

# MICRONOVA

CENTRE FOR MICRO- AND NANOTECHNOLOGY

## VTT Information Technology

- ❑ Microelectronics
- ❑ Microsensors and metrology
- ❑ Wireless radio communication

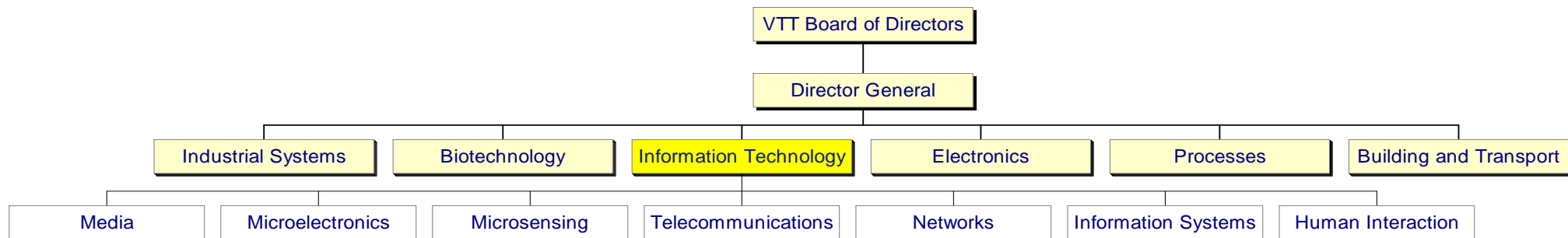
## FACILITIES

- ❑ 13200 m<sup>2</sup> including 2600 m<sup>2</sup> clean room
- ❑ shared with Helsinki University of Technology
- ❑ housing 5 startup companies

## RESEARCH STAFF

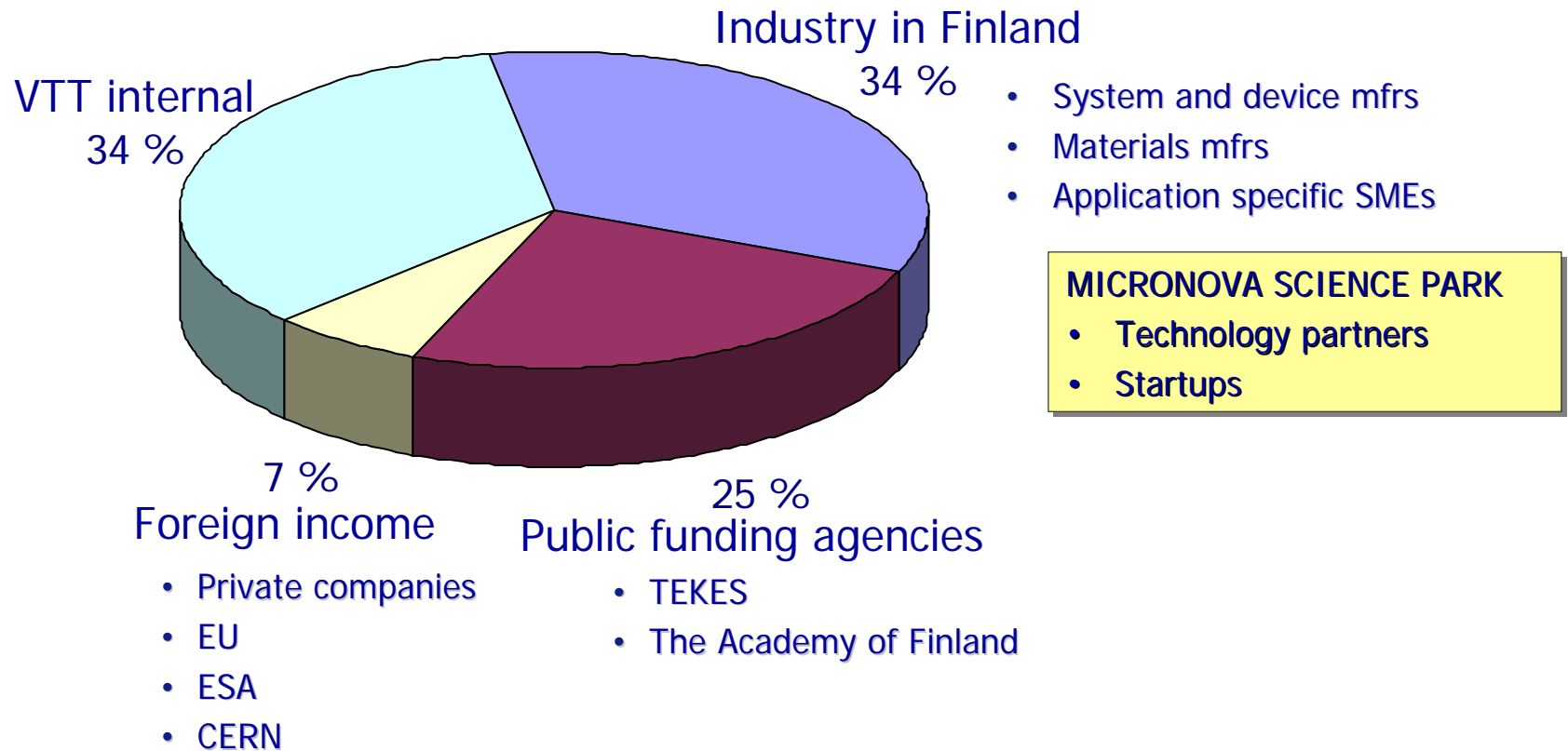
- ❑ 320 people , 200 at VTT

# VTT organisation map



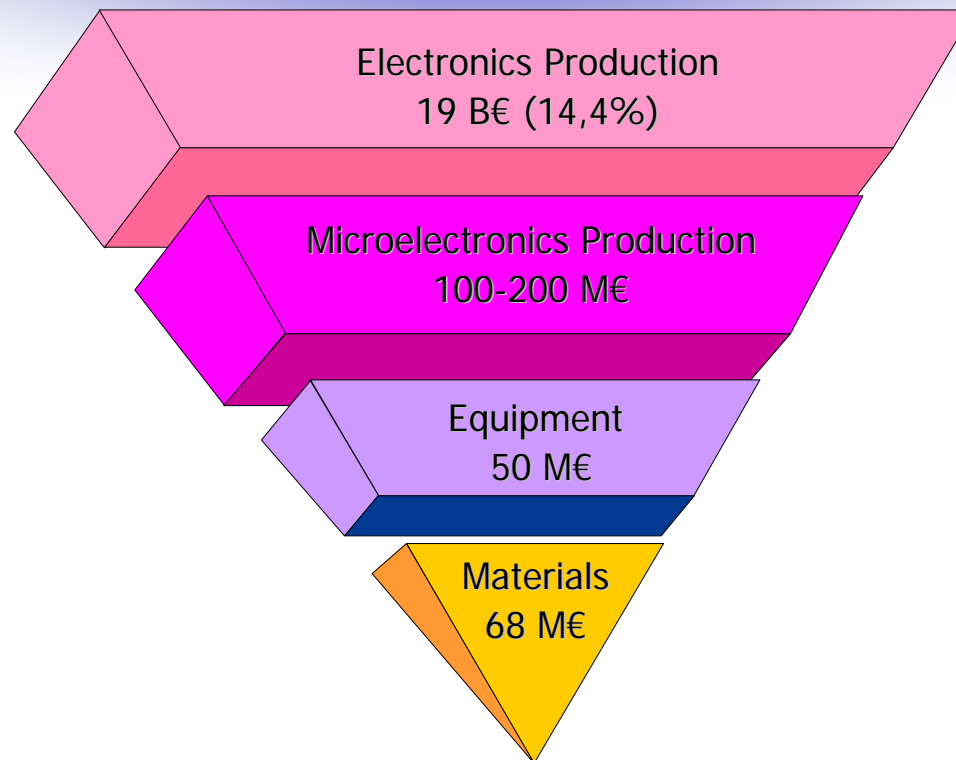
- VTT: 3000 people
- ICT+ Electronics: 420 people

# CUSTOMERS AND SOURCES OF FUNDING



# MICROELECTRONICS FOOD CHAIN

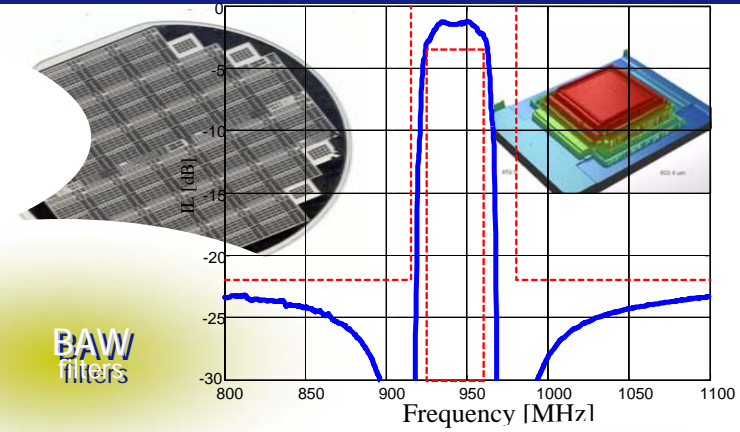
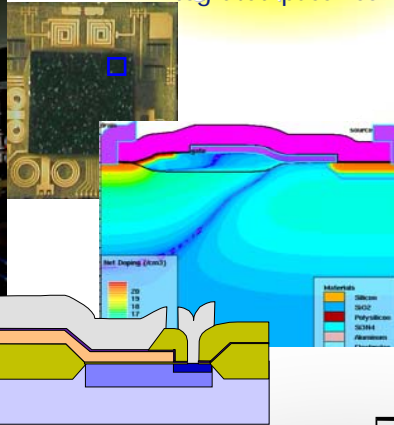
**Finnish GDP 132 B€ (0,47%)**



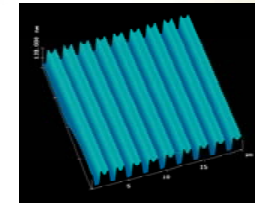
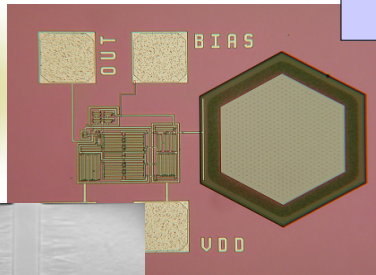
Flip Chip  
packaging



