

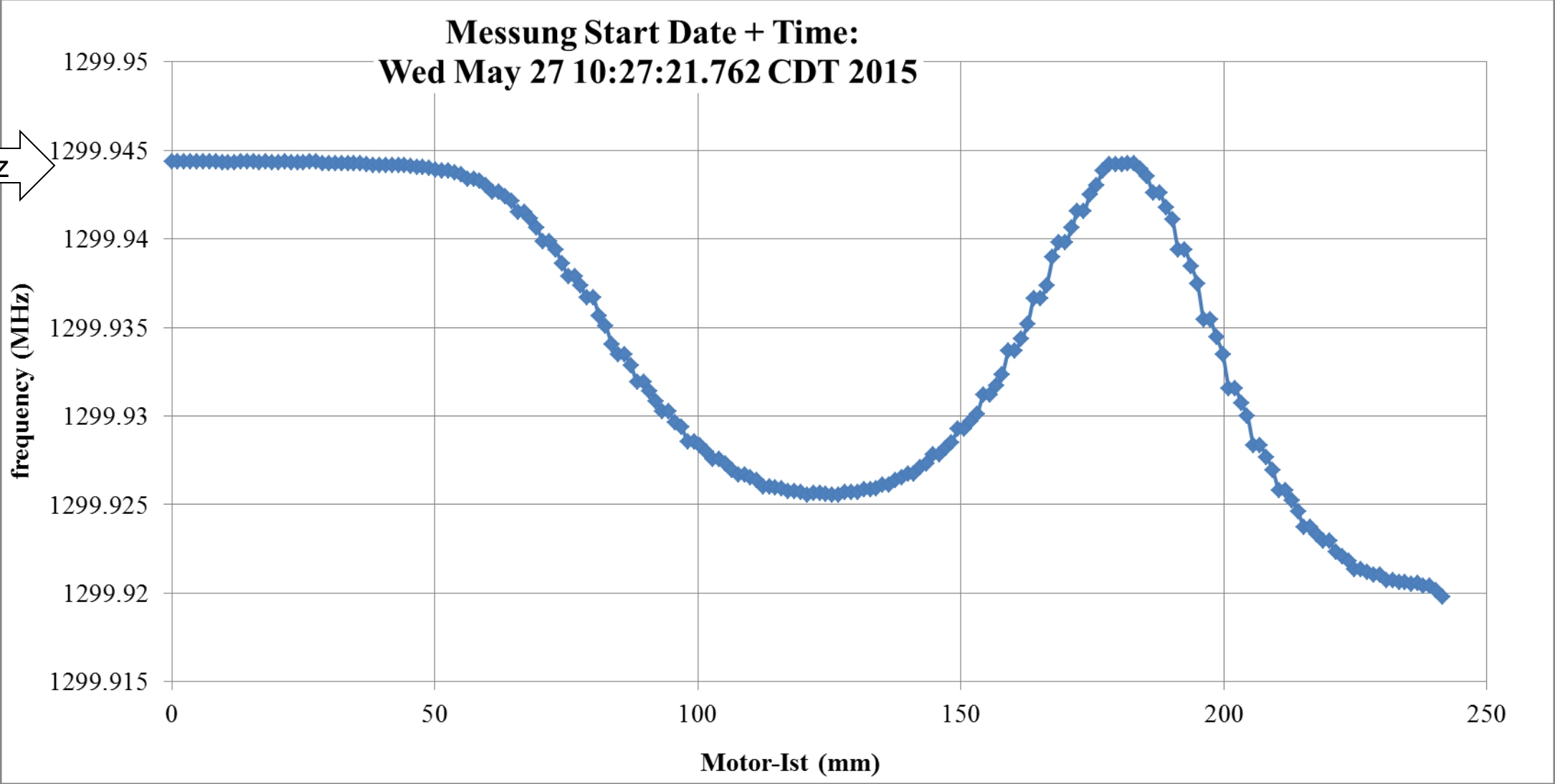
Gun4.5: field balance fit

$E_z(z)$ for the Gun4.5 prototype

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PPS, 19.04.2018

Bead Pull Measurements

