Optical Inspection at DESY

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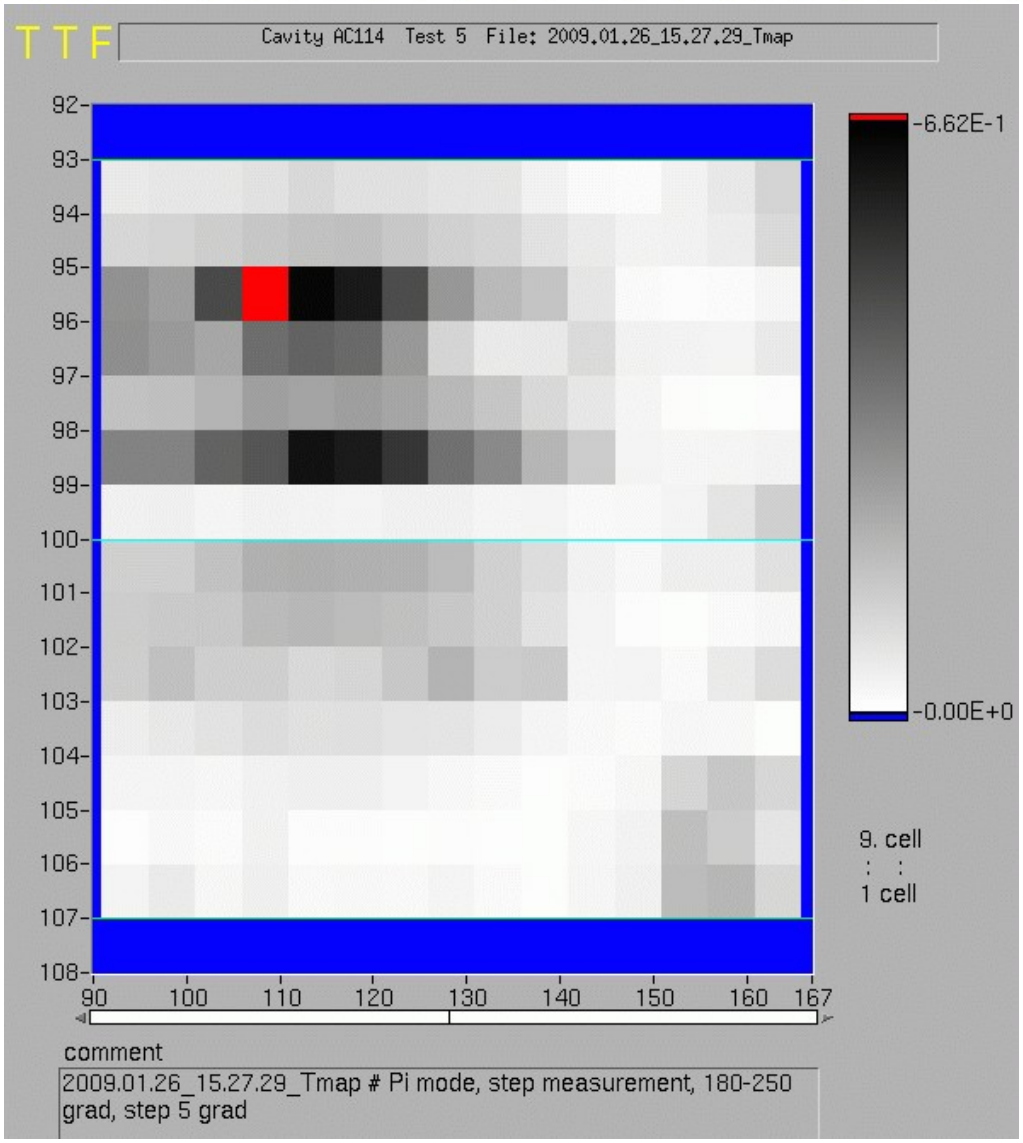
TILC09

