

PITZ-1.8 setup for beam dynamics simulations

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PPS 19.01.2010

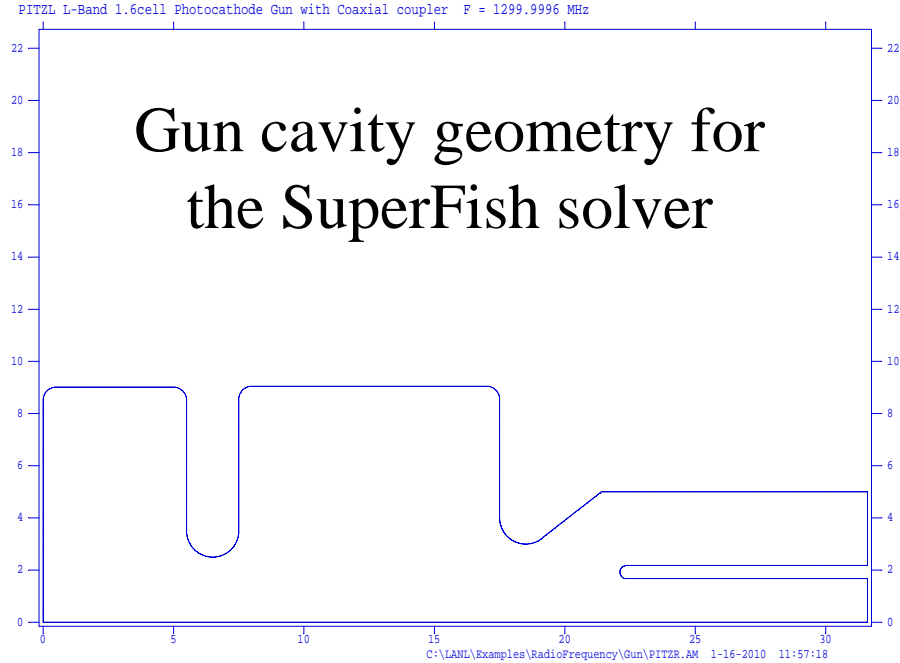
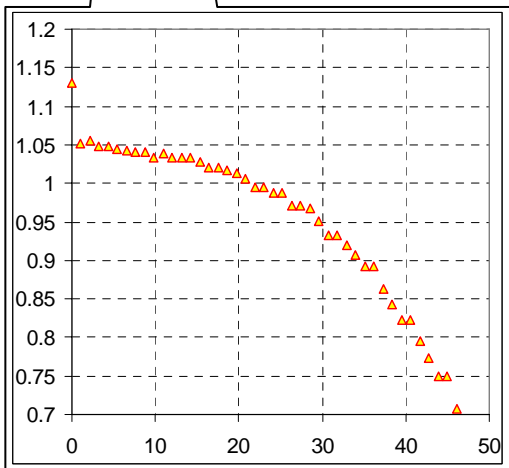
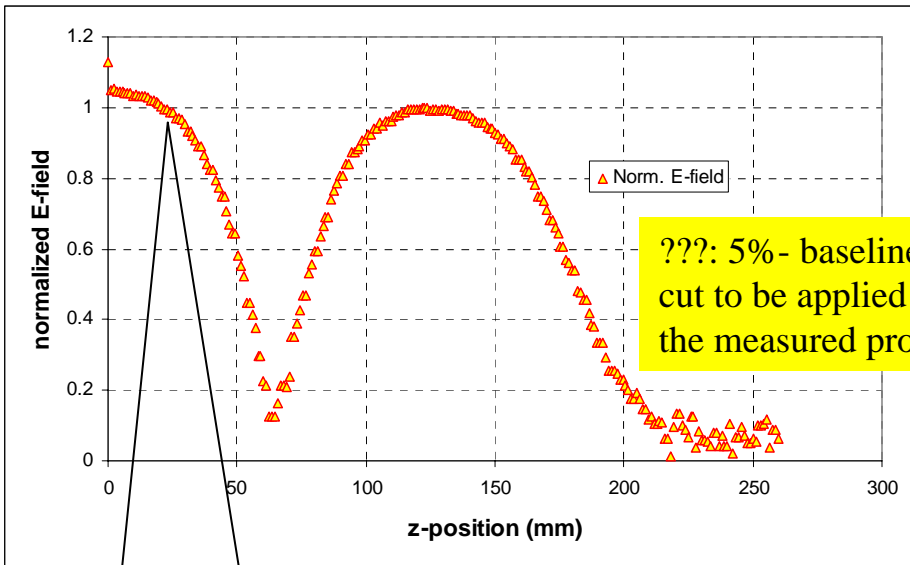
PITZ-1.8 simulations

- EM fields for BD simulations;
 - Gun-4.1: simulation of the measured field profile
 - Solenoids field (combined smoothed distribution)
 - CDS booster field
- General setup (ASTRA input desk)
- Test ASTRA run

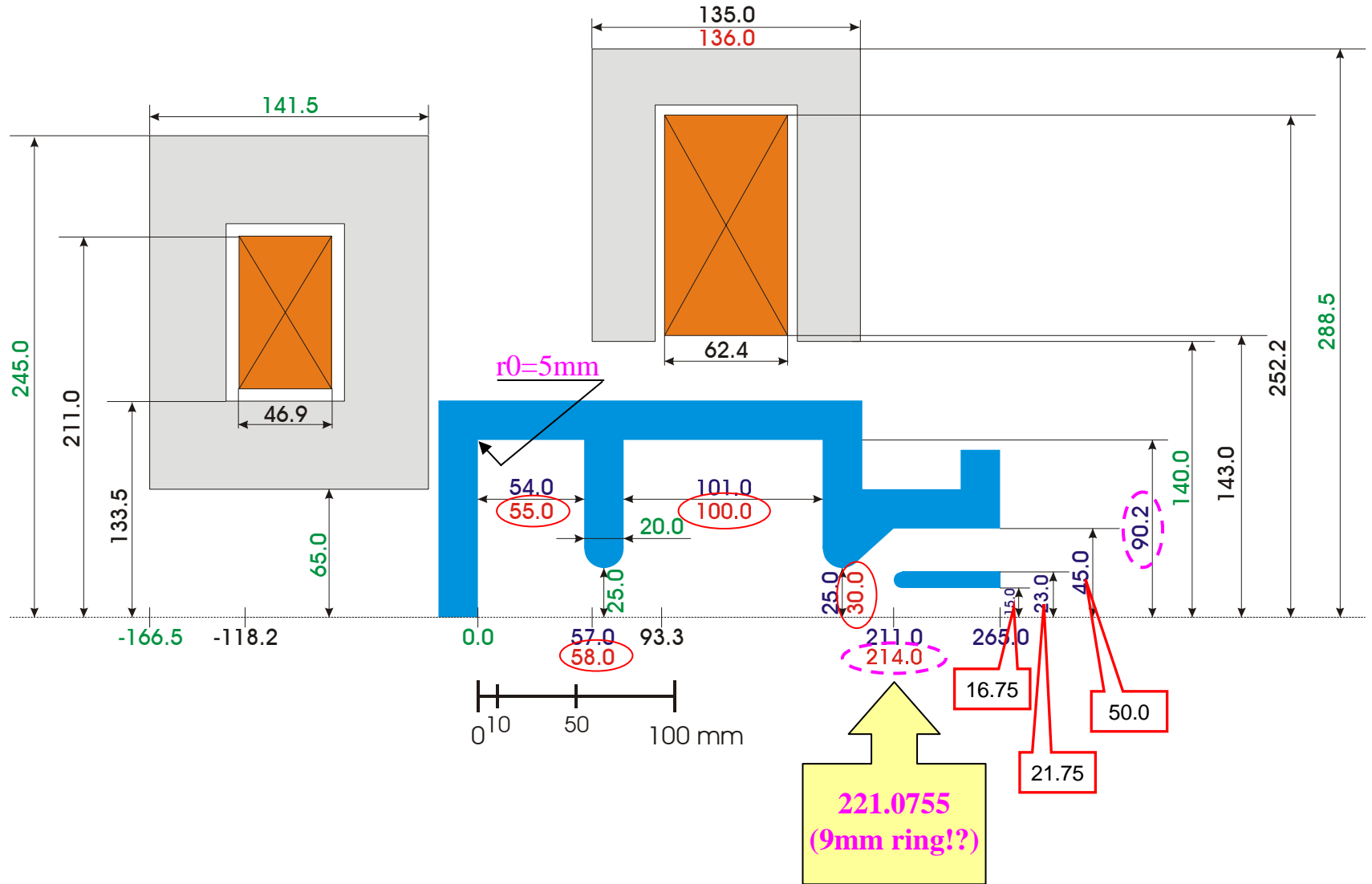
Gun-4.1: simulation of the measured field profile

“Bead-pull measurements”
(SR->MK)

