

# Potential of a Nanotechnology Center in Wroclaw as seen from outside

**Alfred Forchel**

**Chairman of Nanotechnology Cluster of  
State of Bavaria**

- **background and international situation**
- **research opportunities**
- **enhanced possibilities for international collaboration**
- **potential for new start-up companies**

## Nanotechnology Research Situation in Bavaria

- several excellent research centers at different universities and public research institutes
  - CeNs: Center for NanoScience, LMU (Prof. Kotthaus member of cluster advisory board)  
Walter-Schottky-Institute, TUM  
Microstructure Laboratory and Röntgen Center Würzburg  
...
  - Research networks  
bavarian- , german- oder EU - wide, international, regional

Julius  
Maximilians  
University  
Würzburg

Advanced  
research  
and  
teaching  
in the  
heart of  
Germany







W.C. Röntgen 1901



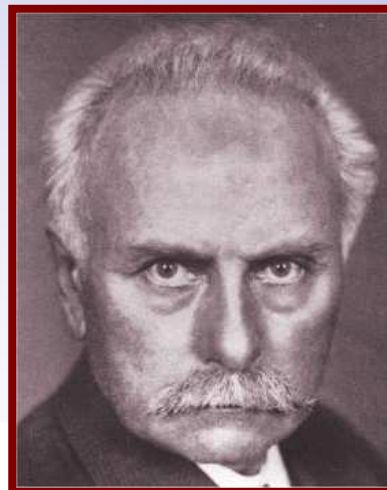
F. Braun 1909



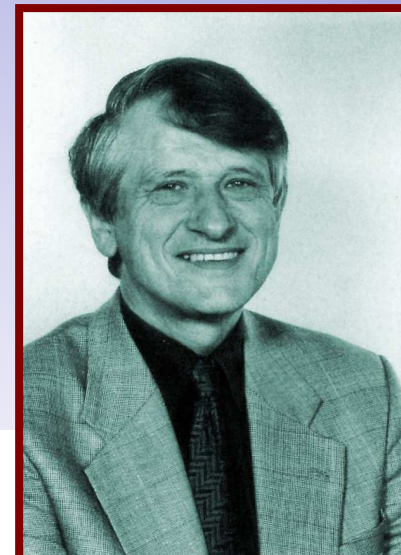
W. Wien 1911



M. v. Laue 1914



J. Stark 1919



K. v. Klitzing 1985

**6 Nobel  
Laureates  
in Physics  
worked  
at Würzburg  
University**

## Campus „Am Hubland“ - Sciences and Humanities

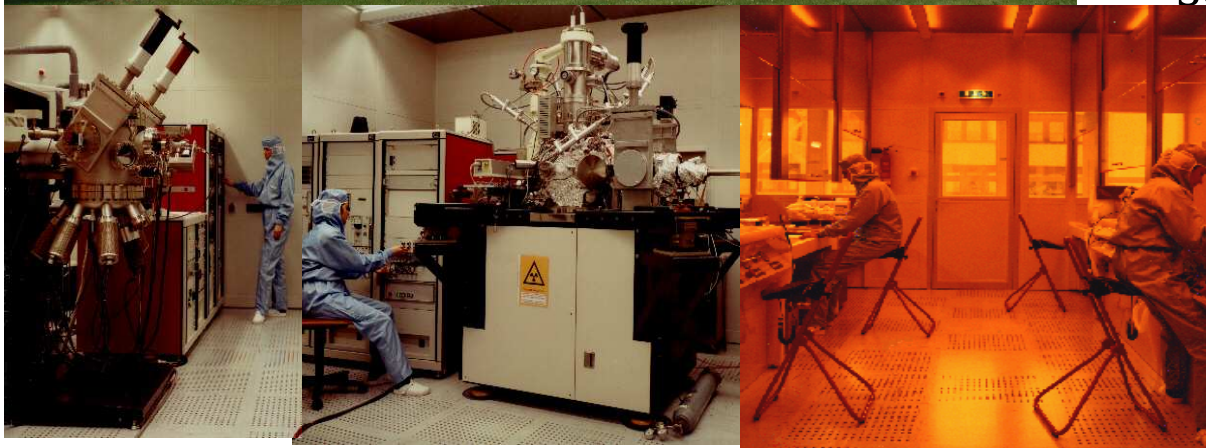


## Microstructure Laboratory at Würzburg University



550 m<sup>2</sup> cleanroom  
for nanotechnology

epitaxy  
different III-V MBEs,  
Nanopatterning by e-  
beam/focused ion beam  
semiconductor process line

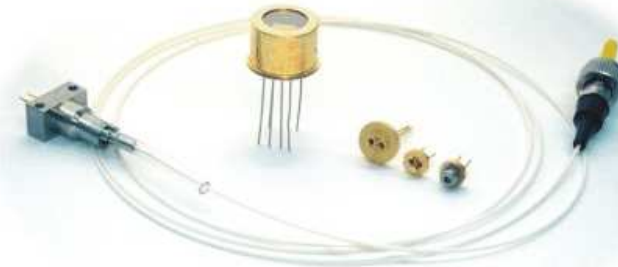


about 50 staff members  
including grad. Students  
~ 35 MEuro investment

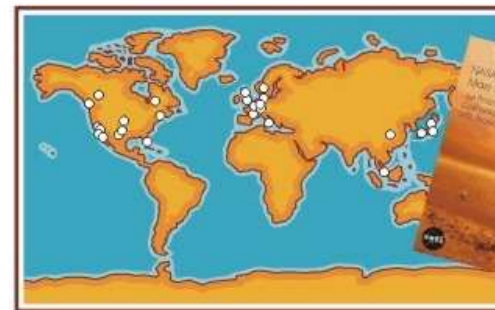
# nanoplus Nanosystems&Technologies GmbH, Gerbrunn



Nanosystems and  
Technologies  
GmbH  
**nanoplus**



Laser sensors for your applications  
worldwide...



