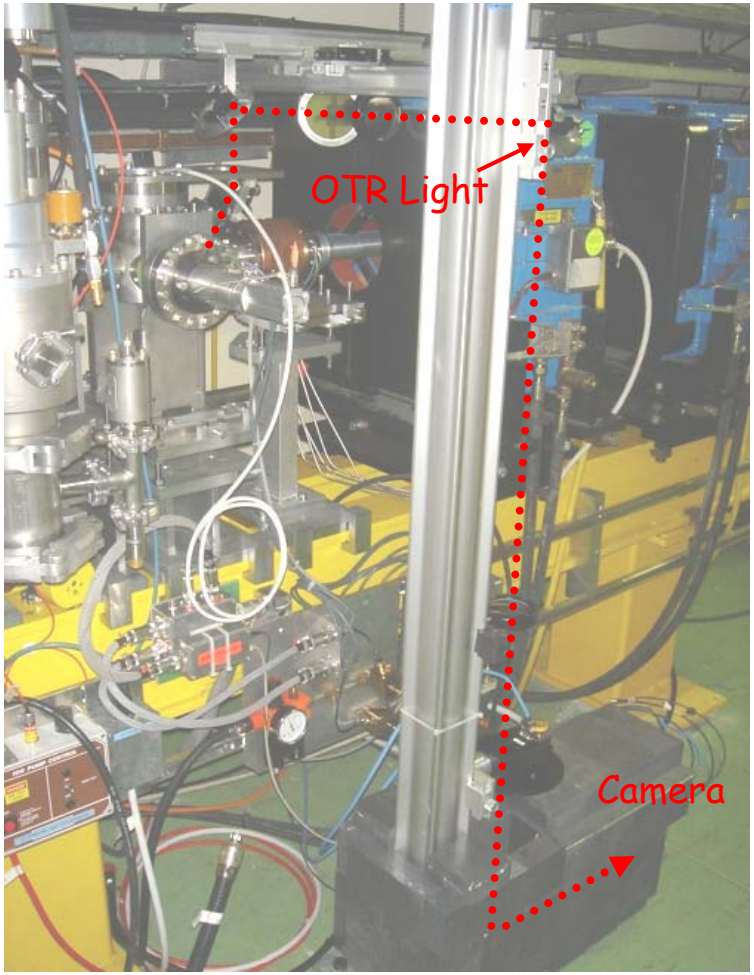
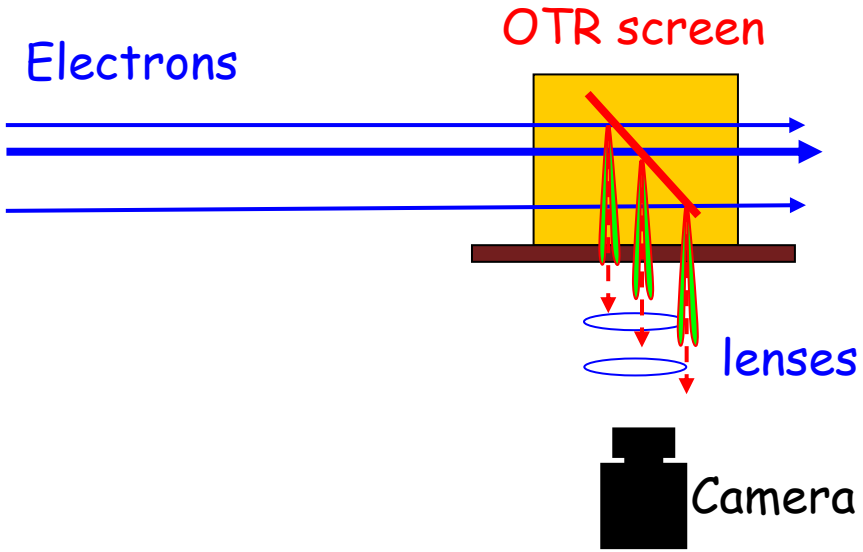
Some Results of Beam Instrumentation

- Optical Transition Radiation screen :
  " Problem of measuring large beam sizes "
- Time resolved energy measurement :
  " Segmented (slit) Dump versus
  Segmented Photomultiplier "
- Bunch Length Measurement with the 1.5GHz RF Deflector

OTR system

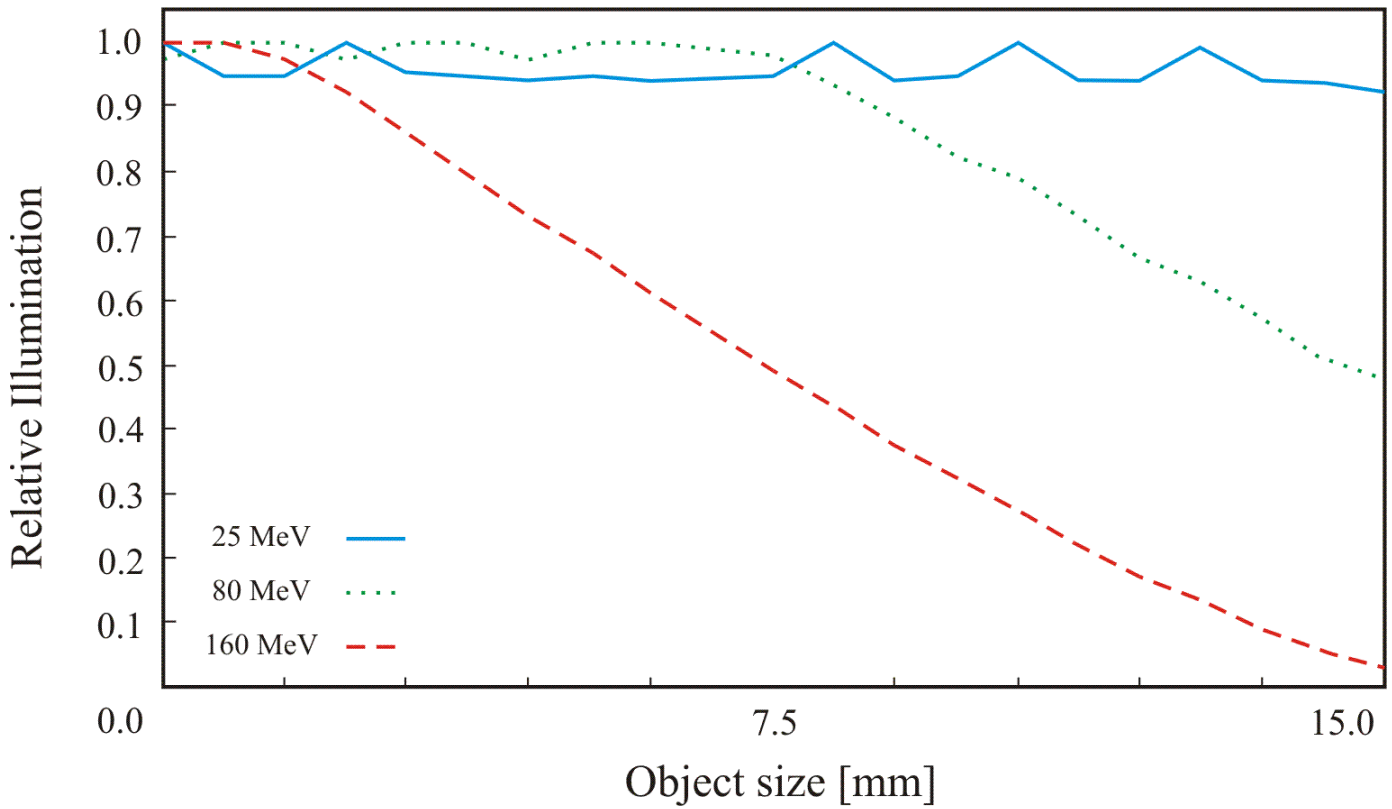




- OTR Screen : ~2/γ angular distribution
- 1.5m long Optical line : two achromats and a camera lens : Given angular acceptance