Field balance: FB~1.05

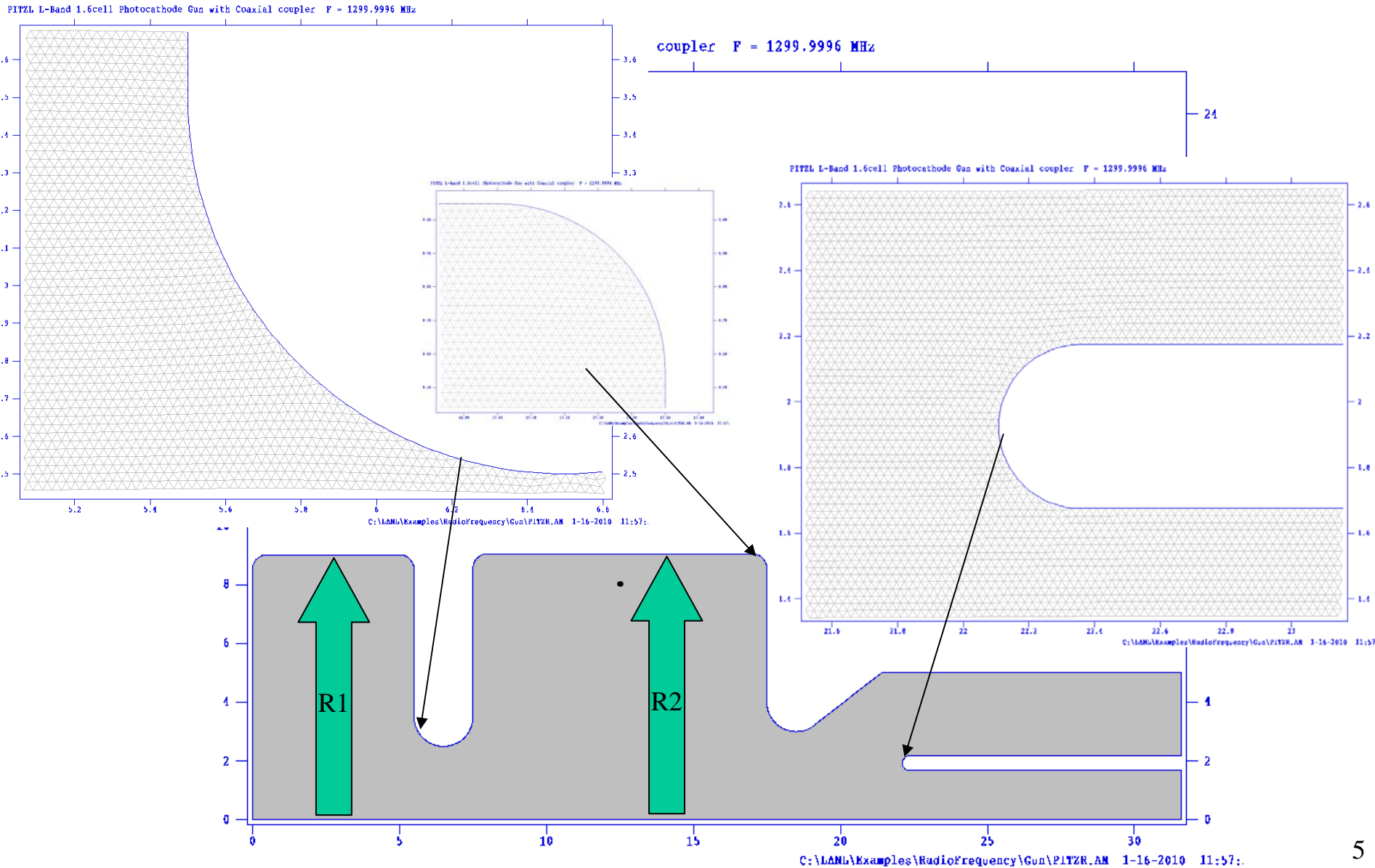


PITZ Gun



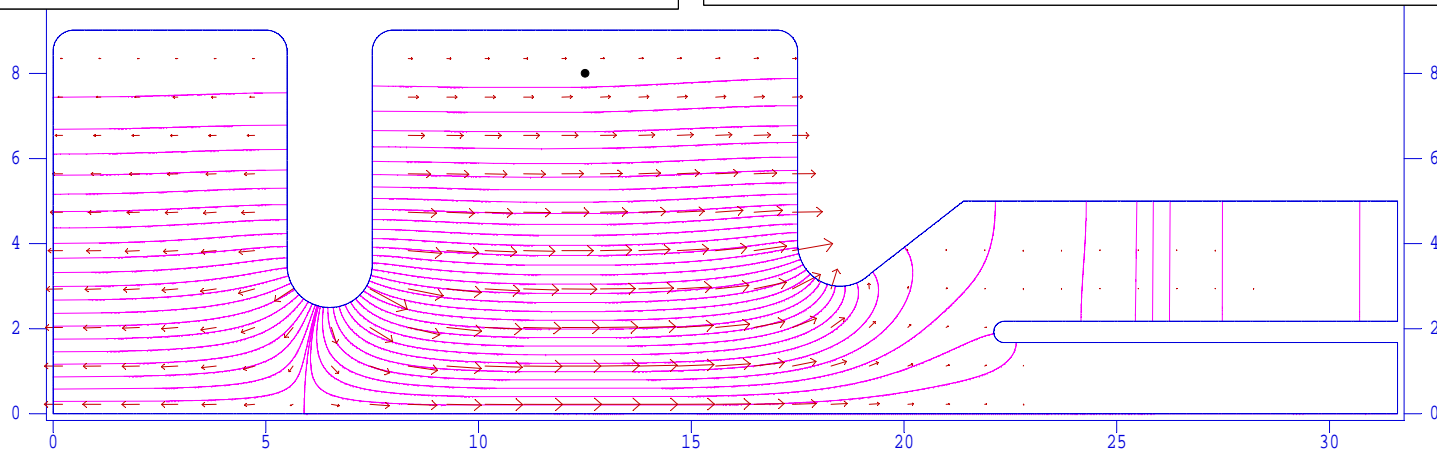
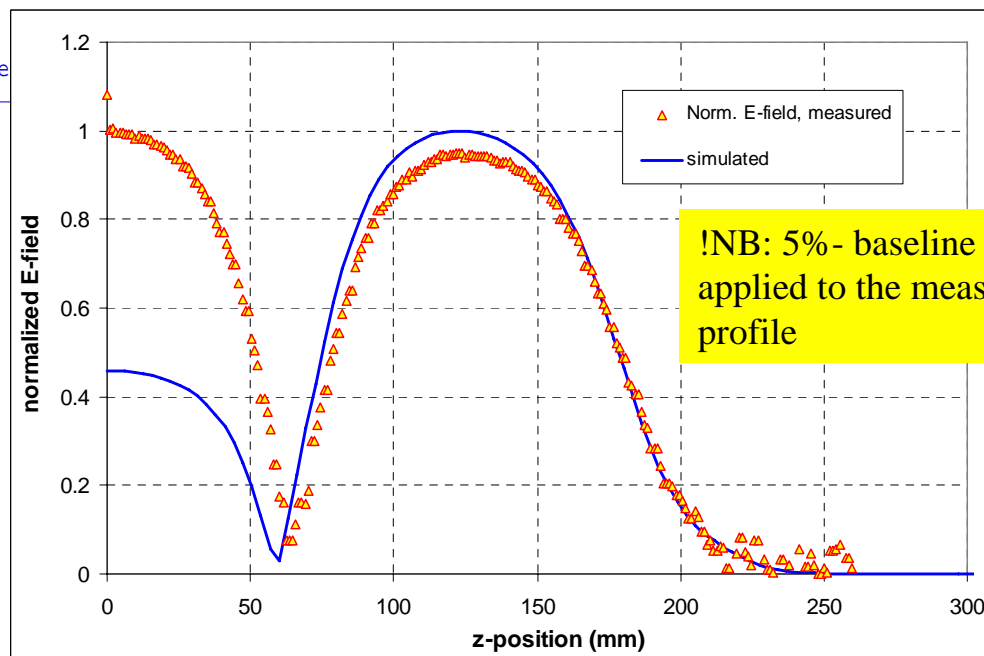
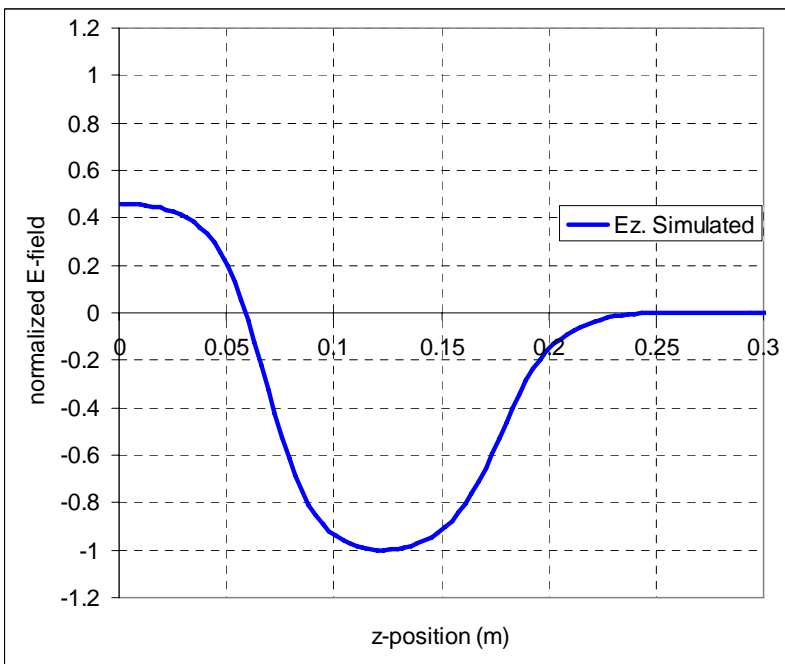
Gun-4.1: simulation of the measured field profile

Generated Mesh



Gun-4.1: simulation of the measured field profile

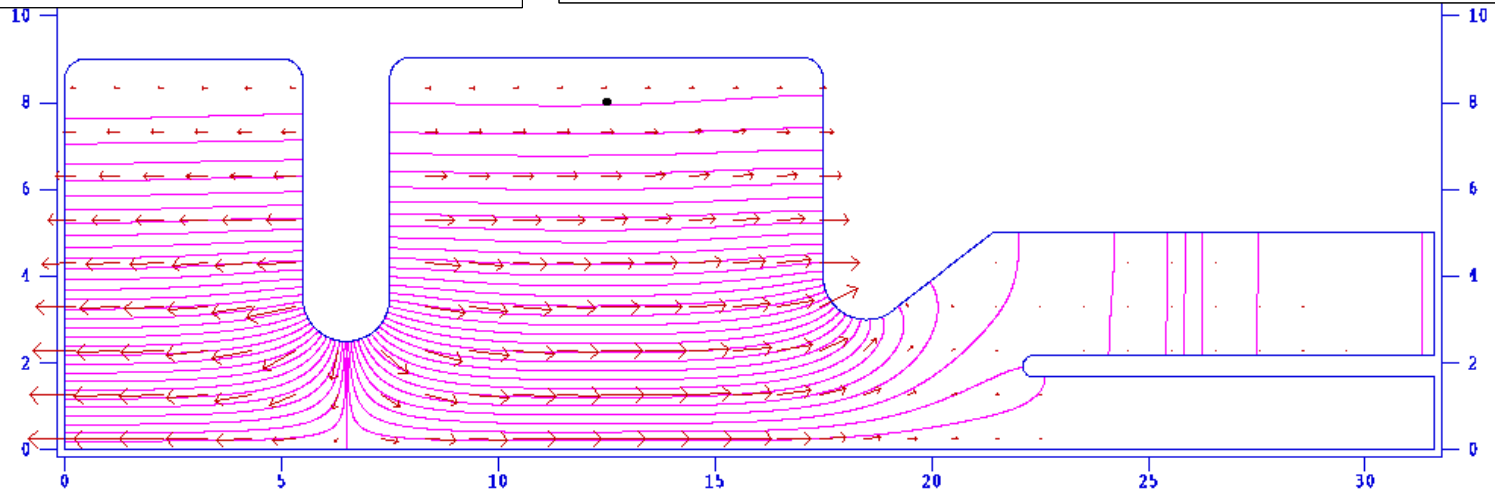
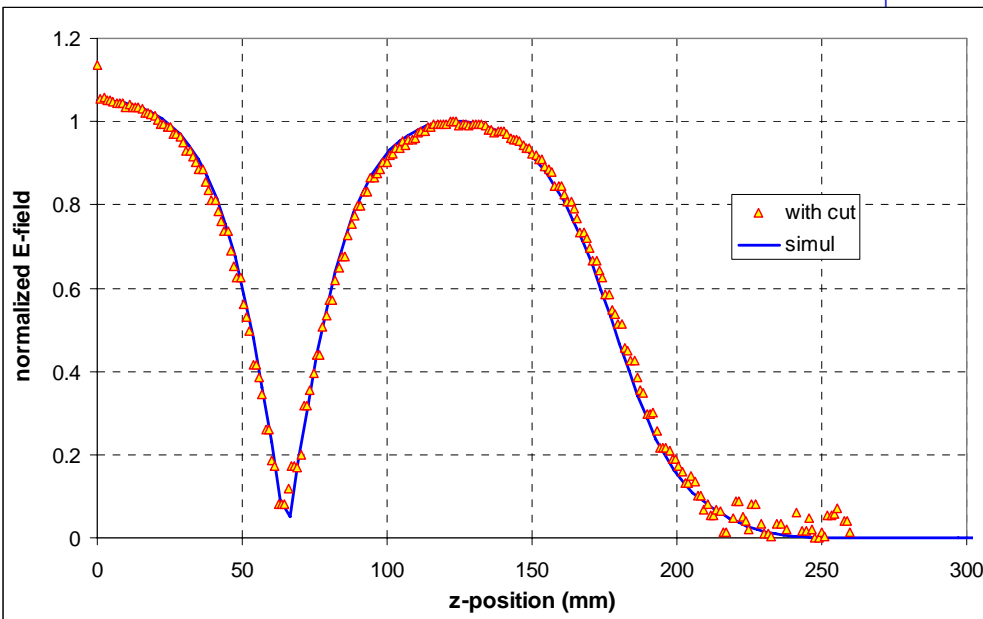
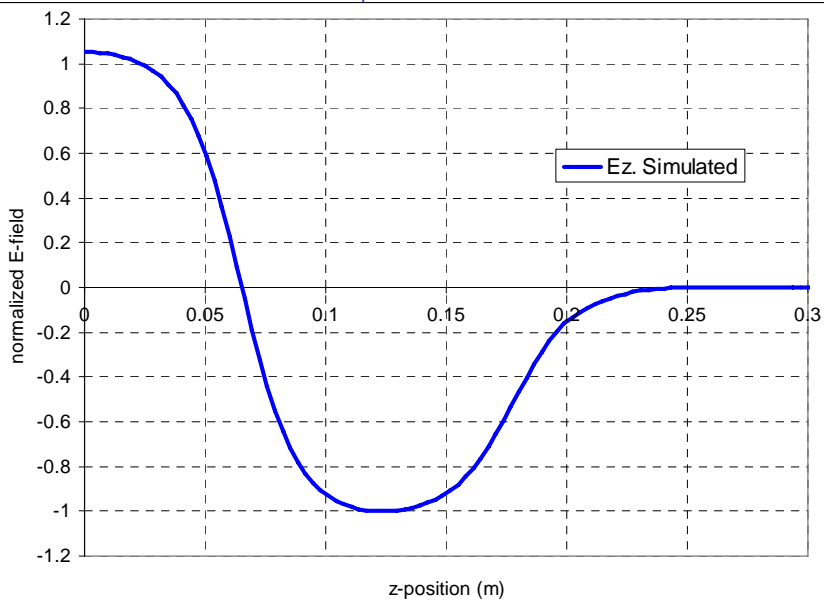
Default case: $R1=R2=90.2\text{mm}$ \rightarrow $f=1.3031923\text{GHz}$; $\text{FB}=0.4592(!)$



