# Introduction

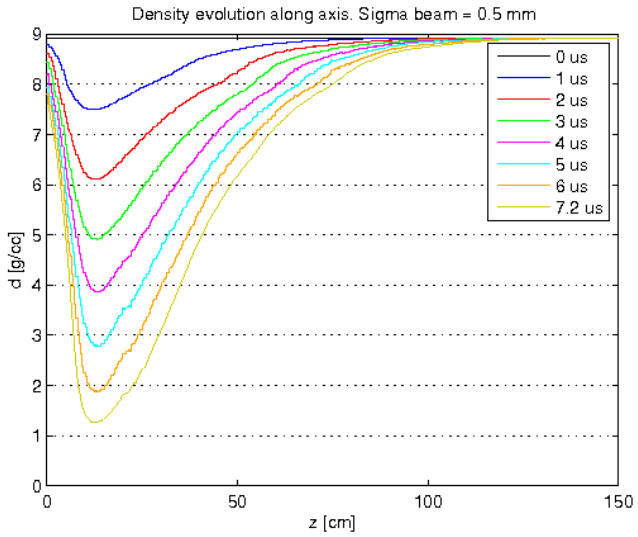
- **Machine Protection and High Energy Density States in Matter for High Energy Hadron Colliders** (PhD thesis started March 2008)

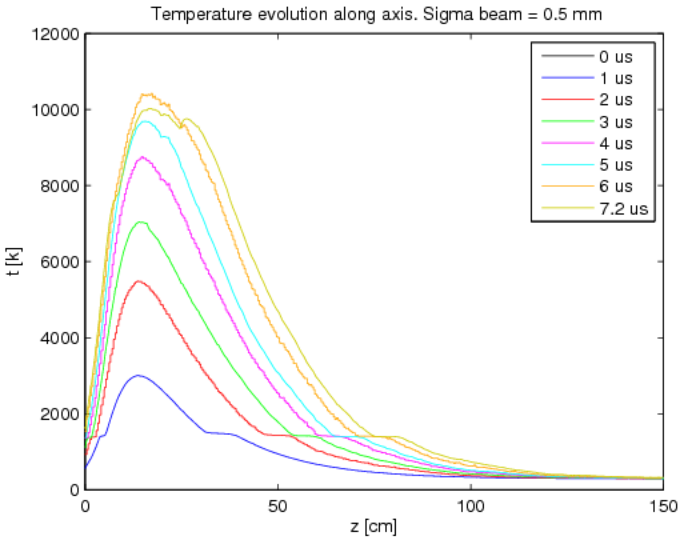
- Studying the consequences of different beam loss scenarios: TCT, connection cryostat, DFBs, busbars, …

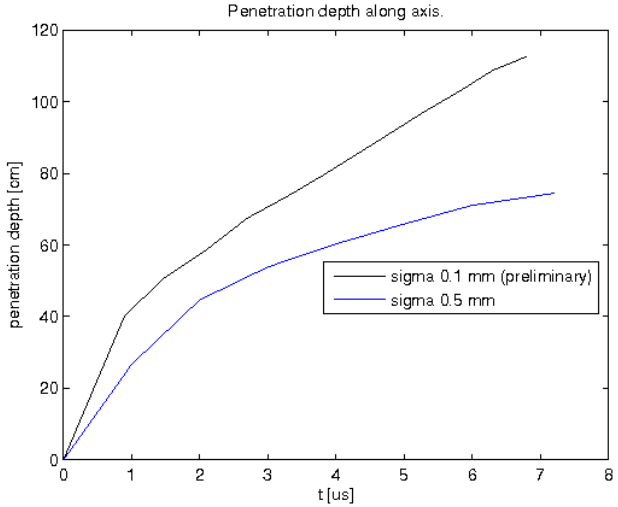
- Simulations of full LHC/SPS beam impact on materials (copper, CFC). FLUKA & BIG2 programs.

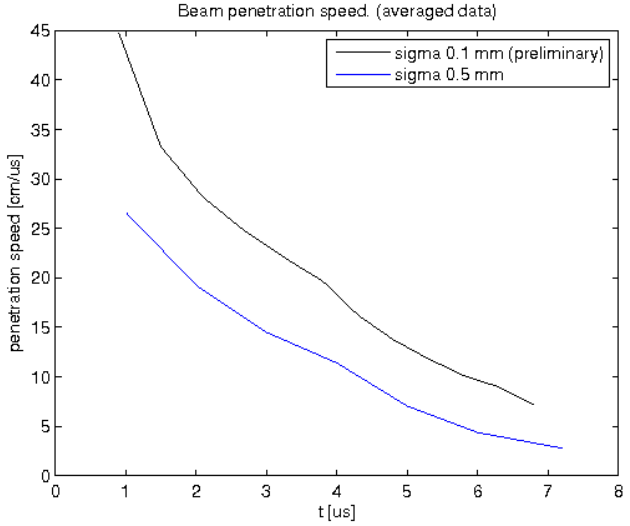
- Design an experiment to reproduce simulation results (HiRadMat).

