TECHNISCHE UNIVERSITÄT WIEN

IAP

Atomic and Plasma Physics

invacuo

circuit solutions

Michael Kendler

TU Wien, Institute of Applied Physics

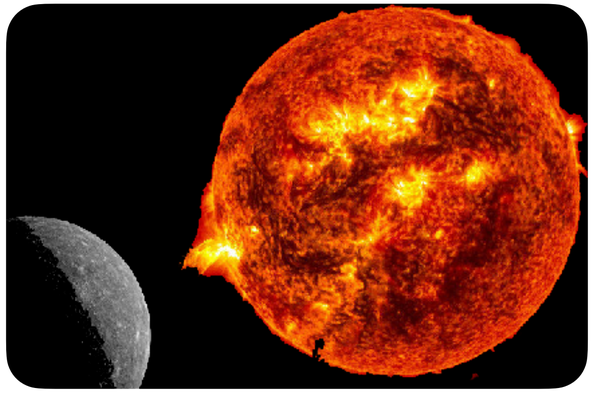
Who we are:

TU WIEN

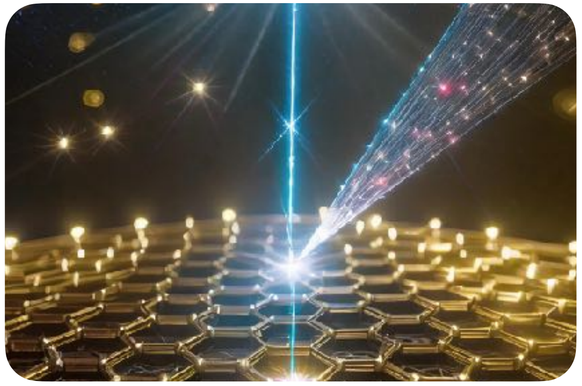
Atomic and Plasma Physics

What we do:

Sputtering experiments

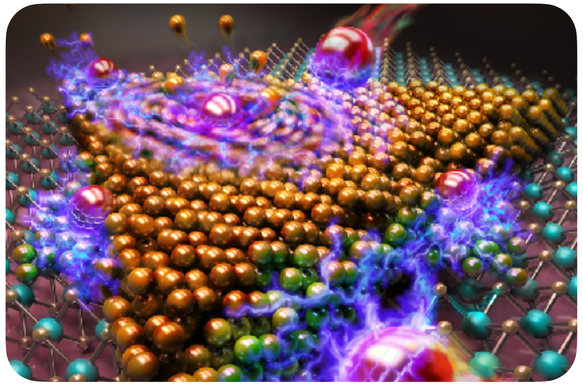


Ions sources + Detectors



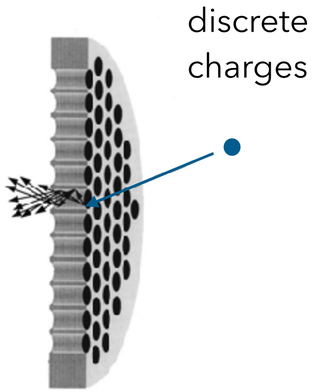
Correlated electrons

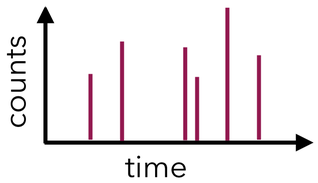
Highly charged Ions

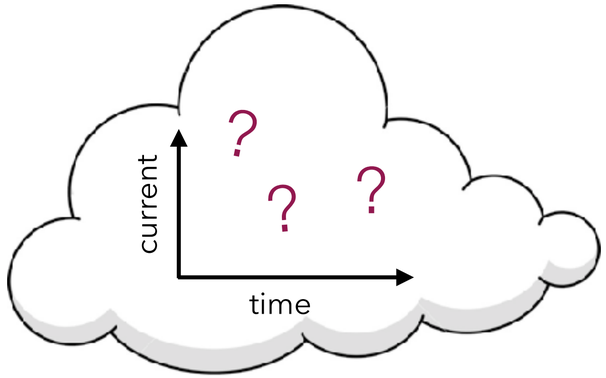


Motivation: Precise fA-current meter for vacuum applications

particle counting

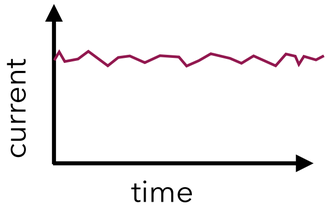


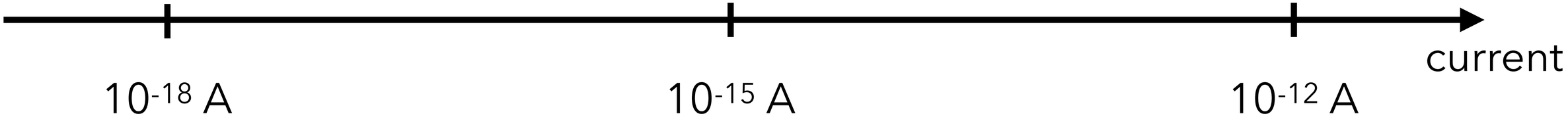




technology gap

continuous measurement



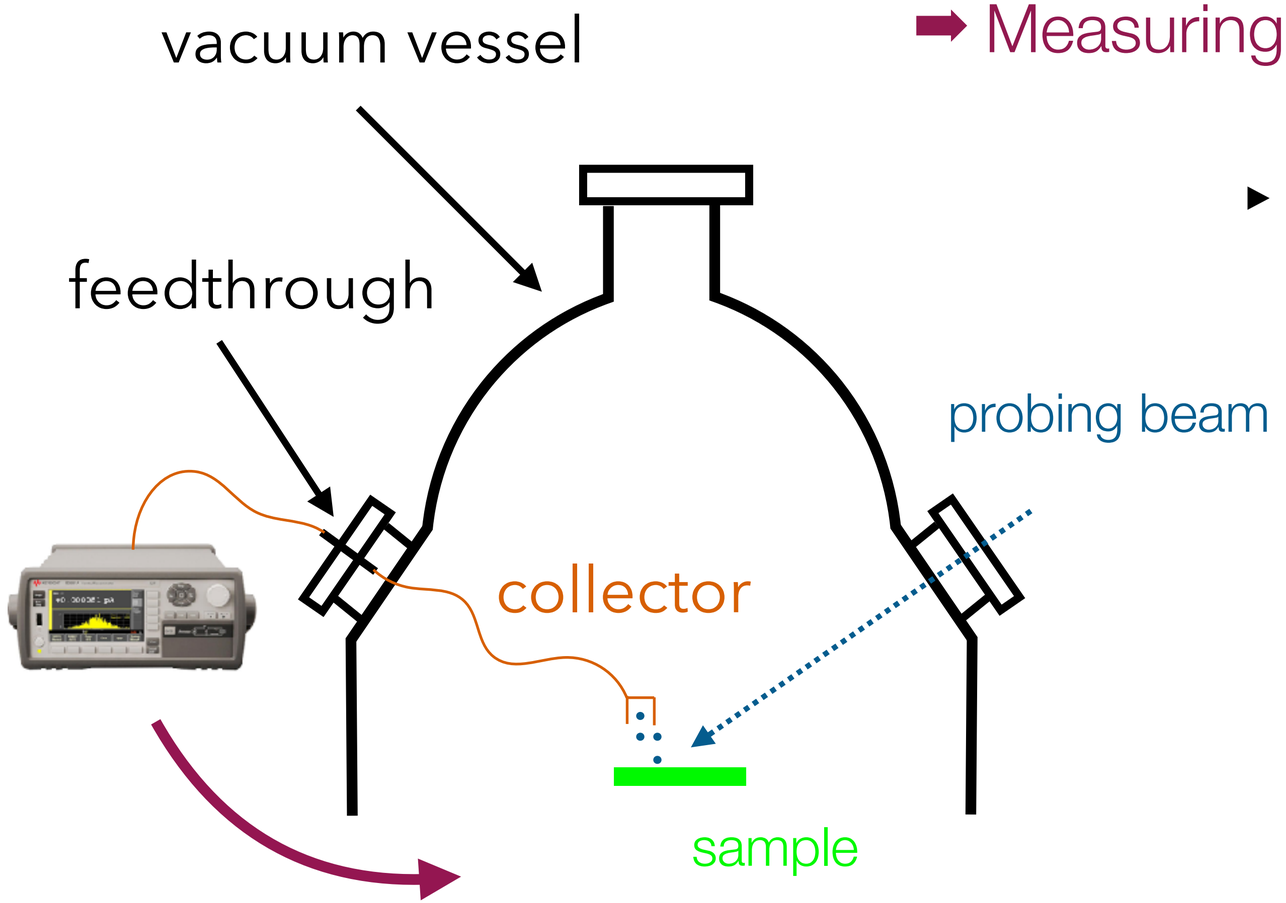


10^{-18} A

10^{-15} A