Gun-4.1: simulation of the measured field profile

(R1;R2) optimization for frequency (1.3GHz) and FB=1.051

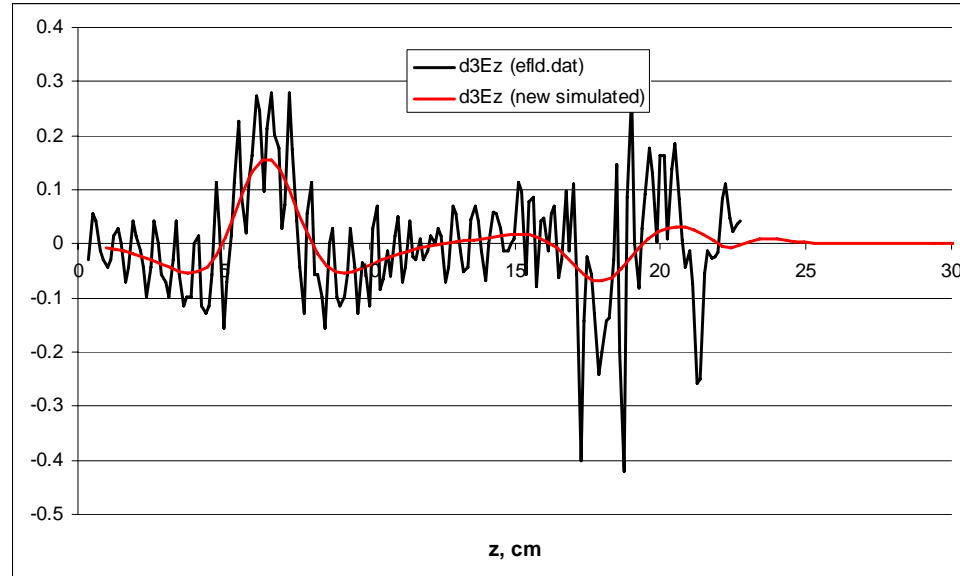
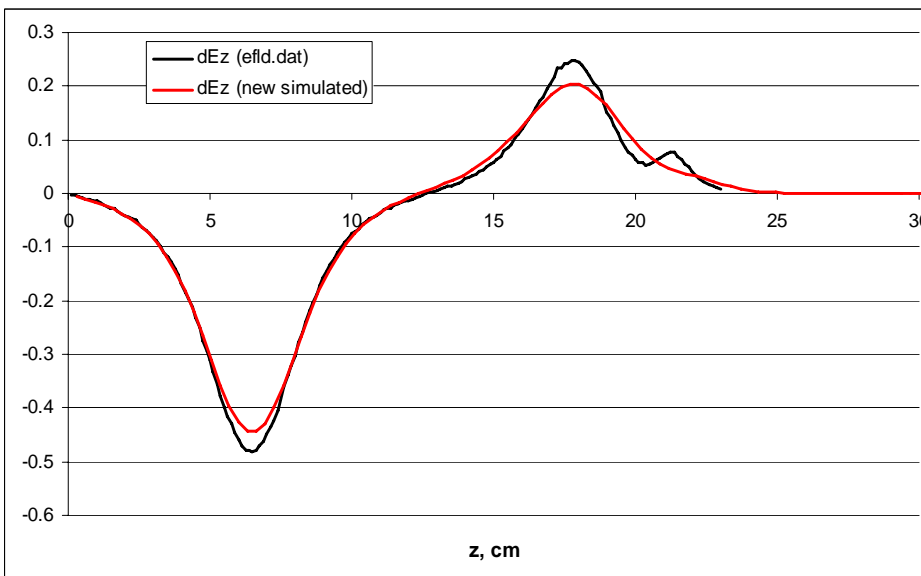
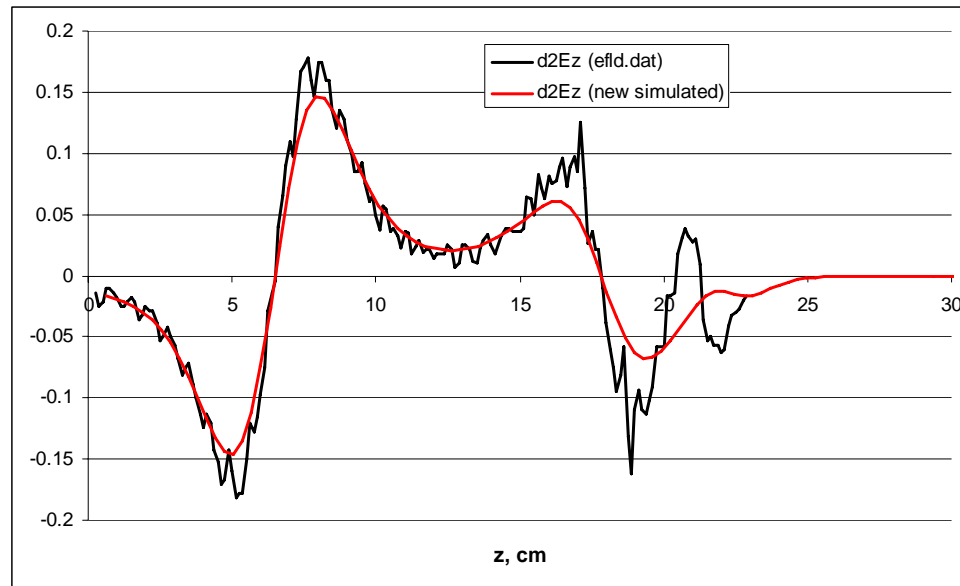
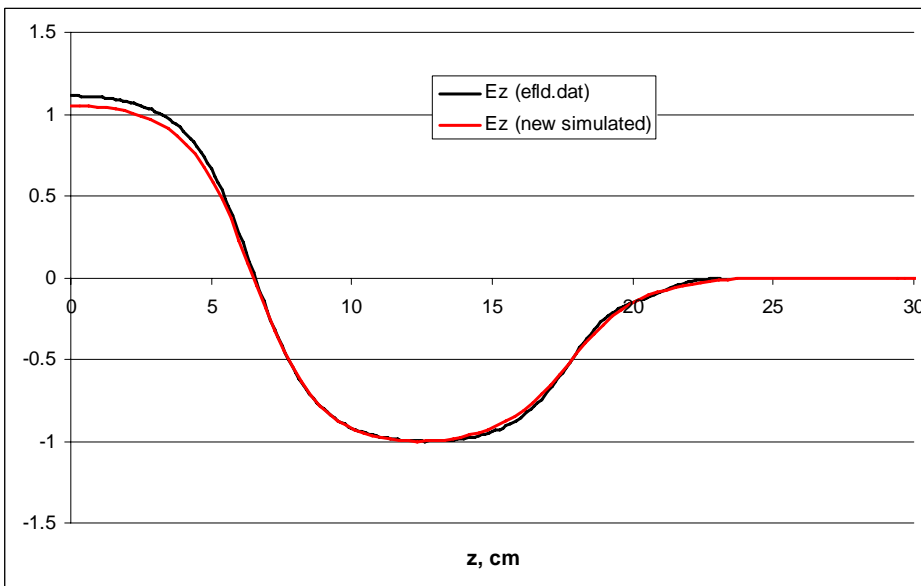
(R1=90.140mm; R2=90.484mm) → f=1.2999996GHz; FB=1.0510



R1=R0-60um
R2=R0+284um
R0=90.2um

Gun-4.1: simulation of the measured field profile

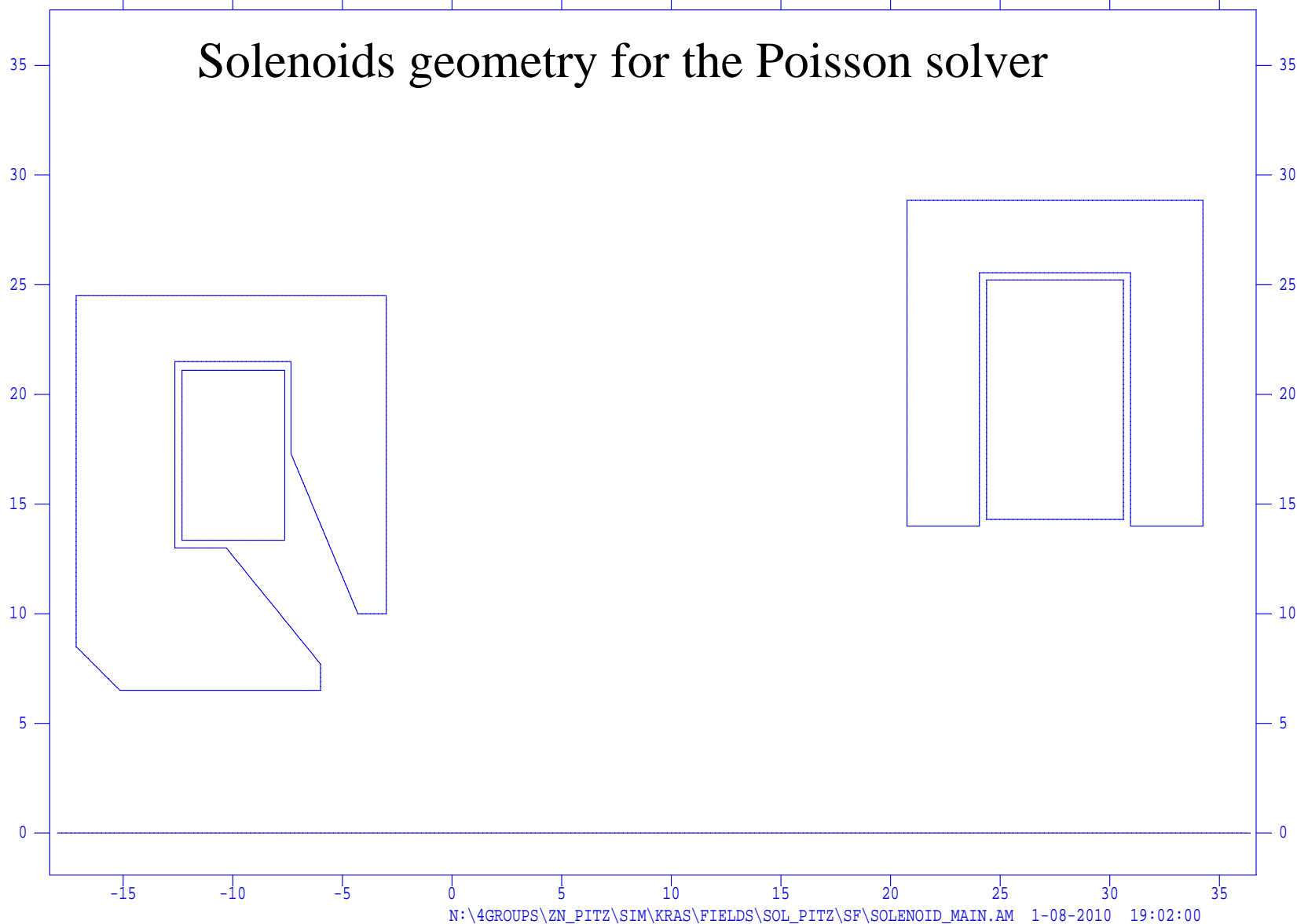
Field distribution + derivatives



New rf-gun file = "gun41cavity.txt"

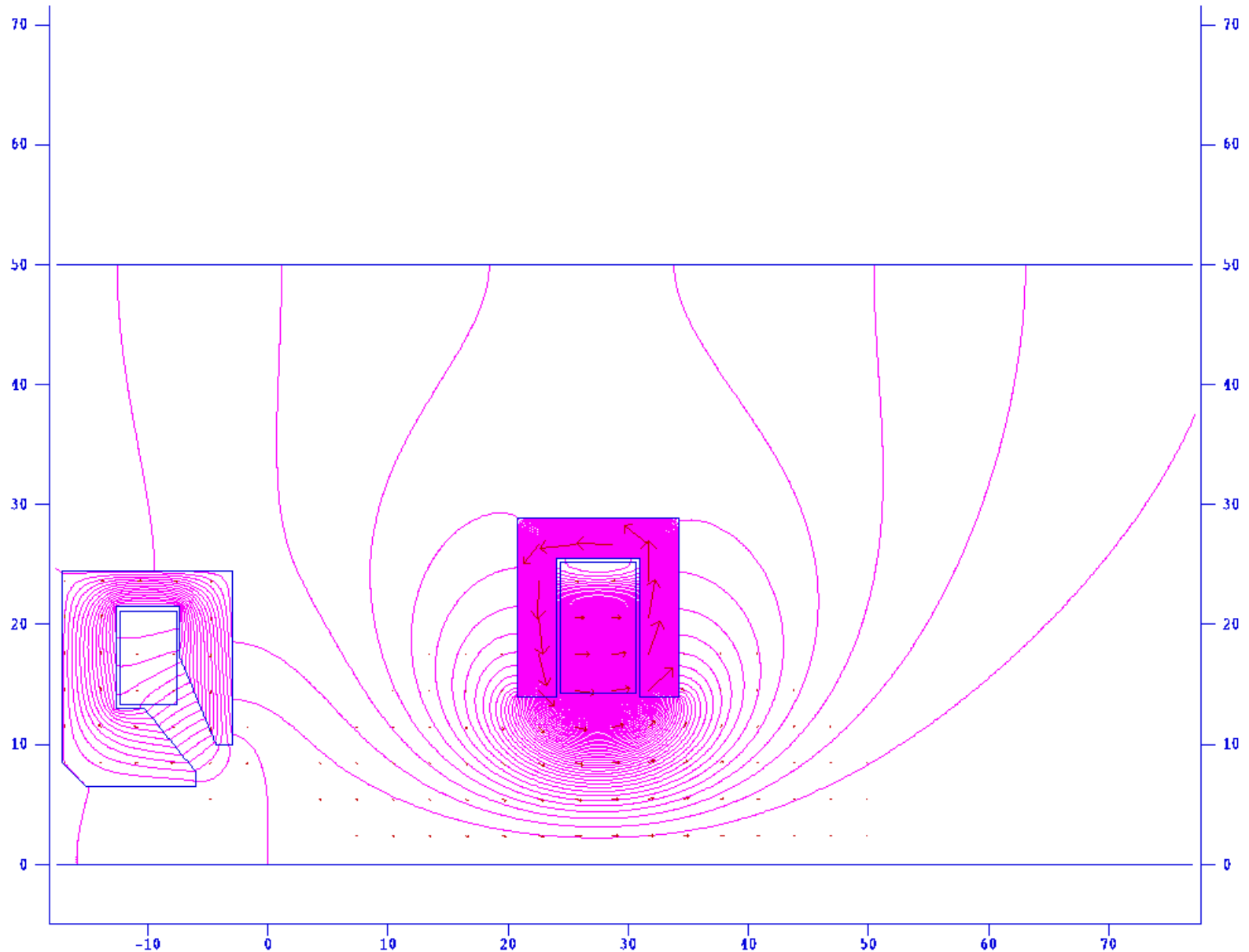
Gun solenoids: simulation of the measured field profile

