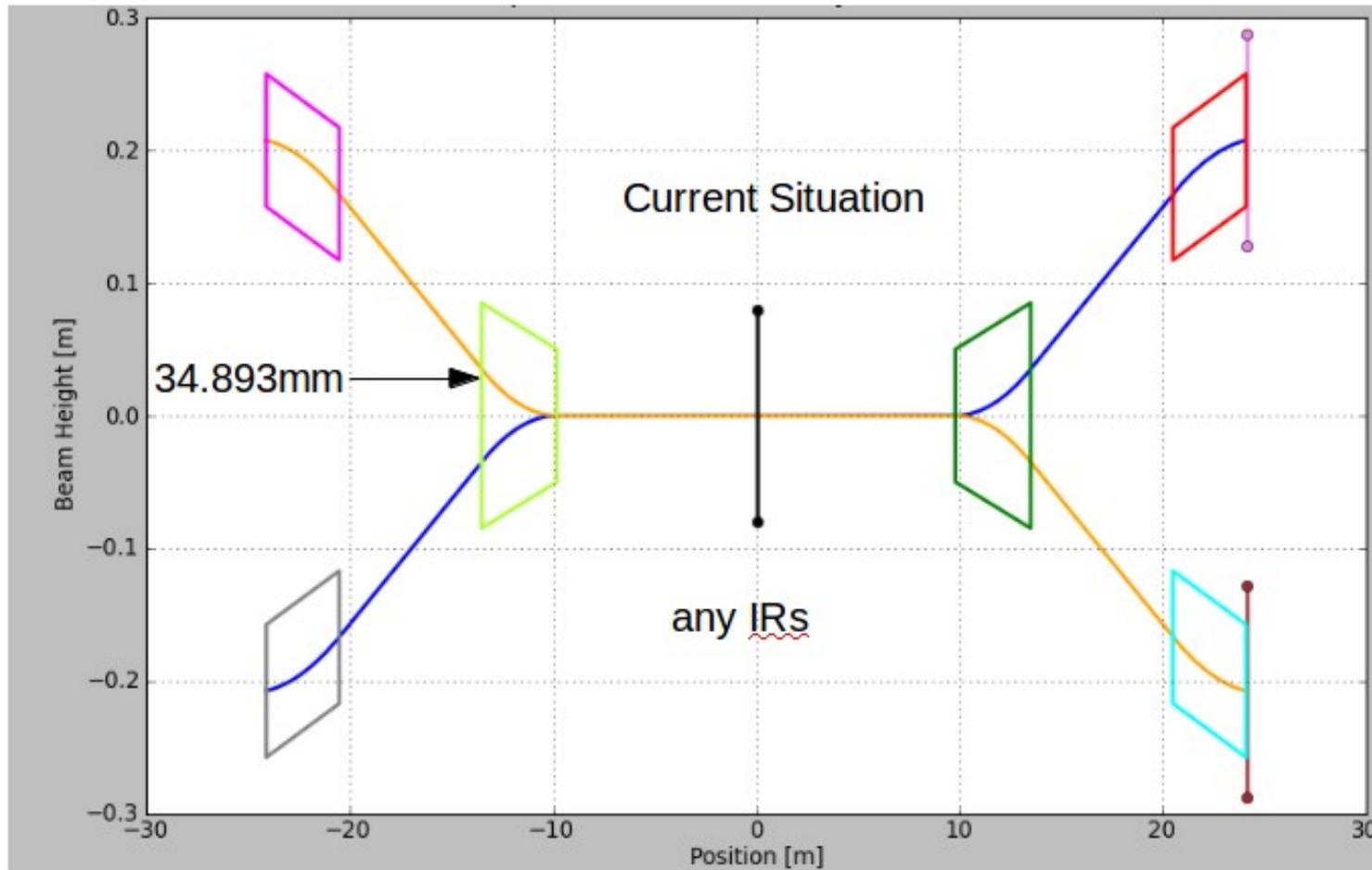


DX Physical Aperture Measurement

Al, Mei, Simon, Steve, Yun

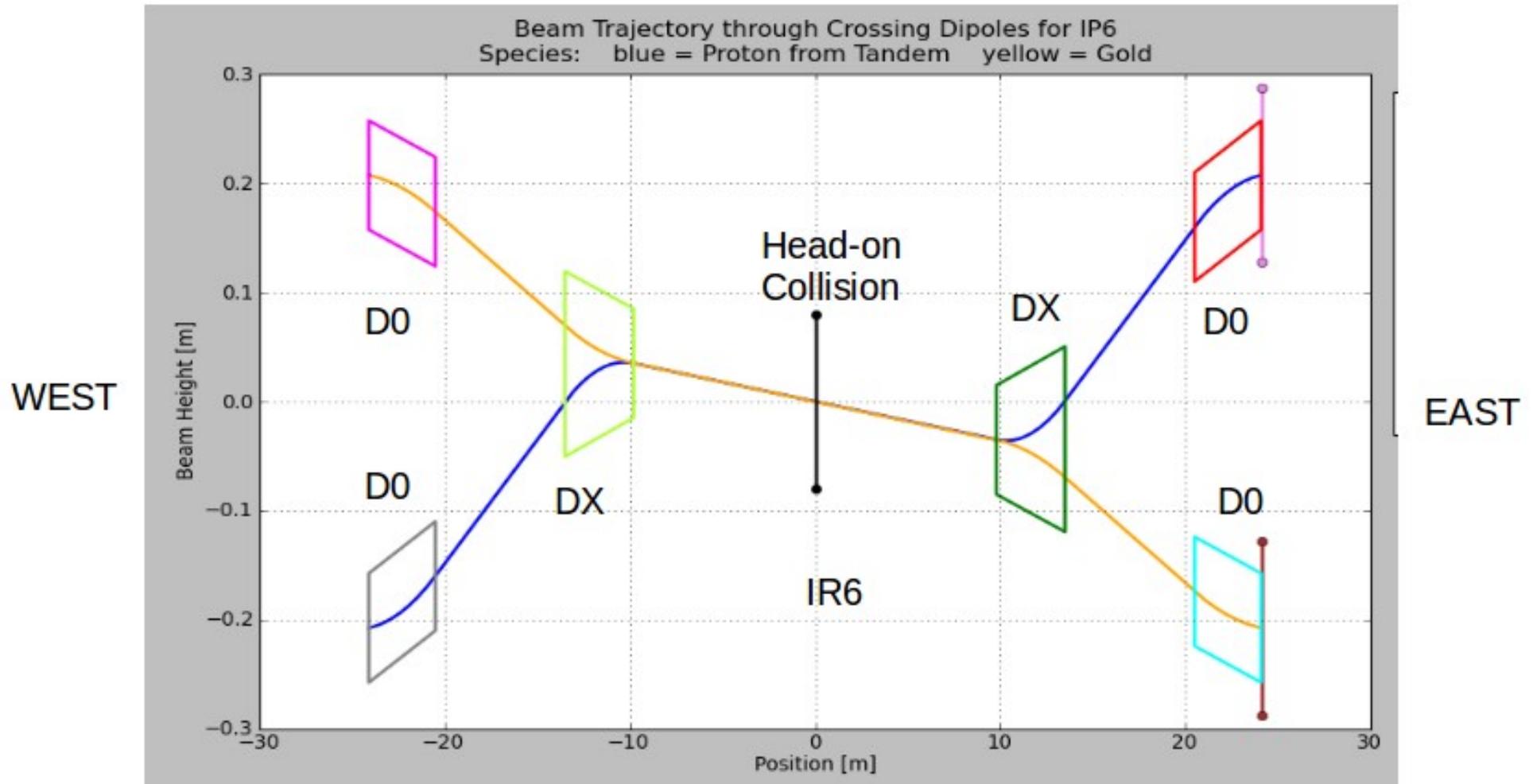
2014 March 26, APEX

Same Specie & Same Energy



- 1) For the same species and energies, no orbit tilt between DX magnets.
- 2) At exit of DX magnets, orbits offset by 34.893mm from the pipe axis.
- 3) **The physical aperture at DX magnets is 68.326mm.**