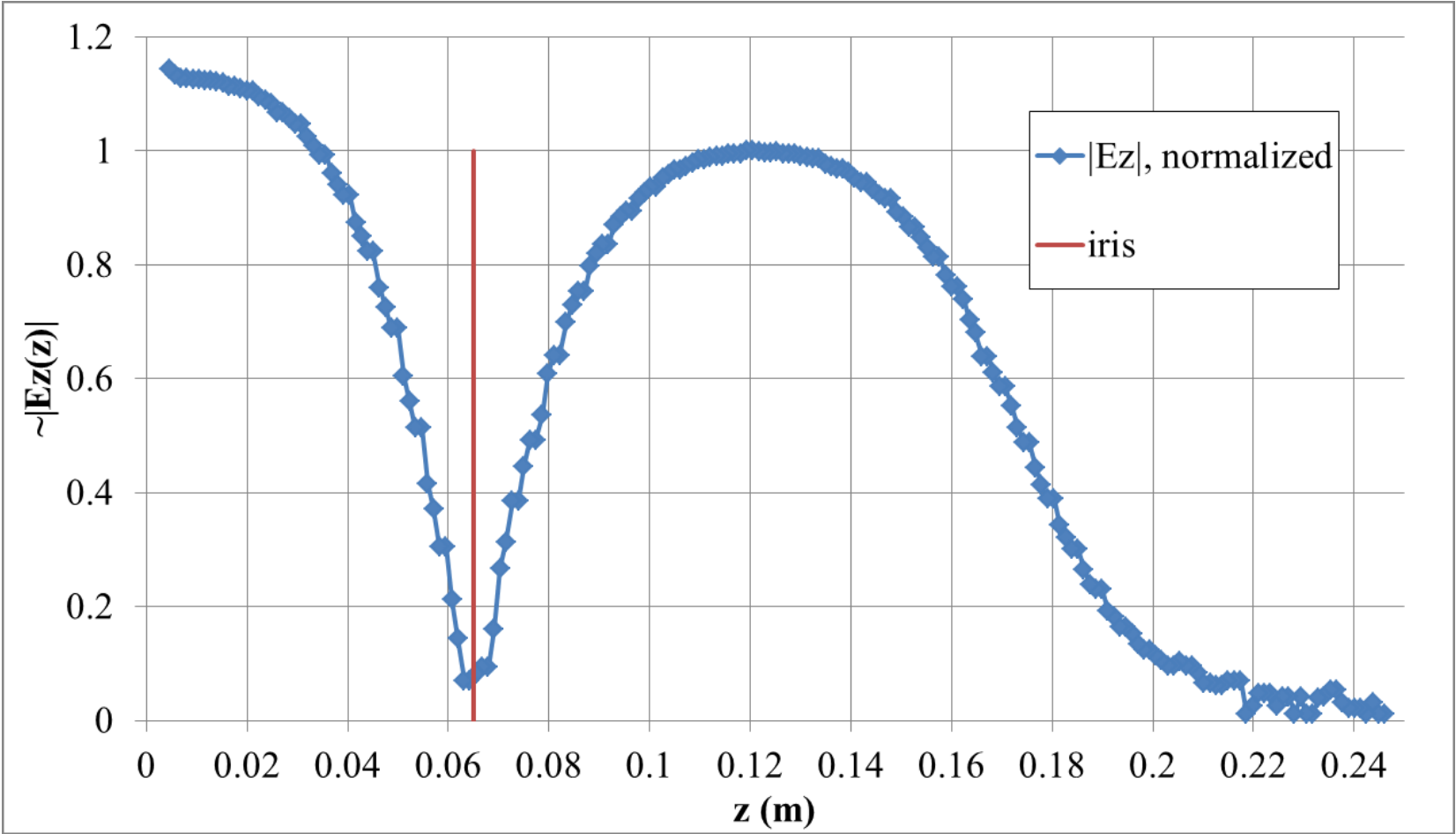
Measurements on 27.05.2015



Bead Pull Measurements: data treatment

-- $f_0 \rightarrow |Ez(z)| \rightarrow$ normalized w.r.t. full cell max, assumed iris position $z=0.06505\text{m}$

