

Electronics Structure

1. Distribution of Tasks

2. Short Introduction

3. Electronic structure

Bloch's Theorem

Central equation

Band structure

4. How to measure band structure

Photoemission

Angle resolved photoemission

Debye Theory



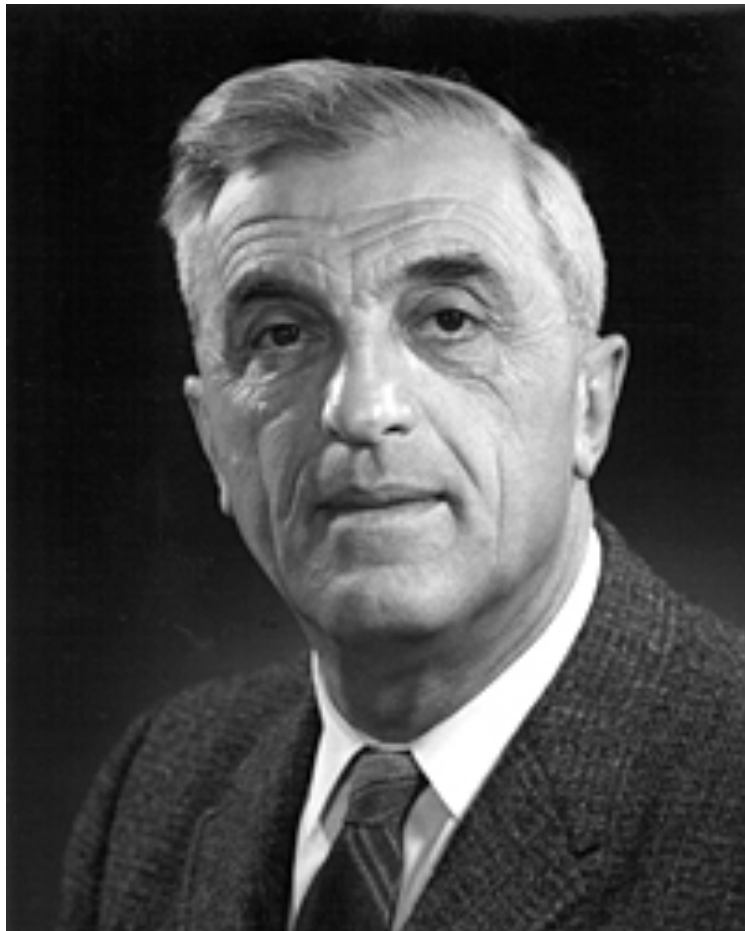
Peter Debye

In 1911, when [Albert Einstein](#) took an appointment as a professor at [Prague, Bohemia](#), Debye took his old professorship at the [University of Zurich](#), Switzerland.

Also in 1912, he extended [Albert Einstein](#)'s theory of [specific heat](#) to lower temperatures by including contributions from low-frequency [phonons](#).

https://en.wikipedia.org/wiki/Peter_Debye

Bloch's Theorem



Felix Bloch

Er erhielt 1952 den [Nobelpreis für Physik](#)

Born in Zurich (1905)

