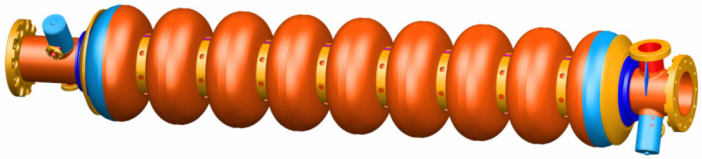
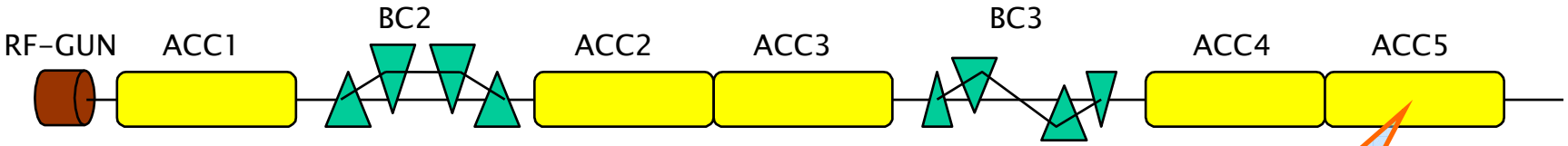
FLASH Accelerator Studies: High Gradient, Cryo and Irradiation Measurements



