

# Tuning FLASH for high beam currents

# PLAN-A: Keep FLASH as it is

- Keep QI's around  $3e6$ , and Pk's as described in excel sheet (flash\_wg\_20100214.xls)
- Flat without beam
- Tilt with beam
- With 3mA of beam loading
  - Tilts range from -10.6% to 4.5%
  - Cavities quench or very close to quench limit
  - Shortening the pulse won't help with <1% tilt
    - (eg. 100 usec pulse still shows 2% tilts)
  - Changing tinj won't help
    - (eg -50 usec changed tilt from -1.88 to -1.85 MV/m)
- Only solution (if no QI change) is lowering power

# PLAN-A: Keep FLASH as it is

ACC6		24.56 MV/m							
Pin [MW]	1.8								
Qext	2.95	2.97	3.00	2.98	3.00	2.98	2.99	2.98	
A [dB]	7.85	7.54	8.16	8.31	12.27	12.03	10.28	10.37	
Pcav [kW]	312	335	290	280	113	119	178	174	
Ecav (end of fill) [MV/m]	29.70	30.74	28.56	28.11	17.80	18.32	22.39	22.18	
Ecav (end of flat) [MV/m]	30.39	31.75	29.19	28.56	15.92	16.52	21.56	21.26	
Tilt [MV/m]	0.7	1.0	0.6	0.4	-1.9	-1.8	-0.8	-0.9	
Tilt [%]	2.3	3.3	2.2	1.6	-10.6	-9.8	-3.7	-4.1	
Ecav, max	34	32	34	32	21	21	29	26	
ΔE	3.61	0.25	4.81	3.44	5.08	4.48	7.44	4.74	
	cav1	cav2	cav3	cav4	cav5	cav6	cav7	cav8	

$I_b = 3\text{mA}$



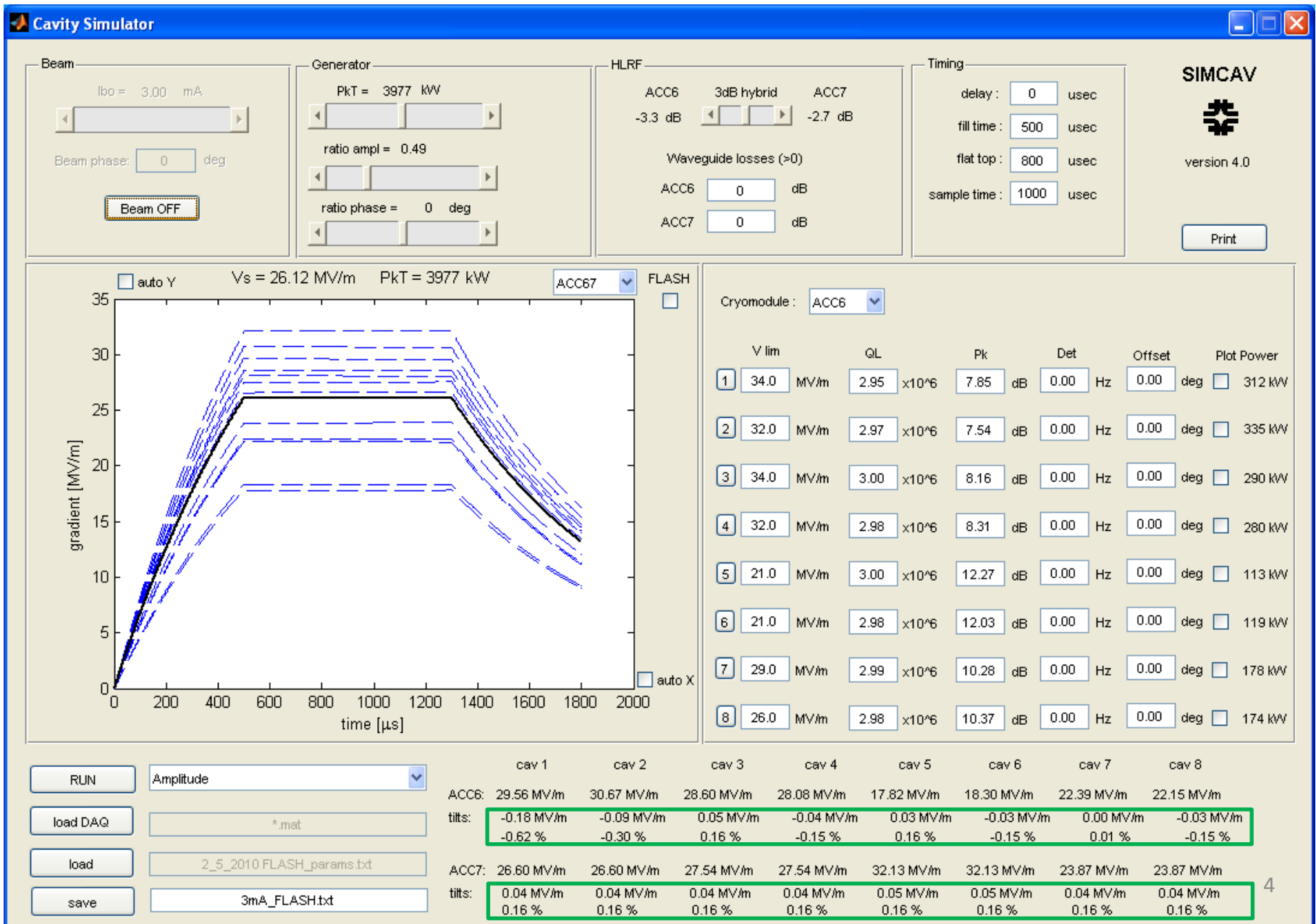
Extreme tilts

ACC7		27.69 MV/m							
Pin [MW]	2.2								
Qext	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	
A [dB]	9.38	9.38	9.08	9.08	7.74	7.74	10.32	10.32	
Pcav [kW]	251	251	269	269	366	366	202	202	
Ecav (end of fill) [MV/m]	26.57	26.57	27.50	27.50	32.09	32.09	23.84	23.84	
Ecav (end of flat) [MV/m]	26.74	26.74	27.89	27.89	33.54	33.54	23.37	23.37	
Tilt [MV/m]	0.2	0.2	0.4	0.4	1.5	1.5	-0.5	-0.5	
Tilt [%]	0.6	0.6	1.4	1.4	4.5	4.5	-2.0	-2.0	
Ecav, max	29	31	34	30	35	39	27	26	
ΔE	2.26	4.26	6.11	2.11	1.46	5.46	3.63	2.63	
	cav1	cav2	cav3	cav4	cav5	cav6	cav7	cav8	



Risk of cavity quench

# PLAN-A: Keep FLASH as it is



# PLAN-A: Keep FLASH as it is

Cavity Simulator

**Beam**

lbo = 3.00 mA

Beam phase: 0 deg

**Generator**

PkT = 3977 kW

ratio ampl = 0.66

ratio phase = 0 deg

**HLRF**

ACC6 3dB hybrid ACC7

-3.3 dB -2.7 dB

Waveguide losses (>0)