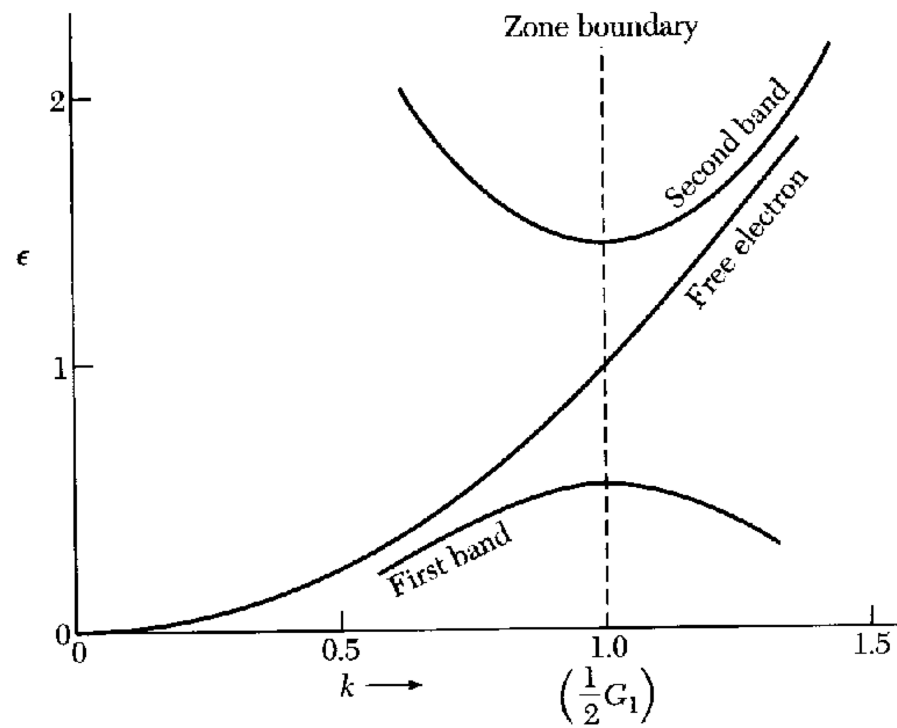
First Director of CERN

'When I started to think about it, I felt that the main problem was to explain how the electrons could sneak by all the ions in a metal....

By straight Fourier analysis I found to my delight that the wave differed from the plane wave of free electrons only by a periodic modulation'

