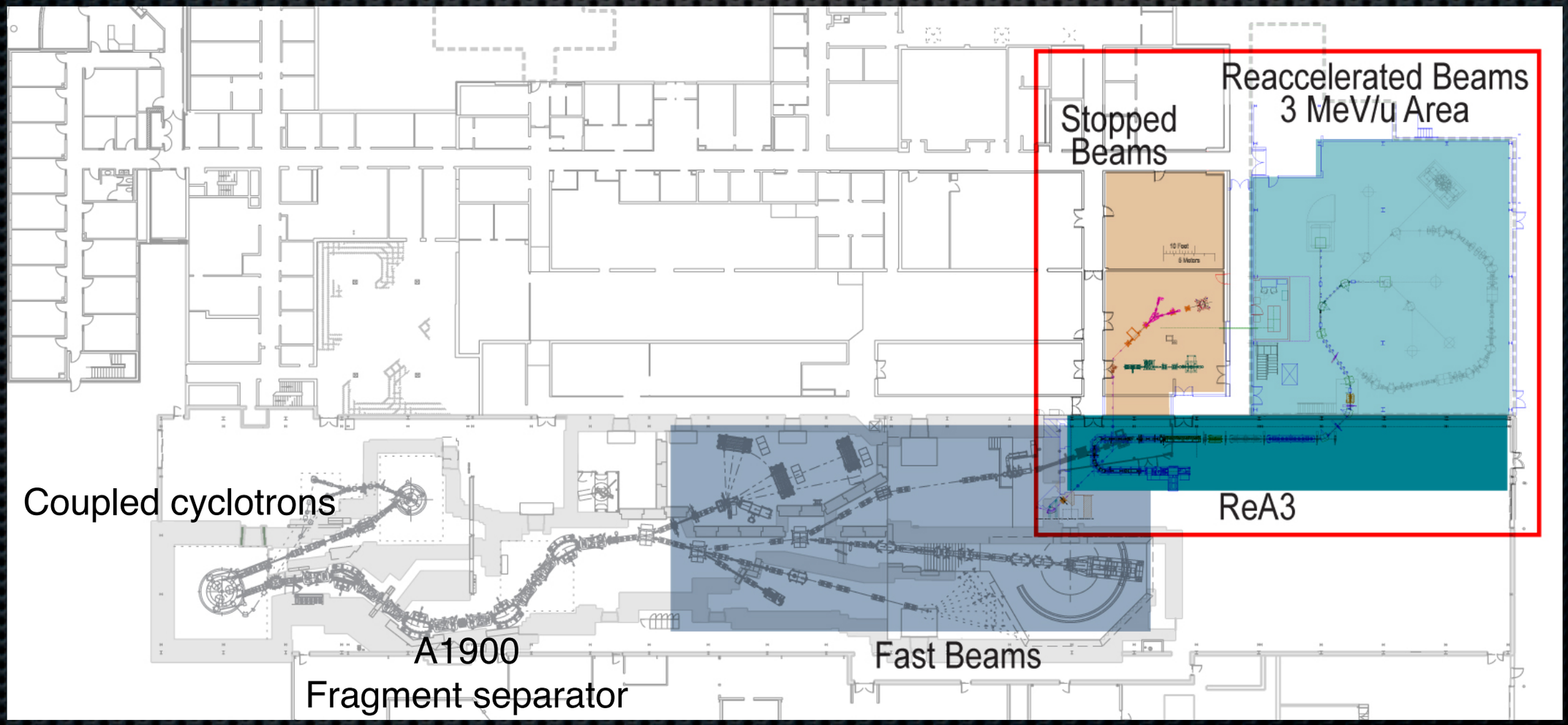
Scintillator screens @ ReA3

George Perdikakis

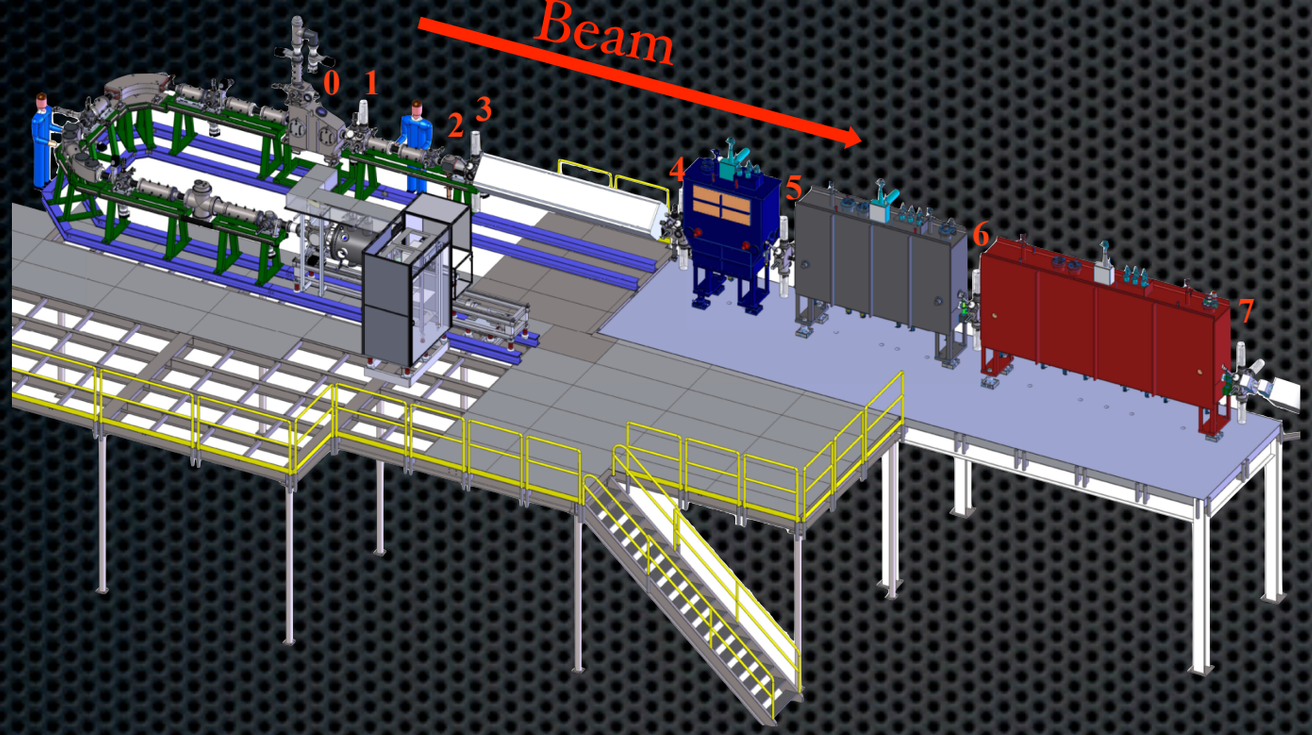
Workshop on Scintillating Screen Applications in Beam Diagnostics
GSI, Germany, 14-16 February 2011

