

NML RadiaBeam

Transverse Profile Monitor

Initial Testing at A0

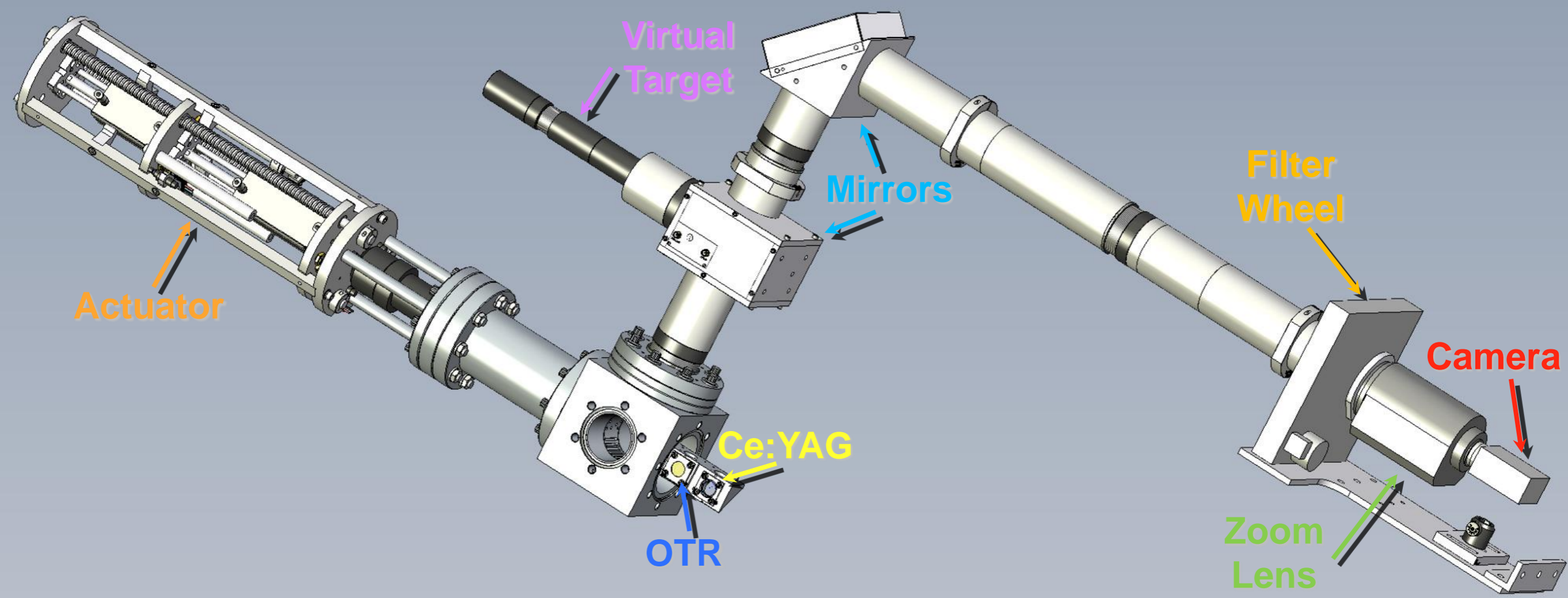
2010 September 29

Alex Lumpkin Bob Flora Congcong Tan James
Santucci Jinhao Ruan Randy Thurman-Keup Yin-

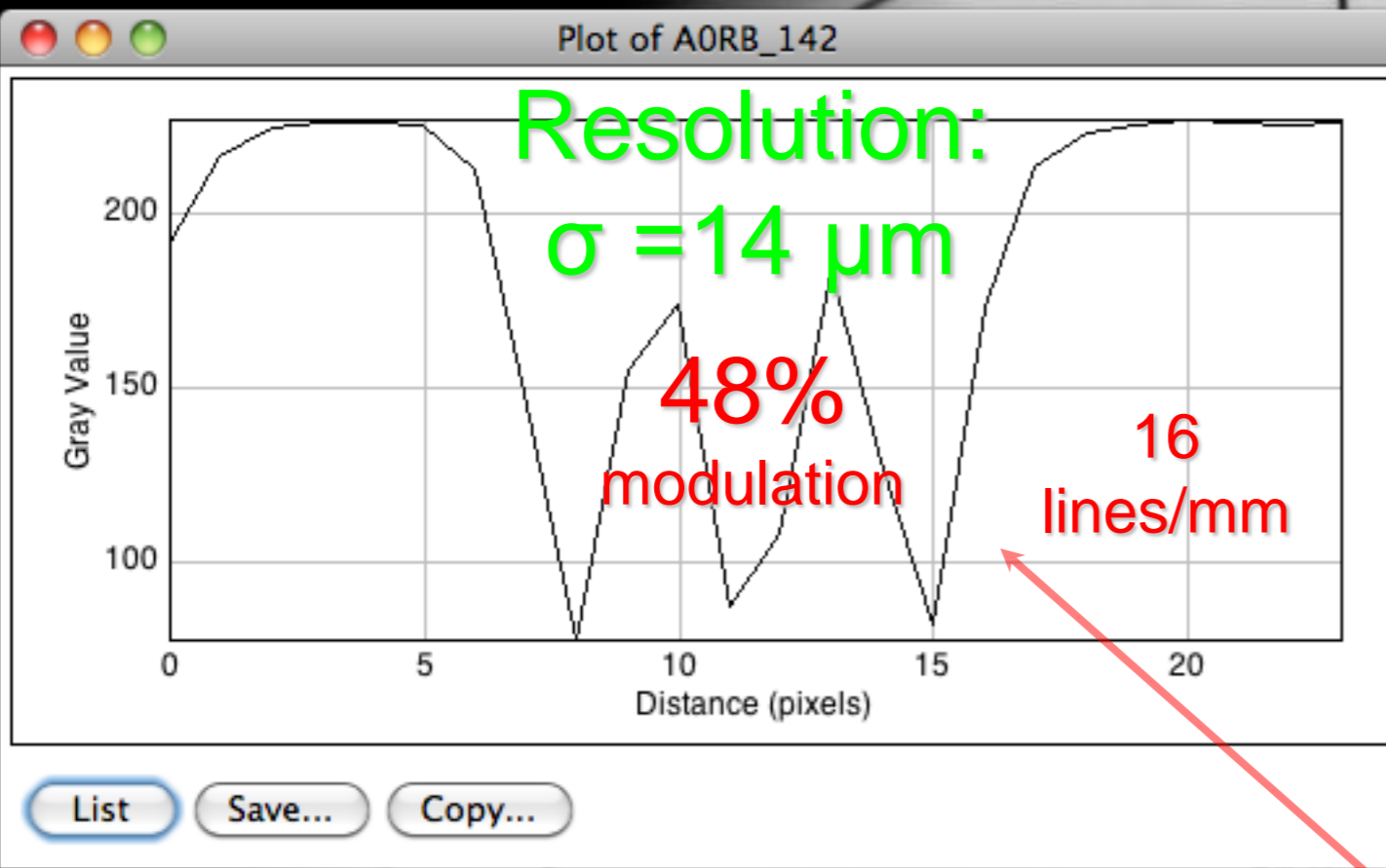
Brad Tennis Elias^e Sun Lopez Ryan Montiel

