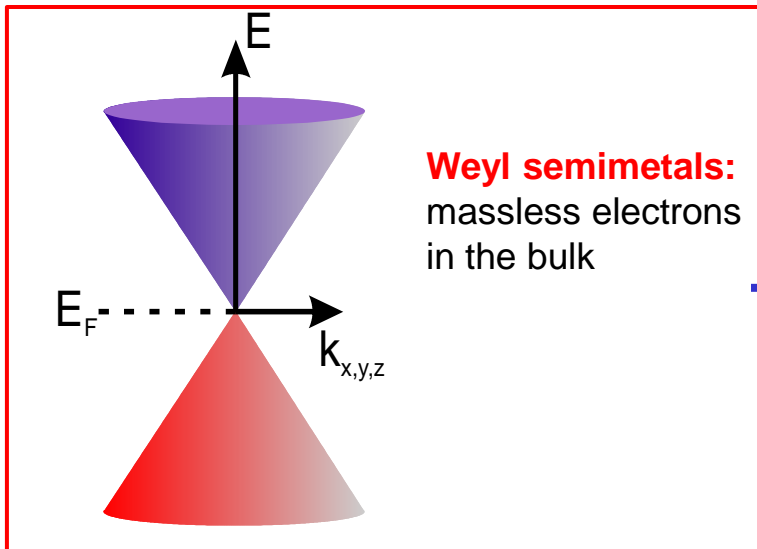
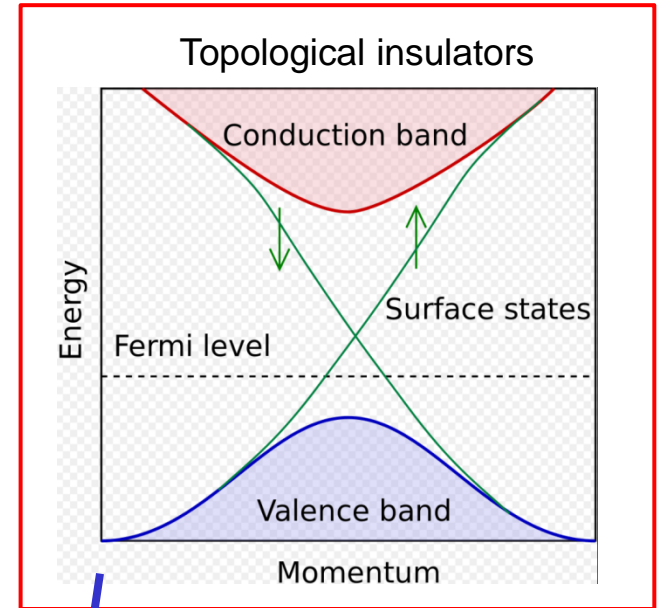
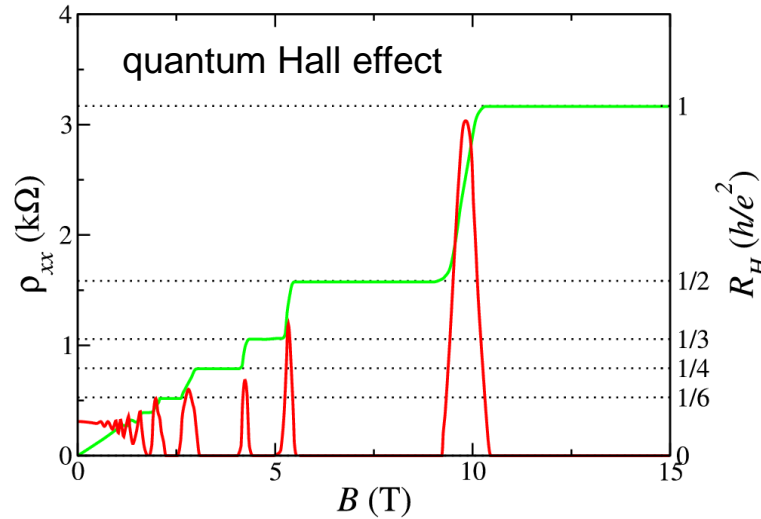




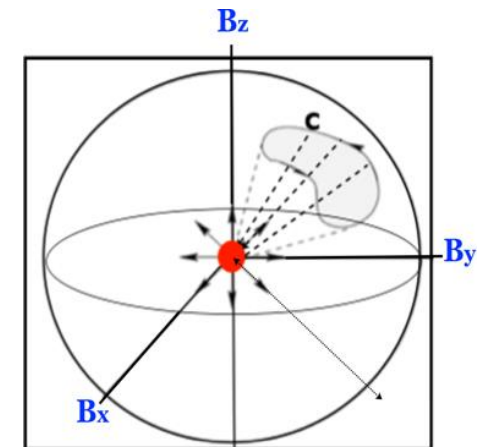
Topological aspects of solid state physics (SS 2021)

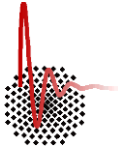


Klaus von Klitzing



Topological invariants
Berry phase






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<https://www.pi1.uni-stuttgart.de/institute/team/Pronin/>

The screenshot shows a web page for Dr. Artem Pronin at the University of Stuttgart. The page has a dark blue header with navigation links for 'University of Stuttgart' and 'Faculty 08'. Below the header is a white section with the university logo and name, and a search icon. The main content area has a blue background and features a circular portrait of Dr. Pronin. To the right of the portrait, his name and title are displayed, along with his research focus. Below this is a white section titled 'Contact' which lists his phone number, email address, and physical address.

University of Stuttgart > Faculty 08 >


 **University of Stuttgart**
1. Physikalisches Institut


EN 🔍 ☰




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1. Physikalisches Institut

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