# Simulations (BIG2 + FLUKA) 150cm x 5cm copper



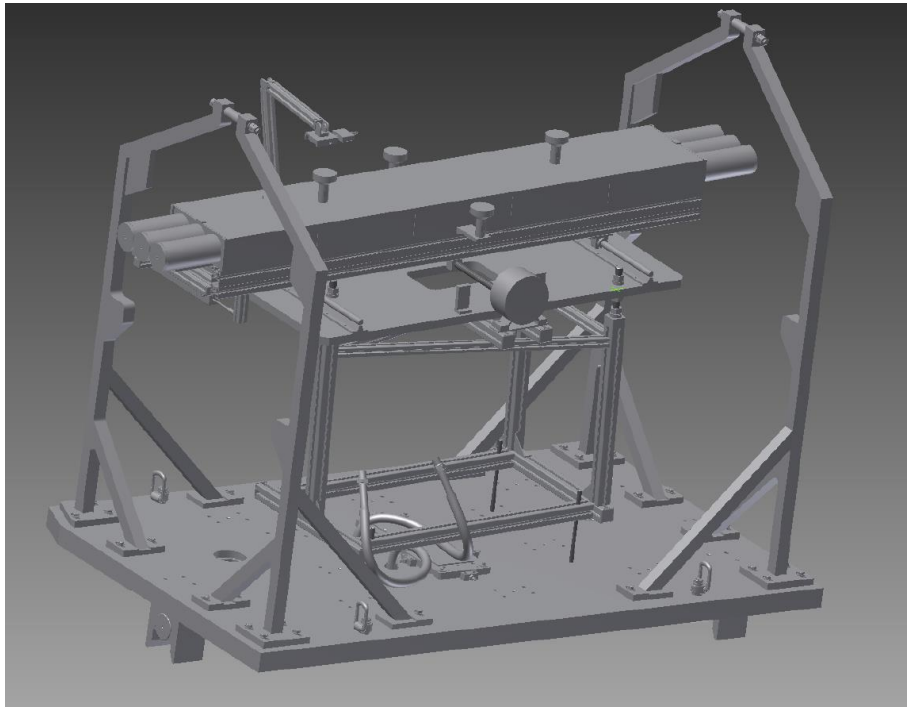



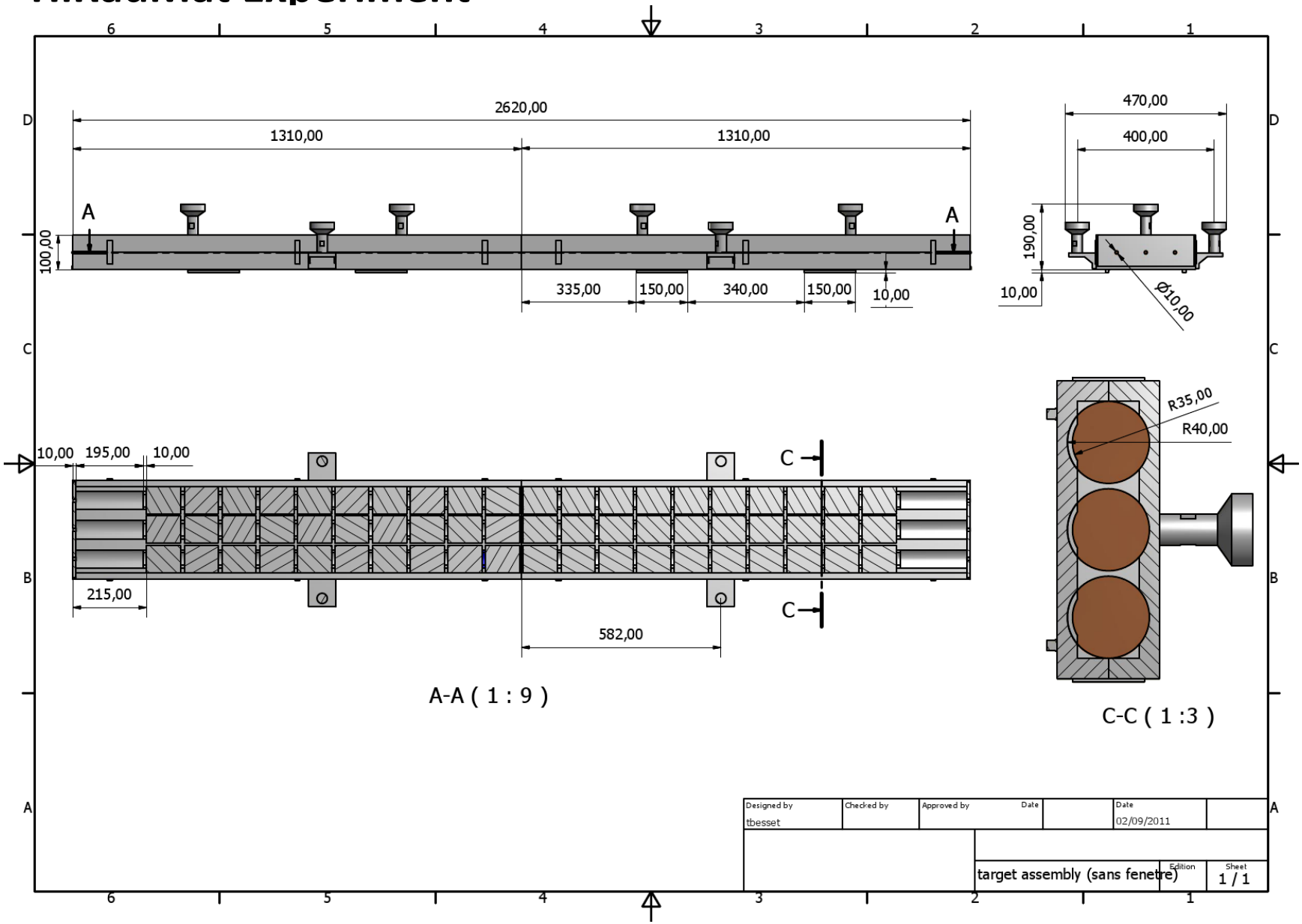
# HiRadMat Experiment

- Motivation: Understand the damage potential of LHC beams.
- Actually there is no experimental data to understand it.
- Simulations (FLUKA & BIG2) show a drilling effect of the beam into matter. Ex: LHC beam drills 35m of copper.
- HiRadMat experiment ‘will’ reproduce simulation results.
- Diamond detector -> monitor density evolution.

