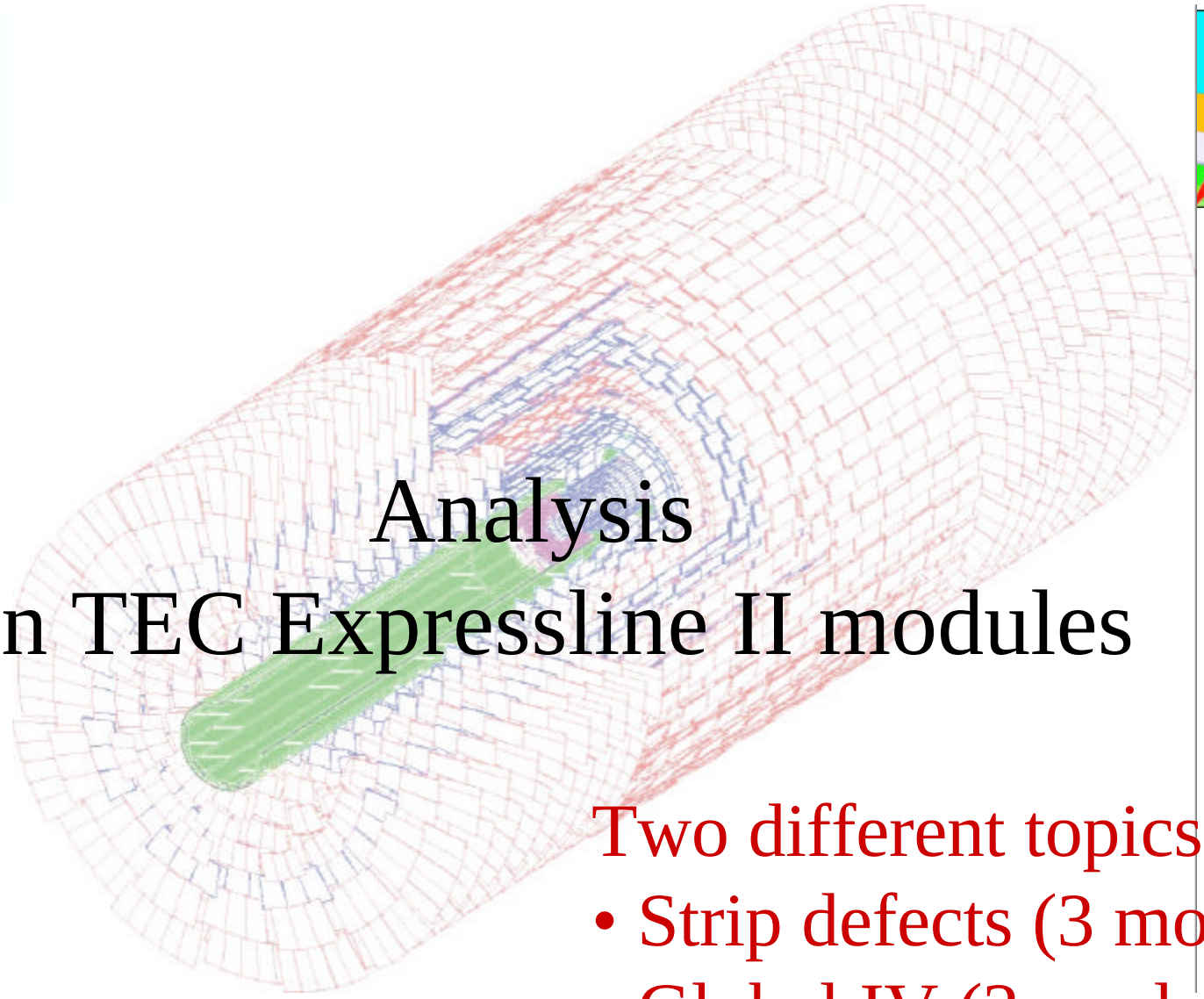


Analysis on TEC Expressline II modules

Two different topics:

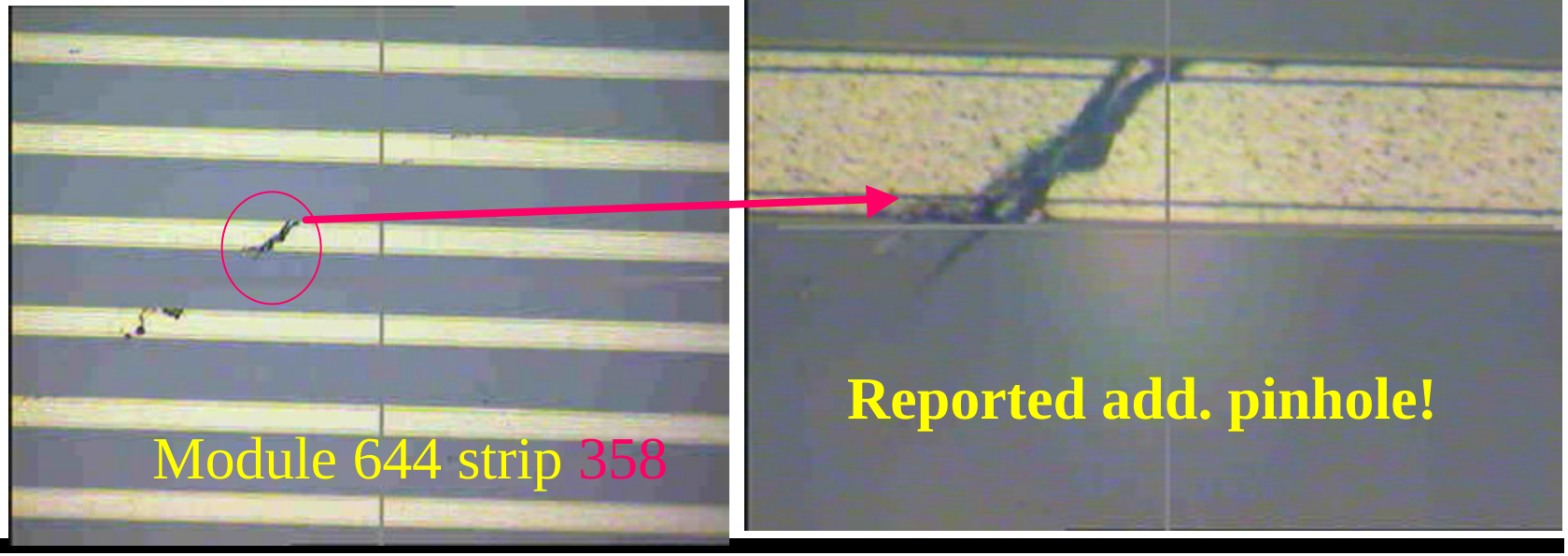
- Strip defects (3 modules)
- Global IV (2 modules)

Good & Bad news: Add. Pinholes
No problem due to bonding!

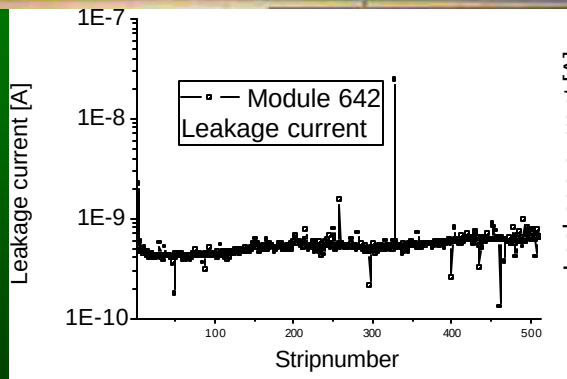
3 (+2 later) additional pinholes were reported by Aachen wrt QTC in Vienna!

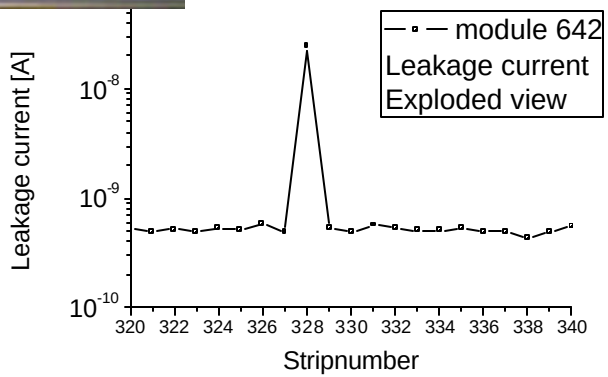
Investigated in KA with QTC and DAQ!