CMOS  
Integrated passives

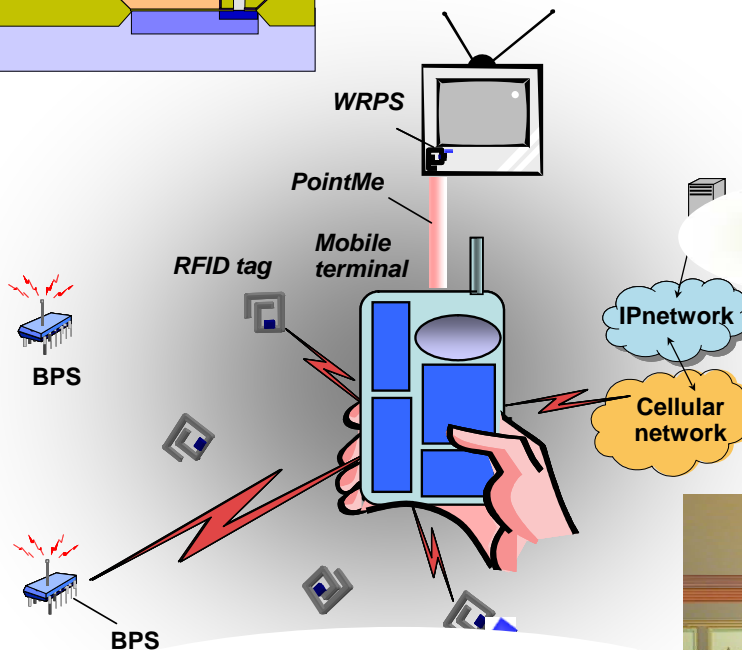
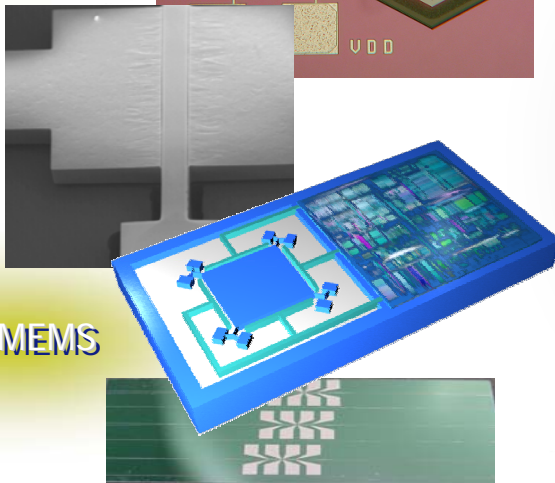


SENSORS

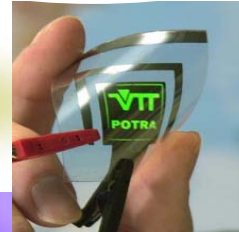


NANO  
imprint

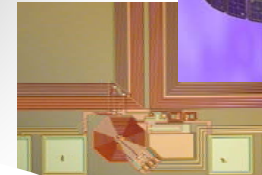
RF-MEMS



OLED



SQUIDS

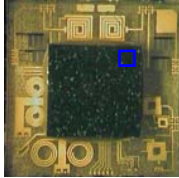


PHOTONICS

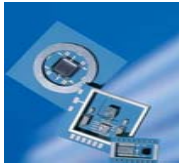
VTT VISION  
Ambient Intelligence

VTT

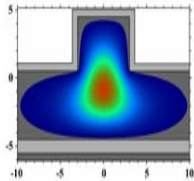
# Core Activities in Microelectronics



RF Module and Circuit Integration



Sensor and Detector Technologies



Photonics and Optical Communication Devices



Advanced Materials and Processing Technologies



Future Emerging Technologies - Nanoelectronics

# IC Technology

- Poly Si BiCMOS

- CMOS, linewidth 0.6  $\mu\text{m}$
- npn  $f_T \sim 25 \text{ GHz}$
- Poly Si resistors 1 k $\Omega$
- poly-nitride-poly capacitors

- Molybdenum gate BeCMOS

- CMOS, linewidth 1.0  $\mu\text{m}$
- BJT enhanced
- Thin film resistors
- MIM capacitors
- EEPROM

- Integrated passive devices

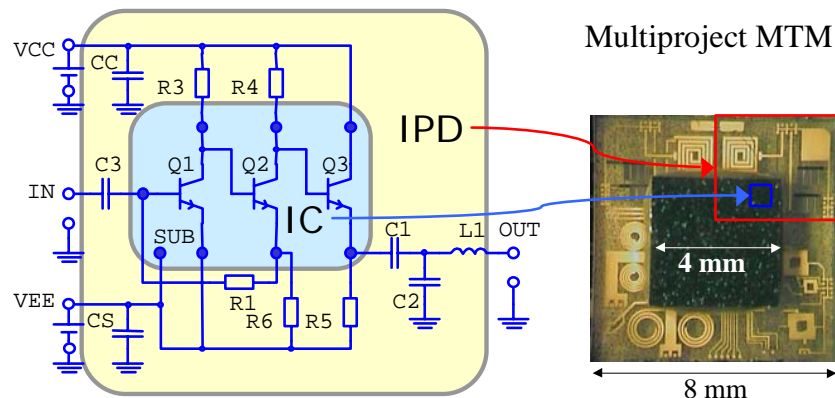
- High res Si or quartz
- Thin film resistors (1 k $\Omega$ )
- MIM capacitors (2 nF/mm<sup>2</sup>)
- Cu inductors ( $Q \sim 50$ )

- New features

- Schottky diodes
- SOI substrate

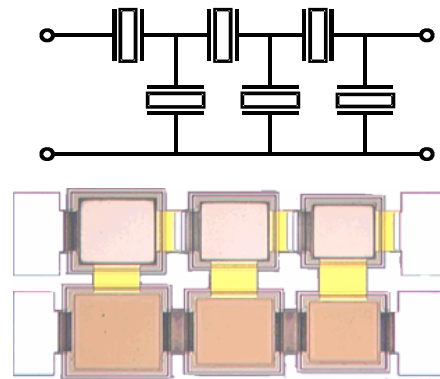
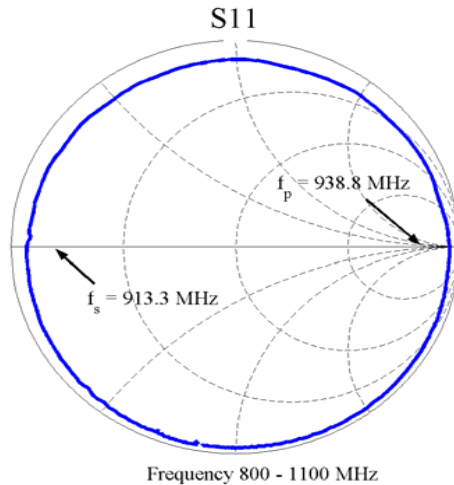
- System in package

- Integrated passives
- CMOS

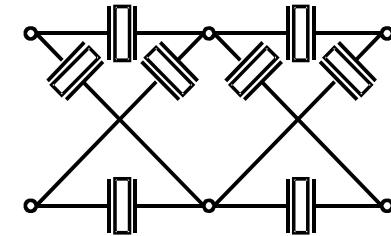




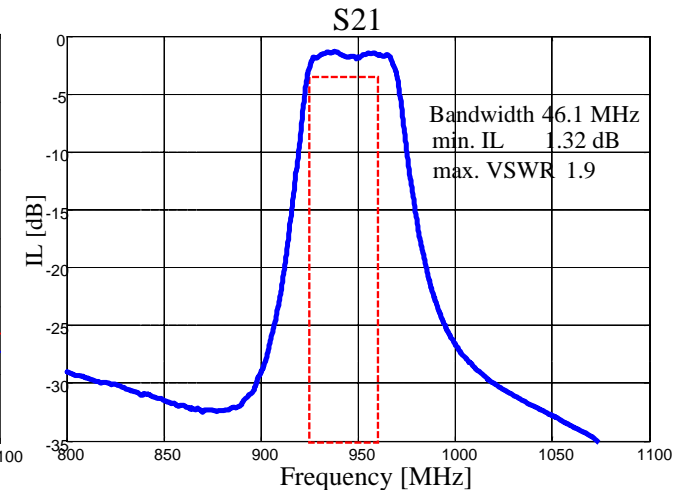
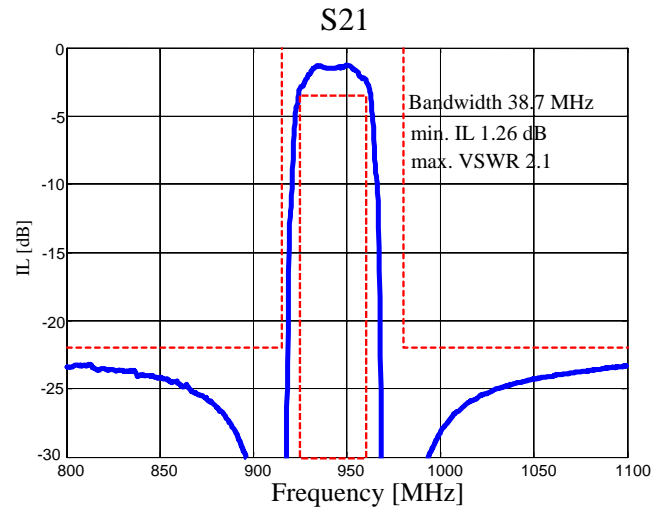
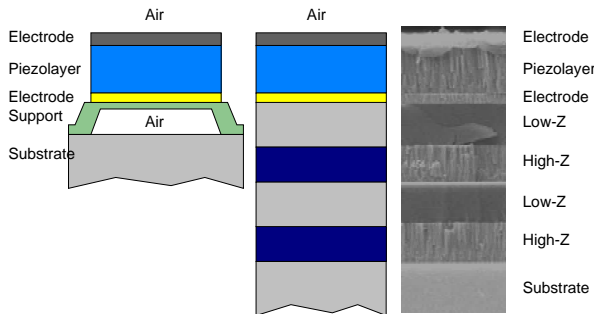
# RF Bulk Acoustic Wave Filters