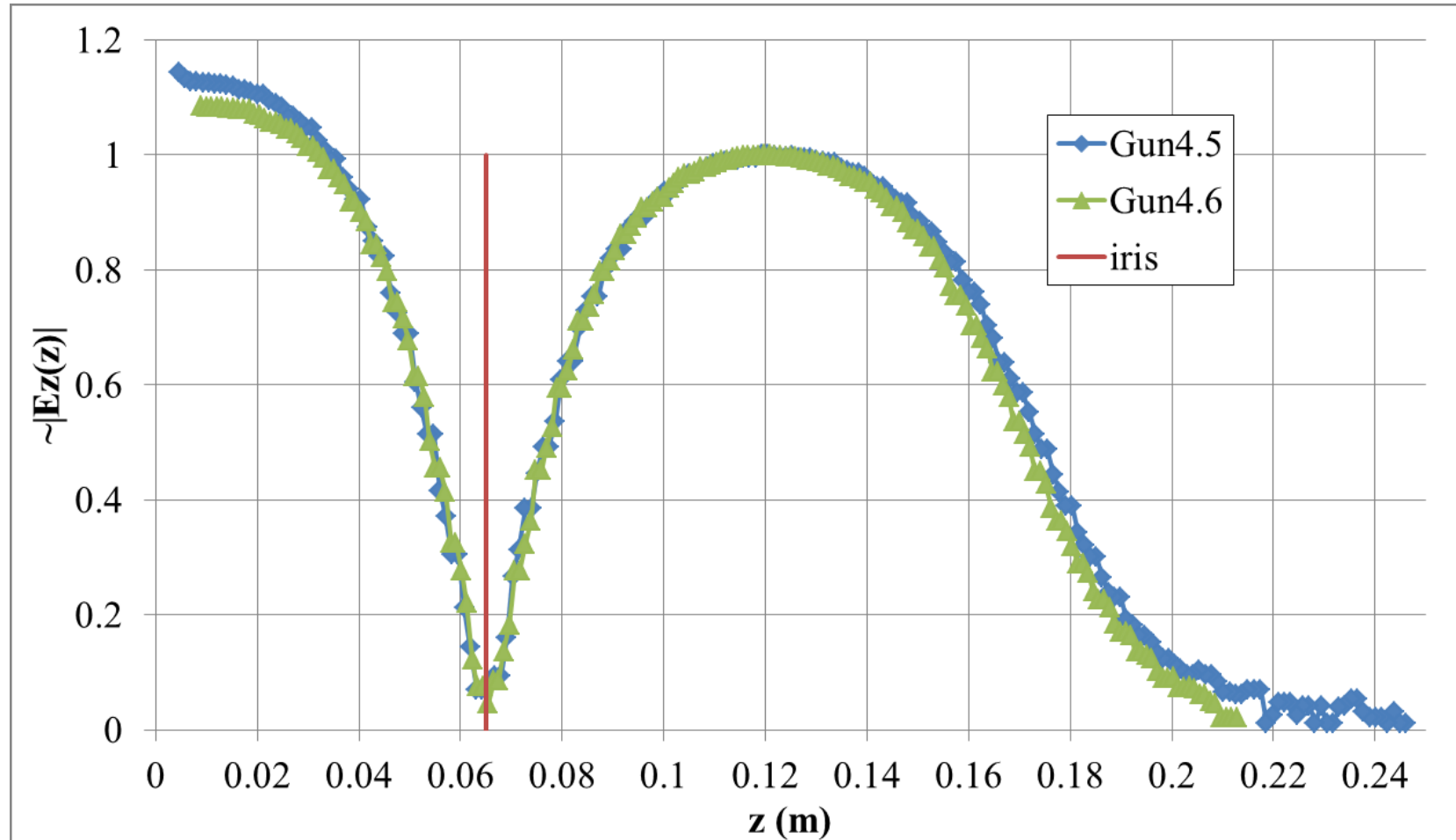
$$\frac{\Delta f(z)}{f} \frac{F_{bead}}{\omega} = \frac{|Ez(z)|^2}{\omega U}$$



