

**MAY 9**

Coffee available from 09.00

### 1. Introduction

- 09.30 Welcome, Quick overview of the electronics and photonics research environment at Chalmers University of Technology, Prof. Peter Andrekson, Chalmers
- 09.50 Challenges for an independent, topic oriented and small funding agency, Prof. Lars Rask, Executive Director, Swedish Foundation for Strategic Research

### 2. Industry R&D perspectives

- 10.10 Electronics R&D at ABB – a large company perspective, Dr. Christer Ovrén, ABB AB
- 10.40 Electronics R&D at Nanoradio – a small company perspective, Mr. Tord Wingren, Nanoradio AB
- 11.10 Photonics R&D at Syntune – a small company perspective, Dr. Patrik Evaldsson, Syntune
- 11.40 Lunch

### 3. Examples of international strategic research

- 13.00 Applied nanoelectronics research, Prof. Walter Riess, IBM, Zurich, Switzerland
- 13.30 Directions in Electronics Research, Prof. Jan Rabaey, University of California, Berkeley, US
- 14.00 Applied Photonics Communications Research, Prof. Klaus Petermann, Technische Universität Berlin, Germany
- 14.30 Coffee

### 4. Examples from Swedish strategic research

- 15.00 Graphene – from academic discovery to future practical use, Prof. Mikael Fogelström, Chalmers
- 15.20 Algorithms for future signal processing, Prof. Erik G. Larsson, Linköping University
- 15.40 DSP Platforms for emerging telecommunication and multimedia, Prof. Dake Liu, Linköping University
- 16.00 III-nitrides for UV and high frequency applications, Prof. Erik Janzén, Linköping University
- 16.20 Increased integration and functionality in photonic circuits, Prof. Min Qiu, Royal Institute of Technology
- 16.40 Break

### 5. Reports from Asia

- 17.00 Electronics and Photonics in Japan, Prof. Anders Karlsson, Science Counsellor, Embassy of Sweden, Tokyo, Japan

- 17.30 Electronics and Photonics in China, Dr. Magnus Breidne, Former Science Counsellor, Embassy of Sweden, Beijing, China

### 6. Poster session

Drinks and snacks

Each SSF-programme may present maximum two posters.

- 19.30 Dinner

### MAY 10

*Mid-term presentations of SSF-funded five-year projects*

Presentations 20 min and questions 10 min

- 08.30 Flexible and low-power wireless transceiver platforms, Prof. Atila Alvandpour, Linköping University
- 09.00 System on Chip solutions for future high speed communication, Prof. Herbert Zirath, Chalmers
- 09.30 WWW – Wireless with Wires, Prof. Lars-Erik Wernersson, Lund University
- 10.00 OPEN – Organic hybrid printed electronics and nanoelectronics, Prof. Magnus Berggren, Linköping University
- 10.30 Break
- 11.00 Laser and System Technologies for Access and Datacom, Prof. Anders Larsson, Chalmers
- 11.30 Next generation optical communication systems, Prof. Peter Andrekson, Chalmers
- 12.00 Wireless Communication for Ultra Portable Devices, Prof. Henrik Sjöland, Lund University
- 12.30 Closing and final words, Dr. Per Andersson, Chairman of the SSF Programme Committee
- 12.45 Lunch
- 14.00 – Internal meeting for the international expert committee – report writing for SSF
- 19.00

### Expert committee

Mr. Tord Wingren, Nanoradio, Chair

Prof. Walter Riess, IBM, Zurich

Prof. Jan Rabaey, University of California, Berkeley

Prof Klaus Petermann, Technische Universität Berlin

Chalmers University of Technology

# Electronics and Photonics Conference

*SSF's program committee:*

Per Andersson  
Björn Broberg  
Maria van Zijl  
Dag Sigurd  
Bertil Svensson



# A Quick overview of the Electronics and Photonics Research Environment at CHALMERS

Peter Andrekson



# Departments in “Area of Advance” ICT

- Dept. of Microtechnology and Nanoscience (MC2)
- Dept. of Signals and Systems (S2)
- Dept. of Computer Science and Engineering

170 senior researchers

20 EU contracts (FP7) in 2010

## CENTERS

- Fiber optic communication center (FORCE)
- Gigahertz center
- CHARMANT and CHASE (antenna systems)

# Major Research Infrastructures



Nanofabrication Laboratory  
A state-of-the-art clean room facility  
European trans-national access facility

