Gun-4.6: field profile and momentum measurements

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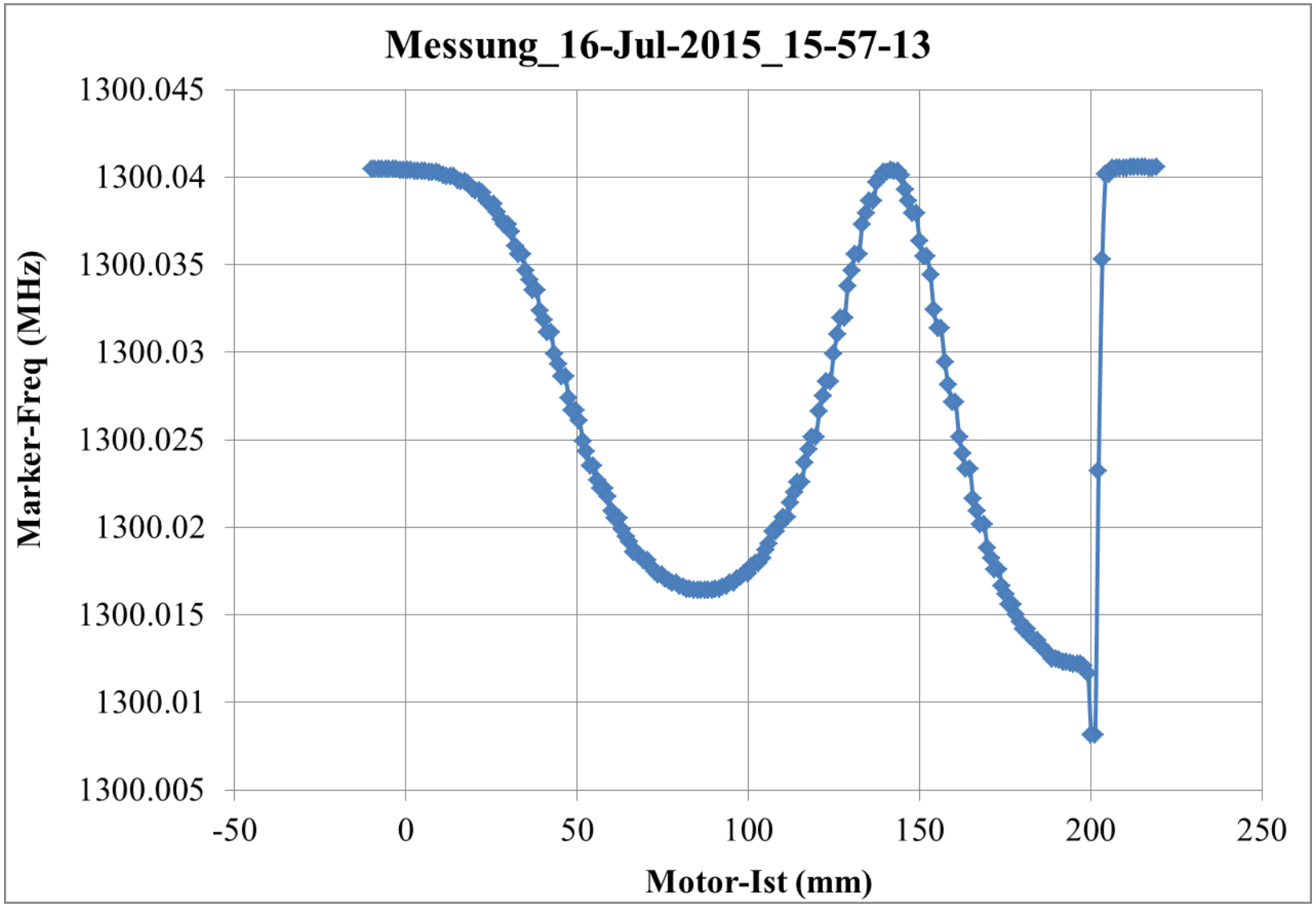
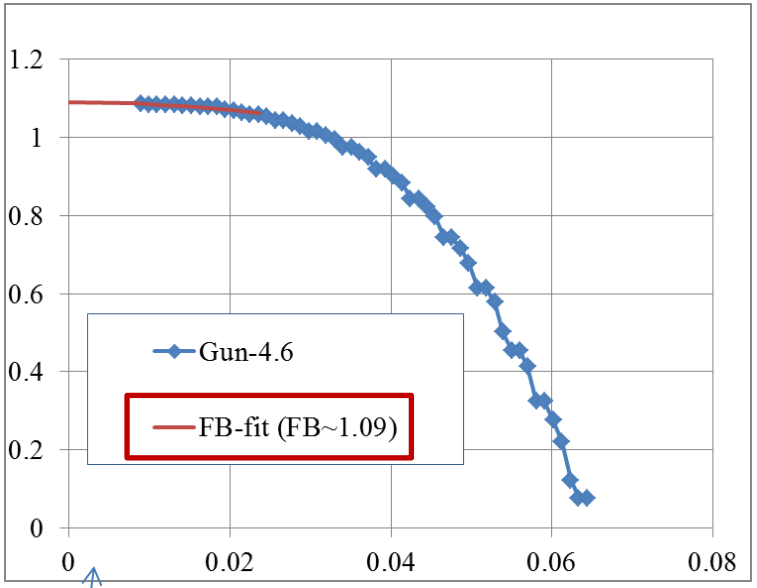
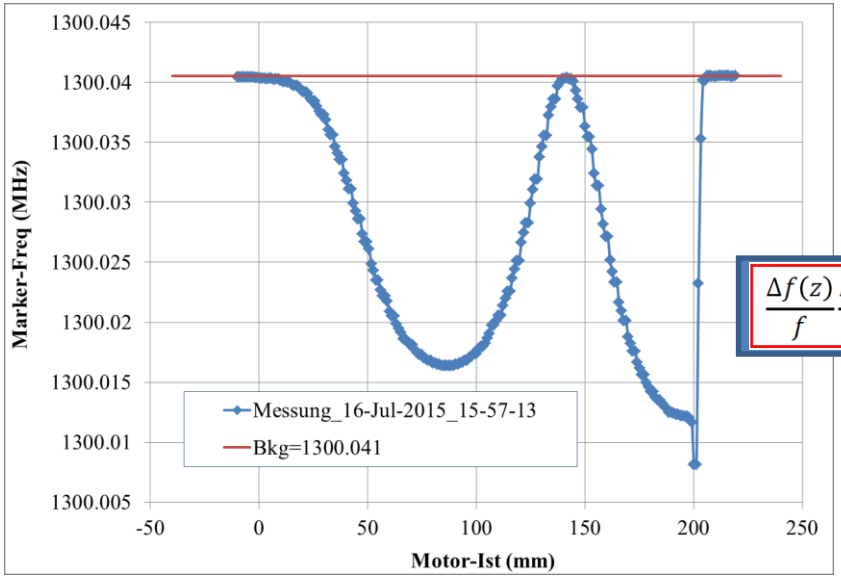
PPS, 04.08.2016