Dallas Heikkinen Jim Fitzgerald Jim Galloway John
Seraphin

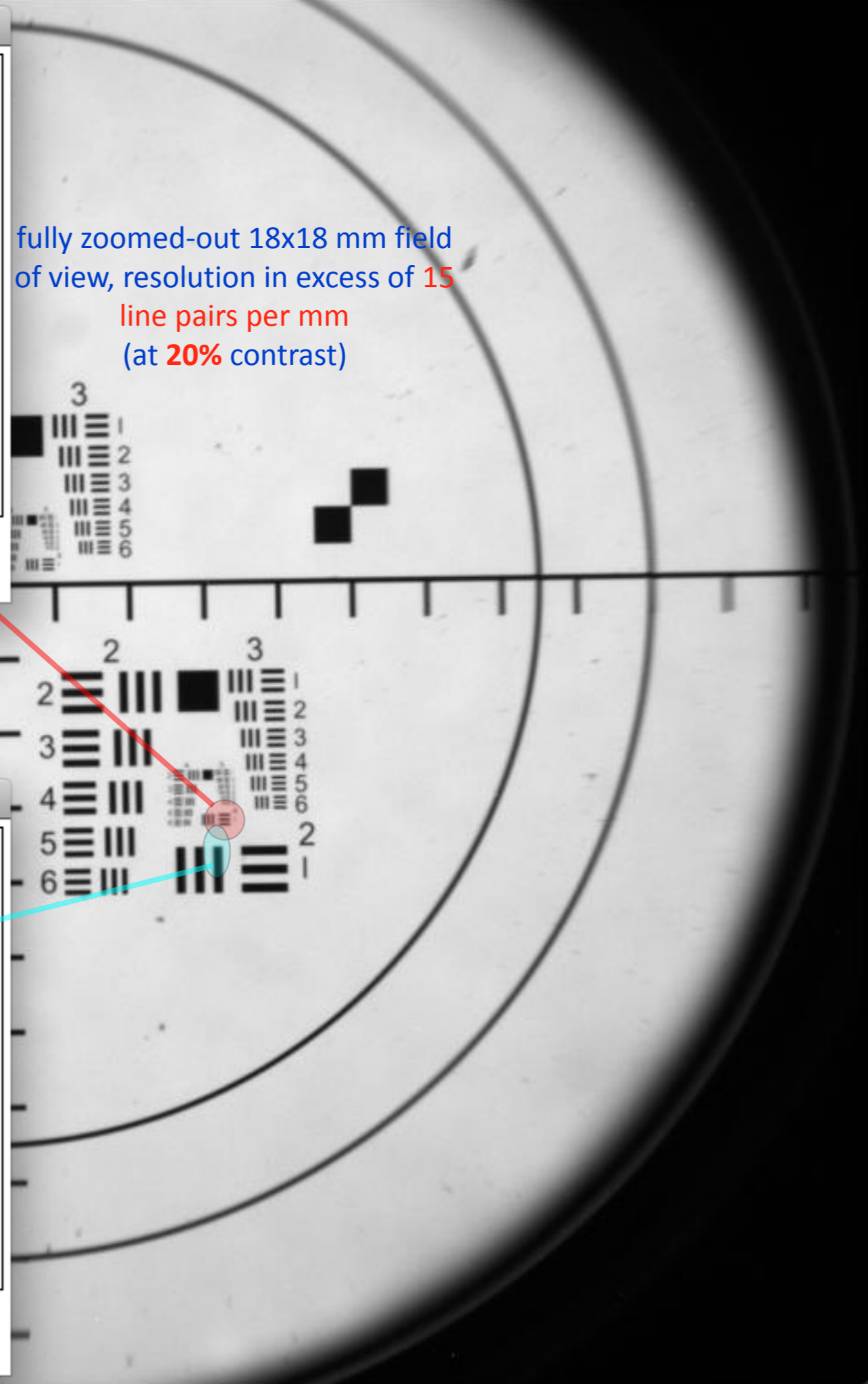
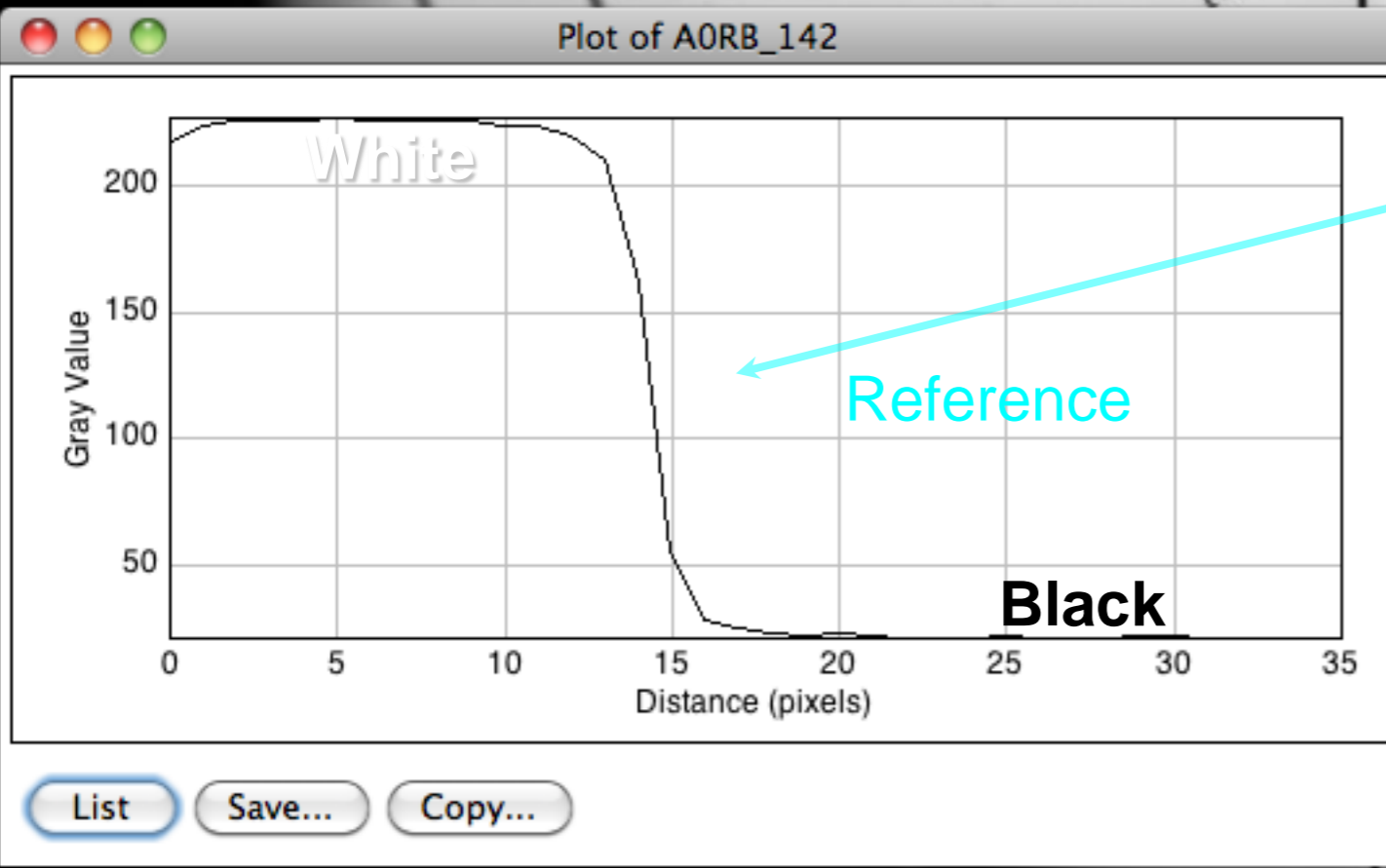
Bob Goodwin Mike Kucera

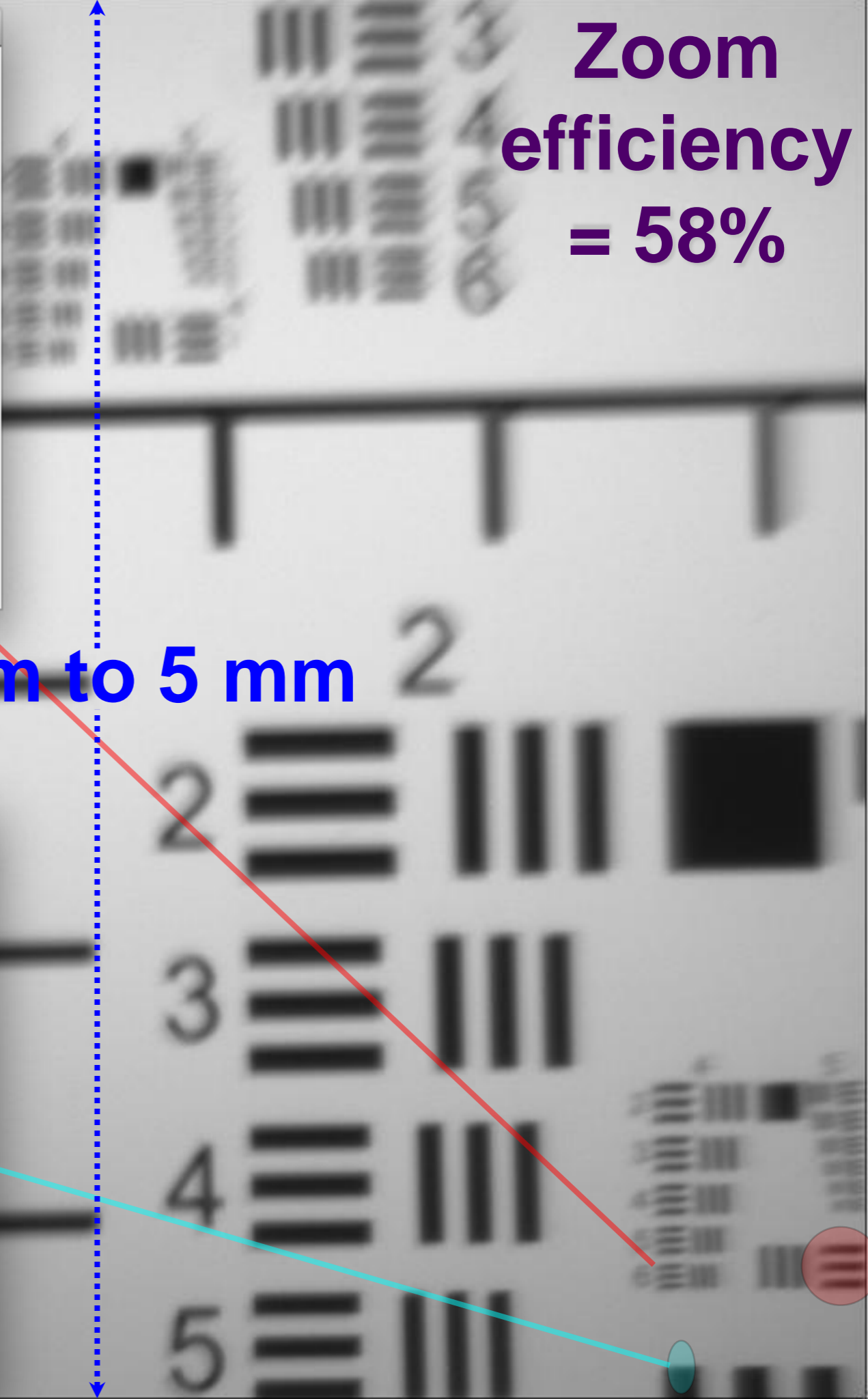
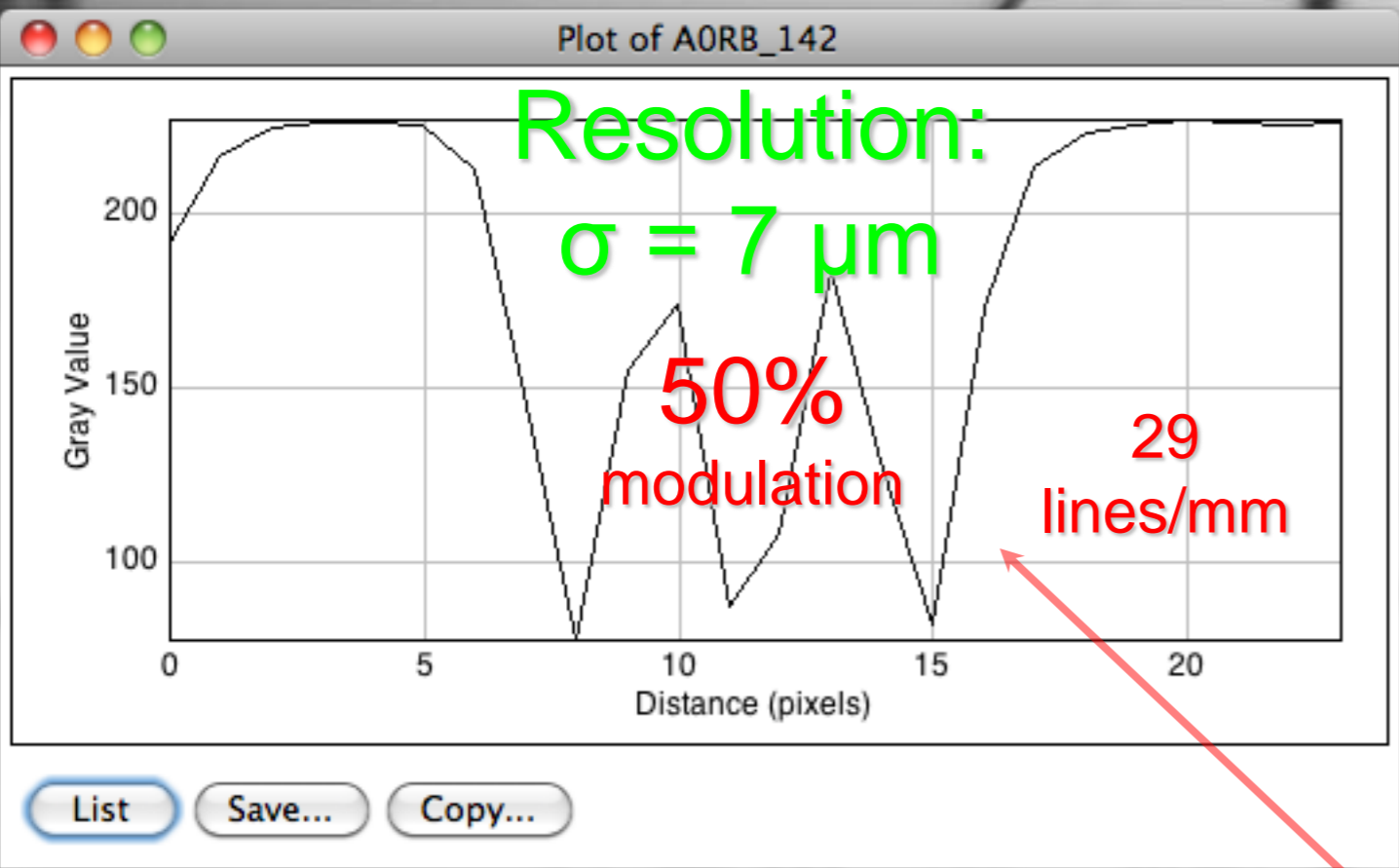