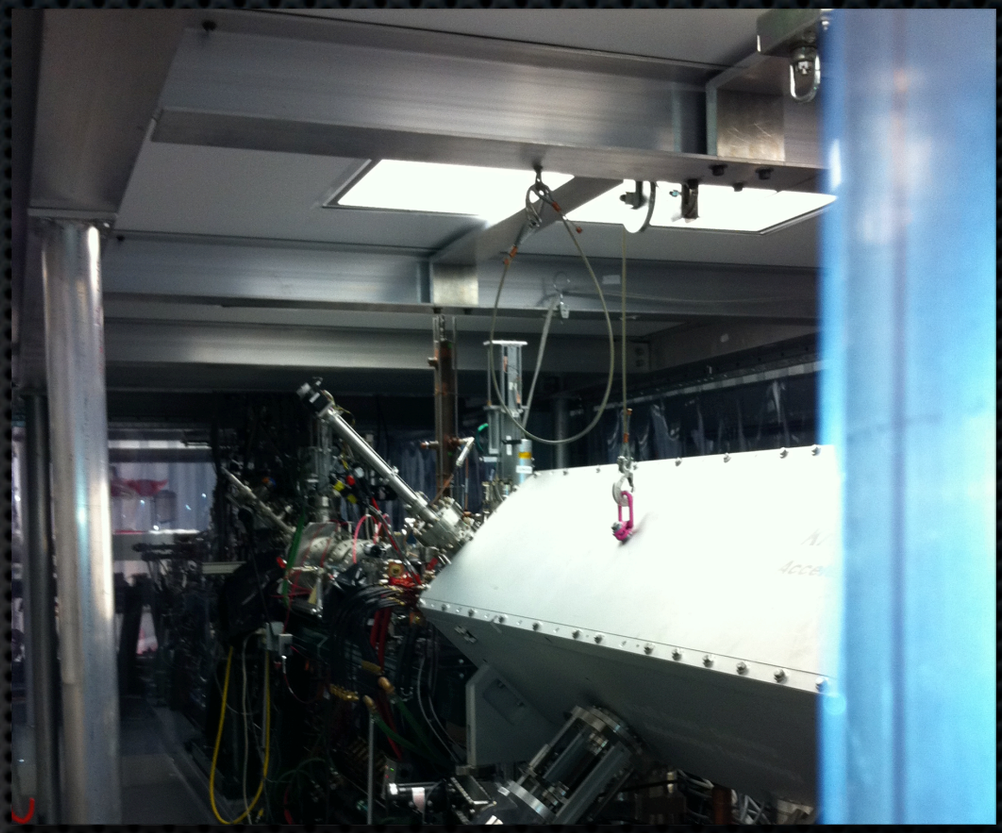
NSCL at Michigan State University

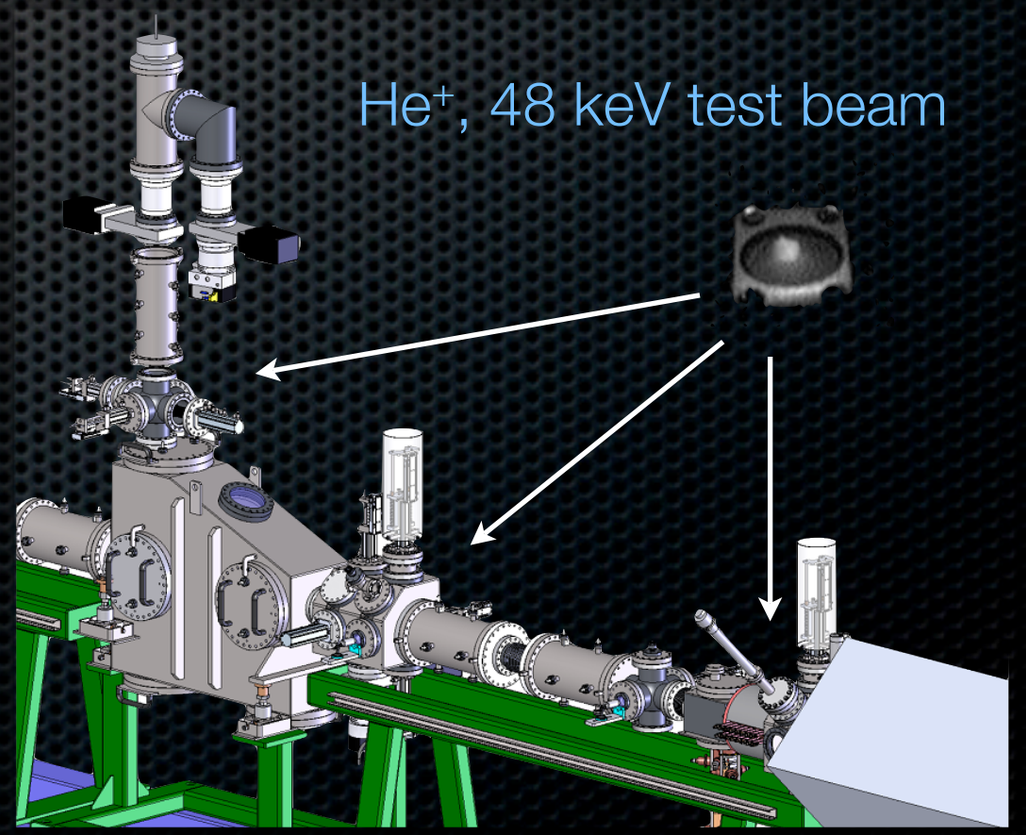


ReA3

Rare Isotope Re-accelerator

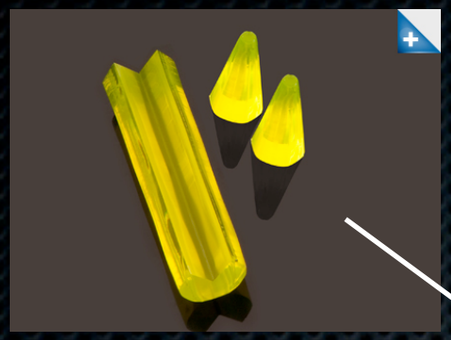


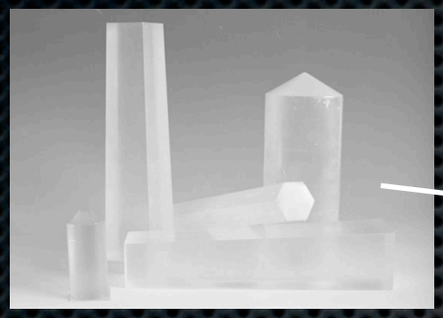




- “High” pilot beam currents ≤ 500pA
- “Low” radioactive beam rates ≤ 10^6 pps
- Ion mass range: ~ 4 ≤ A ≤ 238
