

Karlsruhe probe equipment and QA proposals/expertise

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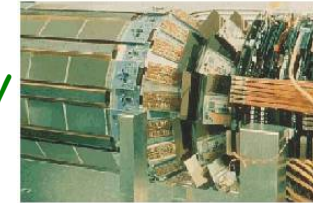
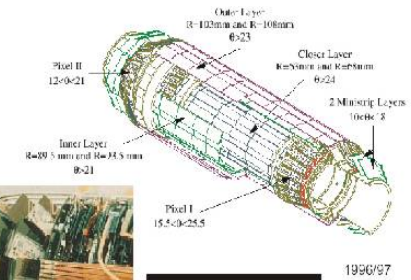
+ 2 possible students



Lab Expertise

Delphi: World largest 1996-2000 1.8m²

- 1.8 m² Silizium
- 175000 Streifen
- 1.2 Mio. Pixel

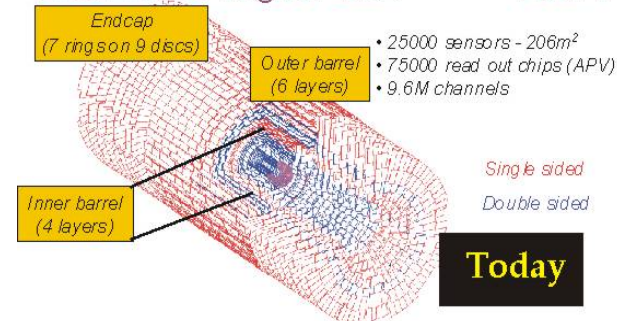


1996/97
Diploma Thesis

CDF: World largest 2000--2007 7.5 m²



CMS: World largest 2007- **** 206m²



Delphi:

- Quality control on sensors and modules, Assembly of Pixel and Outer Barrel modules (Update '97)

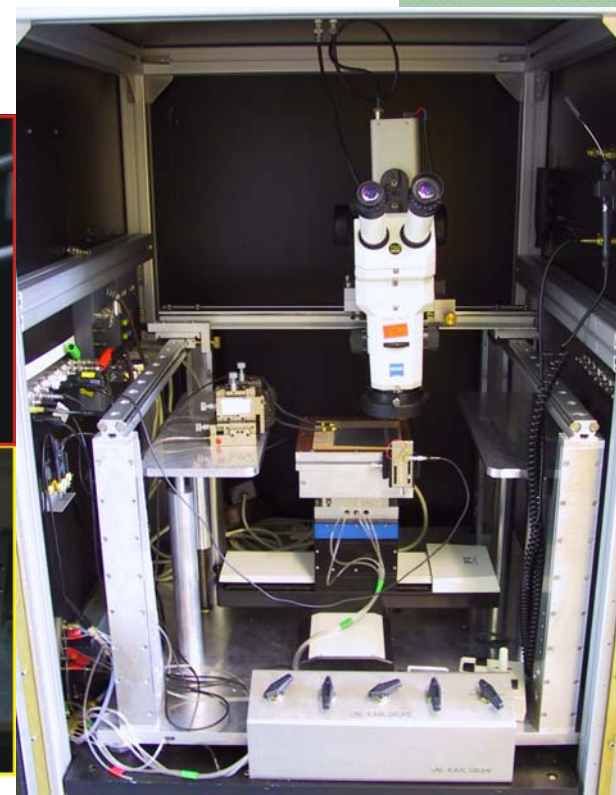
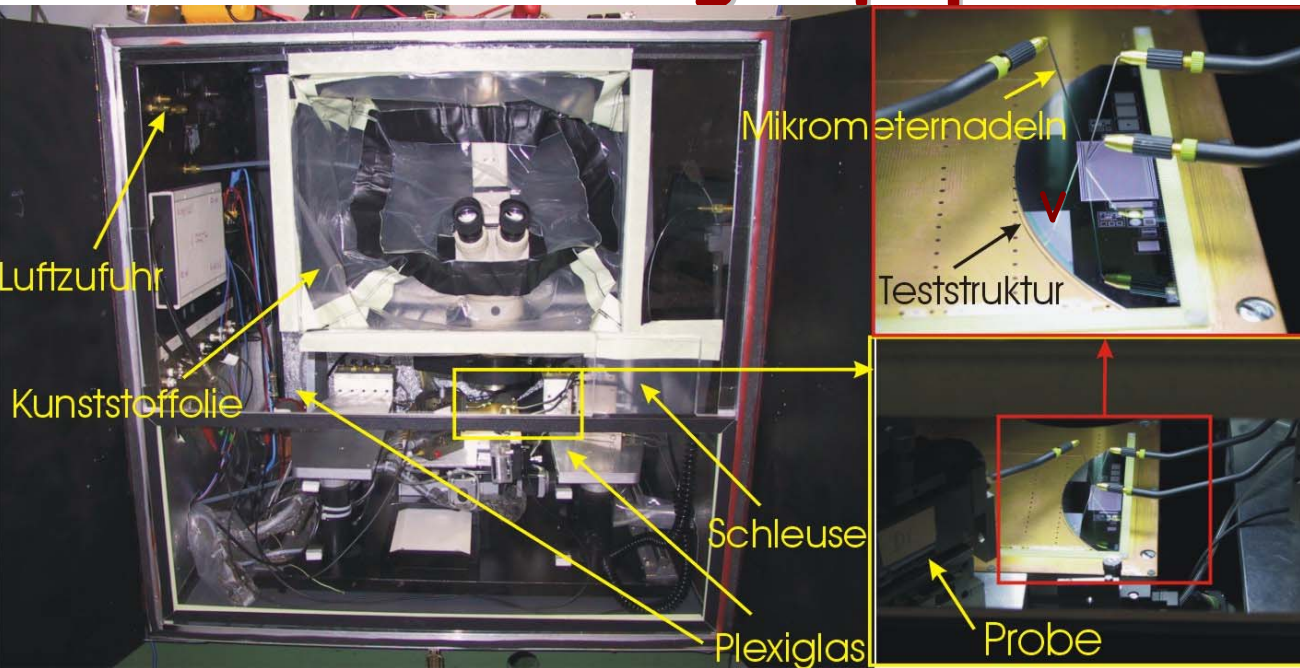
CDF II - ISL:

- Sensor Prototype evaluation
- Quality control, Assembly fixture design and construction

CMS

- Prototyping (sensor & modules)
- Definition of QA procedure, Design of sensors
- Material Analysis
- Long term Testing
- Irradiation
- Definition of QA procedure for modules
 - Dedicated pinhole test, beam dump test, current/noise correlations ...
- Bonding
- Integration

Sensor Testing Equipment I



2 homemade flexible probe stations

- 6" (adaptable for larger size)
- cold chuck -10°C ($+100^{\circ}\text{C}$ to -10°C)
- very flexible
 - individual needles
 - bias travels with sensor
- switching matrix
- RH & T monitoring
- LCR, electrometer, HV, quasistatic CV!
- Camera (incl. frame grabber)
- Double sided jig

Suitable for strip characterization of sensors and full modules



Standard Measurements:

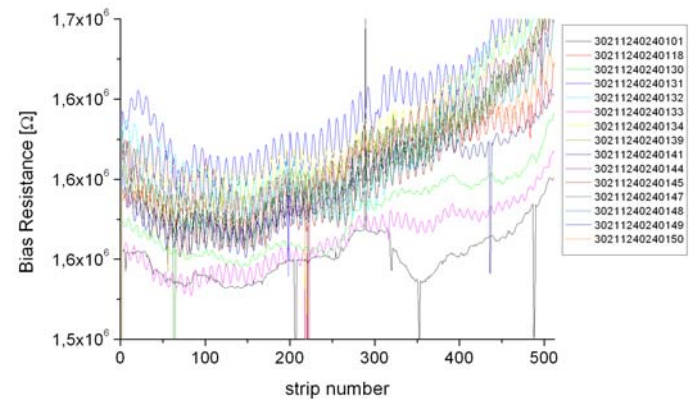
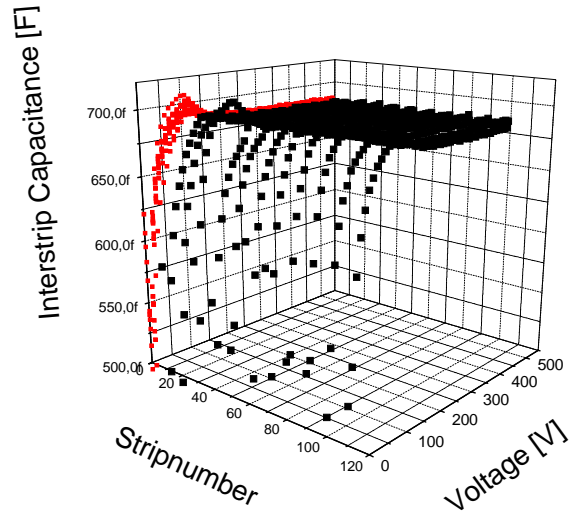
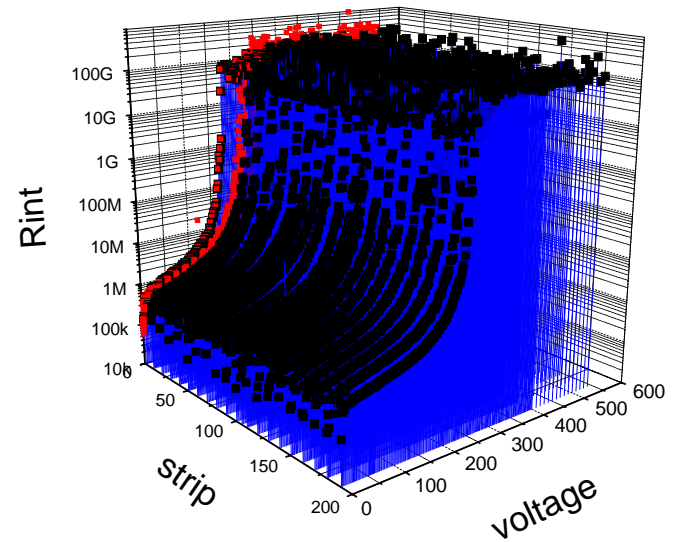
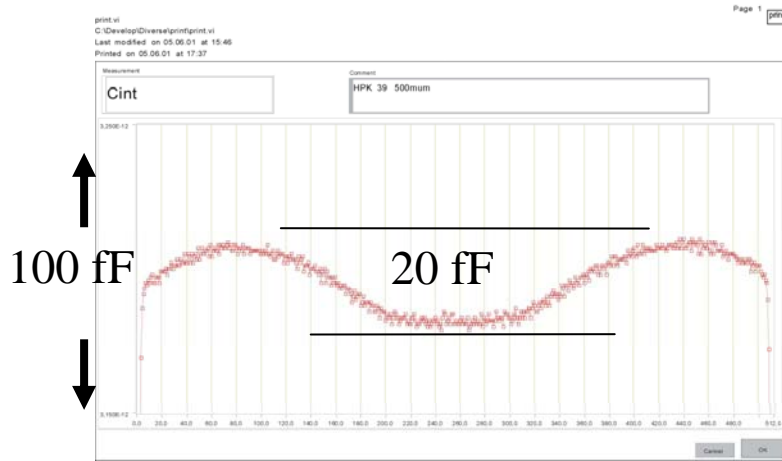
- Global:
 - IV, CV
- Strip:
 - Current, CaC, dielectric current (pinhole)
 - inter strip capacitance, inter strip resistance
- Special:
 - VFlat
 - Isurf

Software specialties:

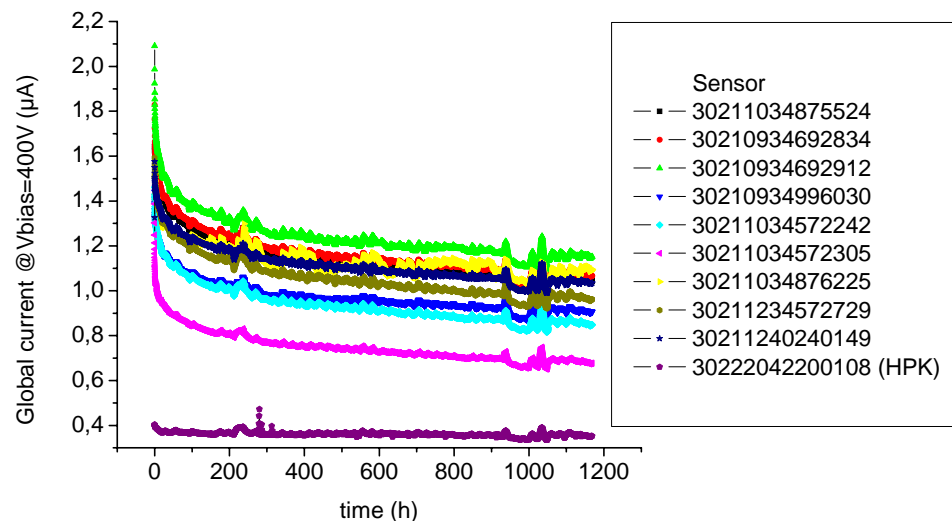
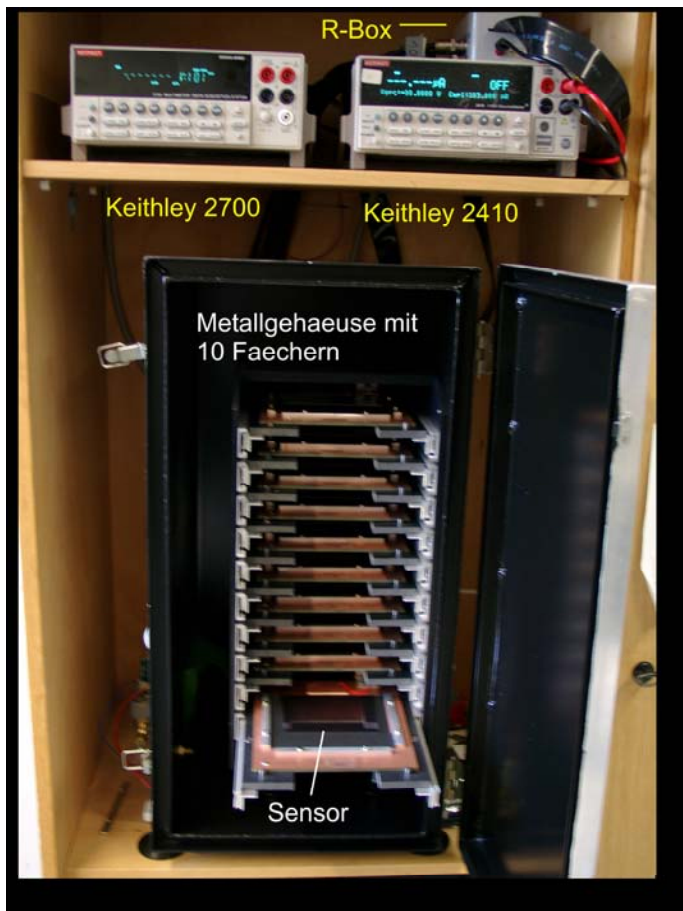
- All parameters versus
 - Time
 - Voltage
 - Temperature
- Defined potential on neighbor pads
 - E.g. current measurement on DC while AC pad on voltage
- Current induced with IR

- Combination of all the above with different parameters; scriptable
- Applicable on full modules

Examples



- Long term testing
 - 10 sensors under bias voltage while logging current

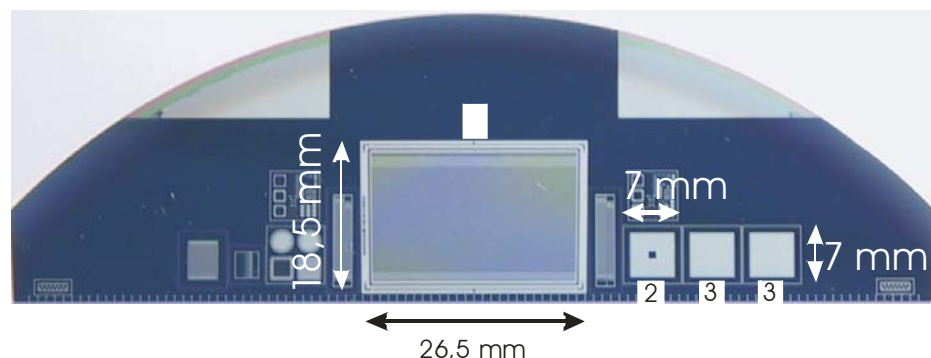


CMS process control (Florence, Strasbourg, Vienna)



- Special exhaustive set of measurements to monitor the processes
 - PQC EXTEND QTC + Redundancy done on dedicated teststructures:
 - Destructive tests
 - Full automatization allows a much higher sample
 - CV \rightarrow V_FD
 - IV Breakdown voltage ,
 - Total leakage current
 - V_Flatband (On MOS structure)
 - Surface Current (On Gate Controlled Diode)
 - Cint in 10% from the parametrization
 - Interstrip resistance $> 1 \text{ G}\Omega$
 - Rpoly
 - P+ Implant Resistance: $R_{p+} < * \text{ k}\Omega/\text{cm}$
 - Metal Layer resistance: $R_{al} < * \text{ m}\Omega/\text{square}$
 - Cac
 - Vbreak(ac) (destructive test)
 - Idiel @ higher voltages
- PQC results affect complete batch