Bead Pull Measurements

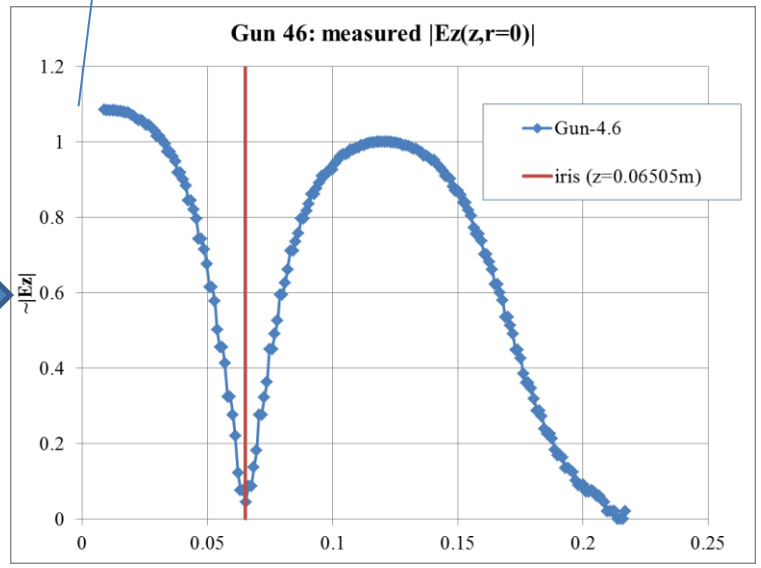


Bead Pull Measurements: data treatment

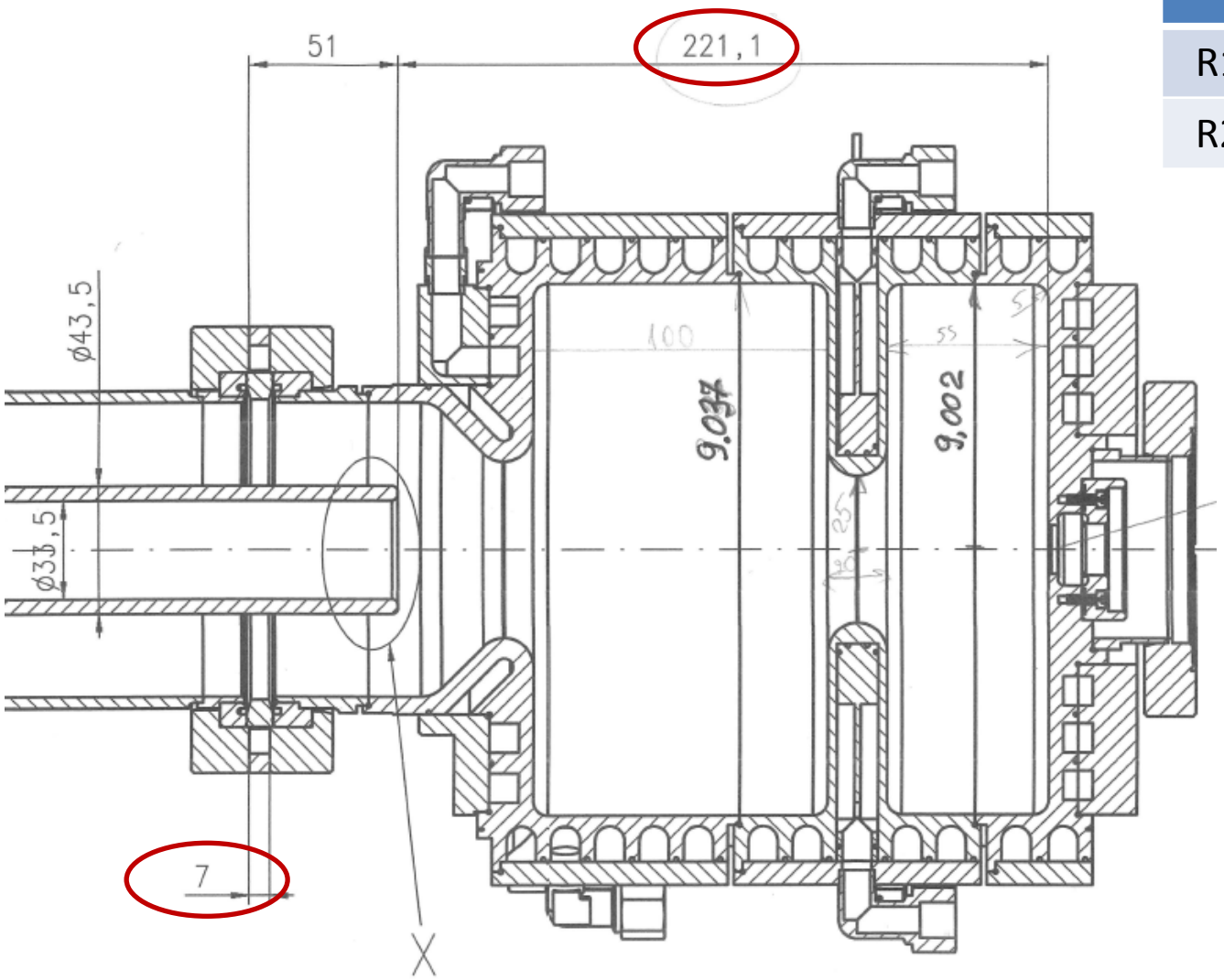




$$\frac{\Delta f(z)}{f}\frac{F_{bead}}{\omega} = \frac{|Ez(z)|^2}{\omega U}$$

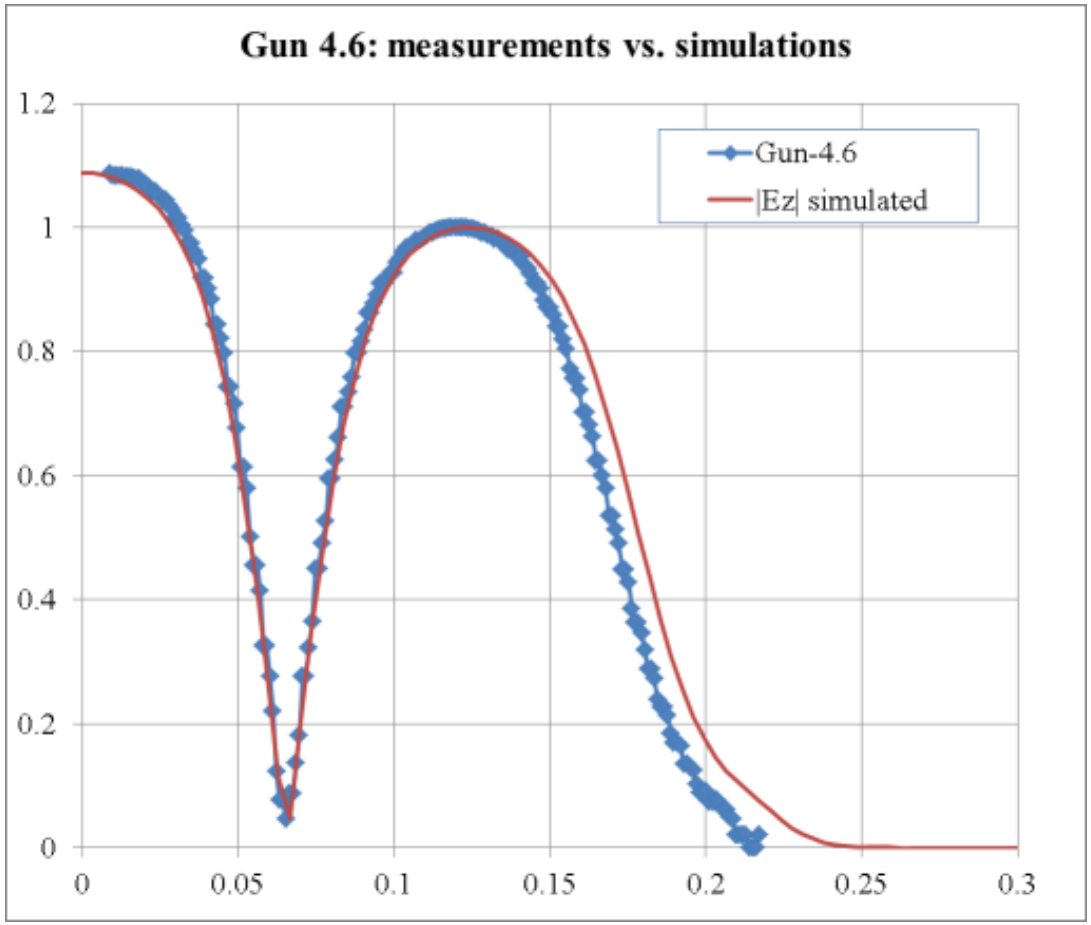


Gun-4.6: geometry check



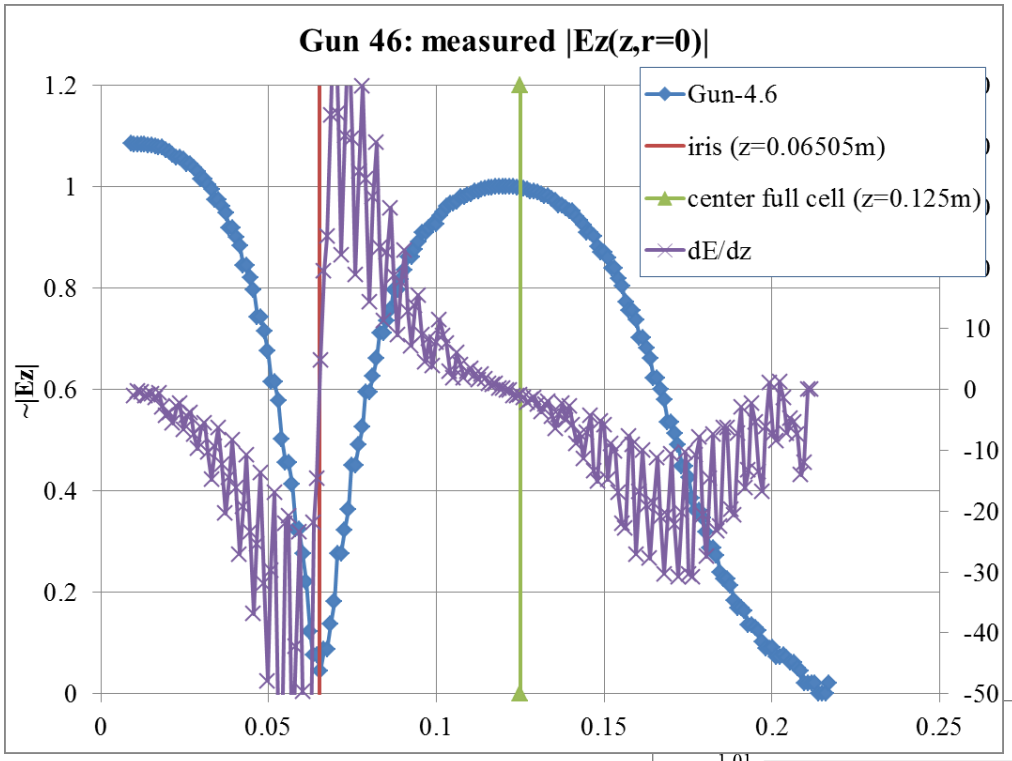
	Gun-4.4	Gun-4.6
R1	89.95	**90.37**
R2	90.32	**90.02**