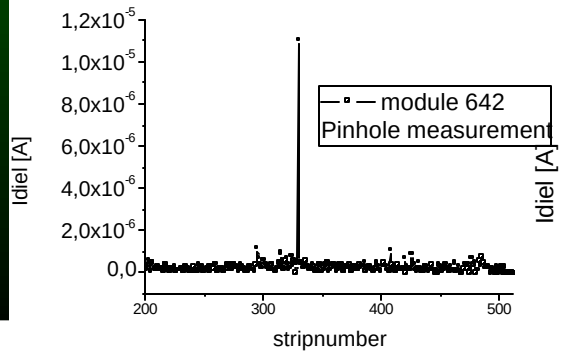
1. 3 pinholes were related to deep scratches!
2. 1 burn!?!
3. 1 misstag

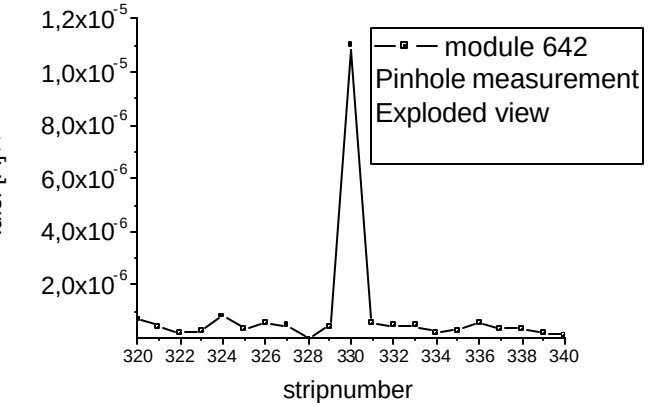


Scratches: sensor defects (mod 642)





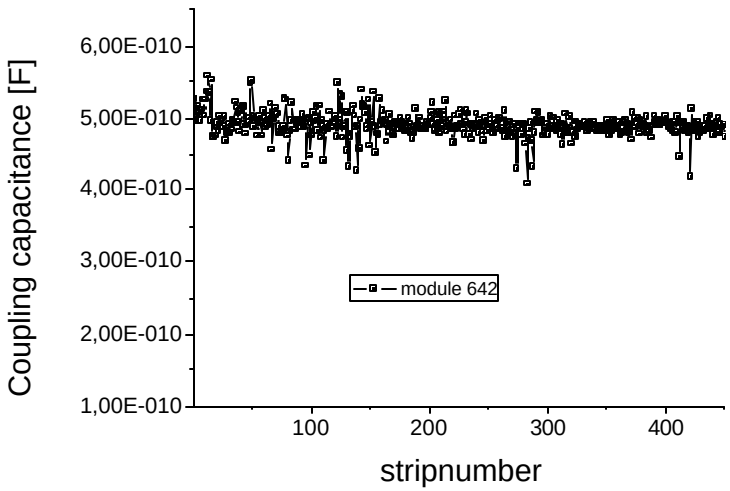




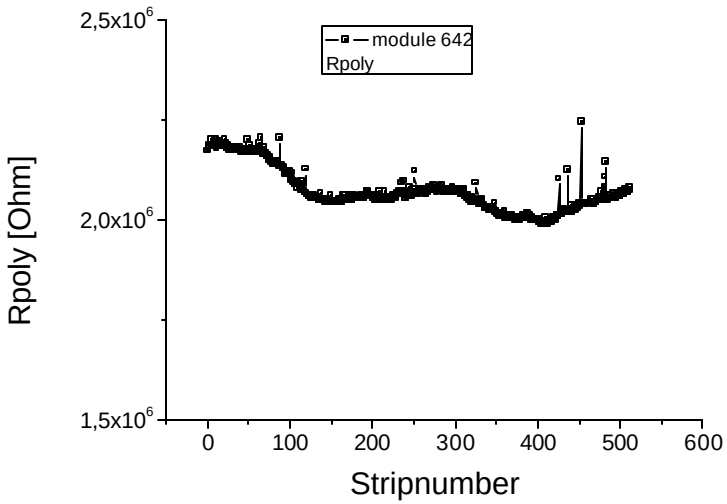
1 Scratch from strip 327 to 331 produced 2 different defects!

Module 642 -- strip scan on module

Coupling capacitances: all in specs
Overflow @ strip 330 ➔ pinhole



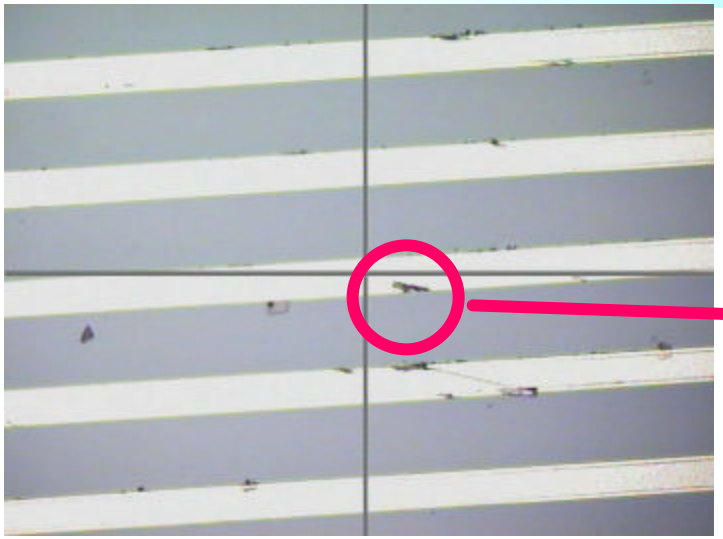
Rpoly: all in specs

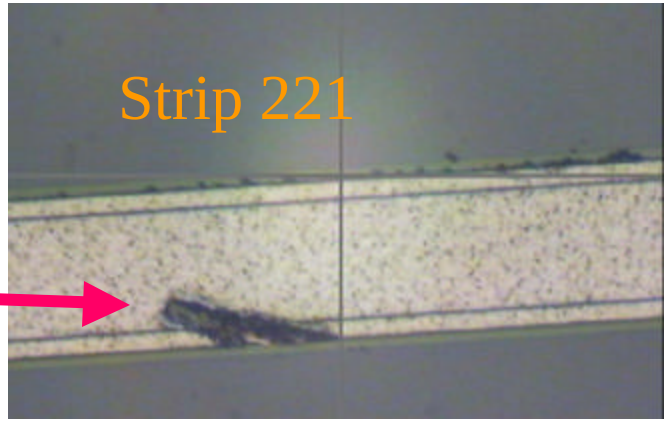


NB. Strip 1 reported as a pinhole:

1. is dubious in the DAQ, but not clearly identifiable as pinhole!
2. shows no damage!
3. is no pinhole according to the Idiel measurement at QTC!

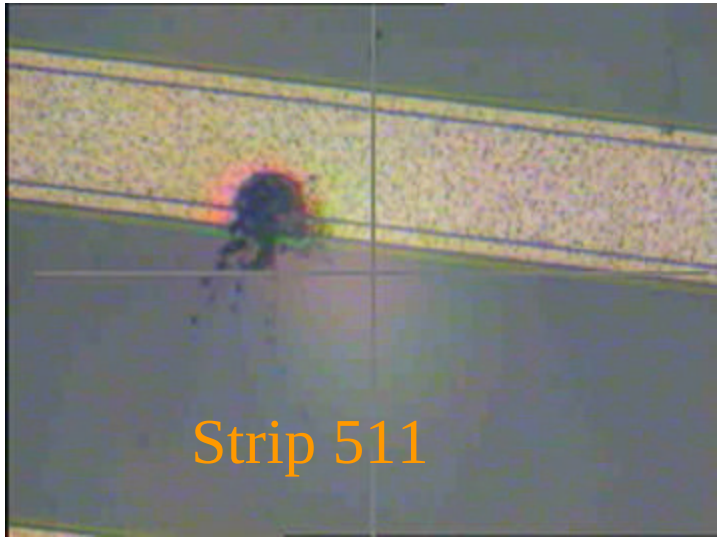
Mod 643 **add** pinholes between DEC02 to JAN03

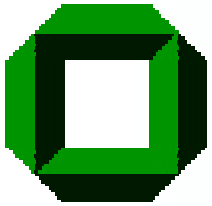




This happened somewhere after the first module tests!

More on this one later





IV

IV problems reported by Aachen

- For a “good” IV evaluation *(with a dubious first one)* one should take at least fast 2-3 IV ramps

  OR ramp up – wait – IV during ramp down.
- The stepping of 100V done in Aachen was not suited for full modules (there’s a chance for higher values)

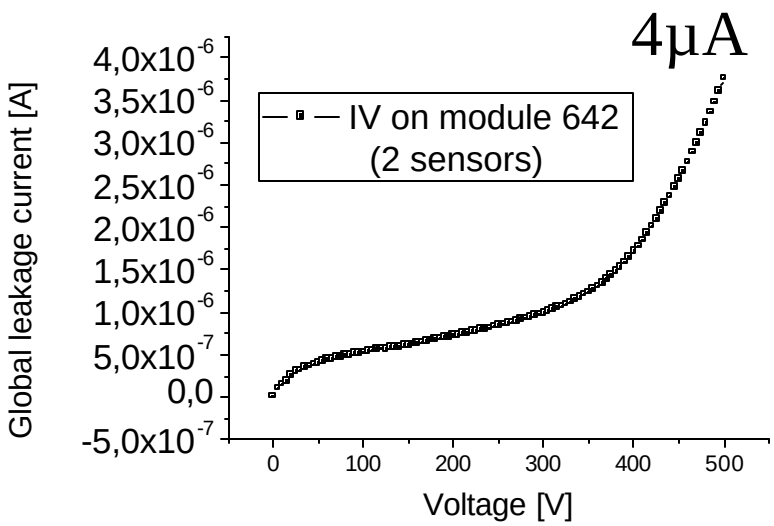
- Module 642 is fine (more on this)
- (mod 503 fine up to ~500V, then fast increase to ~10µA to be investigated).

