

## SRF Accelerating Modules Repair at DESY.



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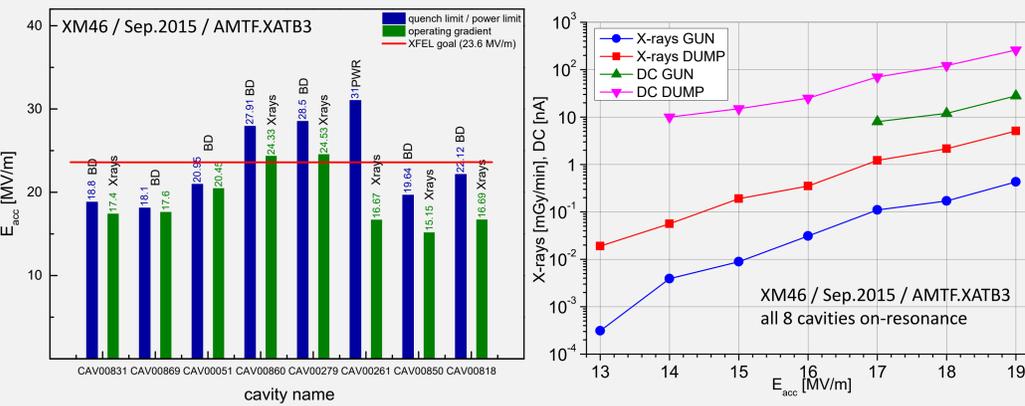
### ABSTRACT

Eight SRF cavities assembled in an accelerating module represent a building block of the particle linear accelerator based on TESLA SRF technology. DESY has two machines, European XFEL and FLASH. Both use almost same module and cavity types. During the module assembly many factors can deteriorate the cavity performance and cause a need for a repair action. Currently two European XFEL modules and two FLASH ones underwent reassembly procedures. The repair was not immediately successful on every of these modules and re-iterations did follow. The degradation causes were investigated. SRF modules were tested on both test-stands at DESY: AMTF and CMTB. The results of the described actions are presented and discussed.

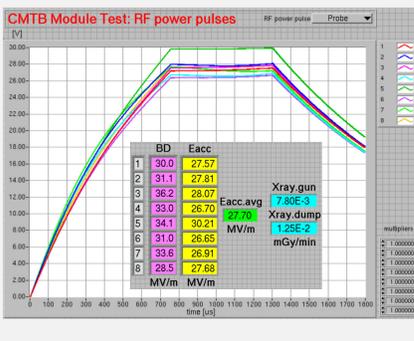
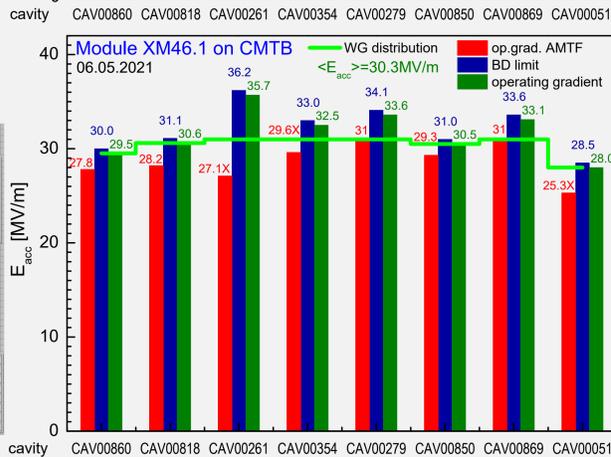
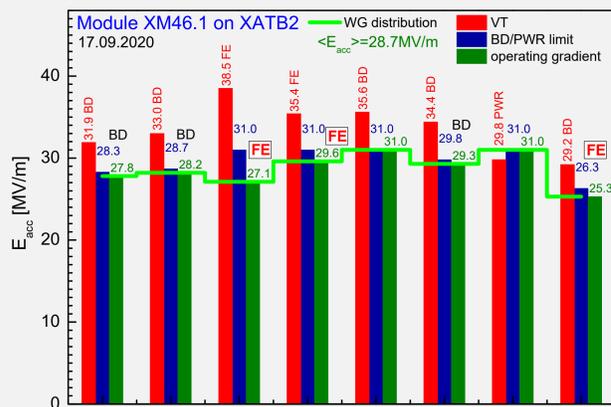
### Module XM46.1