$$z(m) = (246.1 - z_{Motor-ist})/1000$$

Various gun cavities comparison

Gun4.6 vs Gun4.5



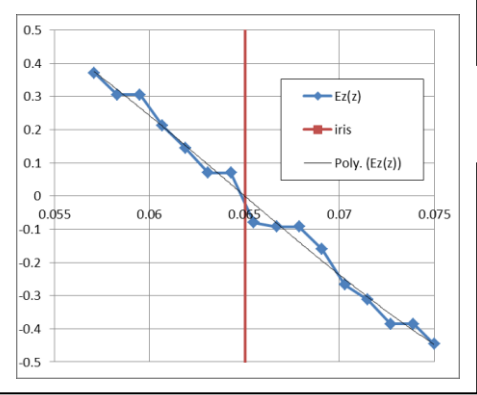
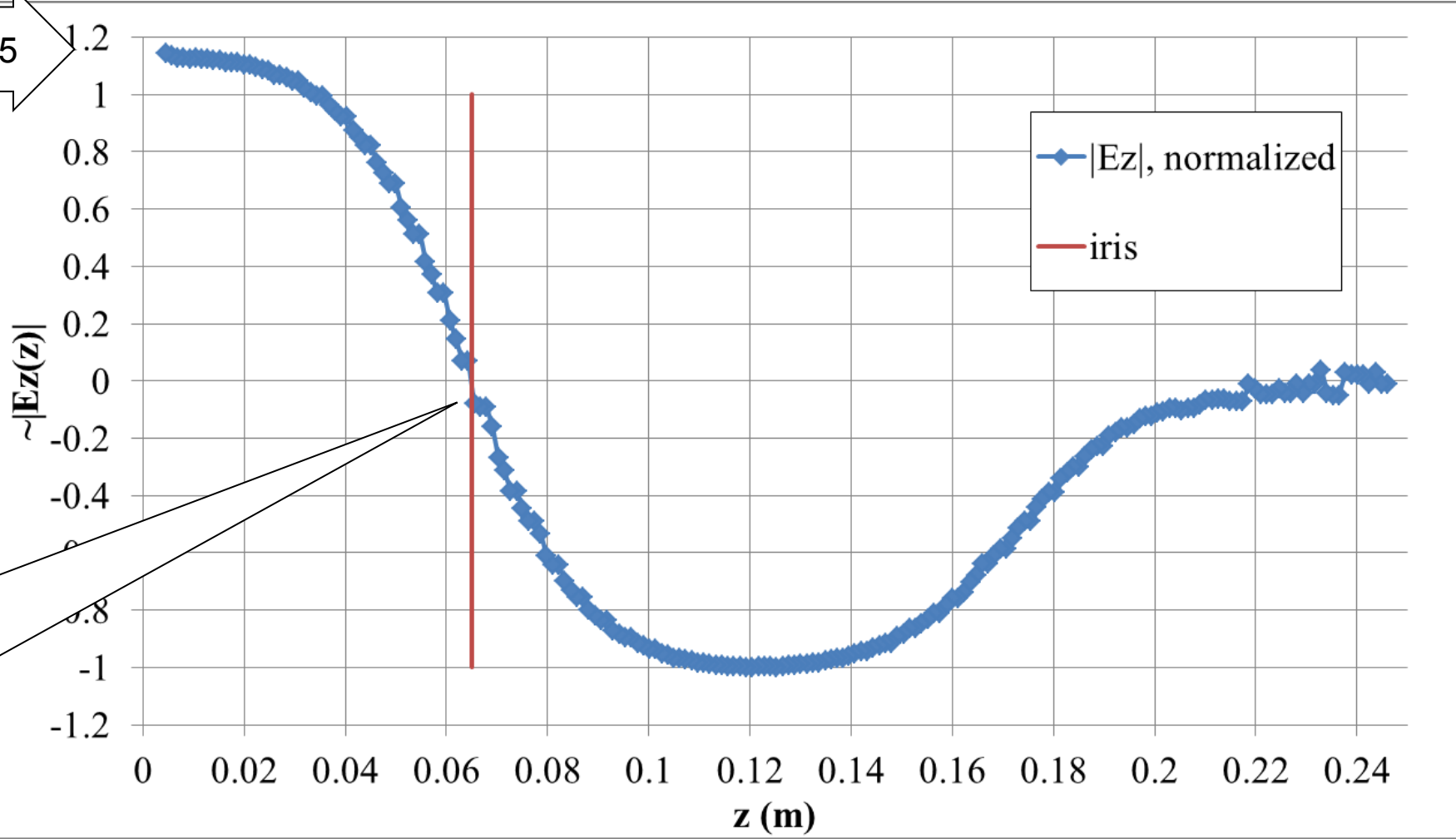
NB: for the Gun4.6 cavity prototype \rightarrow z-scaling factor of ~ 1.08 was applied to fit simulated field profile