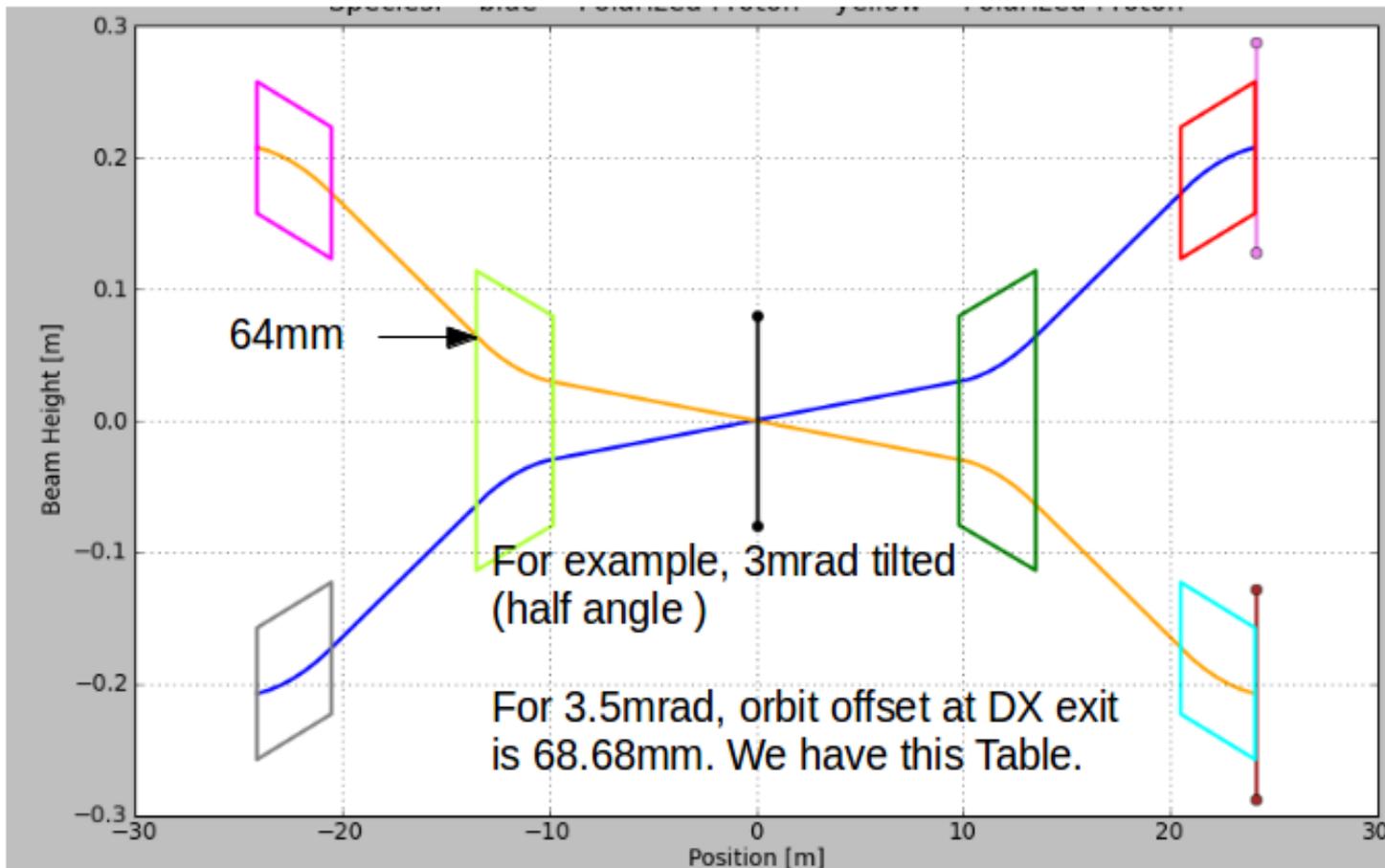
p-Au Collision



- 1) Beam orbits tilted by 3.581mrad w.r.t. The beam pipe axis.
- 2) p beam: 35.09 and 0.424 mm on both ends of DX magnets.
- 3) Au beam: 35.09 and 69.303 mm on both ends of DX magnets.