PITZ Solenoides for L=276 mm with cathode at z=0 - 16 Jun 05 - MK -



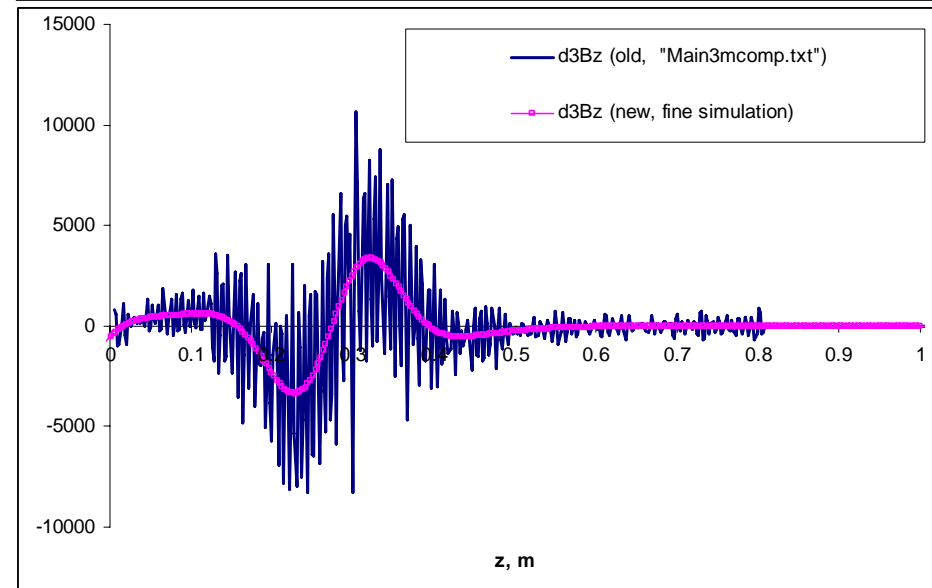
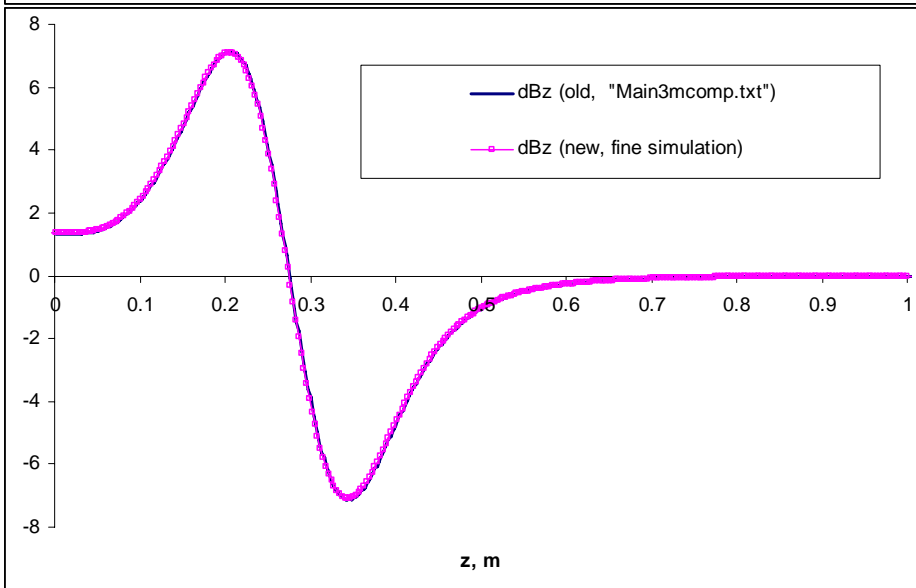
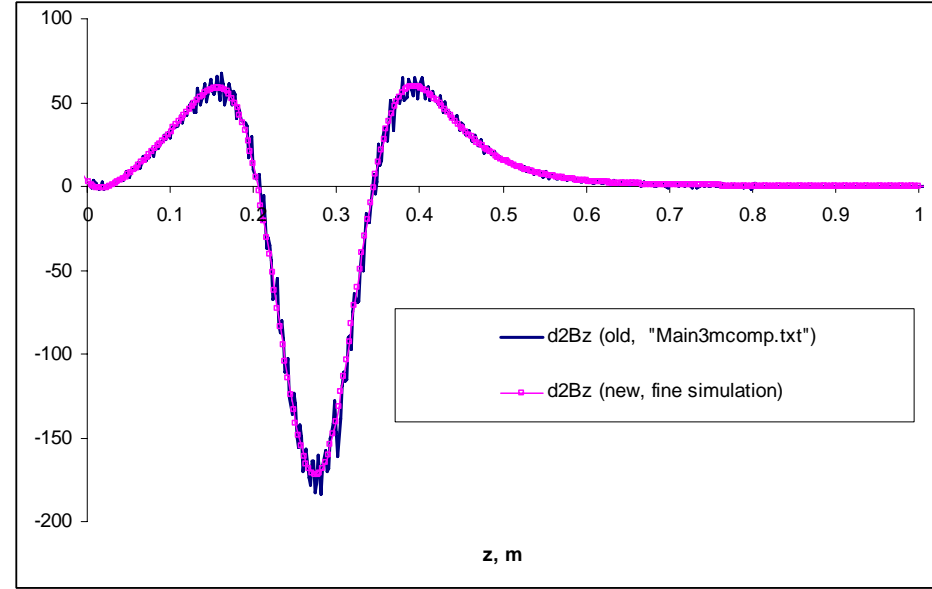
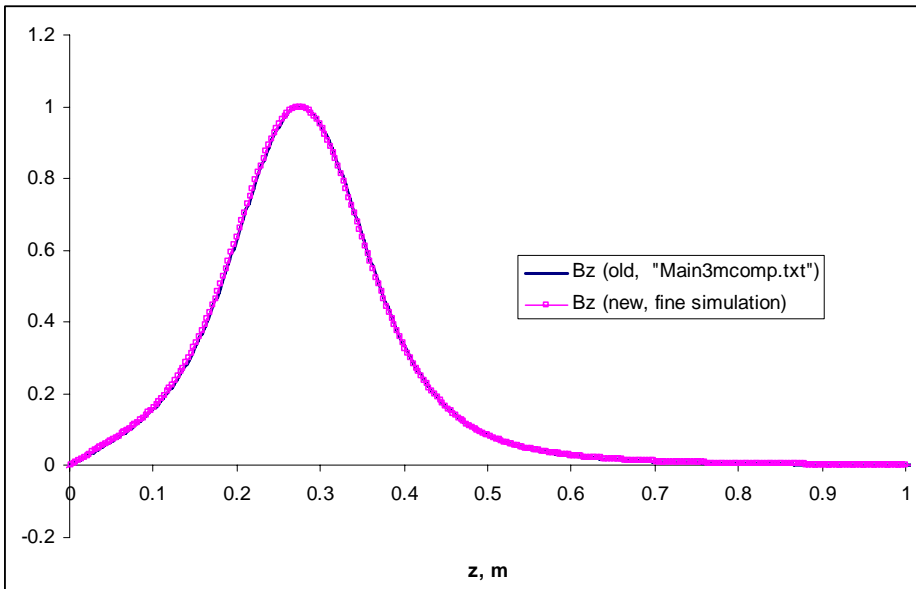
Gun solenoids: simulation of the field profile

Poisson results



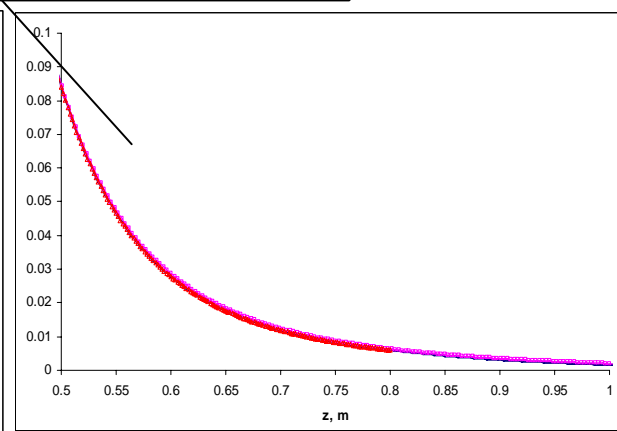
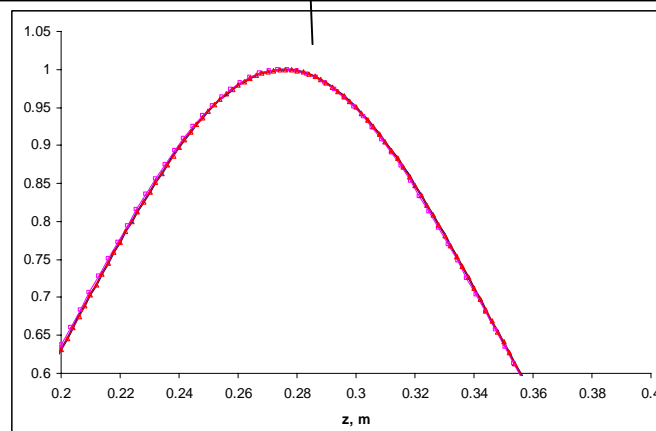
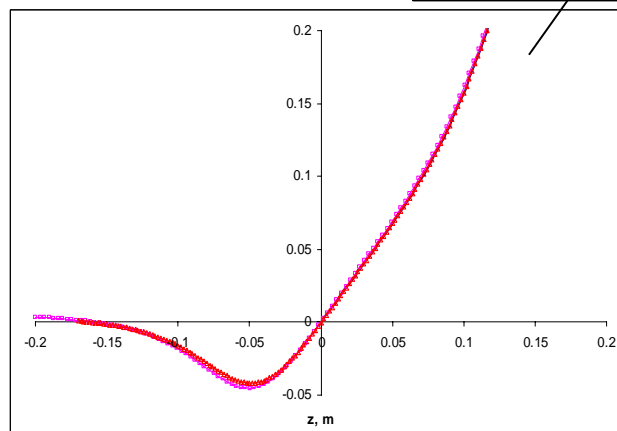
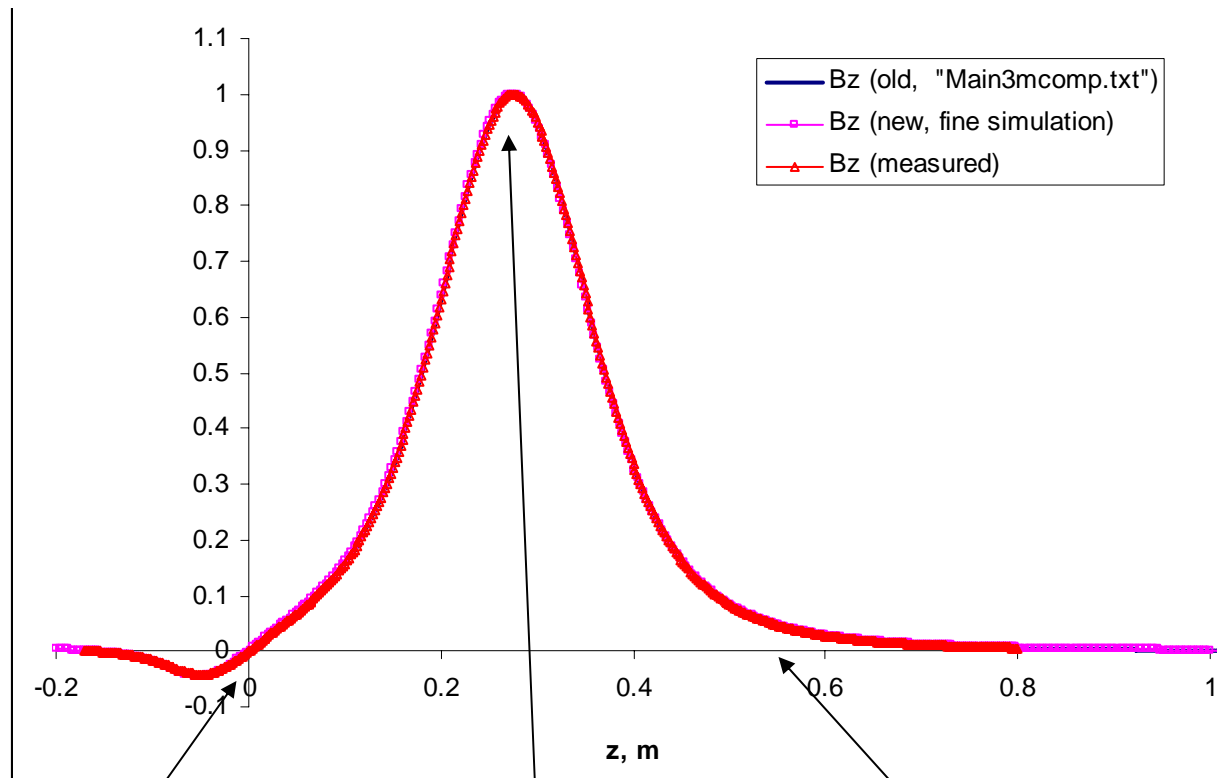
Gun solenoids: simulation of the field profile