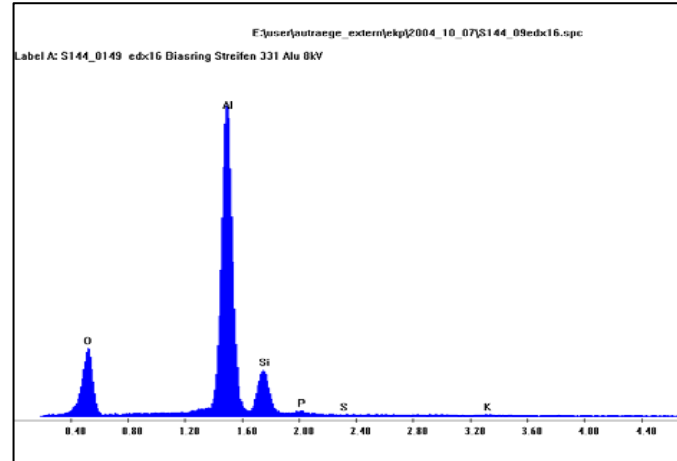
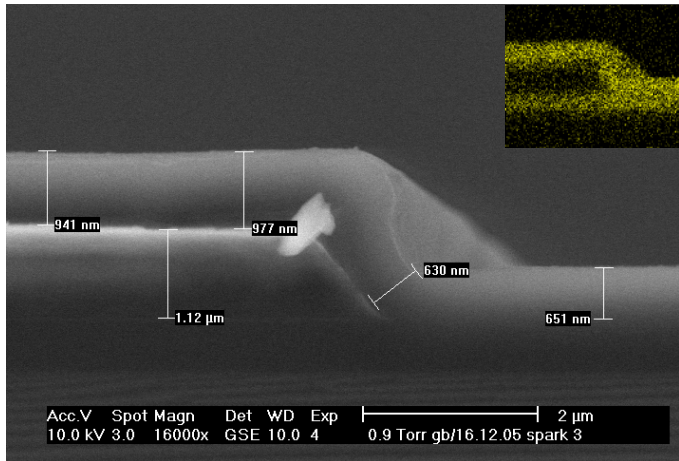
CMS experience told us:
THIS IS VERY IMPORTANT!



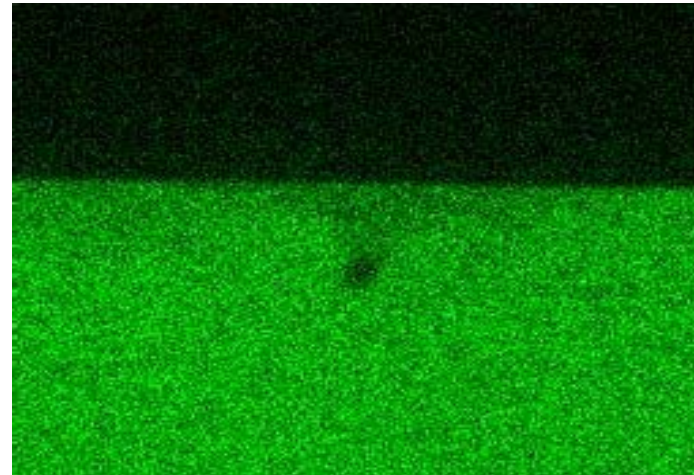
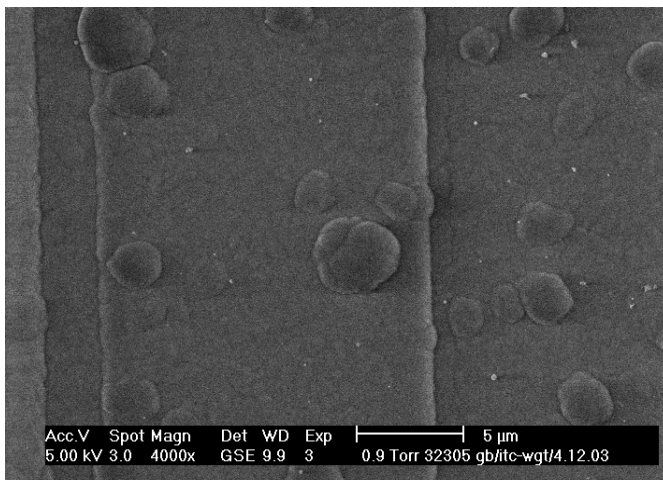
Material Analysis with Environmental Electron microscope