ACC6 0 dB

ACC7 0 dB

**Timing**


delay: 0 usec

fill time: 500 usec

flat top: 800 usec

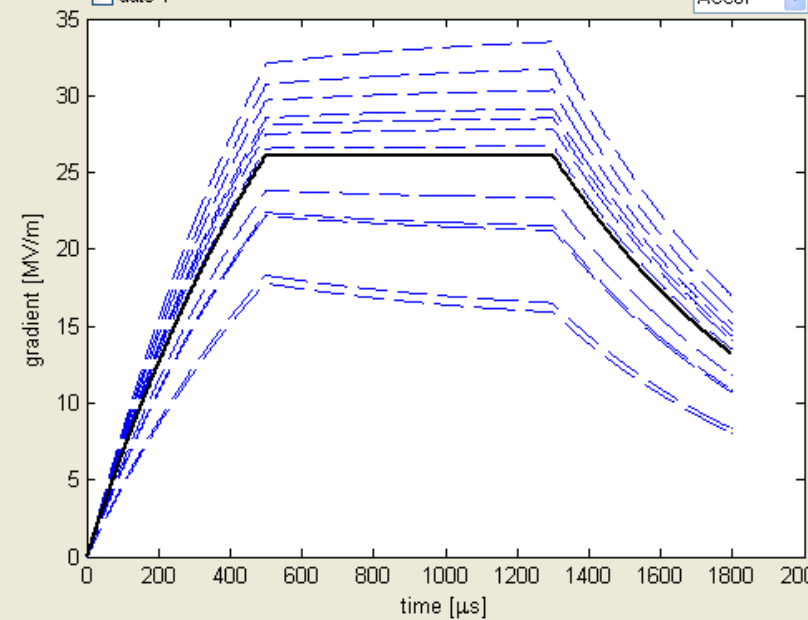
sample time: 1000 usec

**SIMCAV**



version 4.0

auto Y    Vs = 26.11 MV/m    PkT = 3977 kW    ACC67



auto X

Cryomodule: ACC6

	V lim	QL	Pk	Det	Offset	Plot Power
1	34.0 MV/m	2.95 x10 <sup>6</sup>	7.85 dB	0.00 Hz	0.00 deg	312 kW
2	32.0 MV/m	2.97 x10 <sup>6</sup>	7.54 dB	0.00 Hz	0.00 deg	335 kW
3	34.0 MV/m	3.00 x10 <sup>6</sup>	8.16 dB	0.00 Hz	0.00 deg	290 kW
4	32.0 MV/m	2.98 x10 <sup>6</sup>	8.31 dB	0.00 Hz	0.00 deg	280 kW
5	21.0 MV/m	3.00 x10 <sup>6</sup>	12.27 dB	0.00 Hz	0.00 deg	113 kW
6	21.0 MV/m	2.98 x10 <sup>6</sup>	12.03 dB	0.00 Hz	0.00 deg	119 kW
7	29.0 MV/m	2.99 x10 <sup>6</sup>	10.28 dB	0.00 Hz	0.00 deg	178 kW
8	26.0 MV/m	2.98 x10 <sup>6</sup>	10.37 dB	0.00 Hz	0.00 deg	174 kW

	cav 1	cav 2	cav 3	cav 4	cav 5	cav 6	cav 7	cav 8
ACC6:	30.19 MV/m	31.46 MV/m	29.01 MV/m	28.42 MV/m	16.40 MV/m	16.97 MV/m	21.76 MV/m	21.48 MV/m
tilts:	0.66 MV/m	0.97 MV/m	0.60 MV/m	0.42 MV/m	-1.88 MV/m	-1.80 MV/m	-0.85 MV/m	-0.93 MV/m
	2.21 %	3.16 %	2.09 %	1.49 %	-10.55 %	-9.82 %	-3.79 %	-4.18 %
ACC7:	26.67 MV/m	26.67 MV/m	27.77 MV/m	27.77 MV/m	33.14 MV/m	33.14 MV/m	23.48 MV/m	23.48 MV/m
tilts:	0.14 MV/m	0.14 MV/m	0.35 MV/m	0.35 MV/m	1.41 MV/m	1.41 MV/m	-0.49 MV/m	-0.49 MV/m
	0.52 %	0.52 %	1.29 %	1.29 %	4.39 %	4.39 %	-2.04 %	-2.04 %

\*.mat

2\_5\_2010 FLASH\_params.txt

3mA\_FLASH.txt

Amplitude

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# PLAN-A: Keep FLASH as it is

Cavity Simulator

**Beam**

lbo = 3.00 mA

Beam phase: 0 deg

**Generator**

PkT = 3977 kW

ratio ampl = 0.66

ratio phase = 0 deg

**HLRF**

ACC6 3dB hybrid ACC7

-3.3 dB -2.7 dB

Waveguide losses (>0)

ACC6 0 dB

ACC7 0 dB

**Timing**

delay: 0 usec

fill time: 500 usec

flat top: 100 usec

sample time: 500 usec

**SIMCAV**

version 4.0

auto Y
 Vs = 26.11 MV/m PkT = 3977 kW

ACC67

FLASH

Cryomodule: ACC6

	V lim	QL	Pk	Det	Offset	Plot Power
1	34.0 MV/m	2.95 x10 <sup>6</sup>	7.85 dB	0.00 Hz	0.00 deg	312 kW
2	32.0 MV/m	2.97 x10 <sup>6</sup>	7.54 dB	0.00 Hz	0.00 deg	335 kW
3	34.0 MV/m	3.00 x10 <sup>6</sup>	8.16 dB	0.00 Hz	0.00 deg	290 kW
4	32.0 MV/m	2.98 x10 <sup>6</sup>	8.31 dB	0.00 Hz	0.00 deg	280 kW
5	21.0 MV/m	3.00 x10 <sup>6</sup>	12.27 dB	0.00 Hz	0.00 deg	113 kW
6	21.0 MV/m	2.98 x10 <sup>6</sup>	12.03 dB	0.00 Hz	0.00 deg	119 kW
7	29.0 MV/m	2.99 x10 <sup>6</sup>	10.28 dB	0.00 Hz	0.00 deg	178 kW
8	26.0 MV/m	2.98 x10 <sup>6</sup>	10.37 dB	0.00 Hz	0.00 deg	174 kW

	cav 1	cav 2	cav 3	cav 4	cav 5	cav 6	cav 7	cav 8
ACC6:	29.70 MV/m	30.74 MV/m	28.56 MV/m	28.11 MV/m	17.80 MV/m	18.32 MV/m	22.39 MV/m	22.18 MV/m
tilts:	0.12 MV/m	0.18 MV/m	0.11 MV/m	0.08 MV/m	-0.35 MV/m	-0.34 MV/m	-0.16 MV/m	-0.17 MV/m
	0.42 %	0.60 %	0.39 %	0.28 %	-1.99 %	-1.86 %	-0.72 %	-0.79 %
ACC7:	26.57 MV/m	26.57 MV/m	27.50 MV/m	27.50 MV/m	32.09 MV/m	32.09 MV/m	23.84 MV/m	23.84 MV/m
tilts:	0.03 MV/m	0.03 MV/m	0.07 MV/m	0.07 MV/m	0.27 MV/m	0.27 MV/m	-0.09 MV/m	-0.09 MV/m
	0.10 %	0.10 %	0.24 %	0.24 %	0.83 %	0.83 %	-0.38 %	-0.38 %

Amplitude

\*.mat

2\_5\_2010 FLASH\_params.txt

3mA\_FLASH.txt

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# PLAN-A: Keep FLASH as it is

Cavity Simulator
⏏

**Beam**

lbo = 3.00 mA

Beam phase: 0 deg

Beam ON

**Generator**

PkT = 3977 kW

ratio ampl = 0.664

ratio phase = 0 deg

**HLRF**

ACC6 3dB hybrid ACC7

-3.3 dB -2.7 dB

Waveguide losses (>0)