Ladder filter



Lattice filter

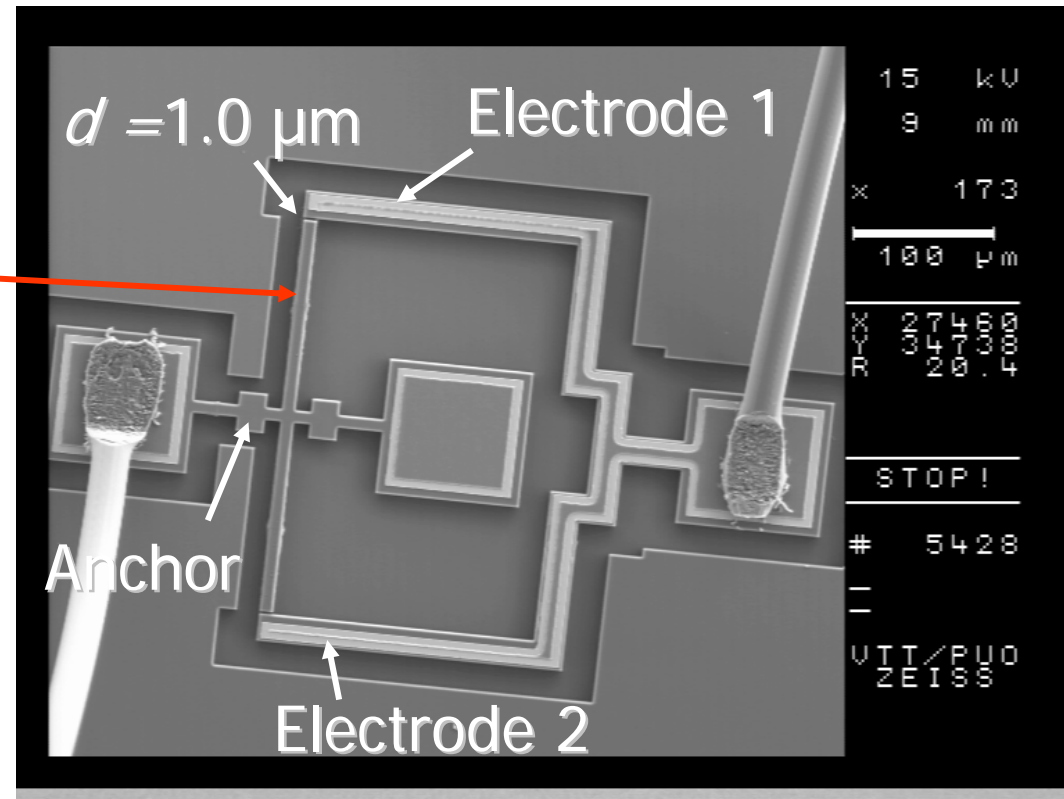


# RF-MEMS

Resonator

$L=176\text{ }\mu\text{m}$

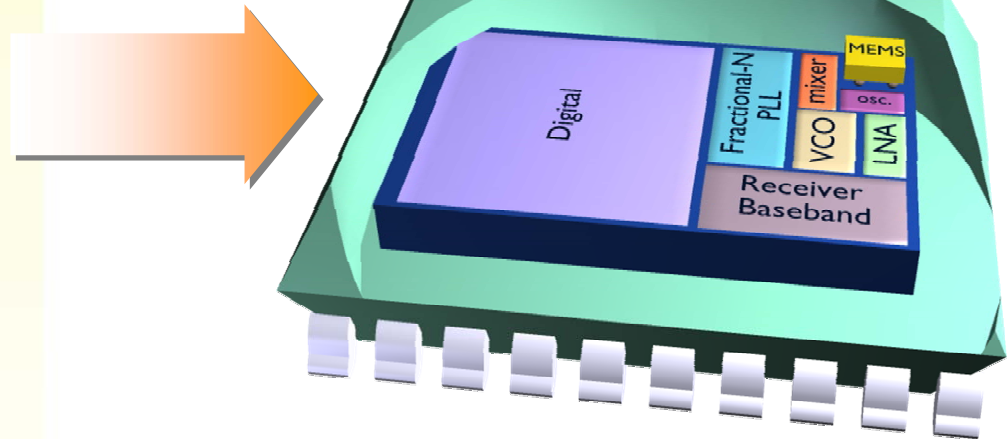
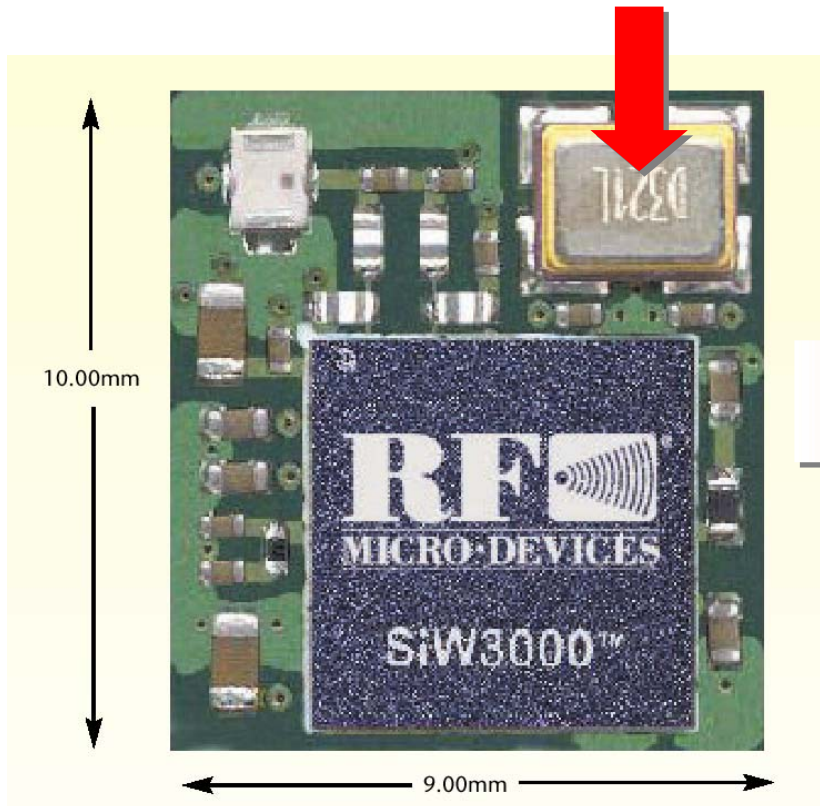
$w=10\text{ }\mu\text{m}$



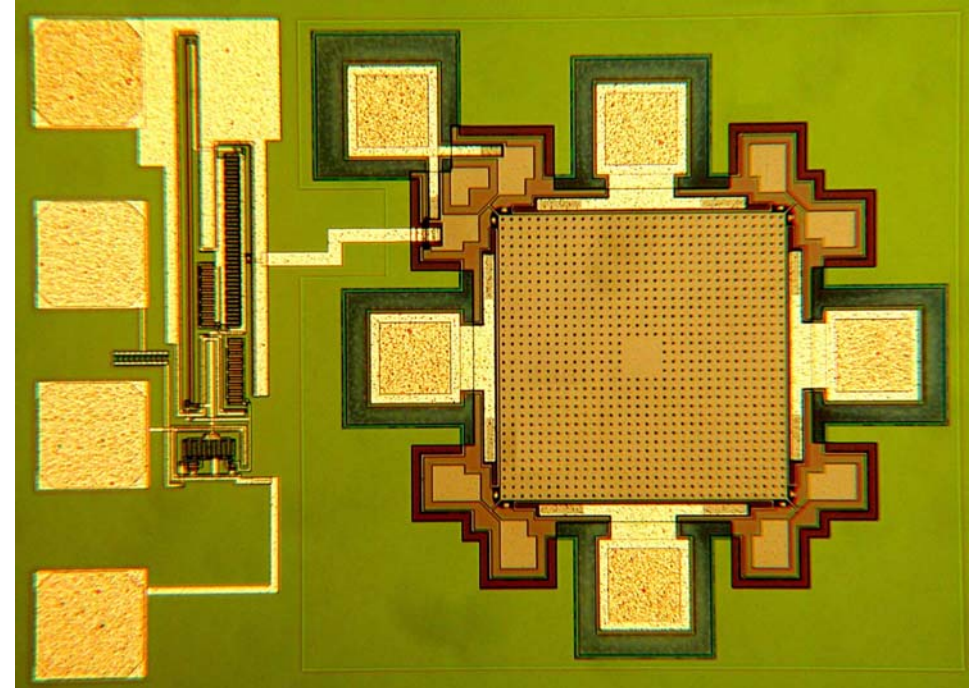
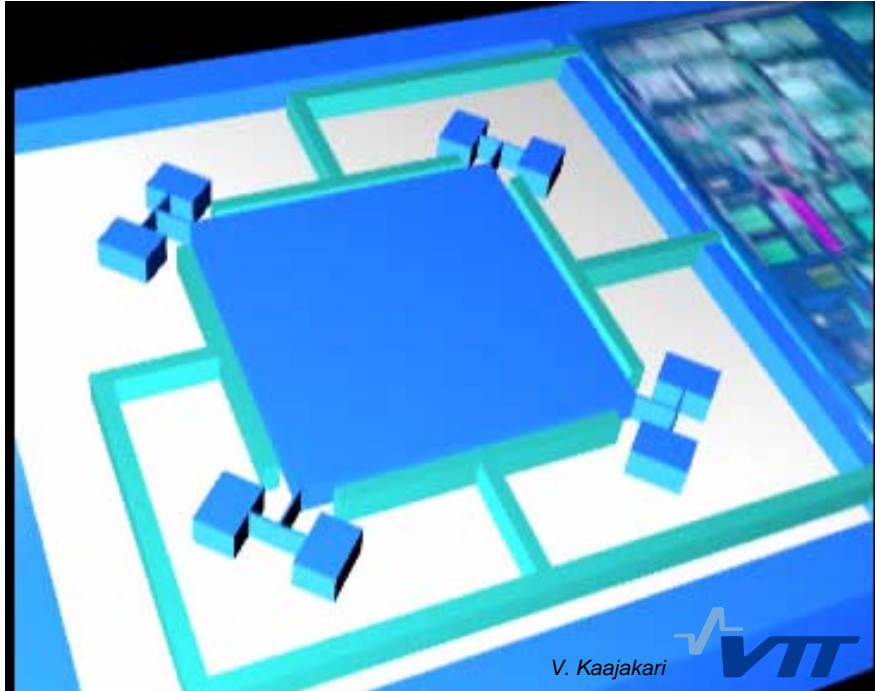
# Reference oscillator