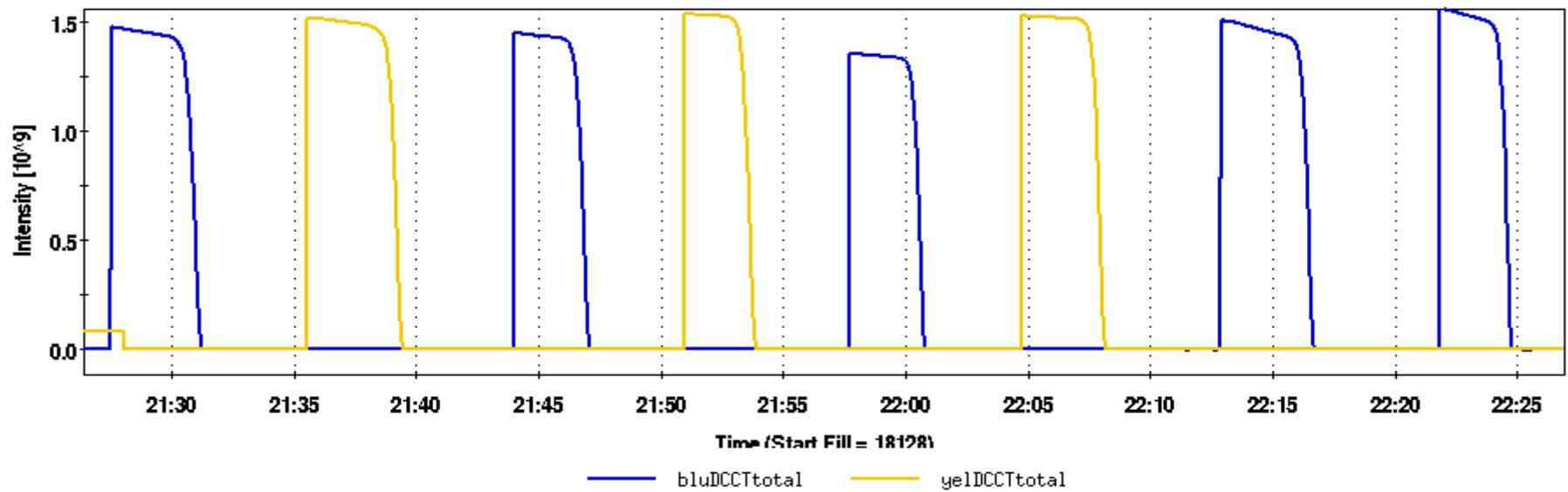
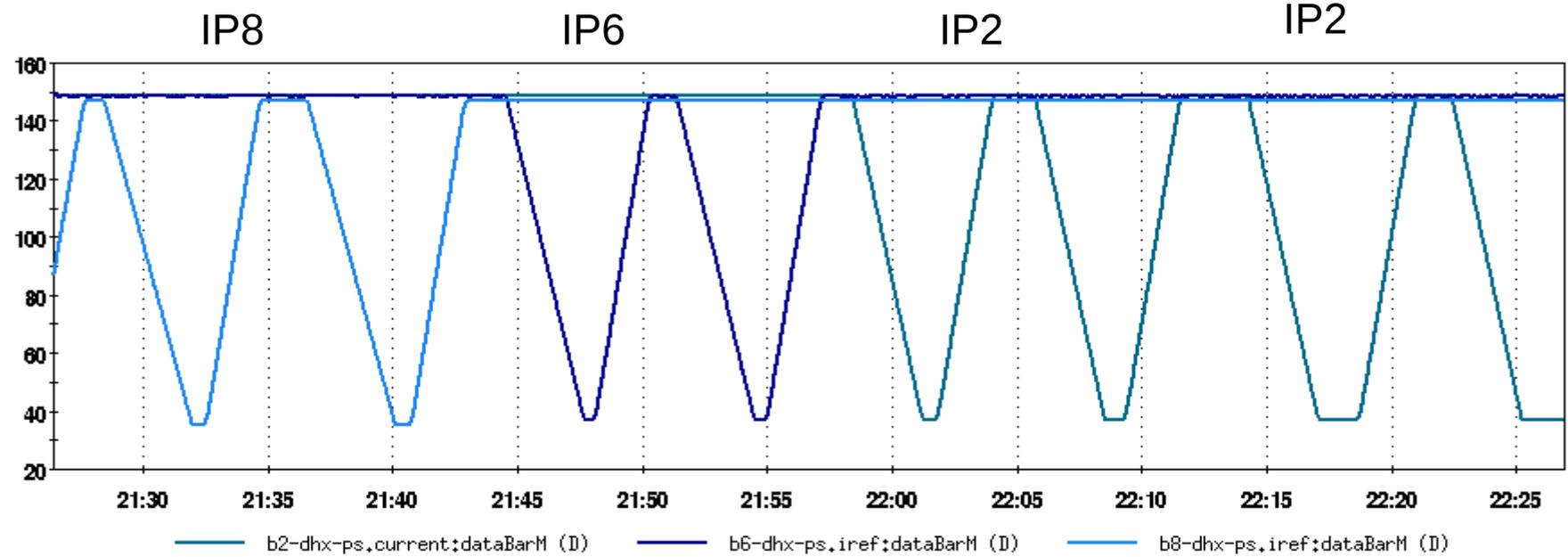
Beam Experiment