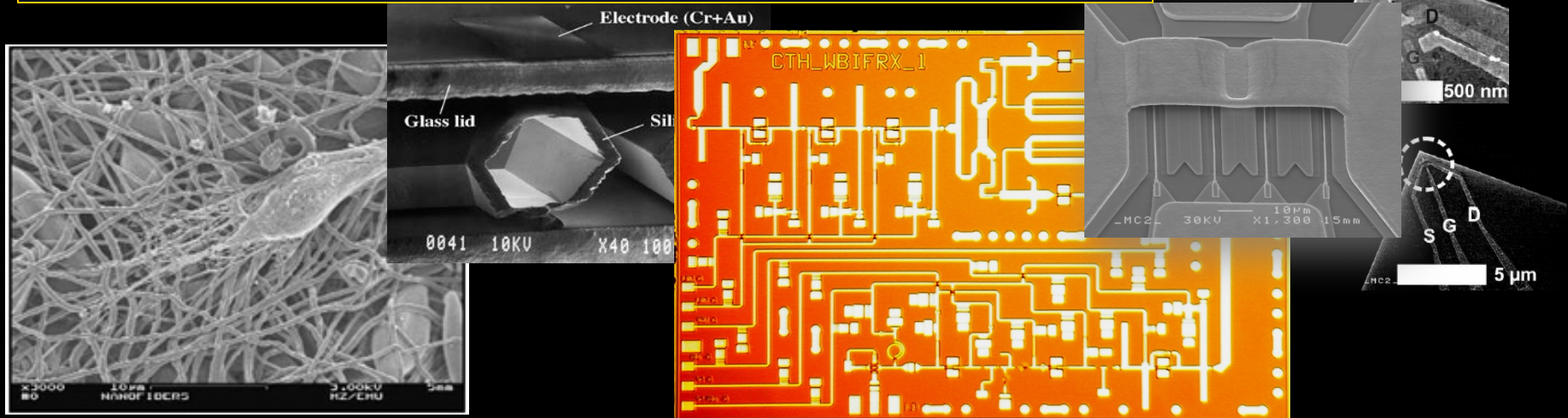
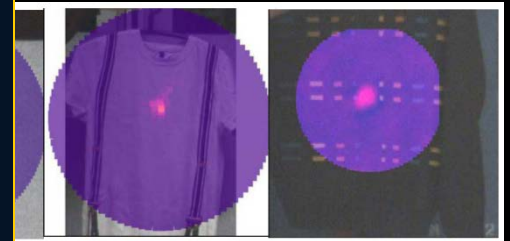
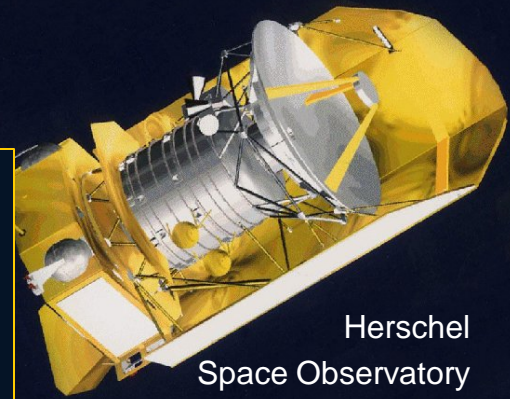


Onsala Space Observatory  
A national research facility



**MC2 consist of seven laboratories:**

- Nanofabrication Laboratory**
- Microwave Electronics Laboratory**
- Photonics Laboratory**
- Terahertz and mm-Wave Laboratory**
- Quantum Device Physics Laboratory
- Applied Quantum Physics Laboratory
- Bio-Nano Systems Laboratory



# Nanofabrication Laboratory

- **Nanofabrication Laboratory at MC2**

- 1240 m<sup>2</sup> clean room
- Broad platform of process tools (~ 170)
- Strong in nano-lithography
- Dedicated processing lines:

*Microwave and photonic devices and circuits*

*Quantum devices*

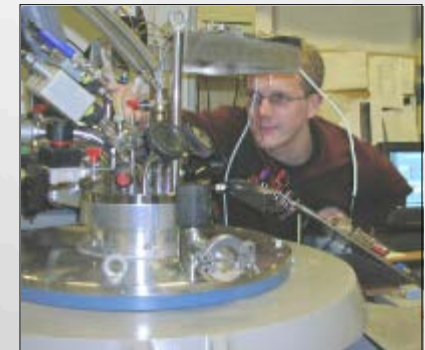
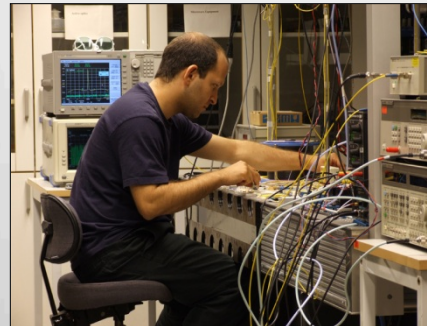
- 180 active users (20 from industry)

- **Measurement facilities**

- High frequency measurements
- Optical measurements
- Low temperature measurements
- Antenna measurements

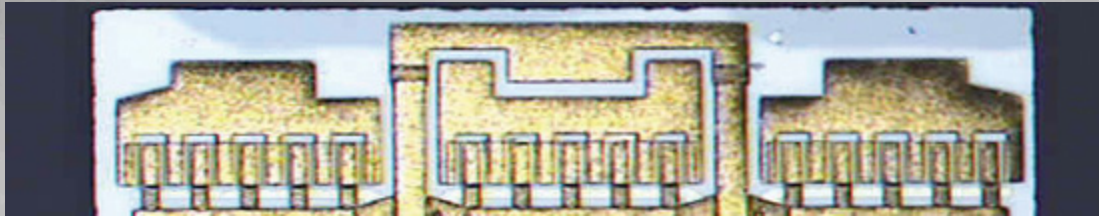
- **Design facilities (CAD)**

- Microwave and electromagnetic
- Electronic system design





# Process lines



## Microwave & Photonics Processing Line

- Complete set of process tools for fabrication of microwave and photonic devices & components resulting in improved stability, quality, and yield in the process flows used in wide bandgap, low-noise, photonic, and terahertz devices.
- The materials processed on this line are predominantly SiC, GaN, and InP based MMICs as well as GaAs based VCSELs.



## Nano & Quantum Technology Line

- Serves to increase the Laboratory's ability to produce state-of-the-art superconducting and quantum devices and novel nano components in higher yield.
- Particular focus on attaining high yield on structures smaller than 20nm. A broad range of applications, from bioelectronics to single electron devices.

# MyFAB

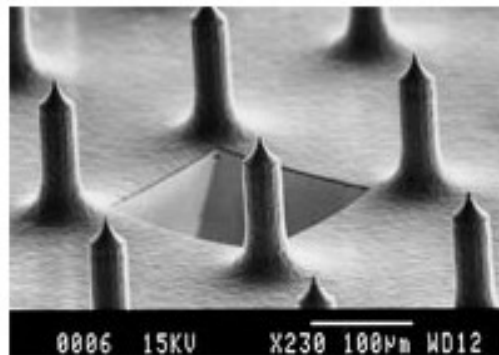
## μ-Fab

### The Swedish Micro and Nano Fabrication Network

Ångström Microstructure Laboratory  
Uppsala University

Nanofabrication Laboratory  
Chalmers University of Technology

Electrum Laboratory - KTH  
Royal Institute of Technology





# Microwave Electronics Laboratory

## Faculty and staff

Herbert Zirath

Jan Grahn

Peter Linner

Pjotr Starski

...

Niklas Rorsman

Per-Åke Nilsson

Total approx. 50 persons

## *MMIC design*

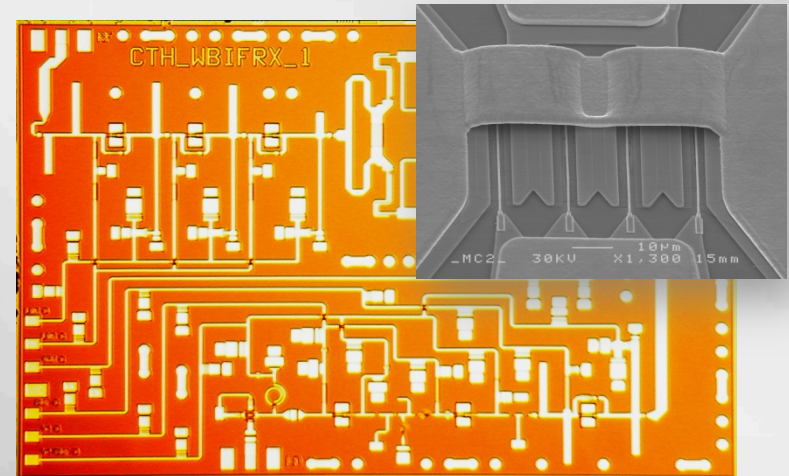
- Multifunctional MMICs
- Wideband, low noise amplifiers
- Frequency generation
- mm-wave CMOS
- THz MMICs
- Mixed signal (>100 Gbps)
- Packaging