## Objective:

- To replace e.g. Bluetooth radio module with single chip transceiver

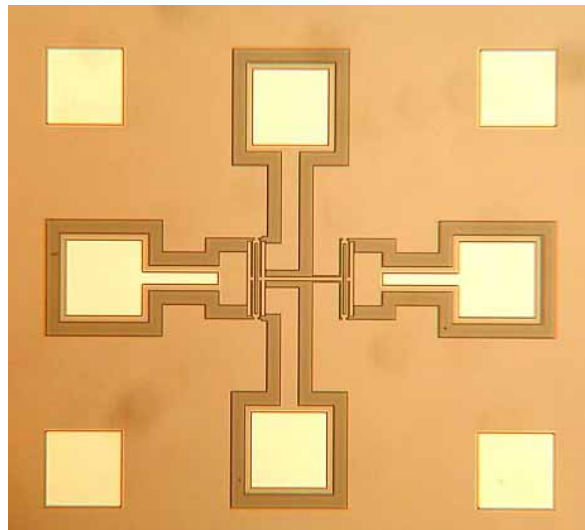
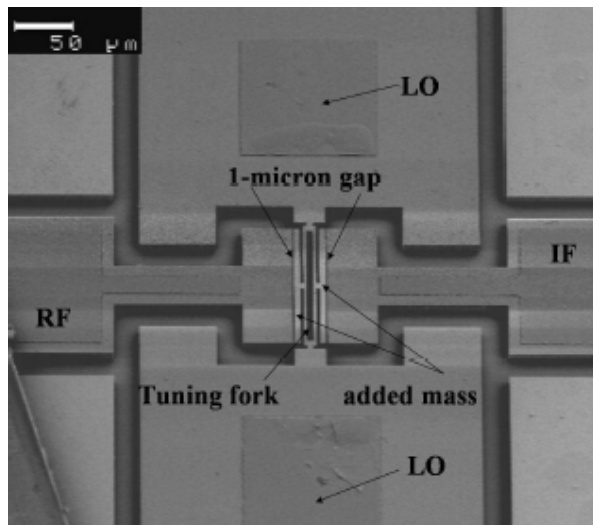
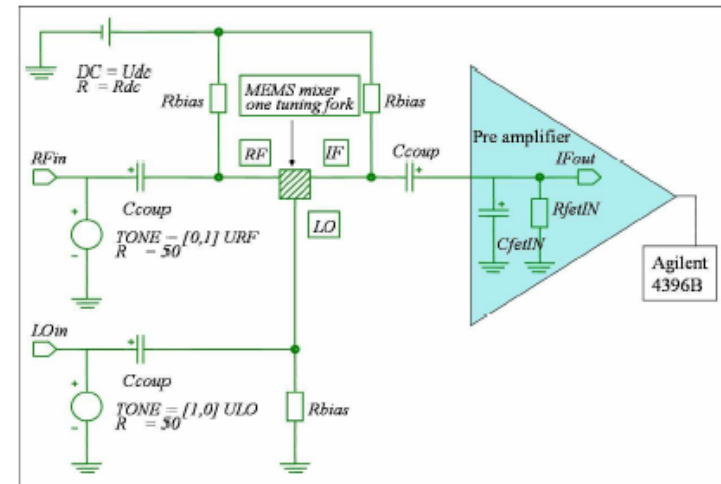
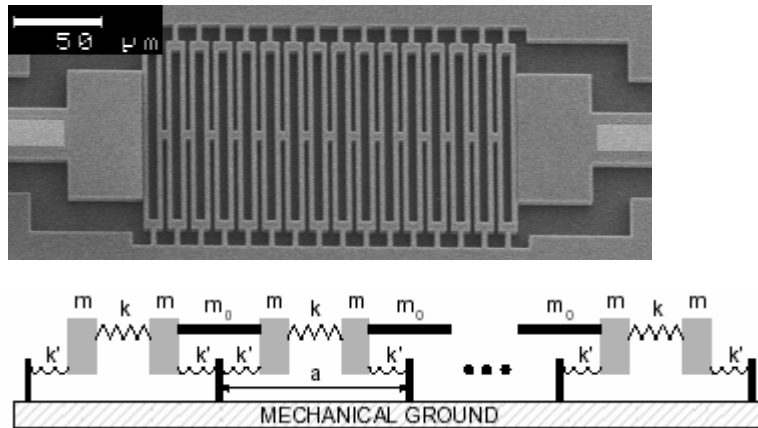


# Square-extensional mode resonator



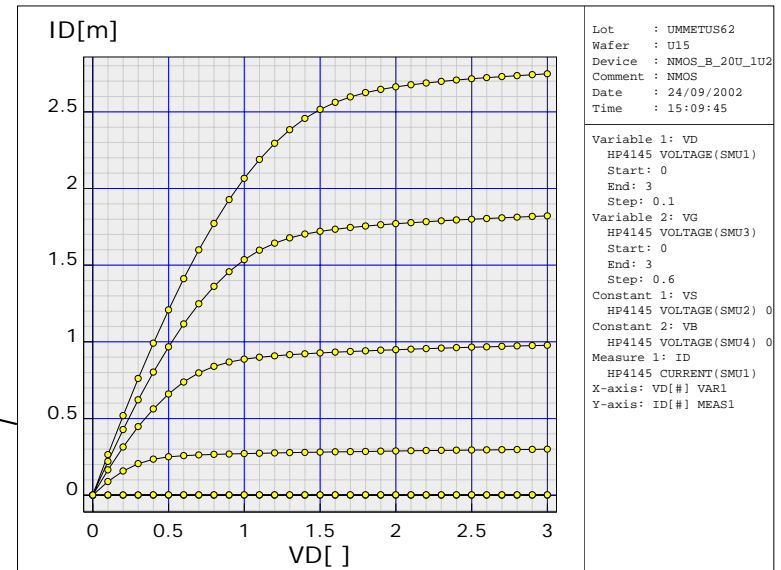
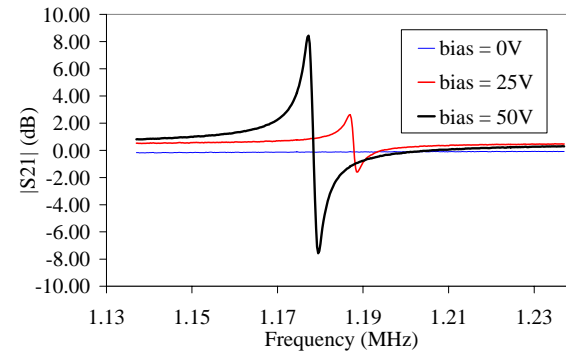
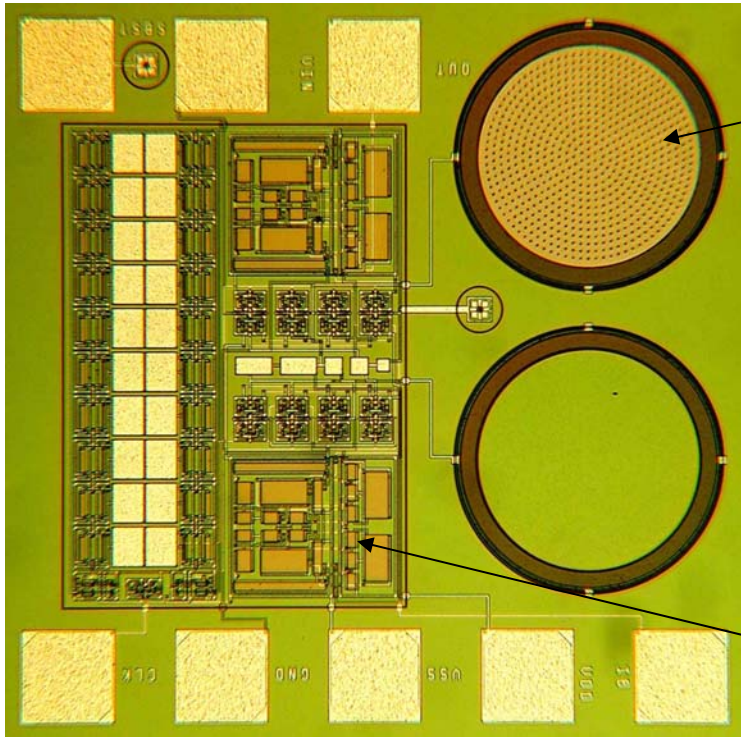
- Bulk Acoustic Wave (BAW) operation
- a square plate “zoomed in and out”