FLASH LINAC

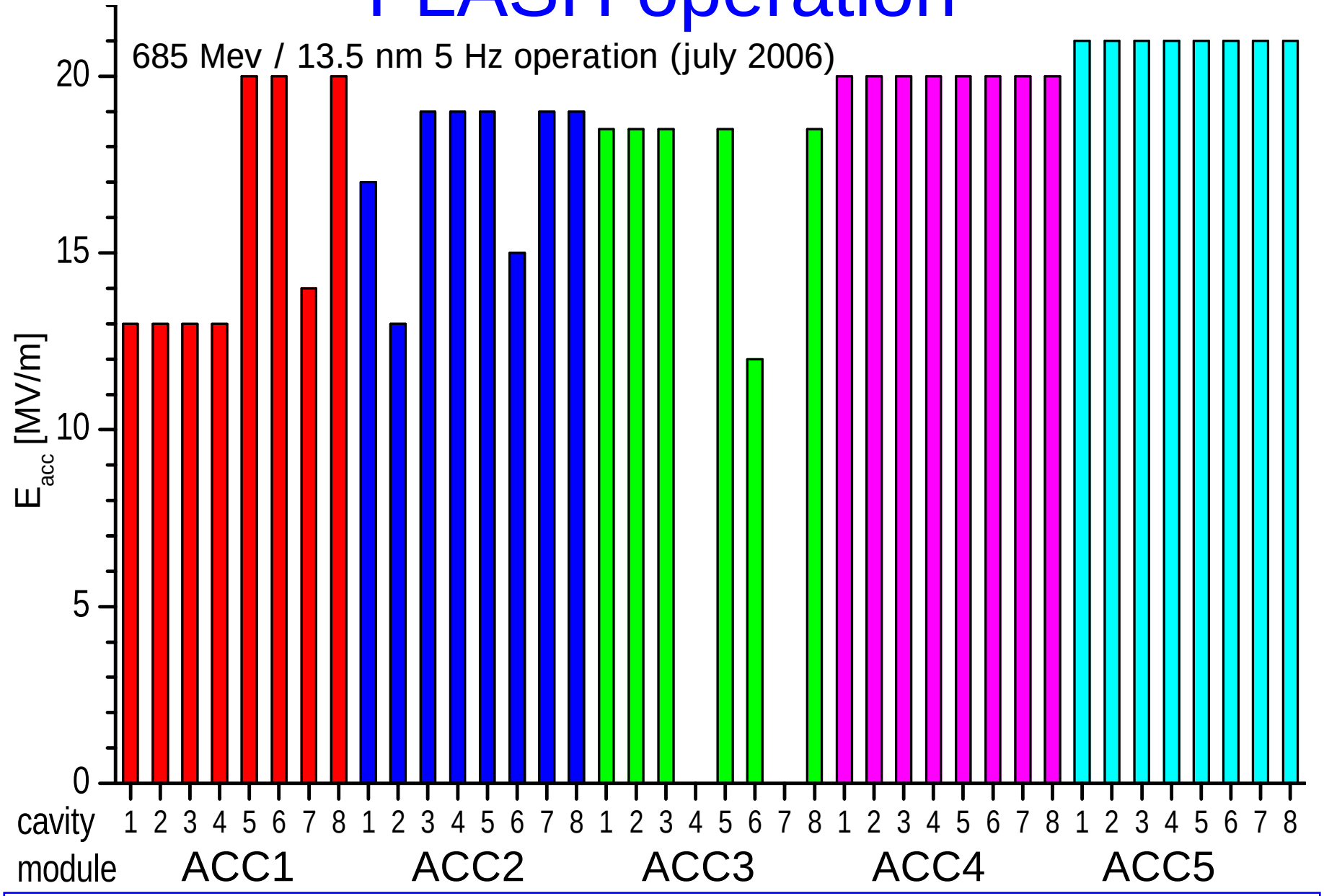


FLASH operation

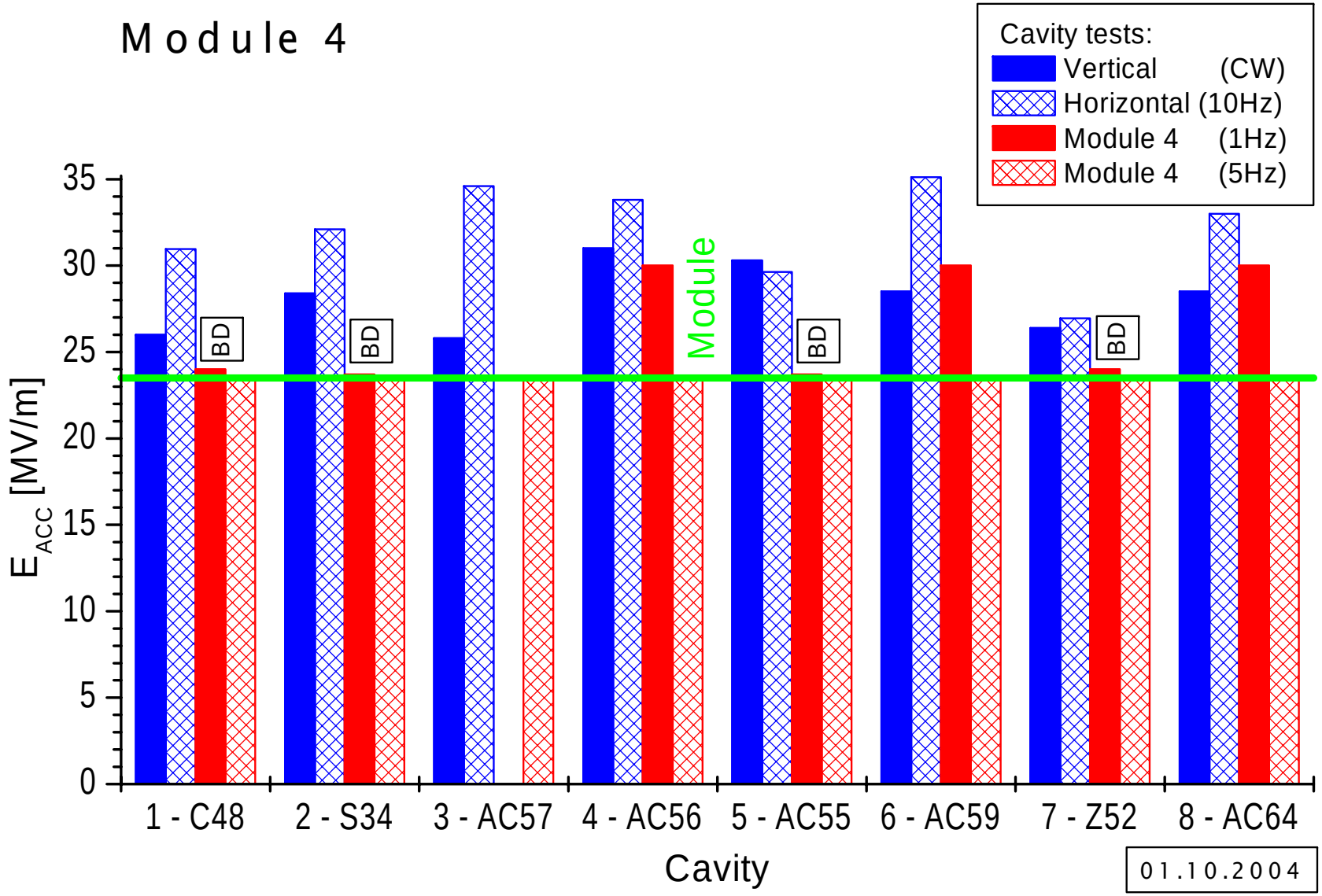
685 Mev / 13.5 nm 5 Hz operation (july 2006)