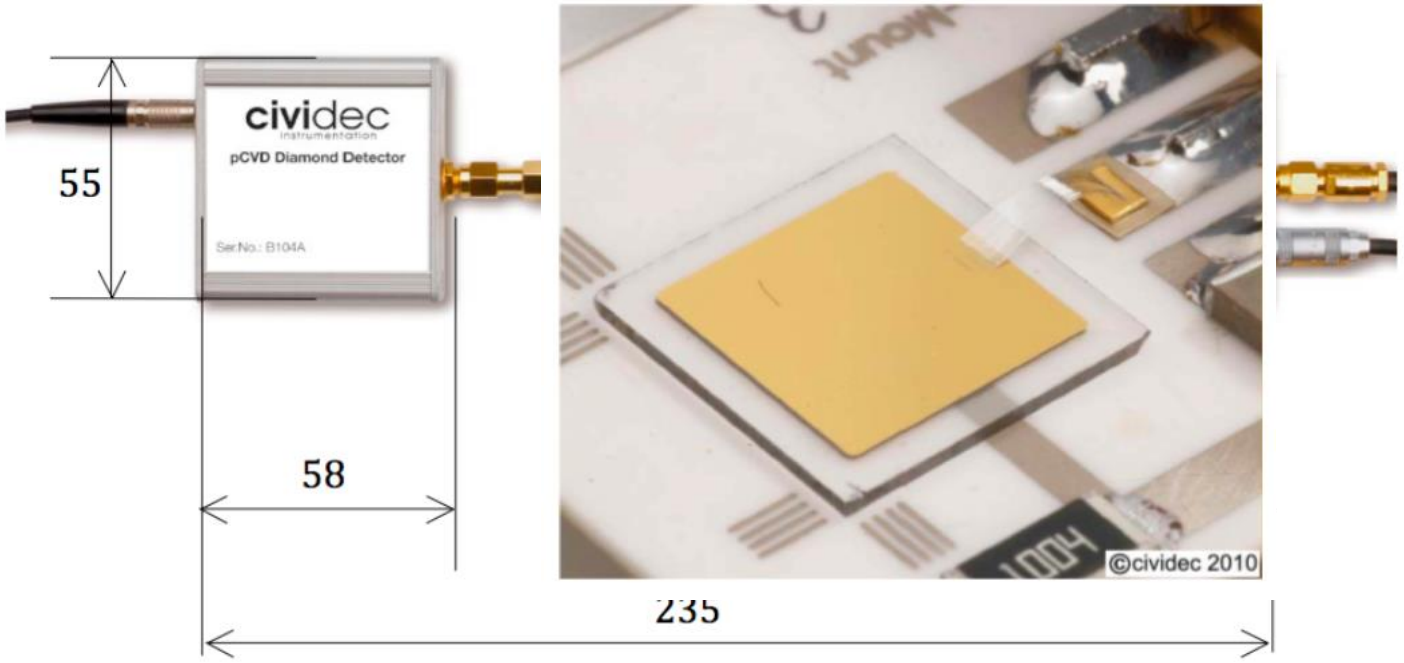
**Target assembly**

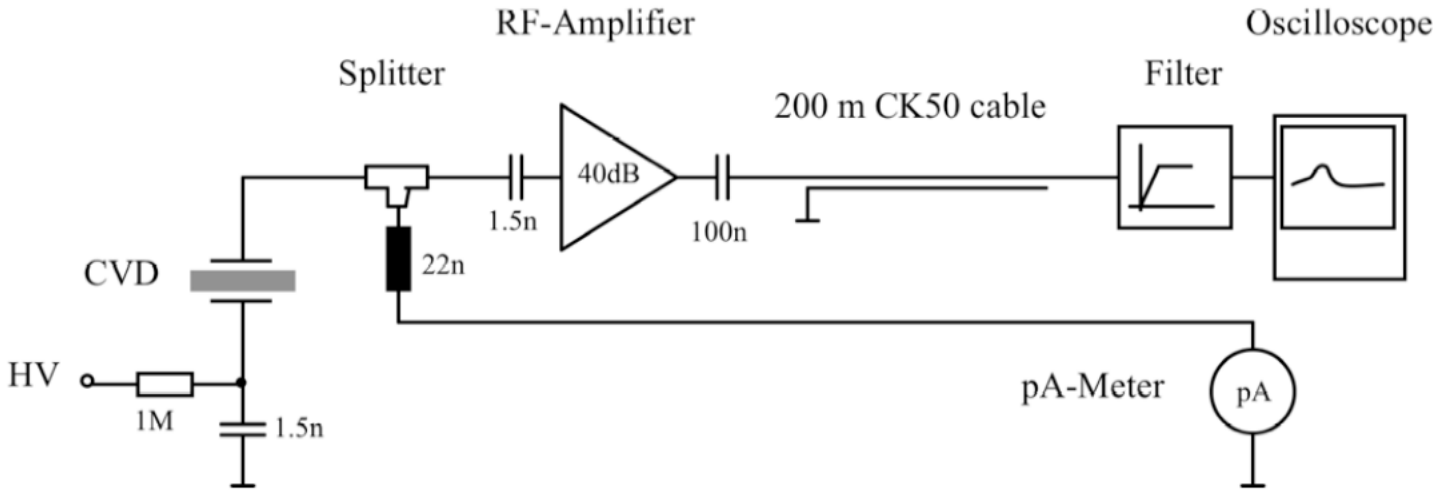


# HiRadMat Experiment



