Diamond Sensor Tests and Installation Plan

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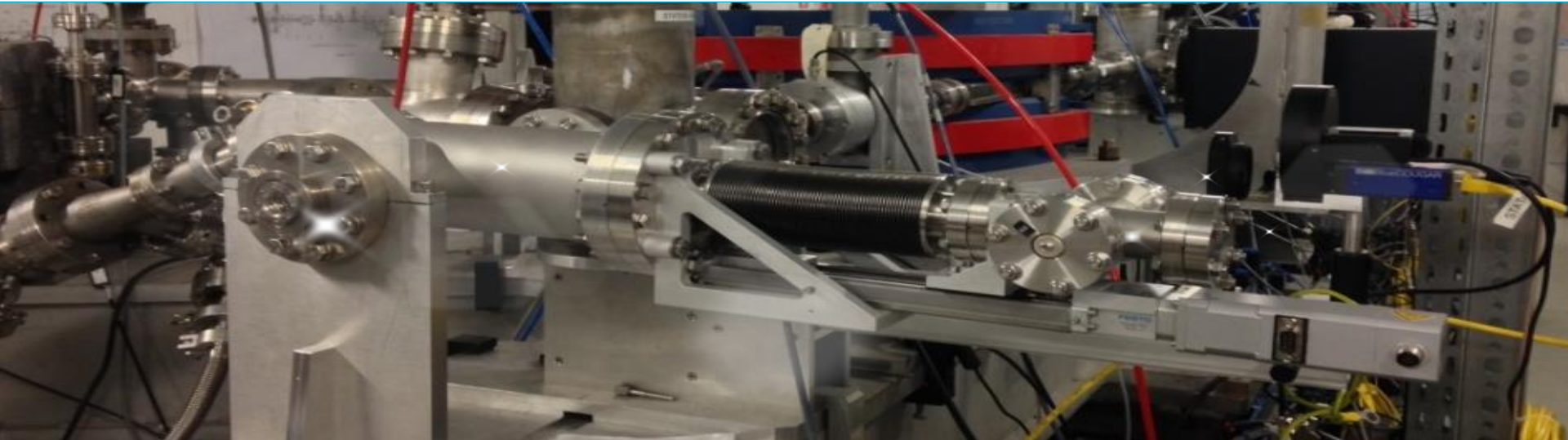
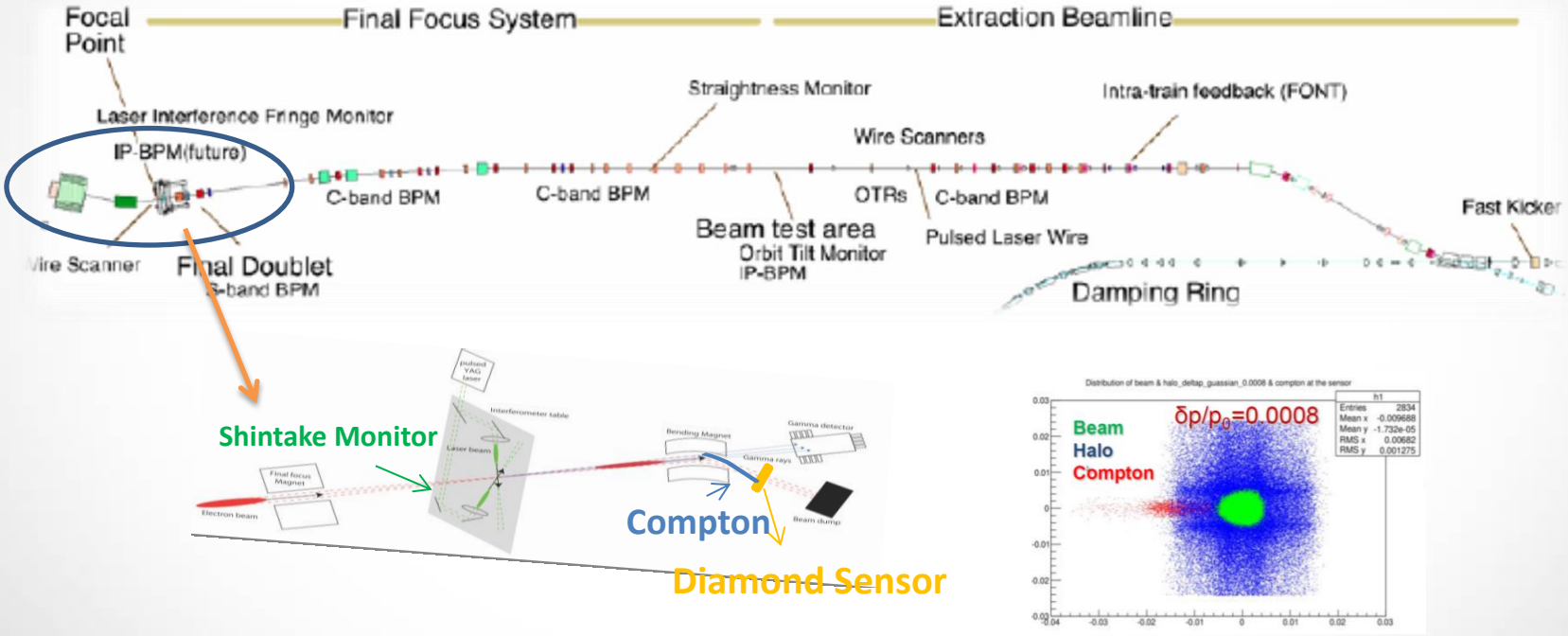


