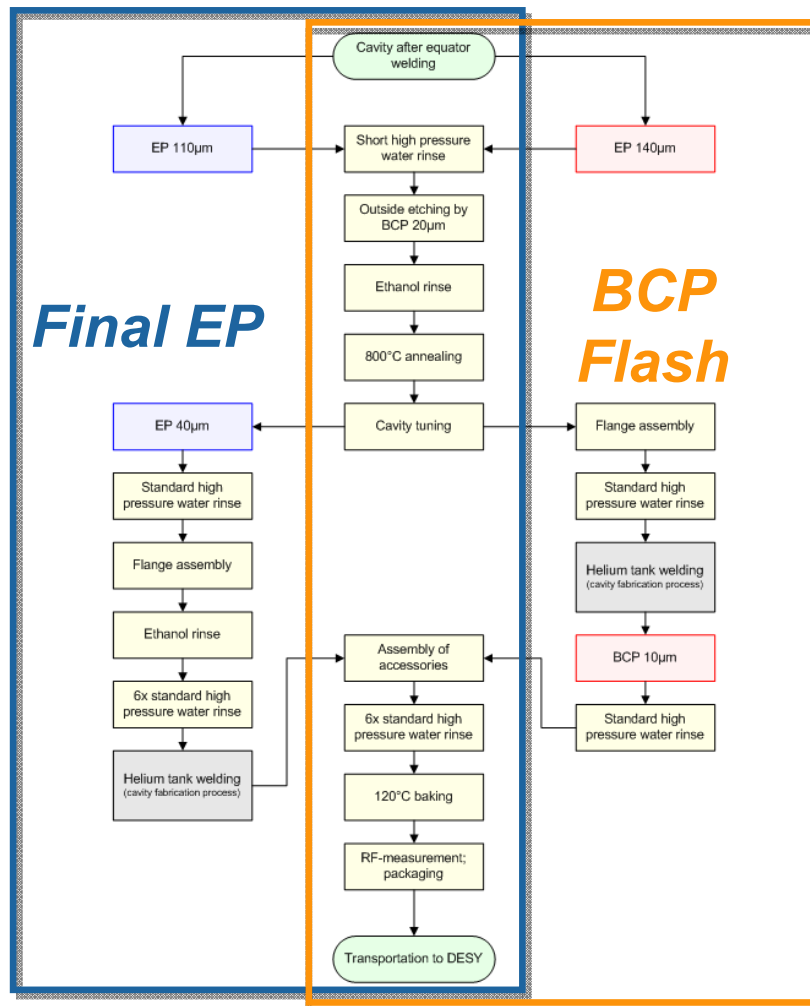


Strategy and Status of Reference Cavities for European XFEL



■ **Two schemes** for the final surface treatment:

- E. Zanon: **BCP Flash**
- Research Instr.: **Final EP**



- at each company:
 - 4 Cav's for set-up of infrastructure
 - 4 Cav's for qualification of infrastructure
- **Close supervision of infrastructure, processes, procedures and handling** by DESY + INFN Milano required
- **No performance guarantee results in:**
 - the risk of unexpected low gradient or field emission is with DESY
 - responsibility for re-treatment at DESY

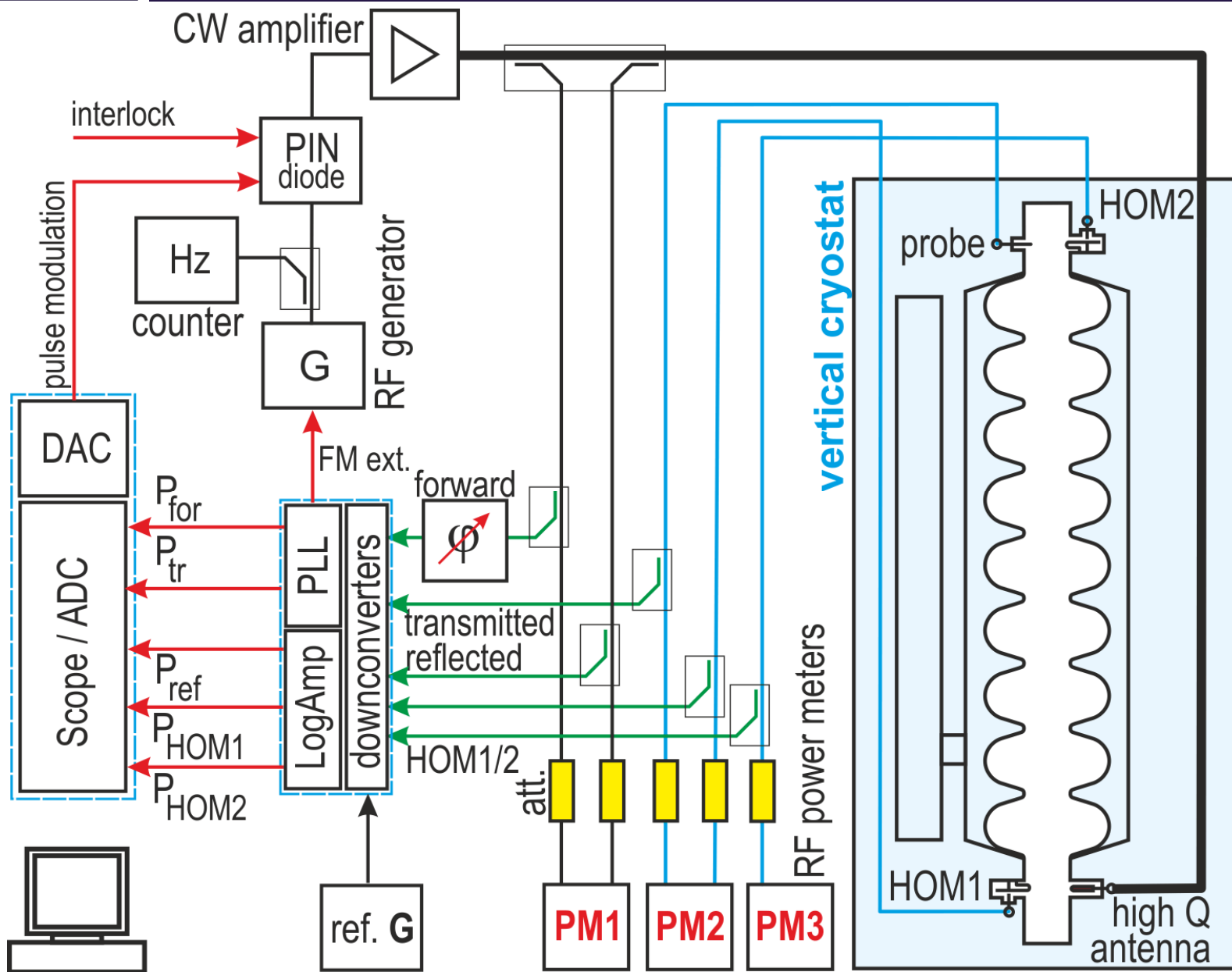
- Four reference cavities fabricated at each company
- First surface treatment and vertical acceptance test w/o He-tank at DESY (following the company preparation scheme: **Final BCP for EZ**; **Final EP for RI**)
- Stepwise qualification of surface treatment infrastructure at companies (after successful set-up of infrastructure with further dedicated cavities)

	RCV#0	RCV#1	RCV#2	RCV#3	RCV#4
Transportation to + from company	OK	↓	↓	↓	↓
+ slow venting / slow pumping (incl. leak check + RGA)		ok(EZ)/ ok(RI)			
+ disassembly of beam tube flange (short side), full HPR-cycle, drying, assembly of beam tube flange			ok(EZ) /x		
+ disassembly of all flanges, assembly of flanges, leak check				ok(EZ) /x	
+ Final 40µm EP (RI)/Final 10µm BCP (EZ), first HPR, ethanol rinse, FMS, 120° C bake					X