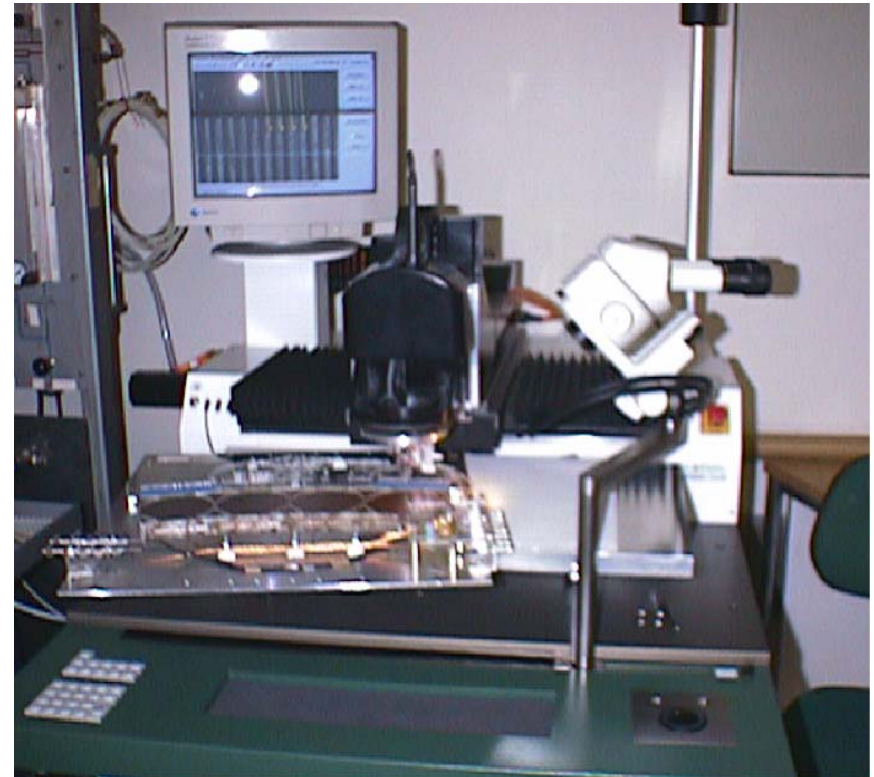
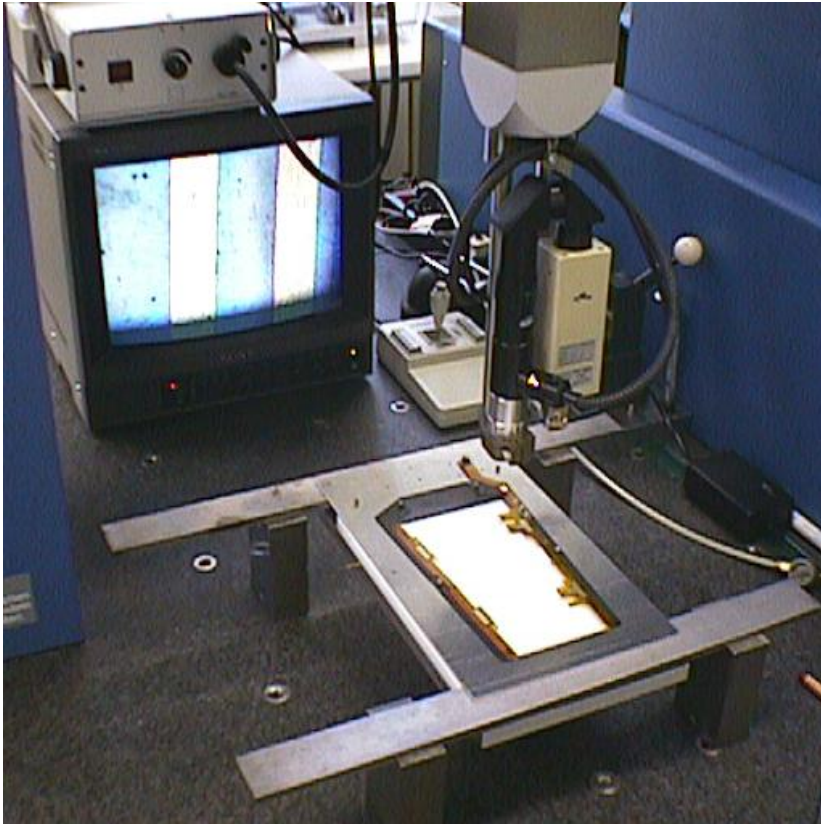
Our neighbor institute runs an ESEM, which is accessible