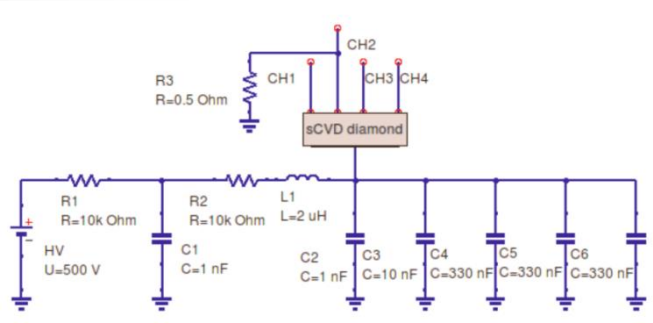
- Motivations
- Expected signal @ATF2
- Diamond Sensor
  - Characteristics
  - Tests @ PHIL
  - Signal Modeling
- Installation plan @ATF2
- Conclusion

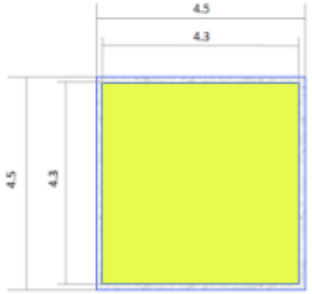
Motivations

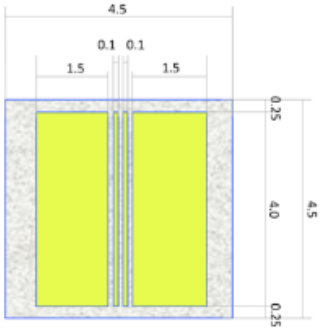


- ***Beam halo transverse distribution unknown → investigate halo model***
- ***Probe Compton recoiled electron→ investigate the higher order contributions to the Compton process (in the future)***

EXPECTED SIGNAL @ ATF2







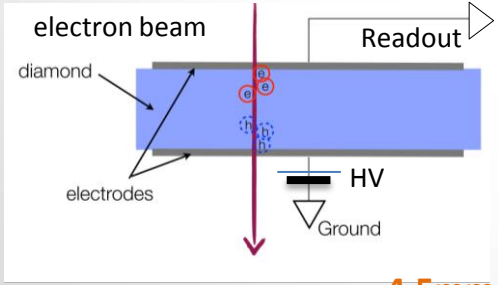
	Total N	Min.～Max. N/mm² @ Sensor	Charge signal/mm²
Beam	10^{10}	6.16×10^{8}	1.6887μC
Halo	10^{7}	1.14×10^{4}～2.24×10^{4}	31.236pC～61.376pC
Compton	28340	30～520	82.2fC～1.4284pC

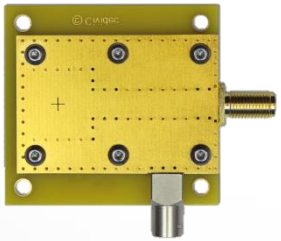
Diamond Sensor Characteristics

ADVANTAGES

- *Large band-gap ⇒ low leakage current*
- *High breakdown field*
- *High mobility ⇒ fast charge collection*
- *Large thermal conductivity*
- *High binding energy ⇒ Radiation hardness*
- *Fast pulse ⇒ several ns*