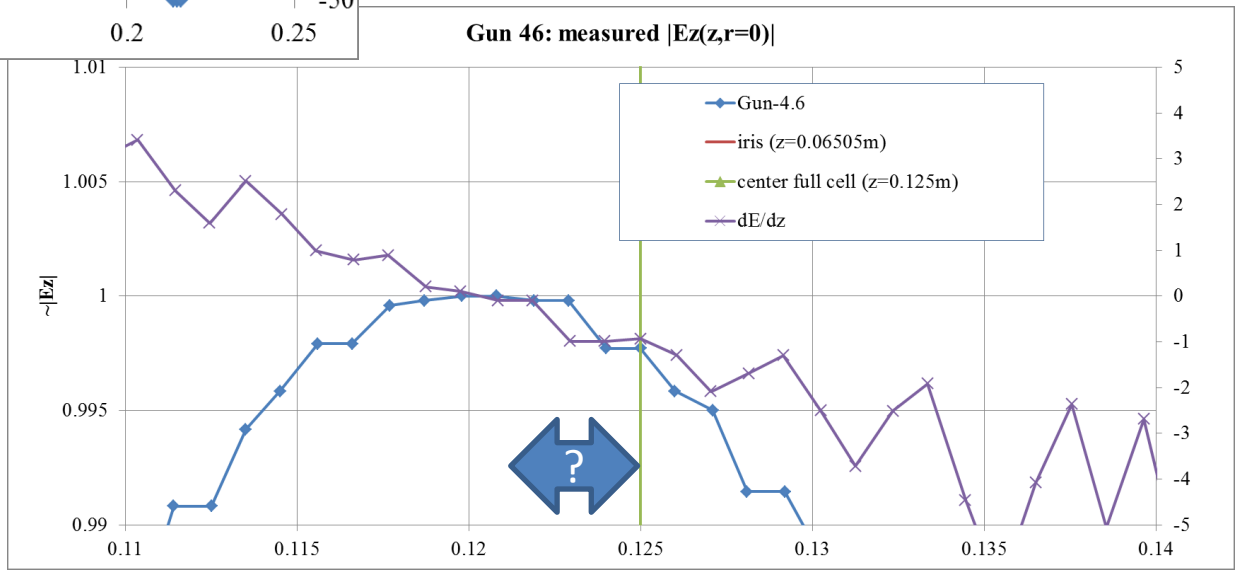
Field Balance modeling (SF simulations)