- Module 643: early breakdown at 100-200V

  (more on this one)

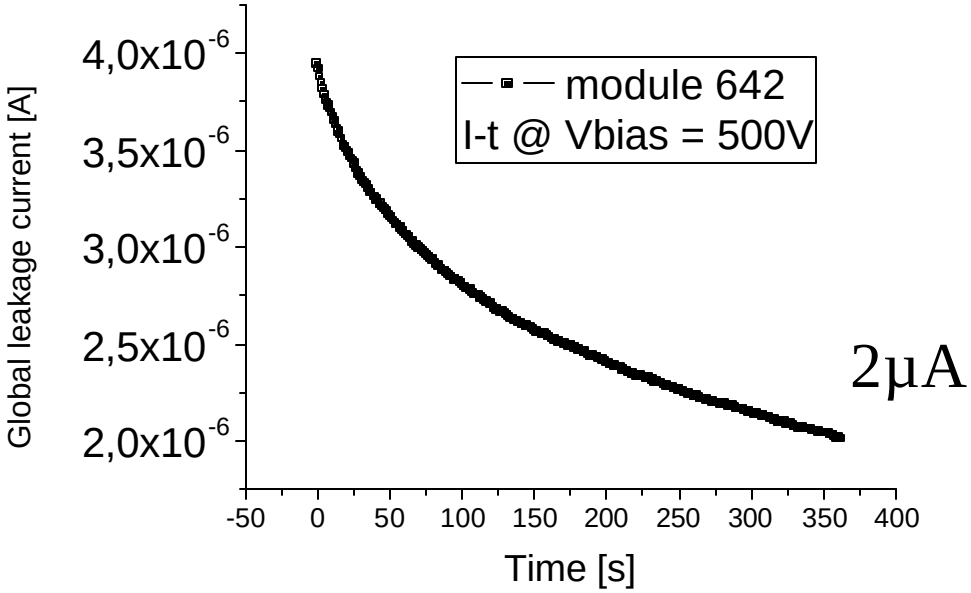
Module 642

High IV + early soft breakdown



Slight but **non-critical** increase in IV!

Compare to the 40µA limit!



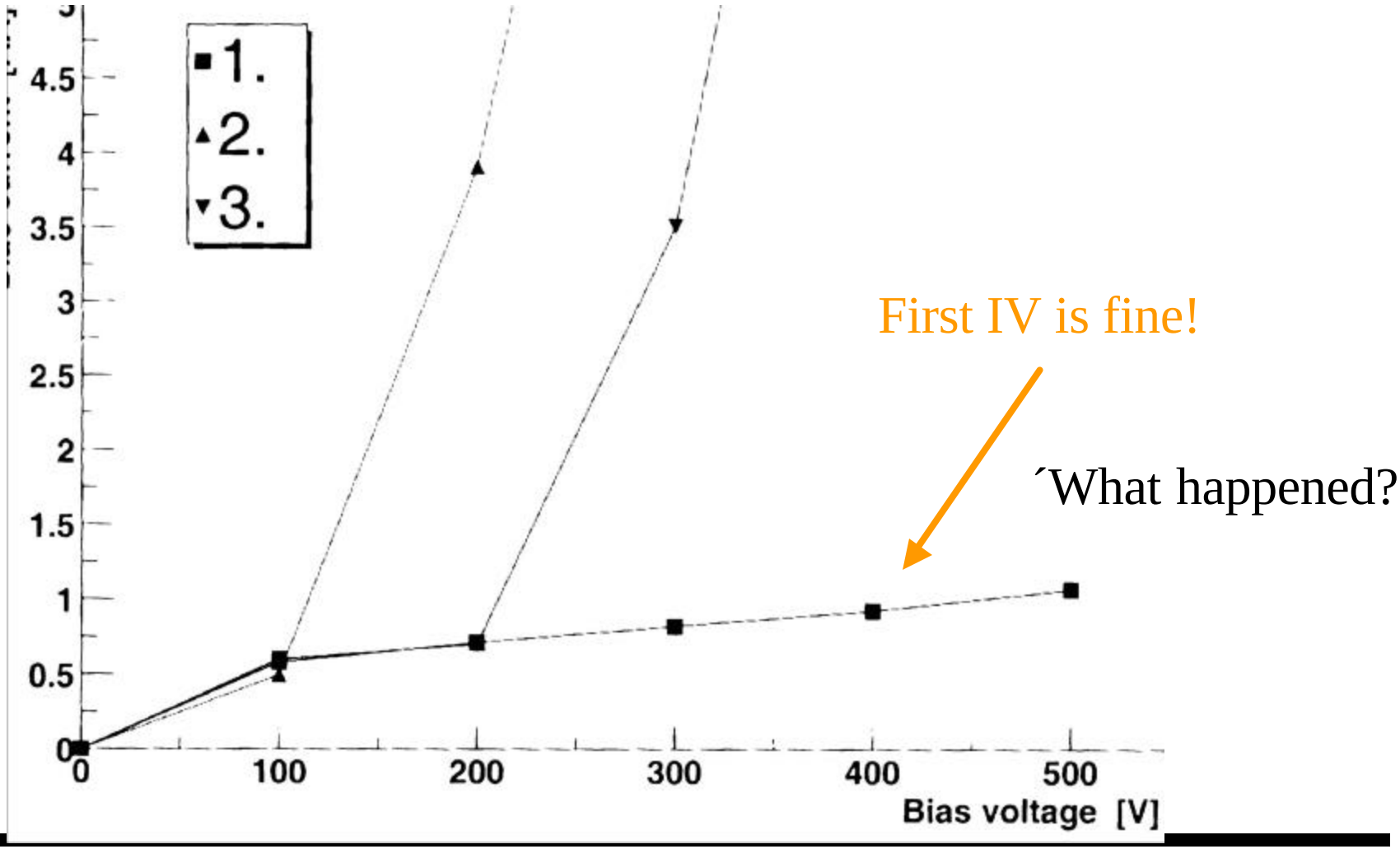
Initial current decrease with time!

Known IV behaviour of sensors!

Mod 643
High IV + early soft breakdown

IV reported by Aachen

Mod 643



First IV is fine!

´What happened?

Module 643 (history)

- Full module shows high global IV
- Optical inspection showed possible candidates for the high IV,
  - NO candidates on the edges
  - NO; on the visible part of the backplane.
  - Yes; on strip level
  - Yes; on bias / guard region

- Strip scan (leakage current) on W6A (on module) show nominal currents (W6B not accessible)

➔ Removal of bonds (for further deep investigation on indiv. Sensors.)

Module 643 history (cont.)

- IV on W6A is ok, IV on W6B shows early breakdown as full module!
- Cleaning improved the current but did not solve the problem:
  - A) Isoprop, B) isoprob plus tissue, (C) ultrasonic bath)
- Strip scans (leakage current) on both sensors show nominal currents!

➔ ➔ IV problem is **NOT** located in the strip region!

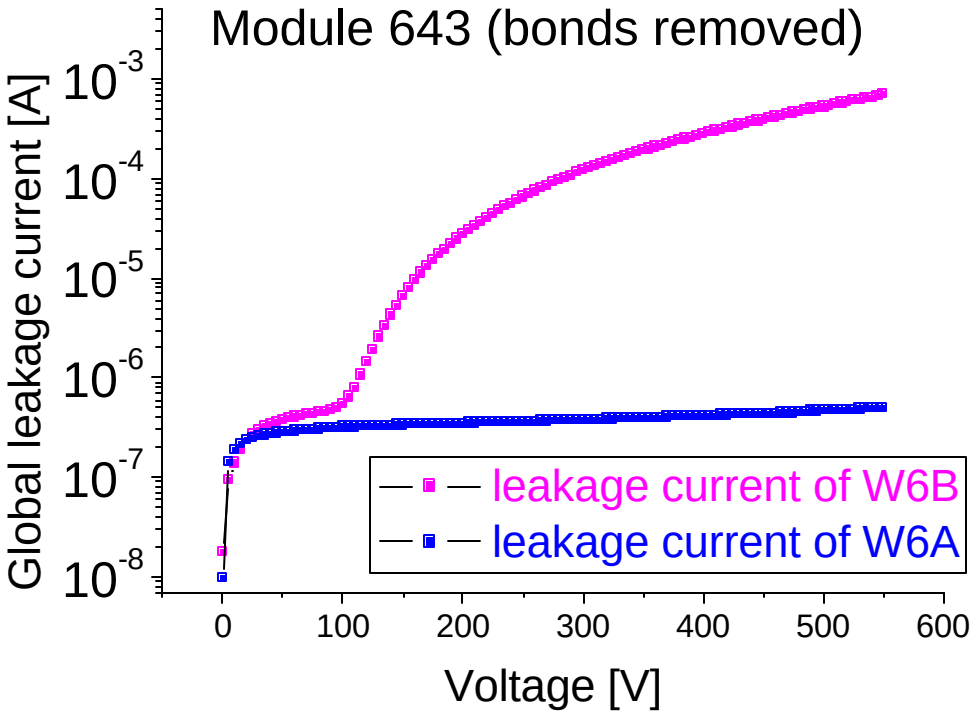
➔Remaining defect location: Backside, Guard-, Bias, n++ -region!