Raw Field Profile

$|E_z| \rightarrow E_z$

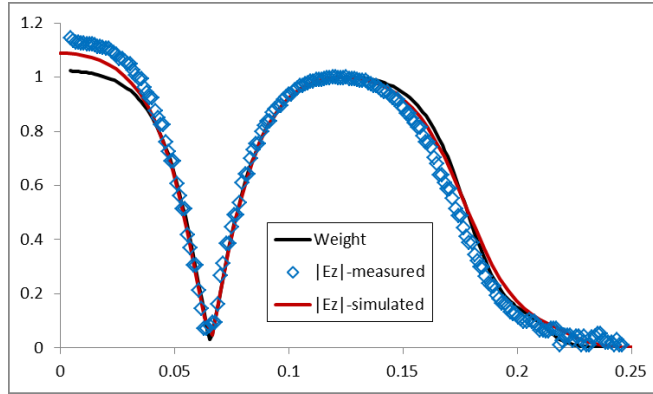
$$E_z(z) = |E_z(z)| \times \text{sign}(z - z_{\text{iris}}) \cdot \text{sign}\left(\frac{\Delta f}{f_0}\right)$$

FB = $E_{\text{cath}} / \max|E_{\text{fullcell}}| \sim 1.15$

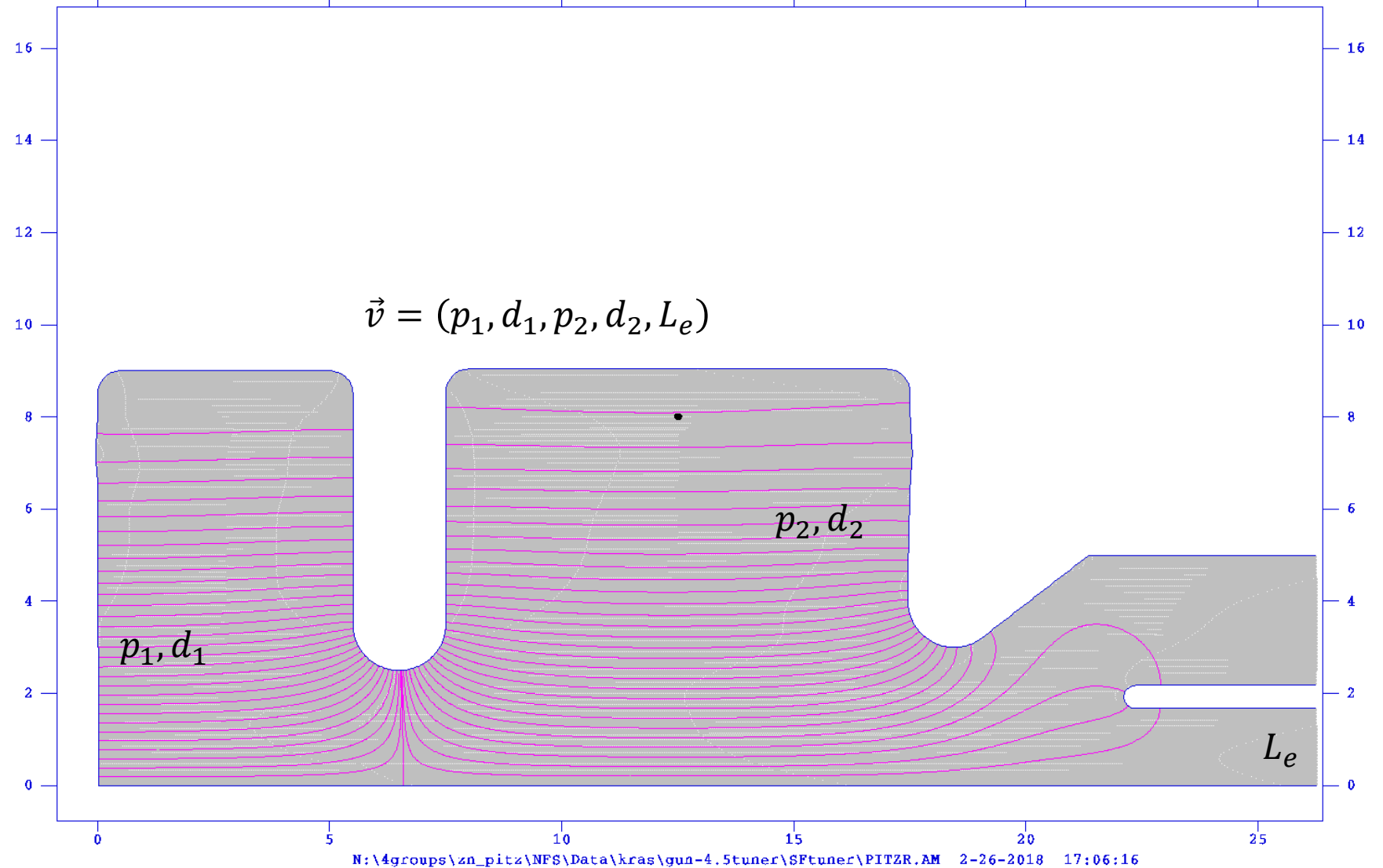


SF simulations

Incl. tuning deformations



PITZL L-Band 1.6cell Photocathode Gun-4.5 with Coaxial coupler F = 1300. MHz



$$\vec{v} = (p_1, d_1, p_2, d_2, L_e)$$

Goal function:

$$\rightarrow \min [D_{freq}(\vec{v}) + \tilde{D}_{field}(\vec{v})]$$

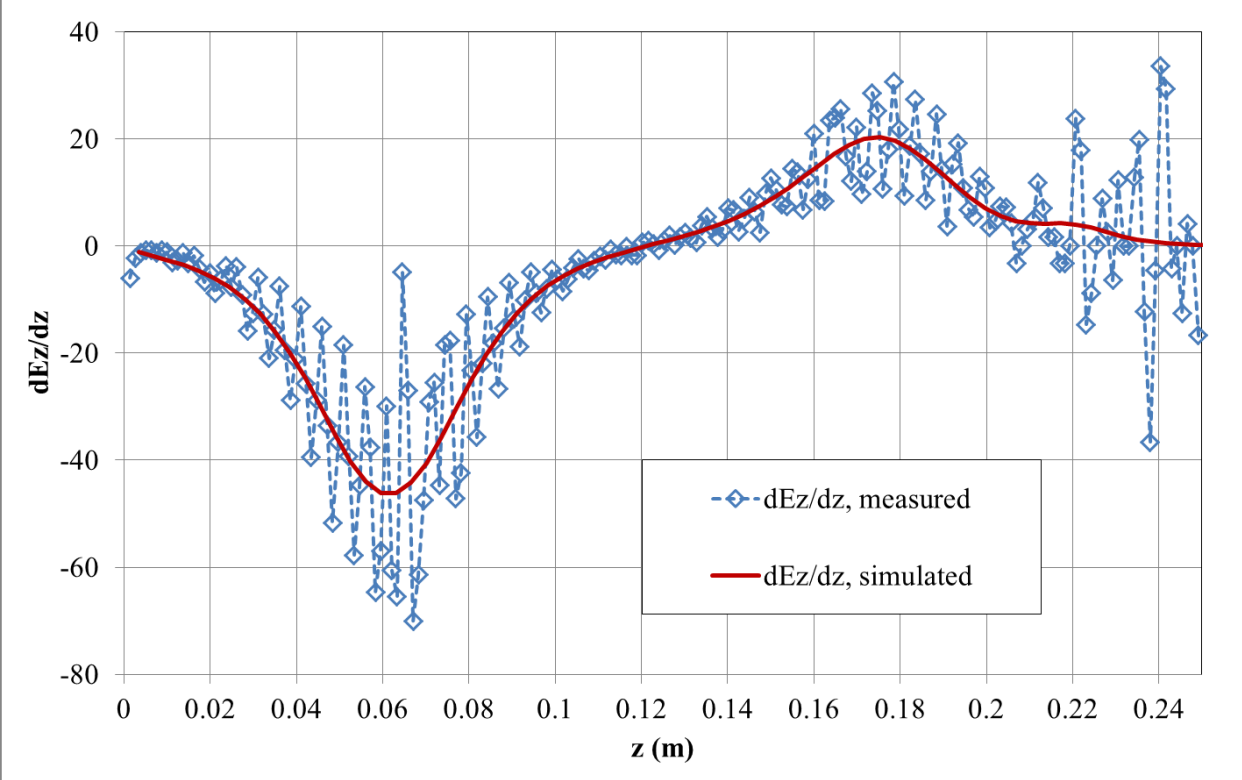