zmeas*1.075→zsimul

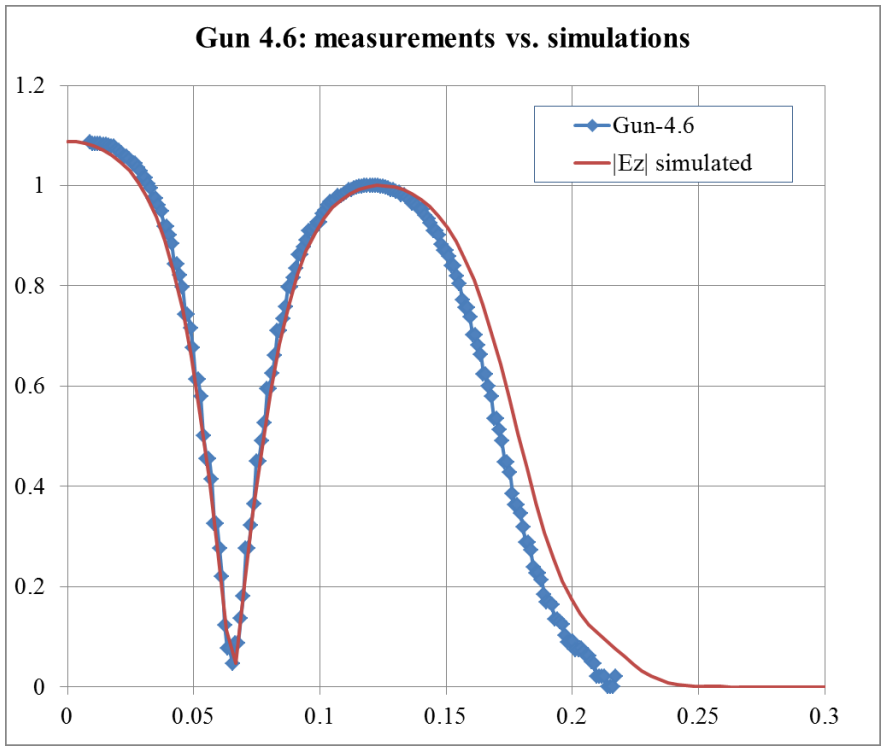
Gun-4.6: geometry check w.r.t. BP



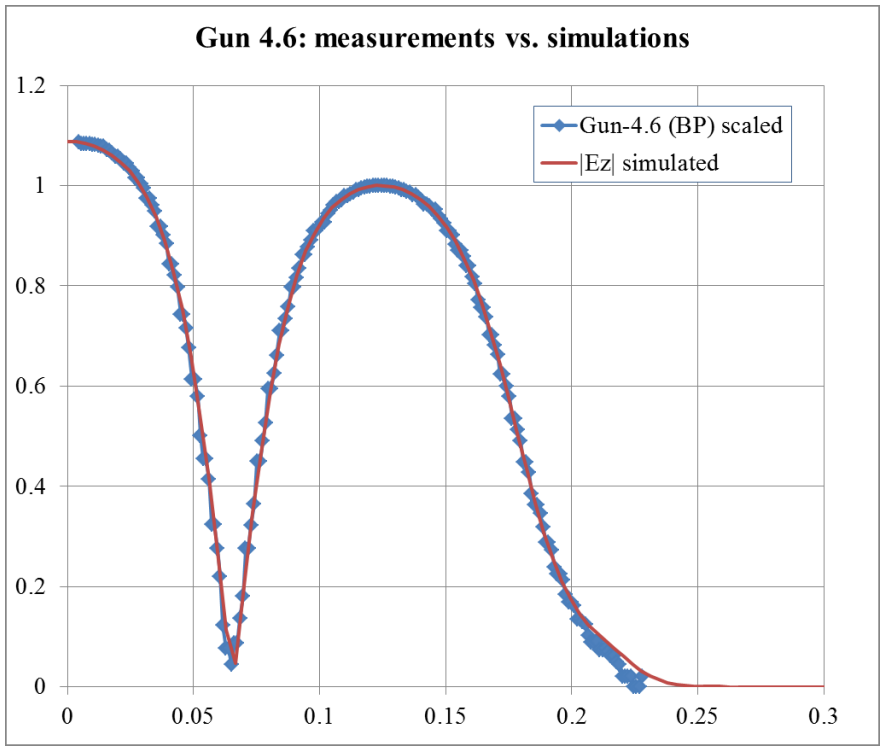


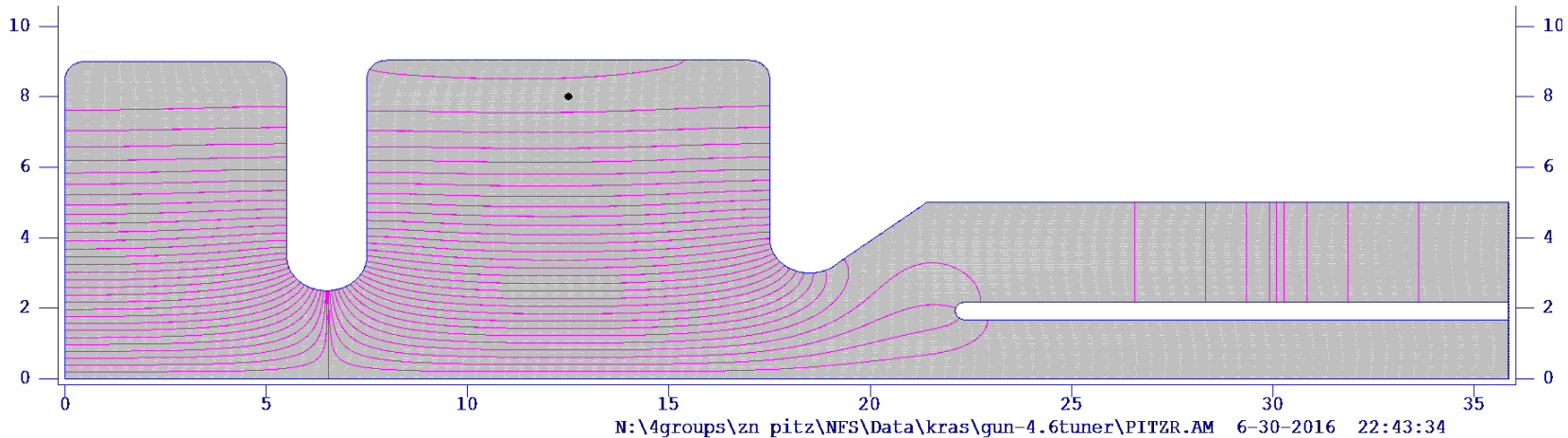
SF simulations: fit using (scale, shift, cut)

Scale=1.000



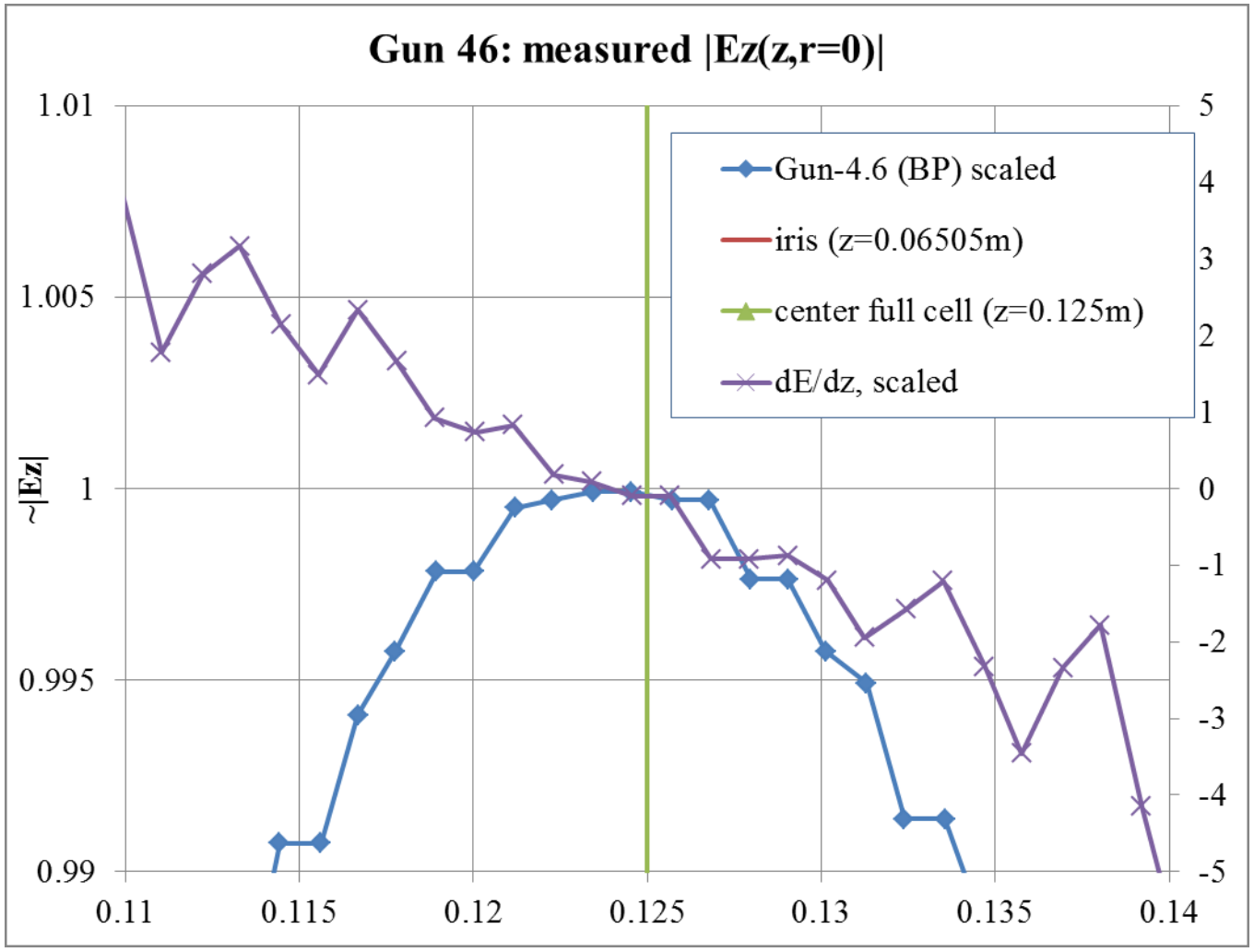
Scale=1.0746





Gun-4.6: geometry check w.r.t. BP

Scale=1.0746

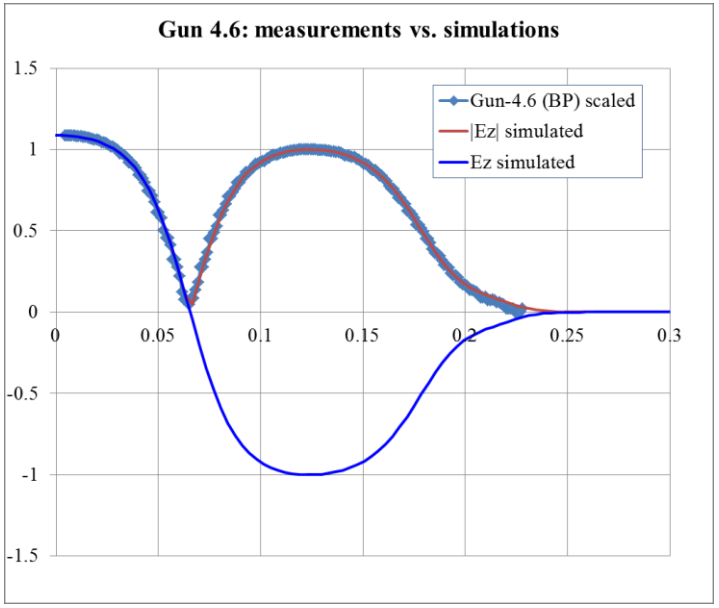


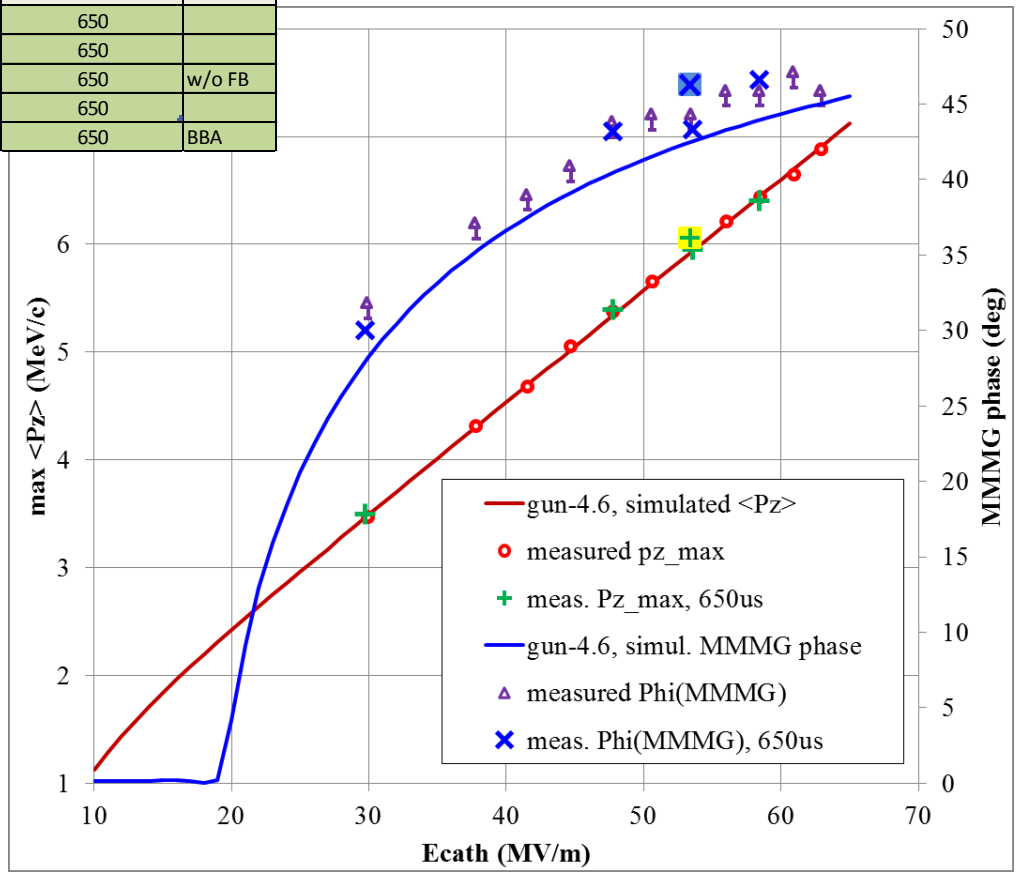
Gun-4.6: Pz measurements (LEDA)