## *Wide bandgap devices and circuits*

- SiC MOSFETs and MESFETs
- AlGaIn-GaN HEMT
- MMICs
- GaN MBE growth

## *Amplifier design*

- High power/high efficiency
- Linearization



# Photonics Laboratory

## Faculty and staff

Anders Larsson  
Peter Andrekson  
Magnus Karlsson  
Sheila Galt  
...  
...  
...

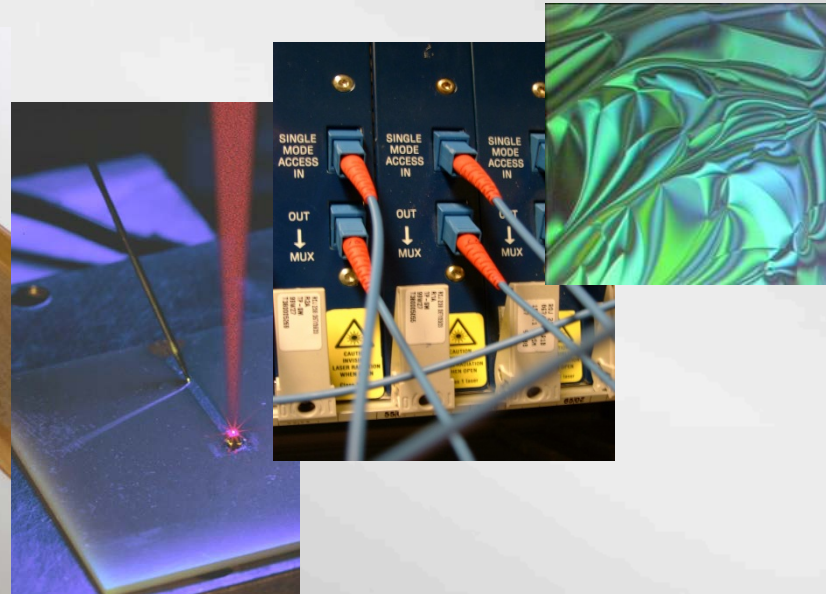
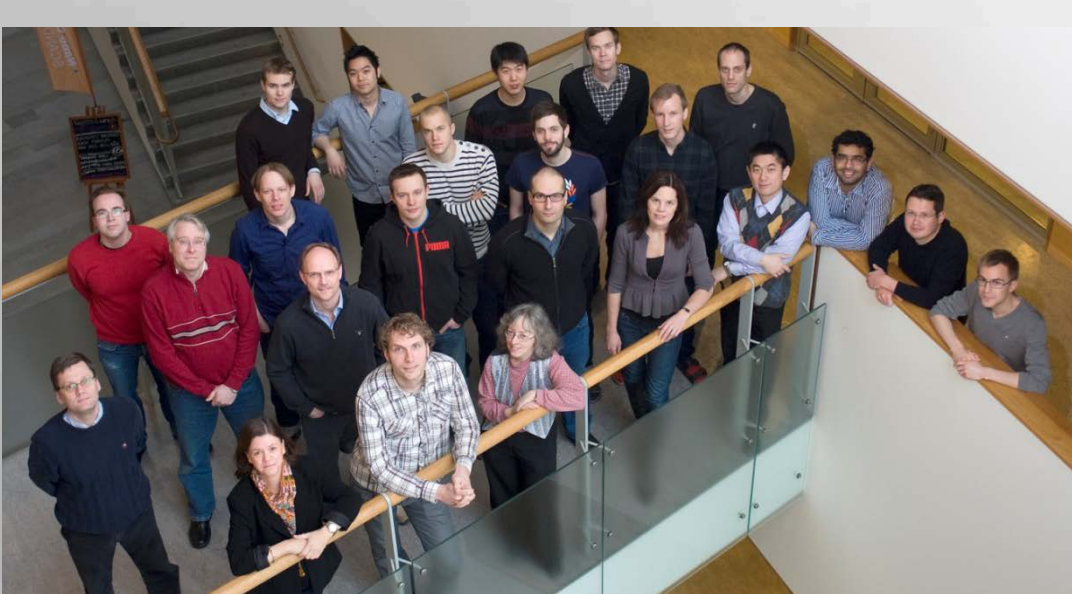
Total approx. 35 persons