### XM46.1 testing history

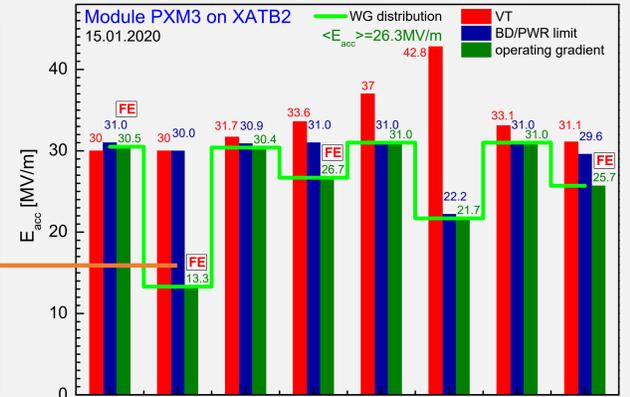
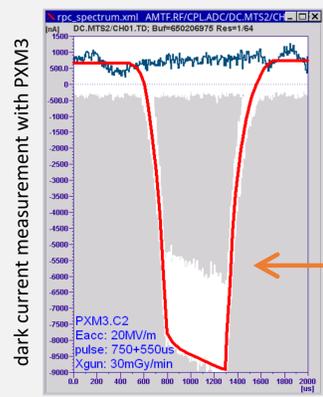
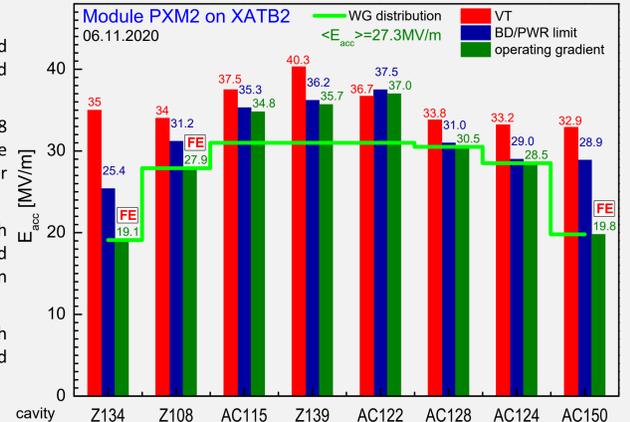


- Module XM46 was delivered to DESY in Sep. 2015 after the assembly at CEA (Saclay).
- Module XM46 1<sup>st</sup> test in Oct. 2015 showed a degradation of the cavity performance with a very high Field Emission.
- Decision was taken not to install/use the module in the Eu-XFEL and re-assemble it after cavities' re-treatment.
- After disassembly XM46 cavities underwent HPR at DESY and after Vertical Test (VT) were accepted for XM46.1 assembly.
- XM46 was re-assembled at DESY to XM46.1 and successfully tested in Sep. 2020.
- The module was tested on two test-stands at DESY: AMTF and CMTB: successful module repair is confirmed on both. Currently a CW module test on CMTB is ongoing.

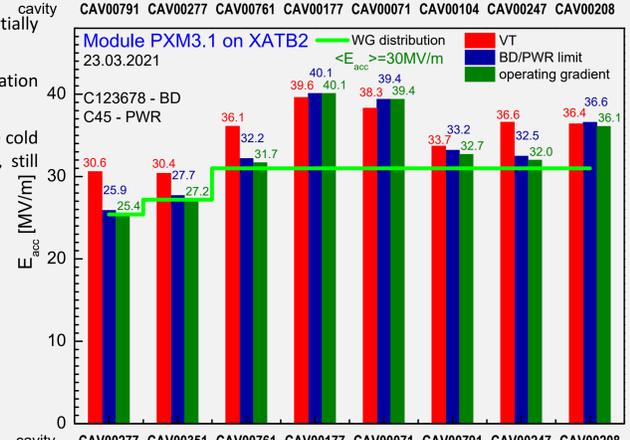
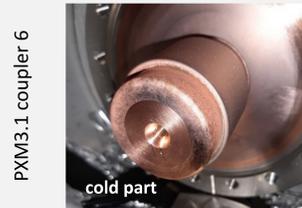