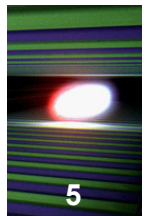
- Remark: Full preparation cycle will be done with CAV for set-up of infrastructure, only

Vertical Cryostat Cavity RF Test for XFEL

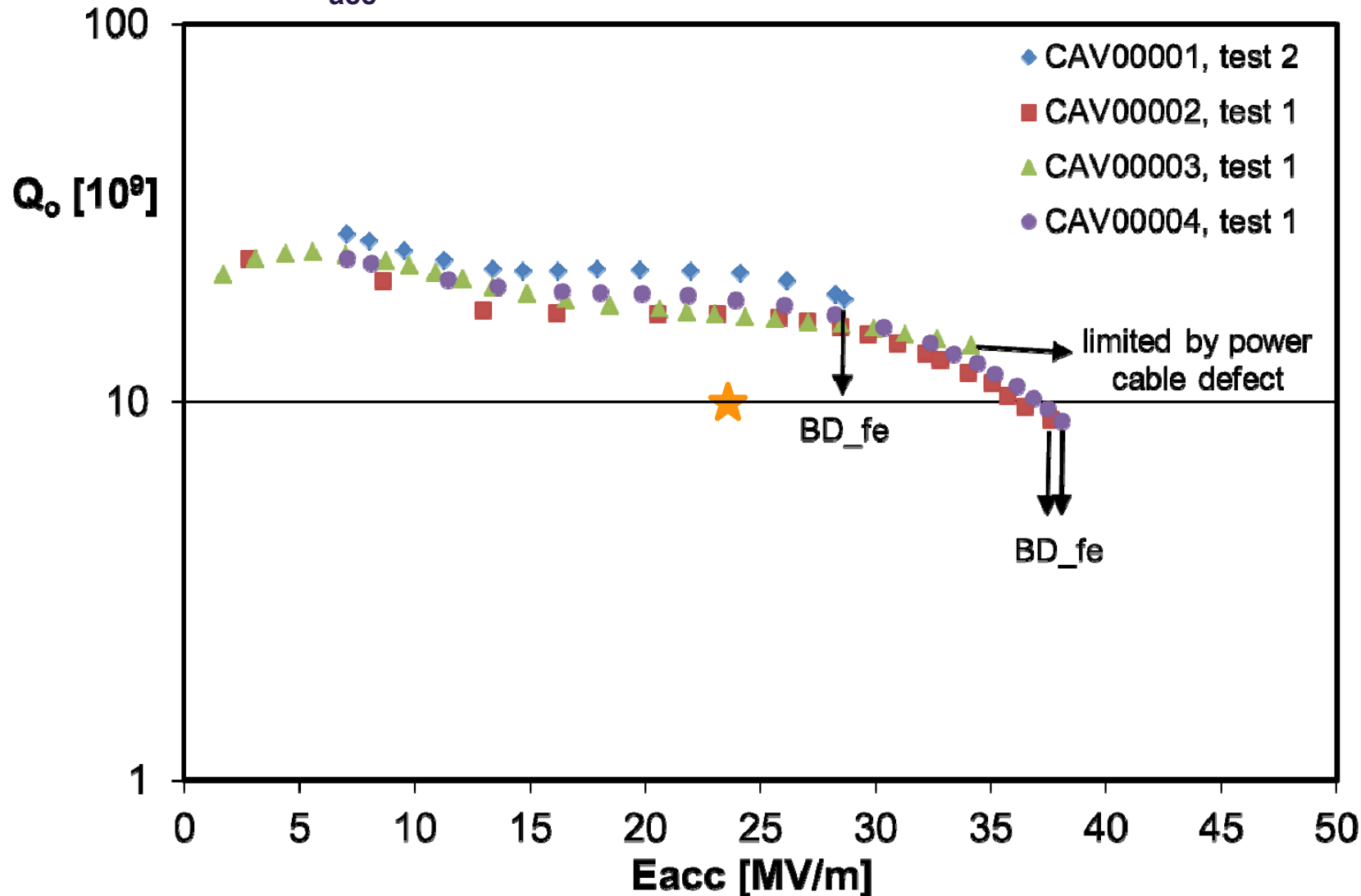
4



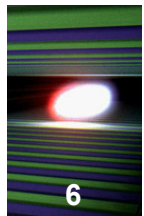
Starting Performance of Reference Cavities: RI (after surface preparation at DESY)



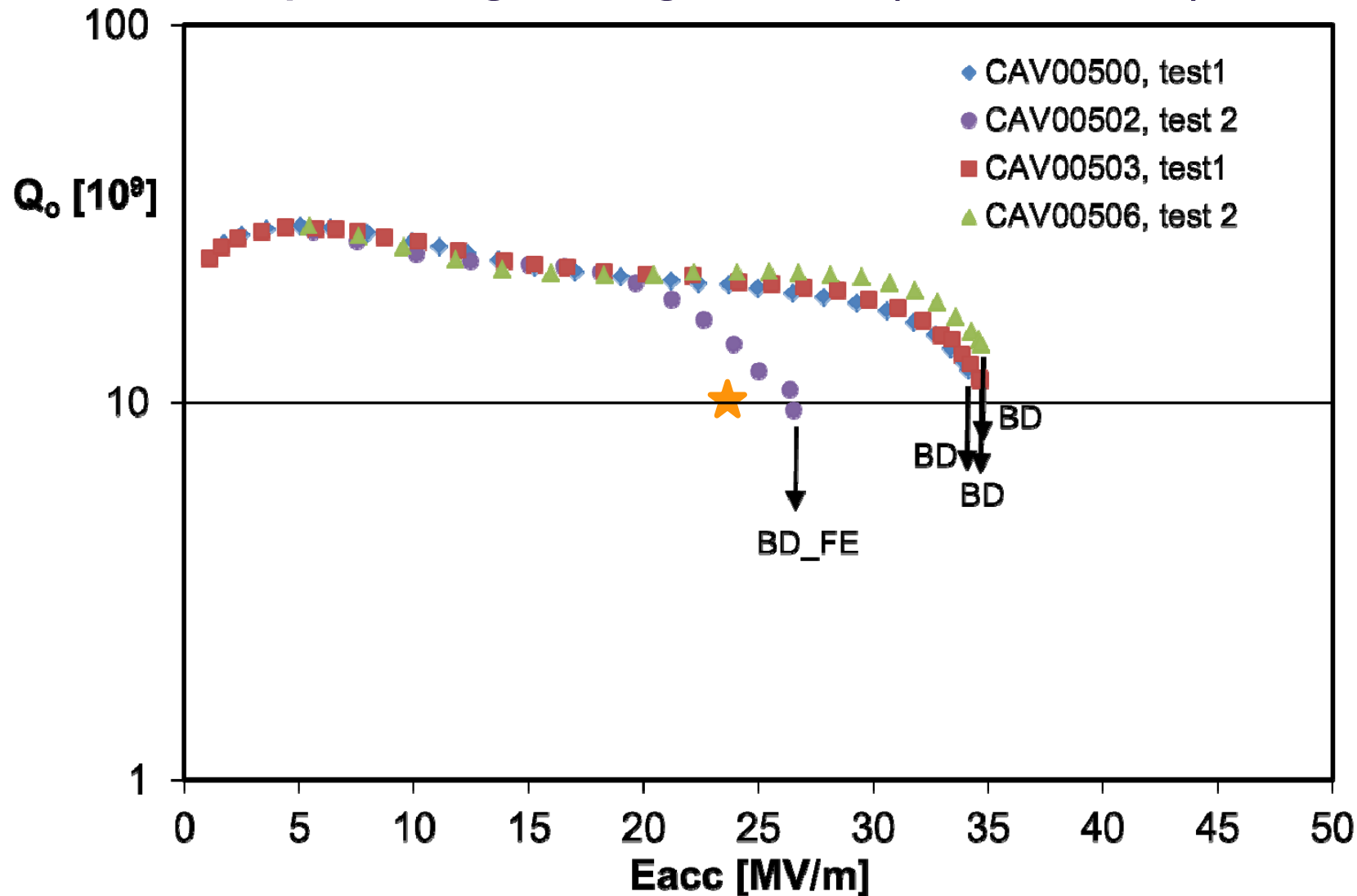
- Acceptance test of four RI reference cavities successful:
All cavities with $E_{acc} > 28$ MV/m!