## *Optoelectronics*

- VCSELs
- Dilute nitrides
- New laser materials

## *Fiber optical communication*

- High speed transmission
- Fiber amplifiers





# Terahertz and mm-Wave Laboratory

## Faculty and staff

Jan Stake

Spartak Gevorgian

Erik Kollberg

Olle Engström

Kjell Jeppson

Total approx. 15 persons

## *Microwave Technology Group*

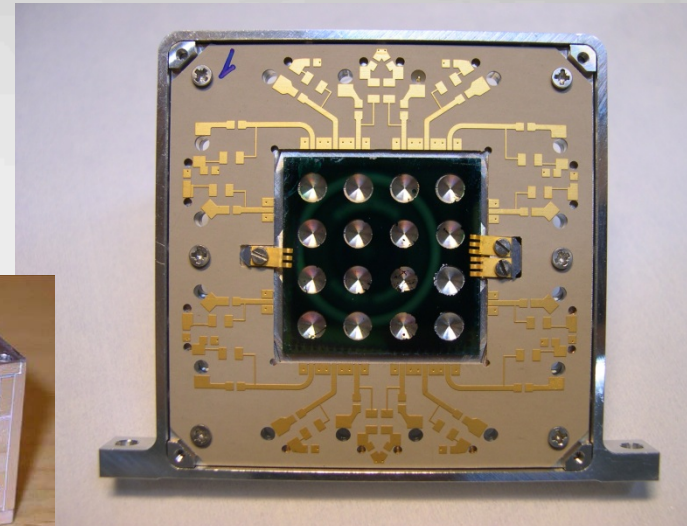
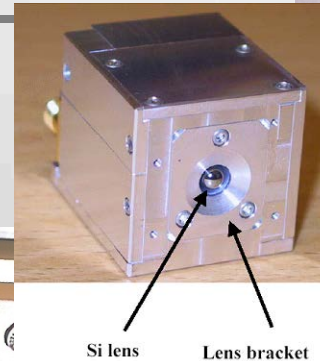
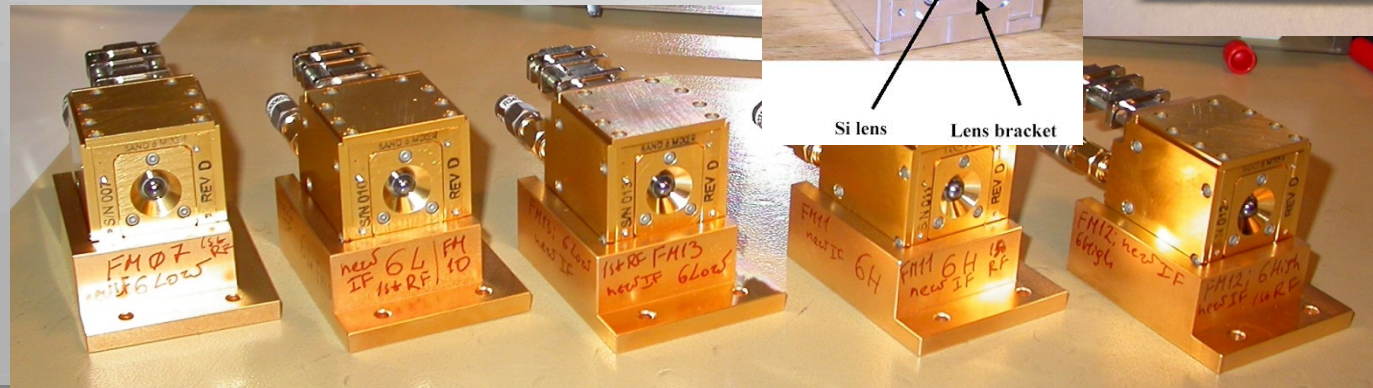
- Ferroelectric materials and devices
- BSTO varactors
- Ferroelectric phase shifters

## *Terahertz Technology Group*

- Hetero barrier varactors
- Hot electron bolometers

## *Solid state electronics*

- High K dielectrics
- Si nanodevices
- Mixed signals



# Success story: 60 GHz circuit design research at Chalmers → communication products

Research in the 1990's and early 2000 on wireless LAN (WLAN) for mm-wave frequencies between Chalmers and Ericsson is being commercialised at several Swedish companies. Key personnel have been hired from Chalmers to Swedish industry.