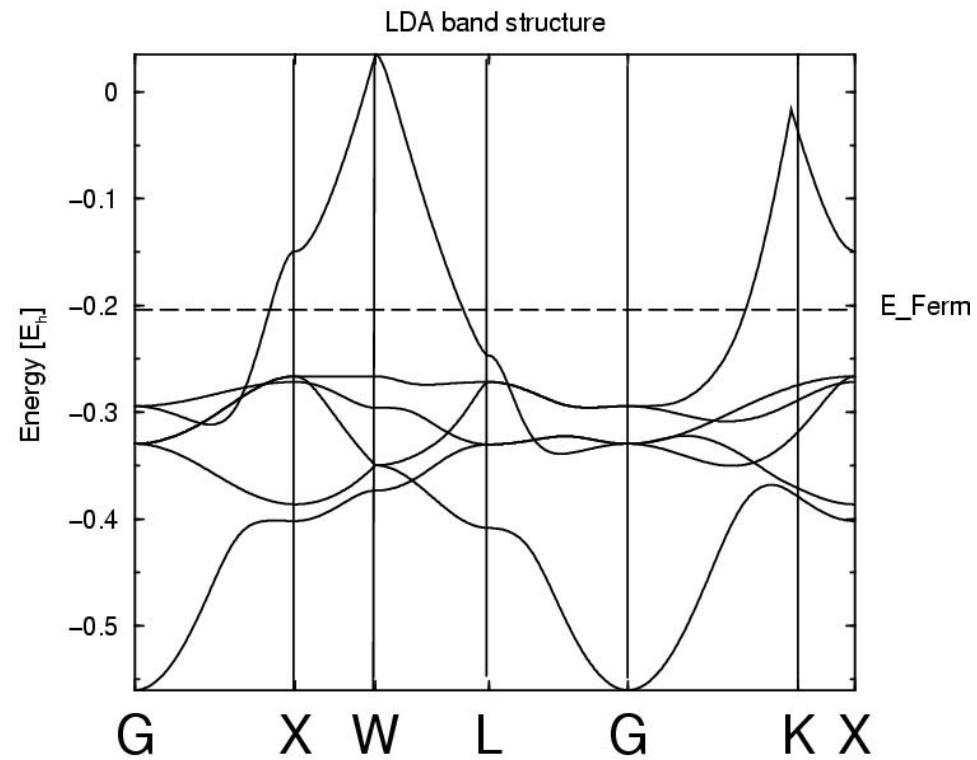
F. BLOCH

Band structure

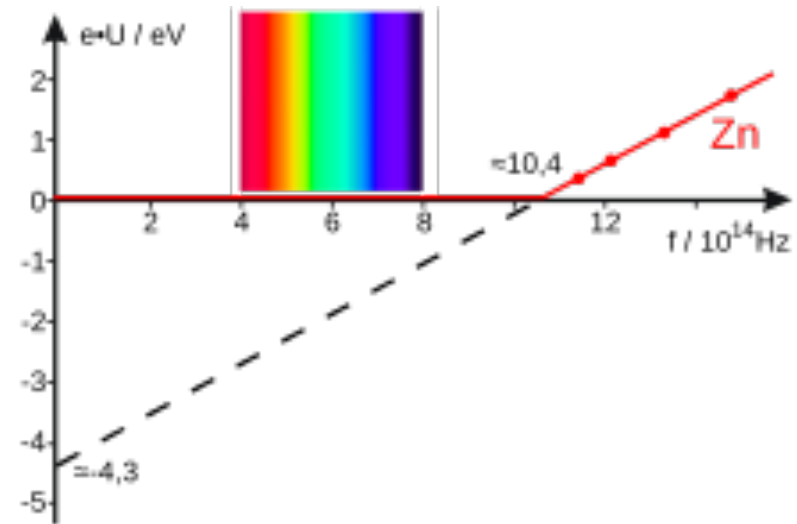
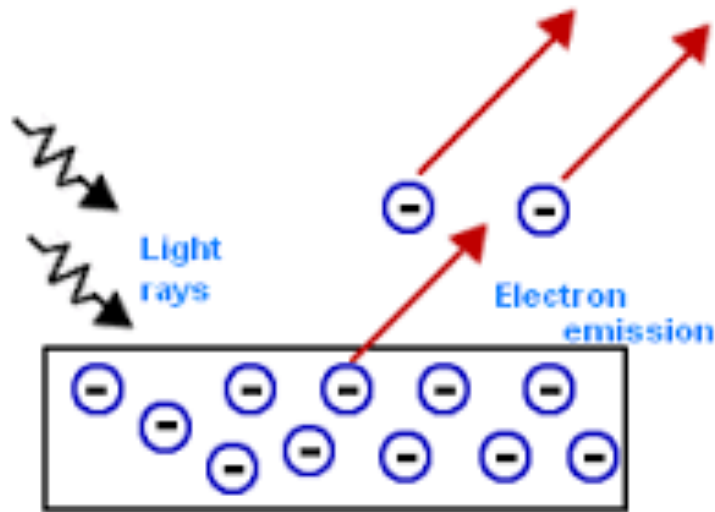


Band structure quiz:

Metal or Insulator?



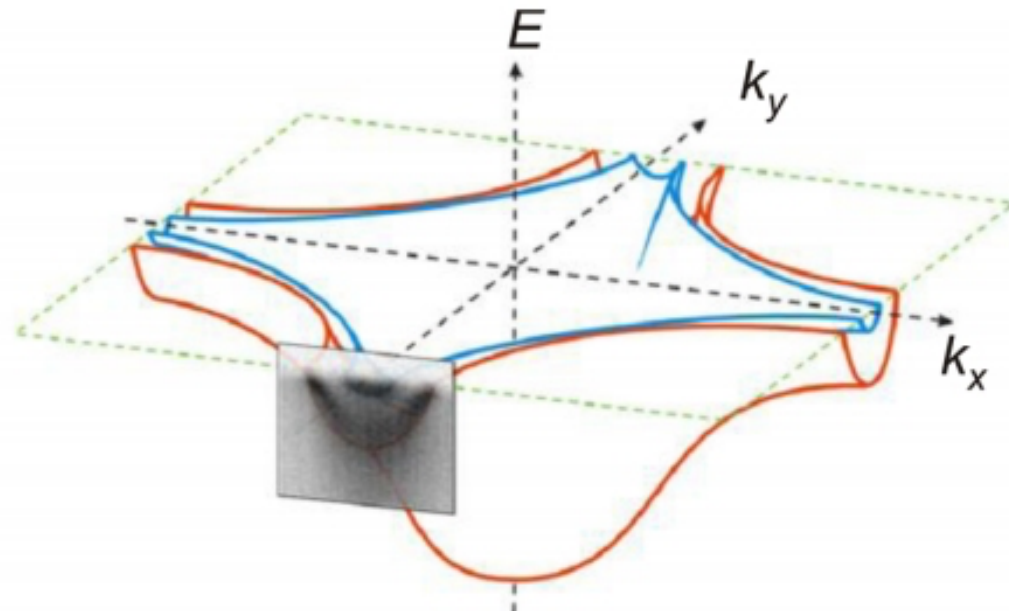
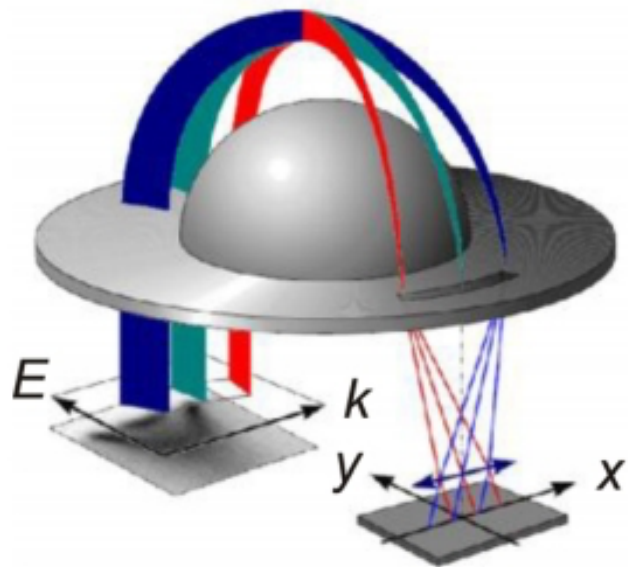
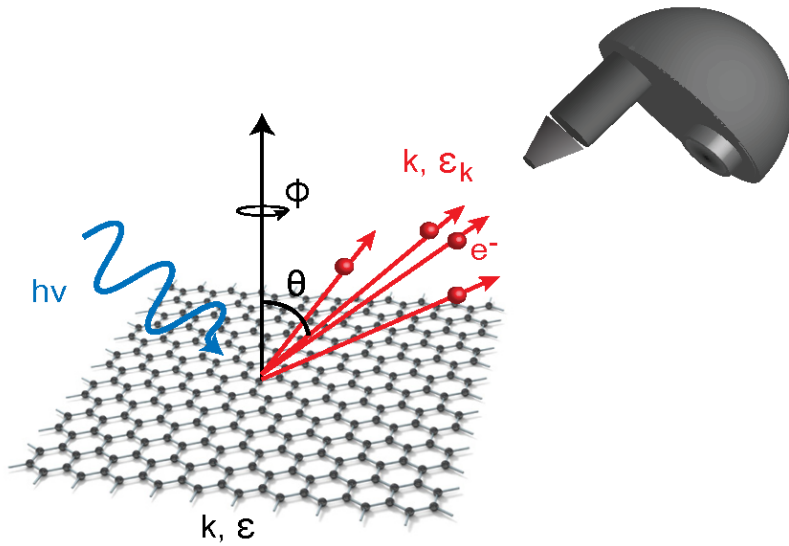
Photoelectric effect