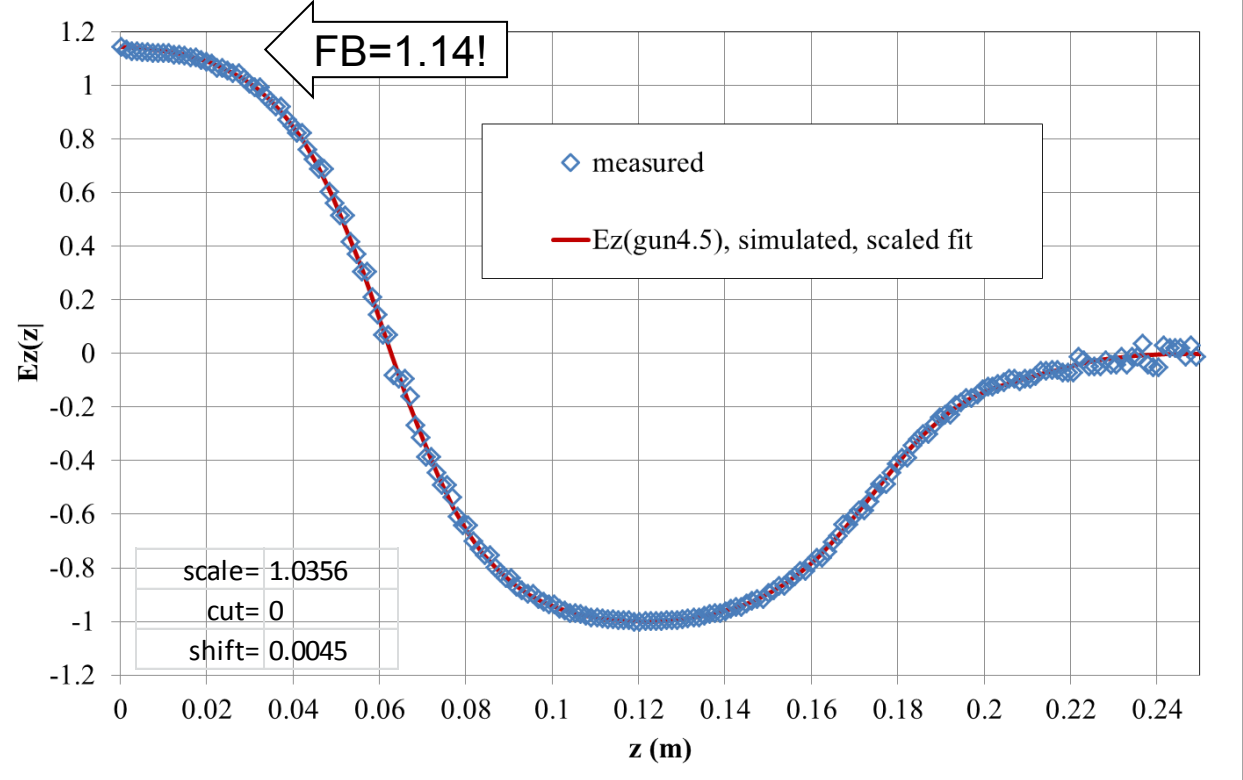
$$D_{freq}(\vec{v}) \propto f - 1300\text{MHz}$$