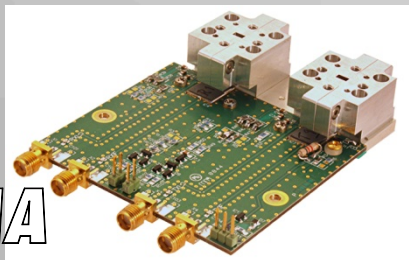
**CHALMERS** 



Most advanced integrated high-performance transmit/receive designs for 60 GHz WLAN and beyond



Secure communication networks at 60 GHz:  
Manufactured and delivered products to customer by Sivers IMA, Kista



**SIVERSIMA**



Ericsson to offer E-band radio products for LTE (Advanced) mobile backhaul



Chalmers spin-off for high-speed circuit designs





# Success story: Fiber Optic Parametric Amplifiers and their applications

We pioneered this research area including 1<sup>st</sup> demonstration of cw gain and subsequently record optical gain and optical bandwidth. Several applications investigated, most notably all-optical ultrafast sampling of optical signals, which was commercialized in 2004.



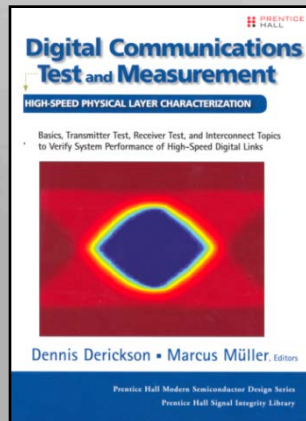
Six PhD dissertations

Highly cited invited review paper:

J. Hansryd et al., "*Fiber-based optical parametric amplifiers*,"  
IEEE J. of Sel. Top. in Q.E., v.8, pp. 506-520, 2002

244 citations (WoS)

Extensive book chapter in:



*Prentice Hall, 2007*

Spinoff company Picosolve (2004)  
acquired by EXFO in 2009  
[now EXFO Sweden AB]

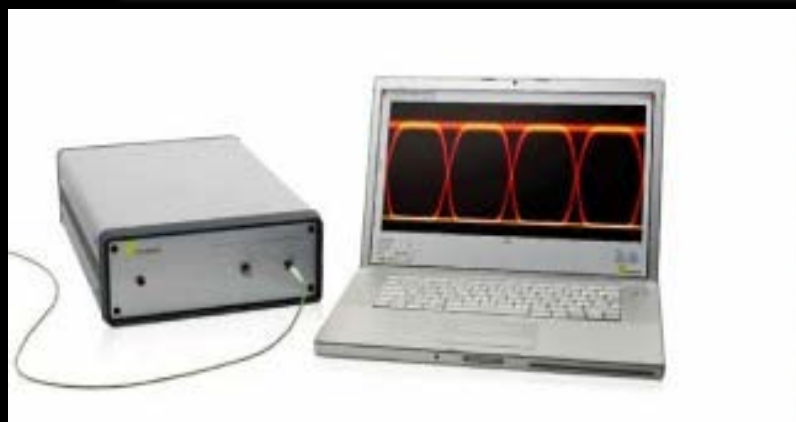
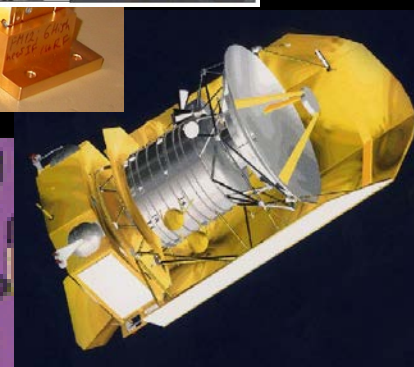
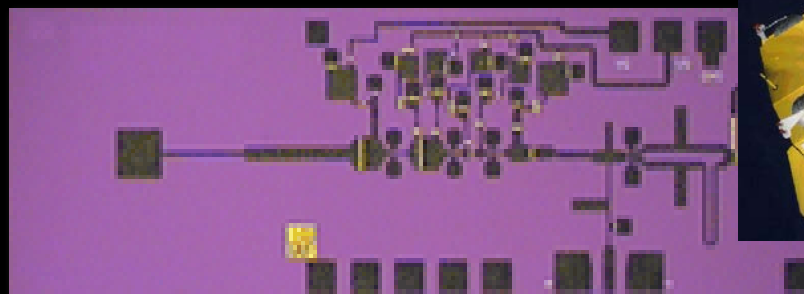
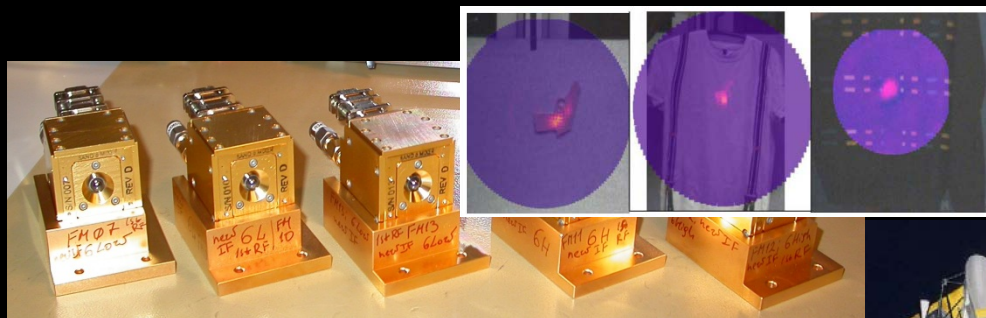
3 generations of products