Illumination plot : Light intensity vs beam position

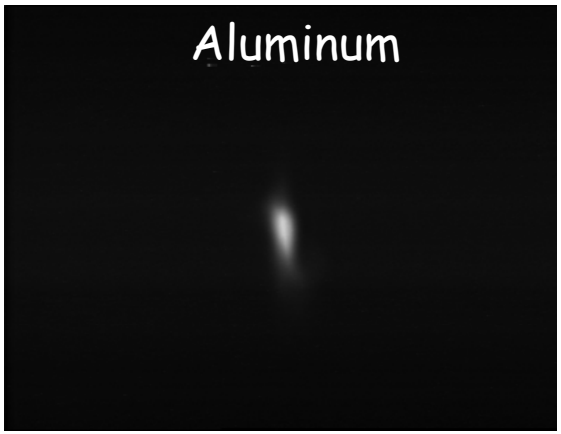
Simulated with ZEMAX

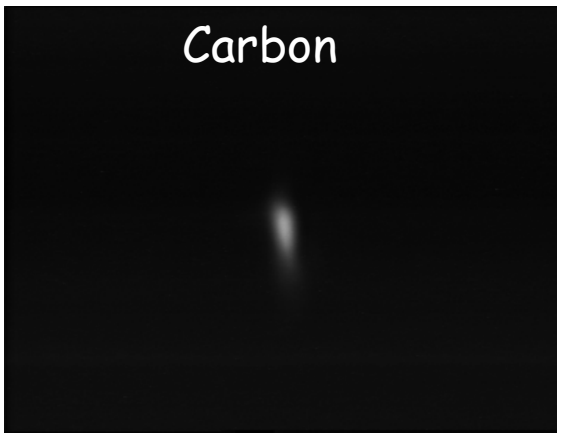


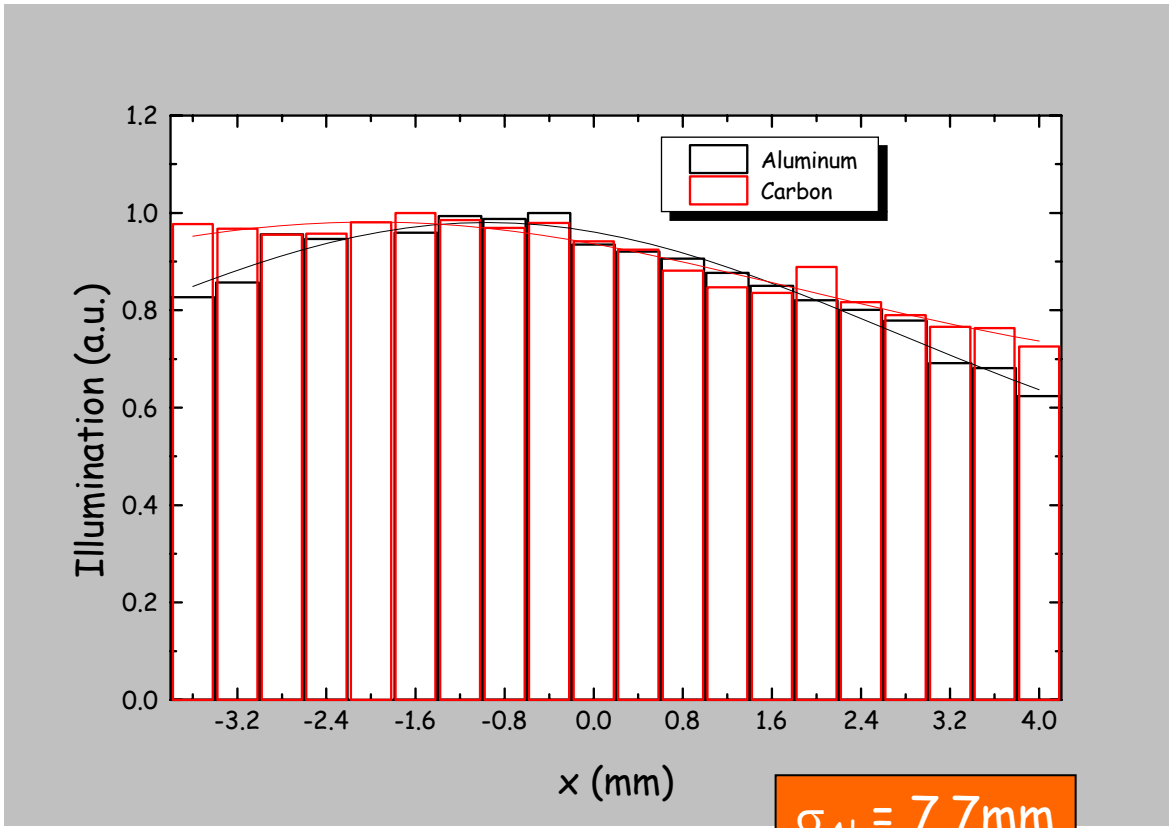
- Effect enhanced if the beam hits the screen with an angle
- Effect enhanced for higher beam energy (smaller $1/\gamma$)