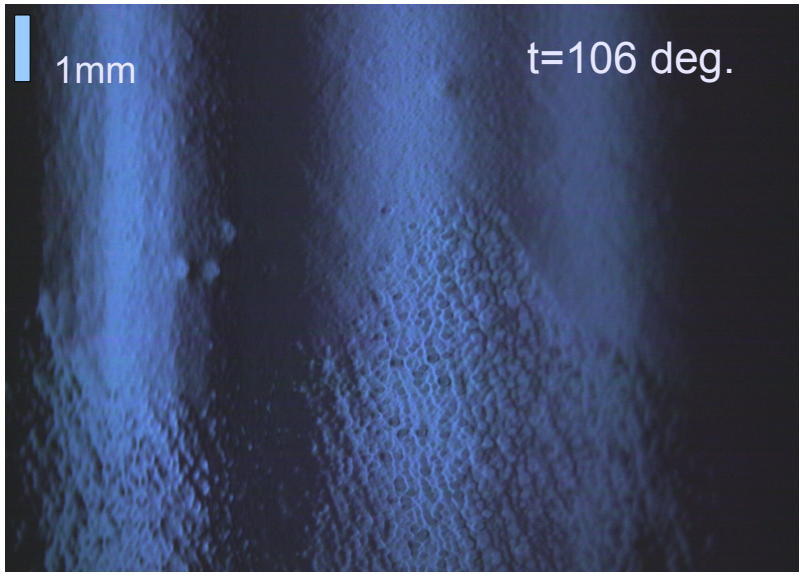
AC114

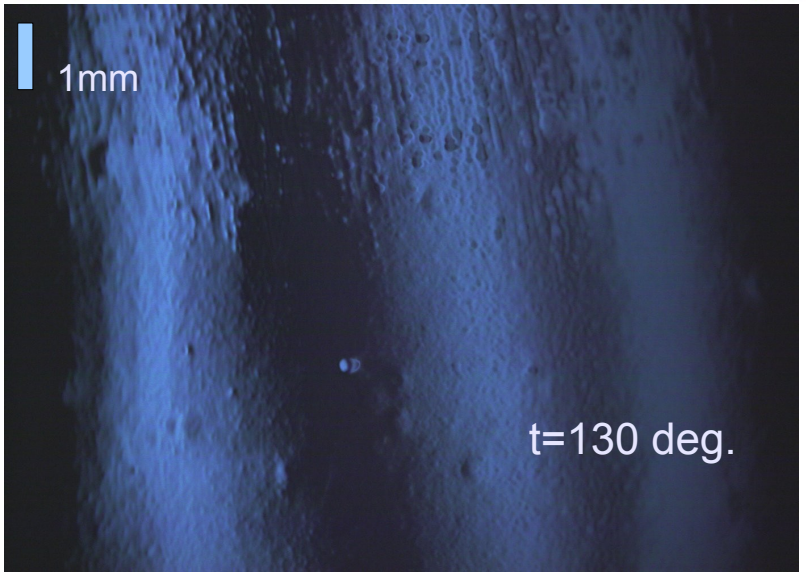
- Cell 2
- Limited at 15 MV/m
- Hotspot in π-mode and 1/9-π–mode

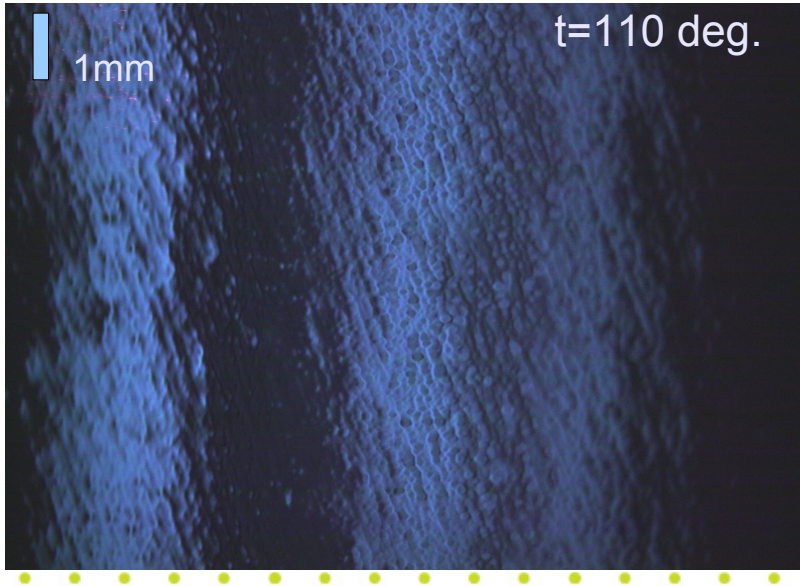
- Lower spot: hotspot in 4/9-, 3/9- and 2/9-π-mode