> 1 MUSD annual revenue

# MC2 SPIN-OFFS

- Nanofactory
- Norse
- LNA
- SMOLTEK
- Midorion
- Wasa Millimeter Waves
- Food Radar
- PicoSolve
- CIT VCSELs
- Gotmic
- SHT





# AREA of ADVANCE at Chalmers: INFORMATION AND COMMUNICATION TECHNOLOGY (ICT)

ANTENNA  
SYSTEMS

MICROWAVE  
TECHNOLOGIES

PHOTONICS

COMMUNICATION  
SYSTEM

PARALLEL  
& DISTRIBUTED  
SYSTEMS

SOFTWARE  
ENGINEERING  
& TECHNOLOGY

Transport & vehicles

Telecommunications

Space & defence & security

Energy & environment

Component suppliers

Component suppliers

Software tools & production

Life science

Infotainment,media

Infotainment,media



# ICT AT CHALMERS: RESEARCH

170 senior researchers of which 50 Professors  
mainly at three ICT Departments

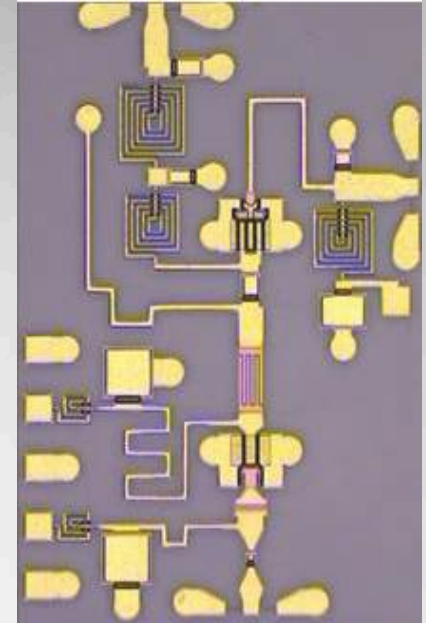
More than 400 MSEK in national grants 2009-2014

20 EU contracts in EC FP7 year 2010

State-of-the-art microwave, antenna and photonics  
fabrication and measurement laboratories

Several success stories *e.g.*:

- Automatic testing of software
- Over-the-air measurements for wireless devices
- Millimeter-wave communication
- Terahertz components and modules for space
- Ultrafast optical sampling
- Vertical cavity surface emitting lasers