- Ion energy: 0.3MeV/u - 6MeV/u

Which viewer?



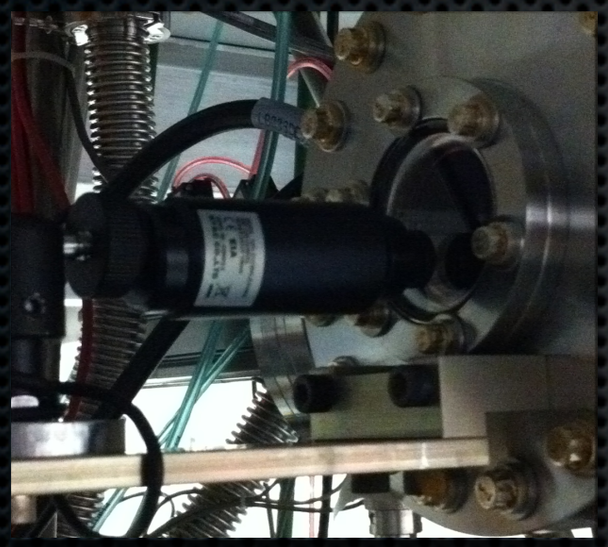


Scintillator	Light Output (ph./kev)	Relative Light Yield (% NaI)	max. Emission Wavelength	Dose after 10min@0.5pA He^+ 48keV
YAG(Ce)	8	21	550nm	57.6MGy
CsI(Tl)	54	45	550nm	40.9MGy
CaF_2(Eu)	19	50	435nm	45.5MGy

Prediction: CsI(Tl) the best choice (?)