# MEMS based RF delay lines and mixers

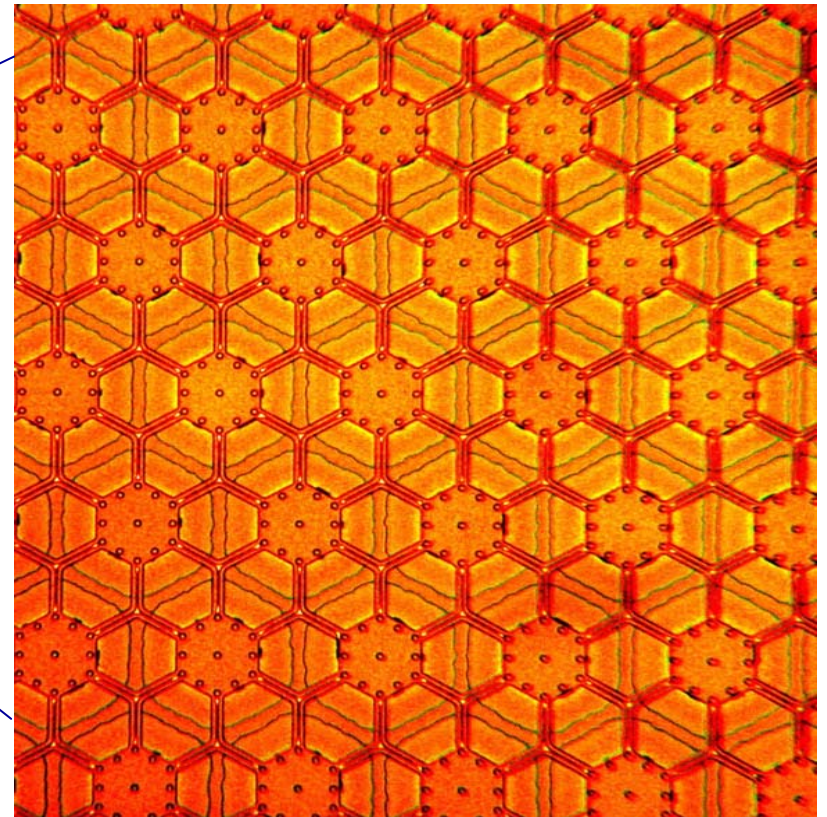
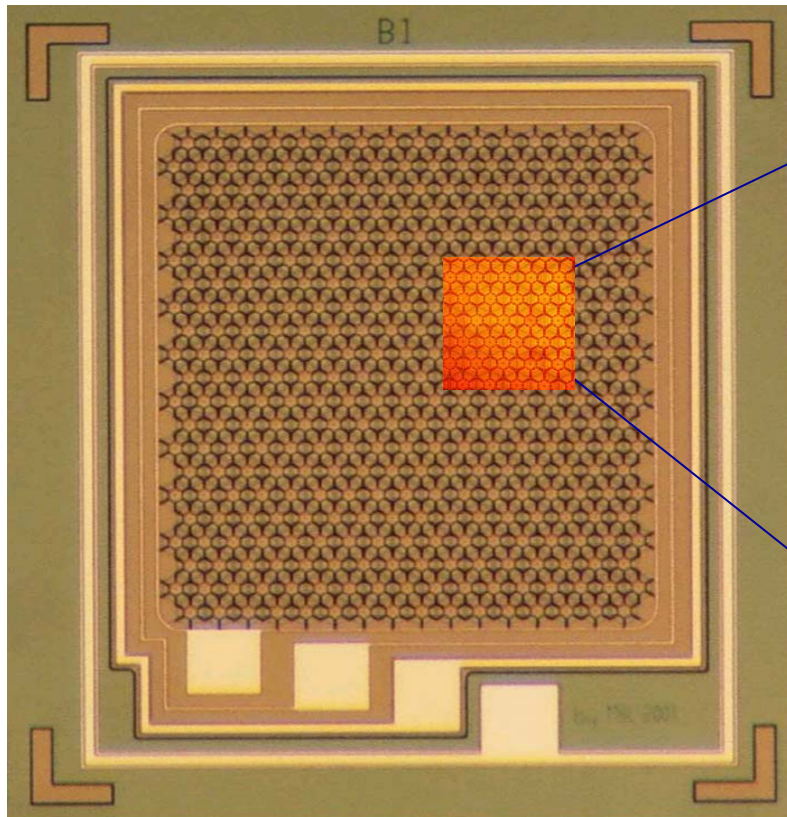




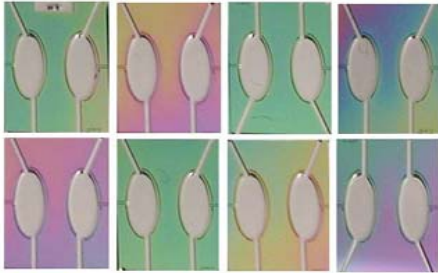
# Integrated sensors



# Capacitive Micromachined Ultrasonic Transducers (cMUT)

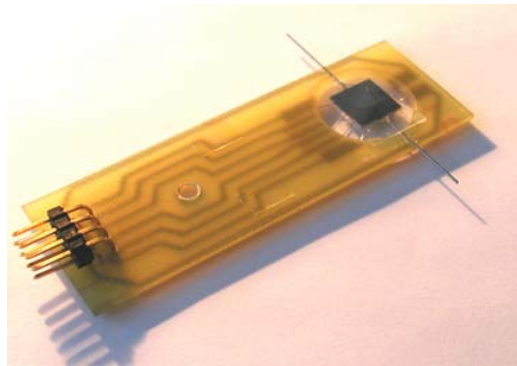


# Silicon PCR Chip for DNA Diagnostics



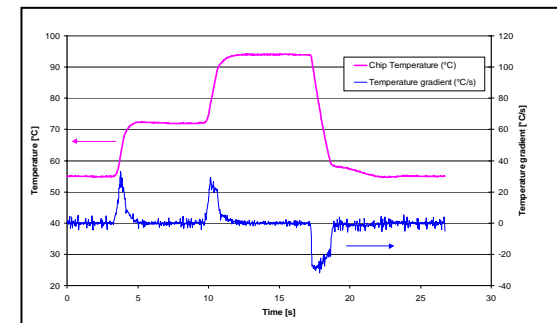
**Microlitre scale liquid cavities: 2-5  $\mu$ l**