What has been observed so far

CL.MTV1030@93.5MeV





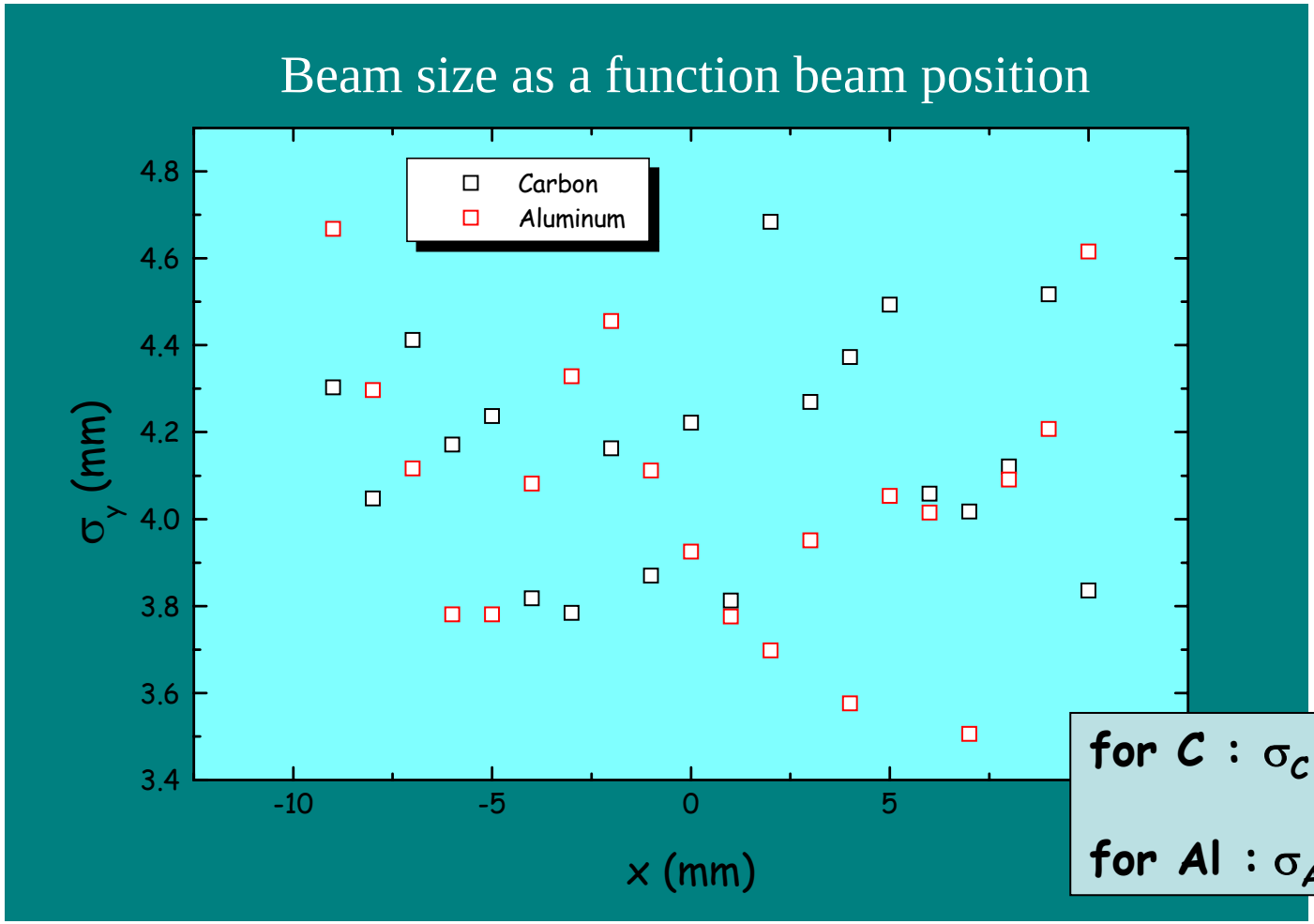


σ_{Al} = 7.7mm

σ_{C} = 8.6mm

What has been observed so far

CL.MTV1030@93.5MeV

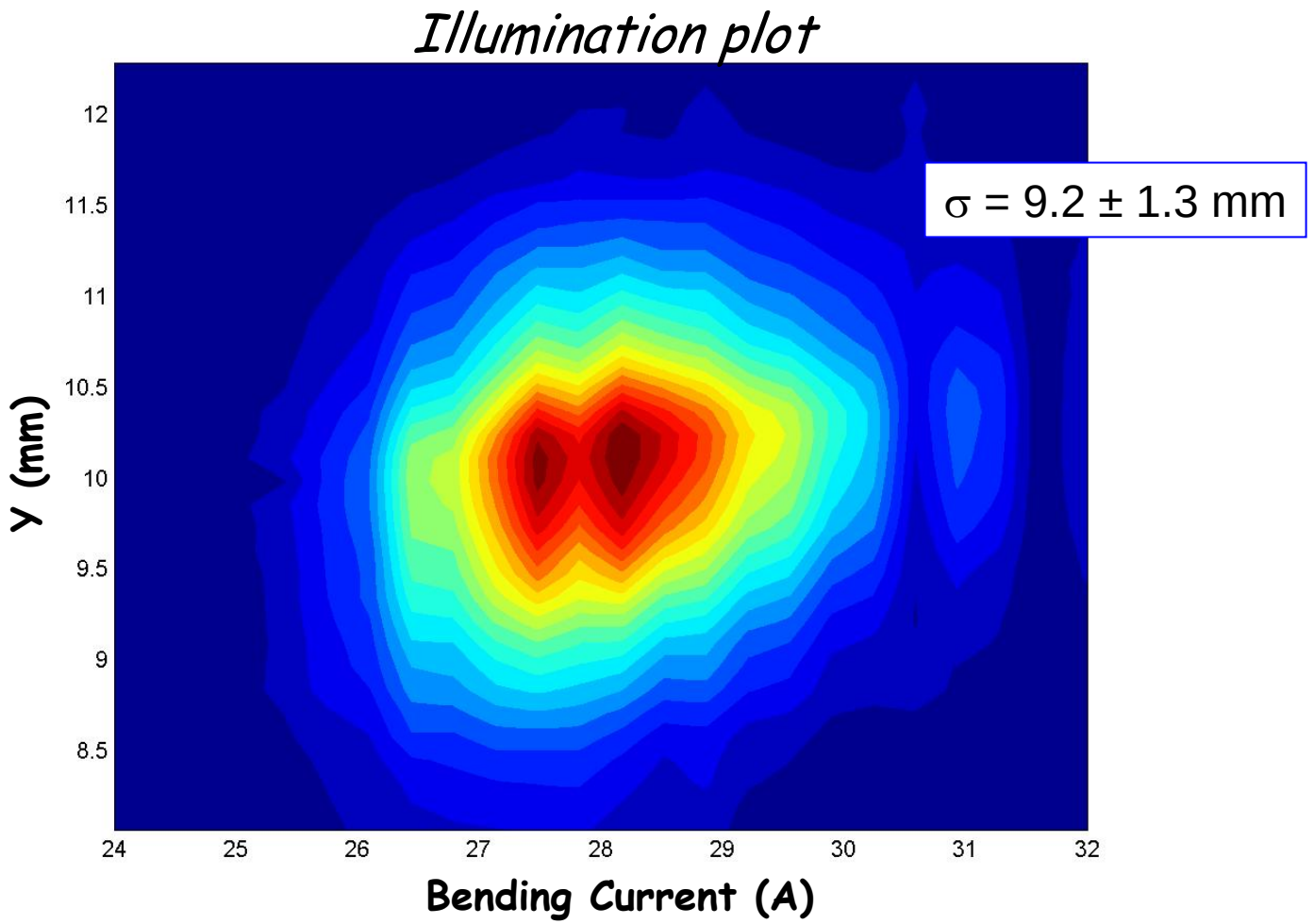


for C : σ_C =4.16± 0.26mm

for Al : σ_{Al} = 4.05± 0.31mm

What has been observed so far

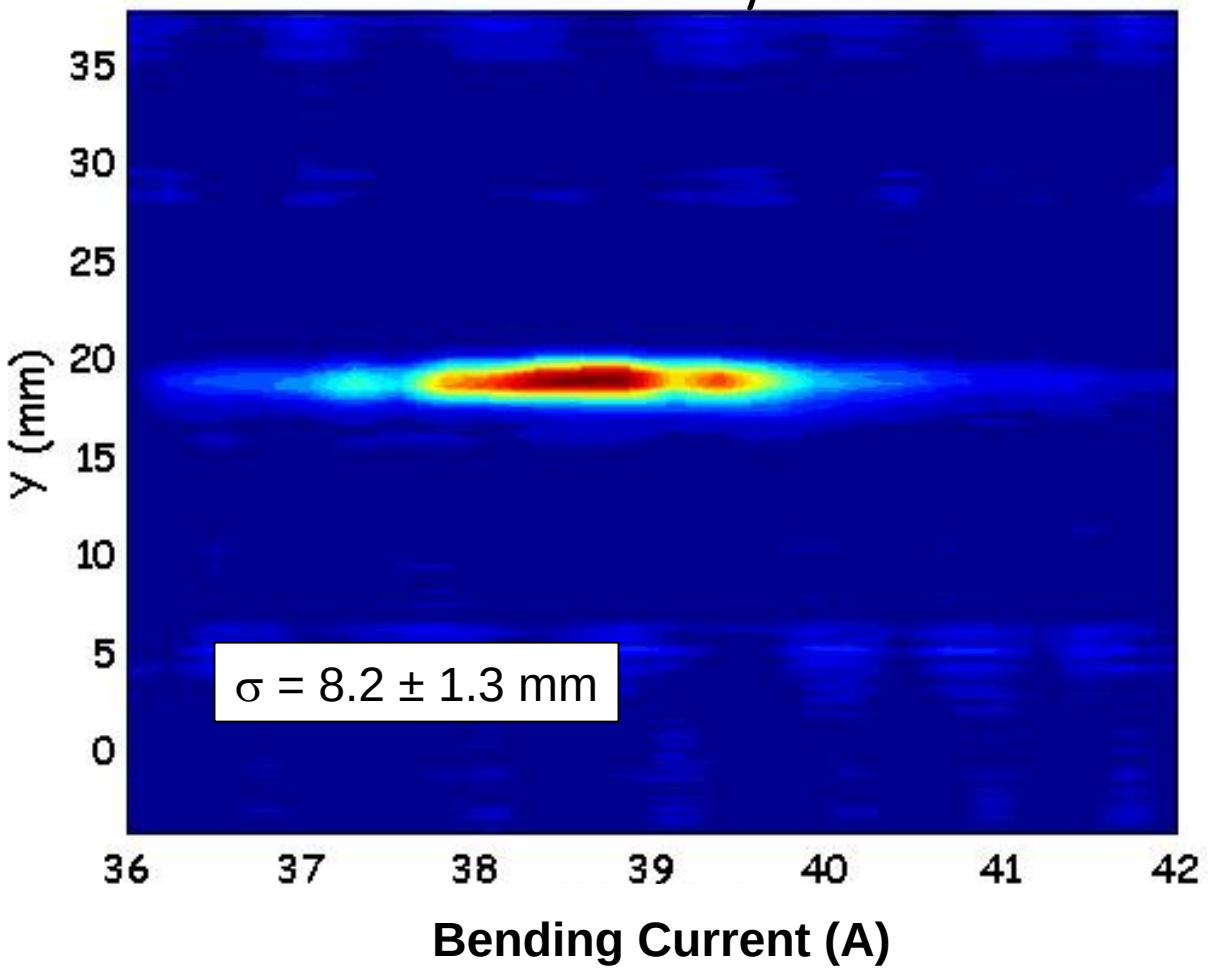
CLS_MTV0750 @ 68MeV : Al screen



What has been observed so far