The “A0 RadiaBeam” project objective is to evaluate transverse beam profile monitors proposed for the [NML](#) Low Energy Beamlines. [A0](#) was simply chosen as a convenient test bed and [RadiaBeam](#) was chosen on the merits of their modular IBIS (Integrated Beam Imaging System) design proposal. Thin metallic foil screens for Optical Transition Radiation (OTR) and Ce:YAG single-crystal scintillators are being investigated along with all supporting mechanical, electronic, and optical systems. The project goal is to move from prototype evaluation into production for NML.



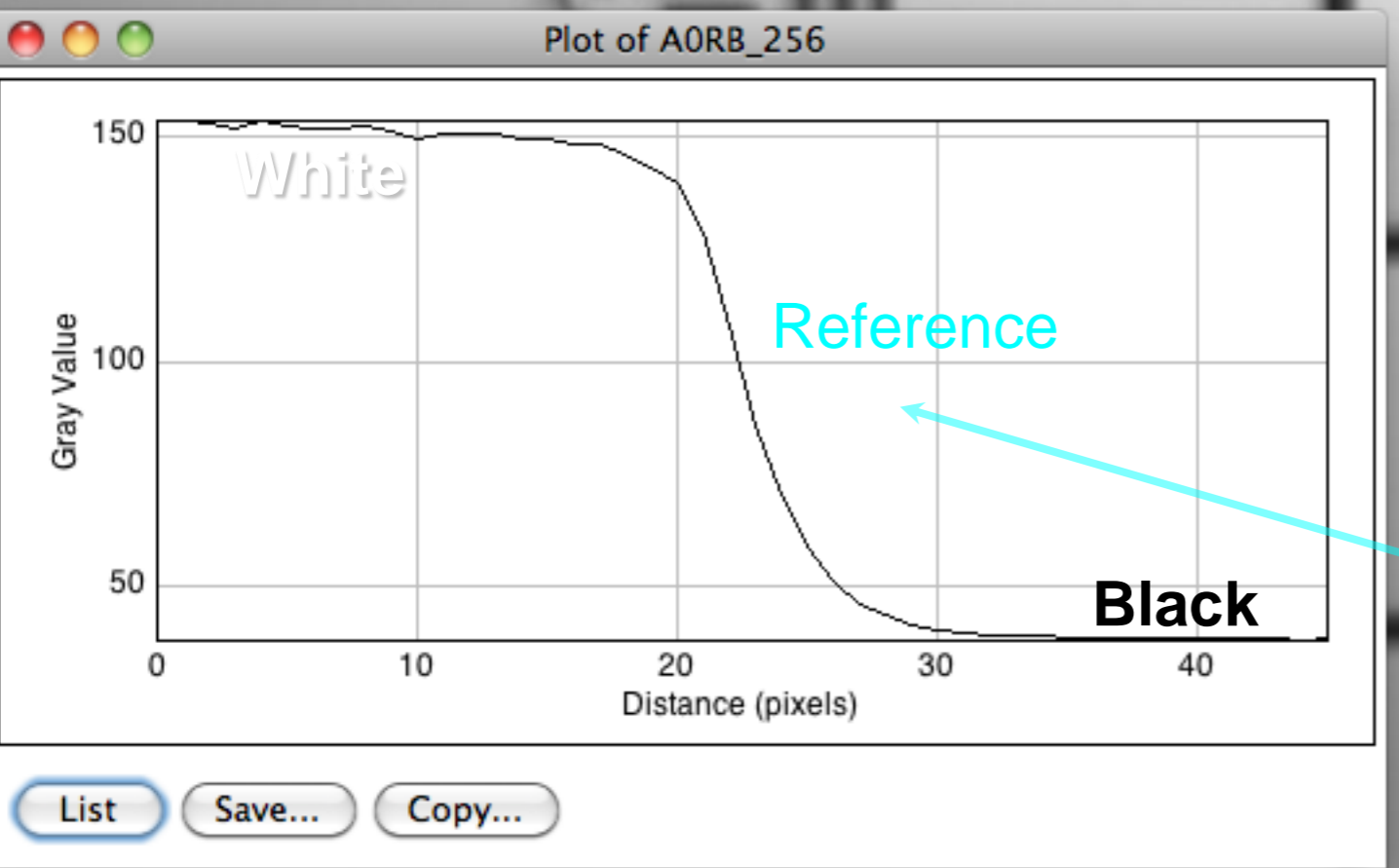
fully zoomed-out 18x18 mm field of view, resolution in excess of 15 line pairs per mm (at 20% contrast)