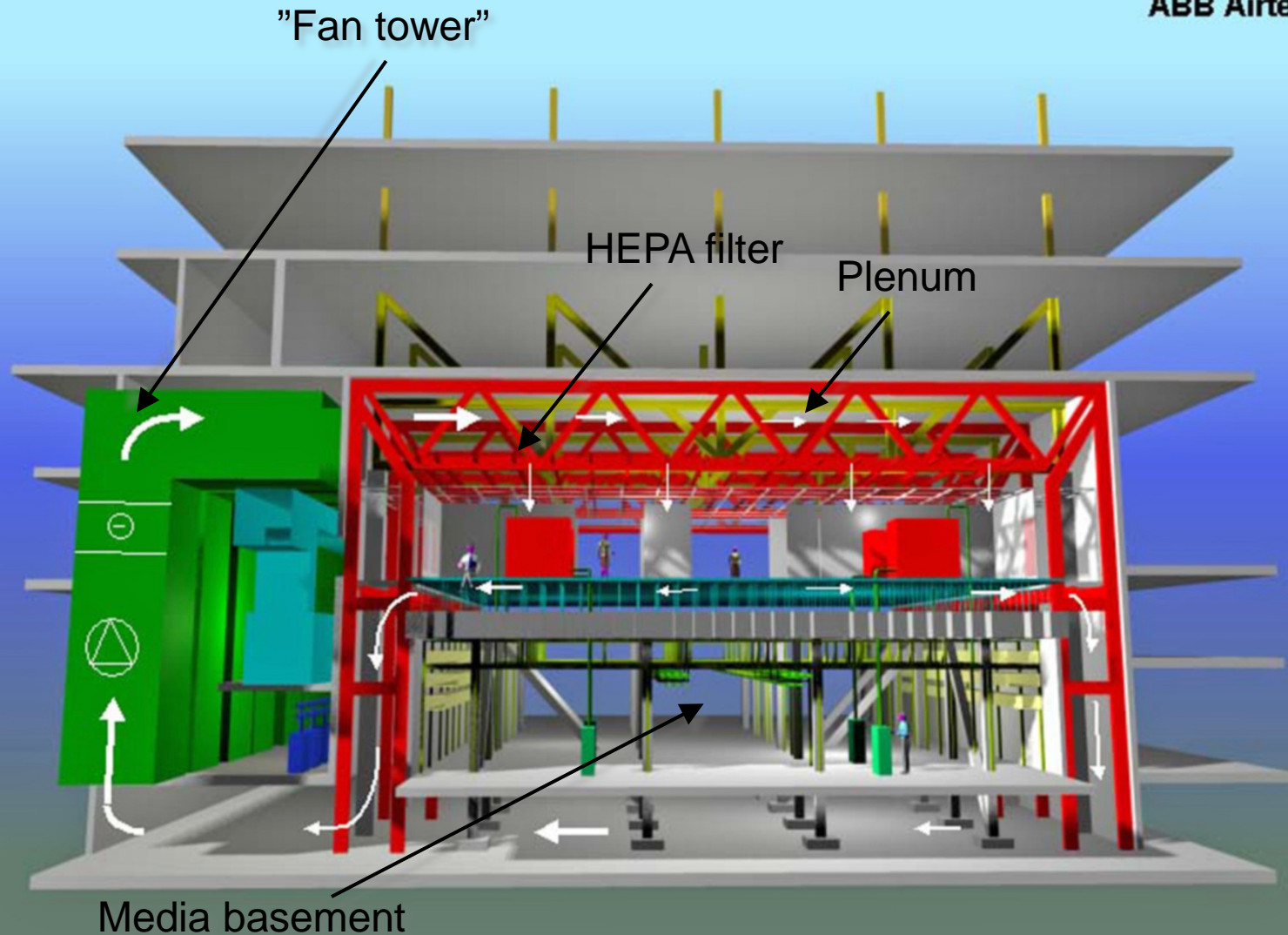




# MC2 Cleanroom Cross Section

**ABB**

ABB Airtech AB



MC2 clean room ventilation system, PL1

# Economy

- Total running cost  $\approx$  53 MSEK
  - 25% rent, 25% depreciation, 25% salaries, 25% consumables
  - Chalmers 27 MSEK, National Funding agencies 7 MSEK, Academic user fees 15 MSEK, External user fees and processing services 4 MSEK
- Academic user fee 16% of external grant
- Commercial users/processing service pay per hour





# Usage

- Researchers from:
  - Dept. of Microtechnology and Nanoscience (MC2) at Chalmers
  - Dept. of Applied Physics at Chalmers
  - Dept. of Chemical and Biological Engineering at Chalmers
  - Dept. of Radio and Space Science at Chalmers
  - Dept. of Physics at Göteborg University
- Users from companies
  - Mainly small research spin offs
- European researchers
- Processing service for external customers
  - Academic/commercial users, mainly Scandinavian



# Usage statistics 2010

- 210 active users
  - Users with at least one booking
- 64 000 booked hours
  - 106 tools with compulsory booking rule
- 12 companies with own personnel
  - 1-2 users/company
- Processing service for >30 customers