module	cavity	E_{acc} [MV/m]	attenuator [dB]	comment
ACC1	1, 2, 3, 4	13	—	capture section, lower gradient
	5, 6, 8	20	—	
	7	14	3	too high FE
ACC2	3, 4, 5, 7, 8	19	—	
	1	17	1	quench
	2	13	3	quench
	6	15	2	quench
ACC3	1, 2, 3, 5, 8	18.5	—	
	4	0		cavity tuner problem / OFF
	6	12	3	quench
	7	0		very high FE / OFF
ACC4	1 … 8	20	—	limited at 23.5 MV/m
ACC5	1 … 8	21	—	limited at 25 MV/m

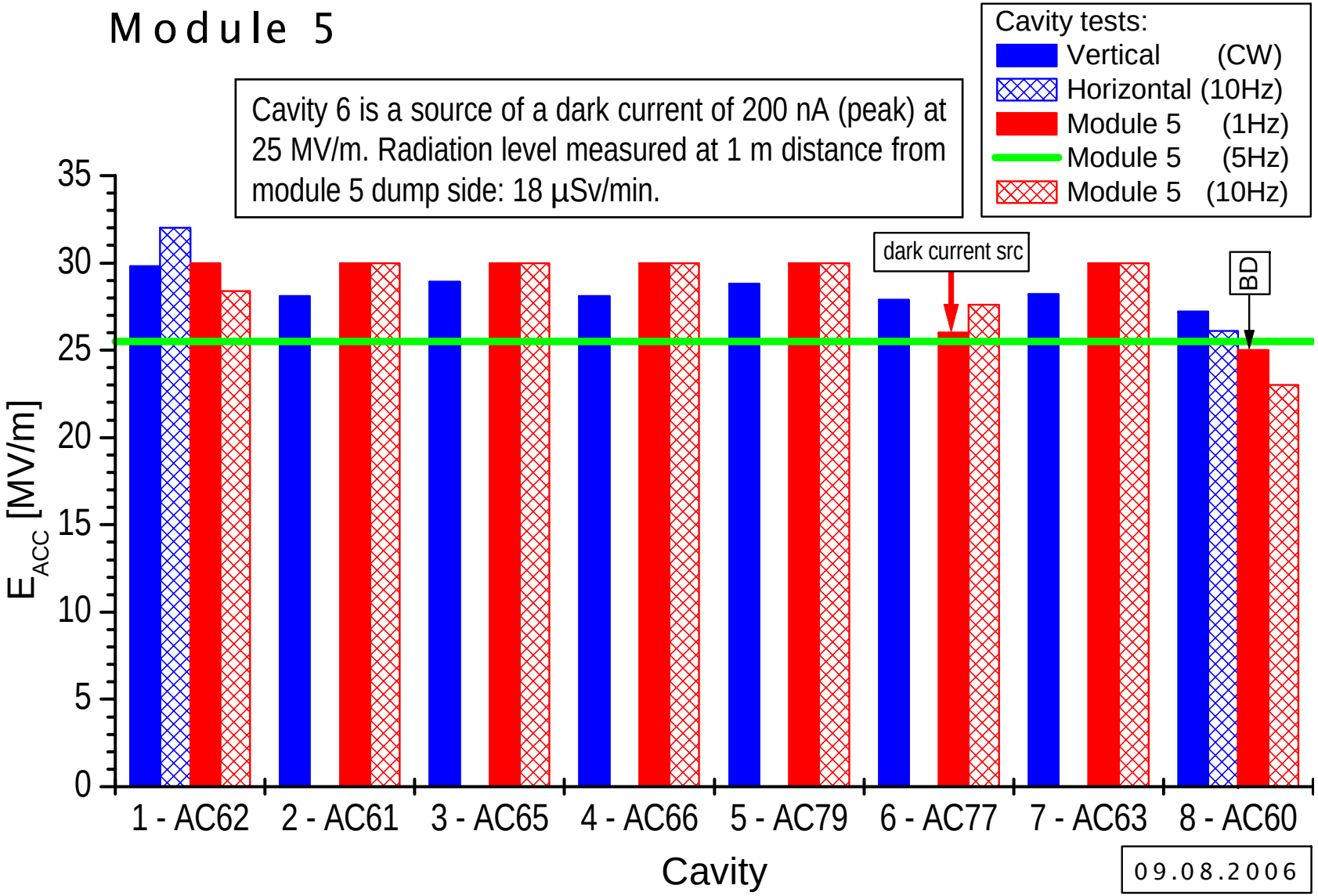
FLASH operation



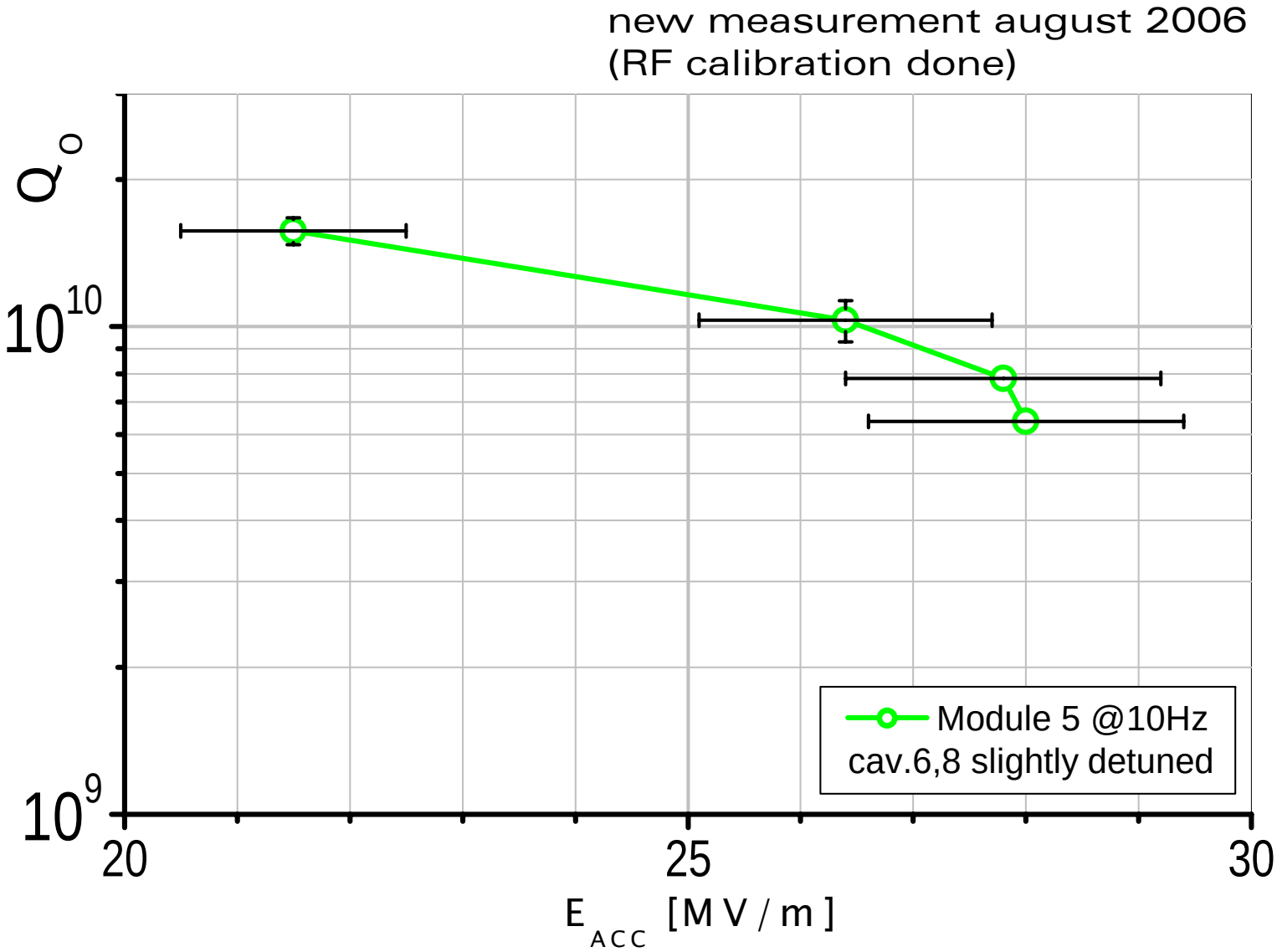
Cavities @ ACC4



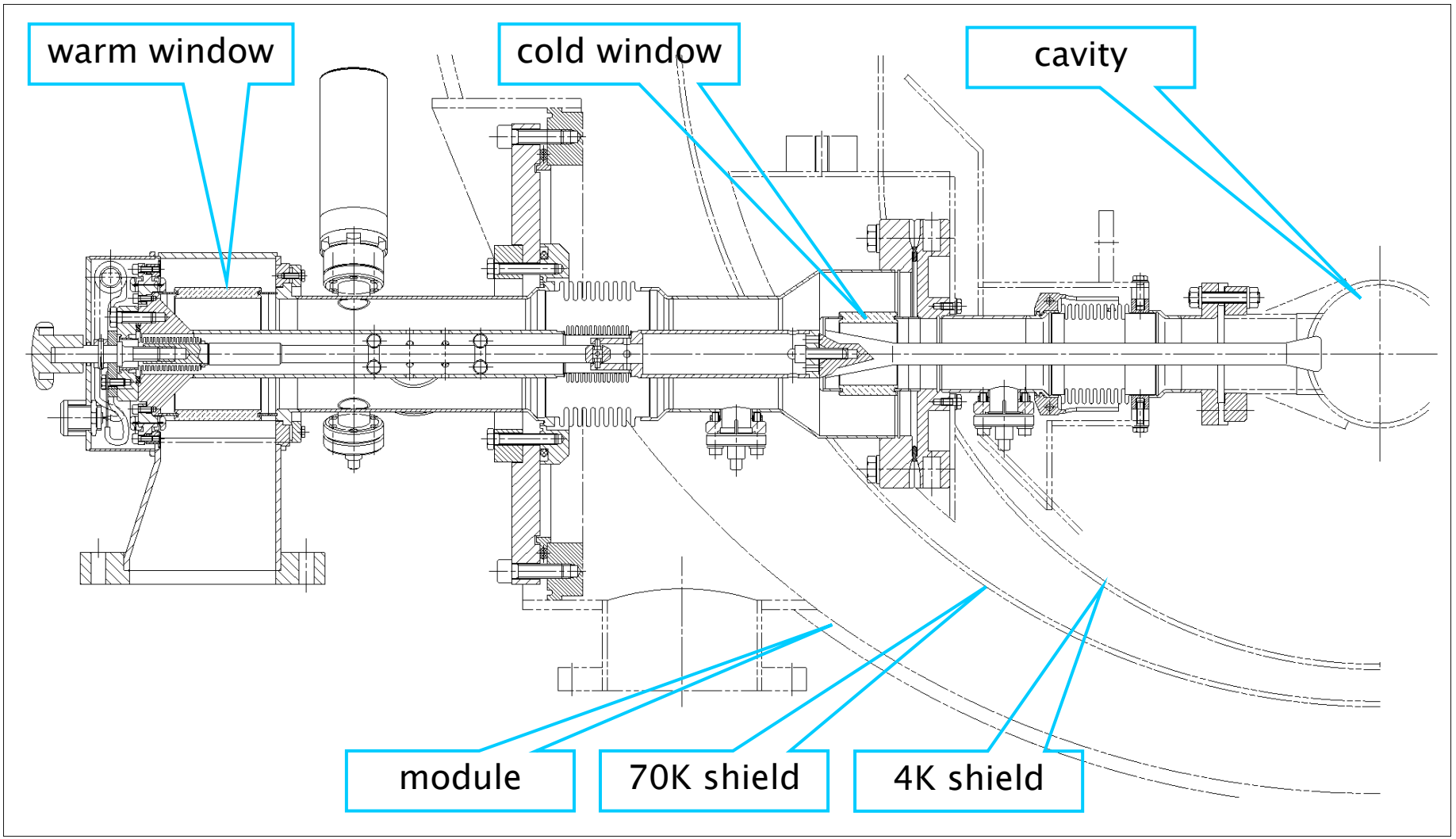
Cavities @ ACC5