Degradation tests

Viewer	Low Current	High Current	Test duration	Comments

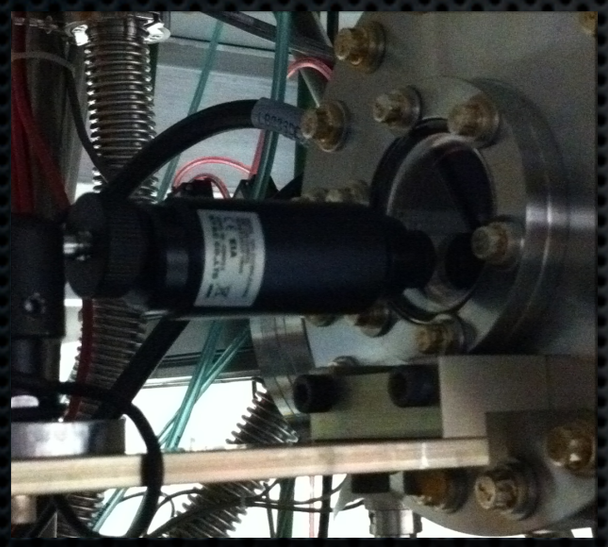


NSCL B&W CCD

- Nominal beam current: ~ 300 pA
- What is the lowest observable intensity?
- Which lasts longer in realistic operations?

Degradation tests

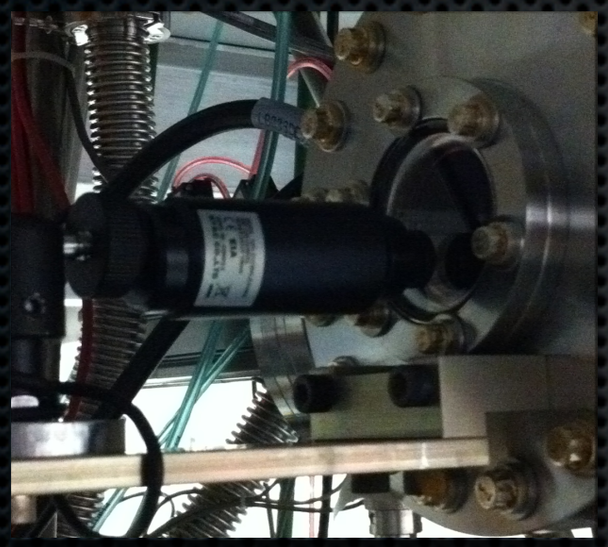
Viewer	Low Current	High Current	Test duration	Comments
YAG(Ce)	200pA		40min	Moderate luminosity



NSCL B&W CCD

Degradation tests

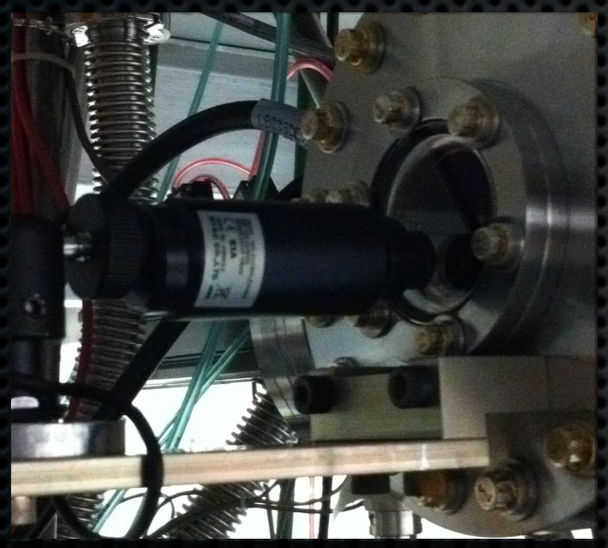
Viewer	Low Current	High Current	Test duration	Comments
YAG(Ce)	200pA		40min	Moderate luminosity
CsI(Tl)	5.9pA	<500pA	~1h	Very high luminosity



NSCL B&W CCD

Degradation tests

Viewer	Low Current	High Current	Test duration	Comments
YAG(Ce)	200pA		40min	Moderate luminosity
CsI(Tl)	5.9pA	<500pA	~1h	Very high luminosity
CaF_2(Eu)	~50pA	>10nA	~3h	Good luminosity Some charging @ 10nA