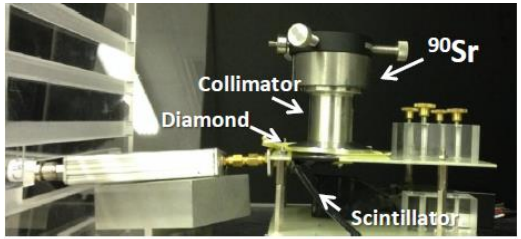
Dynamic range: 1 ->10^8 e^-





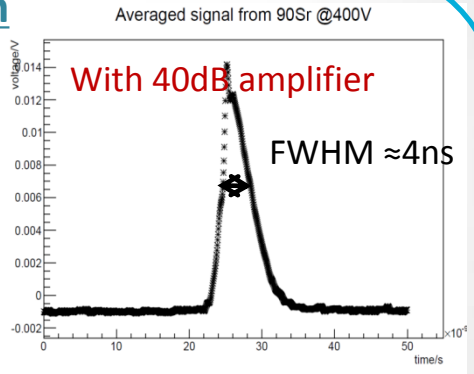
4.5mm X 4.5mm X 500µm

Tests in the Clean Room



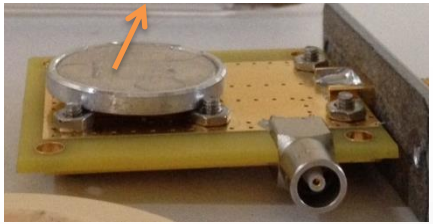
$$^{90}\mathrm{Sr} \xrightarrow{\beta,\,27.7\mathrm{y}} {}^{90}\mathrm{Y} \xrightarrow{\beta,\,64\mathrm{h}} {}^{90}\mathrm{Zr}$$

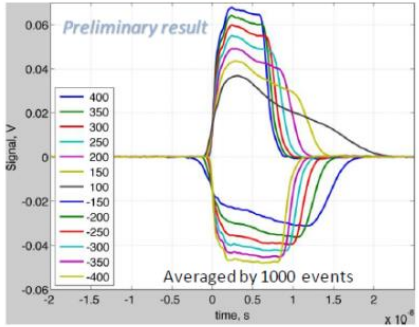
<0.55 MeV <2.27 MeV



Charge generated by 1 MIP for 500 µm diamond (with 100% CCE): 2.88 fC

^{241}Am alpha source: Eα = 5.4 MeV



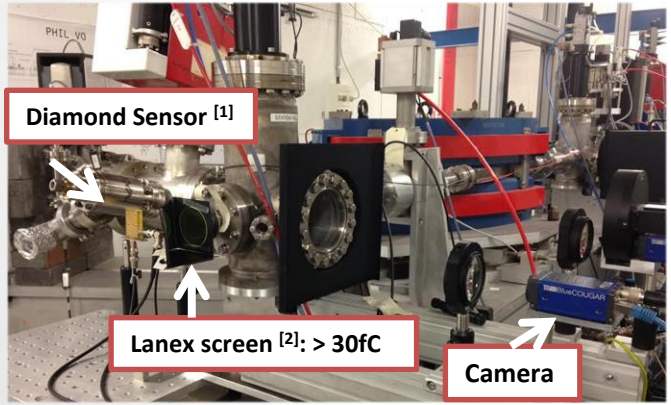


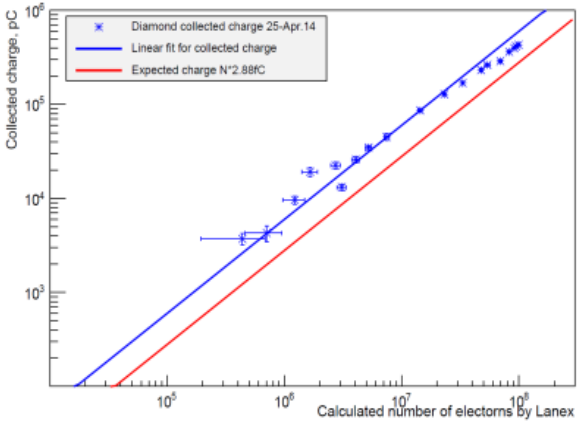
Charge collected at 400V: Q = 67.44 +/- 1.16 fC