Axial field distributions

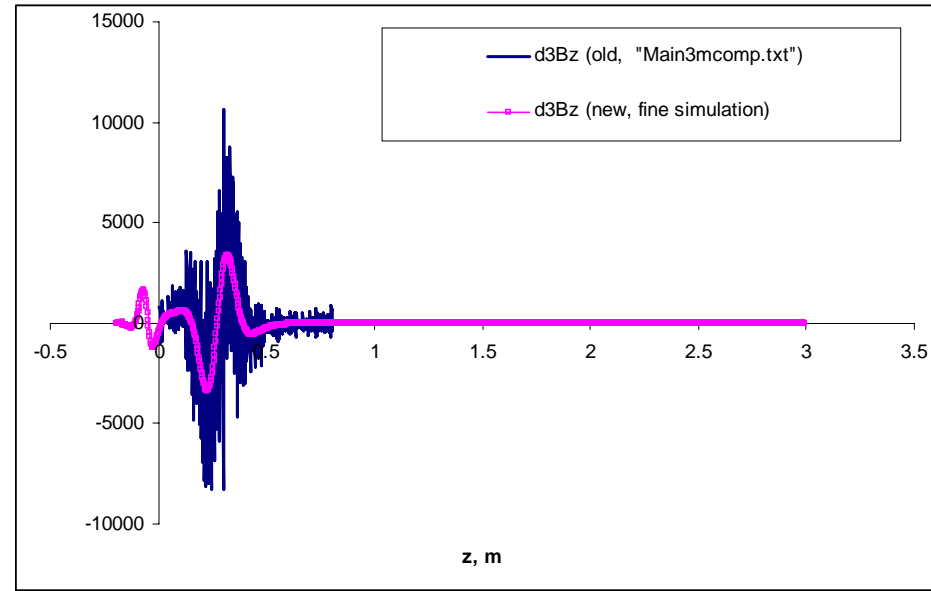
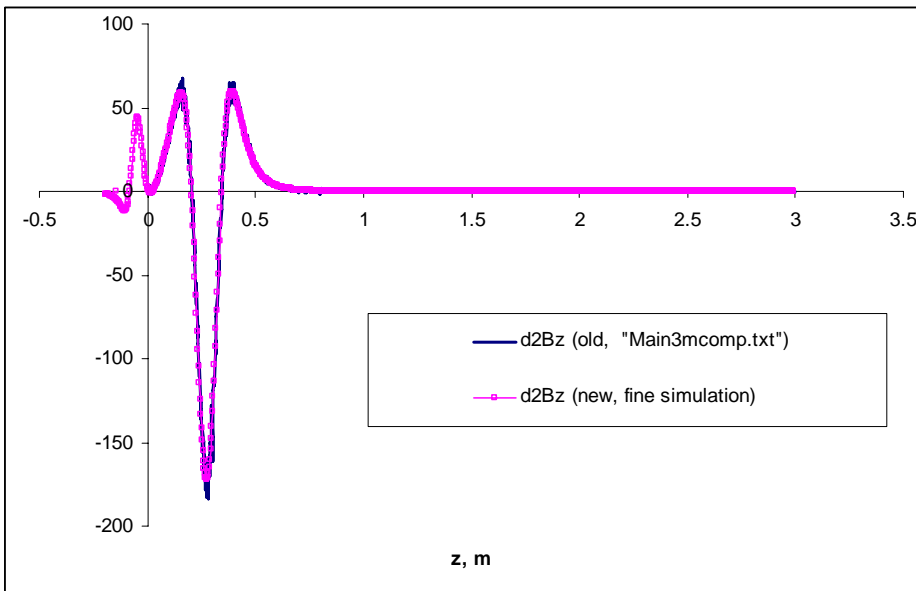
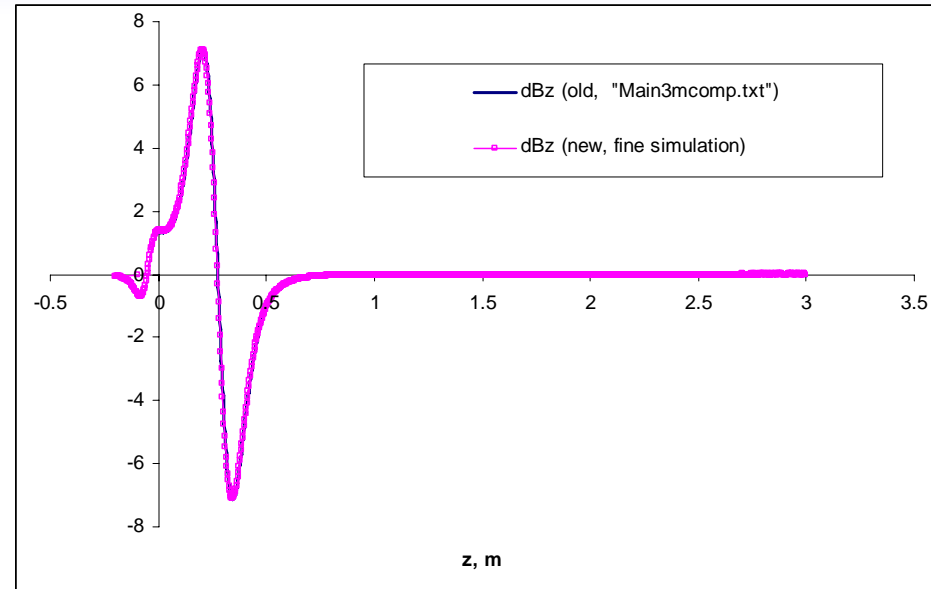
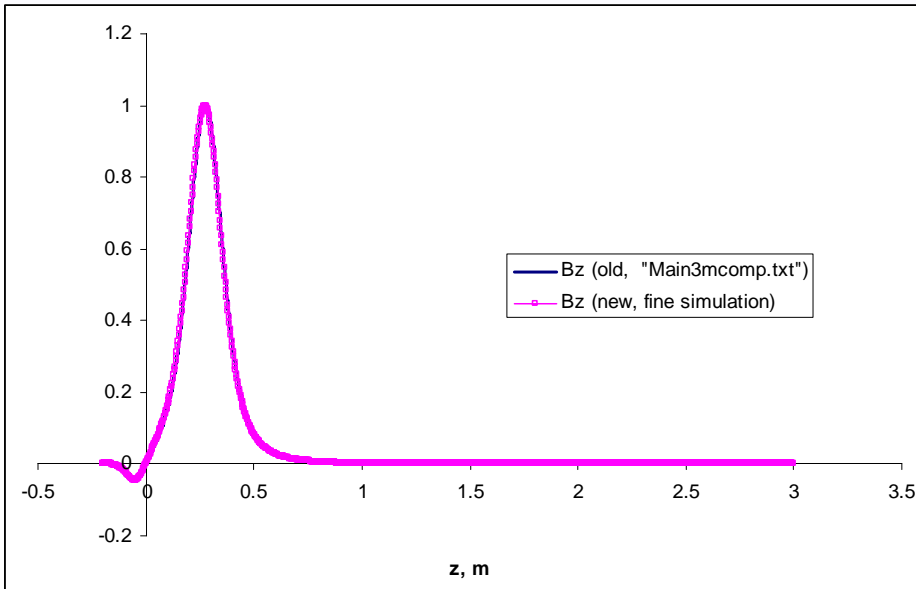