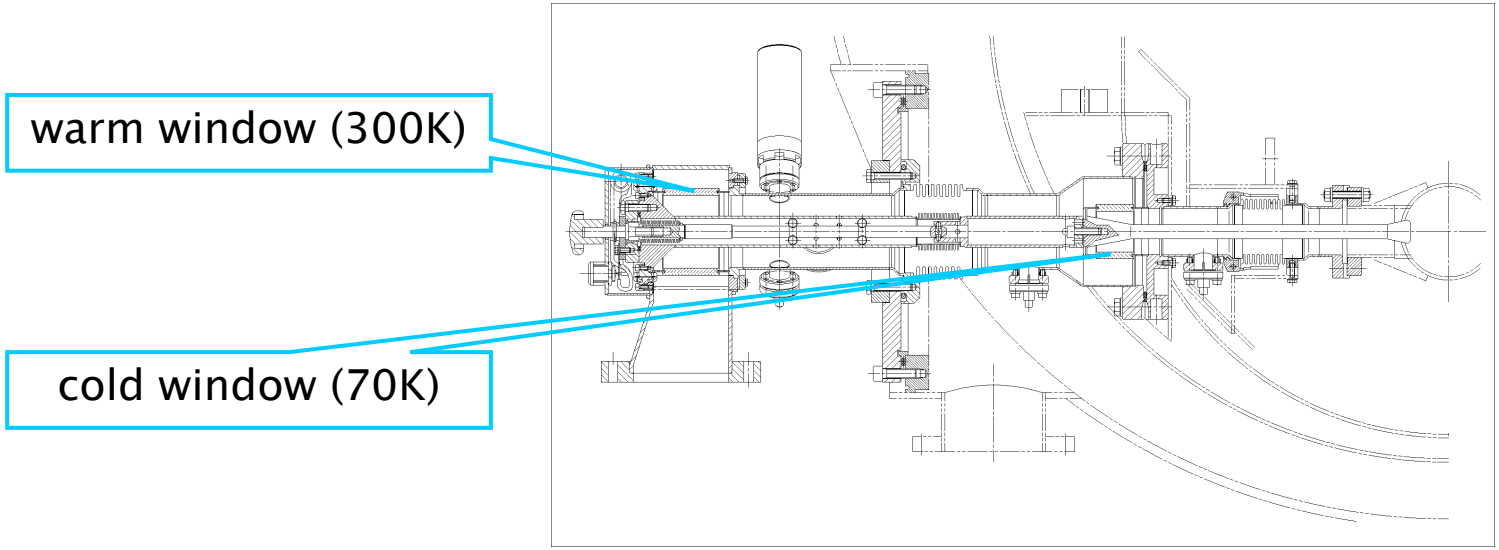
Q_0 Measurements



RF Coupler in the Module



RF Coupler windows temperatures



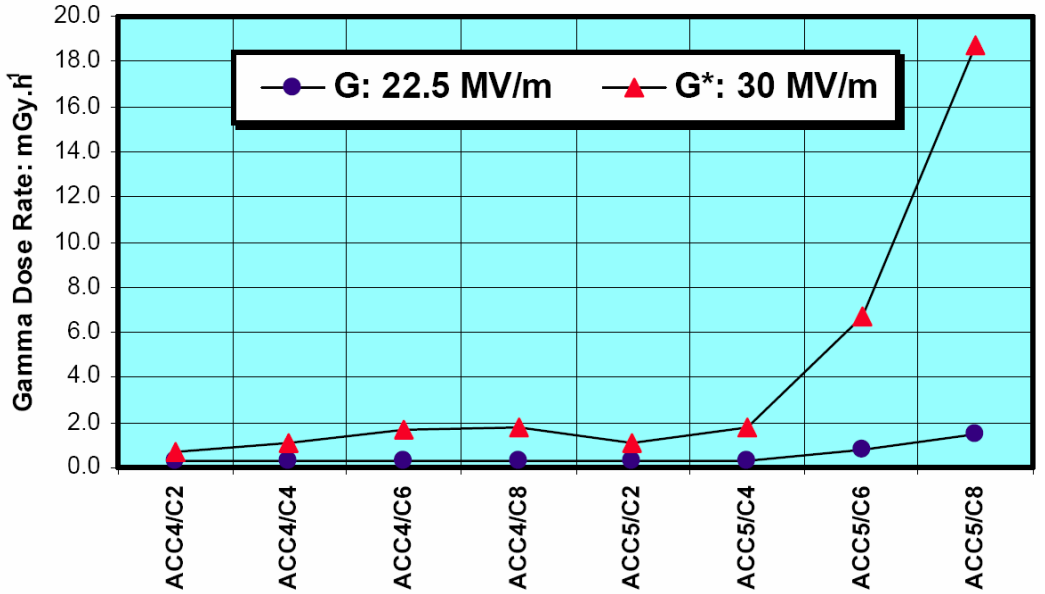
Accelerating module ACC5 high gradient test:

24 hr. at 280 kW pro coupler : 28 MV/m, 10 Hz rep.rate
(cavities 6 and 8 slightly detuned)

ΔT_{70K}=60K (from 80K to 140K) no problem for the cryo system
ΔT_{300K}=27K (from 297K to 324K) warm window cooling with dry N_2 gas must be used above 28MV/m at 10Hz rep.rate

Radiation measurements

TLD cells gamma dose measurements

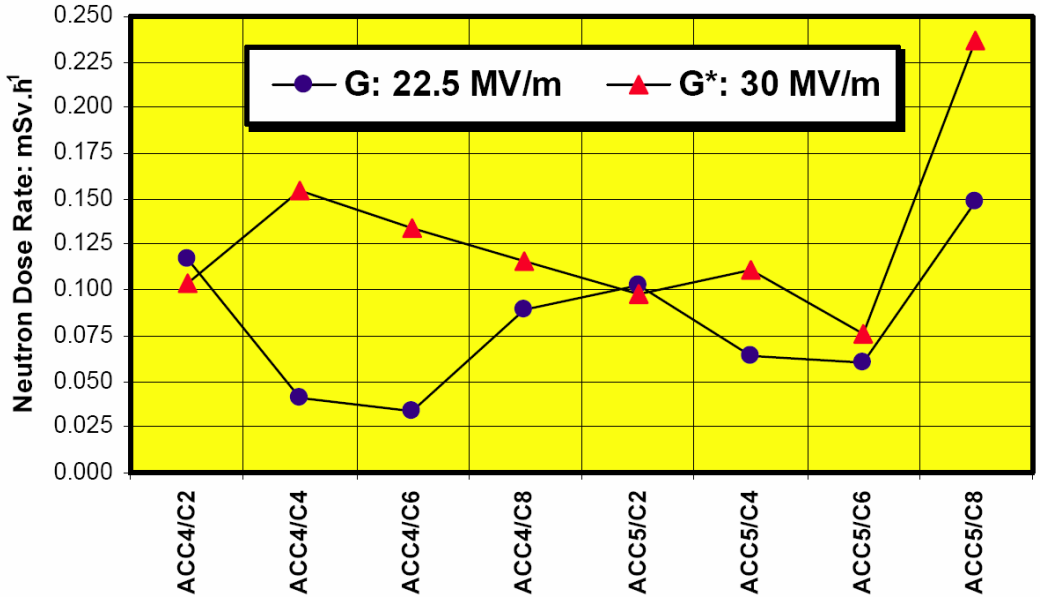


Operation mode:

1. ACC4/5 at 22.5 MV/m
2. ACC4/5 at 14/30 MV/m

rep.rate: 10 Hz.