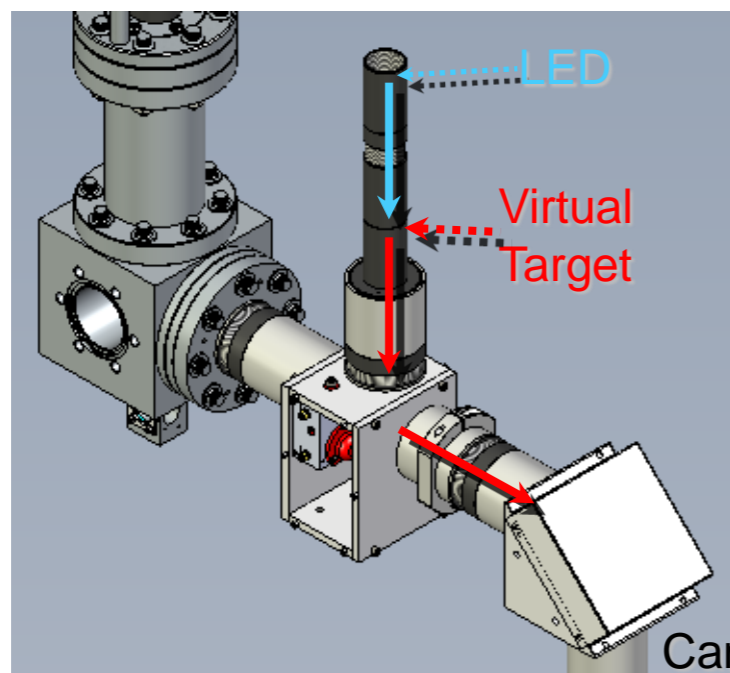
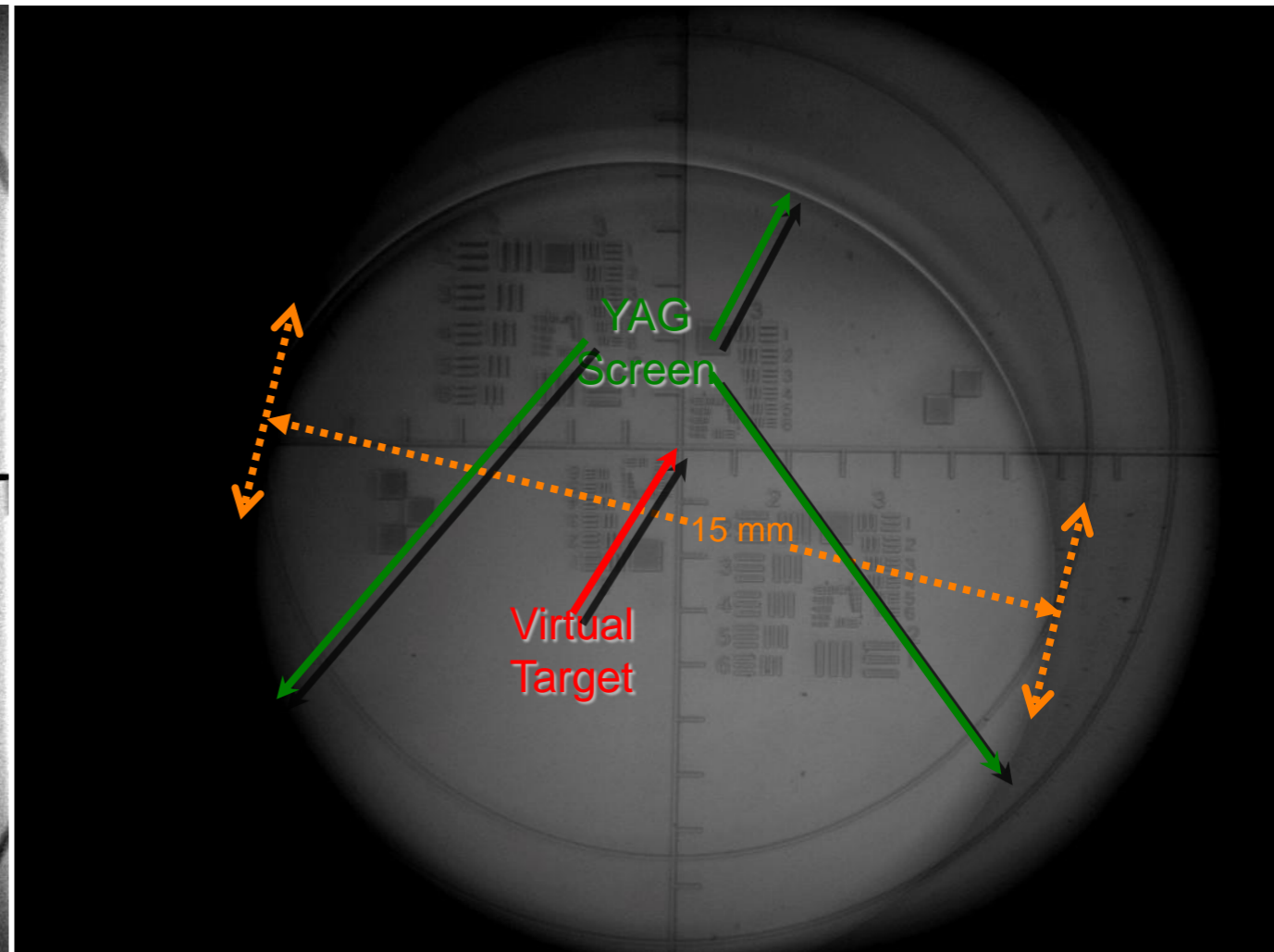
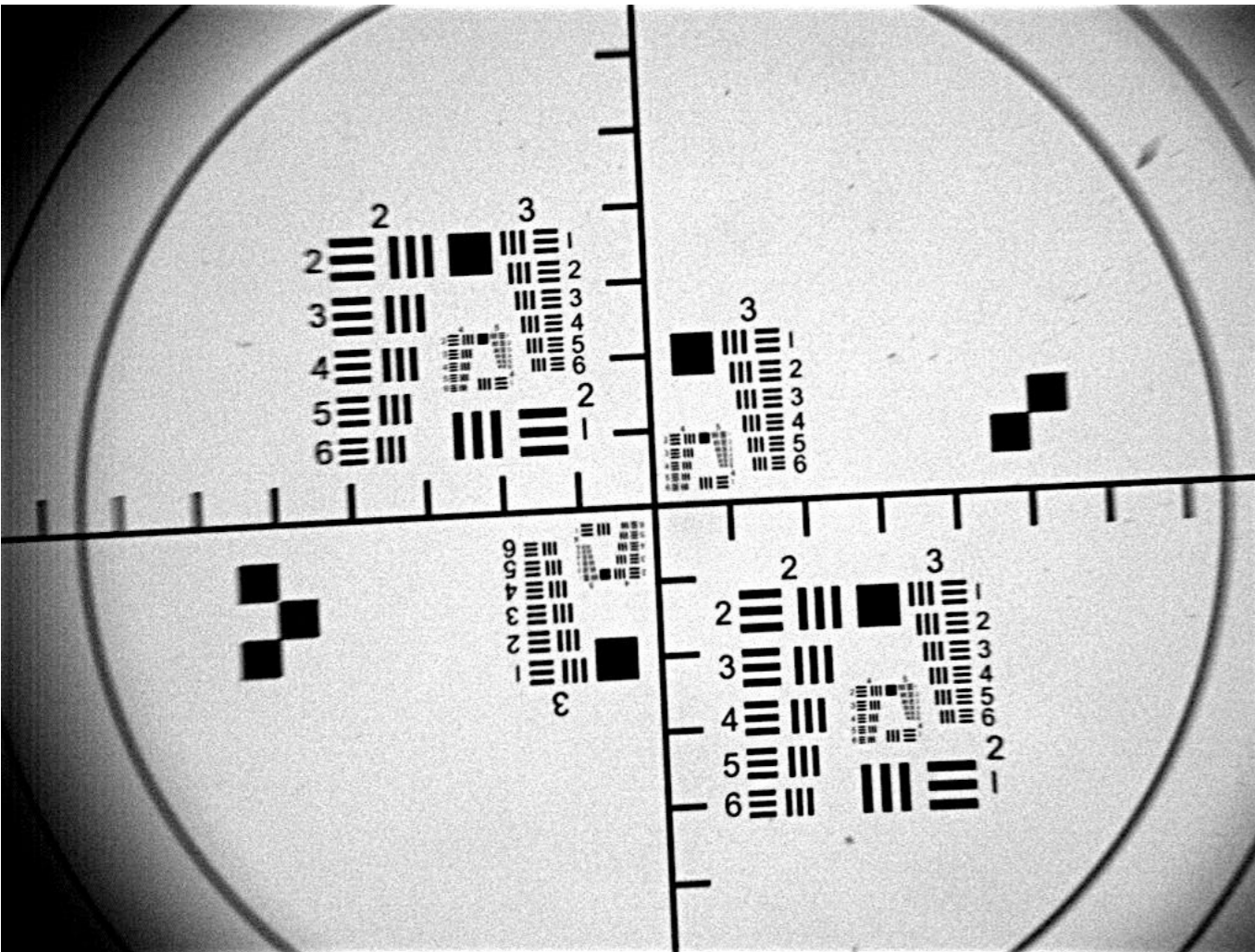