#	P_gun [MW]	pz_max [MeV/c]	SP phase [deg]	SP phase (zero_cross) [deg]	Time of pz_max meas.	Imain [A]	RF puls length [us]	Remarks
1	6.97	6.883	-140	-94.1	11:48:00 (28.06.2016)	474	200	
2	6.013	6.438	-140	-94.1	13:27:00 (28.06.2016)	450	200	
3	5.033	5.995	-138.5	-94.2	14:50:00 (28.06.2016)	418	200	
4	4.011	5.374	-136.5	-92.7	15:52:00 (28.06.2016)	380	200	
5	3.04	4.68	-133	-94	18:17:00 (28.06.2016)	323	200	
6	6.53	6.65	-126	-78.9	10:59:00 (30.06.2016)	460	200	
8	5.52	6.211	-126.5	-80.6	18:54:26(04.07.2016)	434	200	
9	4.507	5.659	-123.5	-79.2	20:29:59(04.07.2016)	401	200	
10	3.516	5.055	-120.5	-79.6	21:39:08(04.07.2016)	357	200	
11	2.517	4.318	-116.5	-79.4	22:45:17(04.07.2016)	315	200	
12*	1.579	3.4702	-124	-92.2	18:14:00 (20.06.2016)	250	200	BBA
13	4.01	5.391	-125	-81.8	10:42:30(05.07.2016)	376	650	
14	5.05	5.949	-126	-82.7	13:28:30(05.07.2016)	410	650	
15	5.01	6.06	-129	-82.7	14:10:43(05.07.2016)	420	650	w/o FB
16	6.003	6.405	-127.5	-80.9	18:30:42(05.07.2016)	446	650	
17*	1.552	3.495	-111	-81	11:00 (04.07.2016)	248	650	BBA

Ecath (MV/m)	Pgun (MW)
30.2	1.60
33.7	2.00
41.3	3.00
47.7	4.00
53.3	5.00
58.4	6.00
60.0	6.34
63.1	7.00

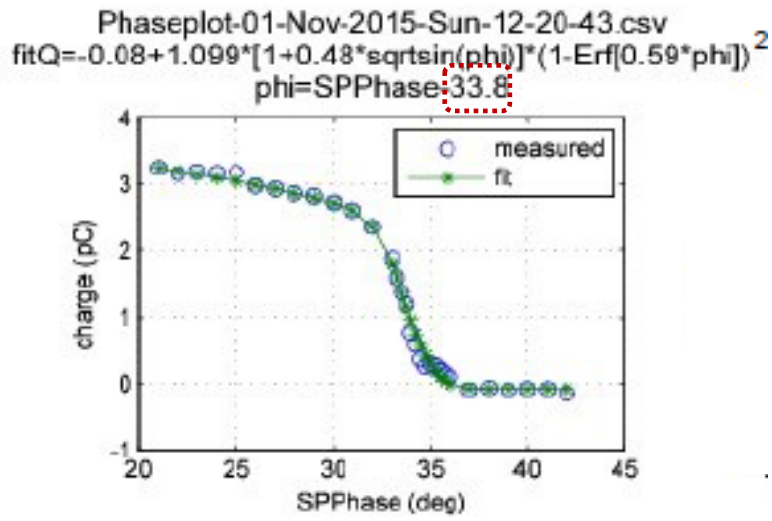
$$P_{gun}=0.00176*E_{cath}^{2}$$



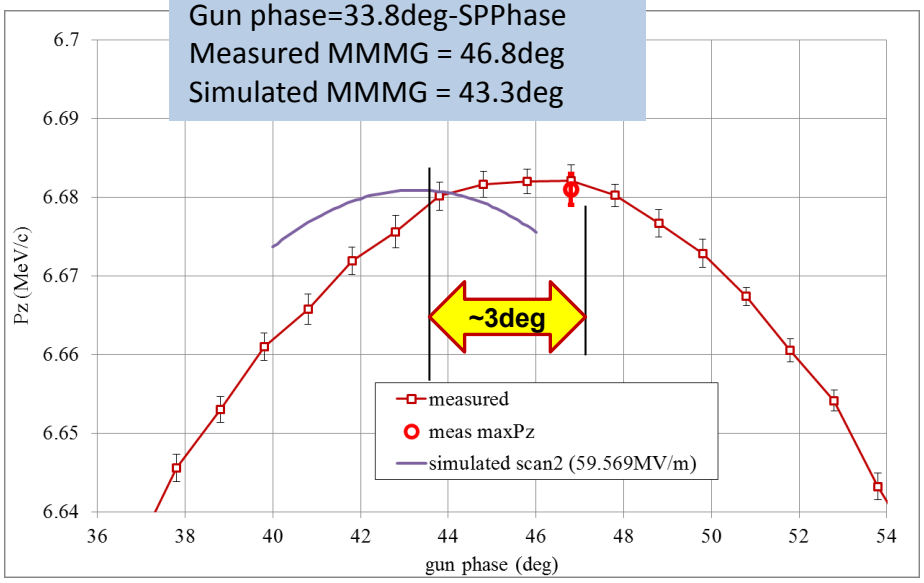


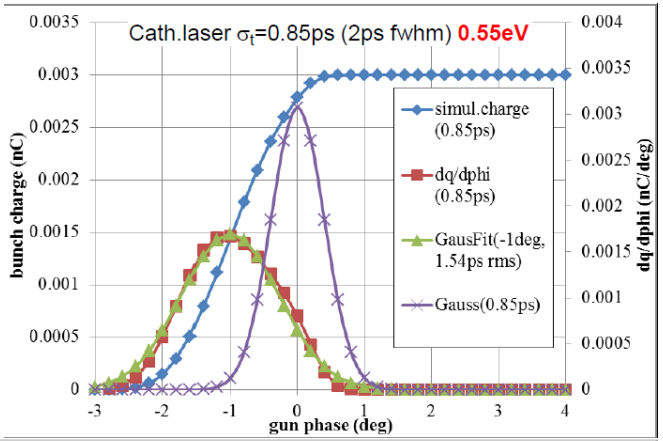
Update on photo emission studies: zero-crossing phase

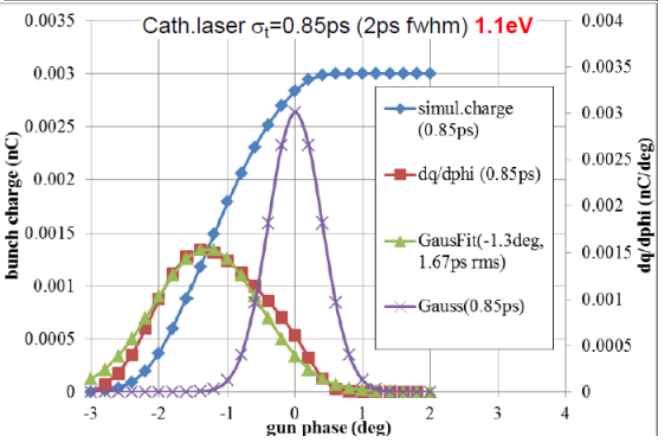
Still not understood: Zero-crossing phase ←→ MMMG phase ➔ 2-3 deg phase shift between measurements and simulations