➔ **Removal of W6B with a scalpel** → no further increase in IV!

➔**NO** visible breaks on the backplane (add. inspection on the edges)

➔➔ Remaining defect location: Guard-, Bias, n++ -region!

IV on module 643

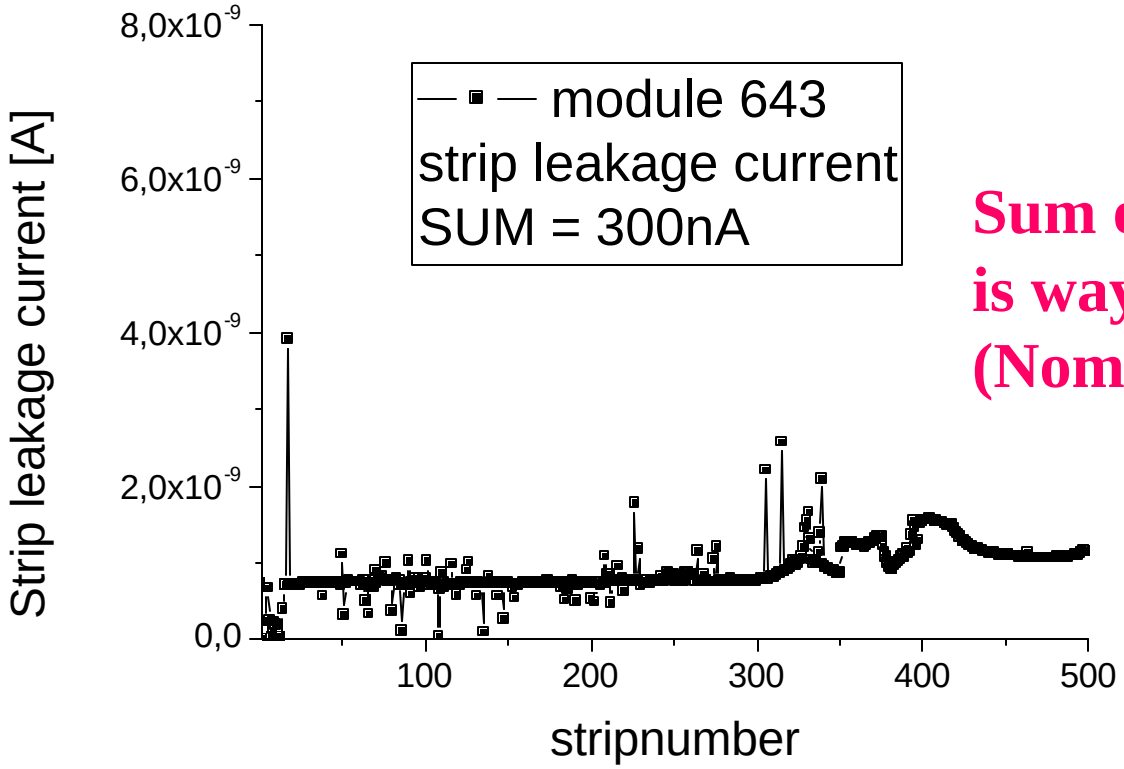


➔ **Closer investigation on W6B SENSOR**

Starting assumption:

1. indiv. strip failure as seen on sensors
2. backplane cracks/chips
3. guard scratches
4. bias scratches
5. contact of guard and n++

Module 643
Strip leakage current

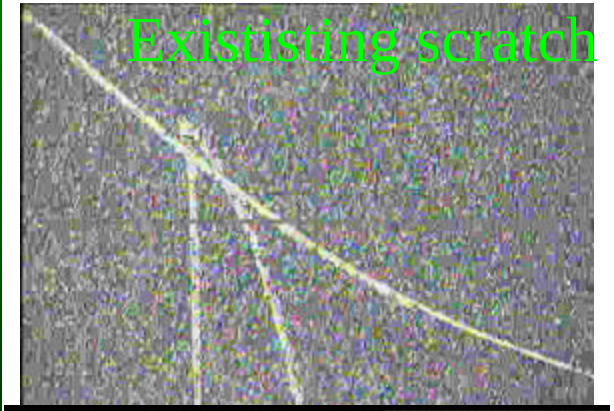


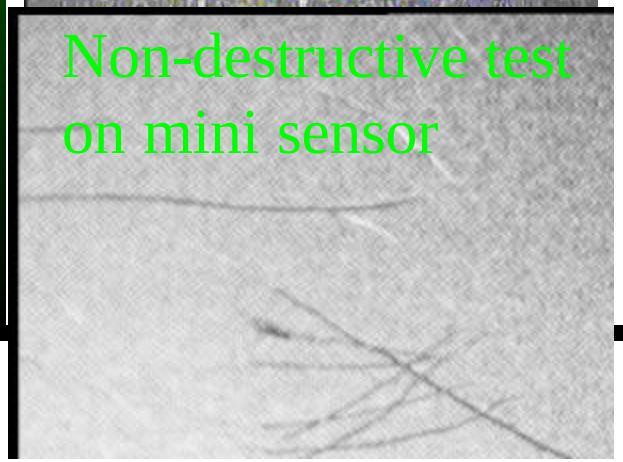
Sum of individual currents is way below the total current! (Nominal values)

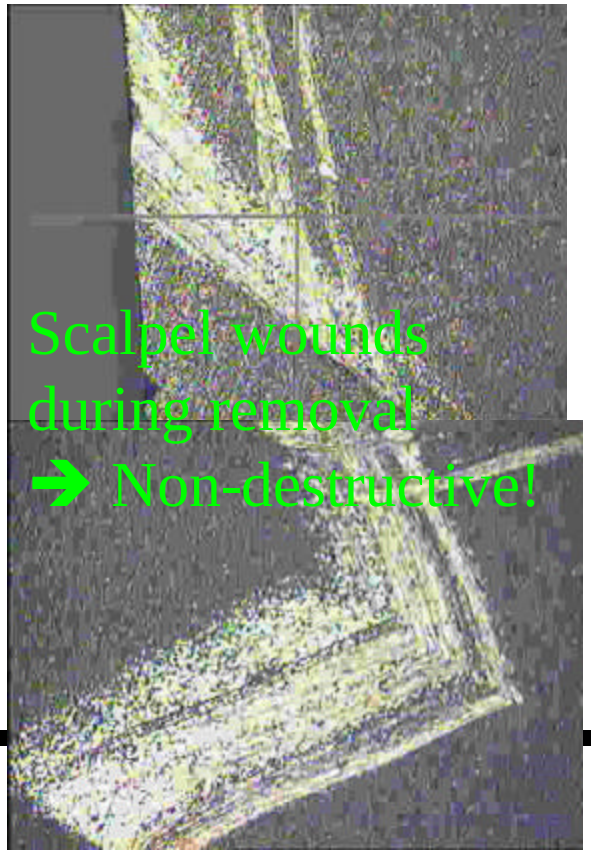
Individual strip currents are as expected for HPK (very low)!
Other strip parameters checked for are in specs!

Backside – not critical

Non critical scratches on the backside compare with scratch tests on the backside and scalpel scratches (during removal), which did not increase the current.