Zoom efficiency = 58%

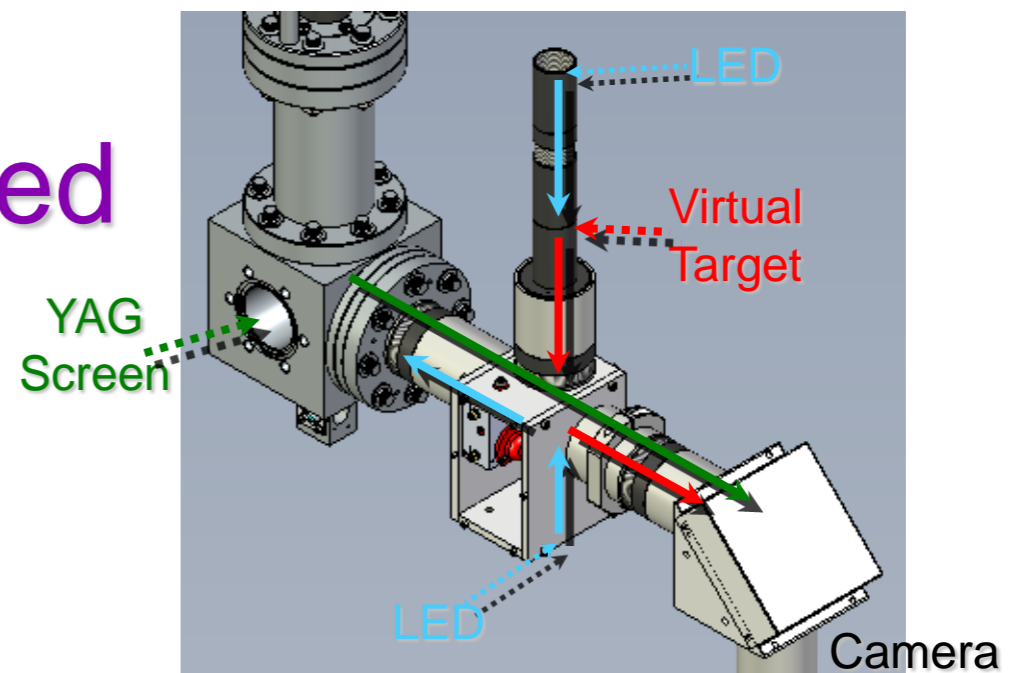
Zoom to 5 mm



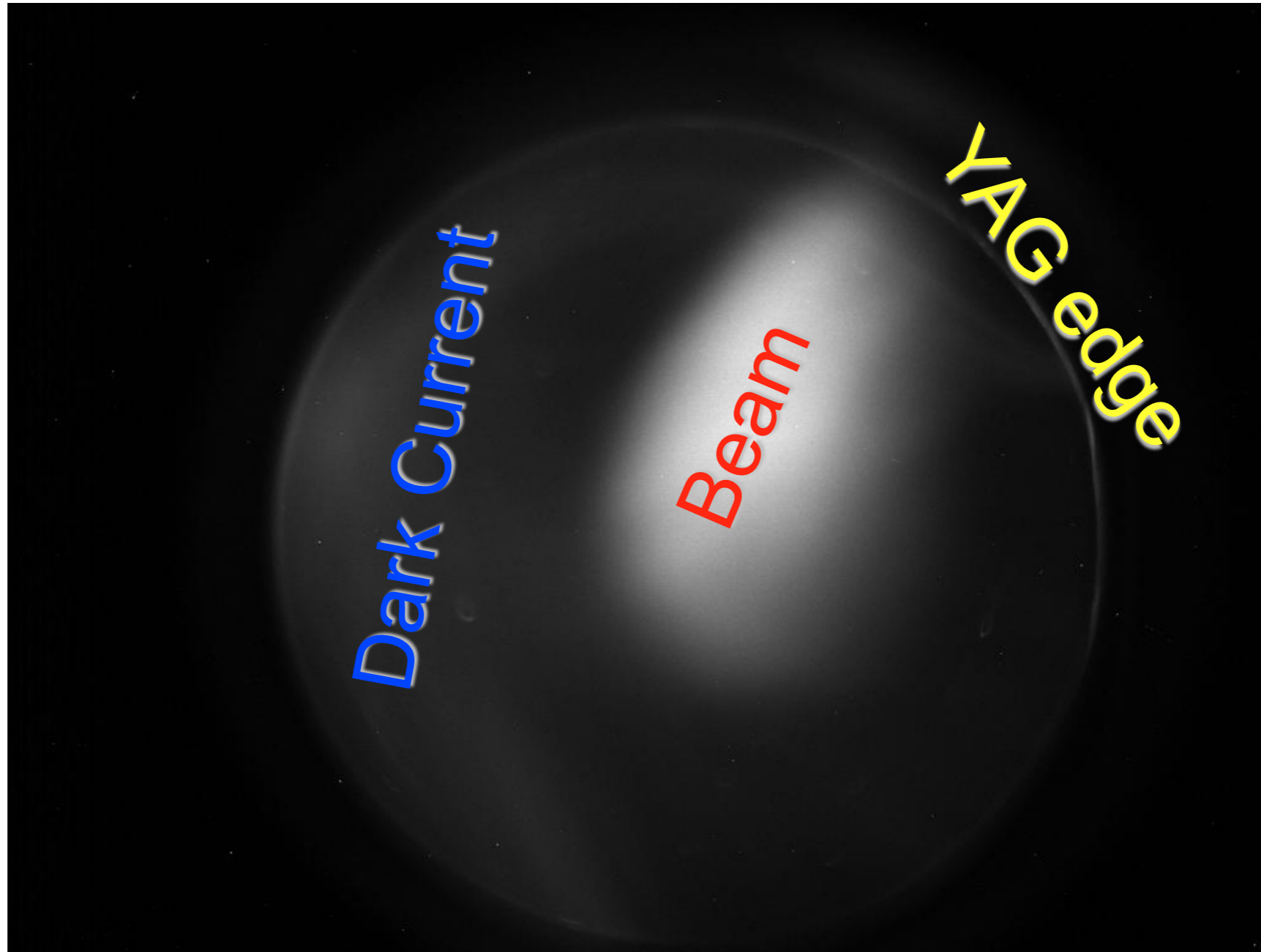
Virtual Target



Z matched

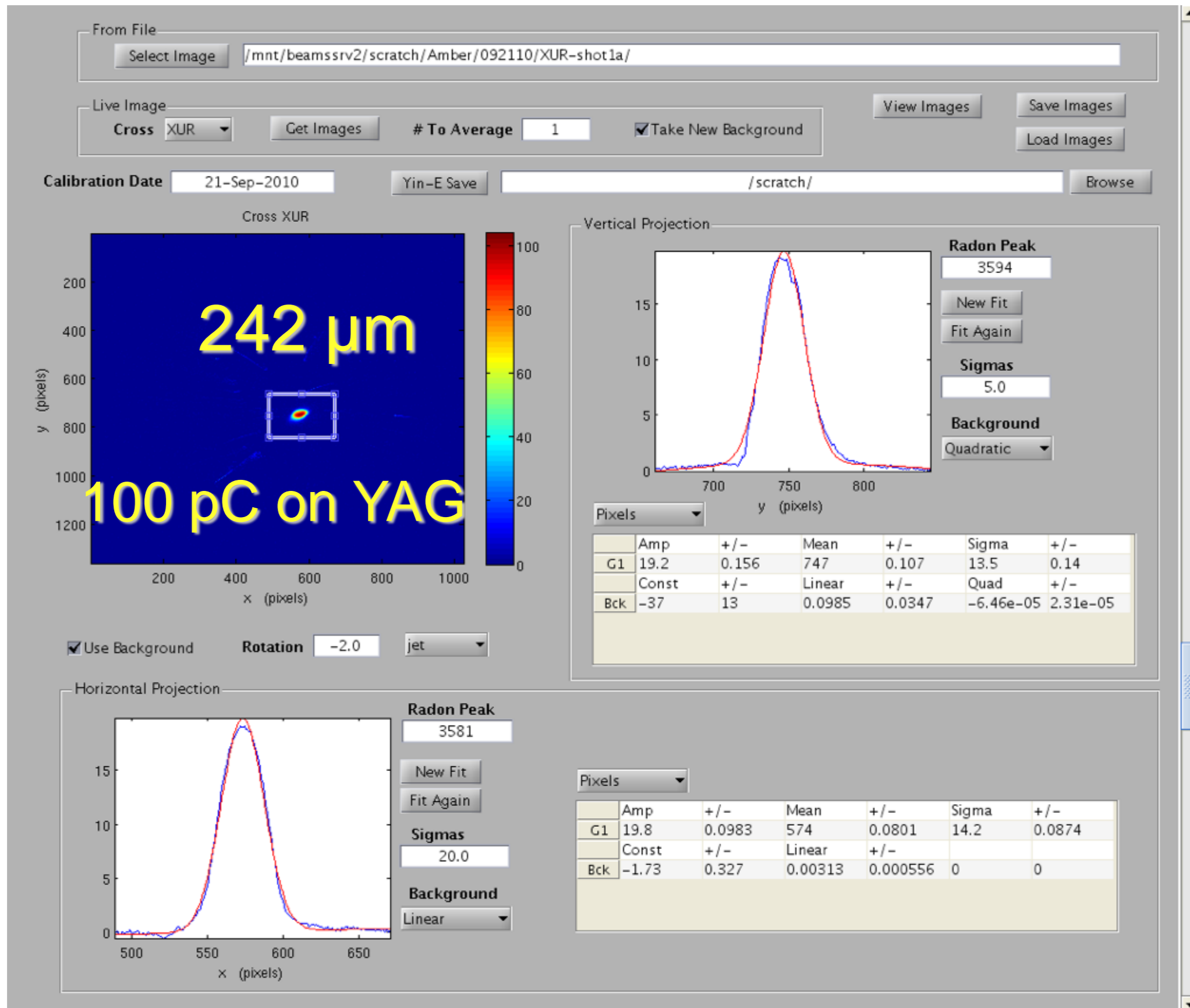


First Light

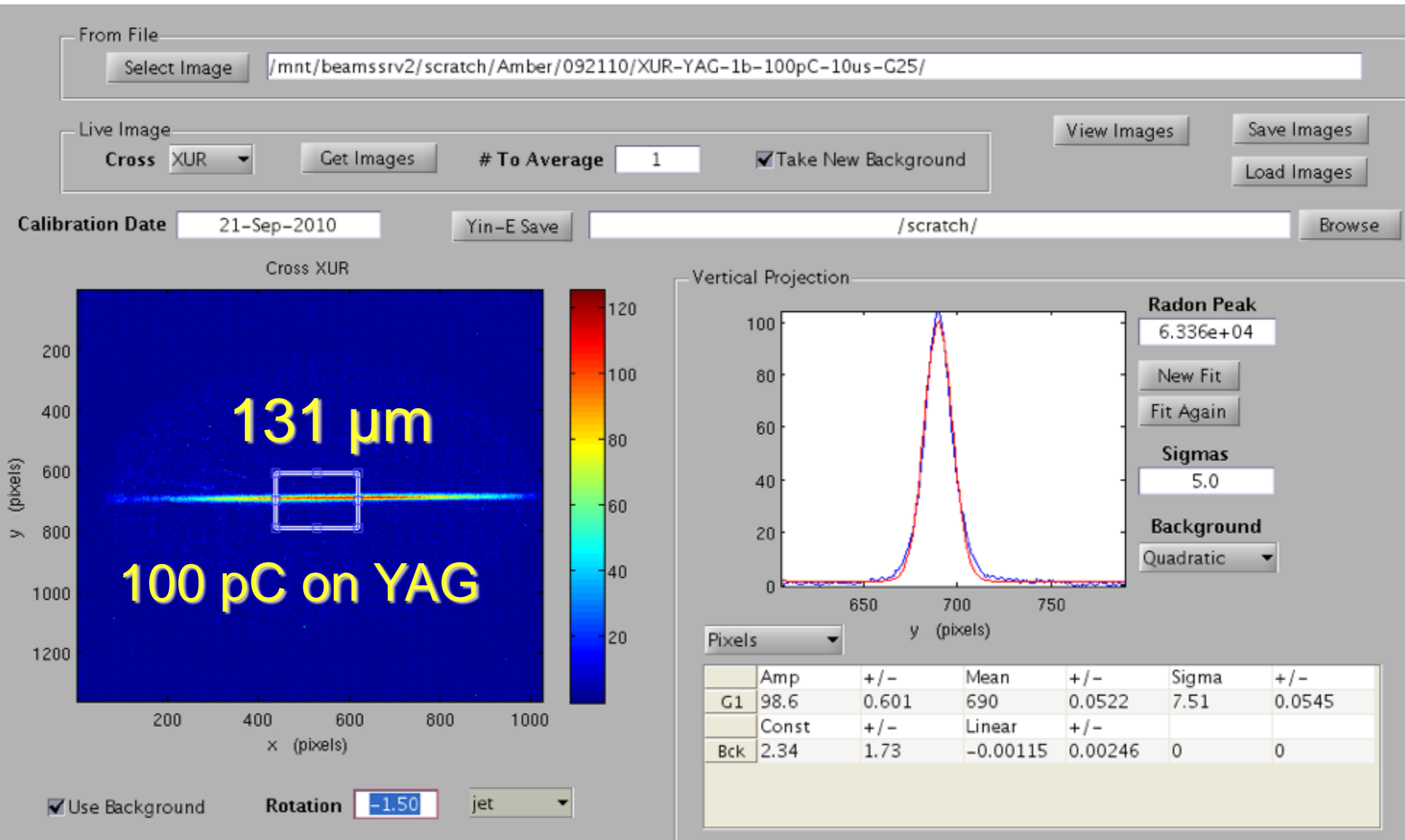


10 bunches on YAG

Small Round Beam



Narrow Beam Stripe



Short Flat Beam

From File
 Select Image

Live Image
 Cross Get Images # To Average Take New Background View Images Save Images Load Images

Calibration Date Yin-E Save Browse

Cross XUR

Vertical Projection

Radon Peak

 New Fit
 Fit Again
 Sigmas

 Background

	Amp	+/-	Mean	+/-	Sigma	+/-
G1	9.64	0.118	679	0.0479	3.4	0.0484
	Const	+/-	Linear	+/-		
Bck	-0.207	0.106	0.000598	0.000152	0	0

Horizontal Projection

Radon Peak

 New Fit
 Fit Again
 Sigmas

 Background

	Amp	+/-	Mean	+/-	Sigma	+/-
G1	3.09	0.0521	352	0.106	5.49	0.11
	Const	+/-	Linear	+/-		
Bck	0.216	0.0982	-0.00012	0.000272	0	0