Gun phase=33.8deg-SPPhase
Measured MMMG = 46.8deg
Simulated MMMG = 43.3deg





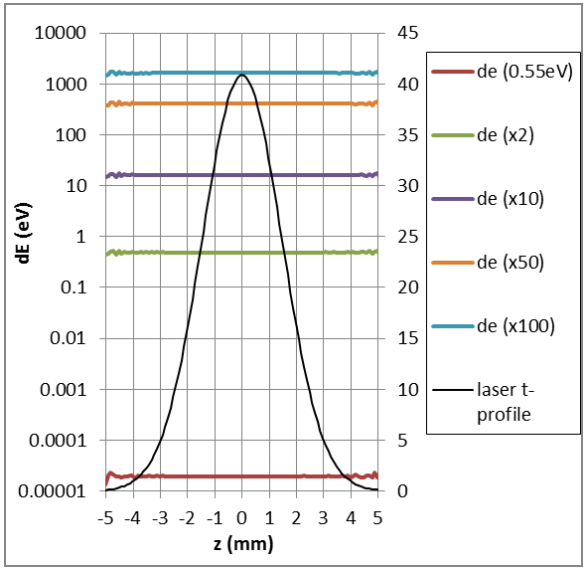


cathode laser		Ekin (eV)	delta phi	dq/dphi-Gauss.fit	fit-σ_t/σ_t
σ_t (ps)	fwhm (ps)		deg	fit-σ_t (ps)	
0.85	2	0.55	-1	1.54	1.81
0.85	2.6	1.1	-1.3	1.67	1.96

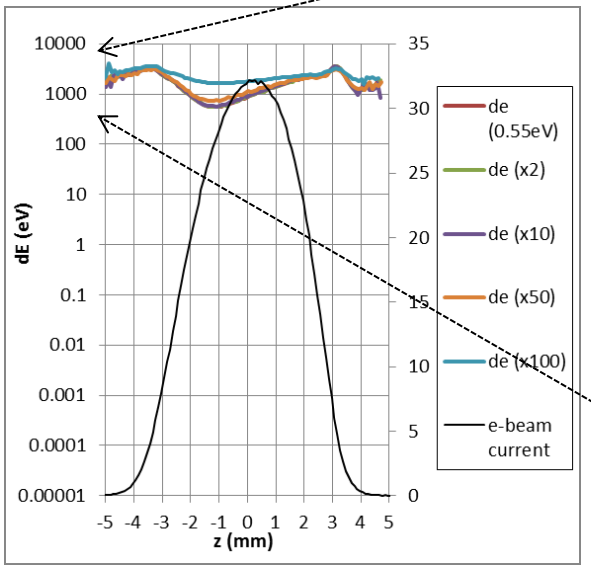
ASTRA simulations with “Pz-heater” at cathode (→ δE-program at PITZ)

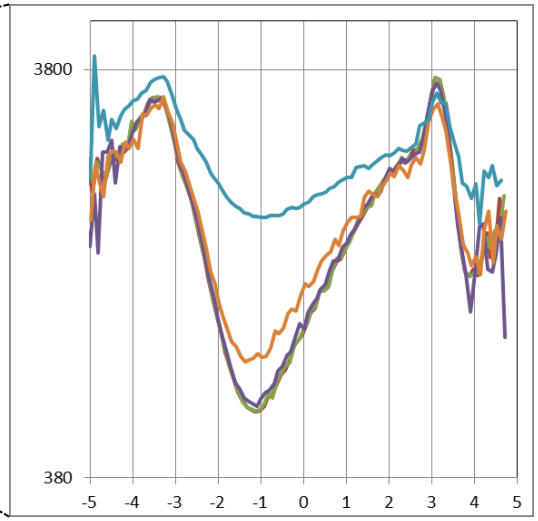
ASTRA simulations with “Pz-heater” at cathode

cathode (z=0)



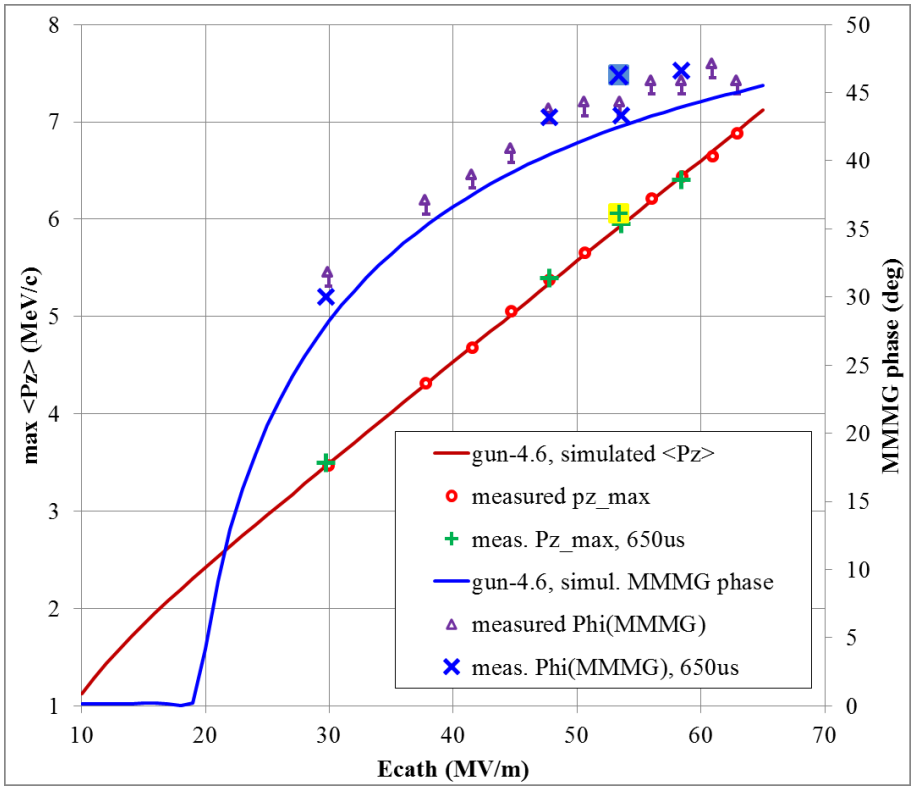
EMSY1 (5.27m)