### FLASH / PXM2 and PXM3 Modules

- Modules PXM2 and PXM3 are planned for the FLASH linac upgrade in 2022 and will replace two older modules there.
- PXM2 suffered from C1, C2 and C8 degradation with increased FE. Module PXM2 was stored and transported under dry N<sub>2</sub> gas pressure, not under vacuum.
- PXM3 C1/C2 coupler antennae did touch the cavity through an incident, C6 cold coupler part was exchanged in the clean room. PXM3 cavities 2 and 6 degraded.
- It was decided to re-assemble both modules after re-treatment (HPR) and partial exchange of their cavities.

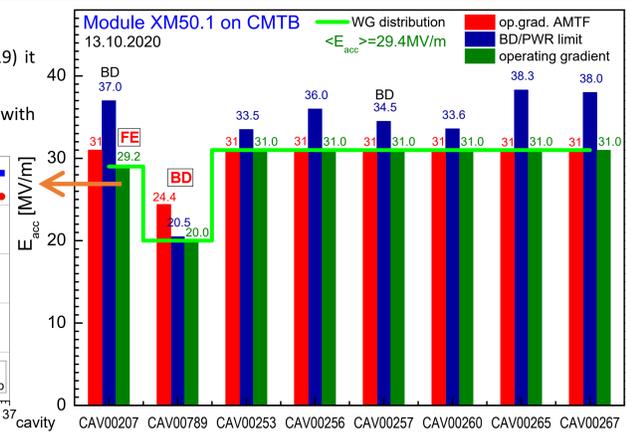
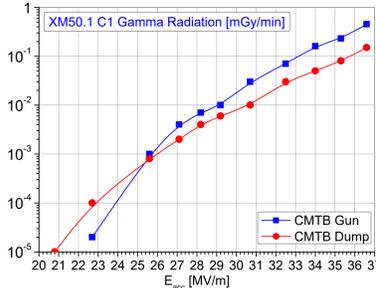


- PXM3 cavities were re-treated and partially exchanged and installed in PXM3.1.
- Cavities test was successful: no degradation between VT and module test.
- Coupler 6 (CAV00791) suffered from the cold part problem: it degraded during test, still under investigation.
- PXM3.1 re-assembly will follow.



### Module XM50.1 case

- After test in AMTF (reported at SRF2019) it was installed and tested on CMTB.
- C1/C2 suffered some degradation: C1 with high FE and C2 with earlier breakdown.



### Conclusions

- Four SRF accelerating modules with degraded cavities performance were disassembled, cavities were re-treated with HPR, tested and also partially exchanged against spare ones. Then re-assembly followed with mixed results and need of re-iteration in some cases. Some degradations might be explained.
- Module XM46.1 showed good performance: the repair was immediately successful. Also transport from AMTF and installation on CMTB did not change this. Module was stored and transported with cavities string under vacuum.
- Module XM50.1 successful repair was reported at SRF2019. After transport and installation on CMTB for CW test first two cavities did suffer from some degradation. The cause is not exactly defined. But the module performance is still in specs.
- Modules PXM2 and PXM3 planned for FLASH linac upgrade in 2022 both got degraded cavities after assembly. Modules storage and transport under dry N<sub>2</sub> pressure, compared to that under vacuum conditions, might explain problems faced later, as contaminating particles may move in gas from string ends. For the first two cavities of PXM3 the fundamental power coupler antennae did touch the cavity surface through the accident during coupler cold parts bellows adjustment, also coupler 6 cold part was exchanged in the clean room. Module PXM2.1 is being currently assembled.
- Module PXM3.1 cavities re-treatment and re-assembly was successful: cavities did not degrade anymore. But the new cold part of FPC, cavity 6, showed a degraded performance in the module test in AMTF with strong RF discharge. Faulty FPC cold part must be exchanged, new module test will follow.

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