AC114







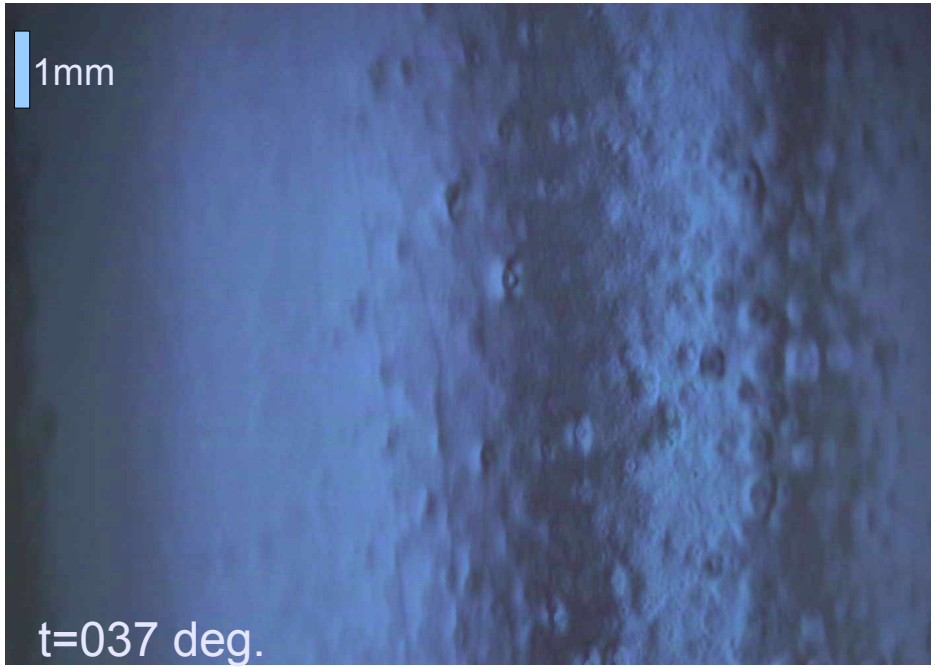
Cell 2, resistor 98 (next to equator)