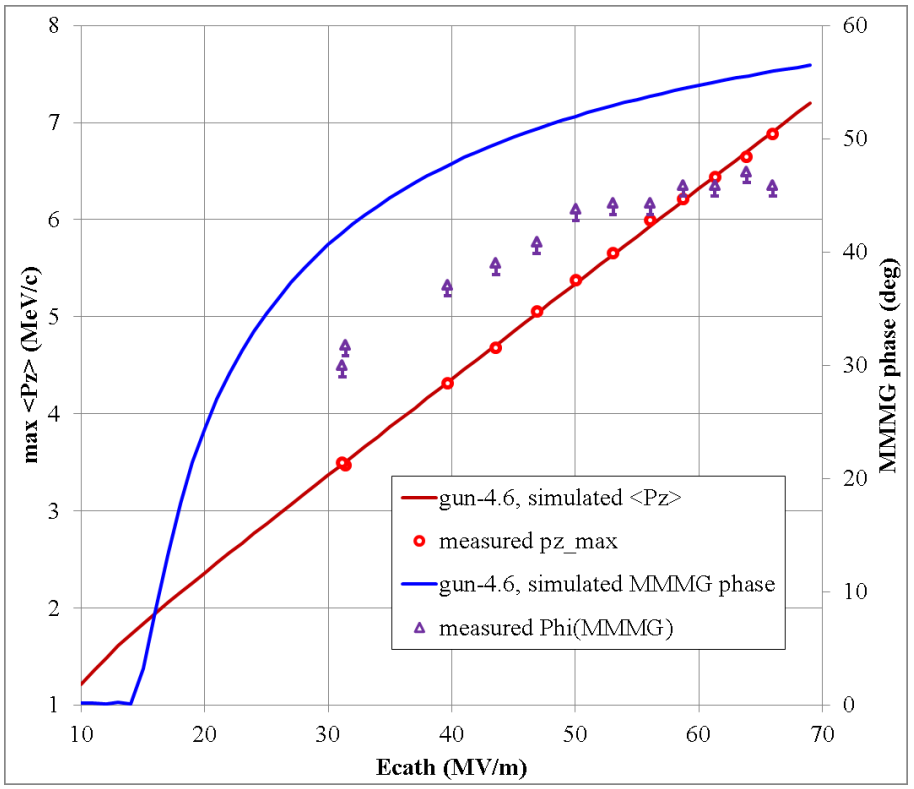


Pz and MMG phase: measurements vs. simulations

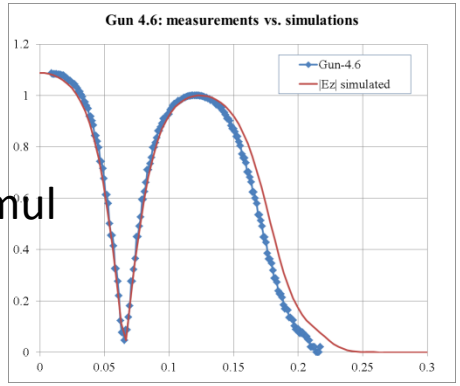
P_{gun} [MW]=0.00176*(E_{cath}[MV/m])^2

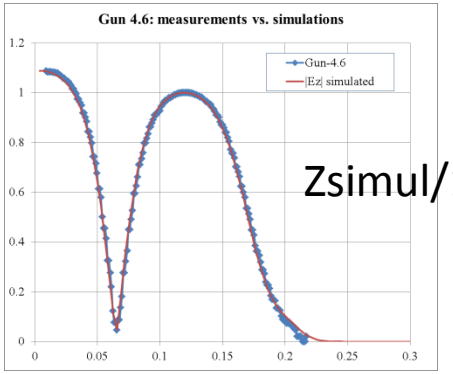


P_{gun} [MW]=0.00160*(E_{cath}[MV/m])^2



zmeas*1.075→zsimul

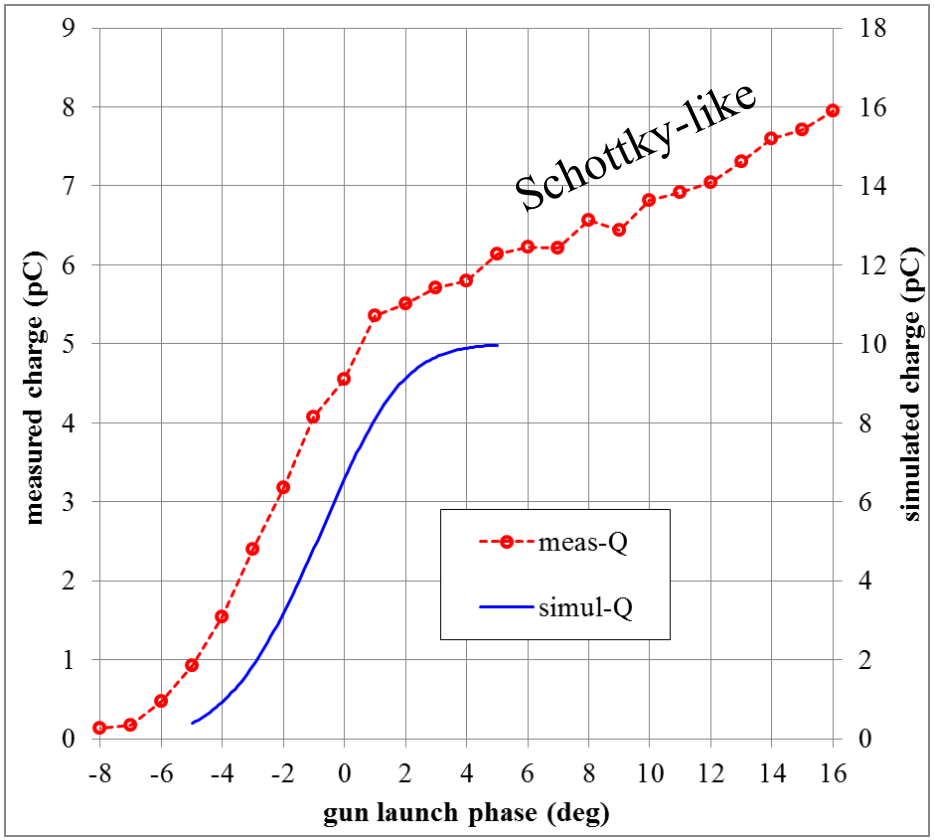




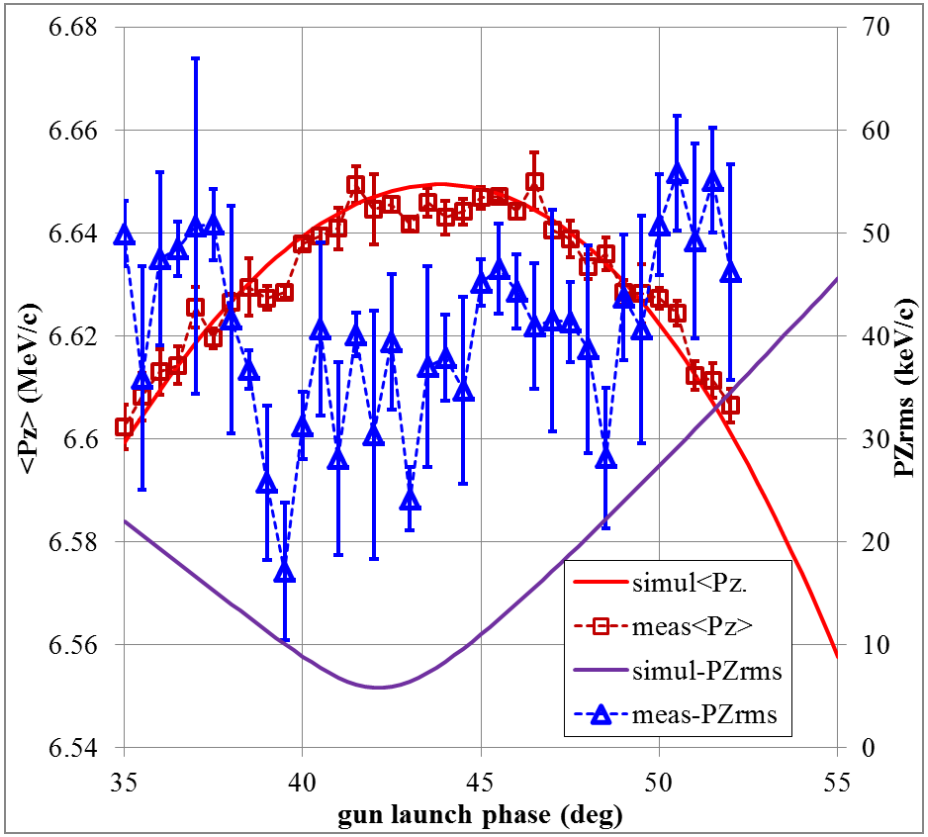
Zsimul/1.075→zmeas

Phase scans simulations (6.5MW)

Bunch charge vs. gun phase (math)



Mean momentum and rms momentum spread vs. gun phase (math)