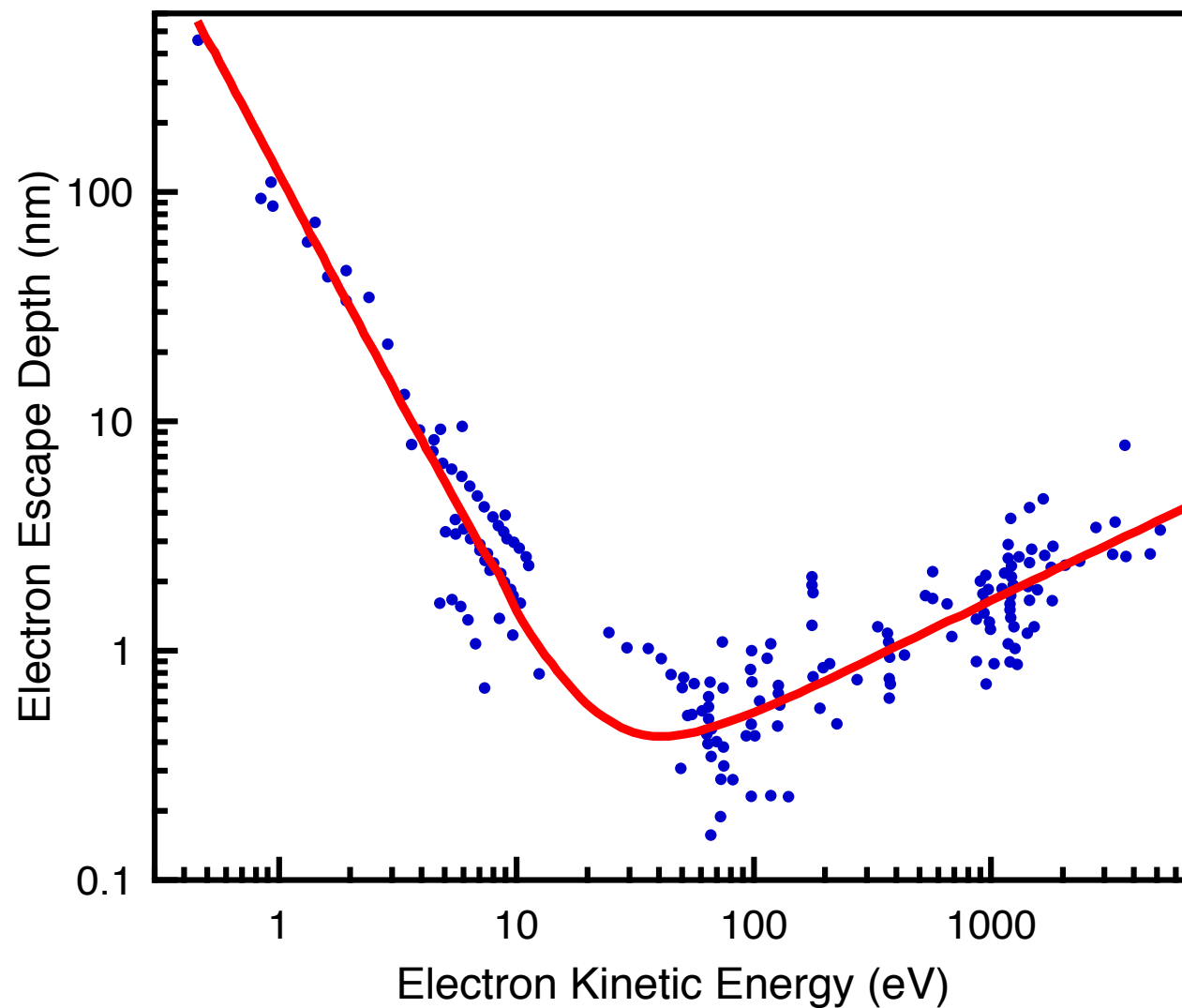
In 1905, Albert Einstein solved this apparent paradox by describing light as composed of discrete quanta, now called photons, rather than continuous waves. Based upon Max Planck's theory of black-body radiation, Einstein theorized that the energy in each quantum of light was equal to the frequency multiplied by a constant, later called Planck's constant. A photon above a threshold frequency has the required energy to eject a single electron, creating the observed effect. This discovery led to the quantum revolution in physics and earned Einstein the Nobel Prize in Physics in 1921.