$$\tilde{D}_{field}(\vec{v}) \propto \int W(z) \cdot \left| |\tilde{E}_{z,meas}| - |E_{z,sim}| \right|$$

$$\tilde{E}_{z,meas}(z_{shift}, z_{scale}, cut^*): \rightarrow \min \tilde{D}_{field}$$

Final field profile

Gun45cavity.txt

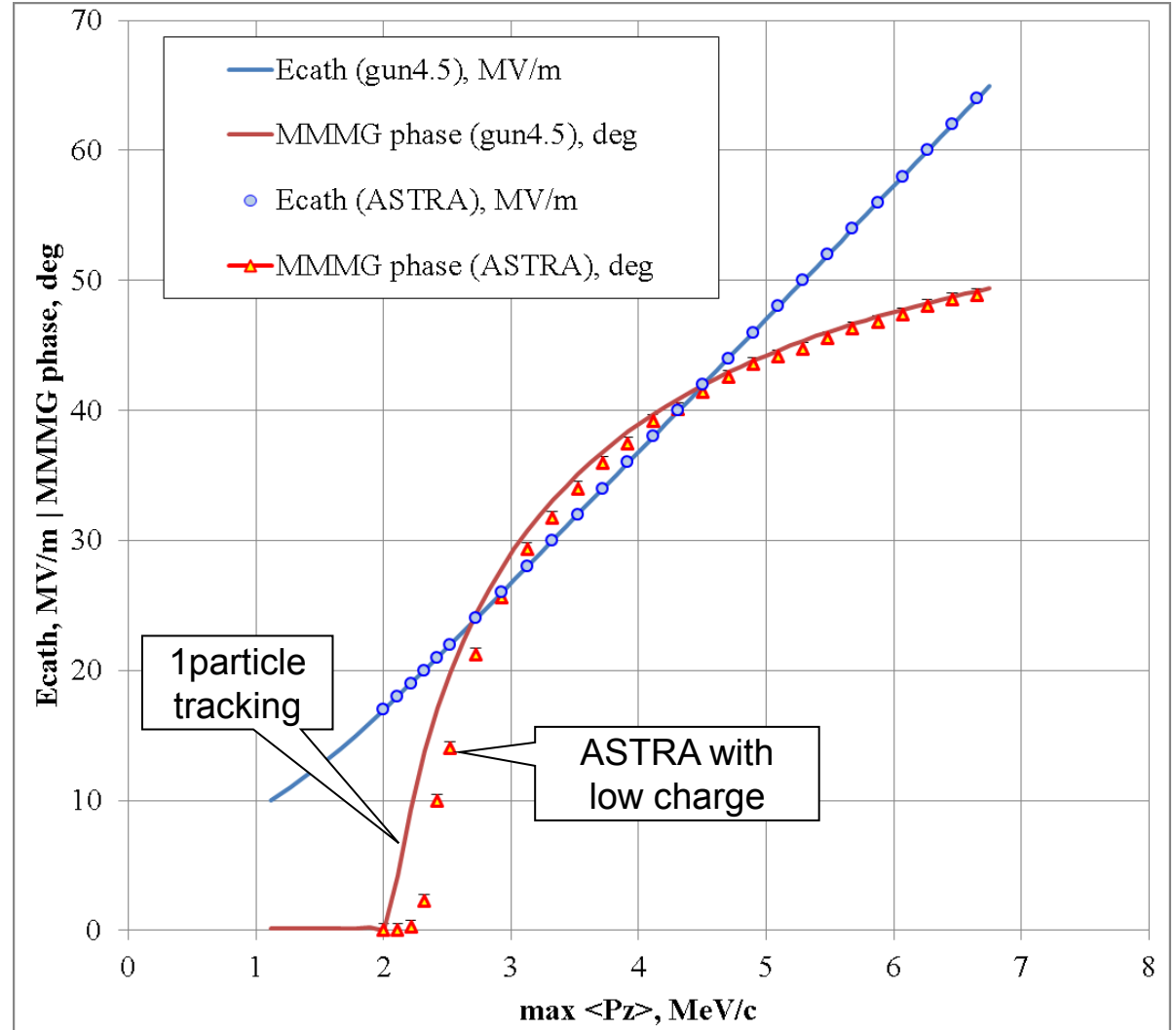


https://pitz.desy.de/pitz_intern/astra/ → Gun field profiles → Gun 4.5 = gun45cavity.txt

Pz-Simulations with Gun45cavity.txt field profile

Max<Pz> and MMMG phase vs. Ecath + comparison with Gun4.6

Ecath MV/m	Gun4.5	Gun4.6	
	max<Pz> MeV/c	max<Pz> MeV/c	RF power MW
10	1.12	1.12	0.18
15	1.78	1.83	0.40
20	2.32	2.42	0.70
25	2.83	2.96	1.10
30	3.33	3.48	1.58
35	3.82	4.01	2.16
40	4.31	4.52	2.82
45	4.80	5.04	3.56
50	5.29	5.56	4.40
55	5.78	6.08	5.32
60	6.27	6.59	6.34
62	6.46	6.80	6.77
64	6.66	7.00	7.21



Conclusions

Gun4.5 cavity field profile

- Bead pull measurements from 27.05.2015 have been used
- Treatment procedure resulted in $|E_z(z)|$ profile
- SF simulations including small deformations (~tuning procedure) yielded smooth field profile $E_z(z)$:
 - ❑ https://pitz.desy.de/pitz_intern/astra/ → **Gun field profiles** → **Gun4.5** (= gun45cavity.txt as e.g. input for ASTRA)
- Obtained field balance: $FB_{\text{Gun4.5}} = E_{\text{cath}} / \max|E_{\text{fullcell}}| = \mathbf{1.143}$ (NB: $FB_{\text{Gun4.6}} = 1.088$)
 - one of possible reasons for high dark current?
- Simulations of mean longitudinal momentum,
 - ❑ e.g. $\max\langle P_z \rangle (E_{\text{cath}} = 60 \text{ MV/m}) = \mathbf{6.27 \text{ MeV/c}}$
 - ❑ NB: Gun4.6 → $\max\langle P_z \rangle (E_{\text{cath}} = 60 \text{ MV/m}) = 6.59 \text{ MeV/c}$ for $P_{\text{gun}} = 6.34 \text{ MW}$