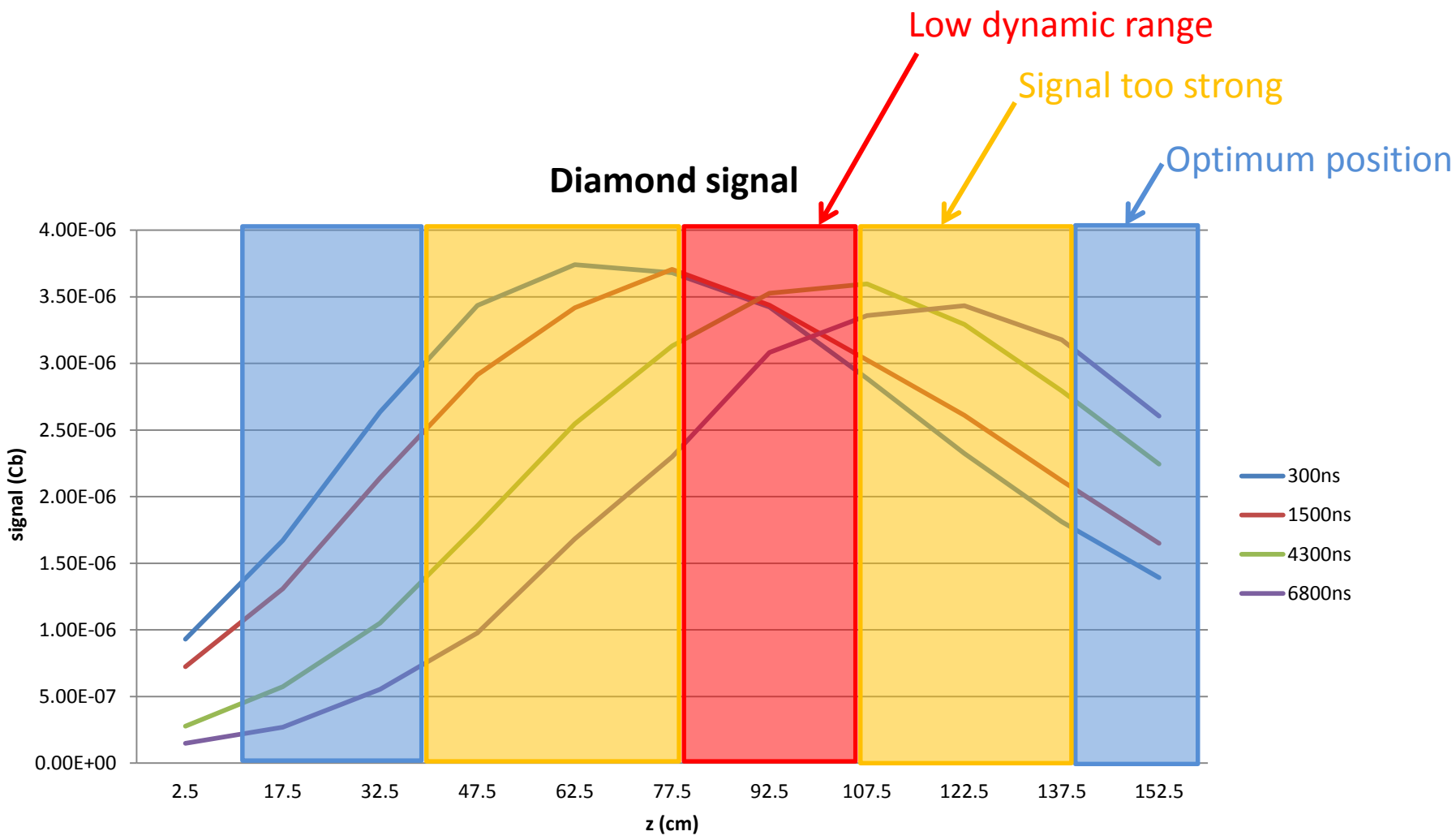
**Diamond detectors.** Radiation hard, ns resolution, high dynamic range, simple.