**Integrated heater and thermistor elements**



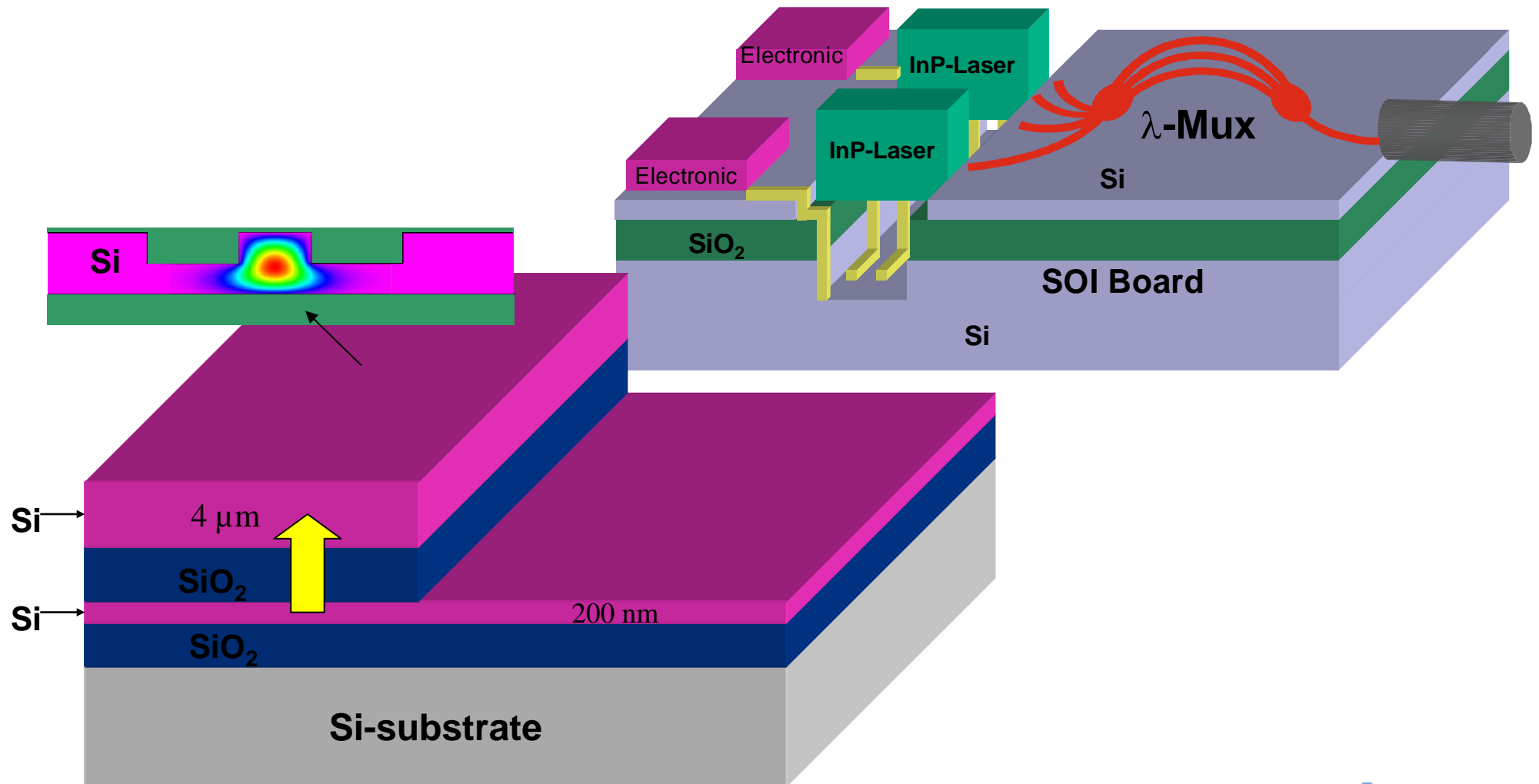
**Microscope glass slide interface**

**Fast thermal controlling:  
heating and cooling: 30°/s**

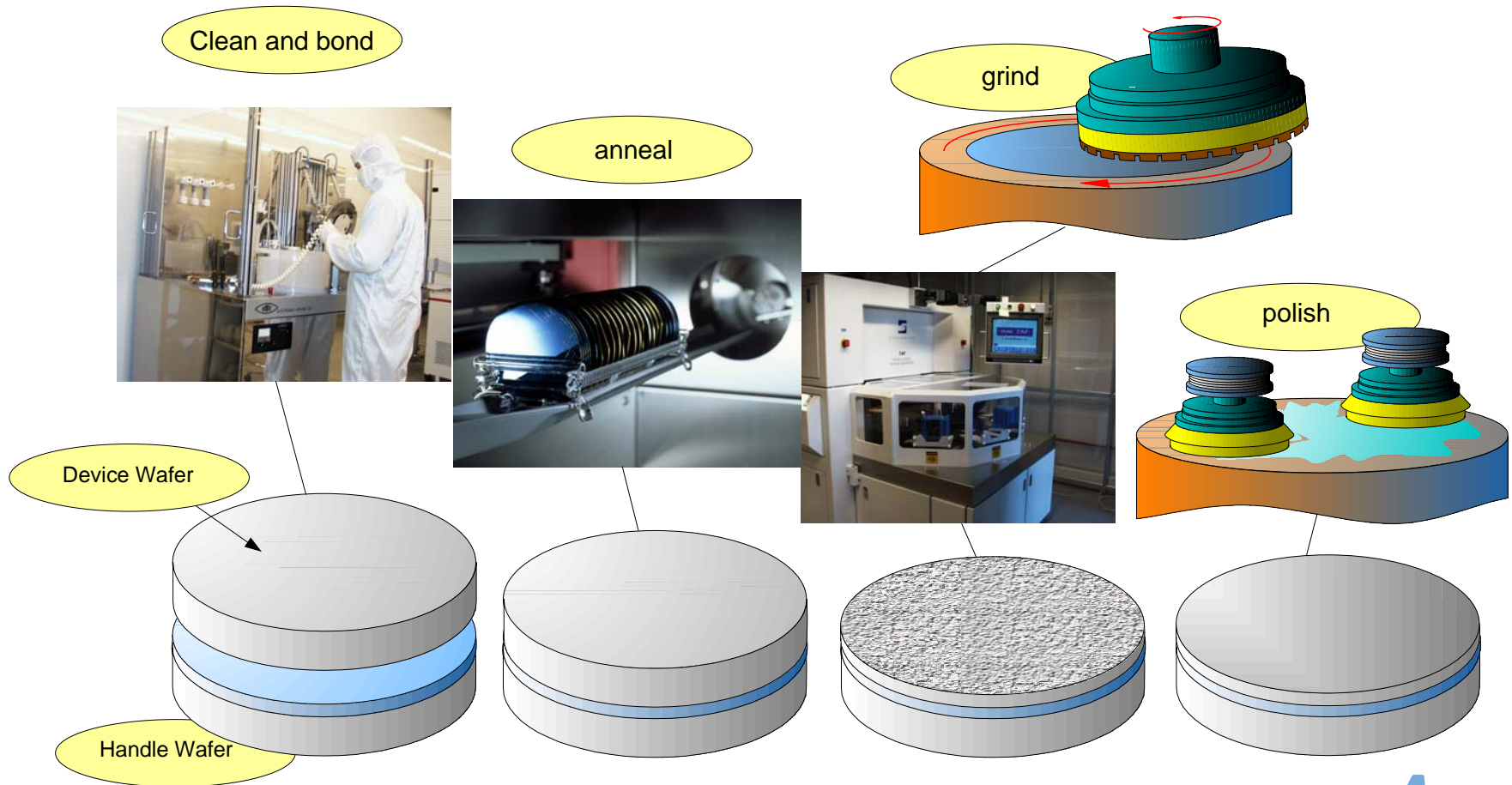




# Merging electronics and optics - Mephisto



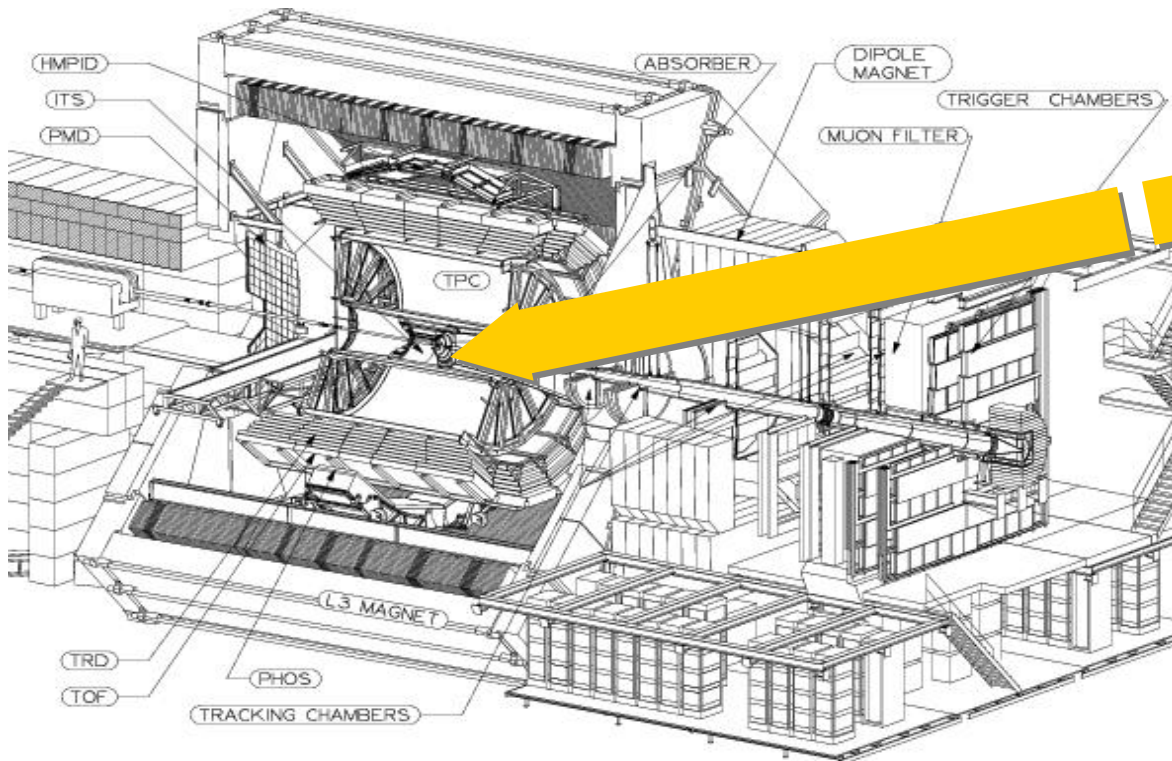
# Bonded SOI wafers



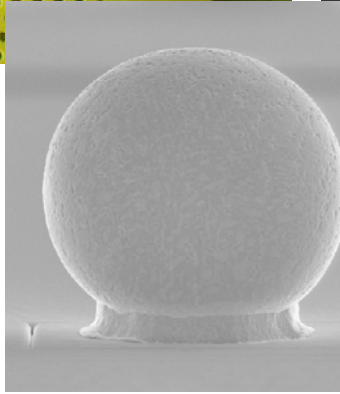
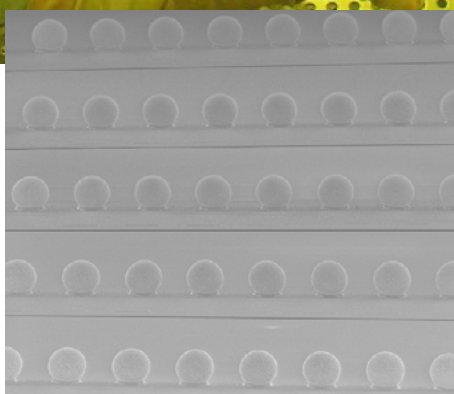
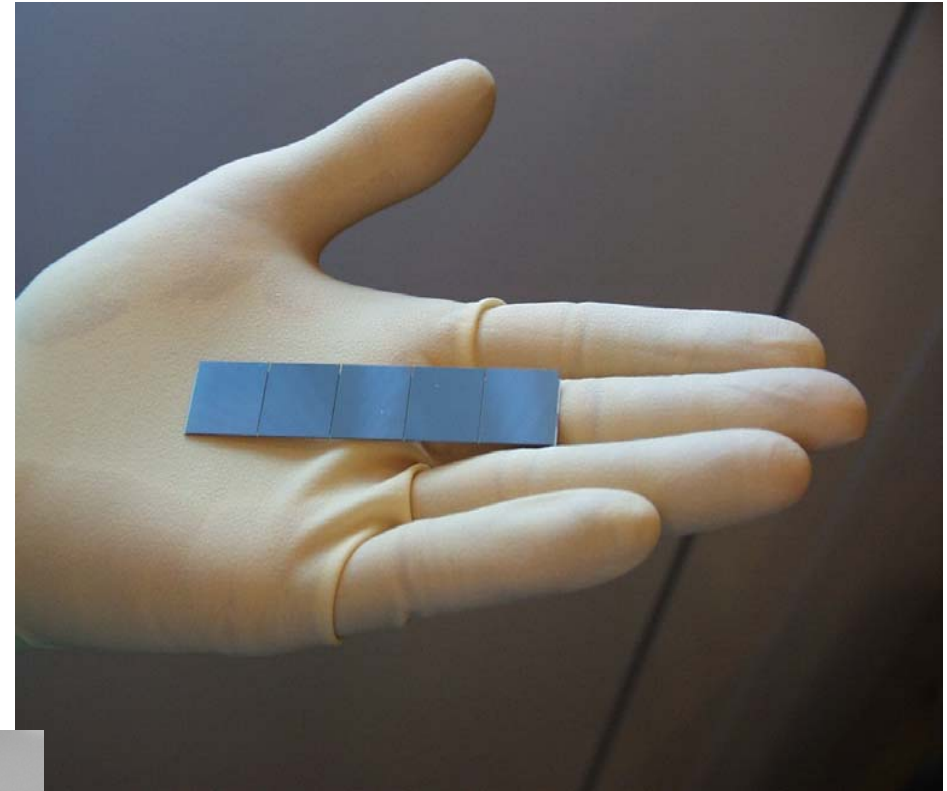
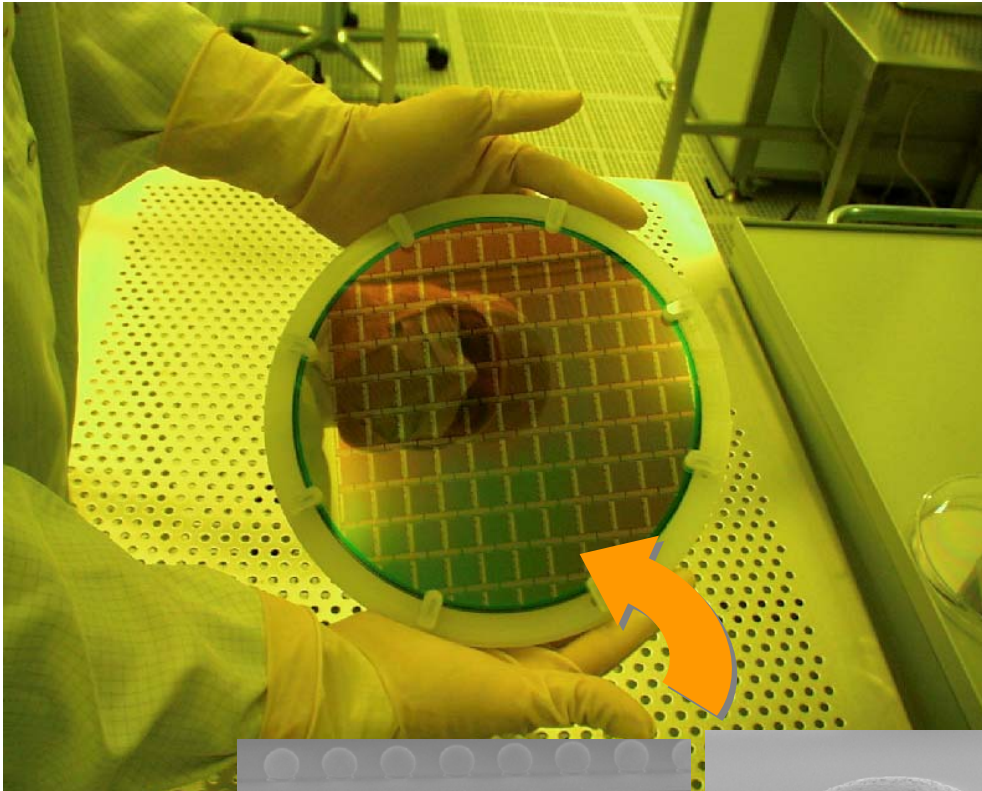
# Detectors for High Energy Physics