hotspot in modes: $4\pi/9$, $3\pi/9$ and $2\pi/9$

leftover from grinding

AC114

- Pits at several areas all over inner and outer surface

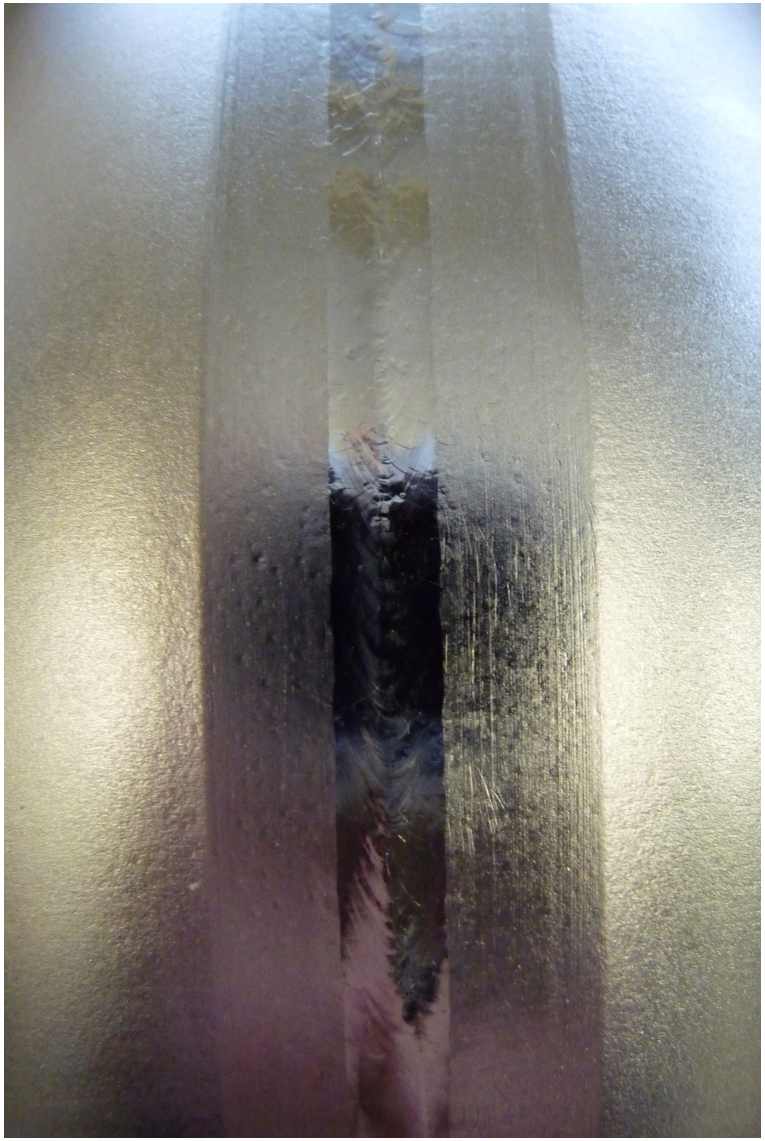


Next to equator of cell 1

Pits on outer surface of Z142

- Pits on machined part next to equator weld
- Cells 2-9
- 250-320 deg.

- On outer surface only BCP is done



Z111

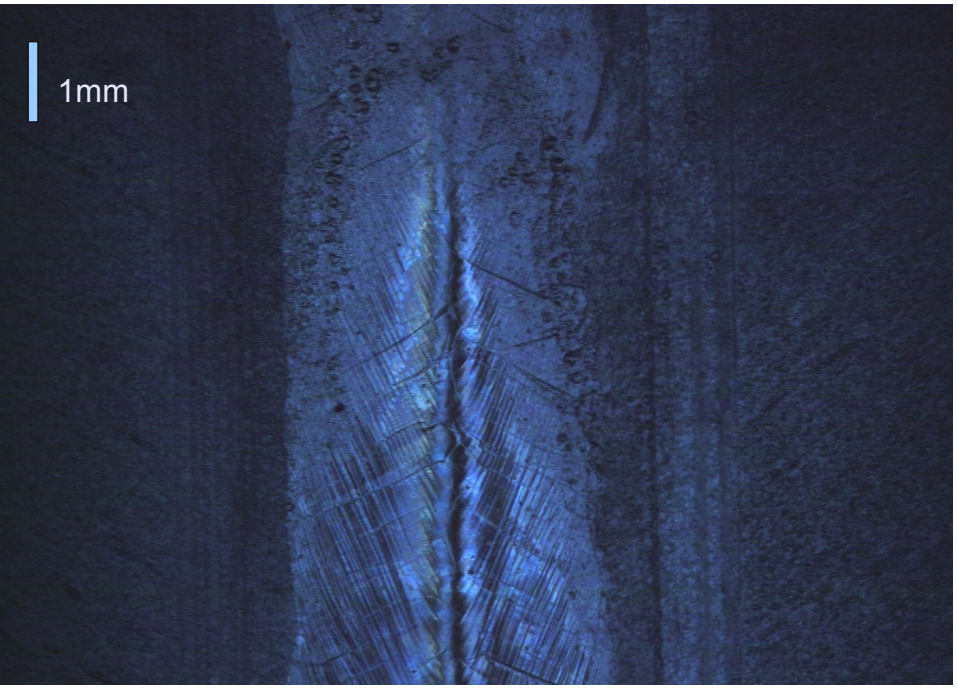
- Sample cut from Z111
- Pits only in one half of each cell → asymmetric process