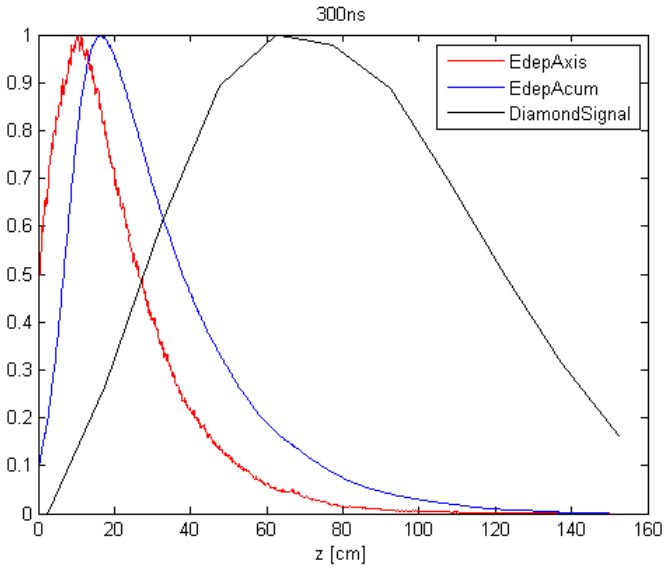


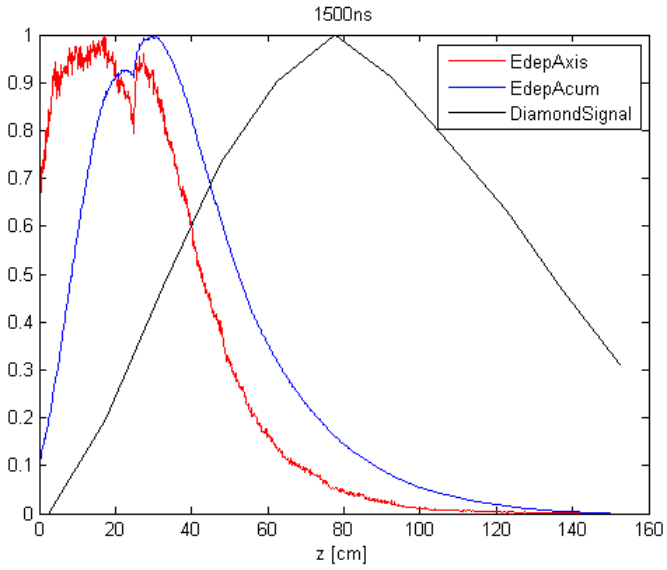



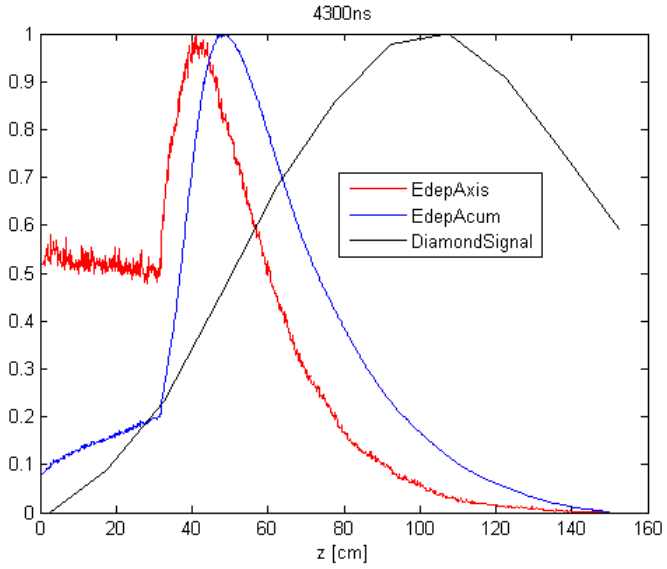
# Diamond location

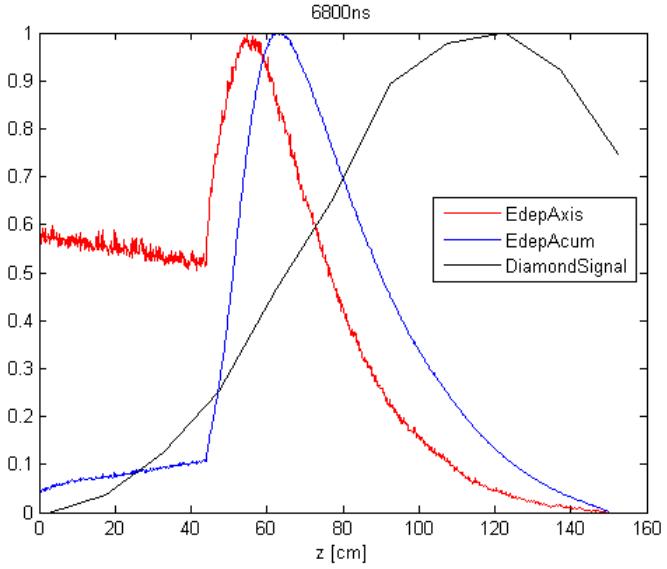
**SPS beam, 288 bunches, sigma = 0.1mm**