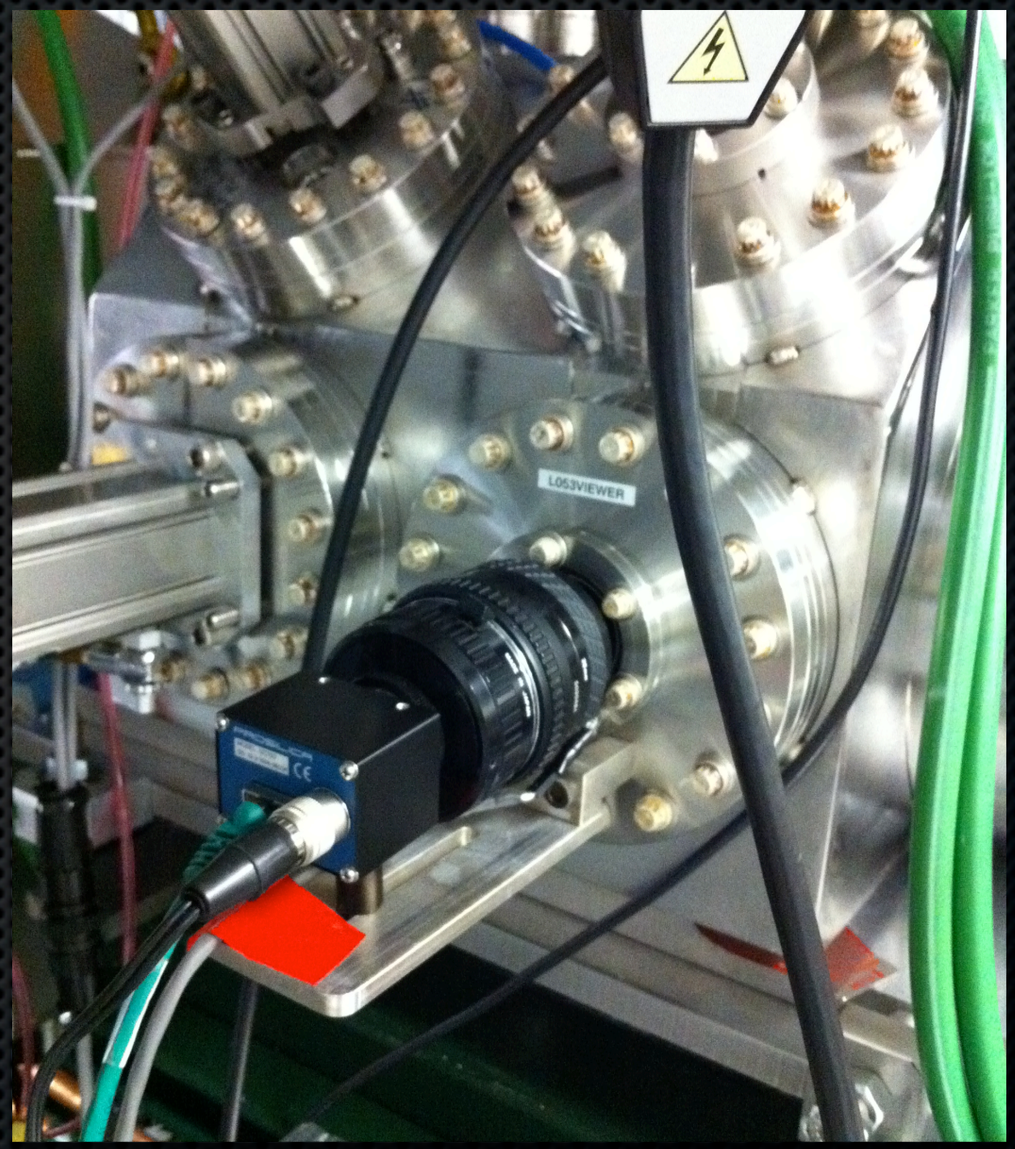


NSCL B&W CCD

CaF_2(Eu) seems the obvious choice.