ACC6 0 dB

ACC7 0 dB

**Timing**


delay: 0 usec

fill time: 500 usec

flat top: 800 usec

sample time: 1000 usec

**SIMCAV**



version 4.0

Print

auto Y
 Vs = 26.11 MV/m PkT = 3977 kW

ACC67

FLASH

Cryomodule: ACC6

	V lim	QL	Pk	Det	Offset	Plot Power
1	34.0 MV/m	2.95 x10 <sup>6</sup>	7.85 dB	0.00 Hz	0.00 deg	312 kW
2	32.0 MV/m	2.97 x10 <sup>6</sup>	7.54 dB	0.00 Hz	0.00 deg	335 kW
3	34.0 MV/m	3.00 x10 <sup>6</sup>	8.16 dB	0.00 Hz	0.00 deg	290 kW
4	32.0 MV/m	2.98 x10 <sup>6</sup>	8.31 dB	0.00 Hz	0.00 deg	280 kW
5	21.0 MV/m	3.00 x10 <sup>6</sup>	12.27 dB	0.00 Hz	0.00 deg	113 kW
6	21.0 MV/m	2.98 x10 <sup>6</sup>	12.03 dB	0.00 Hz	0.00 deg	119 kW
7	29.0 MV/m	2.99 x10 <sup>6</sup>	10.28 dB	0.00 Hz	0.00 deg	178 kW
8	26.0 MV/m	2.98 x10 <sup>6</sup>	10.37 dB	0.00 Hz	0.00 deg	174 kW

	cav 1	cav 2	cav 3	cav 4	cav 5	cav 6	cav 7	cav 8
ACC6:	30.19 MV/m	31.46 MV/m	29.01 MV/m	28.42 MV/m	16.40 MV/m	16.97 MV/m	21.76 MV/m	21.48 MV/m
tilts:	0.66 MV/m	0.97 MV/m	0.60 MV/m	0.42 MV/m	-1.88 MV/m	-1.80 MV/m	-0.85 MV/m	-0.93 MV/m
	2.21 %	3.16 %	2.09 %	1.49 %	-10.55 %	-9.82 %	-3.79 %	-4.18 %
ACC7:	26.67 MV/m	26.67 MV/m	27.77 MV/m	27.77 MV/m	33.14 MV/m	33.14 MV/m	23.48 MV/m	23.48 MV/m
tilts:	-4.18 %	0.14 MV/m	0.52 %	0.14 MV/m	0.52 %	0.35 MV/m	1.29 %	0.35 MV/m
	0.52 %	0.52 %	1.29 %	1.29 %	4.39 %	4.39 %	-2.04 %	-2.04 %

RUN

load DAQ

load

save

Amplitude

\*.mat

3mA\_FLASH.txt

default\_params.txt

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# PLAN-A: Keep FLASH as it is

**Cavity Simulator** SIMCAV  
version 4.0  
Print

**Beam**

lbo = 3.00 mA

Beam phase: 0 deg

Beam ON

**Generator**

PkT = 4672 kW

ratio ampl = 0.616

ratio phase = 0 deg

**HLRF**

ACC6 3dB hybrid ACC7  
-3.3 dB -2.7 dB

Waveguide losses (>0)

ACC6 0 dB  
ACC7 0 dB

**Timing**

delay: 0 usec

fill time: 450 usec

flat top: 800 usec

sample time: 1000 usec

auto Y Vs = 26.29 MV/m PkT = 4672 kW ACC67 FLASH

auto X

Cryomodule: ACC6

	V lim	QL	Pk	Det	Offset	Plot Power
1	34.0 MV/m	2.95 x10 <sup>6</sup>	7.85 dB	0.00 Hz	0.00 deg	366 kW
2	32.0 MV/m	2.97 x10 <sup>6</sup>	7.54 dB	0.00 Hz	0.00 deg	393 kW
3	34.0 MV/m	3.00 x10 <sup>6</sup>	8.16 dB	0.00 Hz	0.00 deg	341 kW
4	32.0 MV/m	2.98 x10 <sup>6</sup>	8.31 dB	0.00 Hz	0.00 deg	329 kW
5	21.0 MV/m	3.00 x10 <sup>6</sup>	12.27 dB	0.00 Hz	0.00 deg	132 kW
6	21.0 MV/m	2.98 x10 <sup>6</sup>	12.03 dB	0.00 Hz	0.00 deg	140 kW
7	29.0 MV/m	2.99 x10 <sup>6</sup>	10.28 dB	0.00 Hz	0.00 deg	209 kW
8	26.0 MV/m	2.98 x10 <sup>6</sup>	10.37 dB	0.00 Hz	0.00 deg	205 kW

	cav 1	cav 2	cav 3	cav 4	cav 5	cav 6	cav 7	cav 8
ACC6:	30.42 MV/m	31.72 MV/m	29.23 MV/m	28.63 MV/m	16.42 MV/m	17.00 MV/m	21.86 MV/m	21.58 MV/m
tilts:	0.69 MV/m	1.01 MV/m	0.64 MV/m	0.45 MV/m	-1.85 MV/m	-1.78 MV/m	-0.82 MV/m	-0.90 MV/m
	2.30 %	3.26 %	2.22 %	1.60 %	-10.35 %	-9.65 %	-3.64 %	-4.03 %
ACC7:	26.85 MV/m	26.85 MV/m	27.96 MV/m	27.96 MV/m	33.42 MV/m	33.42 MV/m	23.61 MV/m	23.61 MV/m
tilts:	-4.03 %	0.18 MV/m	0.66 %	0.18 MV/m	0.66 %	0.39 MV/m	1.42 %	0.39 MV/m
	0.66 %	0.66 %	1.42 %	1.42 %	4.50 %	4.50 %	-1.89 %	-1.89 %

RUN

load DAQ

load

save

Amplitude

\*.mat

3mA\_FLASH.txt

default\_params.txt

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# PLAN B: use low QI's, keep Pk's

- As described in Shin's document (PkQI-lik control for ACC6/7 at FLASH, June 19 2010)
- **Flat** with 3mA beam
- **Flat** with 6mA beam
- **No** solution for 9mA beam
- Tilt without beam
- For 3mA configuration
  - QI's are in the  $0.77-1.07 \times 10^6$  range
  - Tilts range from **6.2% to -2.4%**
  - Shortening the pulse **won't help**
    - (eg. 100usec flat top still shows 2% tilts )
  - Changing  $t_{inj}$  **won't help**

# PLAN B: use low QI's, keep Pk's

ACC6		24.41 MV/m							
Pin [MW]	1.8								
Qext	0.80	0.78	0.81	0.82	1.07	1.05	0.92	0.93	
A [dB]	7.85	7.54	8.16	8.31	12.27	12.03	10.28	10.37	
Pcav [kW]	312	335	290	280	113	119	178	174	
Ecav (end of fill) [MV/m]	28.58	29.40	27.67	27.29	18.34	18.80	22.39	22.21	
Ecav (end of flat) [MV/m]	28.11	28.77	27.30	26.99	19.48	19.85	22.77	22.66	
no beam Tilt [MV/m]	-0.5	-0.6	-0.4	-0.3	1.1	1.1	0.4	0.4	
no beam Tilt [%]	-1.6	-2.1	-1.3	-1.1	6.2	5.6	1.7	2.0	
Ecav, max	34	32	34	32	21	21	29	26	
ΔE	5.89	3.23	6.70	5.01	1.52	1.15	6.23	3.34	
	cav1	cav2	cav3	cav4	cav5	cav6	cav7	cav8	

$I_b = 3\text{mA}$



Extreme tilts

ACC7		26.67 MV/m							
Pin [MW]	2.2								
Qext	0.84	0.84	0.83	0.83	0.77	0.77	0.89	0.89	
A [dB]	9.38	9.38	9.08	9.08	7.74	7.74	10.32	10.32	
Pcav [kW]	251	251	269	269	366	366	202	202	
Ecav (end of fill) [MV/m]	26.00	26.00	26.82	26.82	30.64	30.64	23.67	23.67	
Ecav (end of flat) [MV/m]	25.85	25.85	26.60	26.60	29.90	29.90	23.87	23.87	
Tilt [MV/m]	-0.1	-0.1	-0.2	-0.2	-0.7	-0.7	0.2	0.2	
Tilt [%]	-0.6	-0.6	-0.8	-0.8	-2.4	-2.4	0.8	0.8	
Ecav, max	29	31	34	30	35	39	27	26	
ΔE	3.15	5.15	7.40	3.40	5.10	9.10	3.13	2.13	
	cav1	cav2	cav3	cav4	cav5	cav6	cav7	cav8	



Risk of cavity quench

# PLAN B: use low QL's, keep Pk's

Cavity Simulator

**Beam**

lbo = 3.02 mA

Beam phase: 0 deg

**Generator**

PkT = 3977 kW

ratio ampl = 1.001

ratio phase = 0 deg

**HLRF**

ACC6 3dB hybrid ACC7

-3.3 dB -2.7 dB

Waveguide losses (>0)