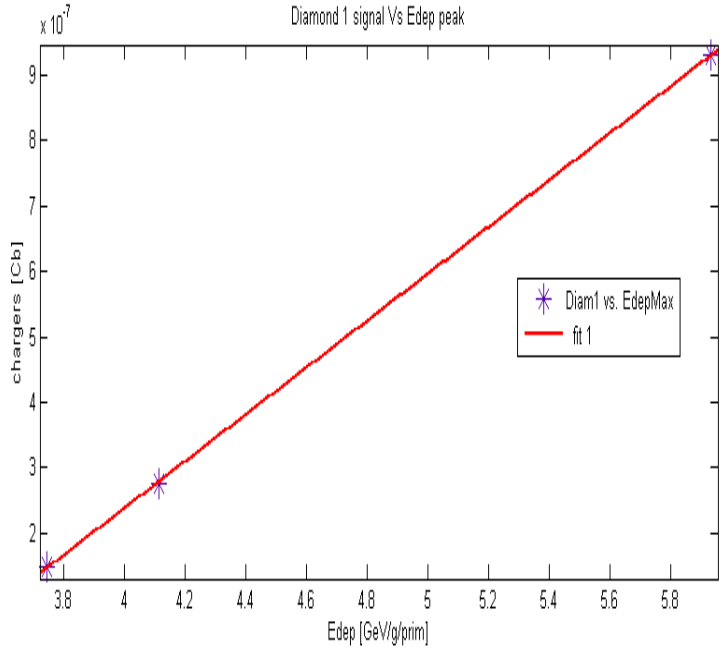


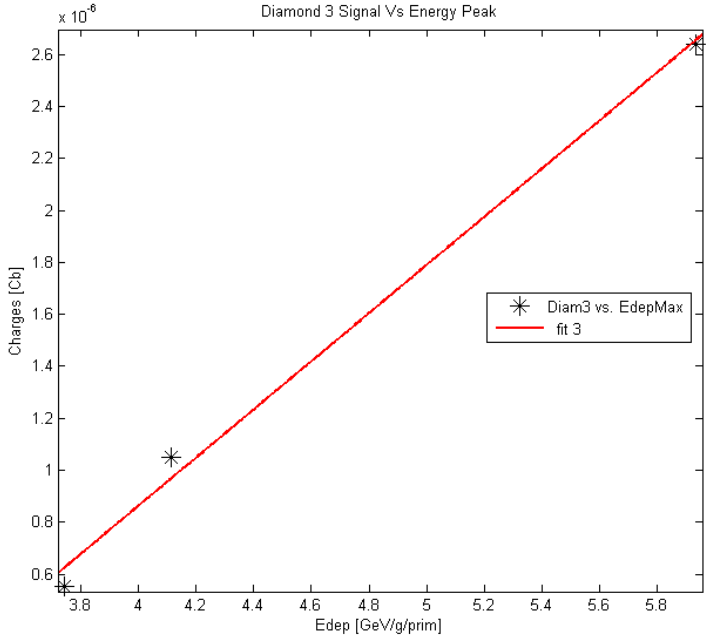

300ns
EdepAxis
EdepAcum
DiamondSignal
z [cm]

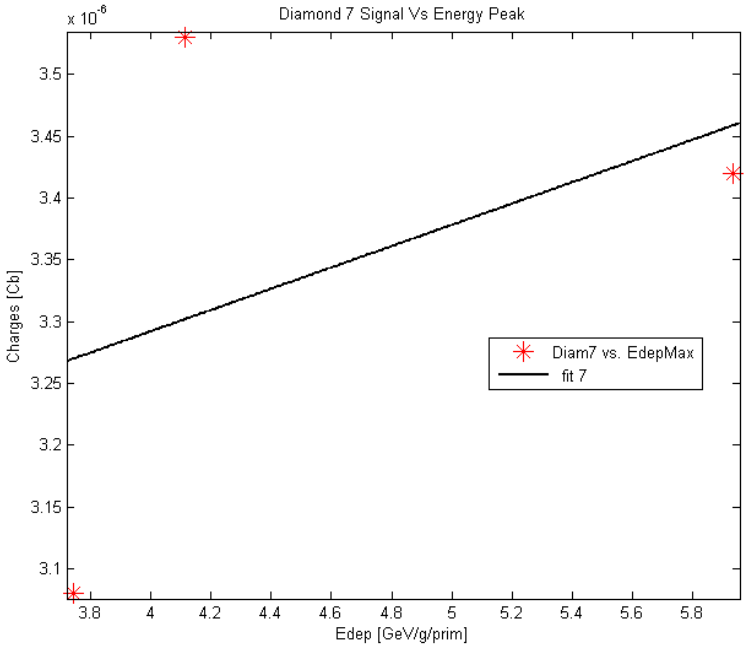

1500ns
EdepAxis
EdepAcum
DiamondSignal
z [cm]

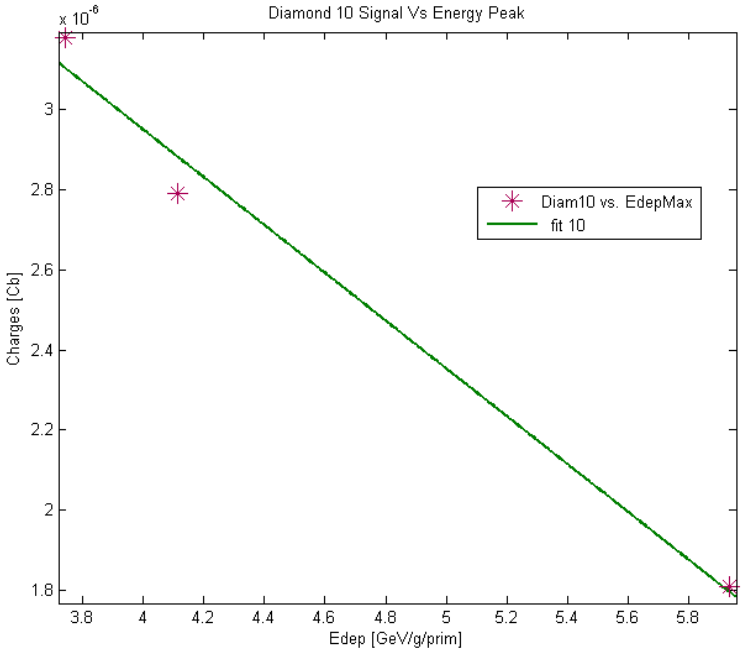

4300ns
EdepAxis
EdepAcum
DiamondSignal
z [cm]


6800ns
EdepAxis
EdepAcum
DiamondSignal
z [cm]


Diamond 1 signal Vs Edep peak
x 10^-7
chargers [Cb]
Edep [GeV/g/prim]
Diam1 vs. EdepMax
fit 1


Diamond 3 Signal Vs Energy Peak
x 10^-6
Charges [Cb]
Edep [GeV/g/prim]
Diam3 vs. EdepMax
fit 3