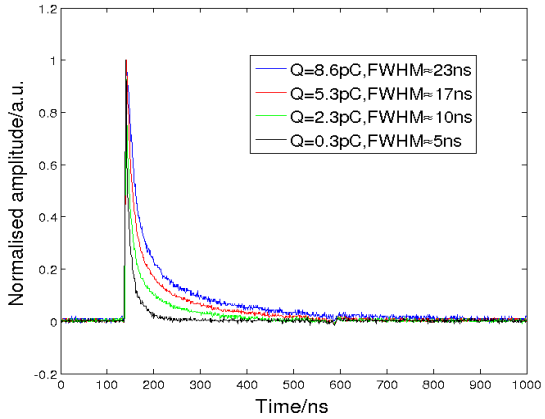
5

Diamond Sensor Tests @ PHIL

Tests In Air







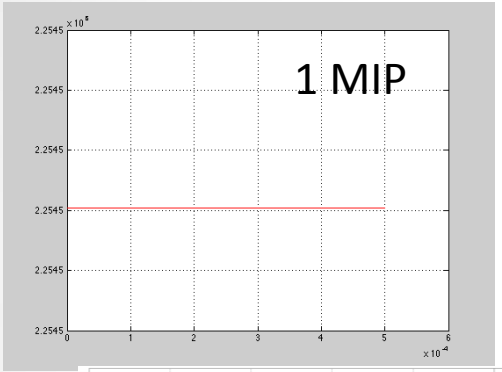
10^5 ->10^8 e^- Tested!

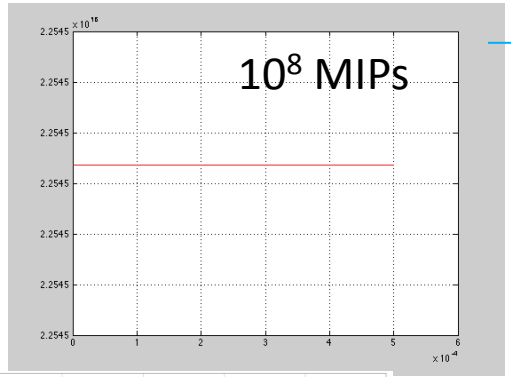
- Saturation of amplitude due to *voltage drop and space charge effect*
- Saturation of charge due to *recombination*

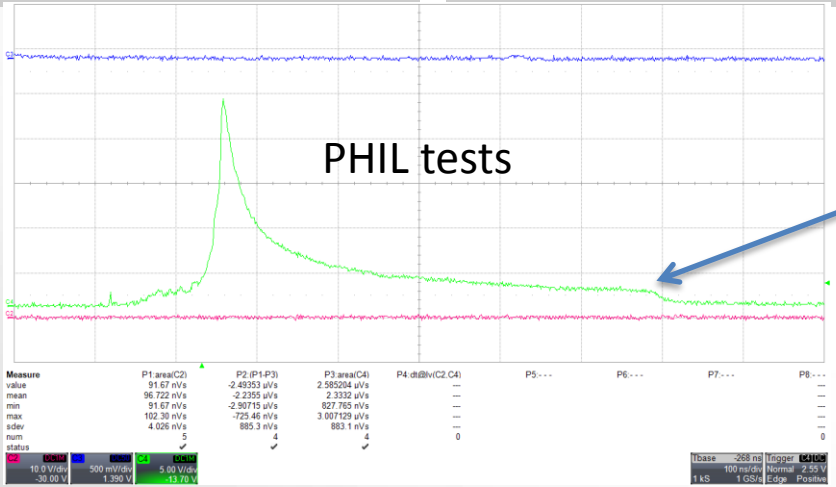
[1] S. Liu et al., THPME092, IPAC2014 proceedings
[2] T. Vinatier et al., THPME094, IPAC2014 proceedings