Use Background Rotation

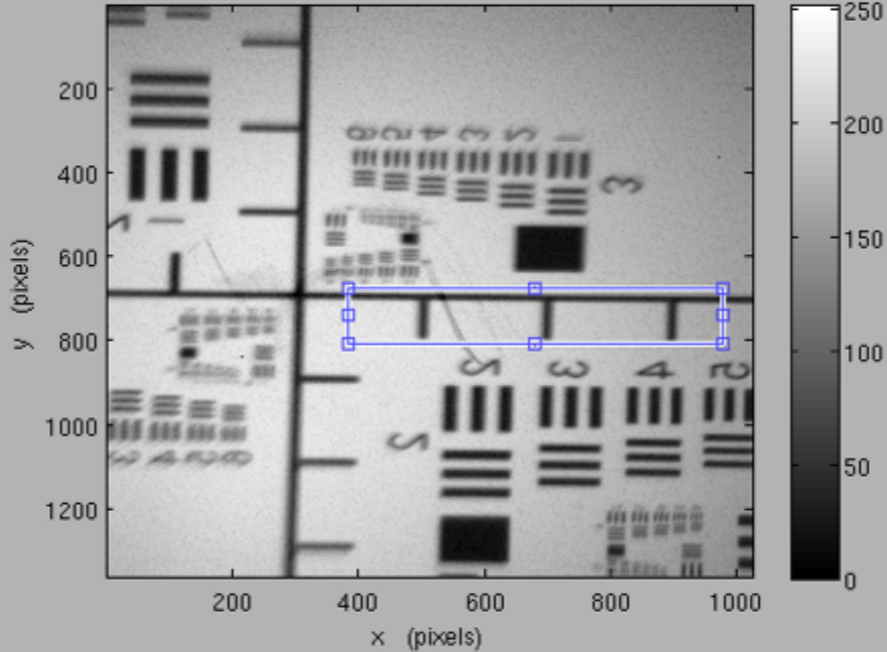
ZOOM

From File
Select Image /mnt/beamsrv2/scratch/Amber/092110/XUR-CALIB-ZoomIN2-5.5mm/

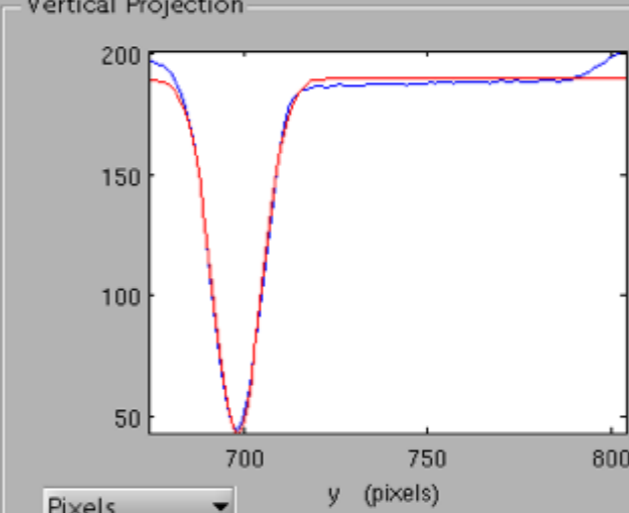
Live Image
Cross XUR Get Images # To Average 1 Take New Background View Images Save Images Load Images

Calibration Date 21-Sep-2010 Yin-E Save /scratch/ Browse

Cross XUR



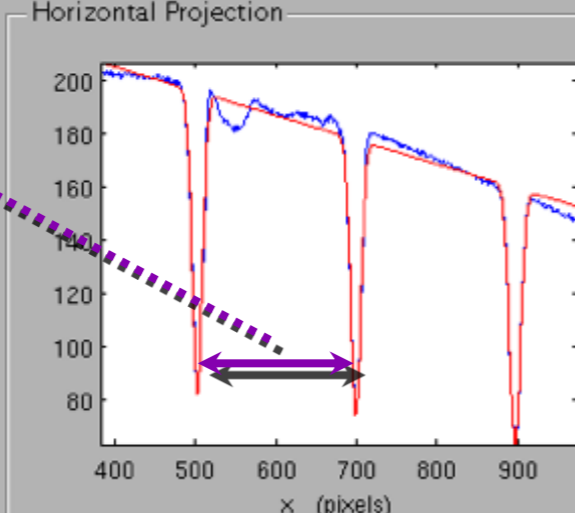
Vertical Projection



Radon Peak
2.07e+05
New Fit
Fit Again
Sigmas
5.0
Background
Linear

	Amp	+/-	Mean	+/-	Sigma	+/-
G1	-146	1.29	698	0.0629	6.54	0.0751
Const			Linear			
Bck	186	7.73	0.00521	0.0103	0	0

Horizontal Projection



Radon Peak
2.745e+05
New Fit
Fit Again
Sigmas
20.0
Background
Linear

	Amp	+/-	Mean	+/-	Sigma	+/-
G1	-113	1.17	503	0.0767	6.46	0.0785
G2	-103	1.19	699	0.0827	6.25	0.0836
G3	-96.4	1.15	897	0.092	6.73	0.0949
Const			Linear			
Bck	242	0.586	-0.0912	0.000842	0	0

1 mm
197 pix
or
5.08 $\mu\text{m}/\text{pix}$

Zoom In

From File

Select Image

/mnt/beamsrv2/scratch/Amber/092110/XUR-YAG-1b-15pC-ZoomIN2-G10-Focusbest/

Live Image

Cross XUR

Get Images

To Average 1

Take New Background

View Images

Save Images

Load Images

Calibration Date

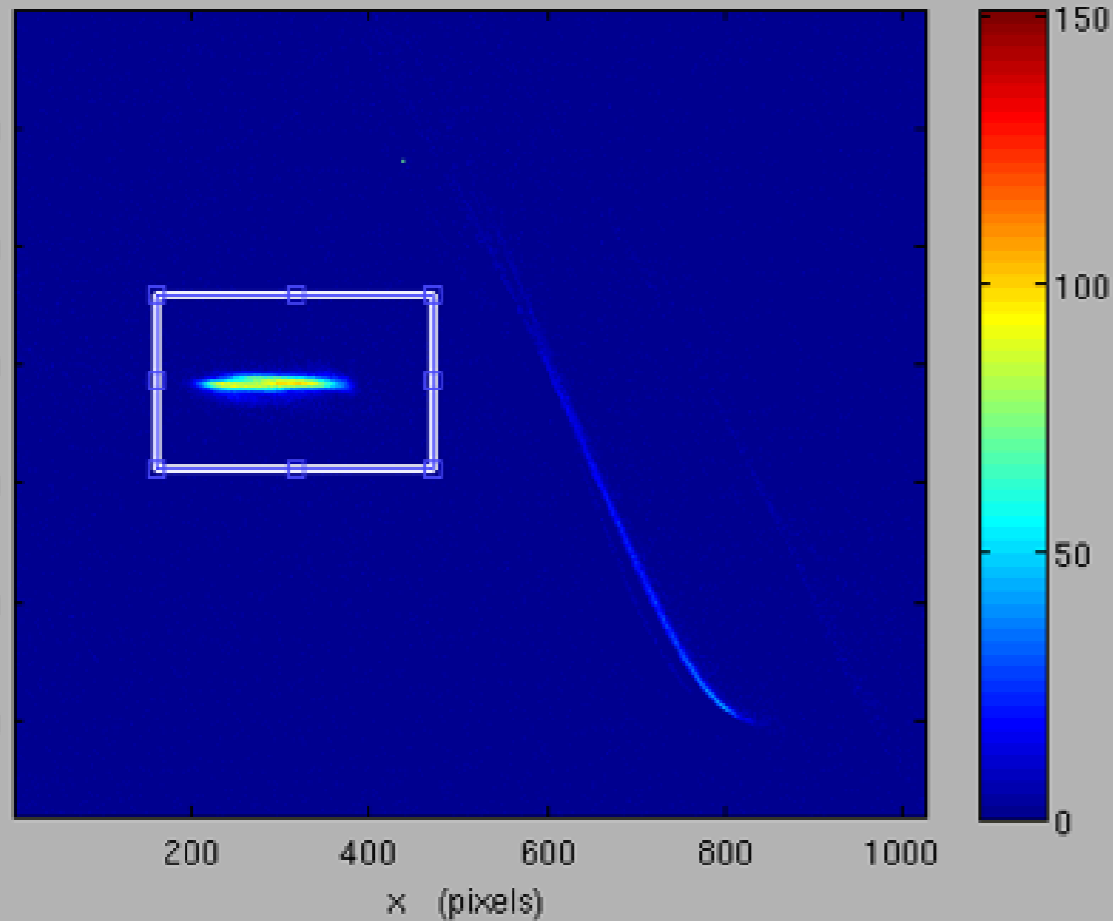
21-Sep-2010

Yin-E Save

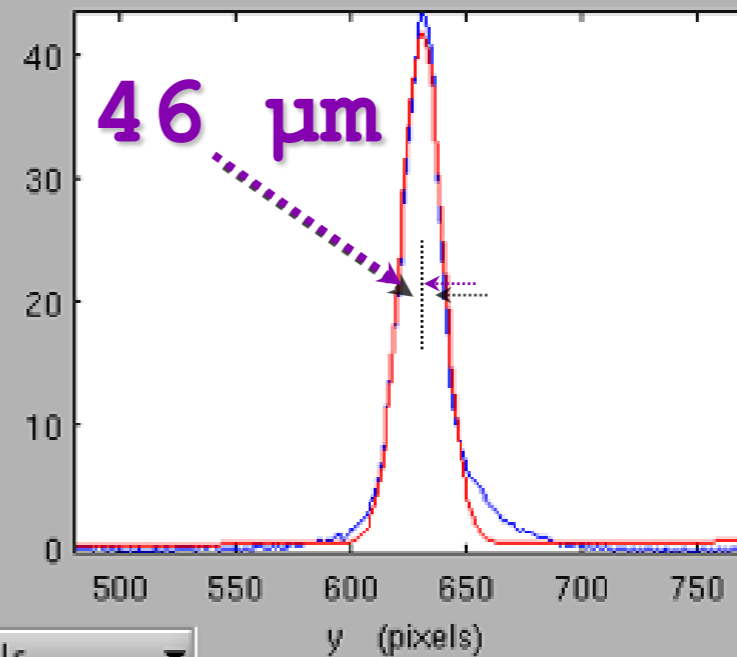
/scratch/

Browse

Cross XUR



Vertical Projection



Radon Peak

1.365e+04

New Fit

Fit Again

Sigmas

5.0

Background

Linear

Pixels

	Amp	+/-	Mean	+/-	Sigma	+/-
G1	41.4	0.286	631	0.0716	9.06	0.0738
	Const	+/-	Linear	+/-		
Bck	-0.13	0.404	0.00101	0.00064	0	0