Diamond 7 Signal Vs Energy Peak
x 10^-6
Charges [Cb]
Edep [GeV/g/prim]
Diam7 vs. EdepMax
fit 7


Diamond 10 Signal Vs Energy Peak
x 10^-5
Charges [Cb]
Edep [GeV/g/prim]
Diam10 vs. EdepMax
fit 10

# Diamond max signal

| Beam | |
|---|---|
| p/bunch | 1.15E+11 |
| Nbunch | 288 |
| Bunch t | 5E-10 |
| Beam t | 7.2E-06 |

| Diamond | |
|---|---|
| eh/um | 36 |
| um | 500 |
| eh/MIP | 18000 |
| surface | 0.64 |

| cte | |
|---|---|
| Cb/e | 1.6E-19 |

| Signal | |
|---|---|
| max at 50cm [A] (0.5ns) | 7483 |
| max at 70cm [A] (0.5ns) | 4339 |

Bounding wire connecting diamond with connector
(D=0.01mm copper wire)

0.5 ns at 300 A: heating from 300 K to 338 K
0.5 ns at 400 A: heating from 300 K to 471 K
0.5 ns at 500 A: heating from 300 K to 418 K
0.5 ns at 600 A: heating from 300 K to 483 K

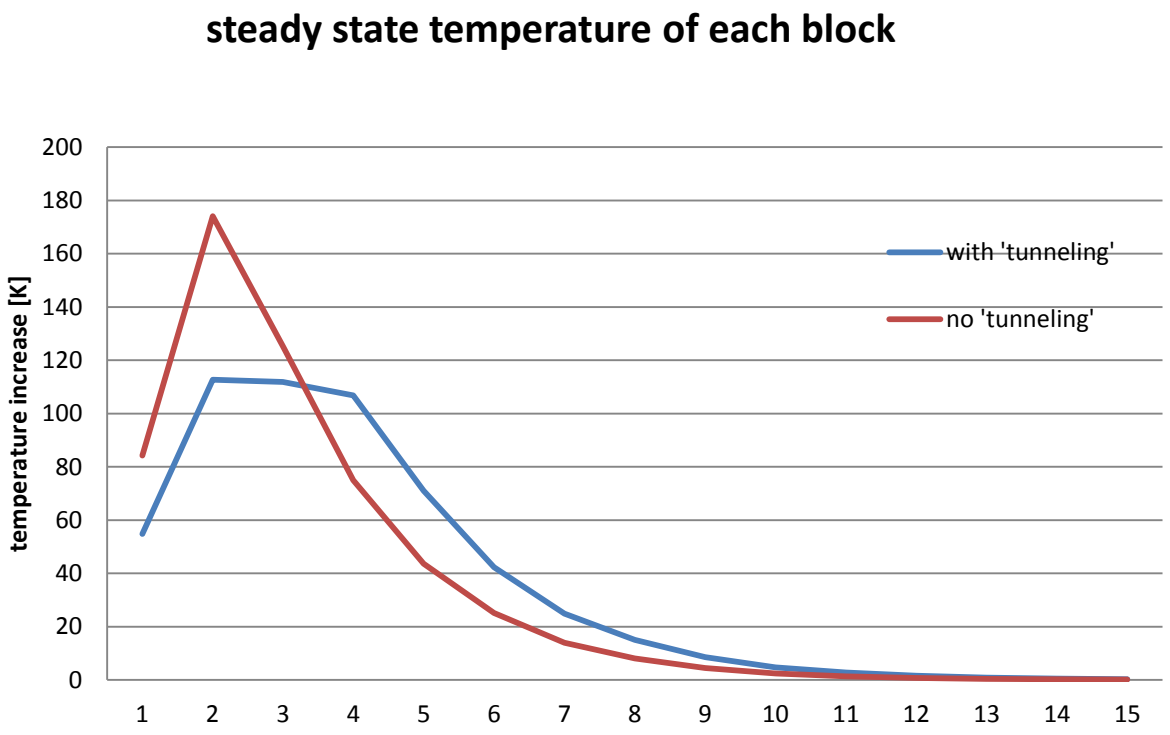
**(Arjan Verweij)**

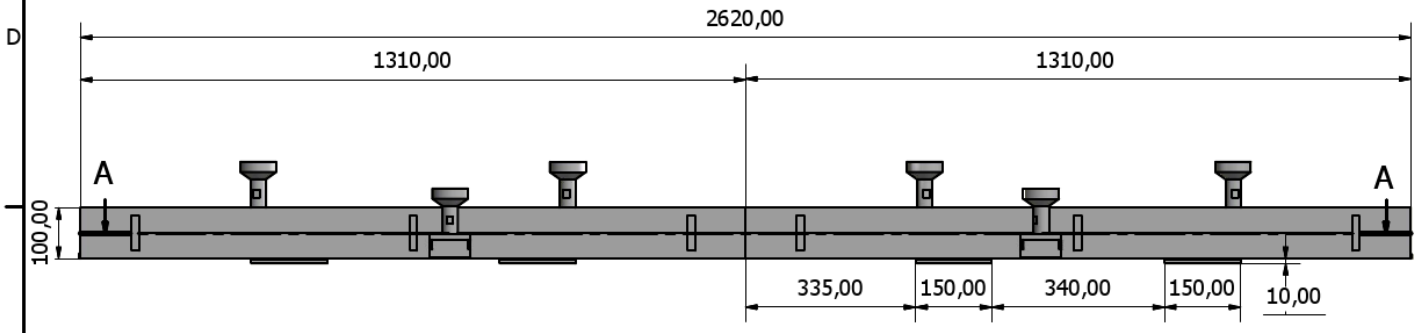
**Diamond Signal too HIGH for the 0.01mm wire**