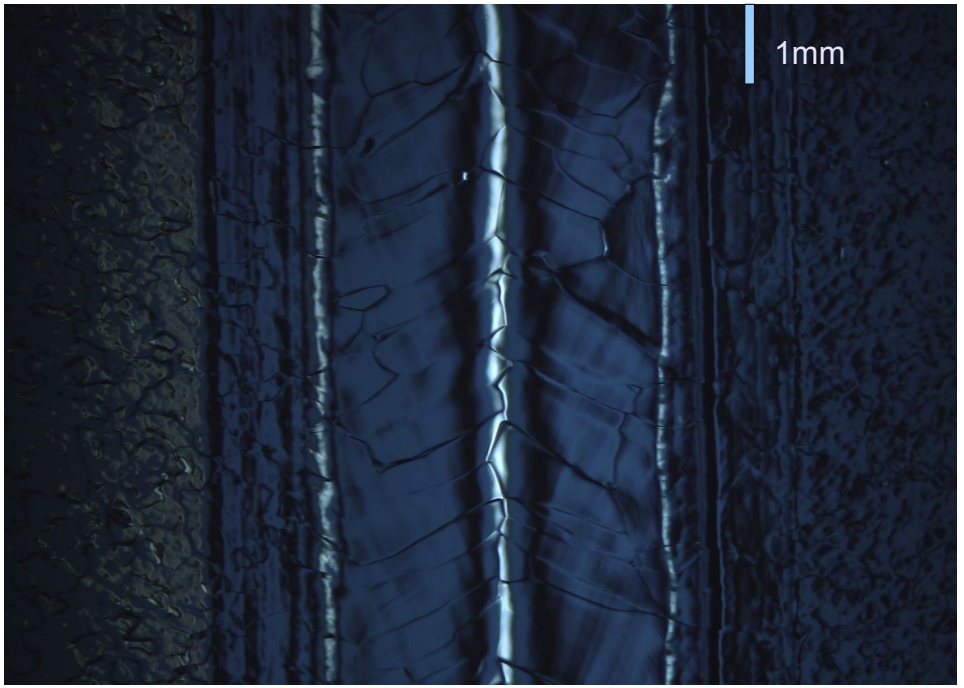
Evolution of defects

- 12 cavities inspected before any surface treatment
  - **4 cavities back from main EP**
    - 2nd inspection before end EP done
    - 3rd inspection after end EP and test with T-map still to come
  - **8 cavities currently at main BCP**
    - Inspections before treatment done
    - Further inspections and test to come

Evolution of defects: Z142

Equator #7 at 44 deg.