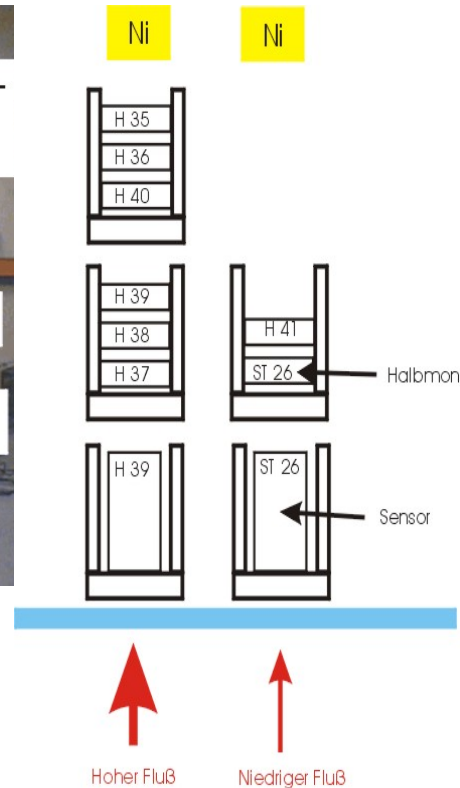
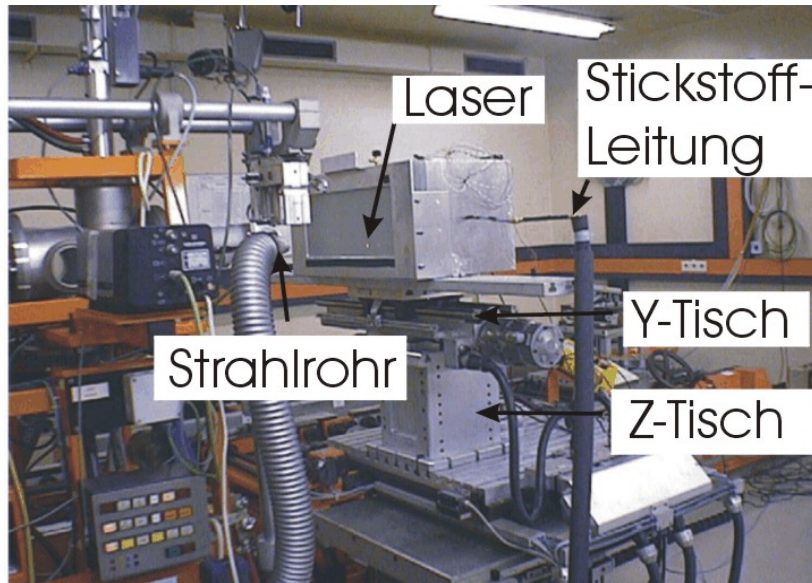
Good resolution
Material analysis



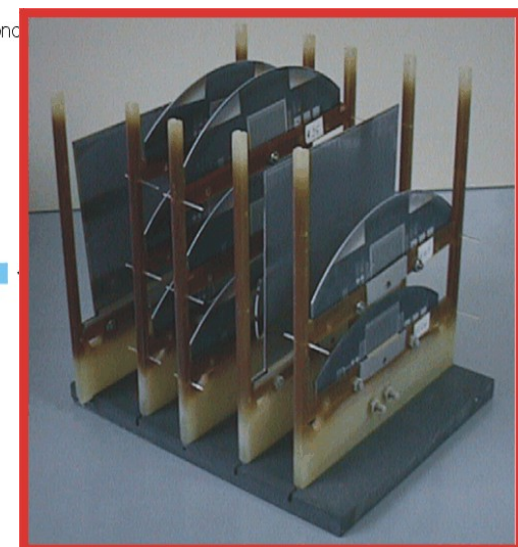
CMS module on our
 $50*50*50\text{cm}^3$ 3D CMM