ACC6 0 dB

ACC7 0 dB

**Timing**

delay: 0 usec

fill time: 500 usec

flat top: 800 usec

sample time: 1300 usec

**SIMCAV**

version 4.0

auto Y

Vs = 25.59 MV/m PkT = 3977 kW

Cryomodule: ACC6

	V lim	QL	Pk	Det	Offset	Plot Power
1	34.0 MV/m	0.80 x10 <sup>6</sup>	7.85 dB	0.00 Hz	0.00 deg	312 kW
2	32.0 MV/m	0.78 x10 <sup>6</sup>	7.54 dB	0.00 Hz	0.00 deg	335 kW
3	34.0 MV/m	0.81 x10 <sup>6</sup>	8.16 dB	0.00 Hz	0.00 deg	290 kW
4	32.0 MV/m	0.82 x10 <sup>6</sup>	8.31 dB	0.00 Hz	0.00 deg	280 kW
5	21.0 MV/m	1.07 x10 <sup>6</sup>	12.27 dB	0.00 Hz	0.00 deg	113 kW
6	21.0 MV/m	1.05 x10 <sup>6</sup>	12.03 dB	0.00 Hz	0.00 deg	119 kW
7	29.0 MV/m	0.92 x10 <sup>6</sup>	10.28 dB	0.00 Hz	0.00 deg	178 kW
8	26.0 MV/m	0.93 x10 <sup>6</sup>	10.37 dB	0.00 Hz	0.00 deg	174 kW

Amplitude

\*.mat

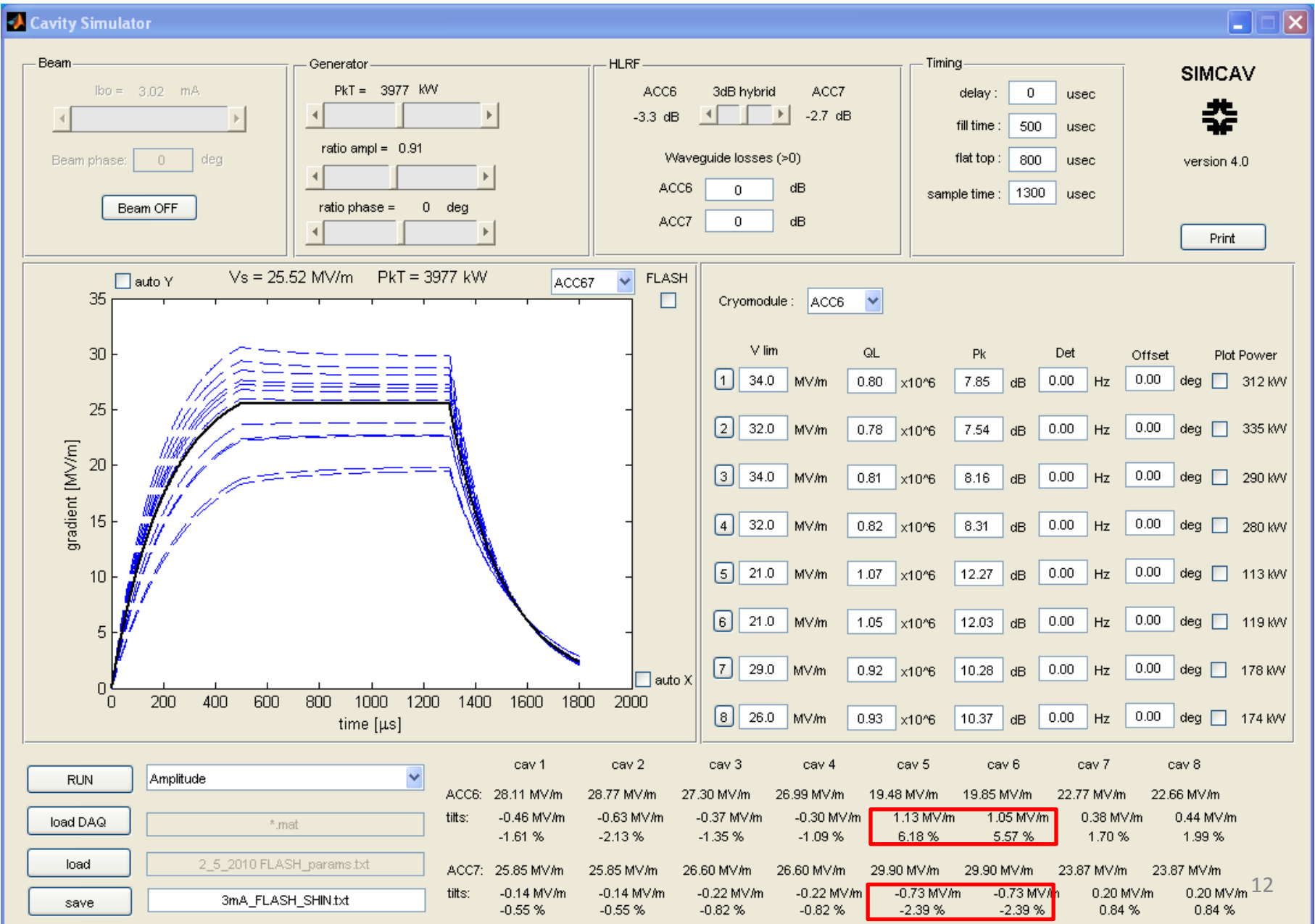
2\_5\_2010 FLASH\_params.txt

default\_params.txt

	cav 1	cav 2	cav 3	cav 4	cav 5	cav 6	cav 7	cav 8
ACC6:	28.63 MV/m	29.41 MV/m	27.70 MV/m	27.33 MV/m	18.35 MV/m	18.80 MV/m	22.39 MV/m	22.23 MV/m
tilts:	0.05 MV/m 0.18 %	0.01 MV/m 0.05 %	0.03 MV/m 0.09 %	0.04 MV/m 0.16 %	0.00 MV/m 0.02 %	0.01 MV/m 0.04 %	-0.00 MV/m -0.01 %	0.02 MV/m 0.08 %
ACC7:	26.02 MV/m	26.02 MV/m	26.87 MV/m	26.87 MV/m	30.69 MV/m	30.69 MV/m	23.69 MV/m	23.69 MV/m
tilts:	0.02 MV/m 0.08 %	0.02 MV/m 0.08 %	0.05 MV/m 0.19 %	0.05 MV/m 0.19 %	0.06 MV/m 0.18 %	0.06 MV/m 0.18 %	0.01 MV/m 0.06 %	0.01 MV/m 0.06 %

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# PLAN B: use low QI's, keep Pk's



# PLAN B: use low QL's, keep Pk's

Cavity Simulator

**Beam**

lbo = 3.02 mA

Beam phase: 0 deg

**Generator**

PkT = 3977 kW

ratio ampl = 0.91

ratio phase = 0 deg

**HLRF**

ACC6 3dB hybrid ACC7

-3.3 dB -2.7 dB

Waveguide losses (>0)

ACC6 0 dB

ACC7 0 dB

**Timing**

delay: 0 usec

fill time: 500 usec

flat top: 100 usec

sample time: 600 usec

**SIMCAV**

version 4.0

auto Y
 Vs = 25.53 MV/m PkT = 3977 kW

ACC67

FLASH

Cryomodule: ACC6

	V lim	QL	Pk	Det	Offset	Plot Power
1	34.0	0.80 x10 <sup>6</sup>	7.85 dB	0.00 Hz	0.00 deg	312 kW
2	32.0	0.78 x10 <sup>6</sup>	7.54 dB	0.00 Hz	0.00 deg	335 kW
3	34.0	0.81 x10 <sup>6</sup>	8.16 dB	0.00 Hz	0.00 deg	290 kW
4	32.0	0.82 x10 <sup>6</sup>	8.31 dB	0.00 Hz	0.00 deg	280 kW
5	21.0	1.07 x10 <sup>6</sup>	12.27 dB	0.00 Hz	0.00 deg	113 kW
6	21.0	1.05 x10 <sup>6</sup>	12.03 dB	0.00 Hz	0.00 deg	119 kW
7	29.0	0.92 x10 <sup>6</sup>	10.28 dB	0.00 Hz	0.00 deg	178 kW
8	26.0	0.93 x10 <sup>6</sup>	10.37 dB	0.00 Hz	0.00 deg	174 kW