Quantitative tests

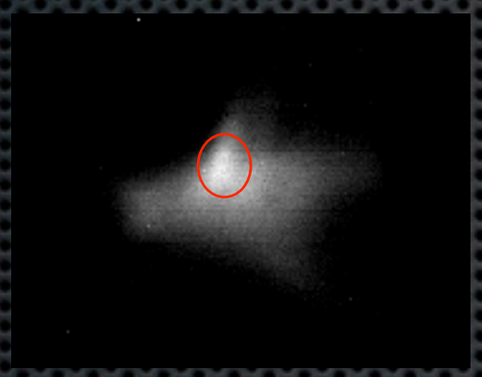
Fixed-gain, fixed exposure CCD camera

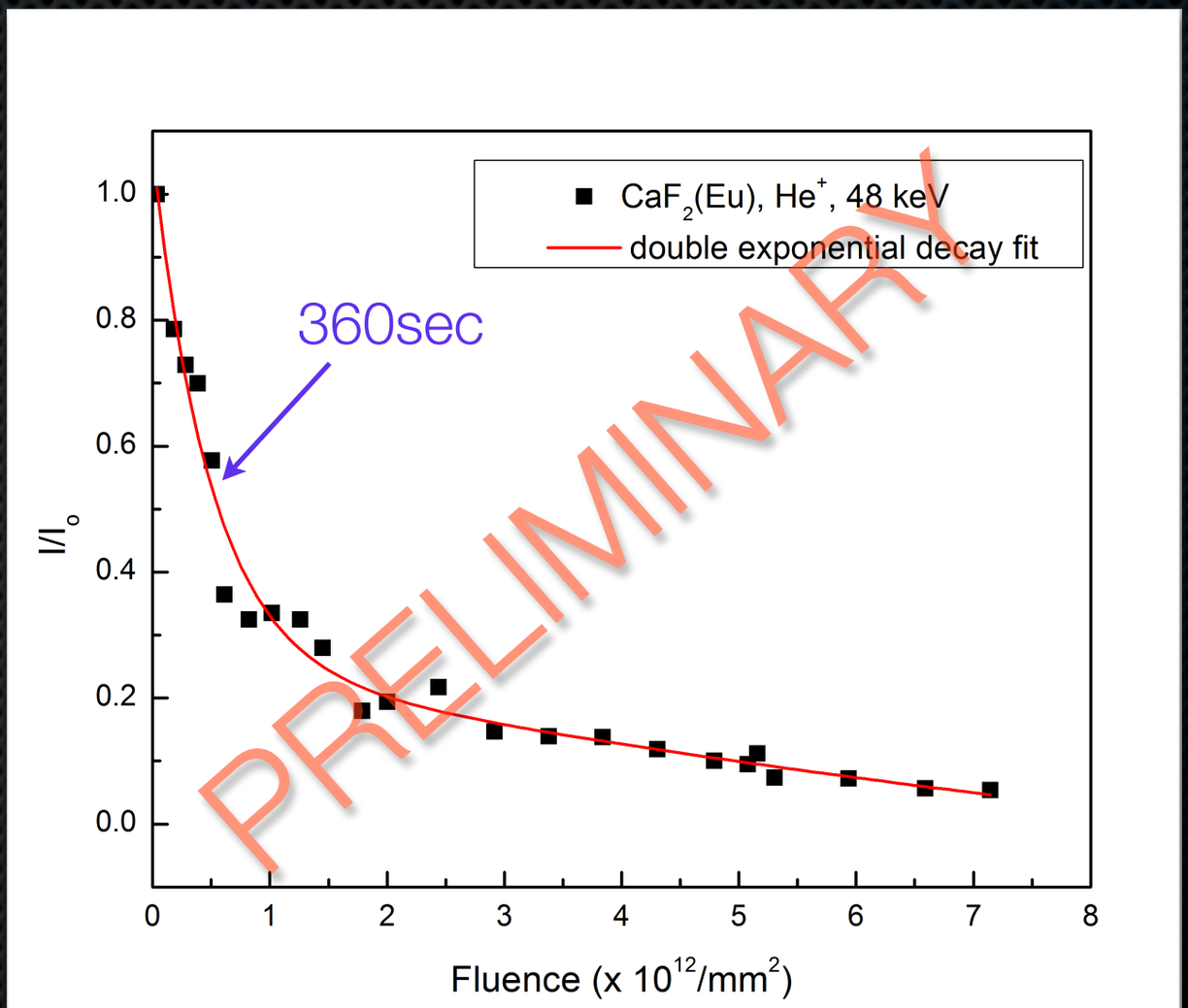


Light Output vs Fluence

1 nA He^+, 48 keV

Test duration: ~5000 sec