Full automatic bonder

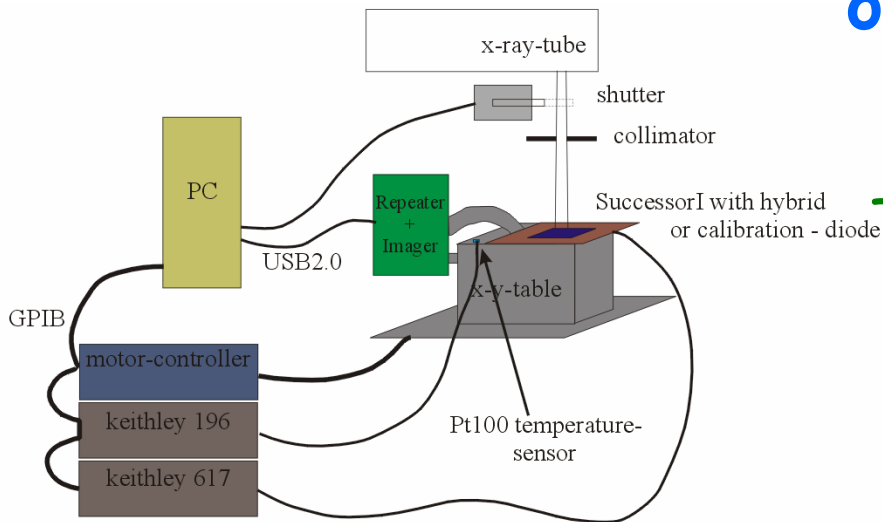


Stacked sensors & test structures



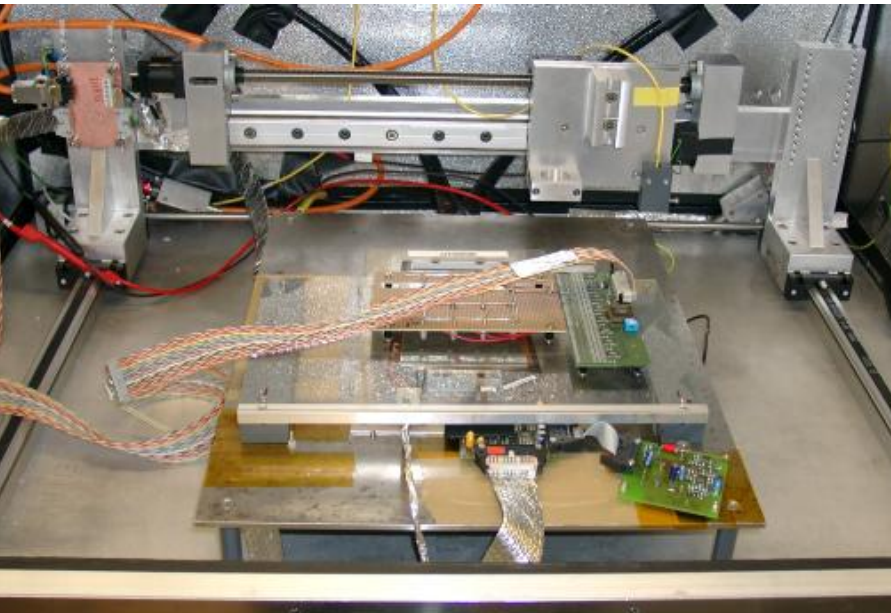
- 34 MeV protons
- 1000 nA (more if needed)
- Beam diameter: 2cm
- Temperature < -10°C (nitrogen)
- Area: 20x40cm²
- Time for 15y LHC (100cm²):15min

Setup for surface irradiation only



- 60keV (~20keV photons)
x-ray source
 - @ 25mA ~148krad/h
(on a spot ~2cm radius)
- Scanning possible
- Not suitable for LHC dose

Diagnose Test Station



Purpose: diagnostics of faulty modules

Full CMS Readout

LED array: (1050nm and 950nm)

Movable LASER: for single strip/pitch scans (1050/650 nm)

- Possibility to set probe needles,
- Tests with a ^{90}Sr source
- Cosmics
- High resolution IV
- Possibility to introduce CV.
- Cold measurements possible with cold N



- Test stands for CMS modules:
 - Full automatized readout
 - Readout warm and cold
 - Scenarios; scriptable
 - Cosmic trigger
 - LED array
 - Continous light
 - to artificially increase leakage current
 - Pulsed light
 - short illumination ~10 strips

Possible later adaptation for special SiLC tests after CMS production!

Fast test after bonding
@ -10°C



- Karlsruhe is well equipped and experienced to evaluate all new sensors and may agree later on to do quality assurance for SiLC
- We are looking forward to get sensors in hand
 - For Karlsruhe: We would „invest“ one-two competent student(s) for the evaluations, BUT we then really need prototypes from the SiLC community