Amplitude

\*.mat

2\_5\_2010 FLASH\_params.txt

3mA\_FLASH\_SHIN.txt

	cav 1	cav 2	cav 3	cav 4	cav 5	cav 6	cav 7	cav 8
ACC6:	28.39 MV/m	29.14 MV/m	27.52 MV/m	27.17 MV/m	18.72 MV/m	19.15 MV/m	22.53 MV/m	22.38 MV/m
tilts:	-0.18 MV/m	-0.26 MV/m	-0.15 MV/m	-0.12 MV/m	0.37 MV/m	0.35 MV/m	0.14 MV/m	0.16 MV/m
	-0.65 %	-0.87 %	-0.54 %	-0.43 %	2.02 %	1.85 %	0.62 %	0.72 %
ACC7:	25.94 MV/m	25.94 MV/m	26.74 MV/m	26.74 MV/m	30.33 MV/m	30.33 MV/m	23.75 MV/m	23.75 MV/m
tilts:	-0.05 MV/m	-0.05 MV/m	-0.09 MV/m	-0.09 MV/m	-0.30 MV/m	-0.30 MV/m	0.07 MV/m	0.07 MV/m
	-0.21 %	-0.21 %	-0.32 %	-0.32 %	-0.98 %	-0.98 %	0.31 %	0.31 %

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# Summary:

- If Pk's and Ql's remain as they are:
  - Beam ON tilts range from -36% to 15%
    - 200 usec flat top (-13% +5%)
  - Need to lower gradient for 9mA
    - 23.4 MV/m instead of 26.1 MV/m
    - ACC6 cav2 : 1.4 MV/m safe margin
- If only Ql's are changed:
  - You can adjust the Ql's for flat with 3mA
    - Beam OFF tilts range from +6.2% to -2.4%
    - 200 usec flat top (+3.4% to -1.6%)
  - You can adjust the Ql's for flat with 6mA
    - Beam OFF tilts range from +36% to -8.6%
    - 200 usec flat top (+12.72% to -4.5%)
    - Need to lower gradient 22.5 in stead of 26.1MV/m
  - No solution for 9mA

# Extra slide: tilt with 1mA

Cavity Simulator

Beam

lbo = 1.02 mA

Beam phase: 0 deg

Beam OFF

Generator

PkT = 3977 kW

ratio ampl = 0.49

ratio phase = 0 deg

HLRF

ACC6 3dB hybrid ACC7

-3.3 dB -2.7 dB

Waveguide losses (>0)

ACC6 0 dB

ACC7 0 dB

Timing

delay: 0 usec

fill time: 500 usec

flat top: 800 usec

sample time: 1000 usec

**SIMCAV**

version 4.0

Print

auto Y    Vs = 26.12 MV/m    PkT = 3977 kW    ACC67

FLASH     auto X

Cryomodule: ACC6

	V lim	QL	Pk	Det	Offset	Plot Power
1	34.0 MV/m	2.95 x10 <sup>6</sup>	7.85 dB	0.00 Hz	0.00 deg	<input type="checkbox"/> 312 kW
2	32.0 MV/m	2.97 x10 <sup>6</sup>	7.54 dB	0.00 Hz	0.00 deg	<input type="checkbox"/> 335 kW
3	34.0 MV/m	3.00 x10 <sup>6</sup>	8.16 dB	0.00 Hz	0.00 deg	<input type="checkbox"/> 290 kW
4	32.0 MV/m	2.98 x10 <sup>6</sup>	8.31 dB	0.00 Hz	0.00 deg	<input type="checkbox"/> 280 kW
5	21.0 MV/m	3.00 x10 <sup>6</sup>	12.27 dB	0.00 Hz	0.00 deg	<input type="checkbox"/> 113 kW
6	21.0 MV/m	2.98 x10 <sup>6</sup>	12.03 dB	0.00 Hz	0.00 deg	<input type="checkbox"/> 119 kW
7	29.0 MV/m	2.99 x10 <sup>6</sup>	10.28 dB	0.00 Hz	0.00 deg	<input type="checkbox"/> 178 kW
8	26.0 MV/m	2.98 x10 <sup>6</sup>	10.37 dB	0.00 Hz	0.00 deg	<input type="checkbox"/> 174 kW

Amplitude

   \*.mat

   0

   default\_params.txt

	cav 1	cav 2	cav 3	cav 4	cav 5	cav 6	cav 7	cav 8
ACC6:	29.56 MV/m	30.67 MV/m	28.60 MV/m	28.08 MV/m	17.82 MV/m	18.30 MV/m	22.39 MV/m	22.15 MV/m
margin:	4.3 MV/m	1.3 MV/m	5.4 MV/m	3.9 MV/m	3.2 MV/m	2.7 MV/m	6.6 MV/m	3.8 MV/m
tilts:	-0.18 MV/m	-0.09 MV/m	0.05 MV/m	-0.04 MV/m	0.03 MV/m	-0.03 MV/m	0.00 MV/m	-0.03 MV/m
	-0.62 %	-0.30 %	0.16 %	-0.15 %	0.16 %	-0.15 %	0.01 %	-0.15 %
ACC7:	26.60 MV/m	26.60 MV/m	27.54 MV/m	27.54 MV/m	32.13 MV/m	32.13 MV/m	23.87 MV/m	23.87 MV/m
margin:	2.4 MV/m	4.4 MV/m	6.5 MV/m	2.5 MV/m	2.9 MV/m	6.9 MV/m	3.1 MV/m	2.1 MV/m
tilts:	0.04 MV/m	0.04 MV/m	0.04 MV/m	0.04 MV/m	0.05 MV/m	0.05 MV/m	0.04 MV/m	0.04 MV/m
	0.16 %	0.16 %	0.16 %	0.16 %	0.16 %	0.16 %	0.16 %	0.16 %

15

# Extra slide: tilt with 1mA

Cavity Simulator

**Beam**

Ibo = 1.02 mA

Beam phase: 0 deg

**Generator**

PkT = 3977 kW

ratio ampl = 0.55

ratio phase = 0 deg

**HLRF**

ACC6 3dB hybrid ACC7

-3.3 dB -2.7 dB

Waveguide losses (>0)

ACC6 0 dB

ACC7 0 dB

**Timing**


delay: 0 usec

fill time: 500 usec

flat top: 800 usec

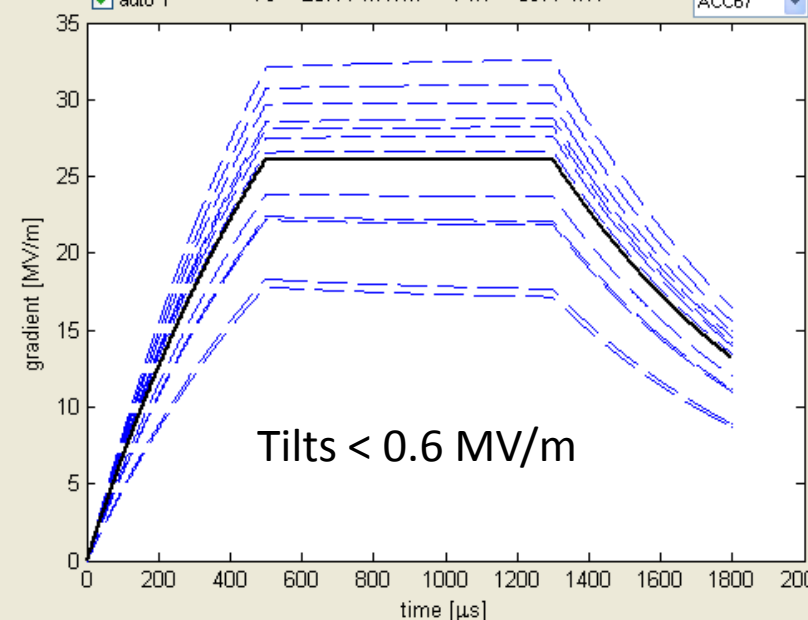
sample time: 1000 usec

**SIMCAV**



version 4.0

auto Y    Vs = 26.11 MV/m    PkT = 3977 kW    ACC67



auto X

Cryomodule: ACC6

	V lim	QL	Pk	Det	Offset	Plot Power
1	34.0 MV/m	2.95 x10 <sup>6</sup>	7.85 dB	0.00 Hz	0.00 deg	312 kW
2	32.0 MV/m	2.97 x10 <sup>6</sup>	7.54 dB	0.00 Hz	0.00 deg	335 kW
3	34.0 MV/m	3.00 x10 <sup>6</sup>	8.16 dB	0.00 Hz	0.00 deg	290 kW
4	32.0 MV/m	2.98 x10 <sup>6</sup>	8.31 dB	0.00 Hz	0.00 deg	280 kW
5	21.0 MV/m	3.00 x10 <sup>6</sup>	12.27 dB	0.00 Hz	0.00 deg	113 kW
6	21.0 MV/m	2.98 x10 <sup>6</sup>	12.03 dB	0.00 Hz	0.00 deg	119 kW
7	29.0 MV/m	2.99 x10 <sup>6</sup>	10.28 dB	0.00 Hz	0.00 deg	178 kW
8	26.0 MV/m	2.98 x10 <sup>6</sup>	10.37 dB	0.00 Hz	0.00 deg	174 kW