10^{-12} A

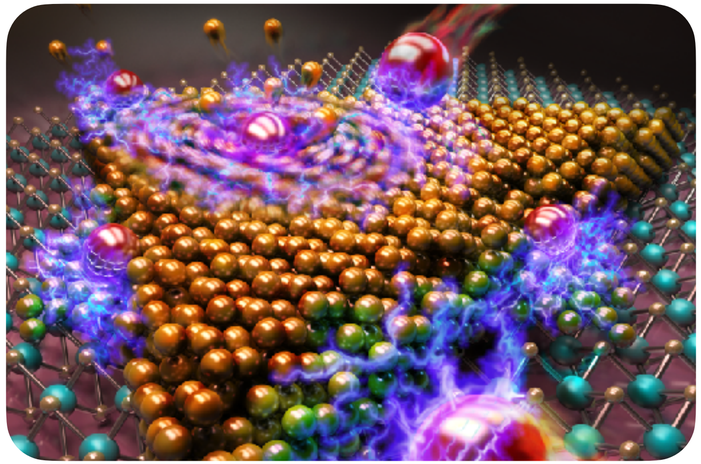
Why is that important in vacuum?



➡ Measuring currents directly at their source

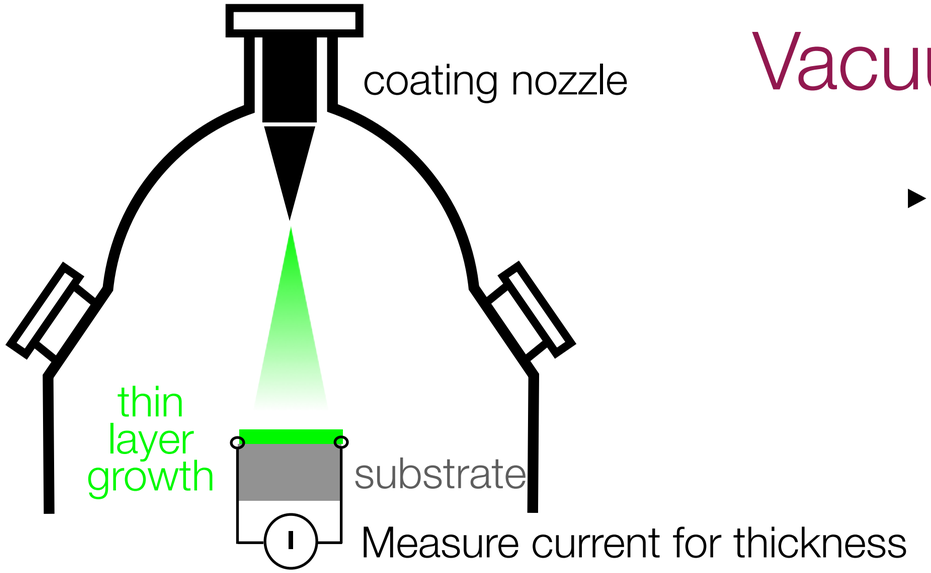
- Shorter cables for less noise
  - Less signal interference inside of the chamber
    - Fewer vacuum feedthroughs needed
      - Less measurement latency

Where is that important?



Research:

- Electron and particle beam diagnostics
  - Surface science and materials characterization
    - Problem with low currents of exotic particles (like highly charged ions)