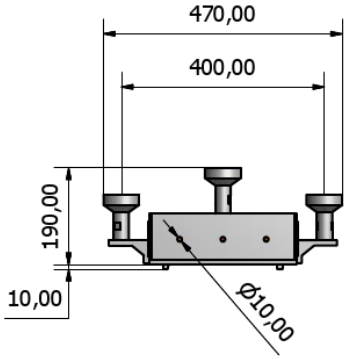
Not considered:
t real signal > 0.5ns
Effective thickness ~ 60%

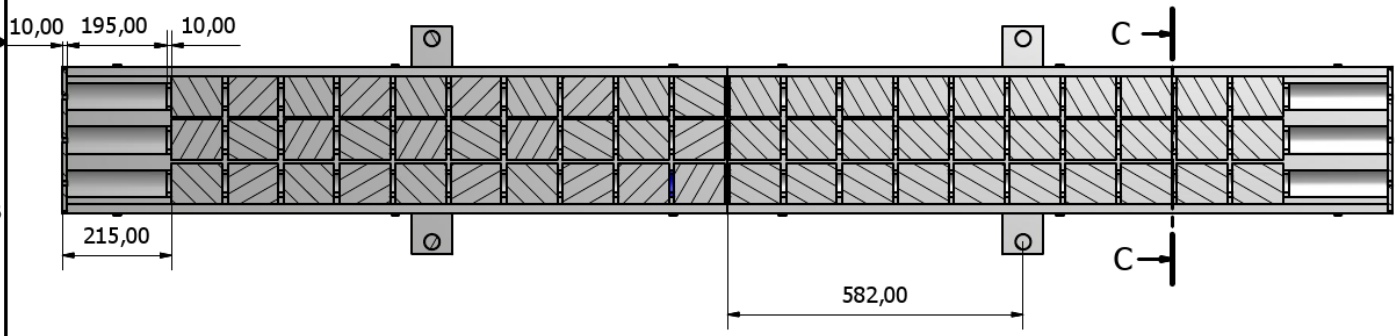
Actions:
Lower voltage
Less bunches
Replace wire/add more wires

# Temperature Blocks

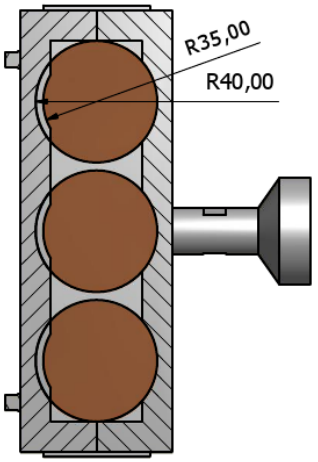





A-A ( 1 : 9 )




C-C ( 1 :3 )

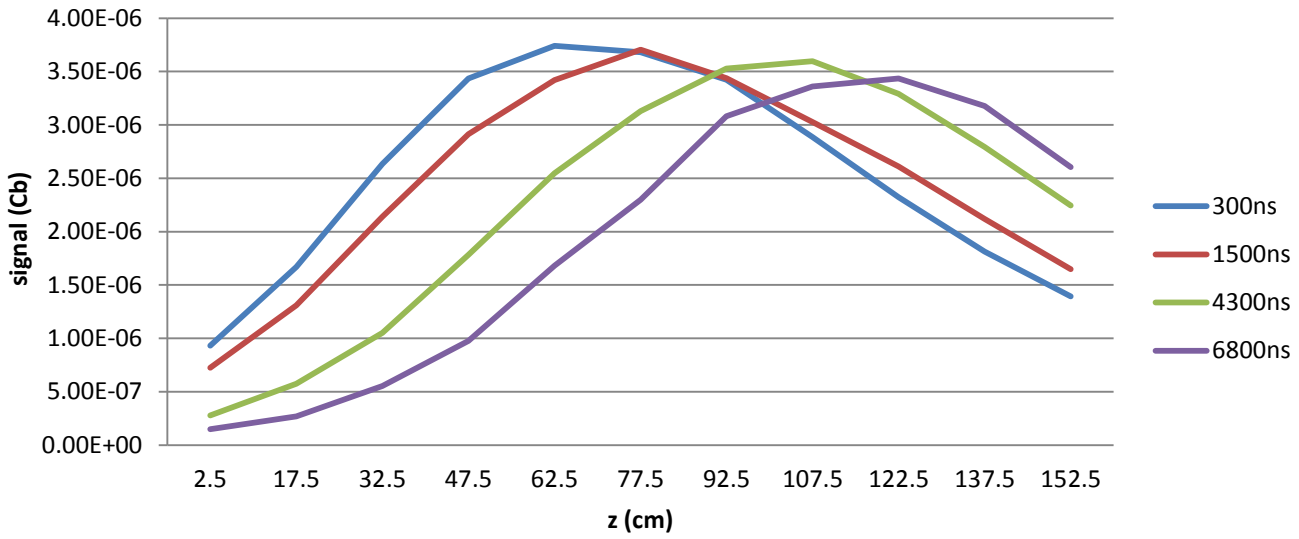
| Designed by | Checked by | Approved by | Date | Date | |
|---|---|---|---|---|---|
| tbesset | | | | 02/09/2011 | |

target assembly (sans fenetre)

Edition

Sheet 1 / 1

## Diamond signal 50cm 0.1mm




## Diamond signal 70cm 0.1mm