Amplitude

   \*.mat

   0

   default\_params.txt

	cav 1	cav 2	cav 3	cav 4	cav 5	cav 6	cav 7	cav 8
ACC6:	29.77 MV/m	30.93 MV/m	28.73 MV/m	28.19 MV/m	17.33 MV/m	17.84 MV/m	22.17 MV/m	21.92 MV/m
margin:	4.2 MV/m	1.0 MV/m	5.2 MV/m	3.8 MV/m	3.2 MV/m	2.7 MV/m	6.6 MV/m	3.8 MV/m
tilts:	0.09 MV/m	0.25 MV/m	0.22 MV/m	0.10 MV/m	-0.63 MV/m	-0.64 MV/m	-0.30 MV/m	-0.35 MV/m
	0.30 %	0.82 %	0.77 %	0.36 %	-3.54 %	-3.49 %	-1.34 %	-1.57 %
ACC7:	26.62 MV/m	26.62 MV/m	27.61 MV/m	27.61 MV/m	32.46 MV/m	32.46 MV/m	23.73 MV/m	23.73 MV/m
margin:	2.4 MV/m	4.4 MV/m	6.4 MV/m	2.4 MV/m	2.4 MV/m	6.4 MV/m	3.2 MV/m	2.2 MV/m
tilts:	0.06 MV/m	0.06 MV/m	0.14 MV/m	0.14 MV/m	0.50 MV/m	0.50 MV/m	-0.15 MV/m	-0.15 MV/m
	0.23 %	0.23 %	0.49 %	0.49 %	1.55 %	1.55 %	-0.64 %	-0.64 %

16



# Extra slide: if more tilting allowed

Cavity Simulator

**Beam**

lbo = 9.00 mA

Beam phase: 0 deg

**Generator**

PkT = 8618 kW

ratio ampl = 1.00

ratio phase = 0 deg

**HLRF**

ACC6 3dB hybrid ACC7  
-3.3 dB -2.7 dB

Waveguide losses (>0)

ACC6 0 dB  
ACC7 0 dB

**Timing**


delay: 0 usec

fill time: 200 usec

flat top: 1000 usec

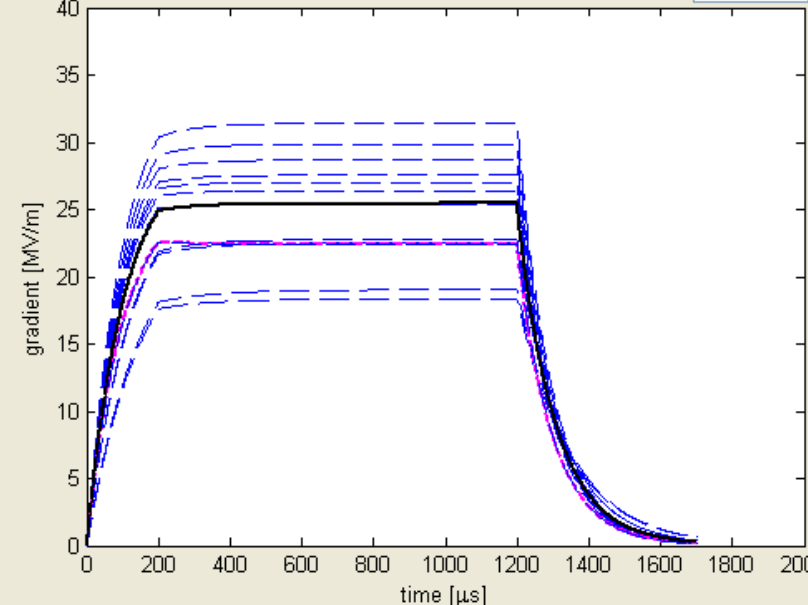
sample time: 1000 usec

**SIMCAV**



version 4.0

auto Y    Vs = 25.43 MV/m    PkT = 8618 kW    ACC67



auto X

Cryomodule: ACC7

	V lim	QL	Pk	Det	Offset	Plot Power
1	29.0 MV/m	0.40 x10 <sup>6</sup>	9.38 dB	0.00 Hz	0.00 deg	<input type="checkbox"/> 544 kW
2	31.0 MV/m	0.40 x10 <sup>6</sup>	9.38 dB	0.00 Hz	0.00 deg	<input type="checkbox"/> 544 kW
3	34.0 MV/m	0.40 x10 <sup>6</sup>	9.08 dB	0.00 Hz	0.00 deg	<input type="checkbox"/> 583 kW
4	30.0 MV/m	0.40 x10 <sup>6</sup>	9.08 dB	0.00 Hz	0.00 deg	<input type="checkbox"/> 583 kW
5	35.0 MV/m	0.40 x10 <sup>6</sup>	7.74 dB	0.00 Hz	0.00 deg	<input type="checkbox"/> 793 kW
6	39.0 MV/m	0.40 x10 <sup>6</sup>	7.74 dB	0.00 Hz	0.00 deg	<input type="checkbox"/> 793 kW
7	27.0 MV/m	0.40 x10 <sup>6</sup>	10.32 dB	0.00 Hz	0.00 deg	<input type="checkbox"/> 438 kW
8	26.0 MV/m	0.40 x10 <sup>6</sup>	10.32 dB	0.00 Hz	0.00 deg	<input type="checkbox"/> 438 kW

Amplitude

   \*.mat

   2\_5\_2010 FLASH\_params.txt

   FLASH\_9mA\_short\_fill.txt

	cav 1	cav 2	cav 3	cav 4	cav 5	cav 6	cav 7	cav 8
ACC6:	28.68 MV/m	29.86 MV/m	27.55 MV/m	27.02 MV/m	18.36 MV/m	19.03 MV/m	22.78 MV/m	22.50 MV/m
margin:	5.3 MV/m	2.1 MV/m	6.4 MV/m	5.0 MV/m	2.6 MV/m	2.0 MV/m	6.2 MV/m	3.5 MV/m
tilts:	0.66 MV/m 2.37 %	0.82 MV/m 2.81 %	0.51 MV/m 1.90 %	0.44 MV/m 1.67 %	0.75 MV/m 4.24 %	0.92 MV/m 5.07 %	0.89 MV/m 4.07 %	0.84 MV/m 3.86 %
ACC7:	25.38 MV/m	25.38 MV/m	26.39 MV/m	26.39 MV/m	31.40 MV/m	31.40 MV/m	22.40 MV/m	22.40 MV/m
margin:	3.6 MV/m	5.6 MV/m	7.6 MV/m	3.6 MV/m	3.6 MV/m	7.6 MV/m	4.4 MV/m	3.4 MV/m
tilts:	0.23 MV/m 0.91 %	0.23 MV/m 0.91 %	0.36 MV/m 1.40 %	0.36 MV/m 1.40 %	1.02 MV/m 3.36 %	1.02 MV/m 3.36 %	-0.16 MV/m -0.71 %	-0.16 MV/m -0.71 %