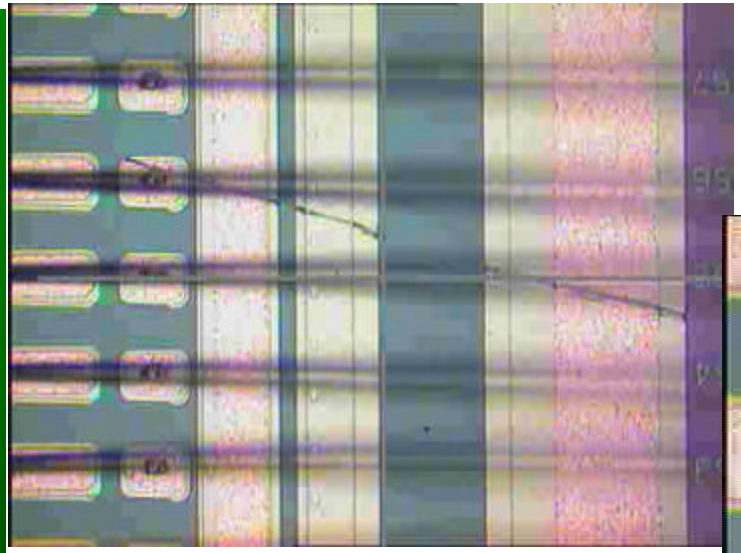




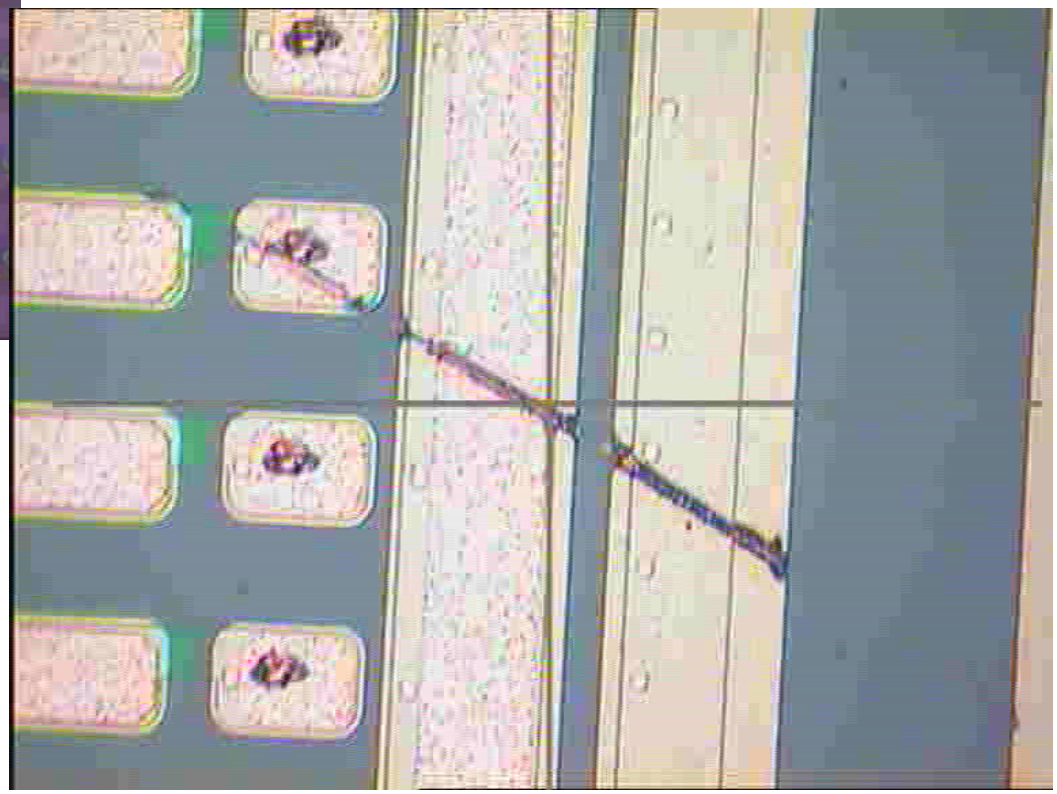


Scratches on the back are probably not critical.

Scratch on n++,guard and bias

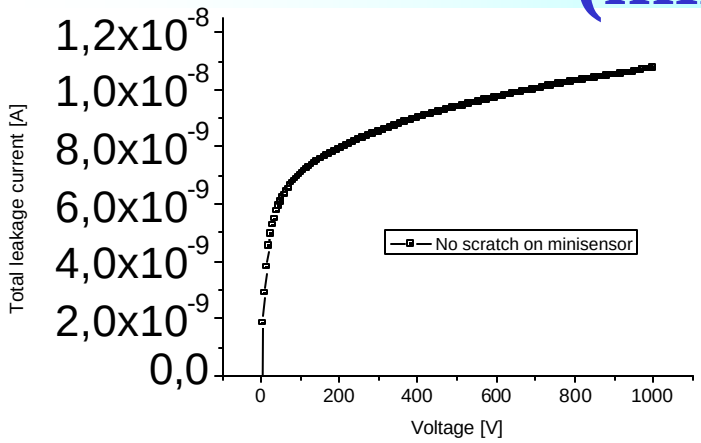


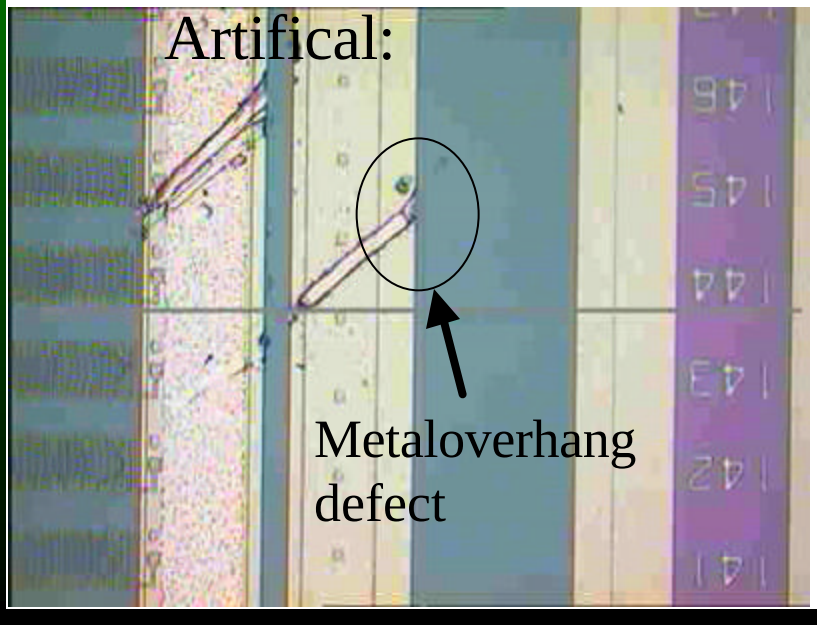
Scratch exists before end of bonding!

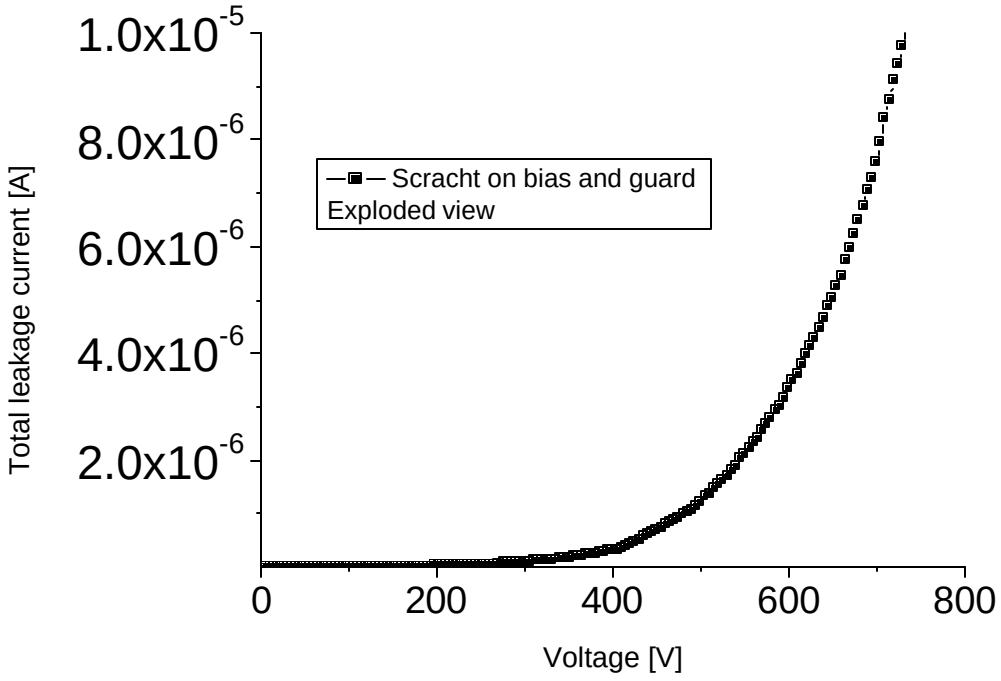


Possible defect candidate:
Metal overhang defect!

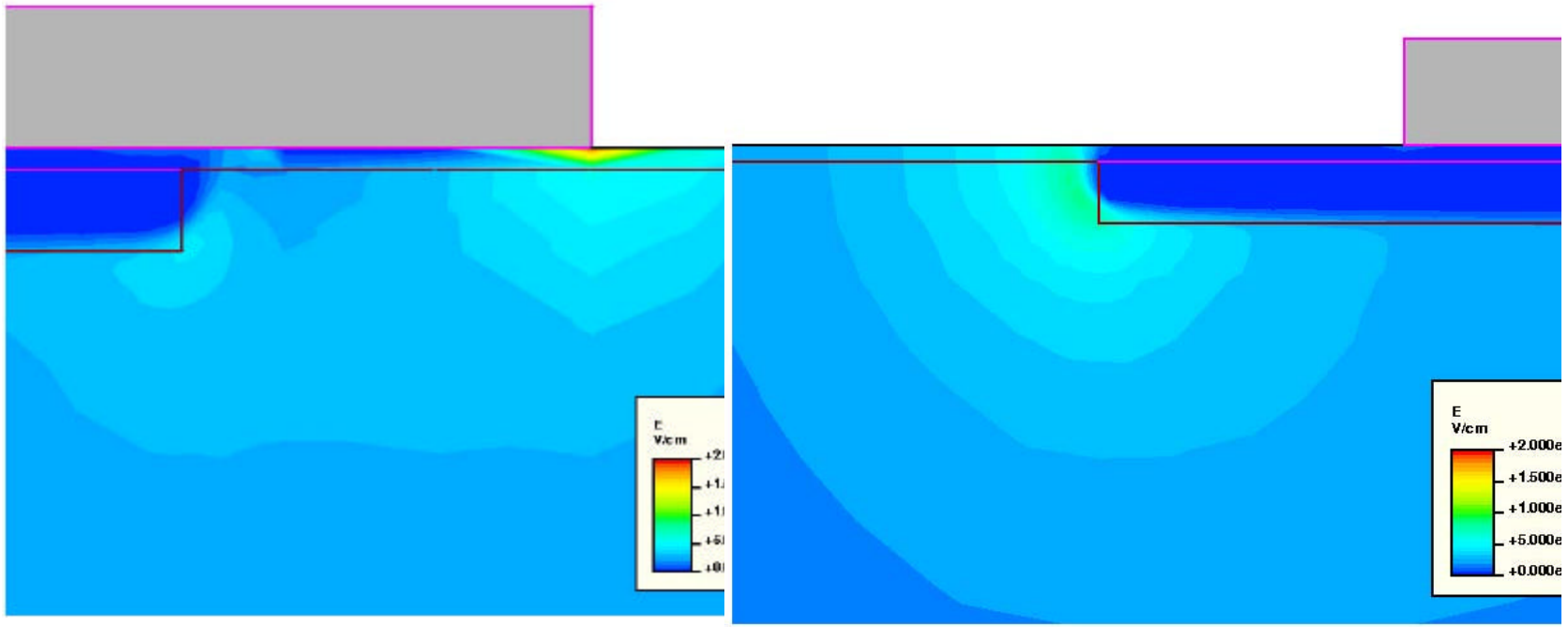
Scratch test on bias & guard (minisensor)