From wikipedia

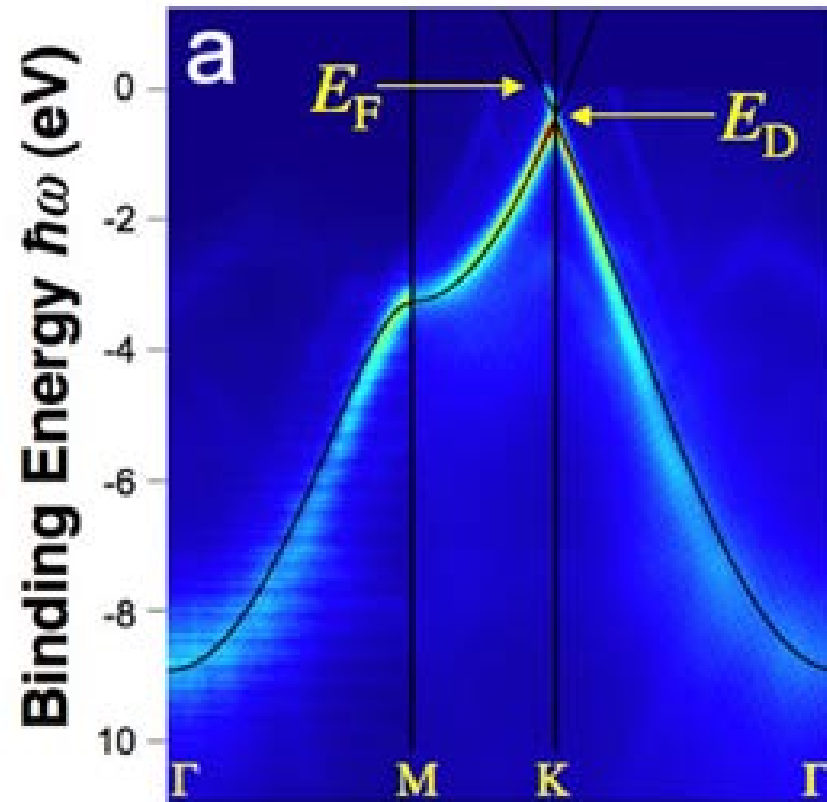
Angle resolved photoemission



Surface sensitive technique

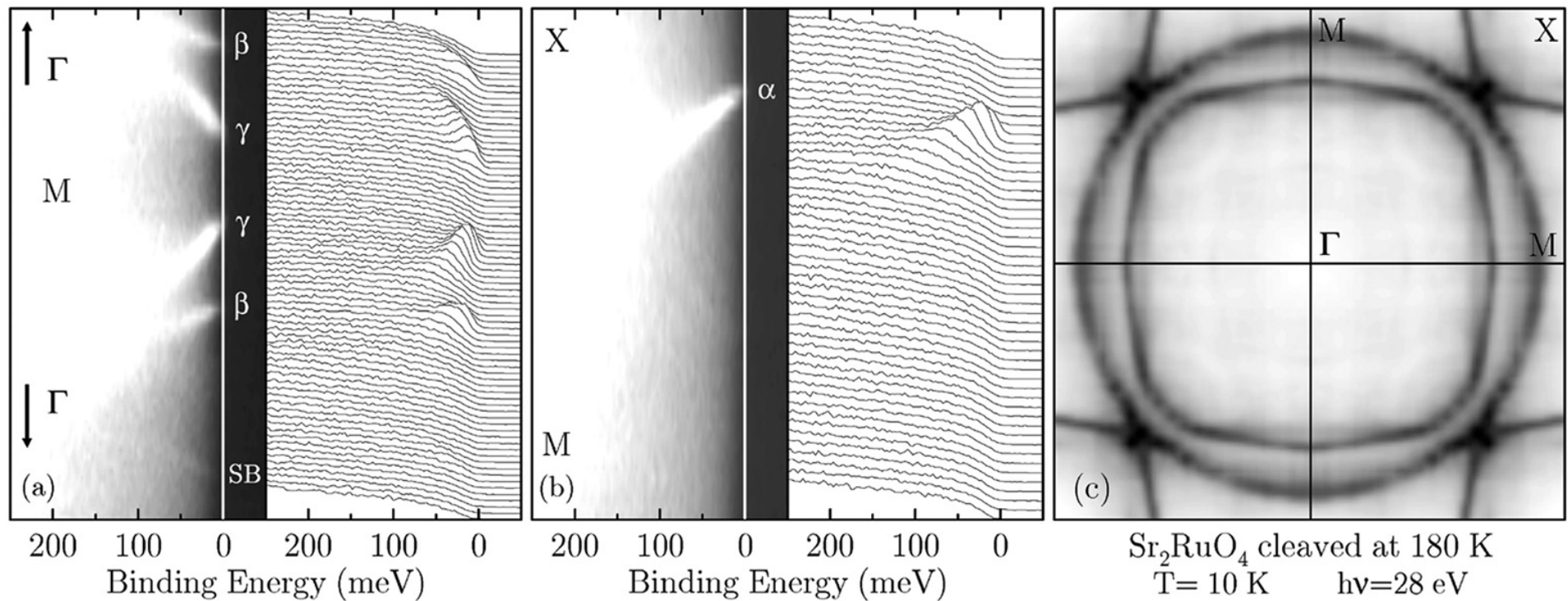


Band structure of graphene

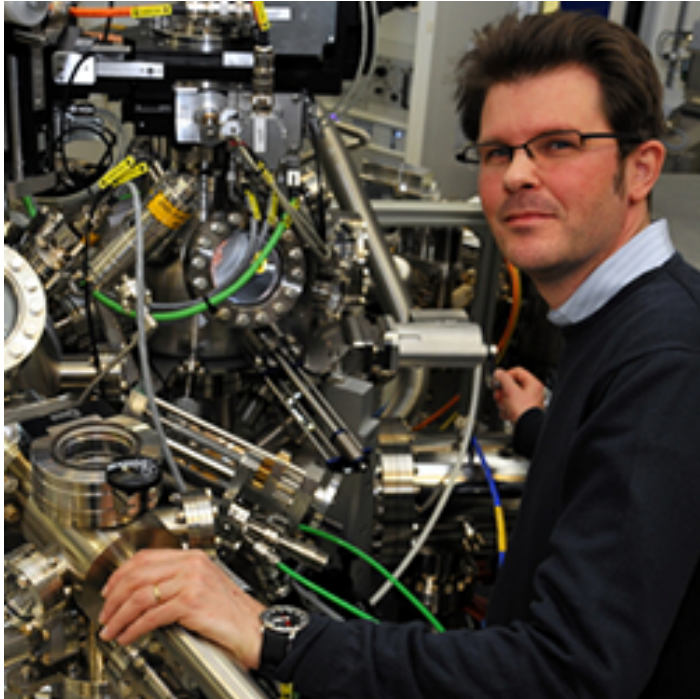


Nature Physics **3**, 36 - 40 (2007)