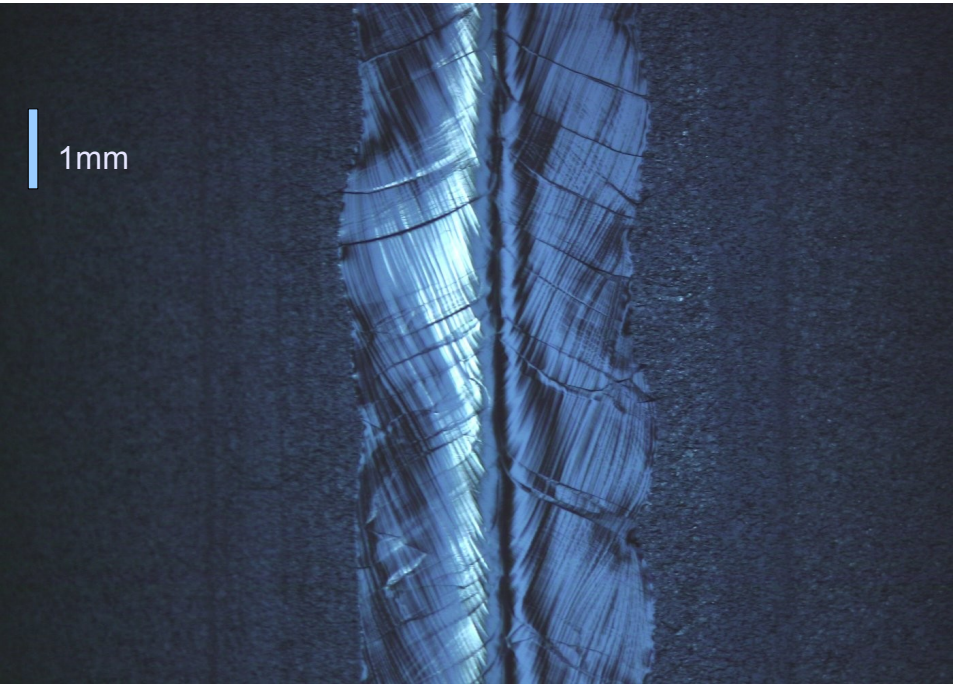
Before treatment

After 108 μm main EP

- Pits at weld interface removed by main EP

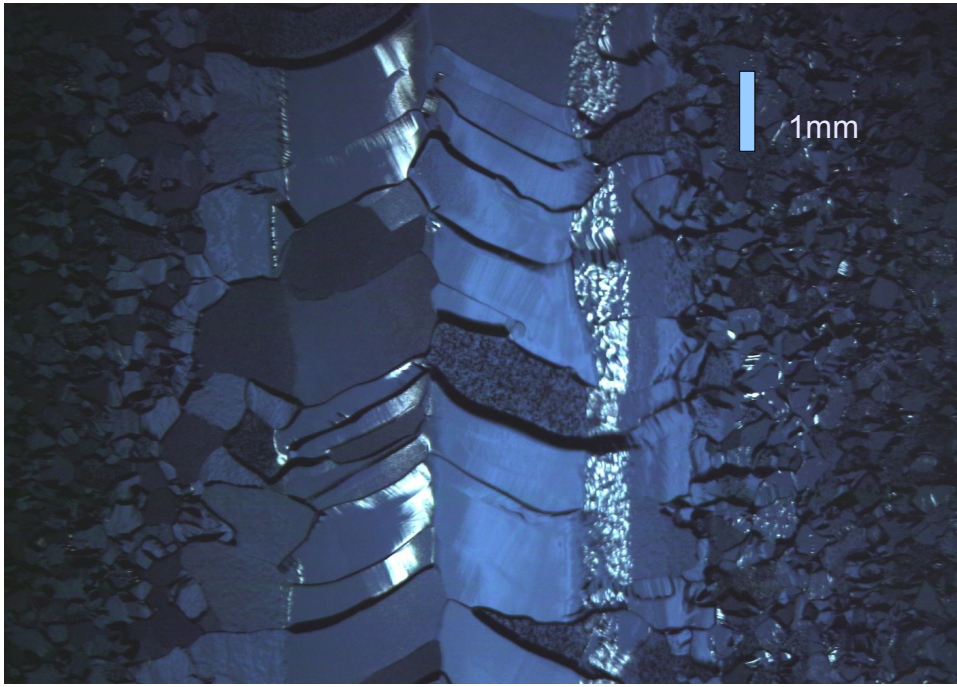
Evolution of defects: Z137

Equator #1 at 23 deg.



Before treatment

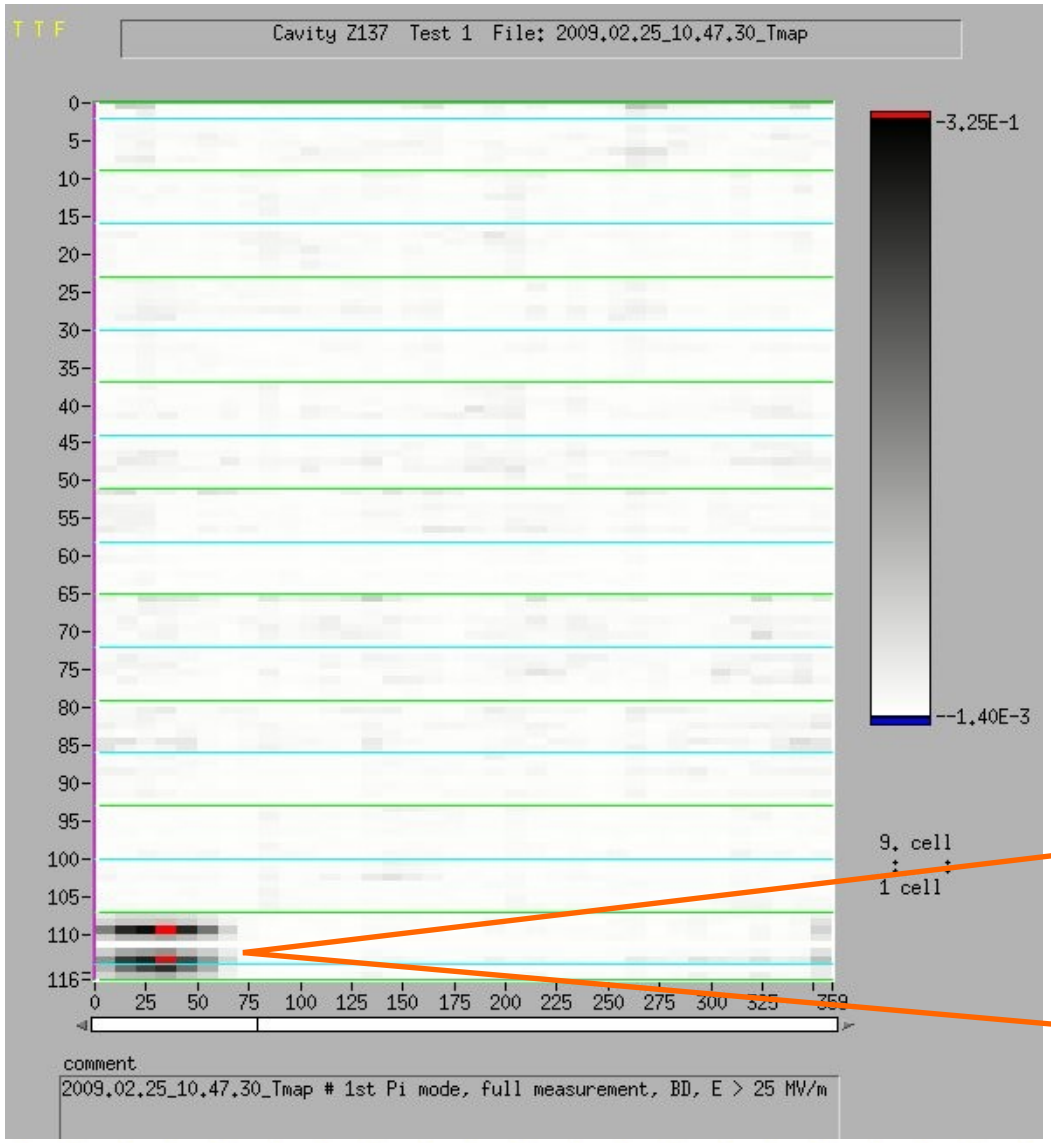
Equator #1 at 20 deg.