Signal Modeling

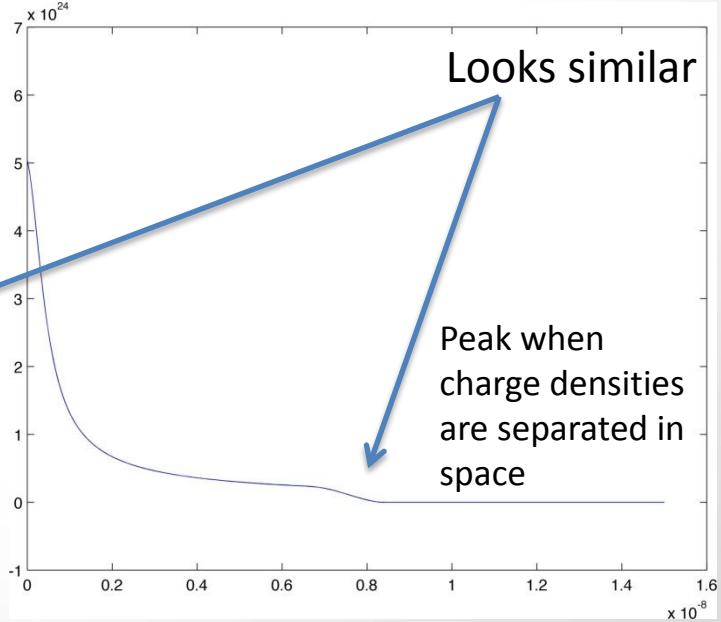
Modeling of Charge collection







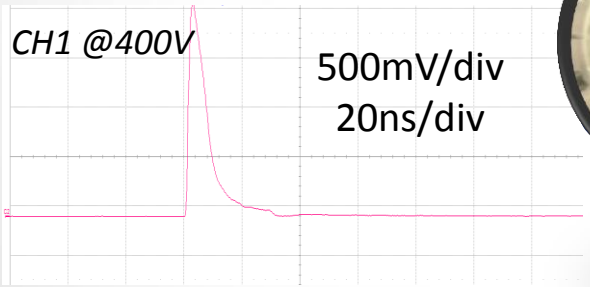
Slowing down due to space charge



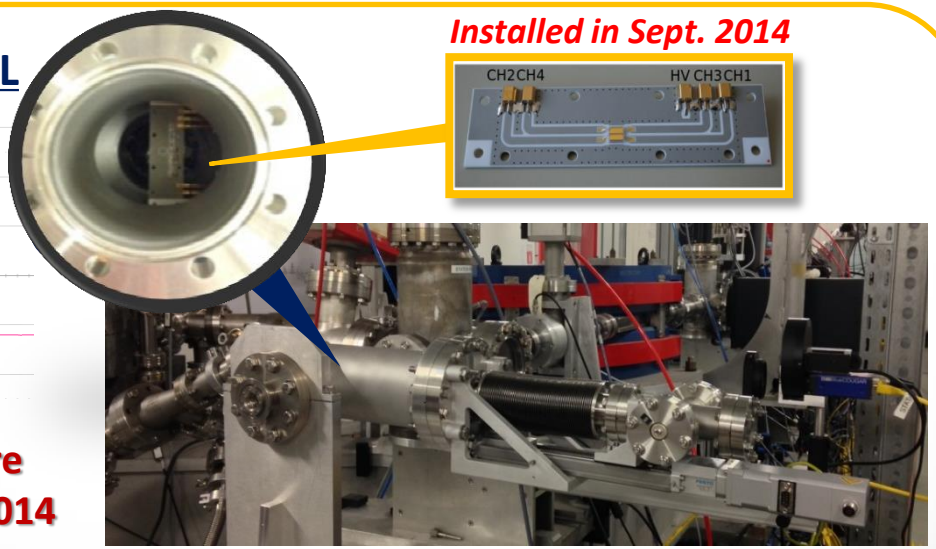
Modeling in progress by V. Kubytskyi

In Vacuum Diamond Sensor Tests @PHIL

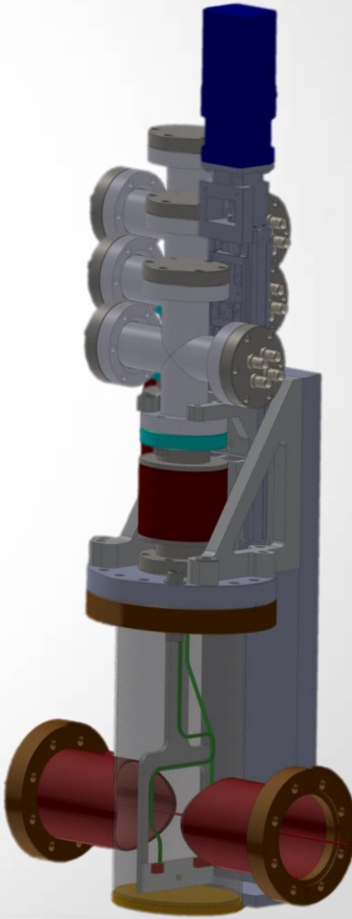
First Test In Vacuum @ PHIL



Tests to be continued before installation @ ATF2 in Nov. 2014



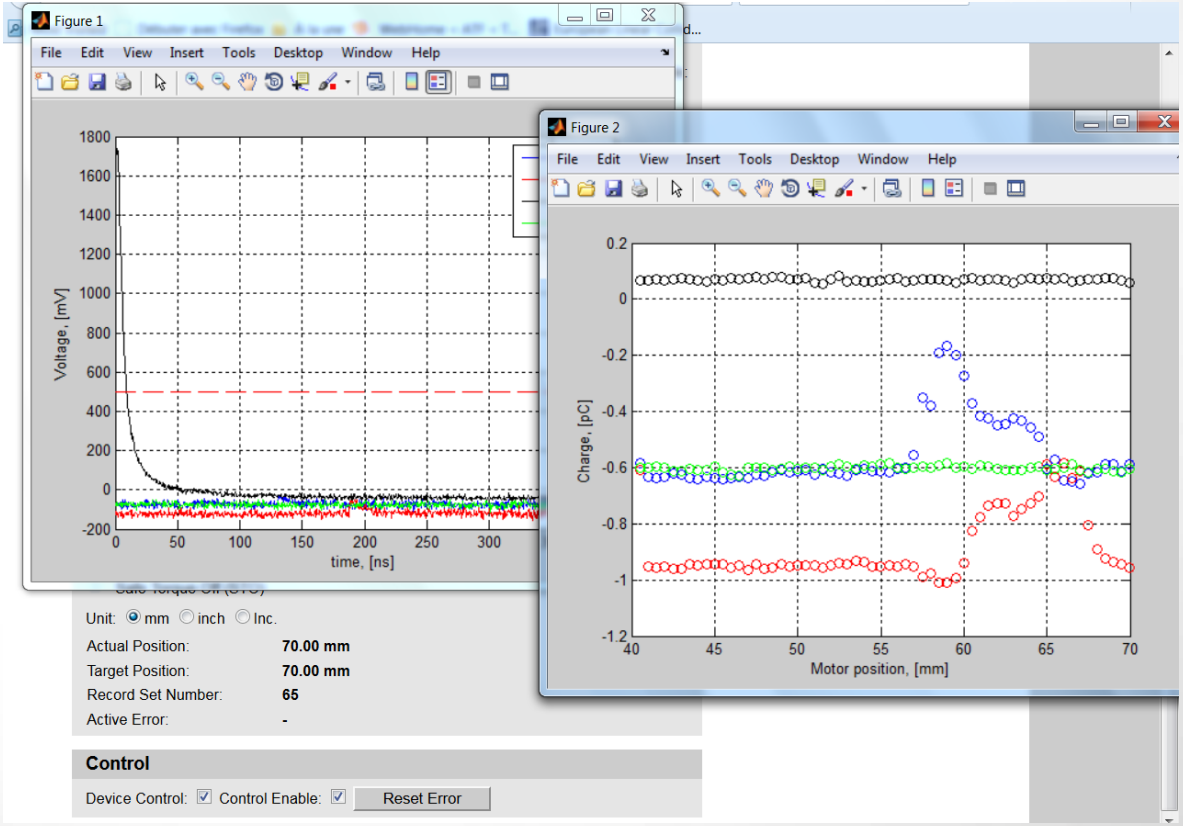
Installed in Sept. 2014



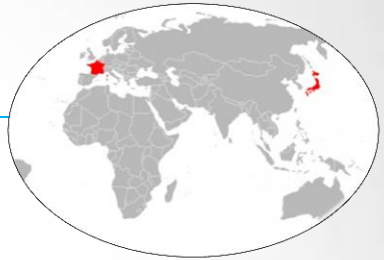
Motor Control & Signal Readout

Matlab program written to control the motor and the scope simultaneously

-> Possible to scan the beam with online analysis



Installation plan @ATF2

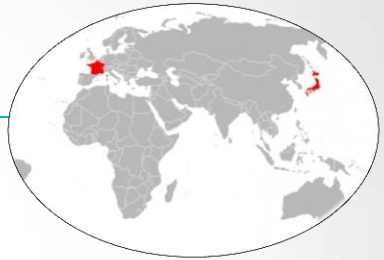


- Motor system will be sent to KEK when?
- Vacuum chamber will be installed when?
- Cables installed already at ATF2?

- Installation of diamond sensor in the week of 11/3-11/9
  (tests of cable connection, software control)

- Operation for 3 weeks in Nov.?

Conclusion



- Tests in the clean room to study the diamond characteristics
- Tested in air at PHIL from 10^5 ->10^8 e-
- Tests to be continued in vacuum for next 2-3 weeks
- Installation at ATF2 for beam halo measurements in Nov. 2014

Thank you!

Back up …

Test with ^{90}Sr Source