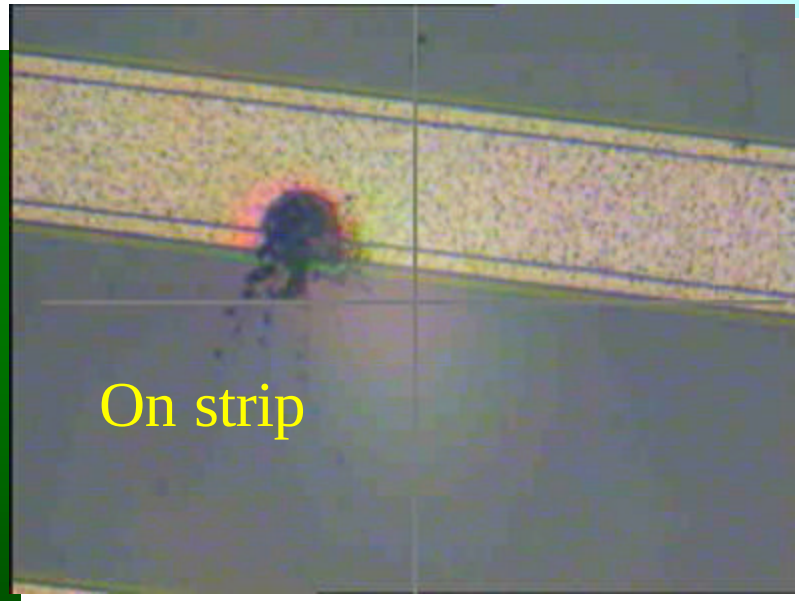


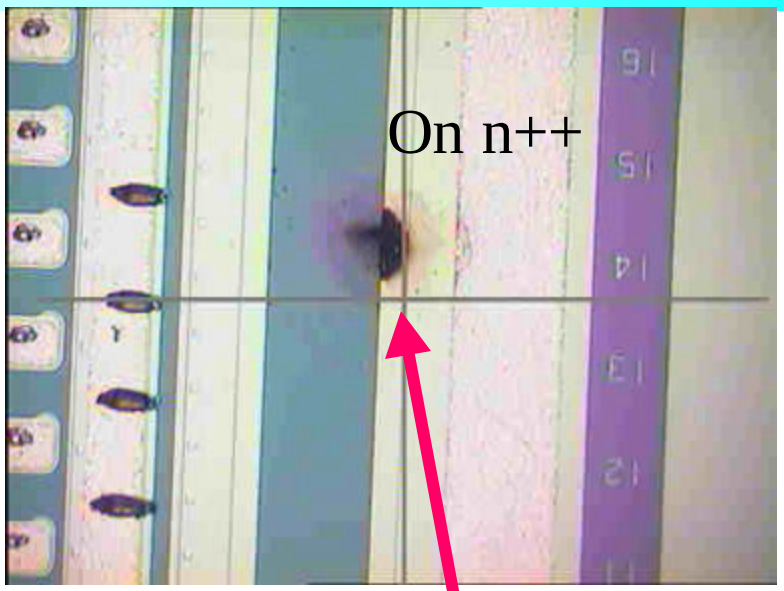


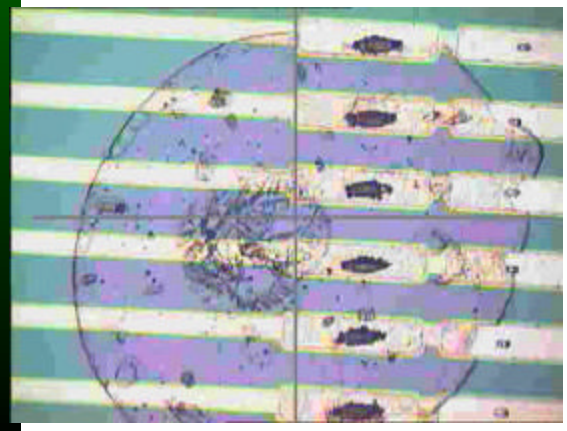
Preliminary field simulations (with ISE TCAD)

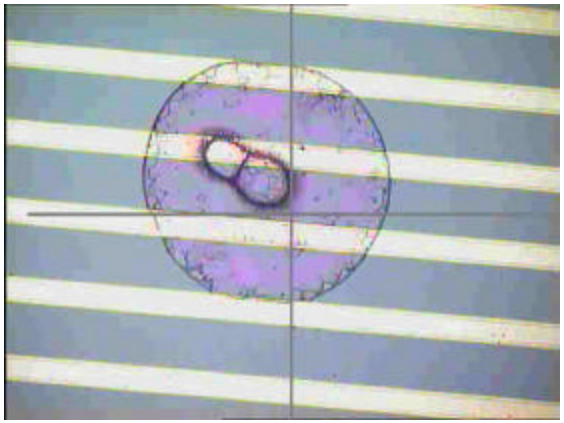


Module 643 (strange)