Gun solenoids: simulation of the field profile

Simulated distributions compared to measurements



Gun solenoids: simulation of the field profile

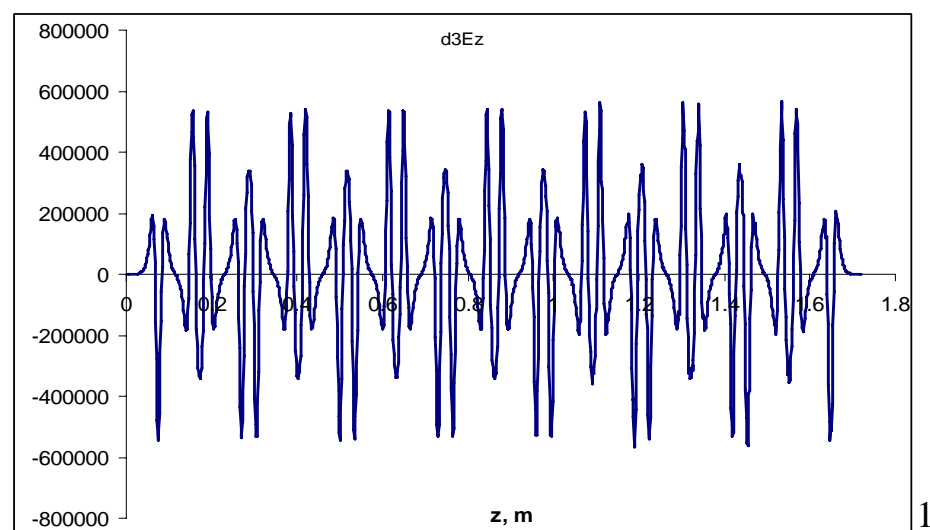
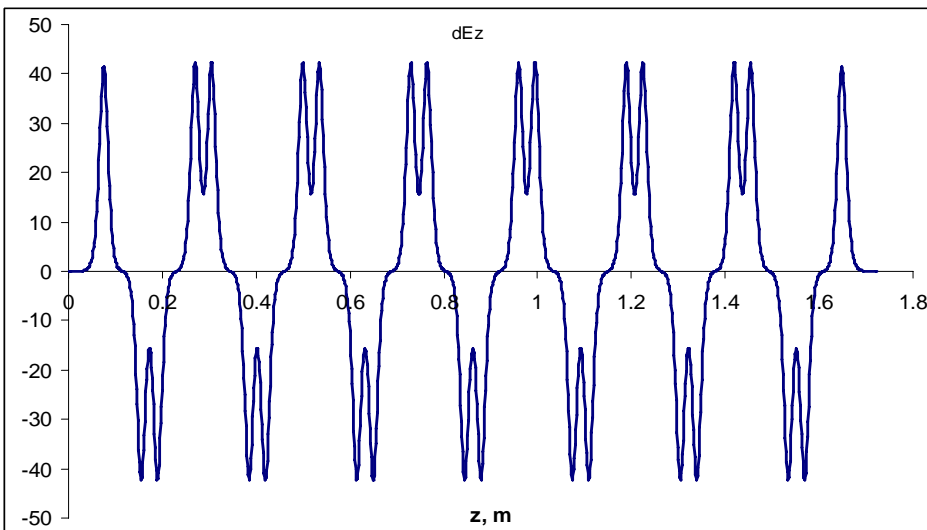
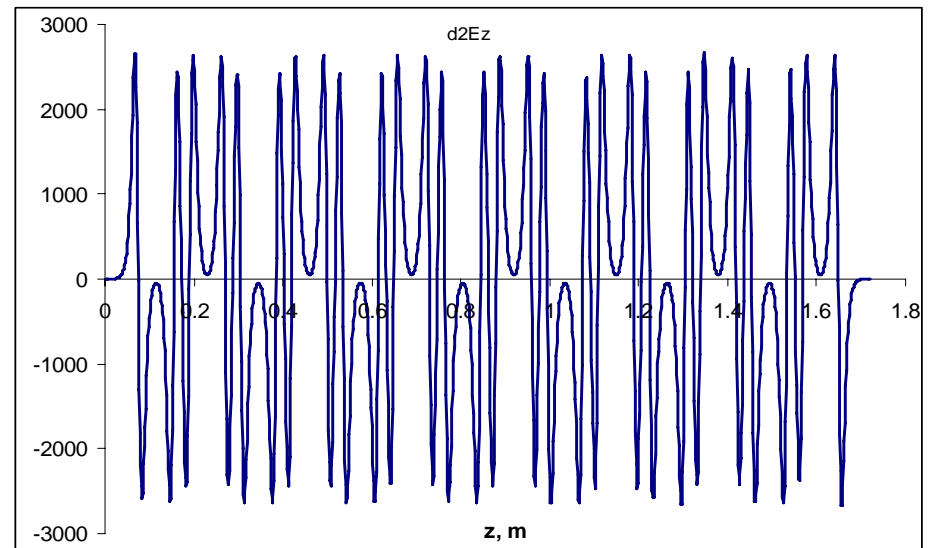
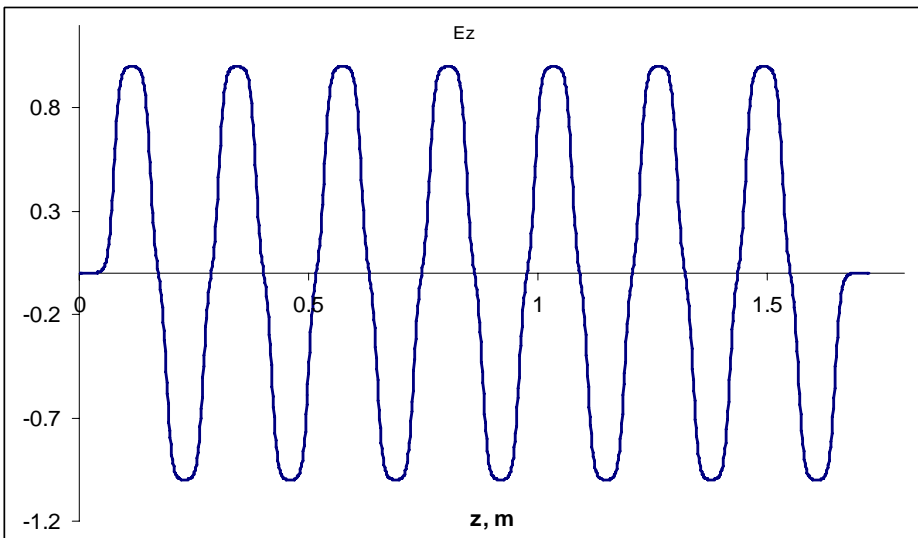


New solenoid file = "gunsolenoidsPITZ.txt"

CDS-booster: Ez field on the z-axis

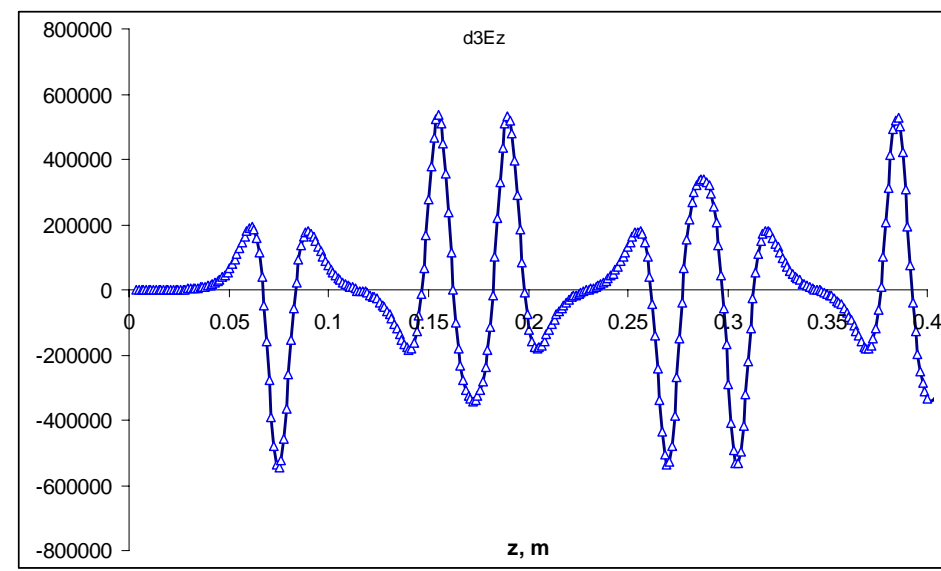
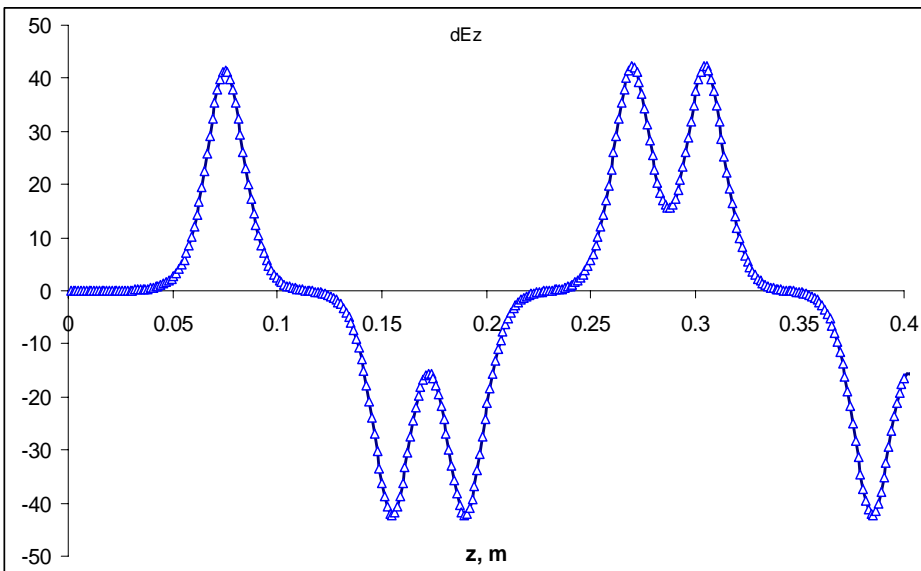
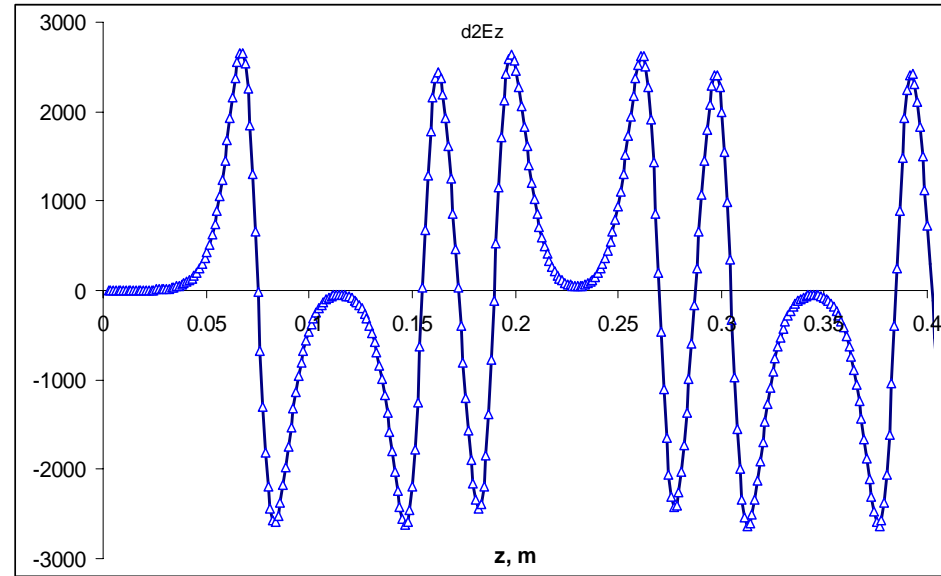
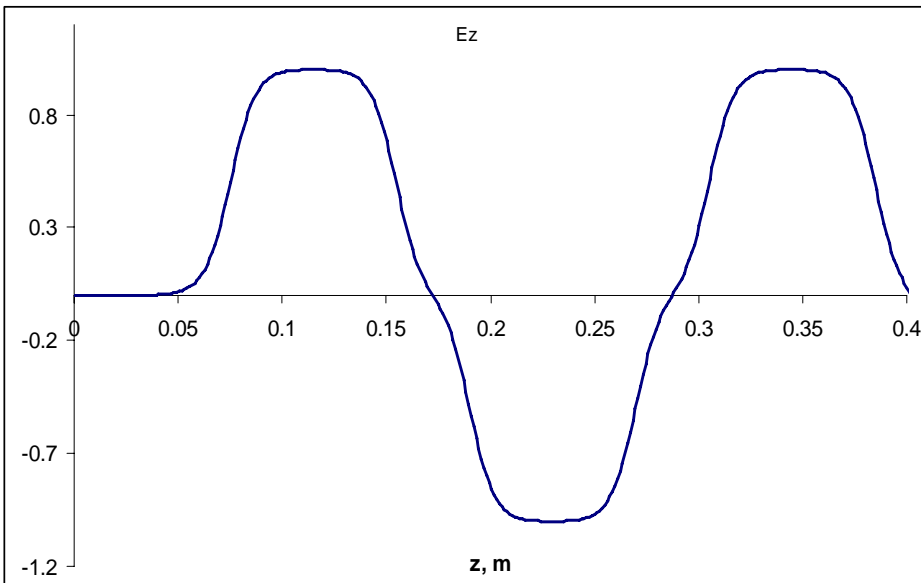
Field distribution for 1/2-cell (+end cells) provided by V.Paramonov

File: **CDS14_15mm.txt** = 14 cells for the structure with 15 mm aperture



CDS-booster: Ez field on the z-axis

Zoom (0→0.4m)



General setup (ASTRA input desk)

```
&NEWRUN
Head= '- PITZ-1.8-'
RUN=3,
Distribution = 'cathode200k.ini',
Xoff=0.0, Yoff=0.0
Qbunch=1.00
Lmagnetized=.F
EmitS=.T, PhaseS=.T, TrackS=.T, RefS=.T
TcheckS=.F, CathodeS=.T, Local_emit=T
TRACK_ALL=T, PHASE_SCAN=F,
AUTO_PHASE=T
ZSTART=0.00, ZSTOP=10
Zemit=1000
Zphase=3
Lmonitor=f
check_ref_part=f
H_max=0.001
H_min=0.0 ! 0.0001
debunch=0.0
Screen(1)= 0.803 ! LOW.Scr1
Screen(2)= 0.903 ! LOW.ICT1
Screen(3)= 0.963 ! before LOW.Dipol
Screen(4)= 1.708 ! LOW.Scr3
Screen(5)= 5.580 ! HIGH1.ICT1
Screen(6)= 5.740 ! HIGH1.Scr1 = EMSY1
Screen(7)= 6.345 ! HIGH1.Scr2
Screen(8)= 7.125 ! HIGH1.Scr3 = EMSY2
Screen(9)= 7.370 ! before HIGH1.Dipol
Screen(10)=8.387 ! HIGH1.Scr4
Screen(11)=8.650 ! HIGH1.ICT2
Screen(12)=8.920 ! HIGH1.Scr5
XYrms= 0.42543
LANDFS = .T,
LPROMPT=.F.
/
```

```
&CHARGE
LSPCH=.T,
N_min = 200.0
Max_Scale = 5.0000E-02
Max_Count = 40
Exp_Control = 0.1000
Lmirror = T
Nrad = 40, Cell_Var = 1.000
Nlong_in = 80
/
```

```
&CAVITY
LEfield=t
File_Efield(1) = 'gun41cavity.txt',
Nue(1)=1.300,
MaxE(1)=60.00,
Phi(1)= -1.03396
C_pos(1)=0.0,
File_Efield(2) = 'CDS14_15mm.txt',
Nue(2)=1.300,
MaxE(2)= 18.7327
Phi(2)= -6.25441
C_pos(2)= 3.068146
/
```

```
&APERTURE
```