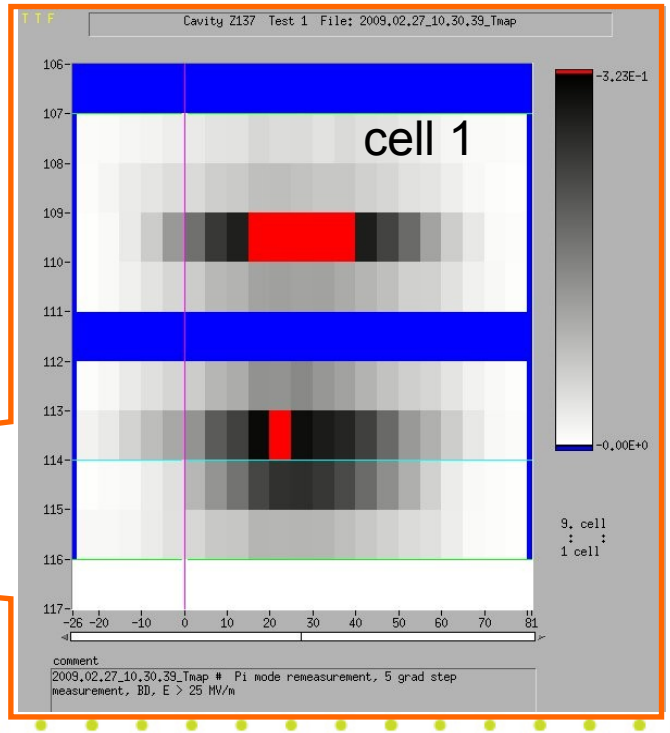
After 108 μm main EP

- Equator #1 shows large steps and rough grains after main EP
- All other equators normal

T-map of Z137



π-mode, BD at 25.2 MV/m



Global correlations T-map ↔ optical inspection

- KEK:
  - **Z110, Z110: groups of spots at quench location**
  - **AES#001: ~800 μm bump at quench location**
  - **MHI5, MHI6: no defects but unstable weld in heating region**
  - **ERL injector 2cell: no hotspot, no defect**
- Cornell:
  - **NR1-2, NR1-3: 5mm scratch from scratched die**
  - **NR1-5: 100 μm pit**

Global correlations T-map ↔ optical inspection

- JLab:
  - **Ichiro5, AES4: FE loaded, damage/pits found at iris/high electric field region**
  - **A15: 200-300 μm pit at quench location**
  - **J2: enhanced roughness in HAZ at hotspot**
- DESY:
  - **Z131: bumps (2x~500μm, 2x200μm) found at heating spots**
  - **AC114: leftover from grinding at hotspot**
  - **Z130: 500 μm pit in equator weld**
  - **Z137: abnormal welding seam (before final treatment) in quenching cell**

Conclusion

- Pits on outer surface → BCP

- Collection of data from all laboratories shows correlation in several cases
- Cavities without correlation exist

- Improve and automate optical inspection further for better statistics and understanding of connection between optical defects and limiting effects