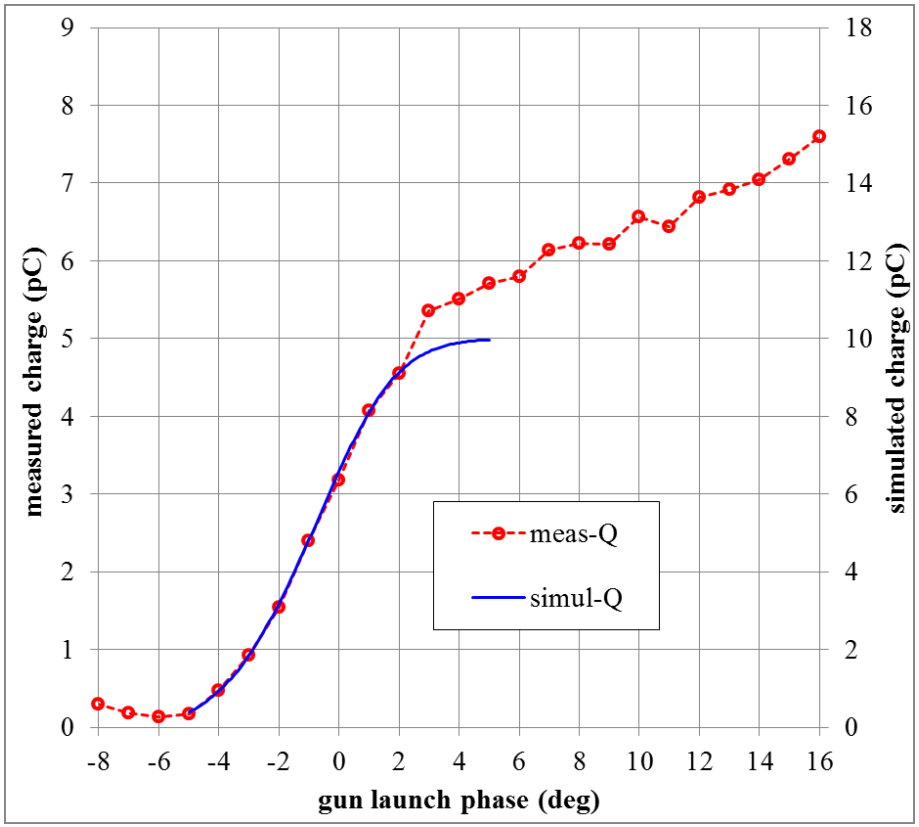


NB:
Ecath=60.9116→60.60704MV/m
➔-0.5%
Pgun [MW]=**0.001778***(Ecath[MV/m])2
➔+1%

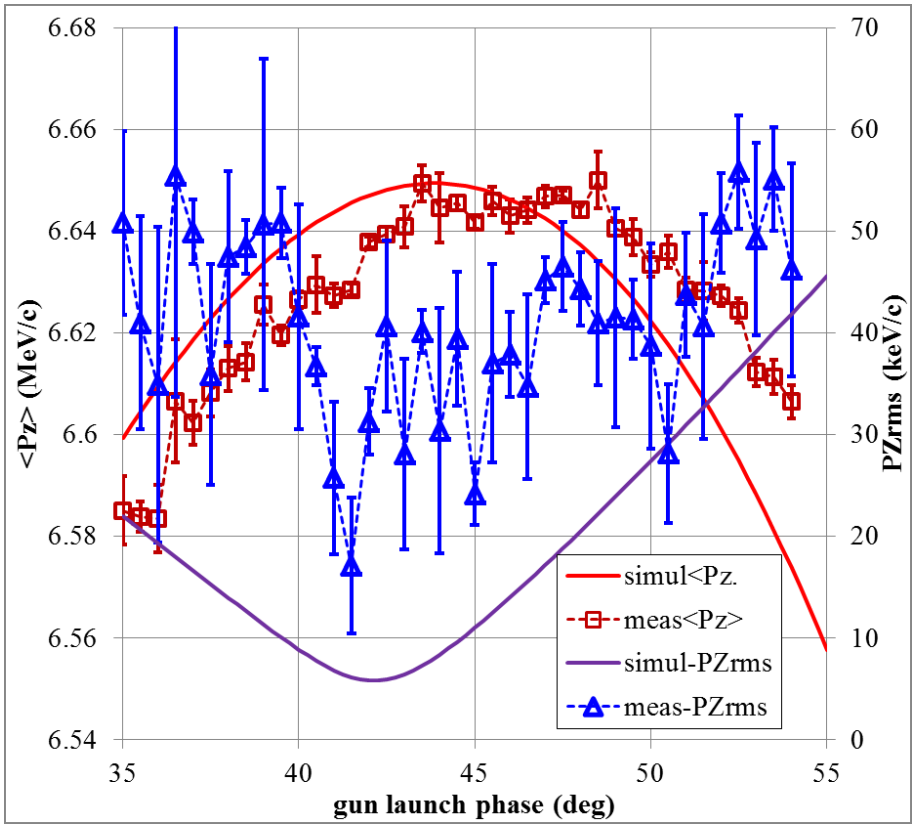
ΔΦ → MMMG

Phase scans simulations (6.5MW)

Bunch charge vs. gun phase (math)



Mean momentum and rms momentum spread vs. gun phase (math)



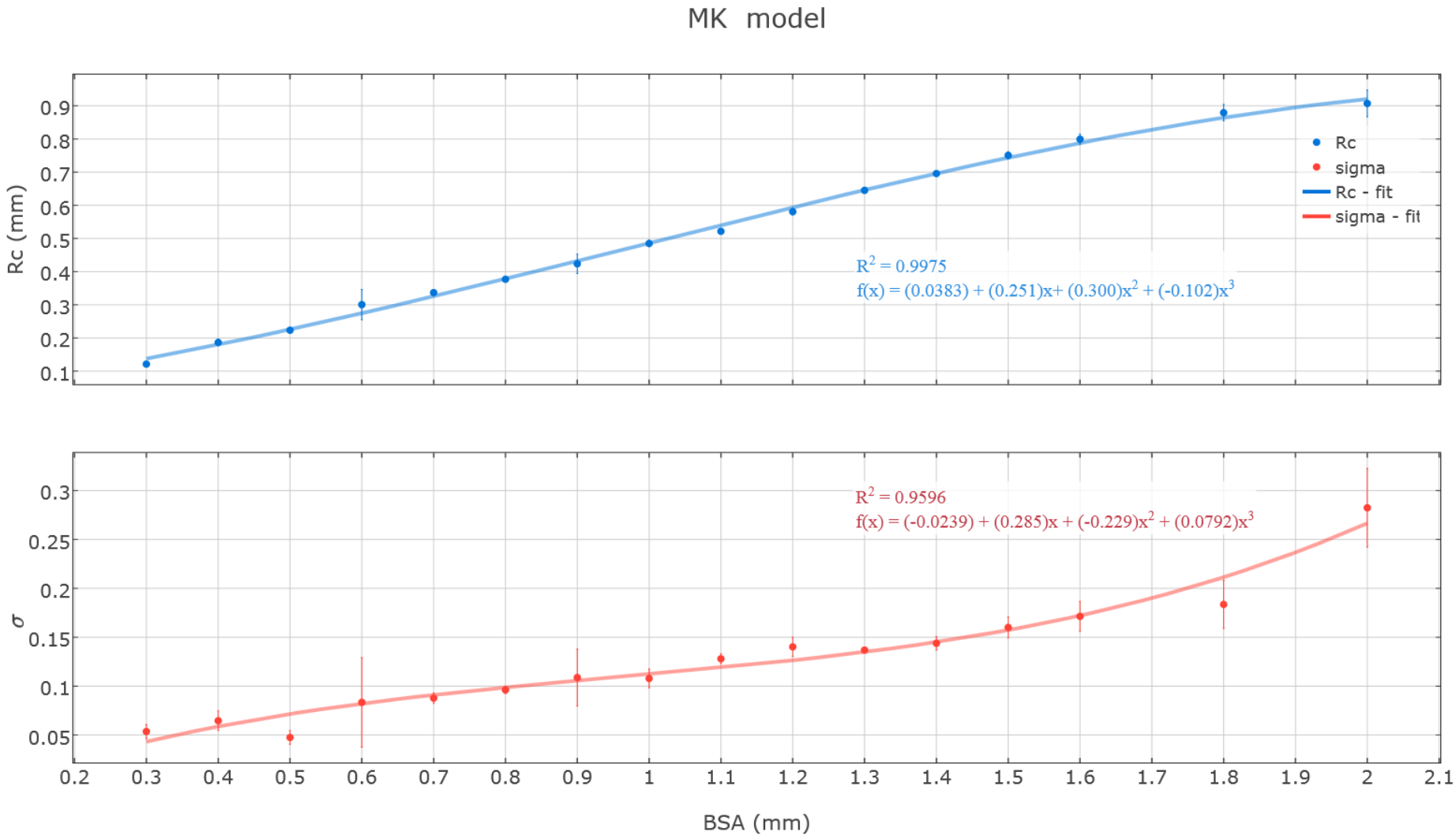
ΔΦ-2deg → **zero-crossing**

Conclusions

- Gun-4.6 bead pull measurements: scaling with a factor of **scale=1.075** (zBP*scale) improves the simulation-measurement comparison. This is also consistent with geometry considerations (cathode-iris-full cell)
- The obtained FB=1.09 (SF simulations done for the nominal geometry) → file **gun46cavity.txt** created (z,ez). Currently uploaded at the PITZ site (PITZ INTERN→ASTRA→Gun filed profiles->Gun 4.6)
- Maximum beam momentum and the MMMG phase have been simulated (single particle tracking)
- Preliminary: Pgun(10MWdc)=**0.00176***Ecath2 based on the maximum mean momentum measurements fit.
  E.g., Ecath=60MV/m → 6.34MW
- MMMG phase obtained from the measurements SPPhase(MMG)-SPPhase(zero-crossing) has a systematic offset of 1-3 deg (NB: 1 deg from the zero-crossing determination?)
- The scale factor artificially applied to the simulated profile (zSF/scale) results in significantly larger discrepancy in the MMMG phase curve
- Could a **"cathode field bump"** explain the discrepancy in gun launch phase?

Core+halo modeling

(C.Saisa-Ard)



NB: ideal radial homogeneous: $\sigma_{x,y} = \frac{BSA}{4}$

Matlab script CHD_MK4.m for VC2 evaliation is updated (\measure\scripts\SVN\MatlabScripts\CoreHaloGenerators\)