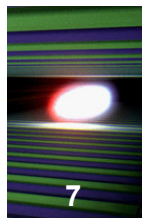
Starting Performance of Reference Cavities: EZ (after surface preparation at DESY)



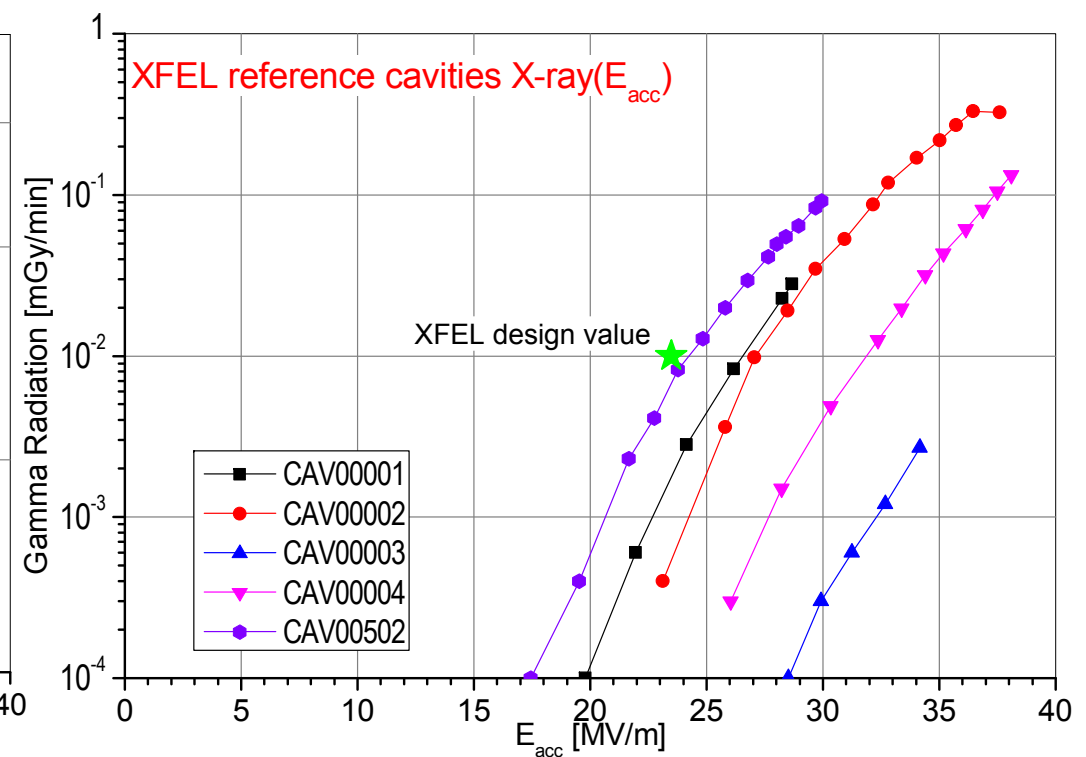
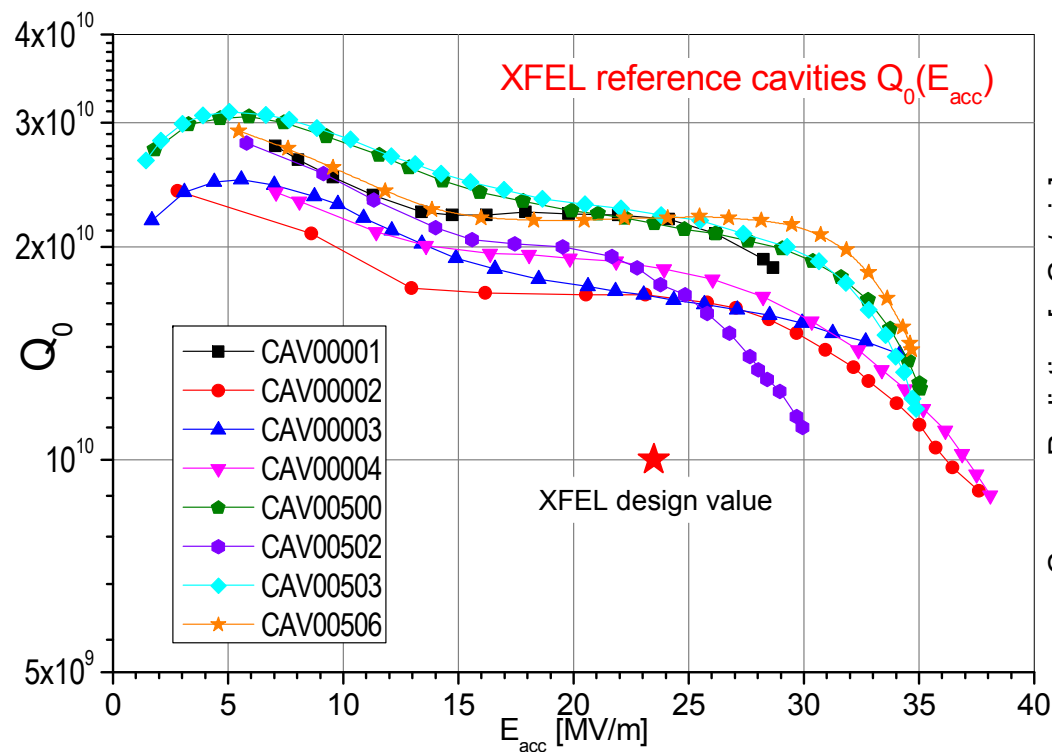
- Three cavities vertical acceptance test successful (no FE)
- CAV00502 accepted though strong radiation (field emission)

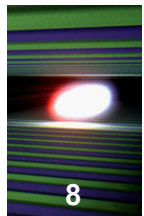


Starting Performance of Reference Cavities: SUMMARY (after surface preparation at DESY)



8 RCVs: acceptance test successful





■ RI:

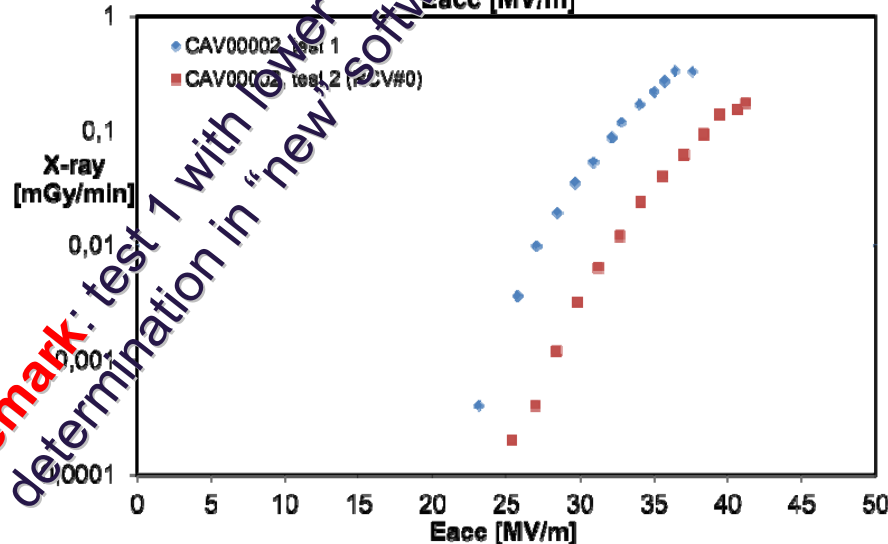
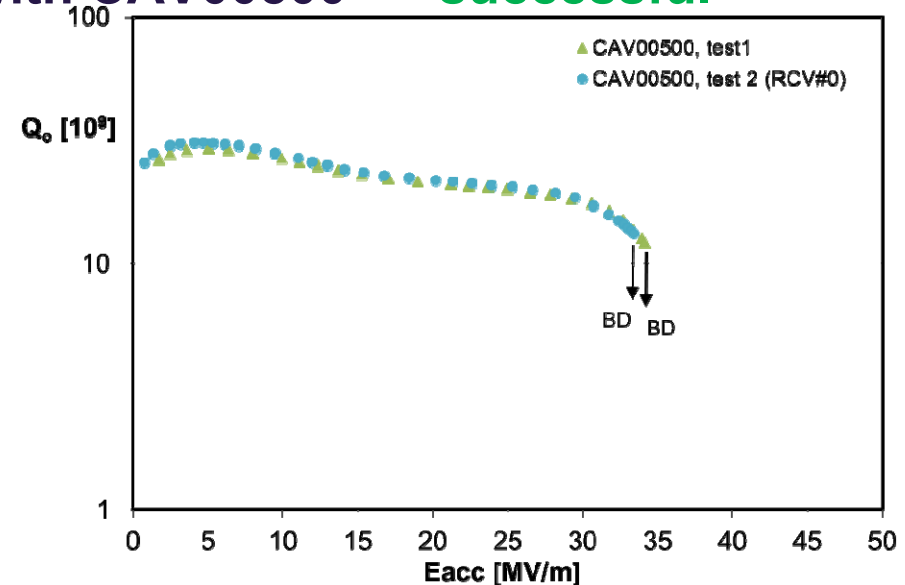
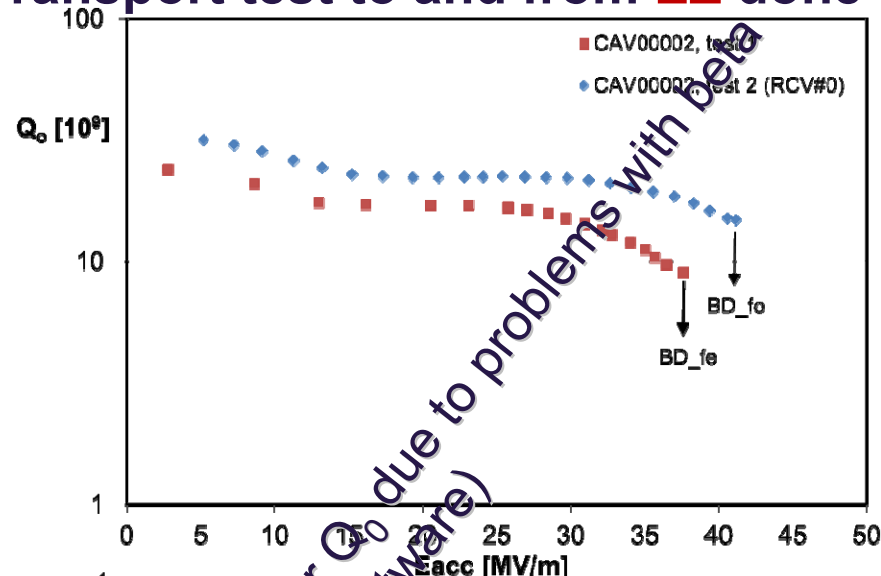
RCV#0: CAV00002, t1 => t2: **ok**
 RCV#1: CAV00001, t2 => t3: **not ok**
 RCV#1.1: CAV00004, t1 => t2: **not ok**
 RCV#1.2: CAV00001, t4 => t5: **ok** (Q-degradation + leak => re-test ongoing)
 RCV#2: CAV00002, t2 => t3: in preparation
 RCV#3:
 RCV#4:

■ EZ:

RCV#0: CAV00500, t1 => t2: **ok**
 RCV#1: CAV00506, t2 => t3: **ok**
 RCV#2: CAV00503, t2 => t3: **not ok**
 RCV#2.1: CAV00500, t2 => t3: **ok**
 RCV#3: CAV00502, t2 => t3: **ok**
 RCV#4: CAV00506, t4 => t5: vertical test in preparation

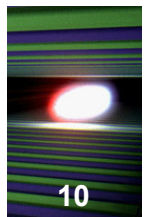
Transport tests: RCV#0 (0. step of RCV qualification)

- Transport test to and from **RI** done with CAV00002 => **successful**
- Transport test to and from **EZ** done with CAV00500 => **successful**

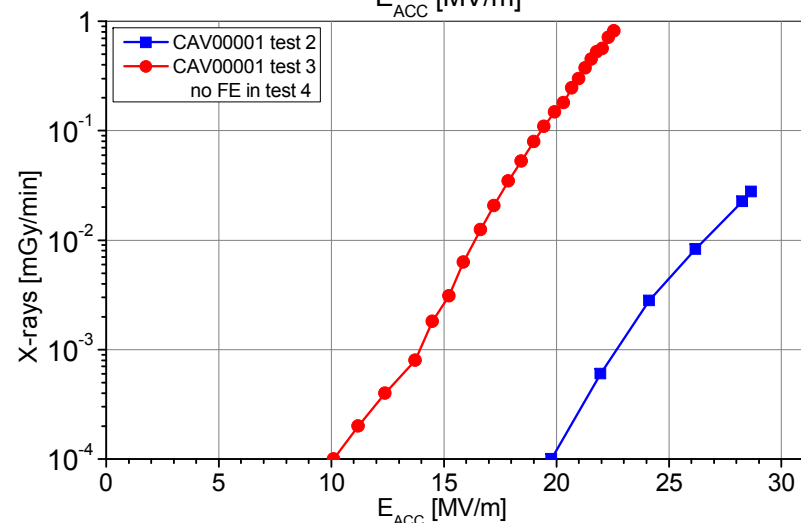
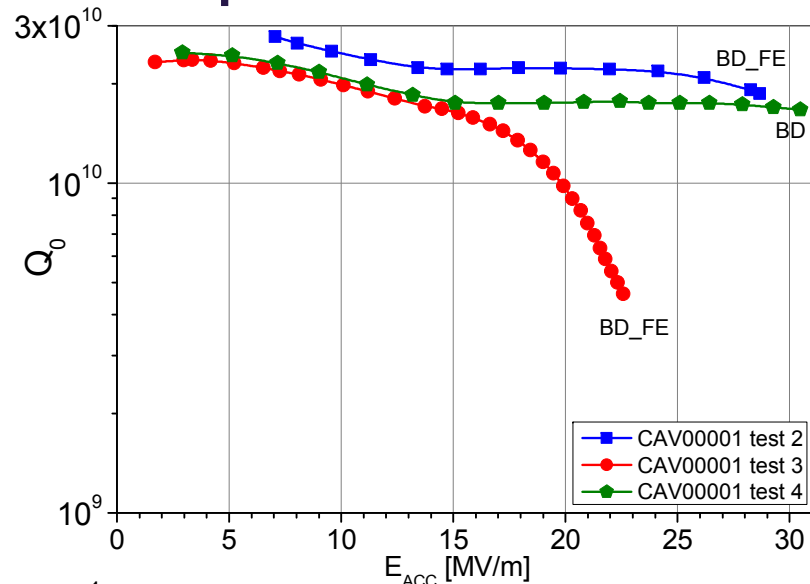