- **CERN LHC DETECTOR EXPERIMENTS**

- ALICE (8192 pixels/5x8192 pixels)
- LHCb-RICH
- NA 60

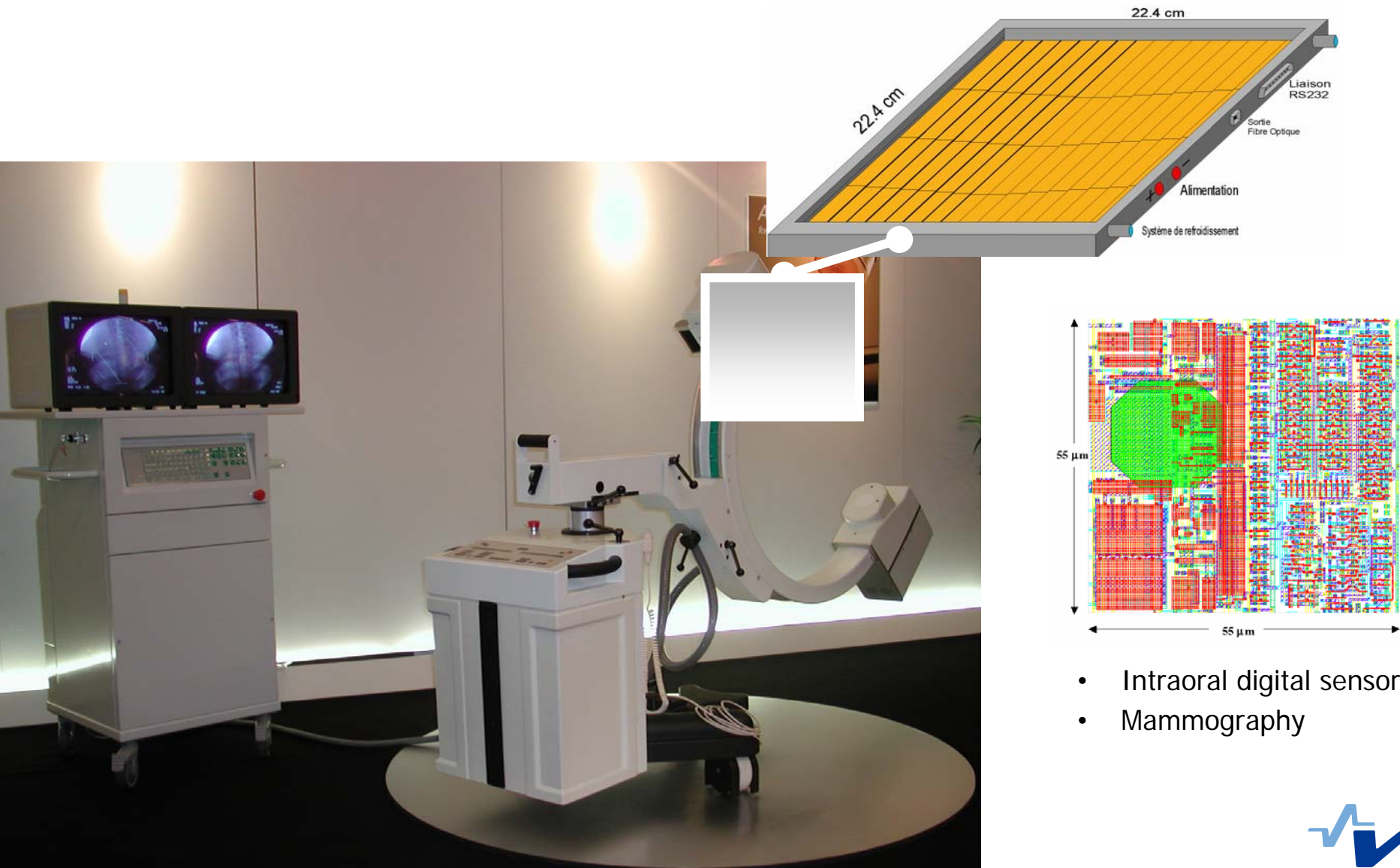


# Hybridized Semiconductor Detectors



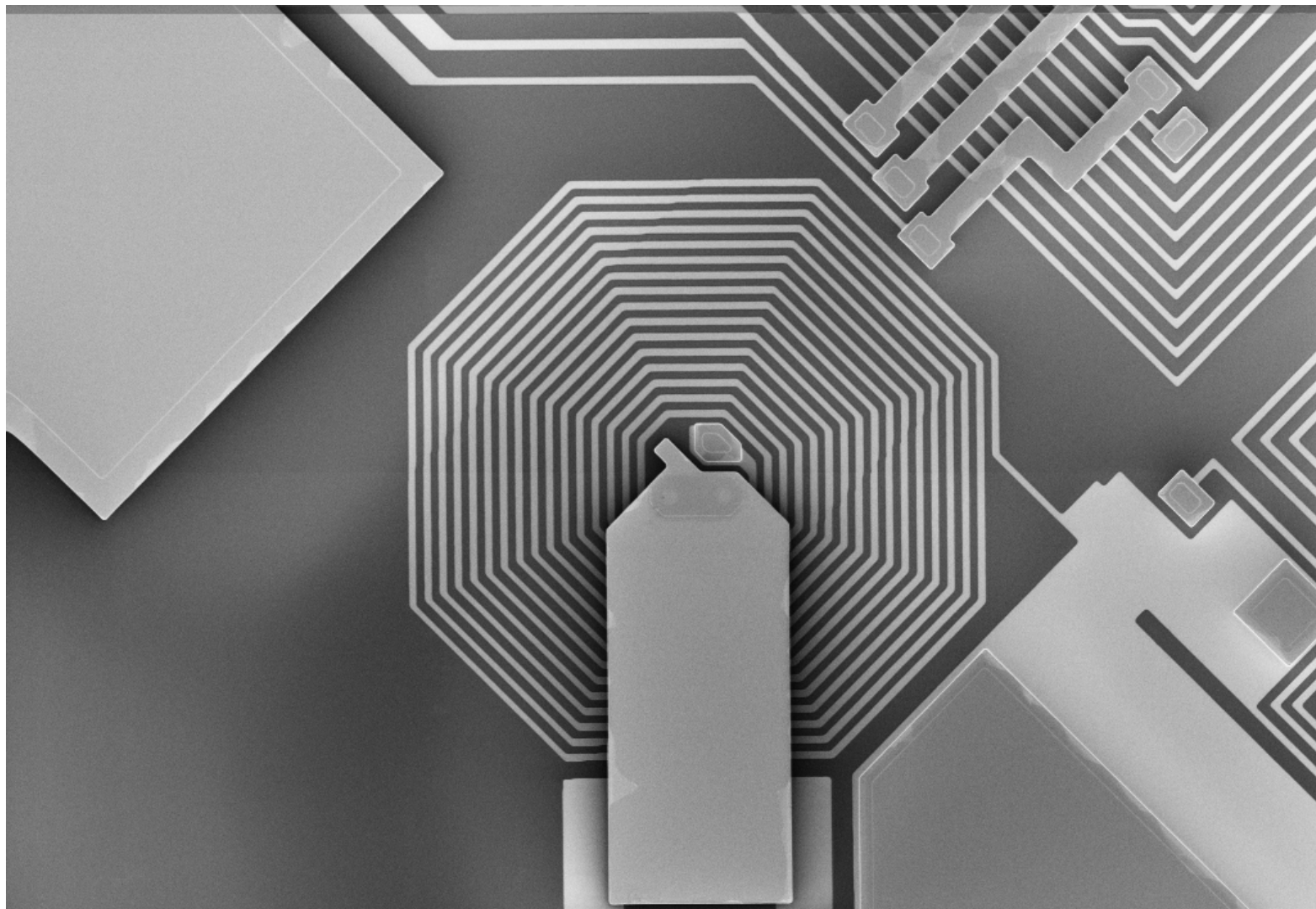


# Detectors for Medical Imaging



- Intraoral digital sensors
- Mammography

# Superconducting devices



Mag = 704 X

10µm  
└─┘

EHT = 10.00 kV

WD = 7 mm

Specimen I = 0 fA

Detector = InLens

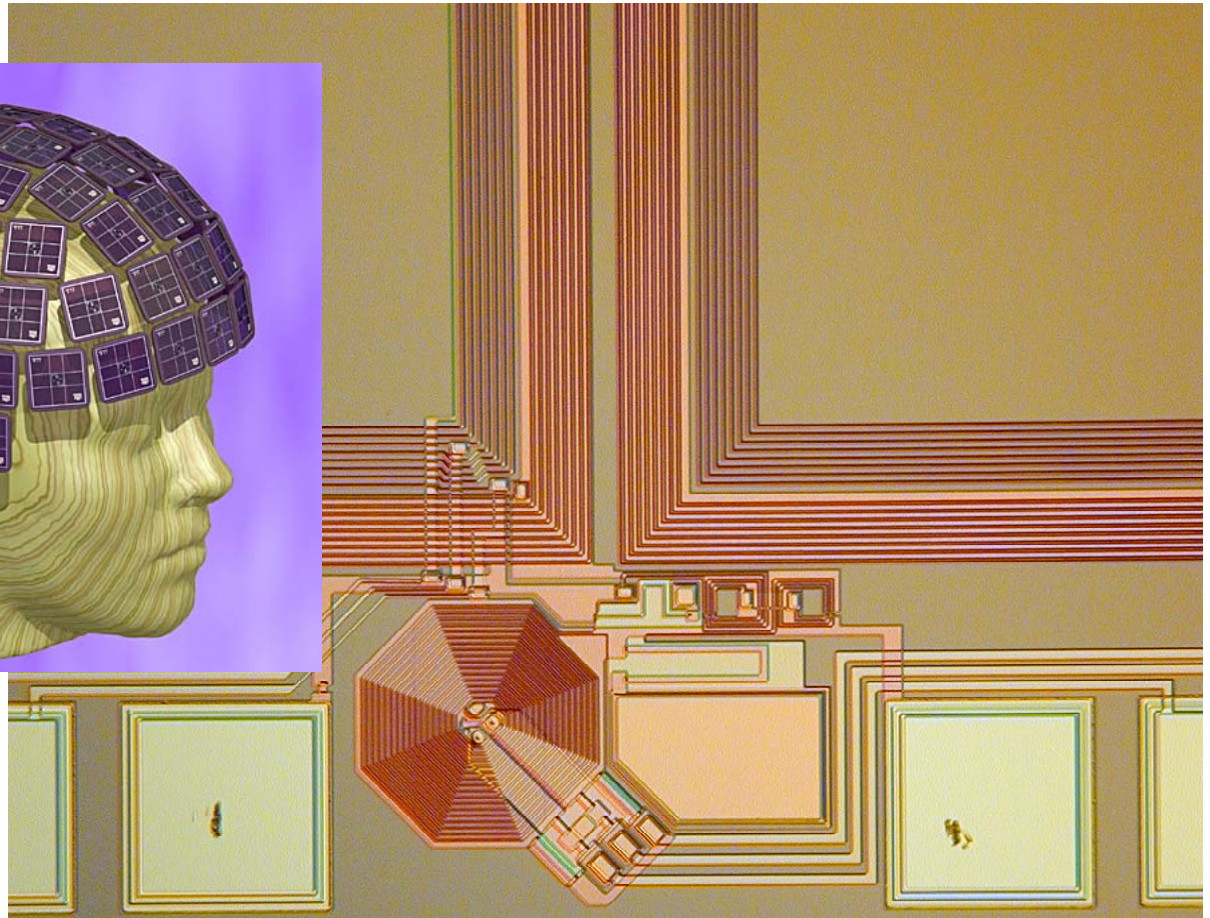
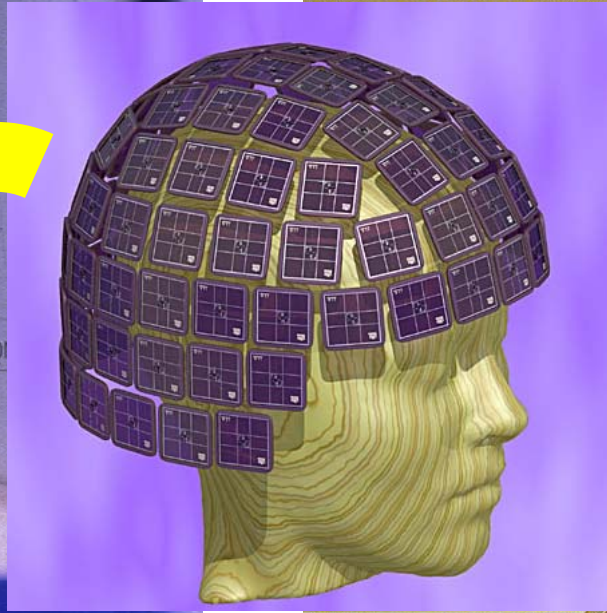
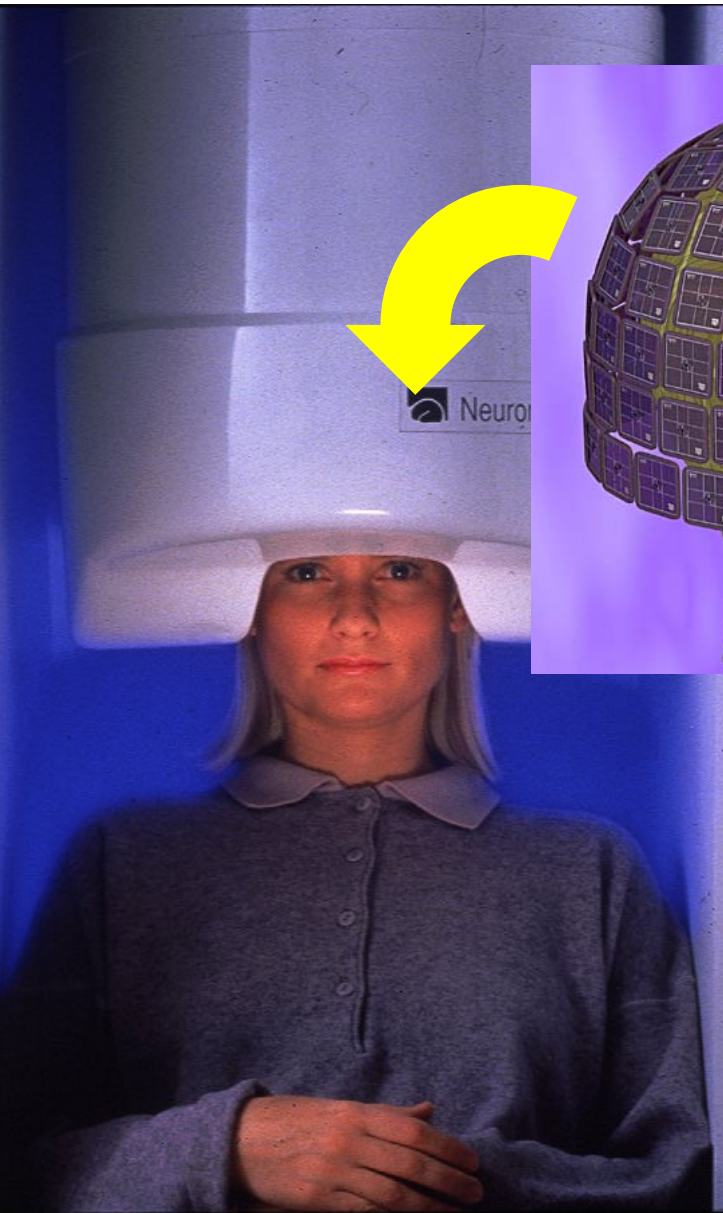