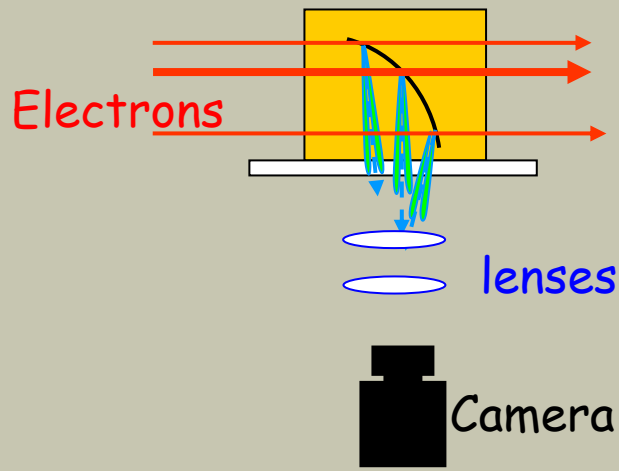
CTS_MTV0455 @ 95MeV : Al screen

Illumination plot



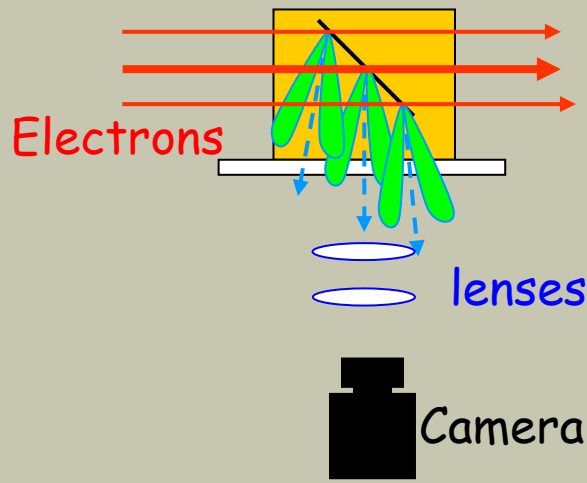
Possibles modifications

Parabolic screen



- Refocus the OTR light onto the camera
- No image deformation since the parabola curvature is small

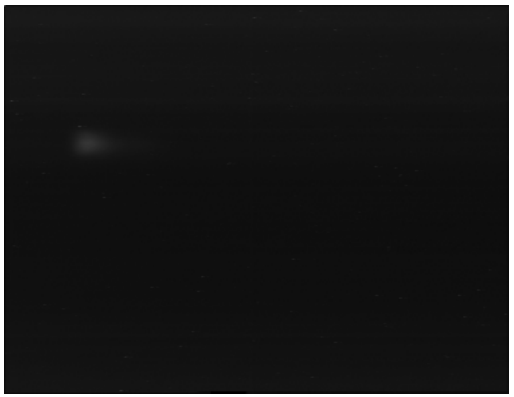
Diffusive screen



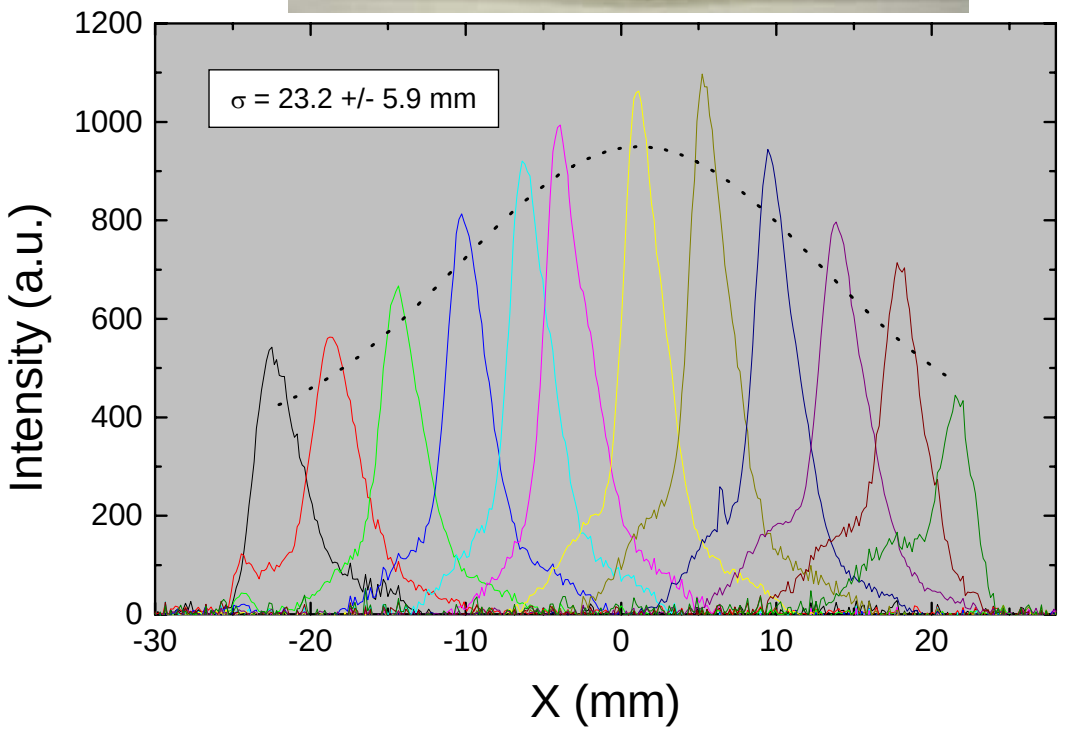
- Enlarge the OTR lobe
- Less light intensity in the middle of the screen