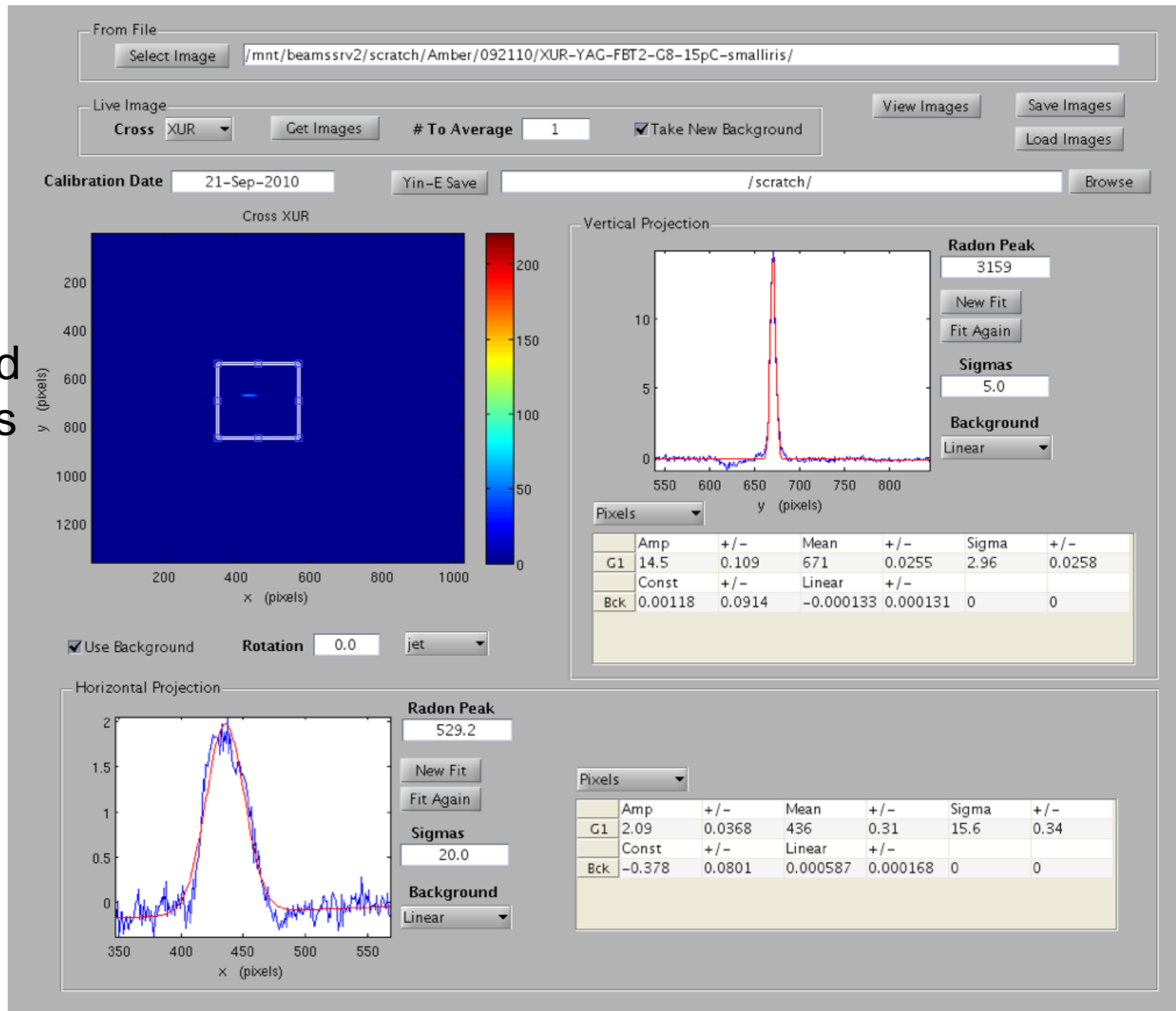
Use Background

Rotation 0.0

jet

Low Charge

We easily measured single bunch beams less than **15 pC** with sigma widths of $\sim 50 \mu\text{m}$.

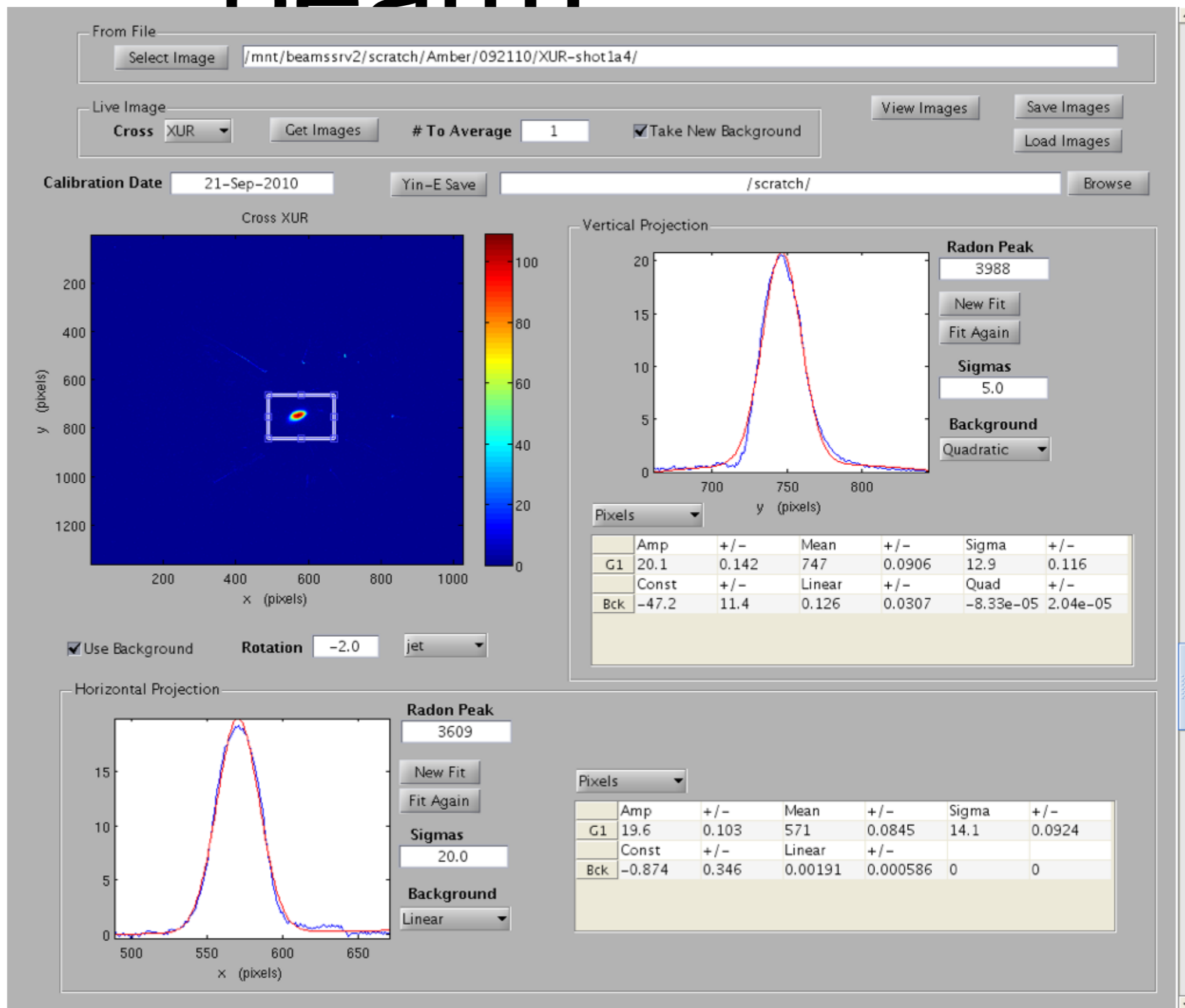


Repeatability (with beam)

2 sets of 5 measurements

- 5 withOUT actuation: $\sim \pm 2$ pixels
- 5 WITH actuation: $\sim \pm 2$ pixels

need to make more measurements just using the LED illumination



Conclusion

- What we DID measure:
 - 46 μm sigma beam
 - 15 pC single bunch
- What we did NOT find:
 - the YAG **saturation** point
 - the OTR **melting** point