SCM On = No

Date : 28 Nov 2001

Time : 14:58:19



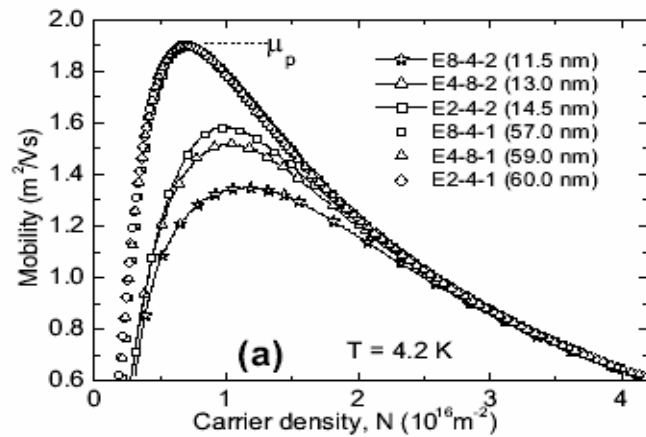
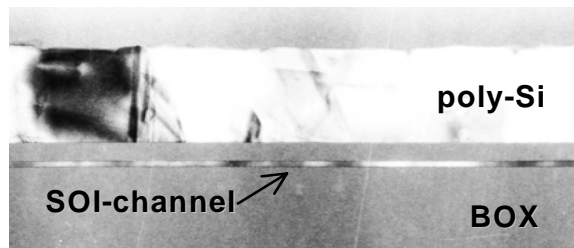
# Biomagnetic sensors



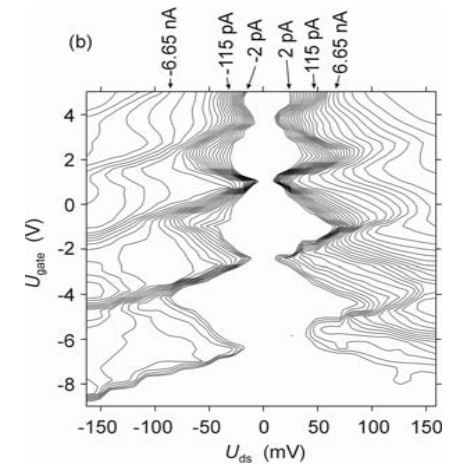
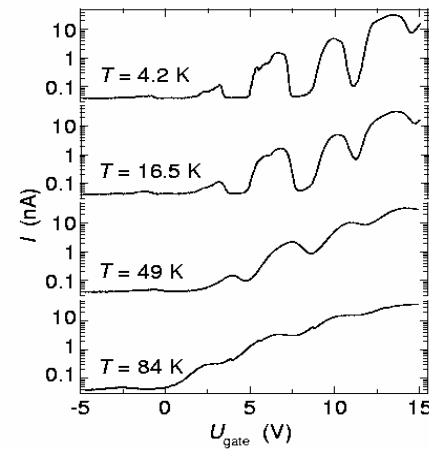
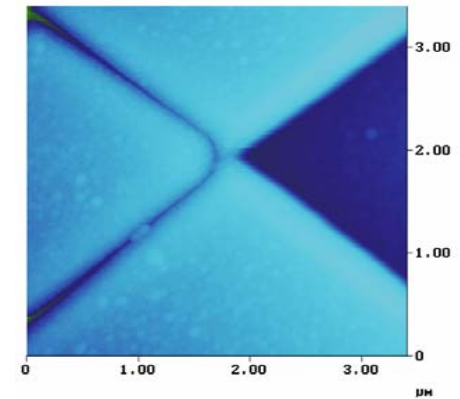
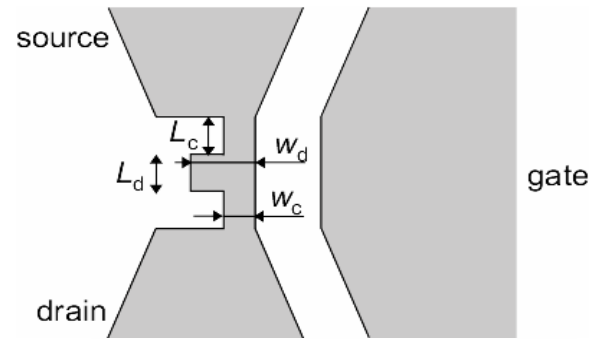
- Superconducting Sensors for Magnetoencephalography
  - Installed base of instruments 23
  - More than 5000 SQUID channels

# Nanoscale ....

## Mobility in ultrathin SOI films



## Single electron transistors





Thank you!