...and beyond



250 m<sup>2</sup> clean room, 400 m<sup>2</sup> Labs & offices, 23 employees

## Application and research potential of nanotechnologies

nanotechnologies generally regarded as key technologies with impact in many application areas including

- telecommunications
- automotive
- construction
- medical and environmental sensing
- cosmetics

.....

simultaneously very interesting for fundamental research

→ nanotechnologies allow to tune electronic, optical or magnetic properties widely or to achieve new properties by adjusting the nanostructure size

## International Centers for Nanotechnology Research

- laboratories in Japan, e.g. at University of Tokyo, Prof. Y. Arakawa, nanotechnologies for communications
- Korean Advanced Nanofabrication Center, Suwon, III-V semiconductors, bionano,...  
very close interactions with companies
- different centers in the US: Cornell University, UC Santa Barbara
- in Europe: institutes in France, UK, Italy, Switzerland, Sweden, Germany  
almost none in new EU member states – severely limits access of these countries to important technological developments

## Requirements for competitive position in nanotechnology research

- infrastructure: state of art clean room laboratory
- equipment permitting to investigate different approaches  
e.g. nanostructures based on epitaxy, chemical reactions, planar technologies
- people – expert professors and highly motivated students
- interactions with industry, regional and abroad
- exchanges with international institutions and networks

## Position of Wroclaw

- several groups at Wroclaw University of Technology work at top international level - mainly in different areas of nanostructure characterization but also in fabrication - strong participation in European Projects
- photonics are an important research topic in several faculties physics, chemistry, microsystem electronics and photonics ...
- during the last years the university has already achieved a lot of infrastructure improvements
- the university attracts large numbers of students
- large companies with interest in photonics are located in the Wroclaw area
  - very good situation for further expansion
  - substantial investment will enable enormous progress<sup>12</sup>

## What type of expansion could be very fruitful?

- nanotechnology laboratory integrated with nanoanalysis focussing on photonics
- strong expertise in photonics available
- new research areas in science and engineering can be developed much faster if there is own in-house technology
  - nanotechnology laboratory would strongly improve competitiveness of Wroclaw University of Technology
- within Poland and EU it would strengthen the position of Wroclaw as major center for photonics
- up to now access to technological results of research for Polish companies limited as technology in international cooperations involving Wroclaw is often made by other partners
- nanotechnology is quite attractive for highschool students

## Nanotechnology and Nanoanalysis Center for Photonics

- work on wide variety of material systems  
ranging from III-V semiconductors to chemical and biological systems, hybrid systems
  - combine synthesis of materials with atomic resolution characterization
  - design, manufacture and analyze devices and circuits
  - wide application areas
    - telecommunications
    - security
    - ....
    - environmental sensing
    - biomedical applications
- broad impact not limited to single field – very flexible reactions to new research and application targets possible

## General benefits of new Nanotechnology and Nanoanalysis Center for Photonics

- conduct research on very challenging, hot topics
- participate in highly competitive research in a leading position
- involve Master and PhD students in this competitive research
- use research center to attract especially bright students
- possibility to form elite university courses
- many opportunities for interdisciplinary interactions
- increase possibilities for formation and support of start-up companies

## Interaction Possibilities

- bilateral: between [Wroclaw University of Technology](#) and [Würzburg University](#)  
but also with other partner Universities worldwide  
also between [Research Centers](#): recently formation of Röntgen Research Center on Complex Material Systems in Würzburg, including about 30 professors from Physics, Nanotechnology, Chemistry and Biology  
[between regions](#): Lower Silesia and Bavaria using the Bavarian Cluster Nanotechnology as German side  
e.g. by [exchange and training of people](#)  
[common research projects](#)
- [in international projects and networks on research or education](#)

## Cooperation possibilities with Bavarian Cluster Nanotechnology

- cluster task: improve participation of companies in EU R&D projects – impossible on a national level, requires combining expertise from different countries – collaboration with WUT and companies is very helpful
- encourage positive attitude of young generation towards nanotechnology to increase numbers of excellent students in science and engineering – similar in Wroclaw and Würzburg
- increase nano-component in teaching at universities based e.g. on visiting professors from the partner university

## Summary

- **Creation of internationally leading Center for Nanotechnology and Nanoanalysis for Photonics in Wroclaw will be based on very good foundation**
  - people
  - previous research results
  - industrial environment
- **Once established it will open up many new possibilities in**
  - university education
  - leading edge research – within disciplines&interdisciplinary
  - economy