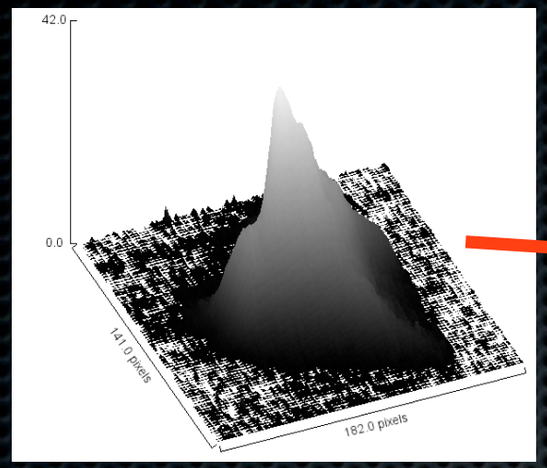


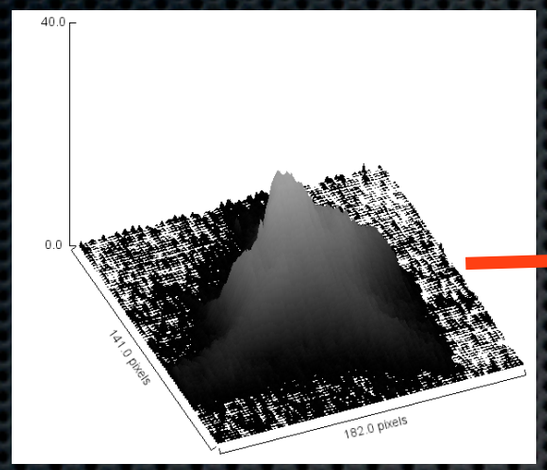


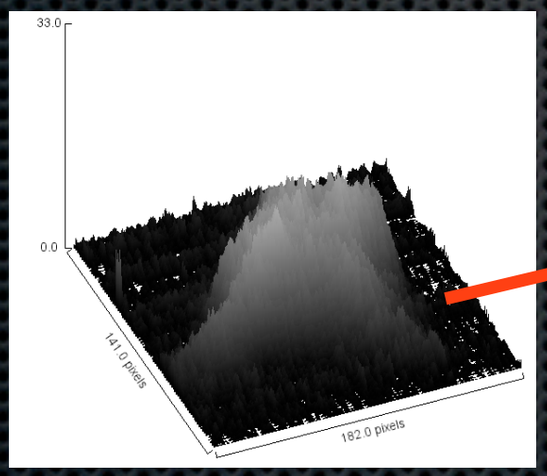
Analysis by Carla Benatti

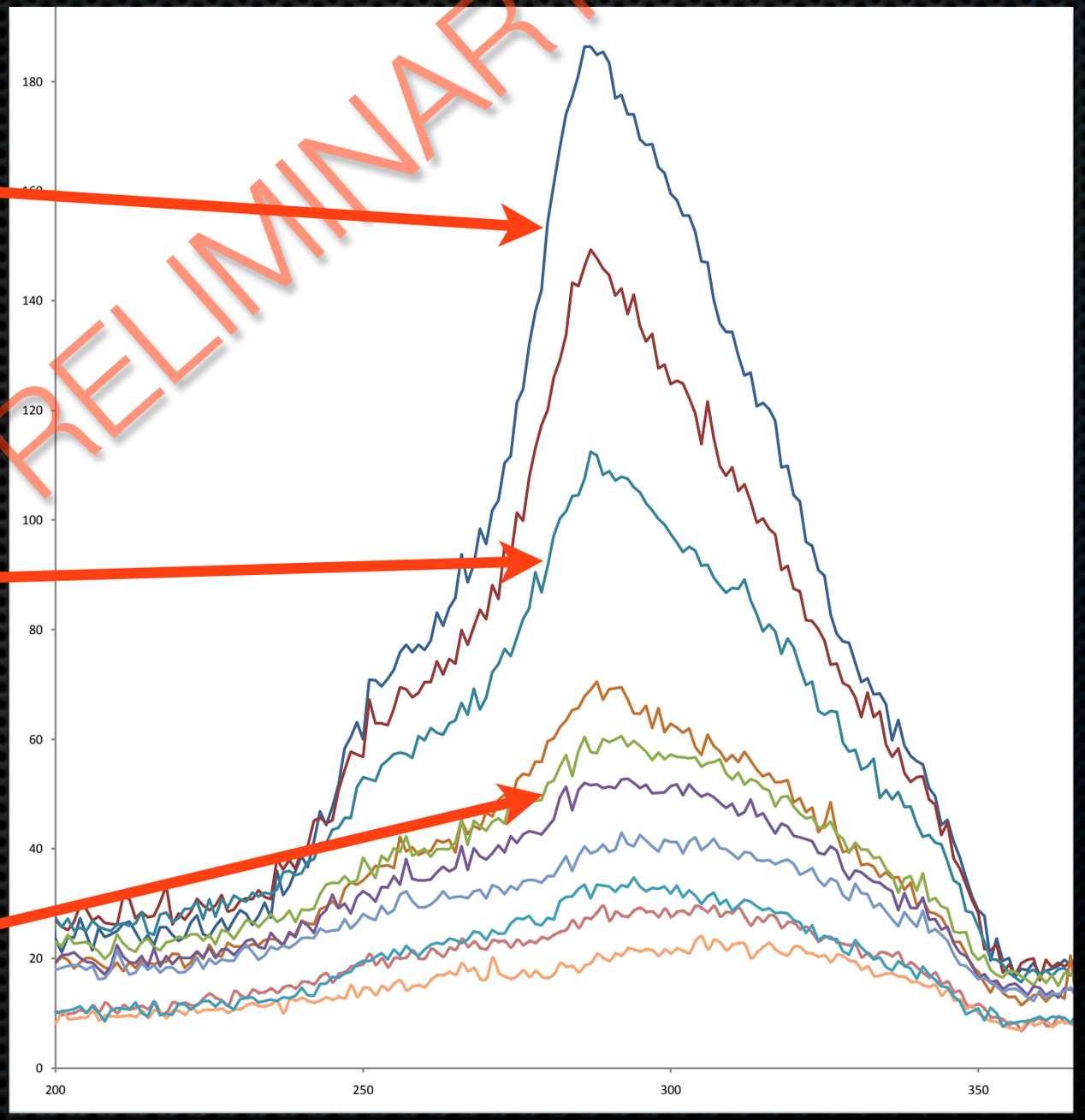
2 - component damage mechanism (fast, slow)