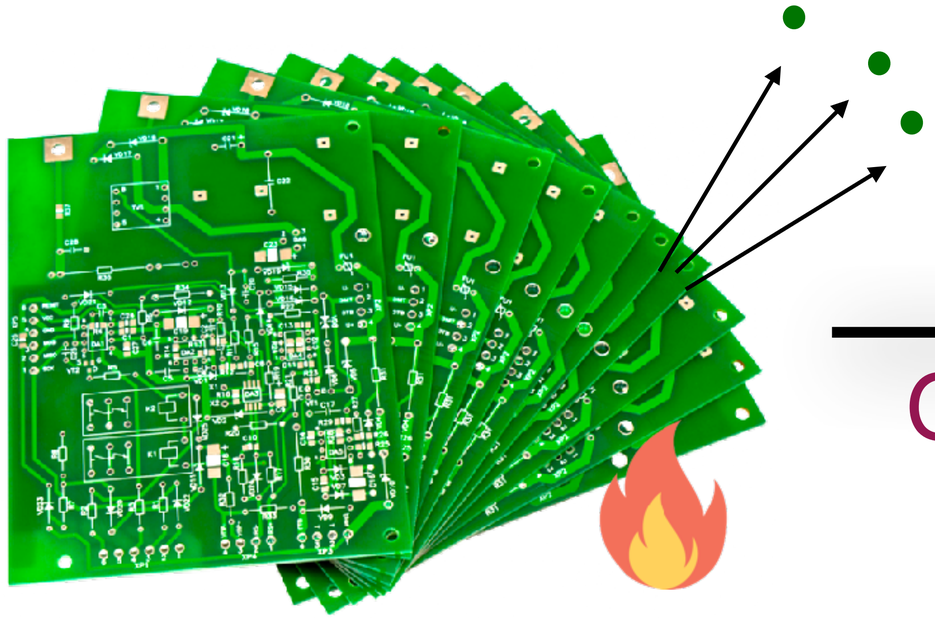


Vacuum Industry:

- Semiconductor device testing
  - Mass spectrometry (pharma, food, security, …)
    - Thickness determination after coating and thin layer deposition

Printed circuit boards (PCBs) for ultra high vacuum

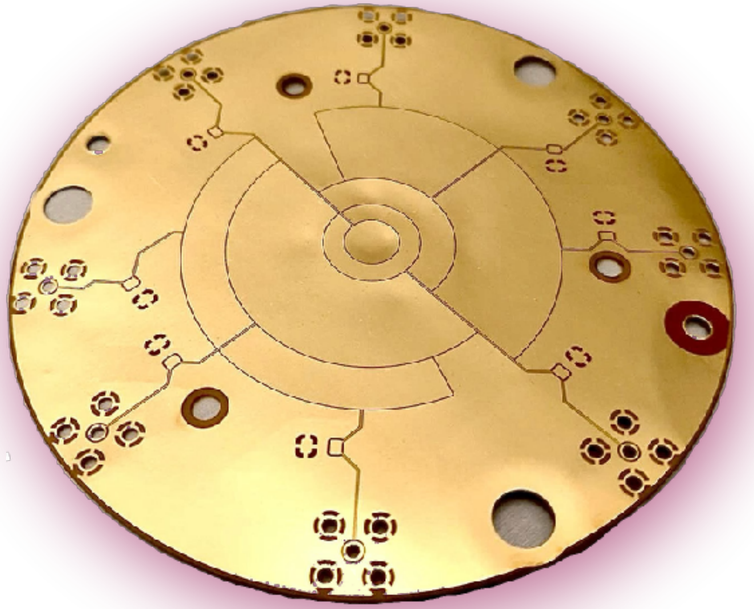
Industry wide problem with FR4 PCBs:



- ✕ Outgassing of volatile components
- ✕ Not suitable for high frequency signals
- ✕ Limited temperature range

Our solution

Segmented polyimide laminates

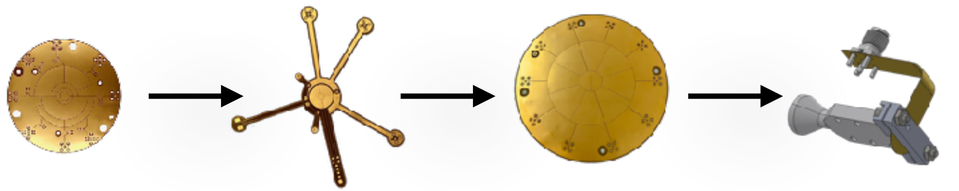


- ✓ **Pending patent** for this technology
- ✓ Suitable for ultra high vacuum
- ✓ Technology platform for in-situ circuits
- ✓ Thin substrate for better signal quality