Test of a Diffusive Screen

CTS_MTV0455 @ 125MeV



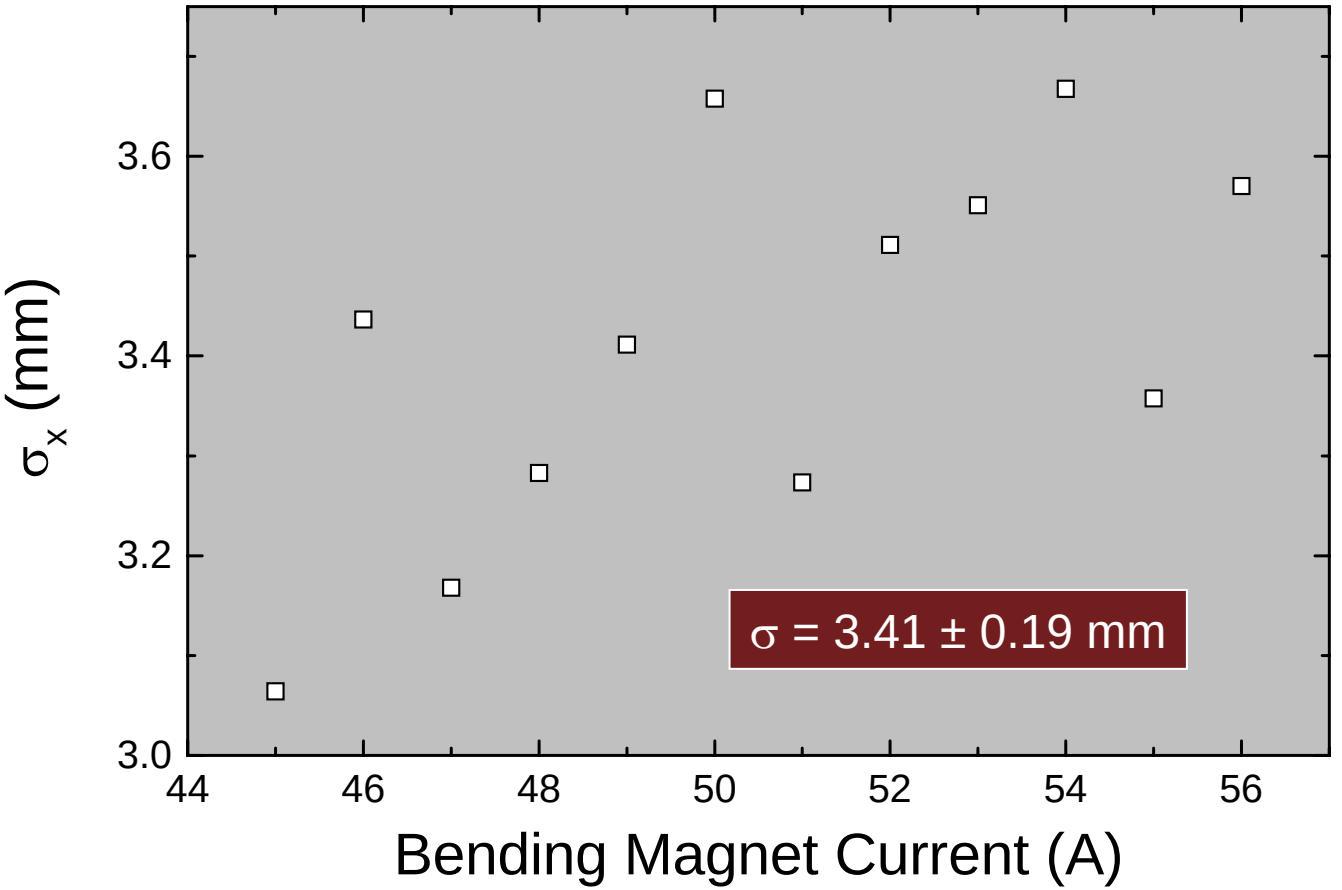
Diffusive Al foil



Illumination increased by more than a factor 3

Test of a Diffusive Screen

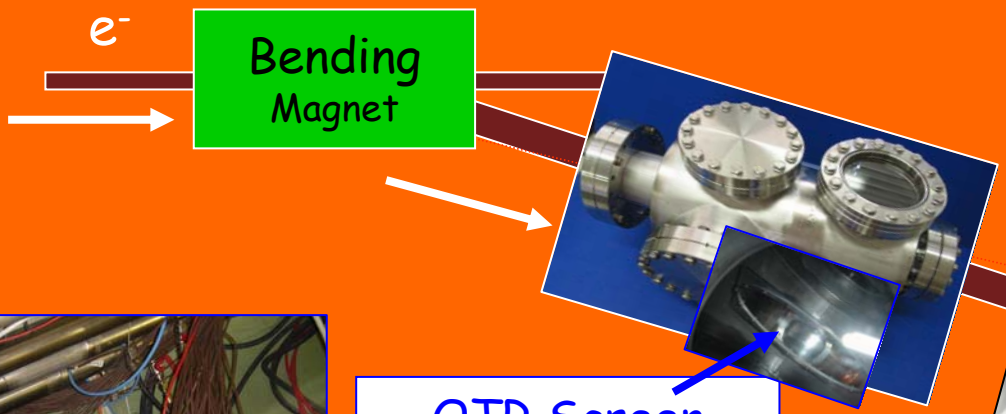
CTS_MTV0455 @ 125MeV

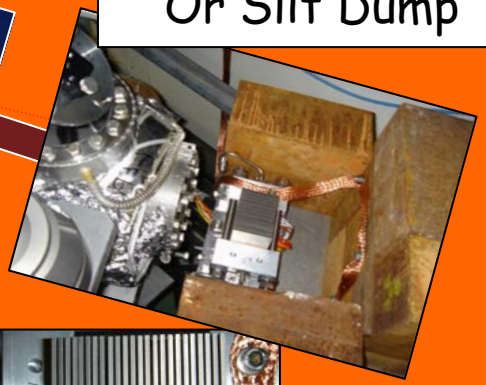


Future test of a parabolic screen

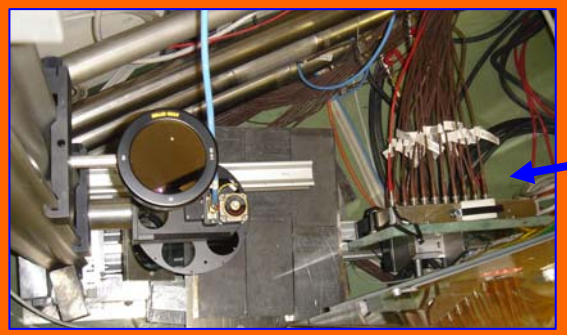
Installed at CLS.MTV1050

Time Resolved Energy Measurement

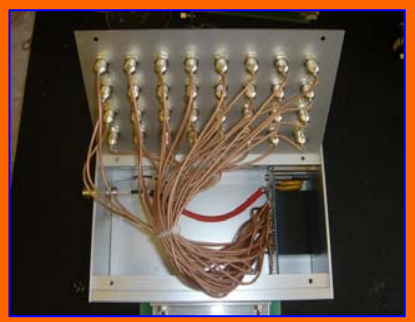




Segmented Dump
Or Slit Dump



OTR Screen
&
Segmented PMT



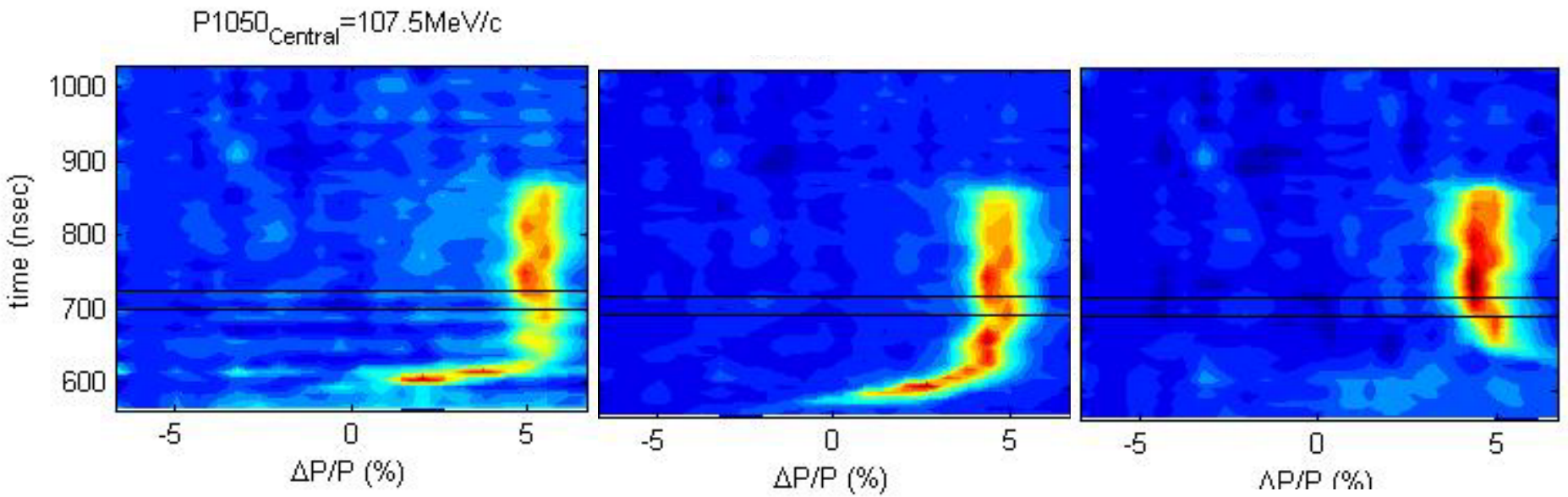
- *32 channels PMT (Hamamatsu)*
- *2mm spatial resolution*
- *36dB, 100MHz amplifier in the klystron gallery*

- 24 Tungsten plates (2mm thick) spaced by ~ 1mm
- Connected to 50 Ω to the ground

- Slit dump (2mm slit and a dump in steel)