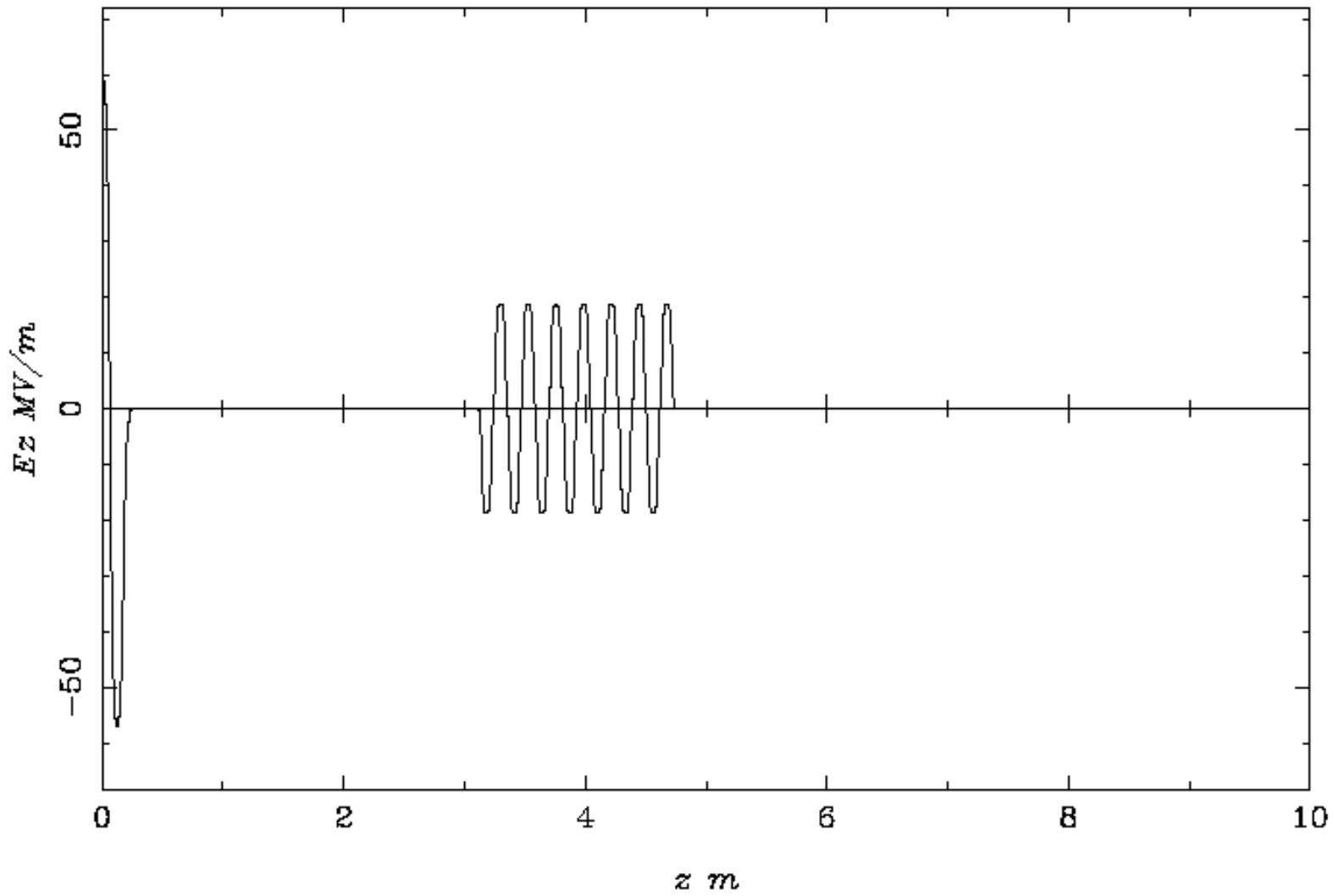
```
....
/
```

Machine parameters → from old optimization for PITZ-2 setup (old ASTRA, old fields)

```
&SOLENOID
LBfield=.T,
File_Bfield(1)='gunsolenoidsPITZ.txt',
MaxB(1)= -0.225533
S_pos(1)=0.0,
S_xoff(1)=0.0,
S_yoff(1)=0.0,
/
```

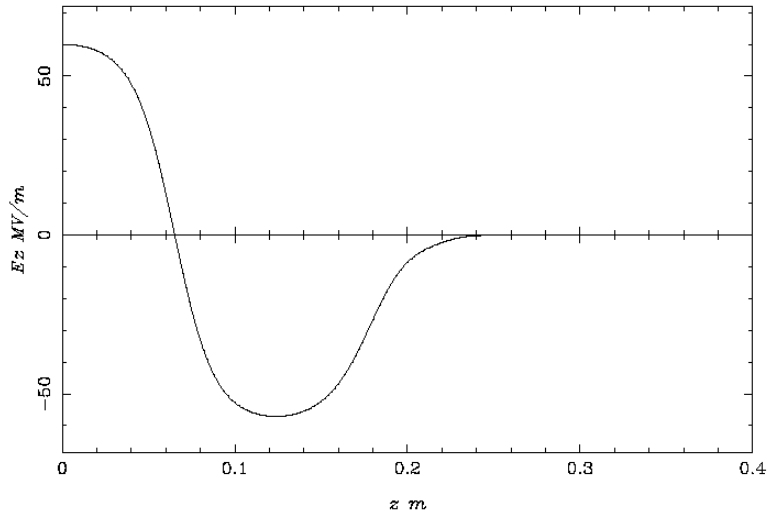

Fields from ASTRA fieldplot

longitudinal electric field

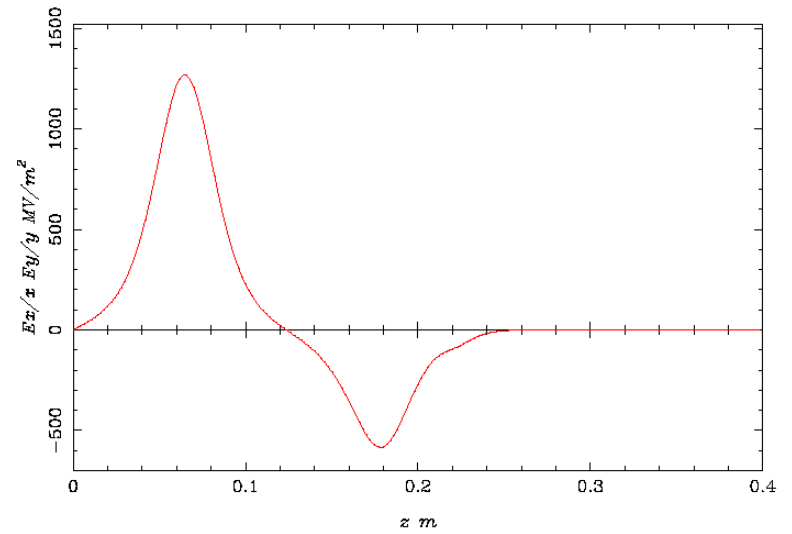


Fields from ASTRA fieldplot: gun cavity

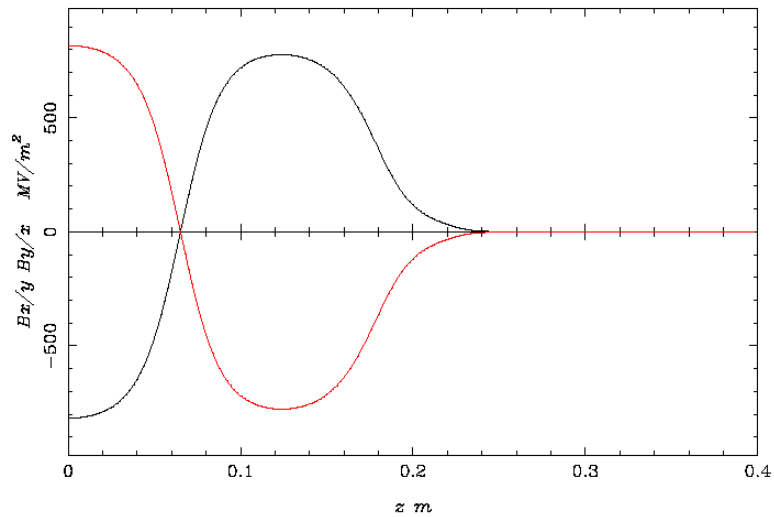
longitudinal electric field



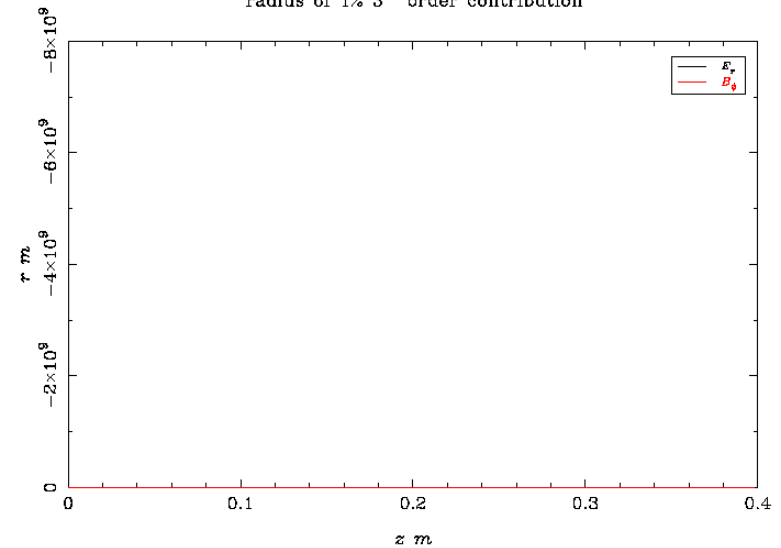
transversal electric field/radius



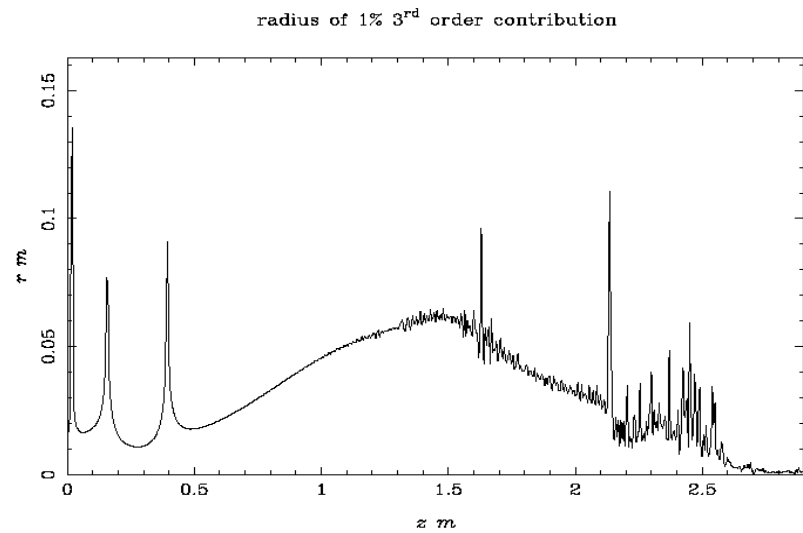
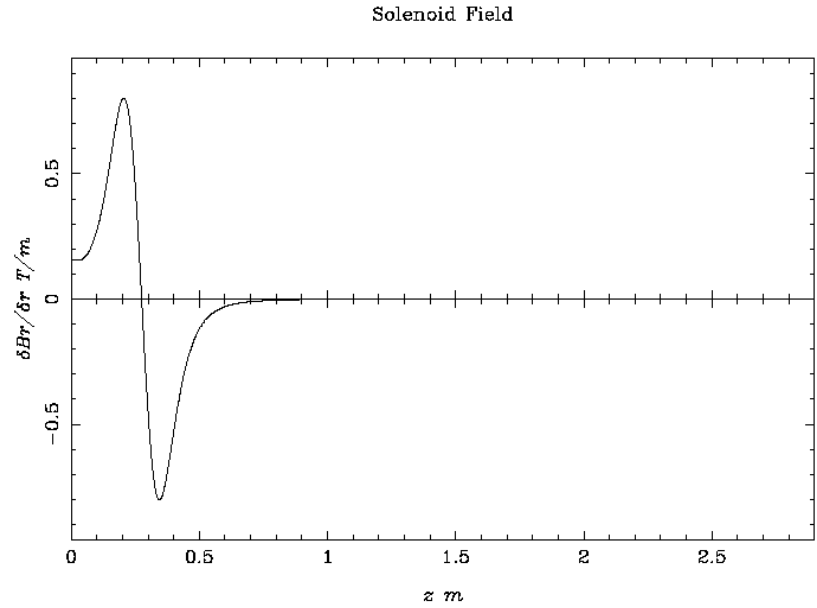
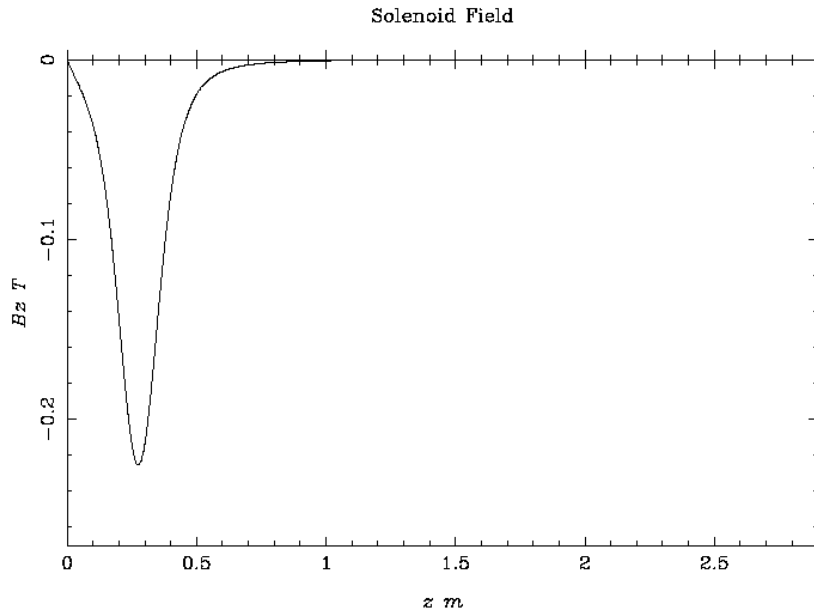
azimuthal magnetic field/radius