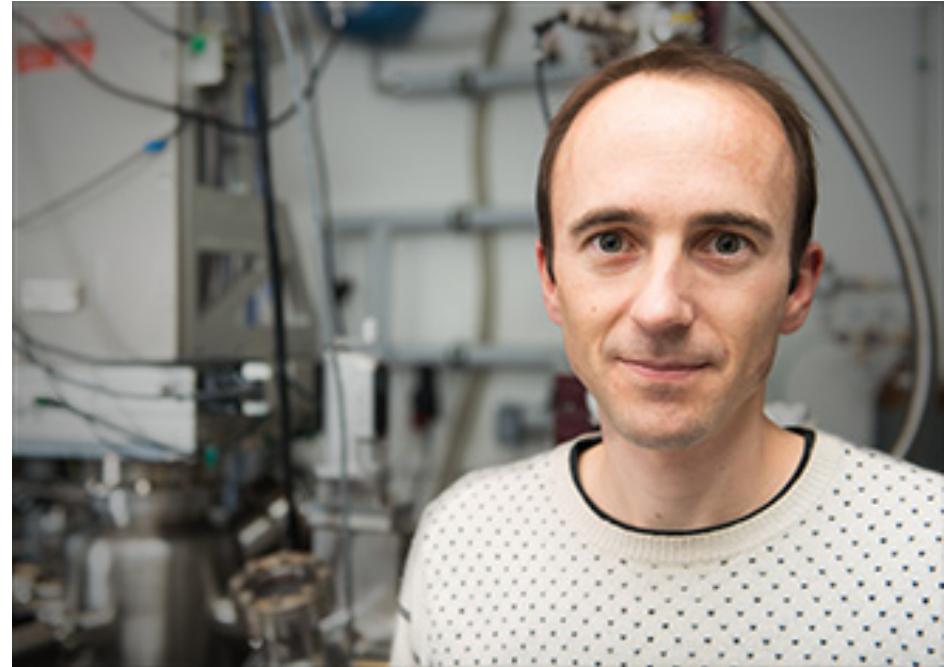
Band structure of Sr_2RuO_4



Former UZH students

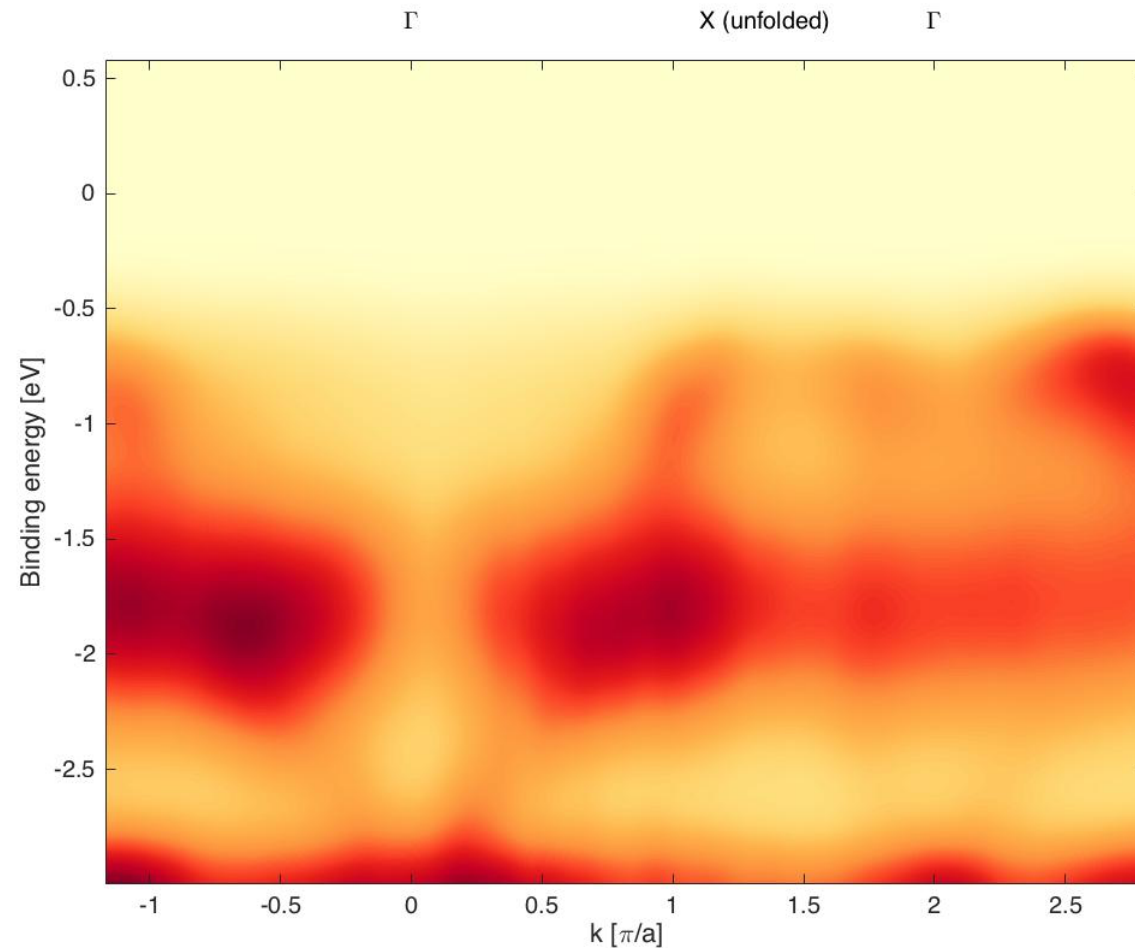


Dr. Moritz Hoesch
Diamond light source



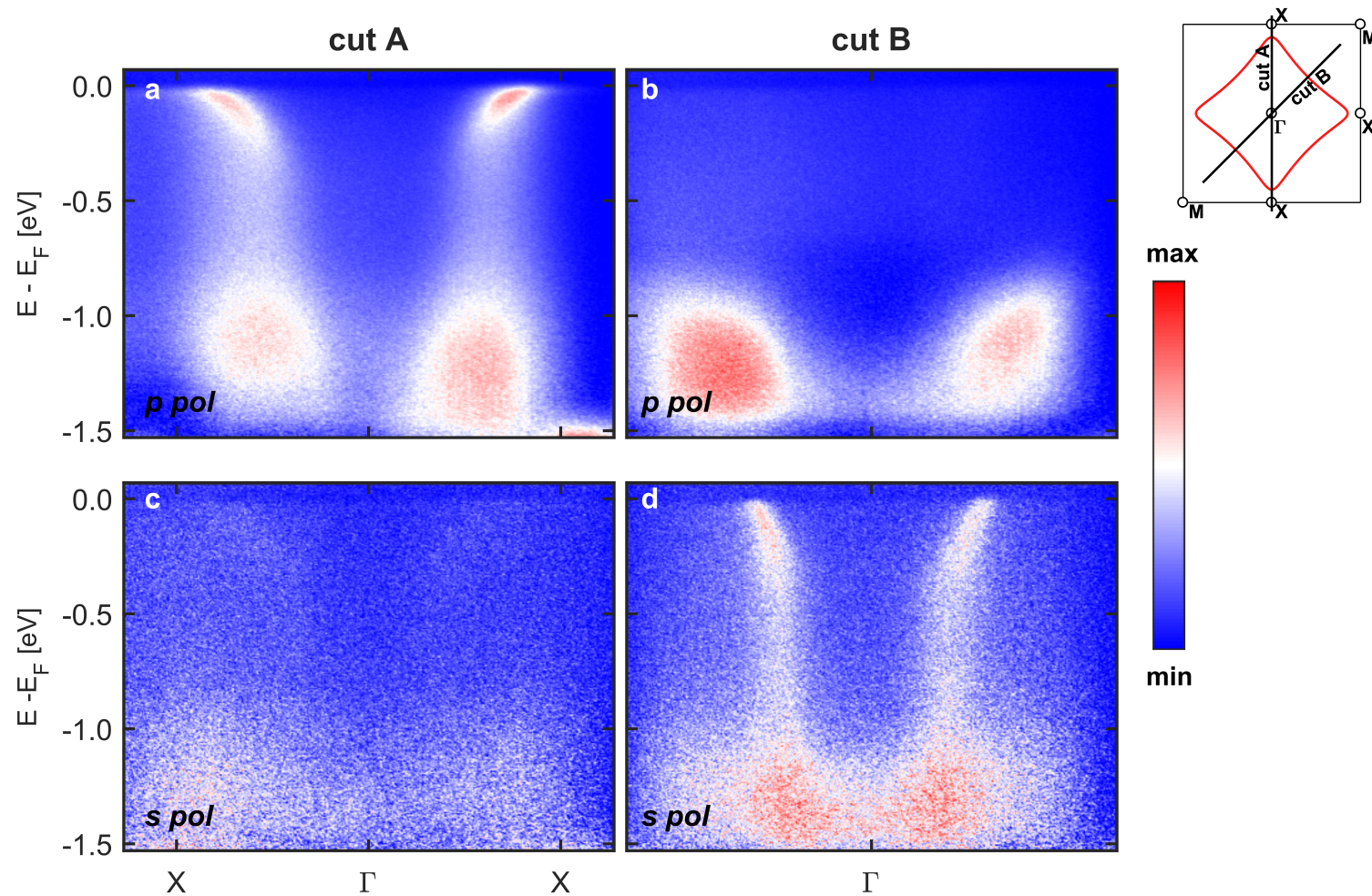
Prof. Felix Baumberger
Uni-Genf

Examples of Bachelor thesis projects: **Fabio Cossalter - 2016**



Band Structure
Insulating (150 K)
 Ca_2RuO_4

Examples of Bachelor thesis projects: Kevin Hauser- 2017



Band structure of a high-temperature superconductor: $\text{La}_{2-x}\text{Sr}_x\text{CuO}_4$

Measure at the SLS, Spring 2017

Course Evaluation (Exam)

Last years exam structure:

- (1) 7.5 min student presentation of 1 one out of 8 pre-defined topics
- (2) 7.5 min discussion of one of the exercises
- (3) 10 min questions spread over the material covered during the lecture