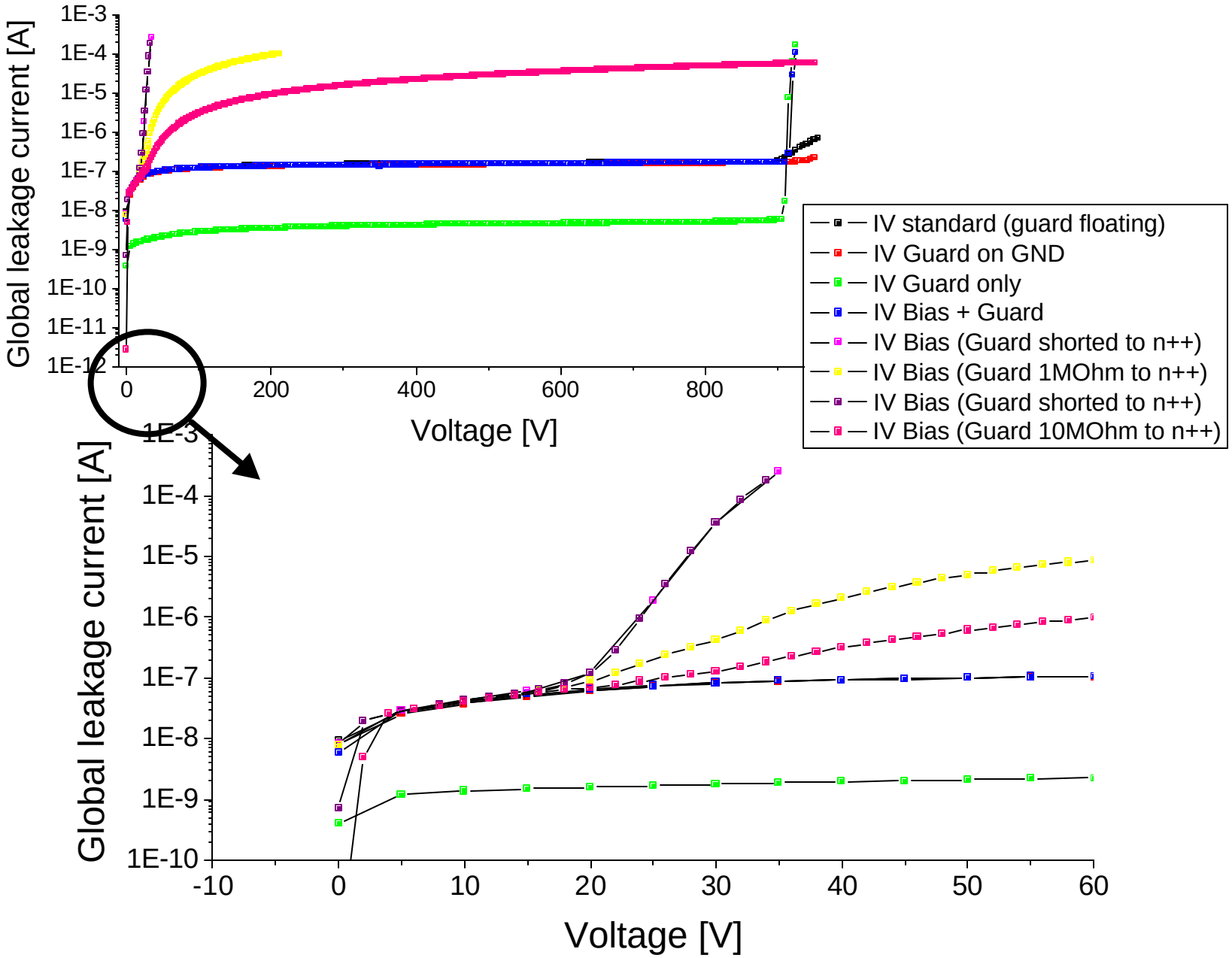




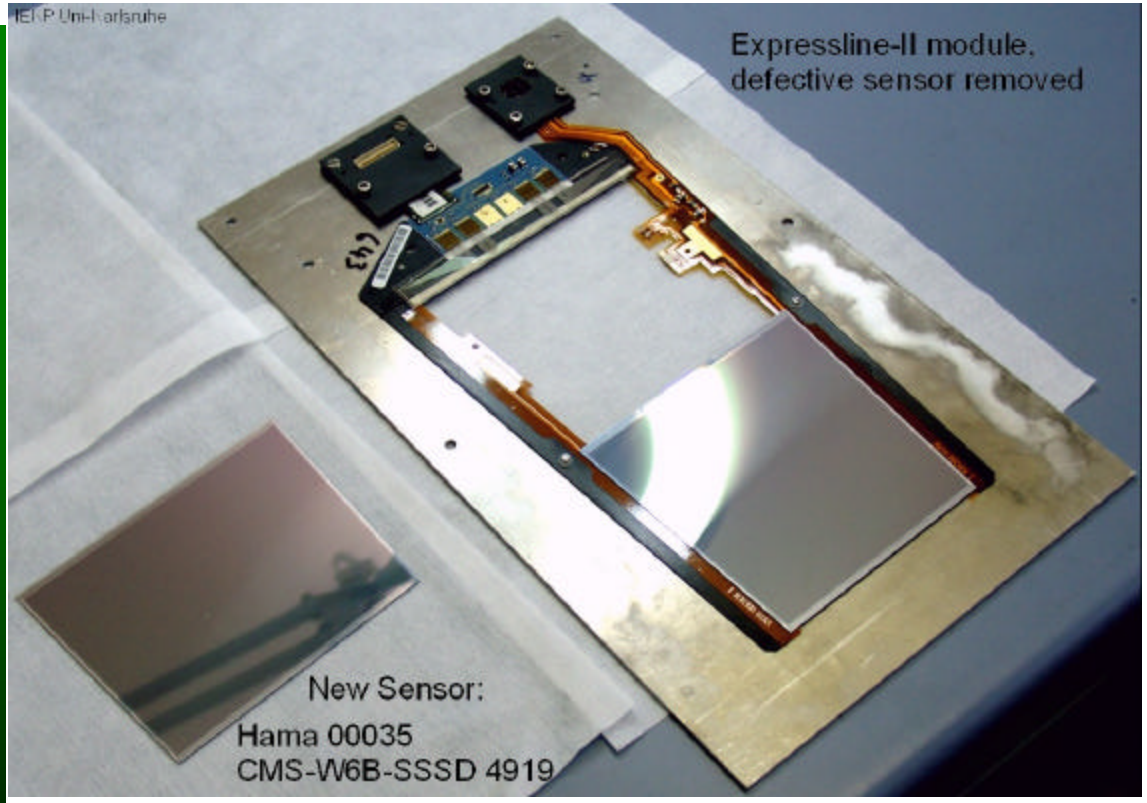
Possible defect candidate:
Short: n++ and guard

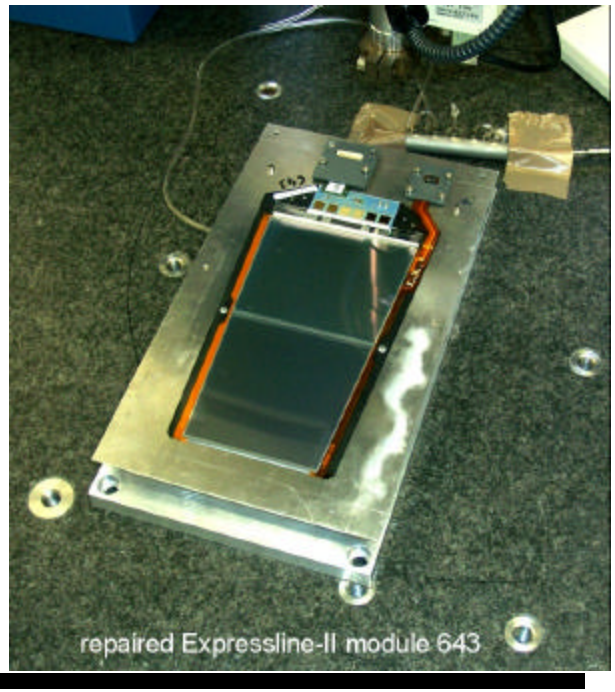
Most probable candidate!

IV with “shorts” in the outer sensor areas



Repair of module 643

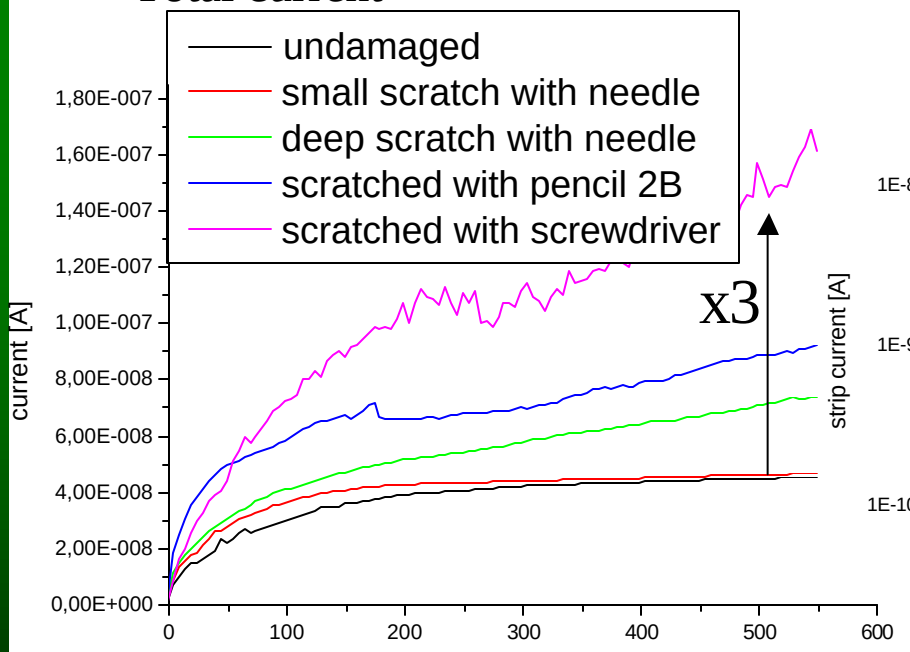




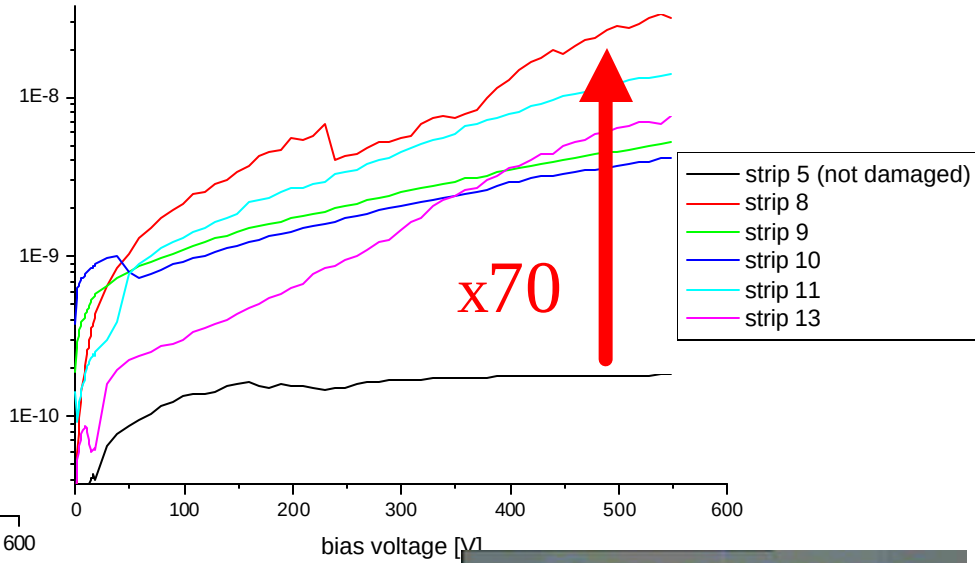
Repair is feasible but not applicable as standard procedure! Not fully bonded yet.