Light Emission Distribution Change









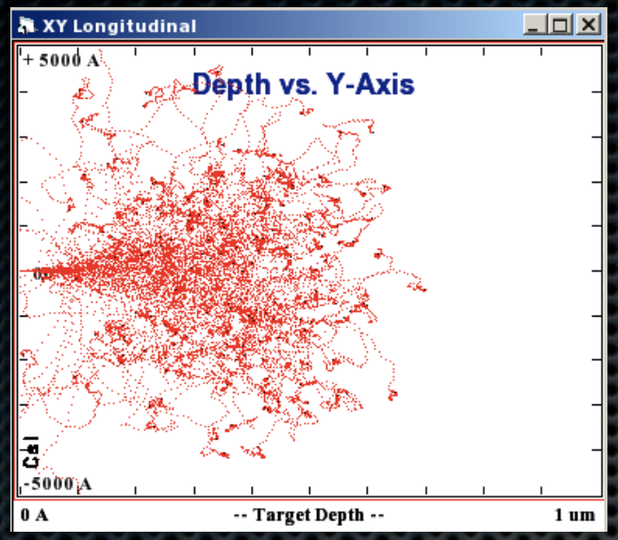
PRELIMINARY

Analysis by Carla Benatti

Crucial for Emittance scanner applications!

Outlook

- Scintillators degrade (faster for low-energy beams)
- We are missing quantitative data of light yield vs dose
- Can we understand (predict) the damage mechanism?
- Calibration procedure for quantitative applications?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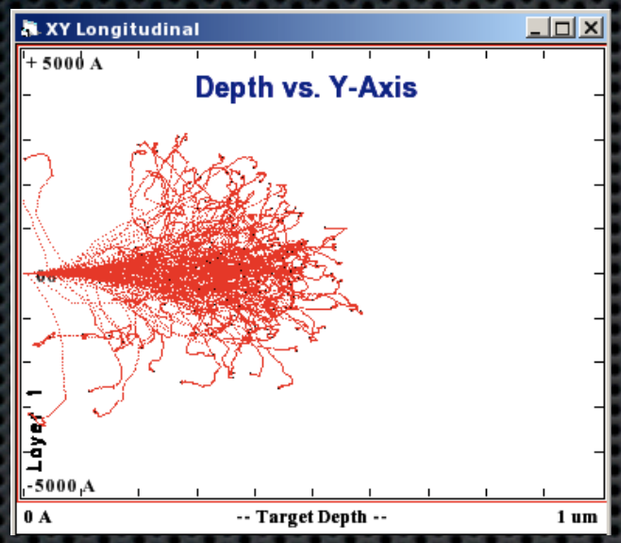
+ 5000 A
Depth vs. Y-Axis
0
Cal
-5000 A
0 A
-- Target Depth --
1 um


XY Longitudinal
+ 5000 A
Depth vs. Y-Axis
0
Layer 1
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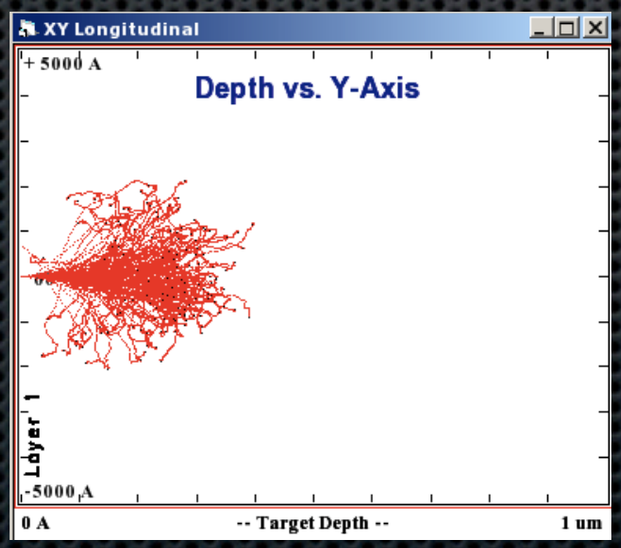
0 A
-- Target Depth --
1 um


XY Longitudinal
+ 5000 A
Depth vs. Y-Axis
0
Layer 1
-5000 A
0 A
-- Target Depth --
1 um