no radiation

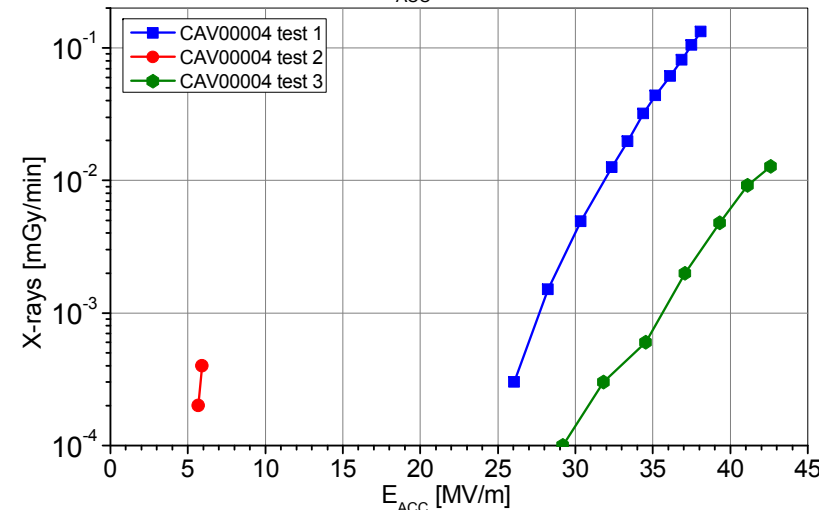
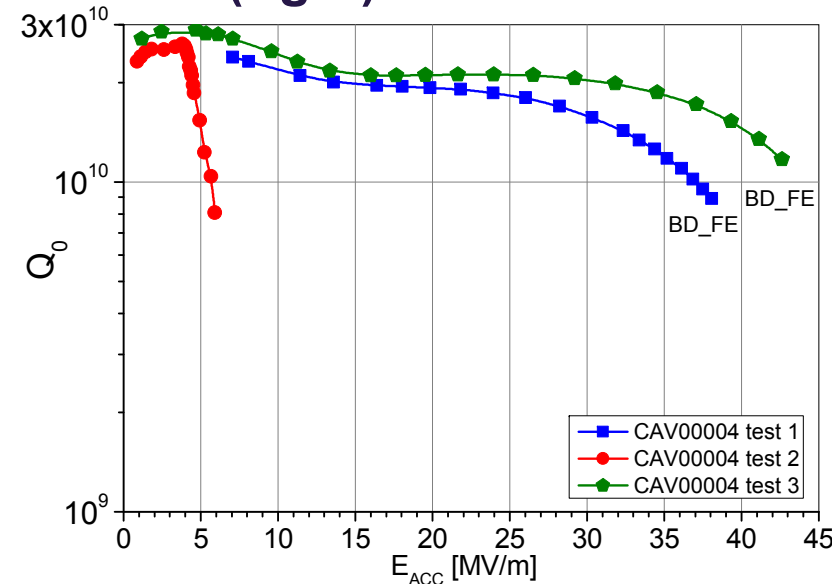
Test of Slow Pumping / Slow venting @ RI: RCV#1 + RCV#1.1



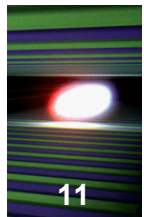
- Test of Slow Pumping / Slow venting at **RI** done with CAV00001 (left) => **failed**
- 2. attempt of SPSV at **RI** done with CAV00004 (right) => **failed**



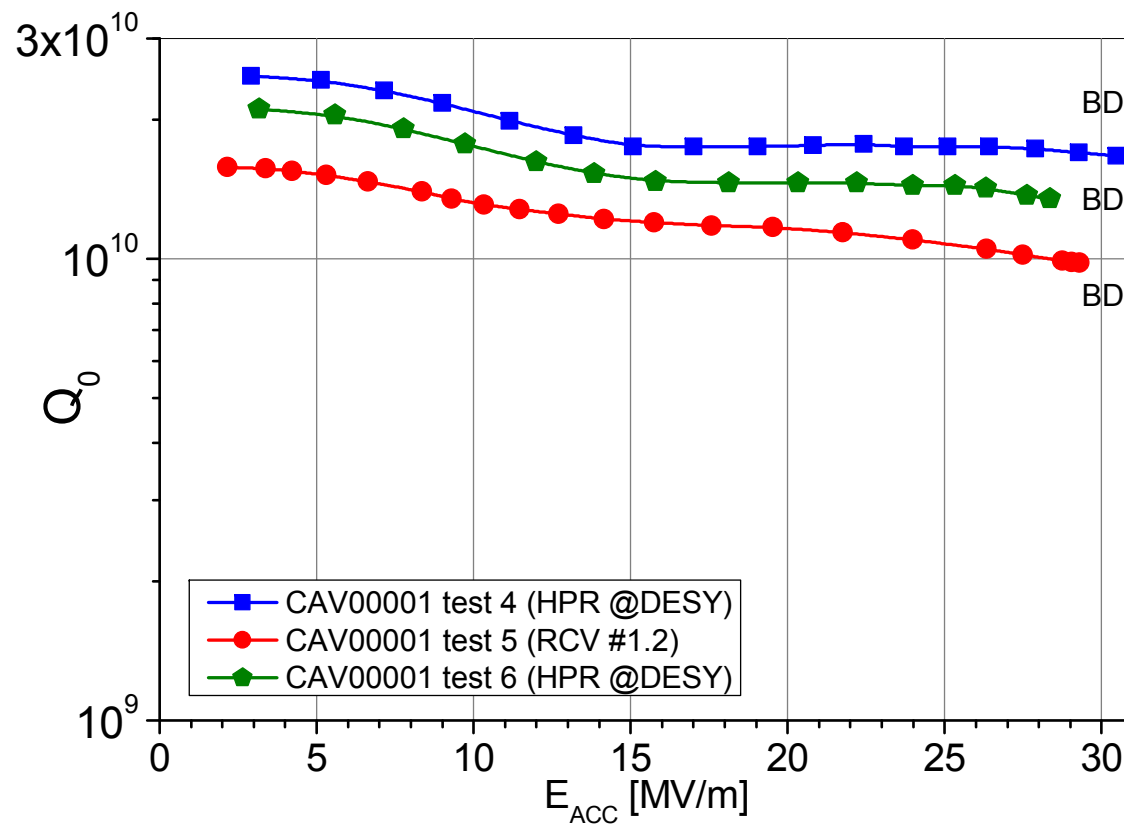
test 4 → cavity retreated by DESY (HPR)



test 3 → cavity retreated by DESY (HPR)



3. attempt of SPSV at RI done with CAV00001 (left) => preliminary ok



no radiation

Remark 1:

Small leak at 2K appeared during test
=> Re-tightening of screws for re-test

Remark 2:

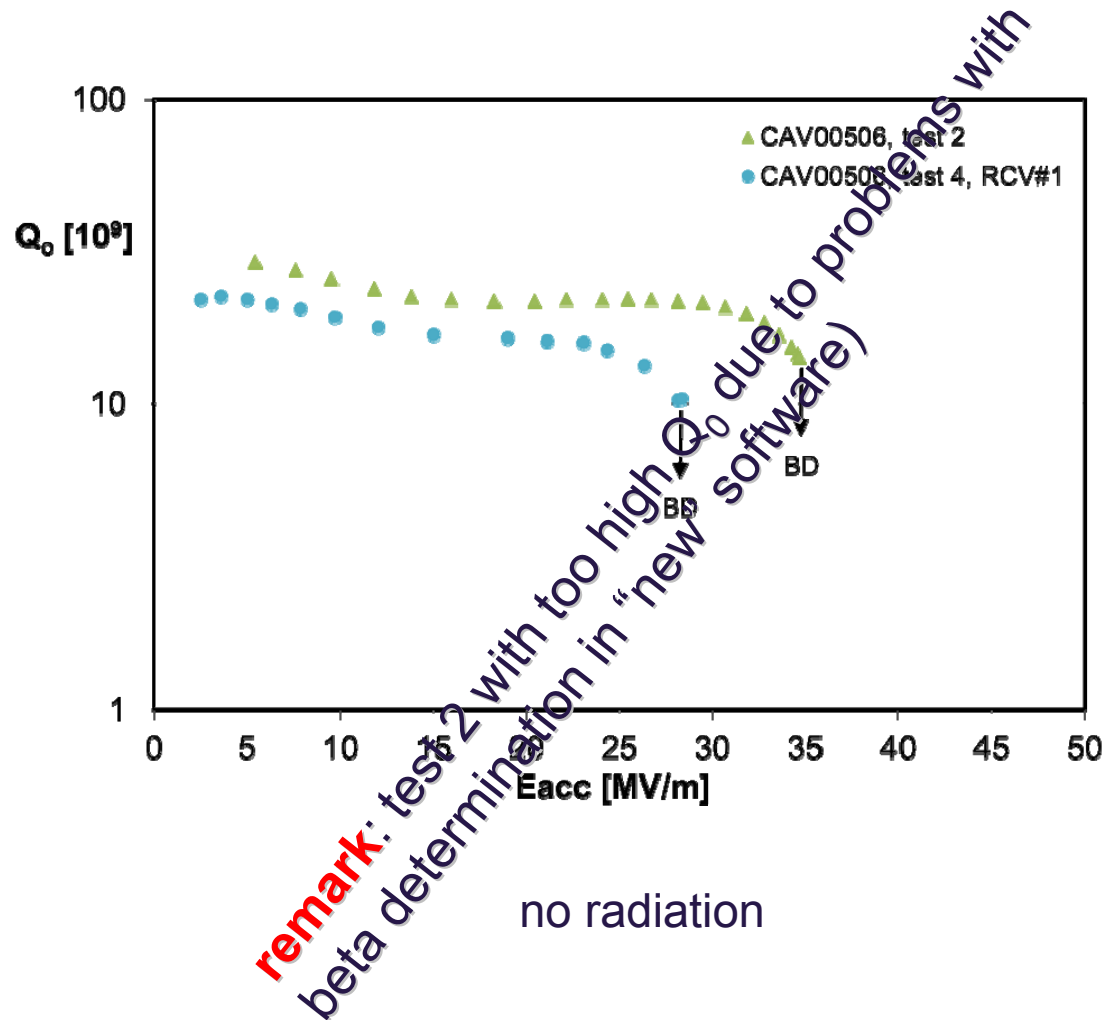
Re-test of CAV00001 ongoing in order
to find reason for Q-degradation
(RF-procedure checked and ok).

Remark 3:

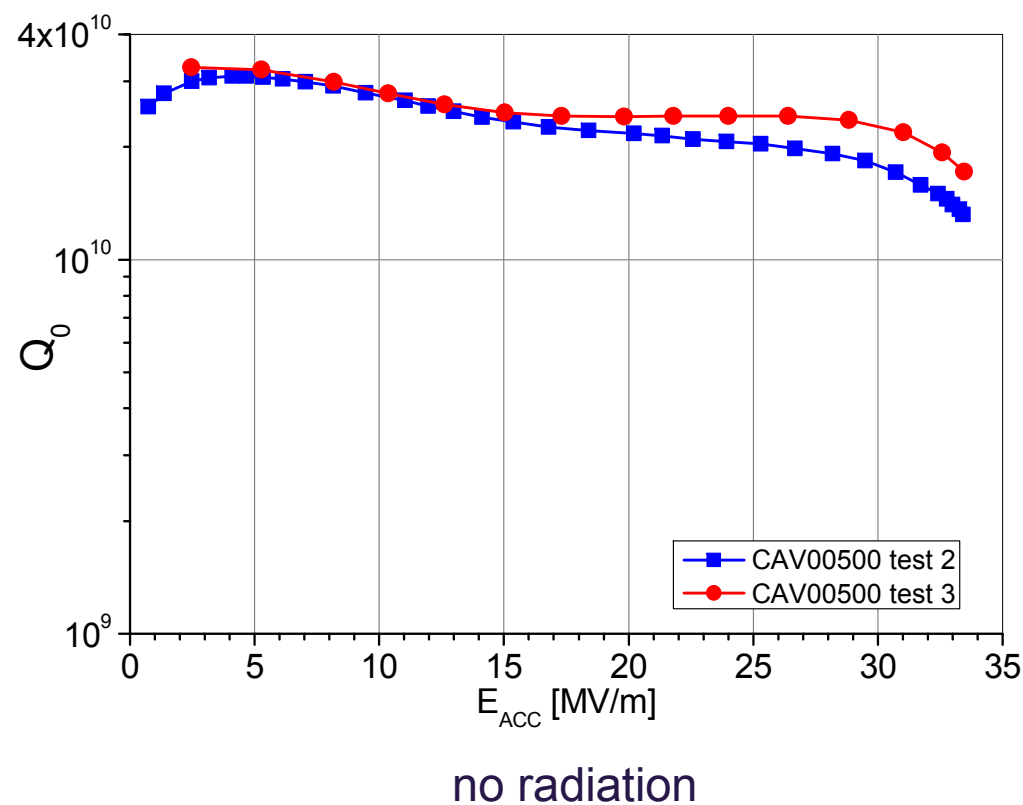
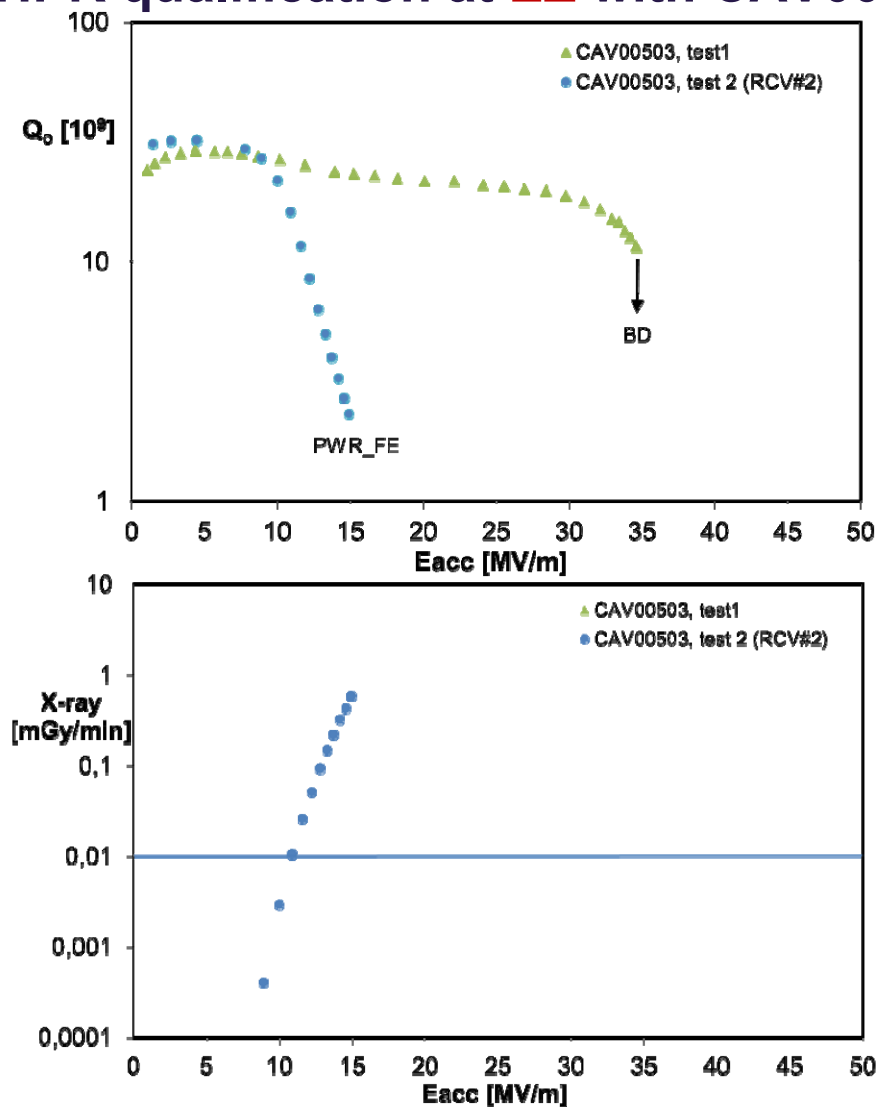
Decision taken to go on with RCV#2