Bubble detectors neutron dose measurements



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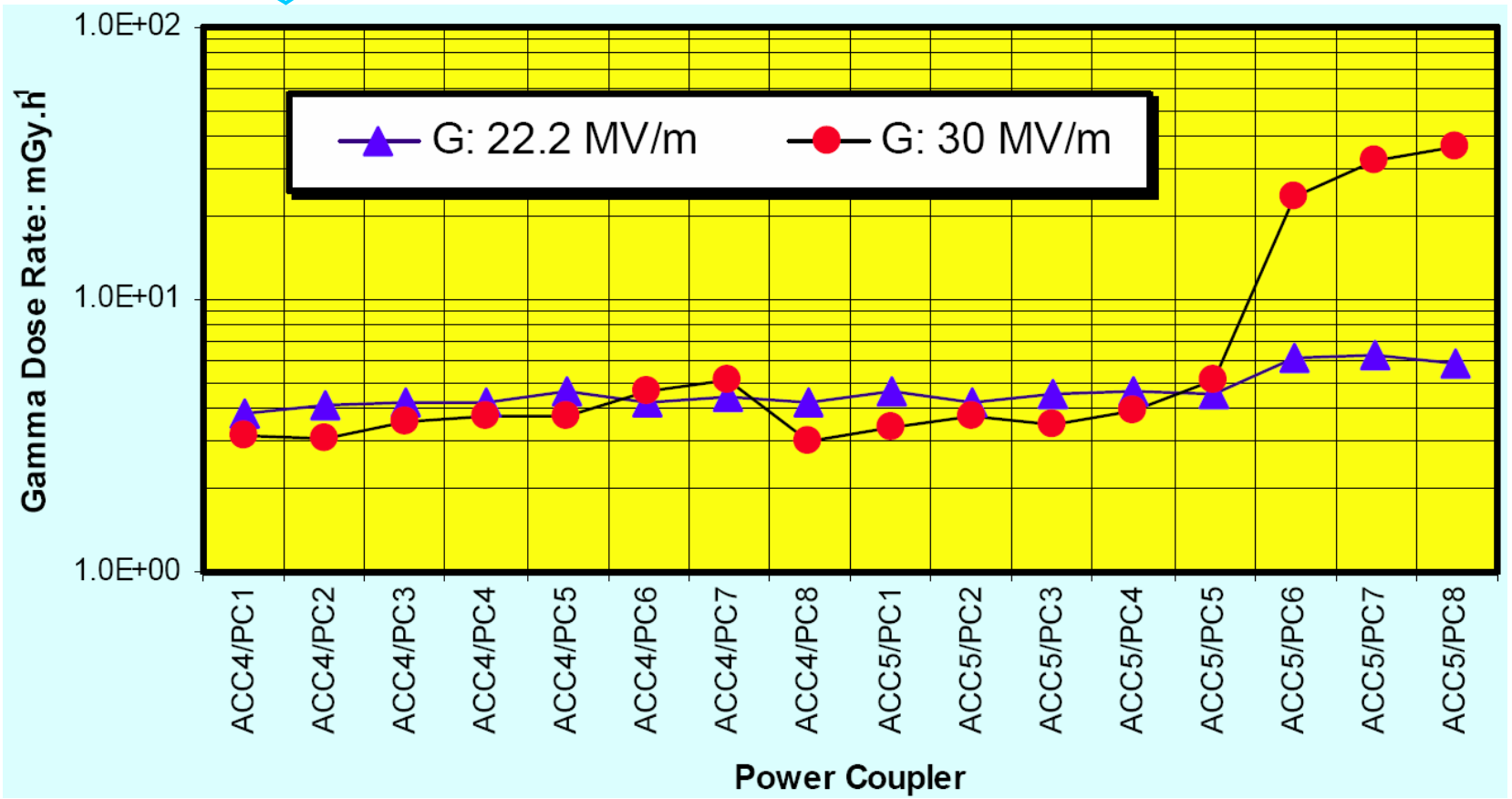
Radiation measurements

GAF chromic films gamma dose measurements



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Conclusions

- ★ The last two modules, 4 and 5, fulfill the TESLA500 specifications.
- ★ ACC5 / module 5, tested at the repetition rate of 5 Hz was operating at the accelerating gradient of 25.5 MV/m , 500 + 800 μs full length flat-top pulse and quality factor of 1×10^{10}.
- ★ ACC5 10 Hz operation was done at 23 MV/m, Q_0 vs E_{acc} curve measured with a new RF calibration and cavities 6 and 8 not complitely detuned (so they contribute to the cryo losses), at 28 MV/m measured $Q_0 = 6.4 \times 10^9$.
- ★ All modules have functioned continuously during certain periods of time.
- ★ The beam operation done with all modules, 700 MeV was reached.
- ★ Irradiation measurements show the increase of the gamma dose near the dump end of the module 5 (ACC5) up to 0.3..0.5 mGy/min with accelerating gradient near and above 25 MV/m with almoust no neutrons. Previous module studies showed, that cavity 6, ACC5, is a source of a dark current (field emission).