Segmented photomultiplier

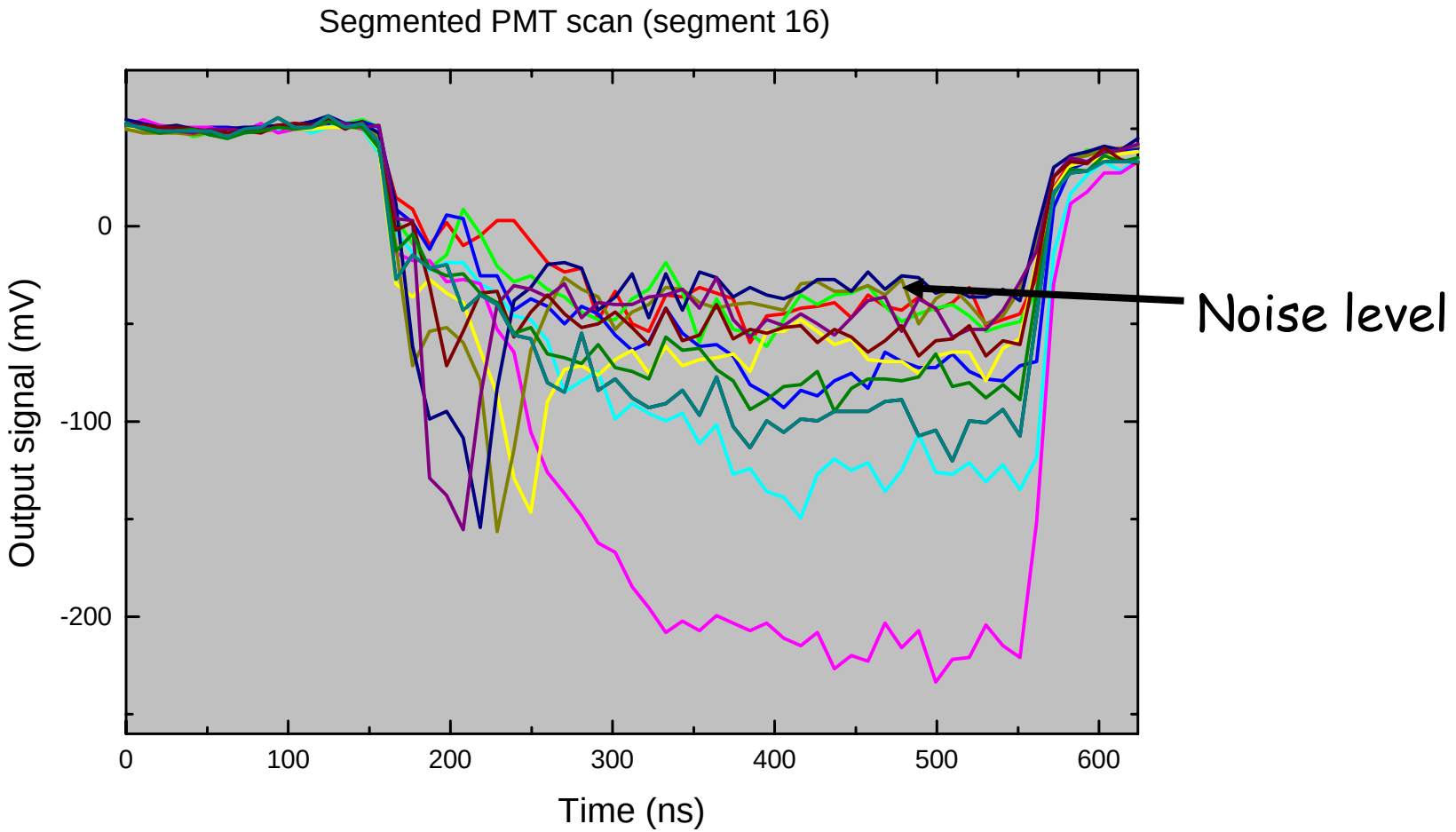
Displacing the timing of klystron 5&6 for transient compensation



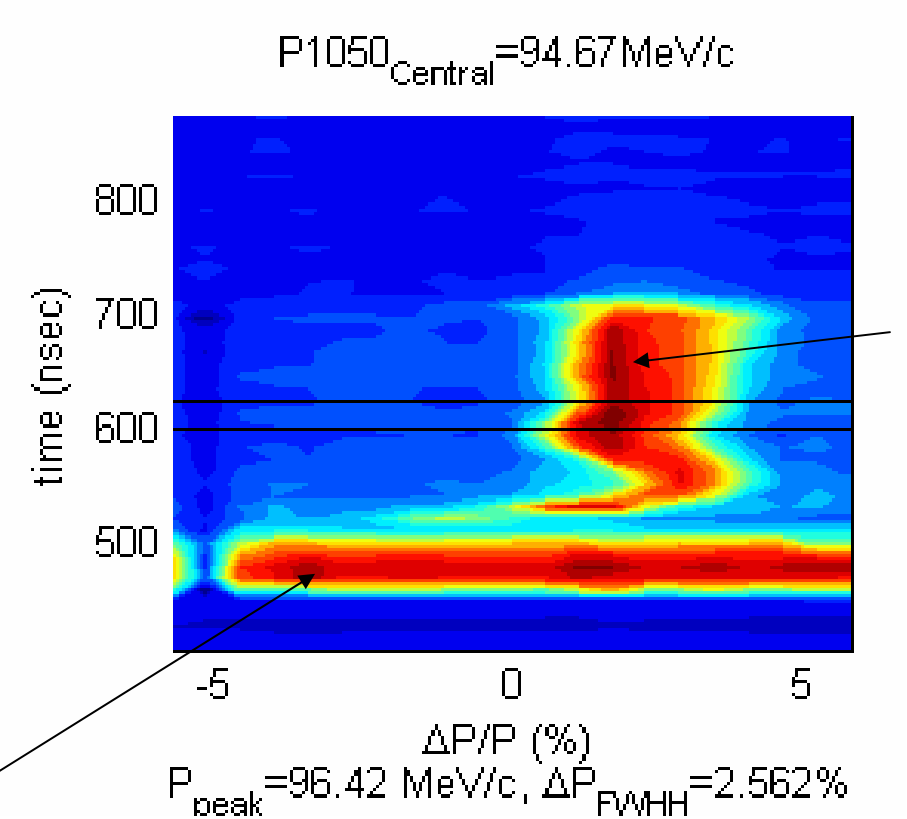
Segmented photomultiplier measurements

@93.5MeV, 5.4A

‘Looking at segment 16 and scanning the beam through’



Segmented photomultiplier measurements



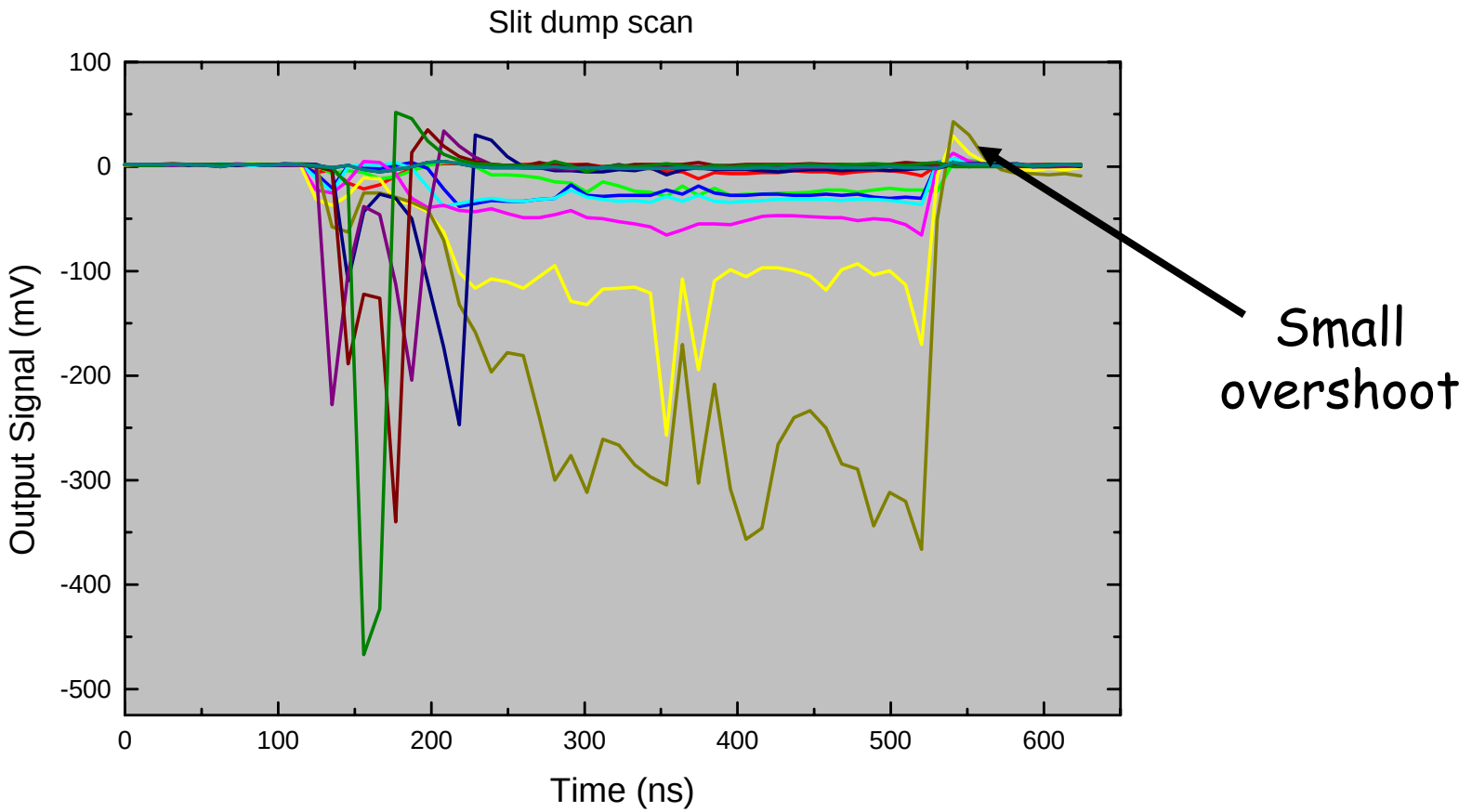
Beam energy spectrum

Noise (sensitive to beam losses conditions)