# Extra slide: if more tilting allowed

**Cavity Simulator**
□ □ ✕

**Beam**

lbo = 6.02 mA

Beam phase: 0 deg

Beam OFF

**Generator**

PkT = 3977 kW

ratio ampl = 0.992

ratio phase = 0 deg

**HLRF**

ACC6 3dB hybrid ACC7

-3.3 dB -2.7 dB

Waveguide losses (>0)

ACC6 0 dB

ACC7 0 dB

**Timing**

delay: 0 usec

fill time: 650 usec

flat top: 1000 usec

sample time: 1000 usec

**SIMCAV**

version 4.0

Print

auto Y Vs = 22.29 MV/m PkT = 3977 kW ACC67 FLASH

auto X

Cryomodule: ACC7

	V lim	QL	Pk	Det	Offset	Plot Power
1	29.0 MV/m	0.52 x10 <sup>6</sup>	9.38 dB	0.00 Hz	0.00 deg	251 kW
2	31.0 MV/m	0.52 x10 <sup>6</sup>	9.38 dB	0.00 Hz	0.00 deg	251 kW
3	34.0 MV/m	0.51 x10 <sup>6</sup>	9.08 dB	0.00 Hz	0.00 deg	269 kW
4	30.0 MV/m	0.51 x10 <sup>6</sup>	9.08 dB	0.00 Hz	0.00 deg	269 kW
5	35.0 MV/m	0.45 x10 <sup>6</sup>	7.74 dB	0.00 Hz	0.00 deg	366 kW
6	39.0 MV/m	0.45 x10 <sup>6</sup>	7.74 dB	0.00 Hz	0.00 deg	366 kW
7	27.0 MV/m	0.58 x10 <sup>6</sup>	10.32 dB	0.00 Hz	0.00 deg	202 kW
8	26.0 MV/m	0.58 x10 <sup>6</sup>	10.32 dB	0.00 Hz	0.00 deg	202 kW

RUN Amplitude

load DAQ \*.mat

load FLASH\_9mA\_short\_fill.txt

save FLASH\_SHIN\_9mA\_beam\_off.txt

	cav 1	cav 2	cav 3	cav 4	cav 5	cav 6	cav 7	cav 8
ACC6:	23.59 MV/m	24.19 MV/m	23.24 MV/m	22.85 MV/m	19.73 MV/m	19.68 MV/m	20.47 MV/m	20.42 MV/m
margin:	10.3 MV/m	7.7 MV/m	10.7 MV/m	9.1 MV/m	1.1 MV/m	1.2 MV/m	8.5 MV/m	5.6 MV/m
tilts:	-0.10 MV/m	-0.12 MV/m	-0.08 MV/m	-0.08 MV/m	0.99 MV/m	0.79 MV/m	0.13 MV/m	0.14 MV/m
	-0.43 %	-0.47 %	-0.34 %	-0.34 %	5.24 %	4.13 %	0.61 %	0.71 %
ACC7:	22.27 MV/m	22.27 MV/m	22.83 MV/m	22.83 MV/m	25.03 MV/m	25.03 MV/m	21.10 MV/m	21.10 MV/m
margin:	6.7 MV/m	8.7 MV/m	11.1 MV/m	7.1 MV/m	9.8 MV/m	13.8 MV/m	5.9 MV/m	4.9 MV/m
tilts:	-0.04 MV/m	-0.04 MV/m	-0.05 MV/m	-0.05 MV/m	-0.13 MV/m	-0.13 MV/m	0.05 MV/m	0.05 MV/m
	-0.18 %	-0.18 %	-0.23 %	-0.23 %	-0.51 %	-0.51 %	0.25 %	0.25 %

18

# Extra slide: if more tilting allowed

Cavity Simulator

**Beam**

lbo = 1.01 mA

Beam phase: 0 deg

**Generator**

PkT = 3977 kW

ratio ampl = 1.00

ratio phase = 0 deg

**HLRF**

ACC6 3dB hybrid ACC7

-3.3 dB -2.7 dB

Waveguide losses (>0)

ACC6 0 dB

ACC7 0 dB

**Timing**

delay: 0 usec

fill time: 600 usec

flat top: 1000 usec

sample time: 1000 usec

**SIMCAV**

version 4.0

auto Y    Vs = 21.92 MV/m    PkT = 3977 kW    ACC67

FLASH

auto X

Cryomodule: ACC7

	V lim	QL	Pk	Det	Offset	Plot Power
1	29.0 MV/m	0.52 x10 <sup>6</sup>	9.38 dB	0.00 Hz	0.00 deg	<input type="checkbox"/> 251 kW
2	31.0 MV/m	0.52 x10 <sup>6</sup>	9.38 dB	0.00 Hz	0.00 deg	<input type="checkbox"/> 251 kW
3	34.0 MV/m	0.51 x10 <sup>6</sup>	9.08 dB	0.00 Hz	0.00 deg	<input type="checkbox"/> 269 kW
4	30.0 MV/m	0.51 x10 <sup>6</sup>	9.08 dB	0.00 Hz	0.00 deg	<input type="checkbox"/> 269 kW
5	35.0 MV/m	0.45 x10 <sup>6</sup>	7.74 dB	0.00 Hz	0.00 deg	<input type="checkbox"/> 366 kW
6	39.0 MV/m	0.45 x10 <sup>6</sup>	7.74 dB	0.00 Hz	0.00 deg	<input type="checkbox"/> 366 kW
7	27.0 MV/m	0.58 x10 <sup>6</sup>	10.32 dB	0.00 Hz	0.00 deg	<input type="checkbox"/> 202 kW
8	26.0 MV/m	0.58 x10 <sup>6</sup>	10.32 dB	0.00 Hz	0.00 deg	<input type="checkbox"/> 202 kW

Amplitude

   \*.mat

   FLASH\_9mA\_short\_fill.txt

   FLASH\_SHIN\_9mA\_beam\_off.txt

	cav 1	cav 2	cav 3	cav 4	cav 5	cav 6	cav 7	cav 8
ACC6:	23.31 MV/m	23.92 MV/m	22.94 MV/m	22.54 MV/m	19.07 MV/m	19.06 MV/m	20.03 MV/m	19.97 MV/m
margin:	10.4 MV/m	7.7 MV/m	10.7 MV/m	9.1 MV/m	1.8 MV/m	1.9 MV/m	8.8 MV/m	5.8 MV/m
tilts:	-0.34 MV/m	-0.34 MV/m	-0.33 MV/m	-0.33 MV/m	0.51 MV/m	0.32 MV/m	-0.22 MV/m	-0.21 MV/m
	-1.44 %	-1.41 %	-1.43 %	-1.46 %	2.71 %	1.72 %	-1.10 %	-1.03 %
ACC7:	21.94 MV/m	21.94 MV/m	22.51 MV/m	22.51 MV/m	24.78 MV/m	24.78 MV/m	20.70 MV/m	20.70 MV/m
margin:	6.8 MV/m	8.8 MV/m	11.2 MV/m	7.2 MV/m	9.9 MV/m	13.9 MV/m	6.0 MV/m	5.0 MV/m
tilts:	-0.32 MV/m	-0.32 MV/m	-0.32 MV/m	-0.32 MV/m	-0.34 MV/m	-0.34 MV/m	-0.27 MV/m	-0.27 MV/m
	-1.43 %	-1.43 %	-1.41 %	-1.41 %	-1.36 %	-1.36 %	-1.28 %	-1.28 %

19

# Extra slide: if more tilting allowed

Cavity Simulator

**Beam**

lbo = 3.02 mA

Beam phase: 0 deg

**Generator**

PkT = 3977 kW

ratio ampl = 1.00

ratio phase = 0 deg

**HLRF**

ACC6 3dB hybrid ACC7

-3.3 dB -2.7 dB

Waveguide losses (>0)