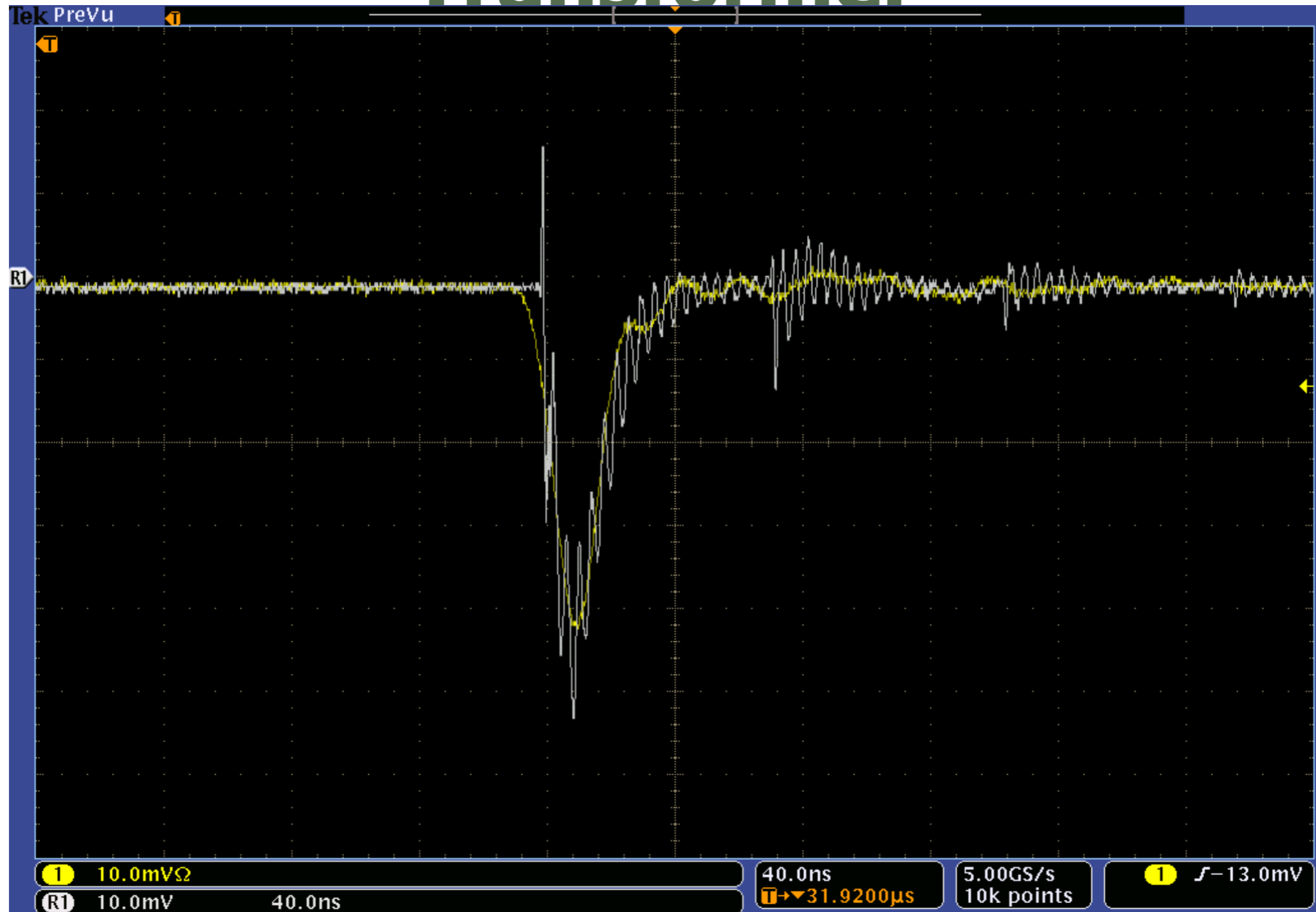
Possible

Improvements

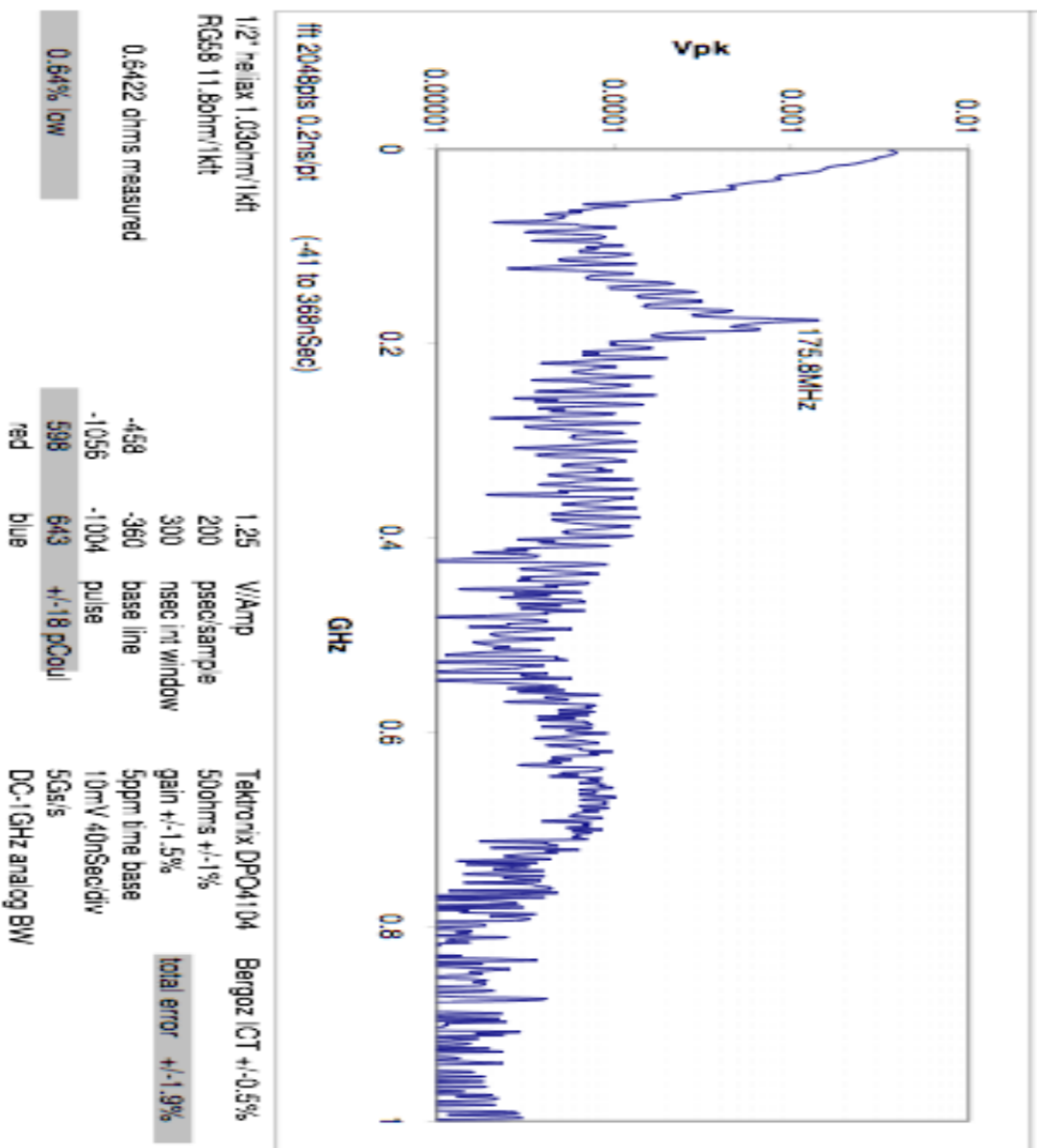
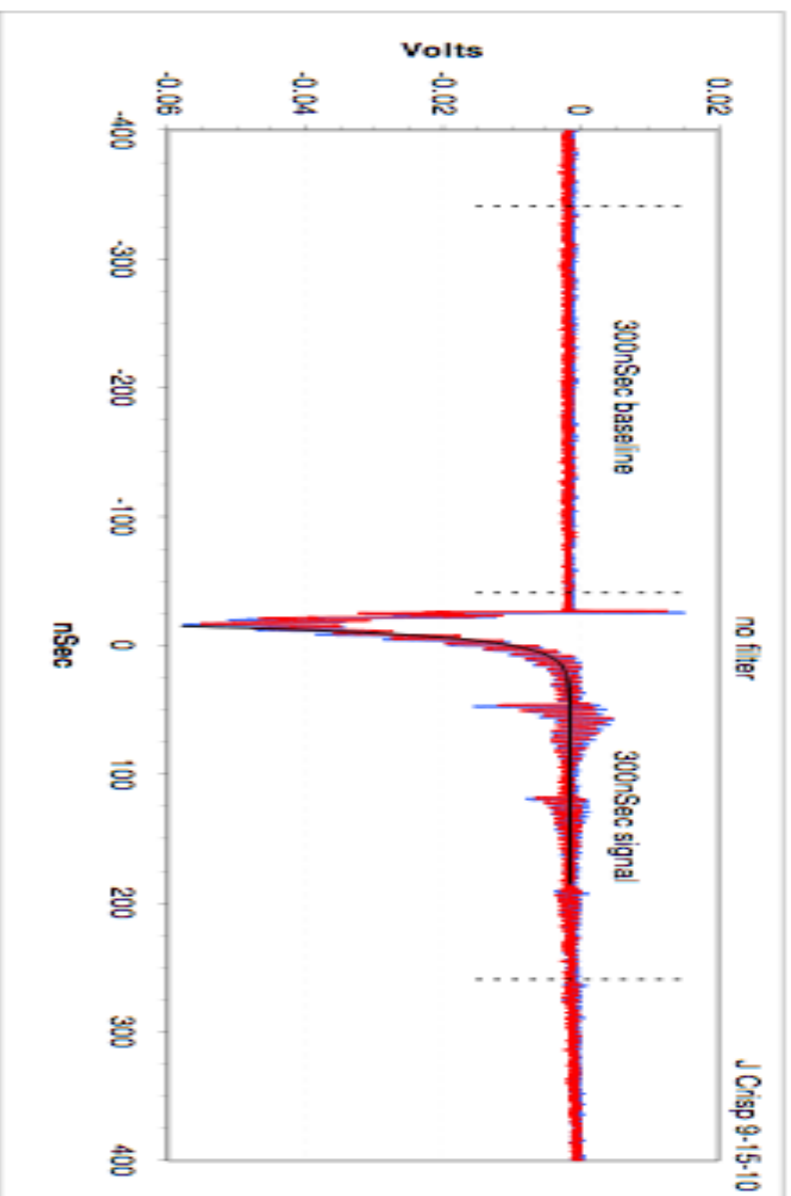
- Replace Virtual Target with 4th position Calibration Target
- Requires binary weighted actuators
- Use annular LED to illuminate Calibration Target or fixed beam splitter with LED
- Zoom lens needs position read back for zoom, aperture, and focus.
- Eliminate bearing over-constraint (use gimbal bearings and relaxed clearance)
- needs to include solenoid & bracket mounted and wired with mounted connector.
- limit switches need to be calibrated and wired with mounted connector
- finger pinch shield needs to be broken up into 3 $2\pi/3$ pieces
- foils need to be delivered mounted and pre-baked.
- Vacuum cross and optical assembly need to be joined with a bolted flange.
- must include an integral ridged backbone
- each cross needs to be delivered as a completely assembled & functional package

Bergoz

In-flange Integrating Current Transformer



Unfiltered Signal



50 MHz Low Pass