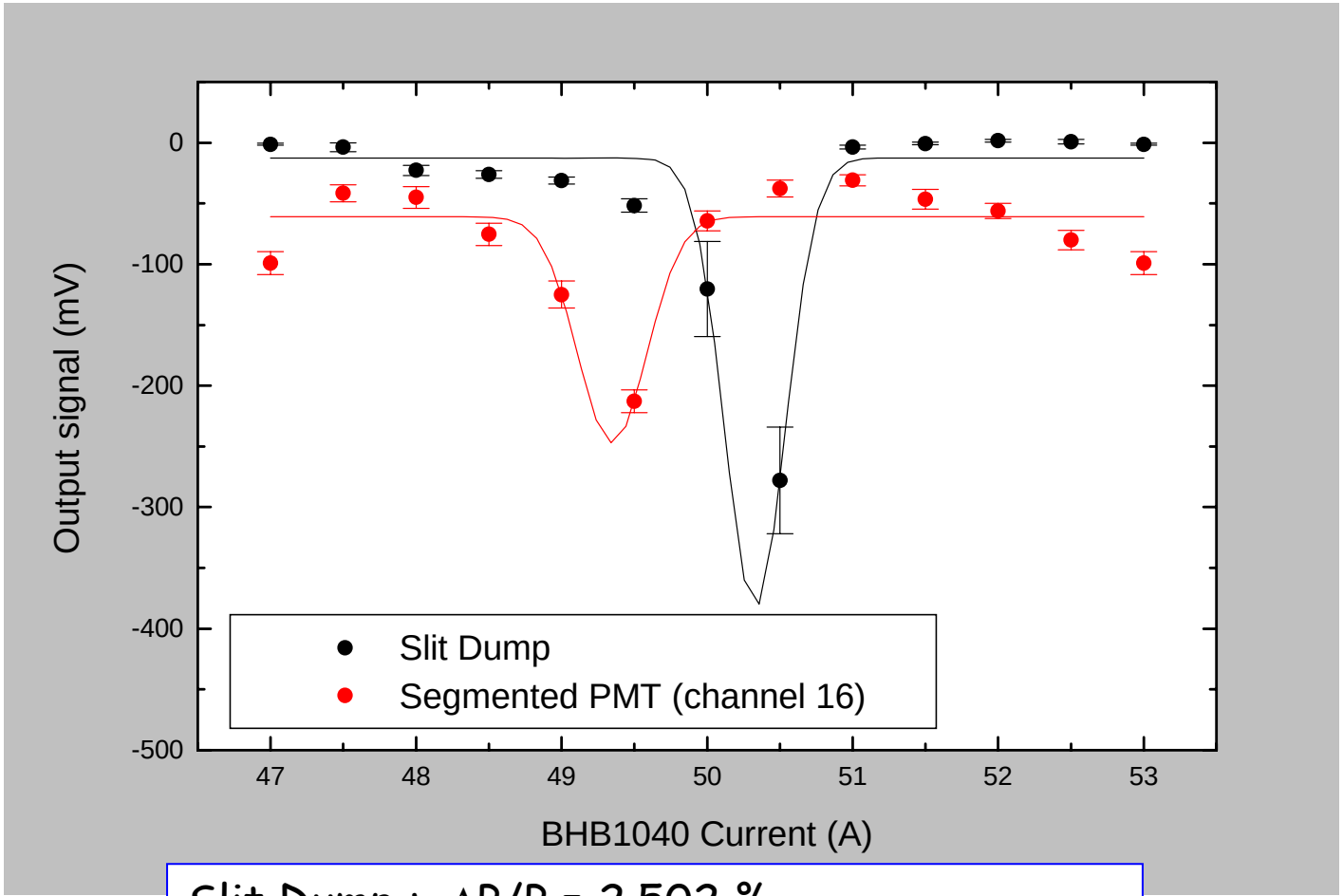
Slit dump measurements

@93.5MeV, 5.4A

‘Looking at slit dump and scanning the beam through’



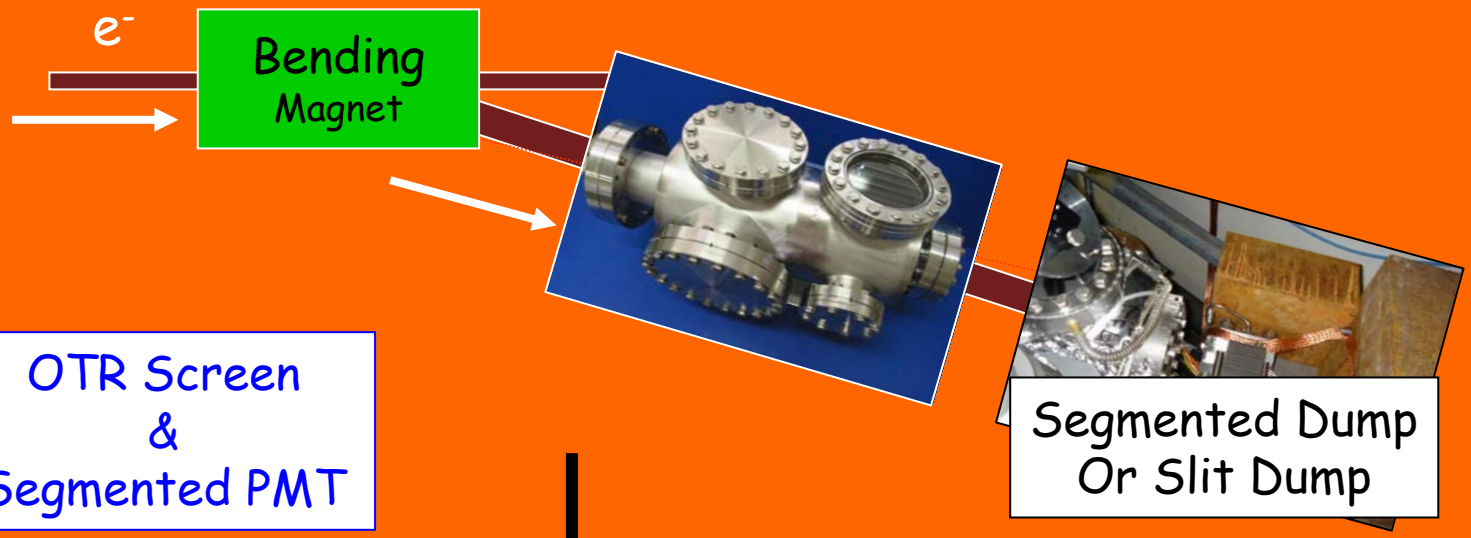
Slit dump vs Segmented photomultiplier



Slit Dump : $\Delta P/P = 2.502$ %

Segmented Photomultiplier : $\Delta P/P = 2.856$ %

Segmented Dump vs Segmented Photomultiplier



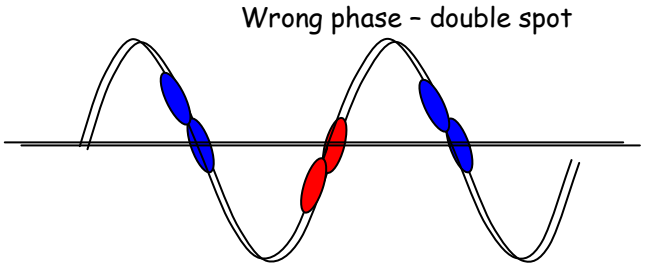
- Limitations link to OTR screen
- Need a fast amplifier
- **Sensitive to radiation**
- **Difficult to align**