Traction and proof

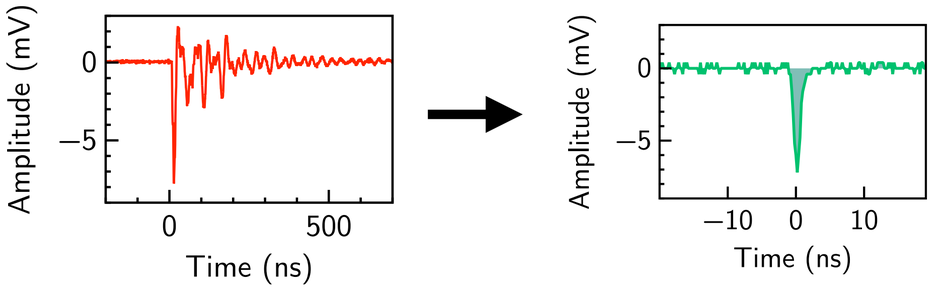
Passive circuits **next step** Active circuits

PCB anodes for particle detectors **[1]:**



First industry partner

Conventional anode **PCB anode**



- Build *in vacuo* pre-amplifier using sealed transistors
- Flexible RF antennas (university partner)
- Integrated Circuits (ICs) with our technology platform

[1] M. Kendler *et al.*, Rev. Sci. Instrum. in press (2026).

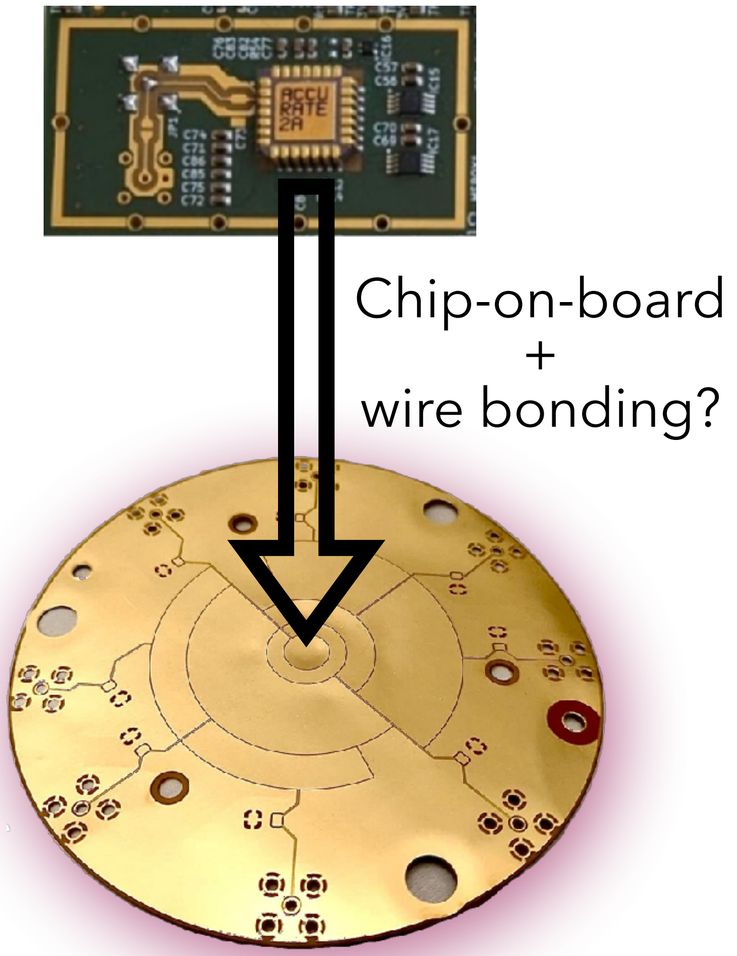
Strategic fit with ACCURATE 2A

Goals:

- Application of this chip in ultra high vacuum
- Measuring the 10-100 fA range directly in-situ
- Increasing accuracy of scientific vacuum instruments

Challenges:

- Using the chip in **bare die format**
- Interfacing to our polyimide PCBs with good **thermal contact**
- Finding a suitable collaboration model



Our project: Transfer.S2S (science to spin-off)

„Printed circuit boards for electronics in extreme environments“

- **Team members:**
  Prof. Richard A. Wilhelm (PI)
  Michael Kendler (PhD student)
  Sophie Wrathall (PhD student)
  Lisa Gmainer (master student)

- **Project duration:**
  three years starting January 2026

- **Project goal:**
  university spin-off company

- **National funding:**

Christian Doppler
Forschungsgesellschaft