ACC6 0 dB

ACC7 0 dB

**Timing**

delay: 0 usec

fill time: 350 usec

flat top: 1000 usec

sample time: 1000 usec

**SIMCAV**

version 4.0

auto Y

Vs = 20.76 MV/m PkT = 3977 kW

ACC67

FLASH

auto X

Cryomodule: ACC7

	V lim	QL	Pk	Det	Offset	Plot Power
1	29.0 MV/m	0.52 x10 <sup>6</sup>	9.38 dB	0.00 Hz	0.00 deg	251 kW
2	31.0 MV/m	0.52 x10 <sup>6</sup>	9.38 dB	0.00 Hz	0.00 deg	251 kW
3	34.0 MV/m	0.51 x10 <sup>6</sup>	9.08 dB	0.00 Hz	0.00 deg	269 kW
4	30.0 MV/m	0.51 x10 <sup>6</sup>	9.08 dB	0.00 Hz	0.00 deg	269 kW
5	35.0 MV/m	0.45 x10 <sup>6</sup>	7.74 dB	0.00 Hz	0.00 deg	366 kW
6	39.0 MV/m	0.45 x10 <sup>6</sup>	7.74 dB	0.00 Hz	0.00 deg	366 kW
7	27.0 MV/m	0.58 x10 <sup>6</sup>	10.32 dB	0.00 Hz	0.00 deg	202 kW
8	26.0 MV/m	0.58 x10 <sup>6</sup>	10.32 dB	0.00 Hz	0.00 deg	202 kW

Amplitude

\*.mat

FLASH\_9mA\_short\_fill.txt

FLASH\_SHIN\_9mA\_beam\_off.txt

	cav 1	cav 2	cav 3	cav 4	cav 5	cav 6	cav 7	cav 8
ACC6:	22.36 MV/m	22.99 MV/m	21.94 MV/m	21.54 MV/m	17.20 MV/m	17.30 MV/m	18.77 MV/m	18.69 MV/m
margin:	11.4 MV/m	8.7 MV/m	11.9 MV/m	10.2 MV/m	3.7 MV/m	3.7 MV/m	10.2 MV/m	7.3 MV/m
tilts:	-0.26 MV/m	-0.27 MV/m	-0.19 MV/m	-0.21 MV/m	1.52 MV/m	1.25 MV/m	0.21 MV/m	0.25 MV/m
	-1.15 %	-1.18 %	-0.85 %	-0.97 %	9.63 %	7.76 %	1.13 %	1.36 %
ACC7:	20.88 MV/m	20.88 MV/m	21.47 MV/m	21.47 MV/m	23.86 MV/m	23.86 MV/m	19.52 MV/m	19.52 MV/m
margin:	8.0 MV/m	10.0 MV/m	12.4 MV/m	8.4 MV/m	10.9 MV/m	14.9 MV/m	7.5 MV/m	6.5 MV/m
tilts:	-0.11 MV/m	-0.11 MV/m	-0.12 MV/m	-0.12 MV/m	-0.28 MV/m	-0.28 MV/m	0.08 MV/m	0.08 MV/m
	-0.52 %	-0.52 %	-0.55 %	-0.55 %	-1.17 %	-1.17 %	0.42 %	0.42 %

20

# Extra slide: if more tilting allowed

**Cavity Simulator**
⏏

**Beam**

lbo = 6.02 mA

Beam phase: 0 deg

Beam ON

**Generator**

PkT = 3977 kW

ratio ampl = 1.00

ratio phase = 0 deg

**HLRF**

ACC6 3dB hybrid ACC7

-3.3 dB -2.7 dB

Waveguide losses (>0)

ACC6 0 dB

ACC7 0 dB

**Timing**


delay: 0 usec

fill time: 260 usec

flat top: 1000 usec

sample time: 1000 usec

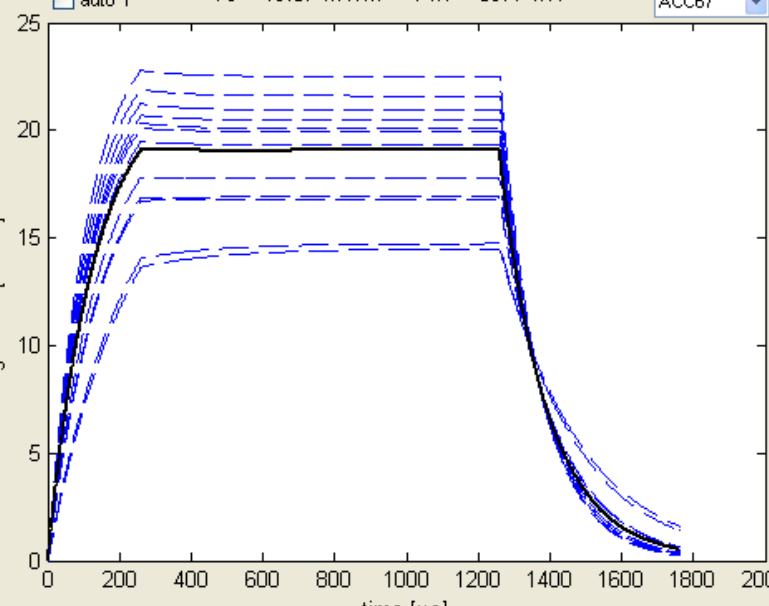
**SIMCAV**



version 4.0

Print

auto Y Vs = 19.07 MV/m PkT = 3977 kW ACC67



FLASH

auto X

Cryomodule: ACC7

	V lim	QL	Pk	Det	Offset	Plot Power
1	29.0 MV/m	0.52 x10 <sup>6</sup>	9.38 dB	0.00 Hz	0.00 deg	251 kW
2	31.0 MV/m	0.52 x10 <sup>6</sup>	9.38 dB	0.00 Hz	0.00 deg	251 kW
3	34.0 MV/m	0.51 x10 <sup>6</sup>	9.08 dB	0.00 Hz	0.00 deg	269 kW
4	30.0 MV/m	0.51 x10 <sup>6</sup>	9.08 dB	0.00 Hz	0.00 deg	269 kW
5	35.0 MV/m	0.45 x10 <sup>6</sup>	7.74 dB	0.00 Hz	0.00 deg	366 kW
6	39.0 MV/m	0.45 x10 <sup>6</sup>	7.74 dB	0.00 Hz	0.00 deg	366 kW
7	27.0 MV/m	0.58 x10 <sup>6</sup>	10.32 dB	0.00 Hz	0.00 deg	202 kW
8	26.0 MV/m	0.58 x10 <sup>6</sup>	10.32 dB	0.00 Hz	0.00 deg	202 kW

		cav 1	cav 2	cav 3	cav 4	cav 5	cav 6	cav 7	cav 8
RUN	Amplitude	ACC6: 20.94 MV/m	21.60 MV/m	20.47 MV/m	20.07 MV/m	14.46 MV/m	14.72 MV/m	16.91 MV/m	16.80 MV/m
load DAQ	*.mat	margin: 12.8 MV/m	10.1 MV/m	13.3 MV/m	11.7 MV/m	6.5 MV/m	6.3 MV/m	12.1 MV/m	9.2 MV/m
load	FLASH_9mA_short_fill.txt	tilts: -0.30 MV/m	-0.30 MV/m	-0.22 MV/m	-0.27 MV/m	0.84 MV/m	0.69 MV/m	0.03 MV/m	0.06 MV/m
save	FLASH_SHIN_9mA_beam_off.txt	-1.42 %	-1.38 %	-1.08 %	-1.33 %	6.16 %	4.89 %	0.18 %	0.38 %
		ACC7: 19.31 MV/m	19.31 MV/m	19.94 MV/m	19.94 MV/m	22.51 MV/m	22.51 MV/m	17.78 MV/m	17.78 MV/m
		margin: 9.5 MV/m	11.5 MV/m	13.9 MV/m	9.9 MV/m	12.2 MV/m	16.2 MV/m	9.2 MV/m	8.2 MV/m
		tilts: -0.18 MV/m	-0.18 MV/m	-0.16 MV/m	-0.16 MV/m	-0.28 MV/m	-0.28 MV/m	-0.04 MV/m	-0.04 MV/m
		-0.90 %	-0.90 %	-0.79 %	-0.79 %	-1.24 %	-1.24 %	-0.23 %	-0.23 %

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