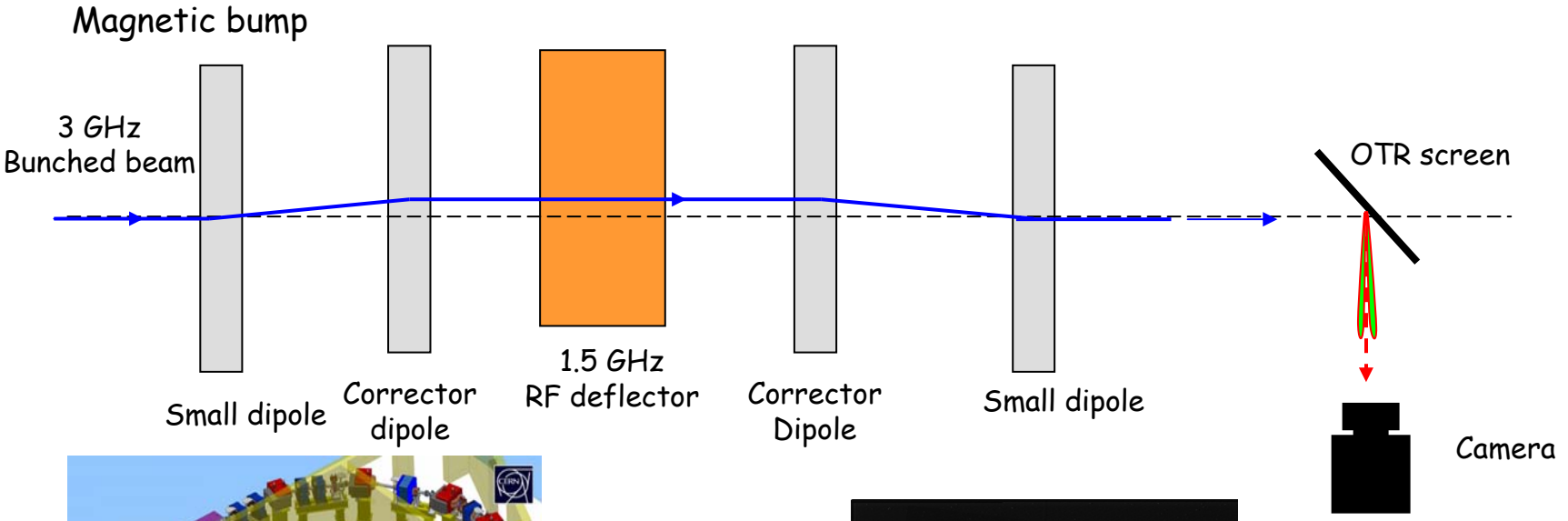
- **Good time resolution**
- **Work for any beam energy**

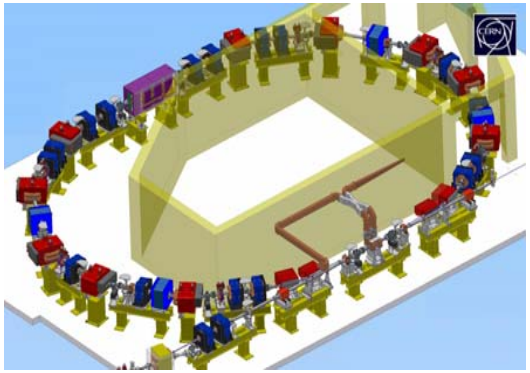
- Bandwidth limited (100MHz)
- Spatial resolution is limited for higher energy beams (> 100MeV)
- Risk of damage at high repetition rate

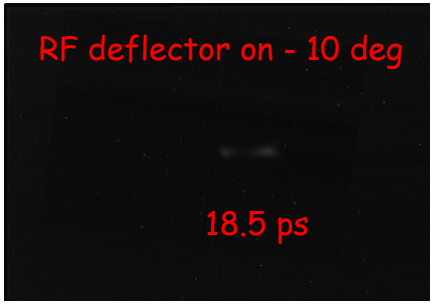
- **Cheap and Simple**
- No need for amplifier

Bunch Length Measurement with the 1.5GHz RF Deflector

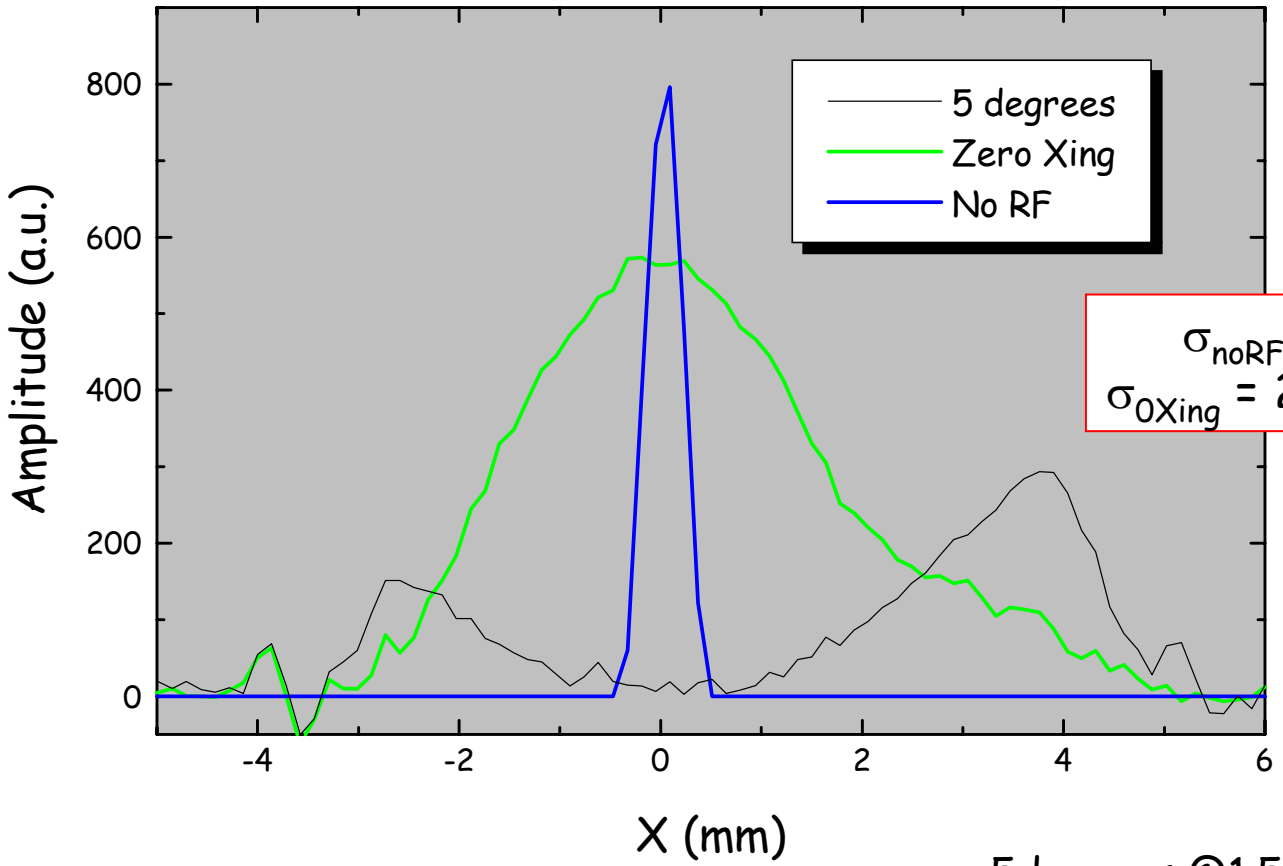








Bunch Length Measurement with the 1.5GHz RF Deflector



σ_{noRF} = 0.35mm
σ_{0Xing} = 2.9mm (6.7ps)

5degrees @1.5GHz = 9.25ps (4mm)

With this setting, the resolution is better than 1ps
More tests must be done to check where the limits are