Test of Slow Pumping / Slow venting @ EZ: RCV#1

- Test of SPSV at EZ done with CAV00506 => **successful**

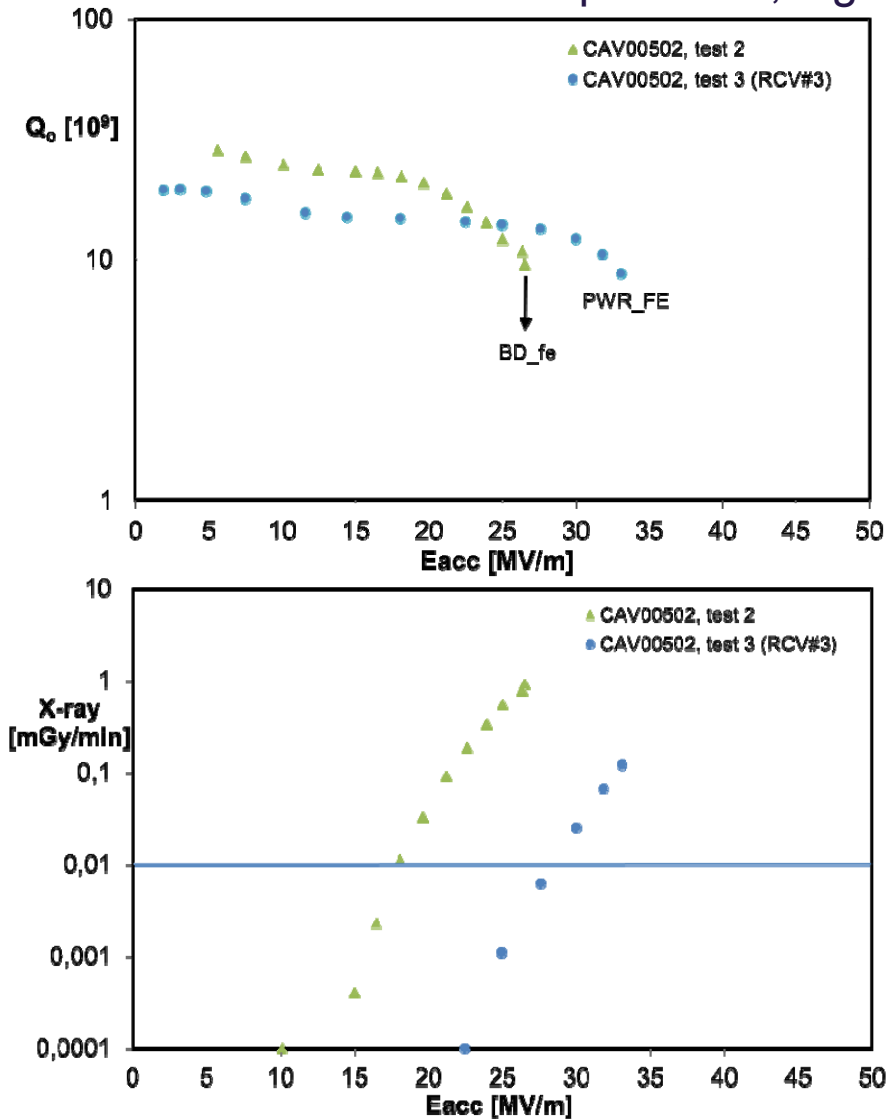


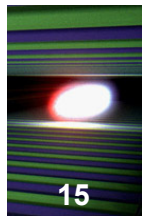
- 1. attempt of HPR qualification done at **EZ** with CAV00503 (left) => **failed**
- HPR qualification at **EZ** with CAV00500 (right) => **successful**



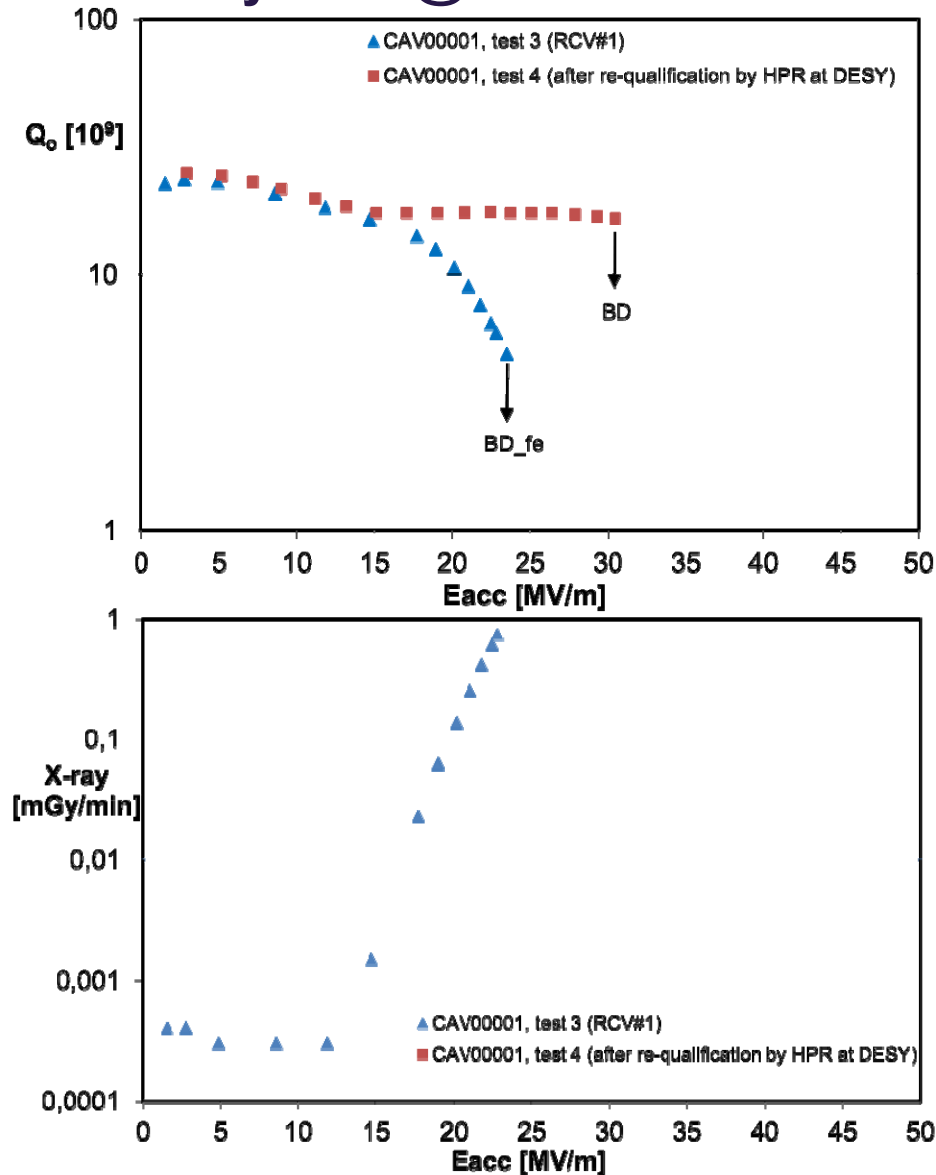
Qualification of full assembly (incl. antenna preparation) @ EZ: RCV#3

- Qualification of full assembly at **EZ** with CAV00502 => **successful**
(lower Q-value w/o obvious explanation; higher Q_{trans} than usual)