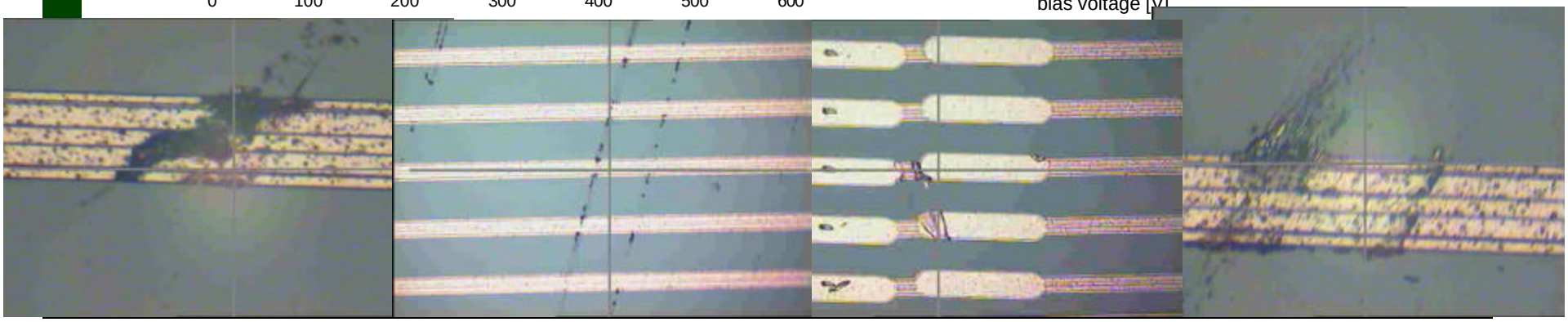
GENERAL: Global IV and Individual strip IV (sensors)
Scratches on QTC level! (e.g. from company or artificial)

Total current



Single strip current





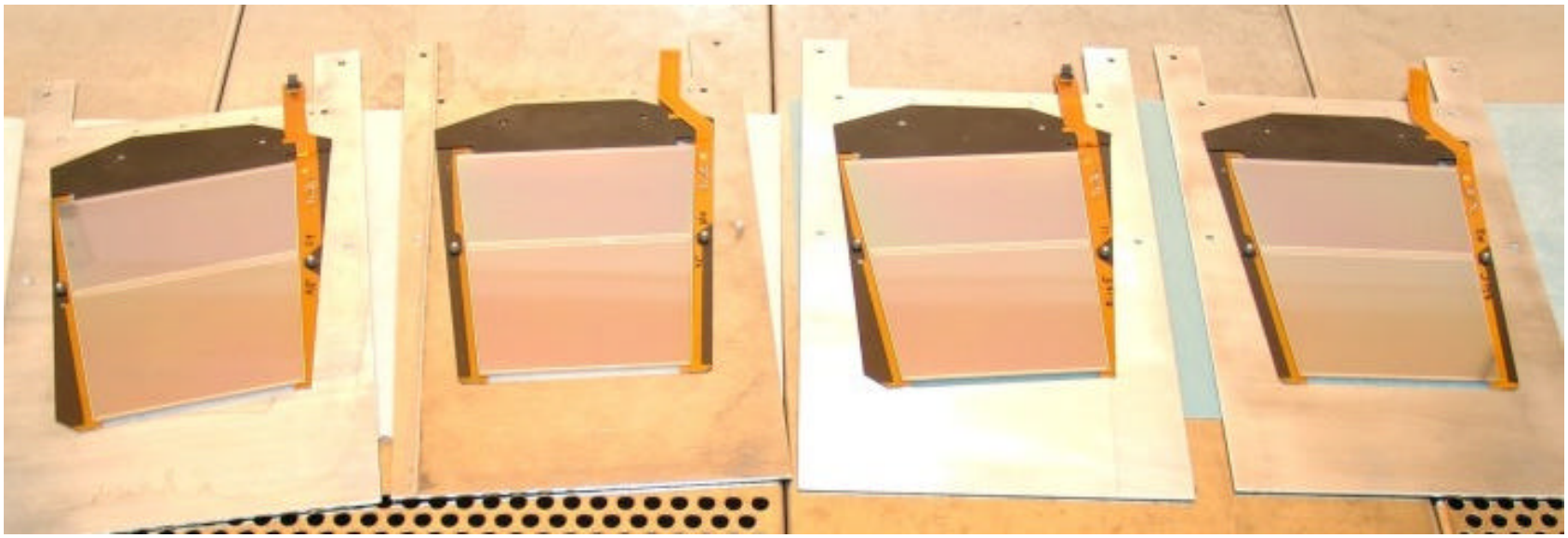
General comment on scratches! During Assymbly, Bonding, Testing

- DO NOT SCRATCH SENSORS / DO NOT POLLUTE THEM!!
  - especially not the guardring !
  - especially not the strips !
  - do not break the edges !
  - do not break any border line !
- **SMALL SUPERFICIAL scratches are enough to change sensor/module characteristics!**
  1. **Local & global HIGH increase of current**
  2. **Add shorts, breaks, pinholes!**

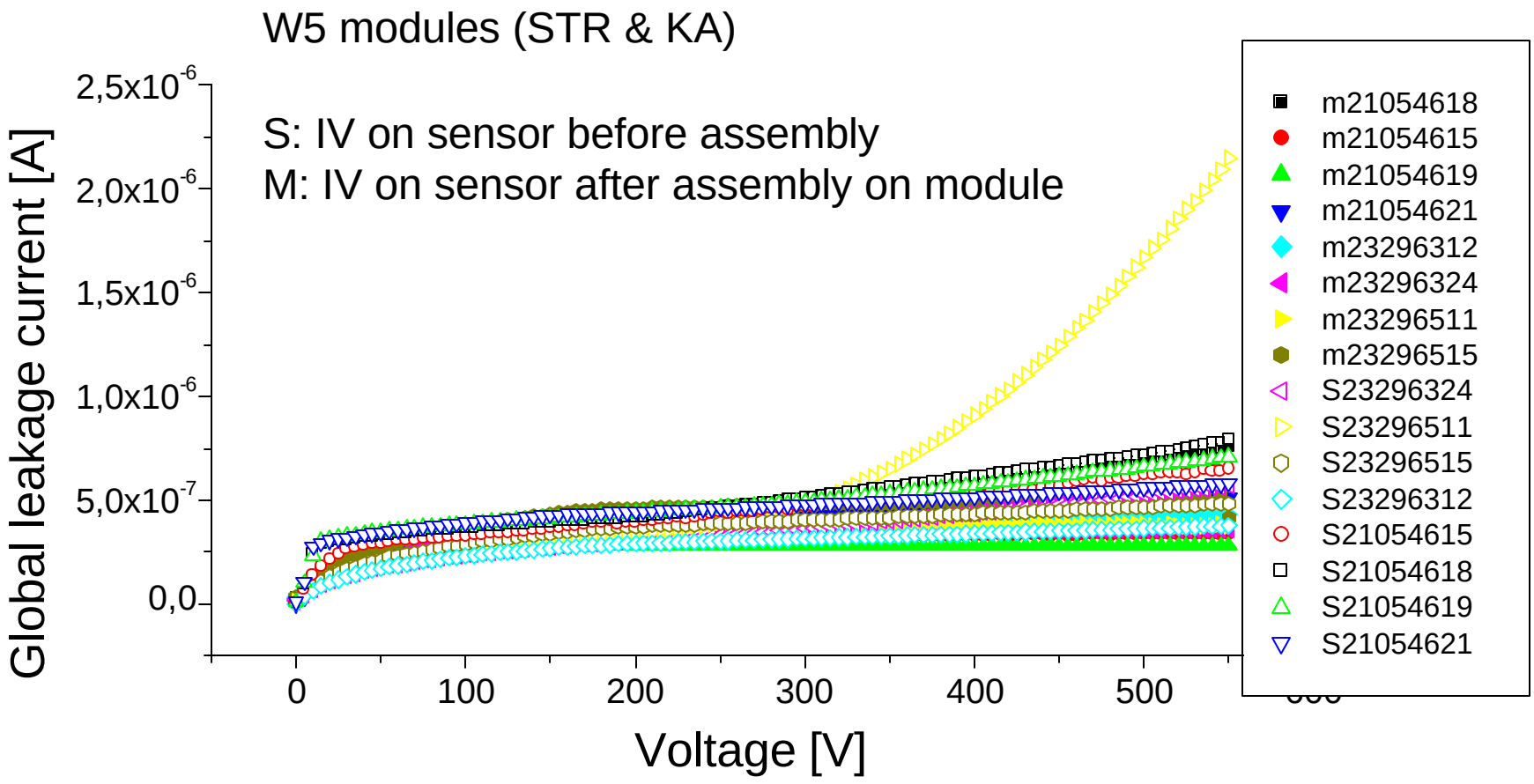
Contrary to older experiments:
The high voltage sensor design is good but vulnerable to scratches!

Pollution: Use Facemasks everywhere working with open sensors/modules!

W5 prototype production (manual)



IV on W5


W5 modules (STR & KA)
S: IV on sensor before assembly
M: IV on sensor after assembly on module
Global leakage current [A]
2,5x10-6
2,0x10-6
1,5x10-6
1,0x10-6
5,0x10-7
0,0
0
100
200
300
400
500
Voltage [V]
m21054618
m21054615
m21054619
m21054621
m23296312
m23296324
m23296511
m23296515
S23296324
S23296511
S23296515
S23296312
S21054615
S21054618
S21054619
S21054621