radius of 1% 3rd order contribution

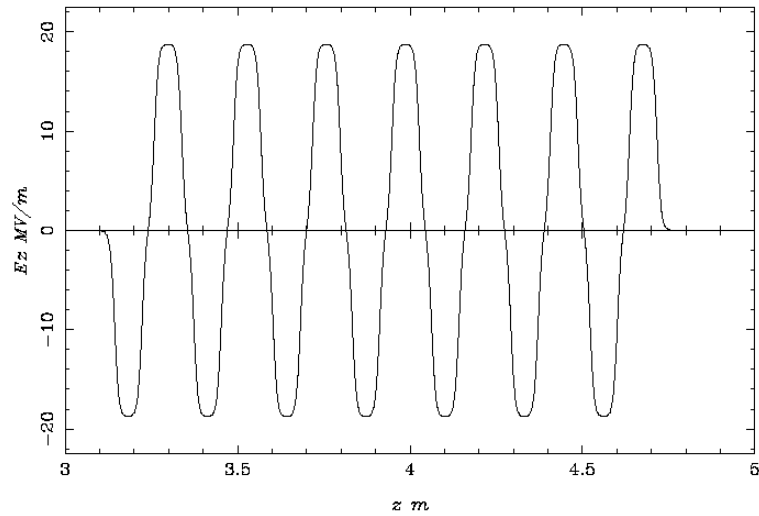


Fields from ASTRA fieldplot: gun solenoids

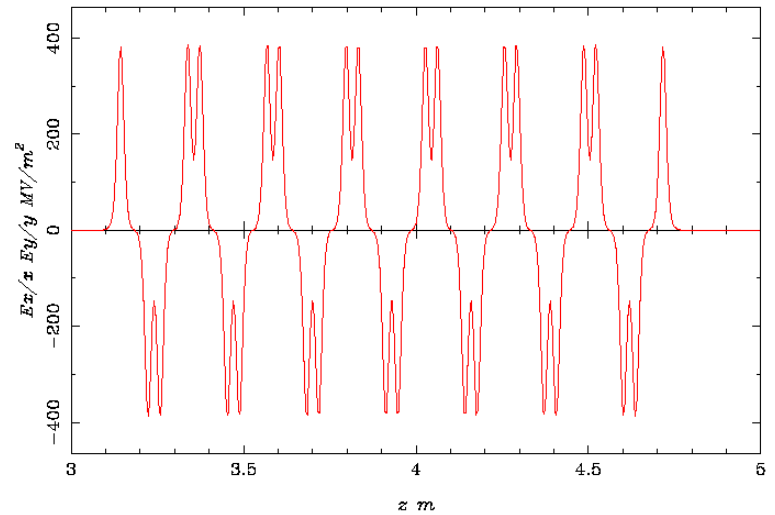


Fields from ASTRA fieldplot: CDS booster

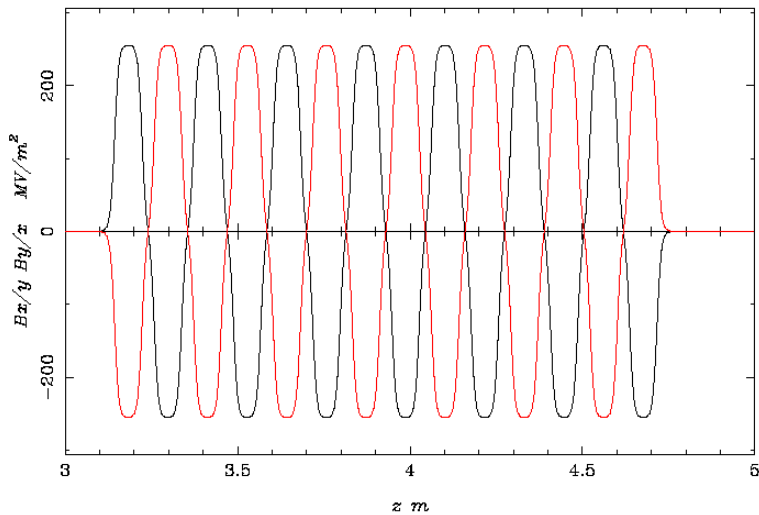
longitudinal electric field



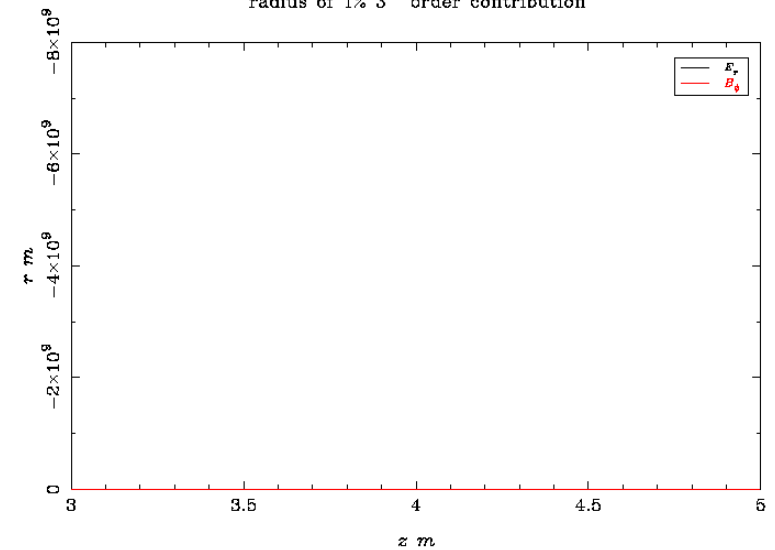
transversal electric field/radius



azimuthal magnetic field/radius

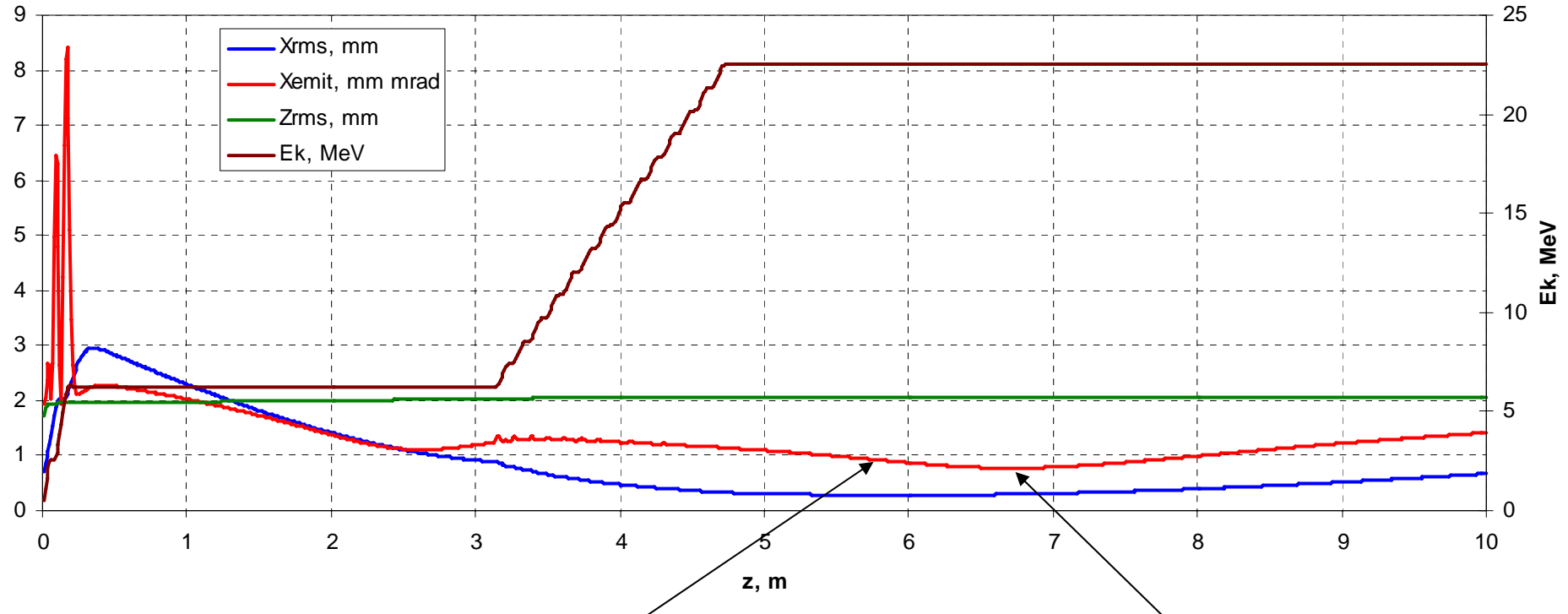


radius of 1% 3rd order contribution

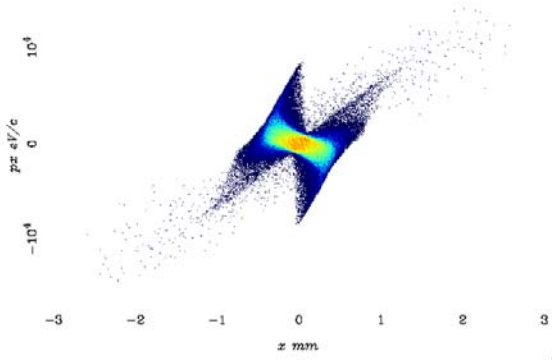


Test ASTRA run (optimization is ongoing!)

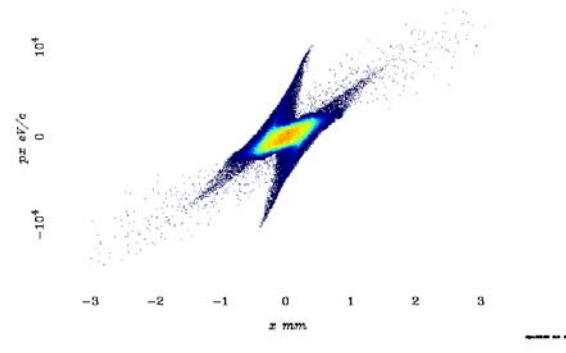
Machine parameters → from old optimization for PITZ-2 setup (old ASTRA, old fields), i.e. were not optimized



$z = 5.740 \text{ m}$
EmX(EMSY1)=0.933 mm mrad



$z = 6.660 \text{ m}$
EmX(min)=0.773 mm mrad



Conclusions

- Field distributions of the main components of PITZ-1.8 have been refined (smoothness improved):
 - Gun-4.1 cavity: gen. OK, some ??? (e.g. coupler position)
 - Gun solenoids: smooth compensated distribution
 - CDS booster: 14 cells, 15mm aperture, centered at 3.930m
- Even not optimized ASTRA input desk → low emittance
- Further optimization is ongoing
- Files will be soon available (PITZ-site? **Machine** → **Setup**??)