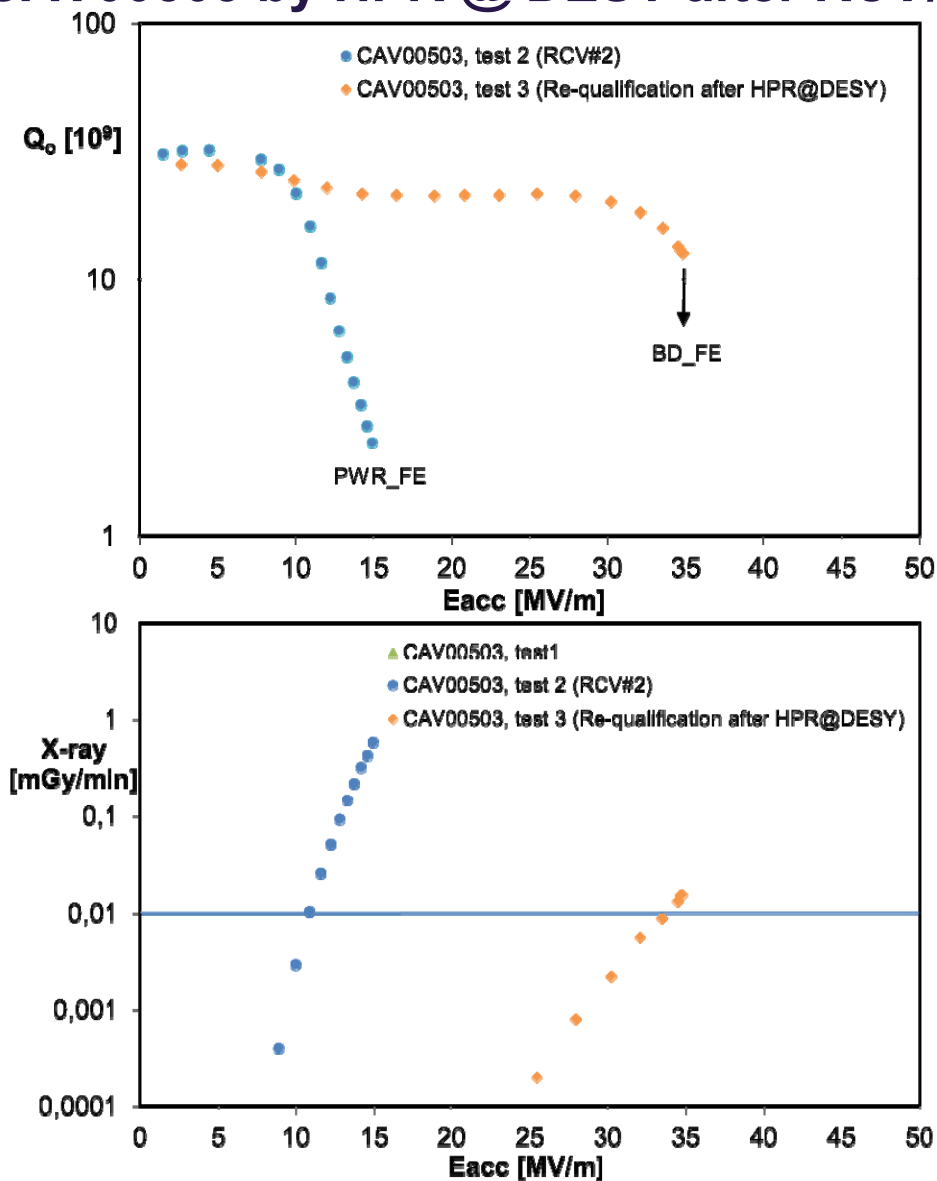




■ CAV00001 by HPR @ DESY after RCV#1 failed at **RI** => **successful**

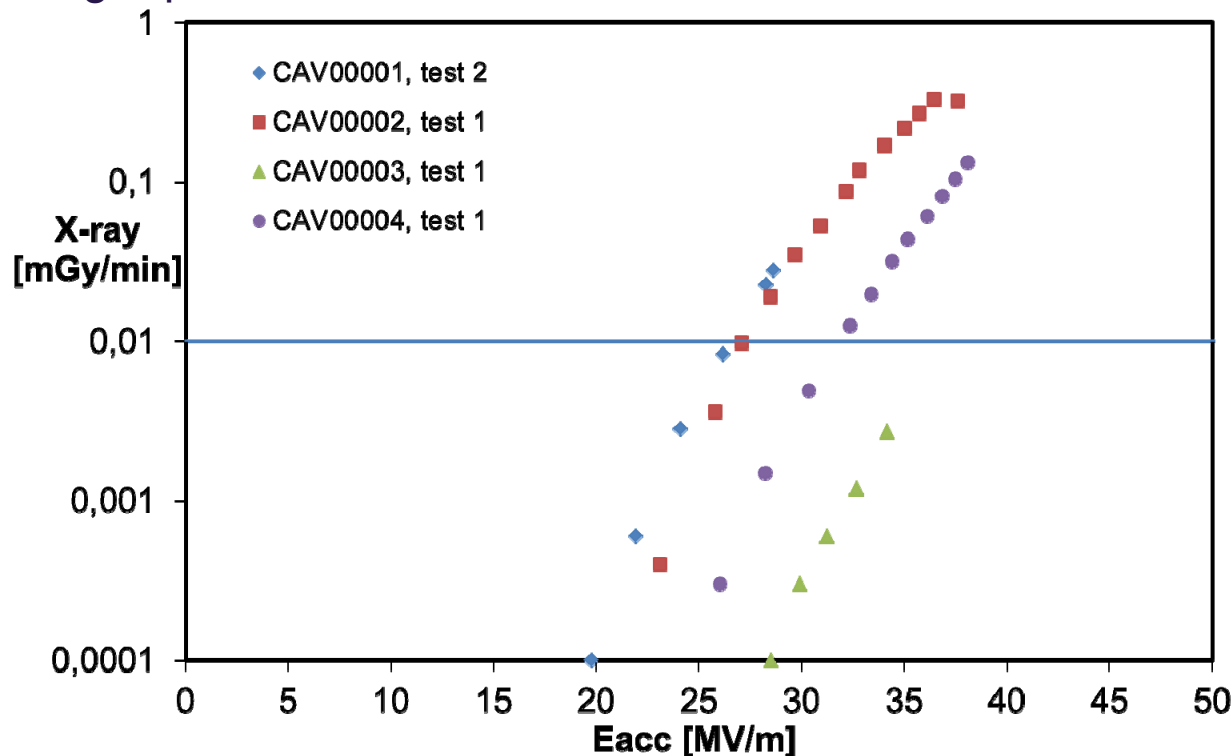


■ CAV00503 by HPR @ DESY after RCV#2 failed at EZ => successful



Usable Gradient of RI Cavities (after 1. DESY preparation)

- Usable gradient for RI cavities:
 - CAV00001, test 2: 26.4 MV/m (radiation > 10^{-2} mGy/min)
 - CAV00002, test 1: 27.1 MV/m (radiation > 10^{-2} mGy/min)
 - CAV00003, test 1: >34.2 MV/m (limited by power cable defect)
 - CAV00004, test 1: 31.7 MV/m (radiation > 10^{-2} mGy/min)
- **Remark 1:** CAV00001 needed additional test due to wrong assembly of valve in test 1 (cavity did not fit in transport box) => HPR + correct valve assembly before test 2
- **Remark 2:** Though qualified the radiation in CAV00001 + CAV00002 are close to acceptable limit!



Usable Gradient of EZ Cavities (after 1. DESY preparation)

- Usable gradient for EZ cavities:
 - CAV00500, test 1: 34.2 MV/m (Quench, no FE)
 - CAV00502, test 2: 17.9 MV/m (radiation > 10^{-2} mGy/min)
 - CAV00503, test 1: 34.6 MV/m (Quench, no FE)
 - CAV00506, test 2: 34.7 MV/m (Quench, no FE)
- **Remark 1:** CAV00502 + CAV00506 showed activation of strong FE in first Q(E) of test 1
- **Remark 2:** CAV00502 after test 1 => OBACHT inspection and HPR
=> OBACHT shows scratches at Iris 9
=> in test 2 again degradation in first Q(E) due to FE and more x-rays than test 1
- **Remark 3:** CAV00506 after test 1 => OBACHT inspection and HPR
=> in test 2 significant improvement with no FE