- 1) Calculate settings of DX and D0 for a tilt angle or a known orbit offset at DX exit.
- 2) Set these strengths into machine and measure the beam decay.
- 3) Increase the angle until a huge beam loss is observed.
- 4) Determine the minimum distance between the beam center and the pipe wall offline.

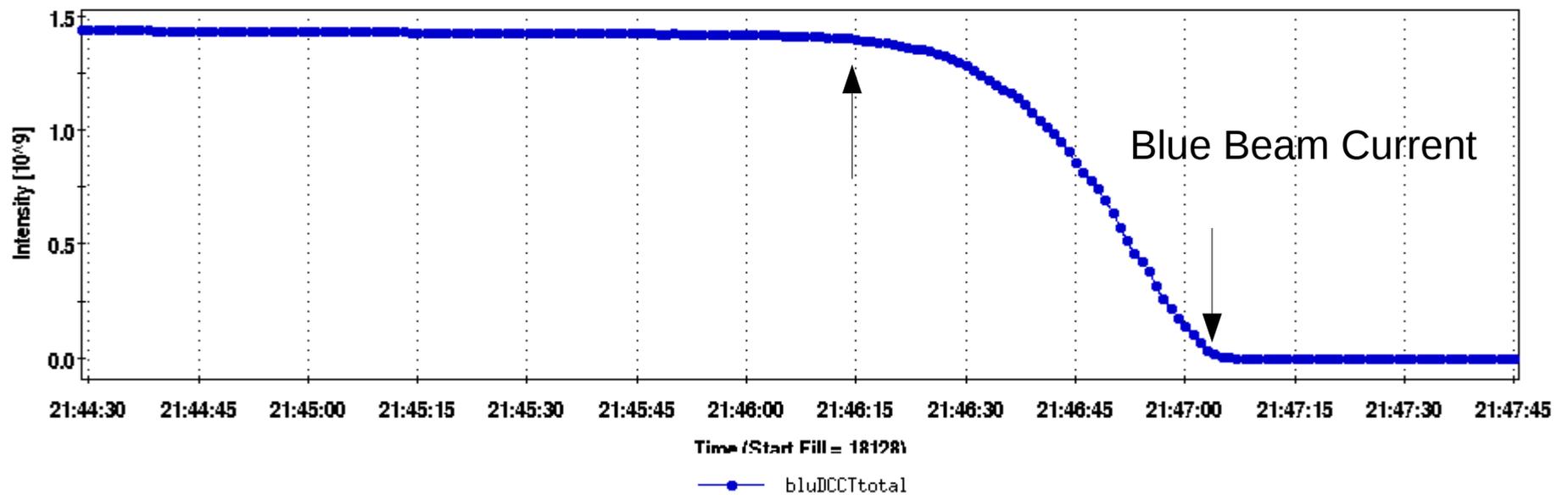
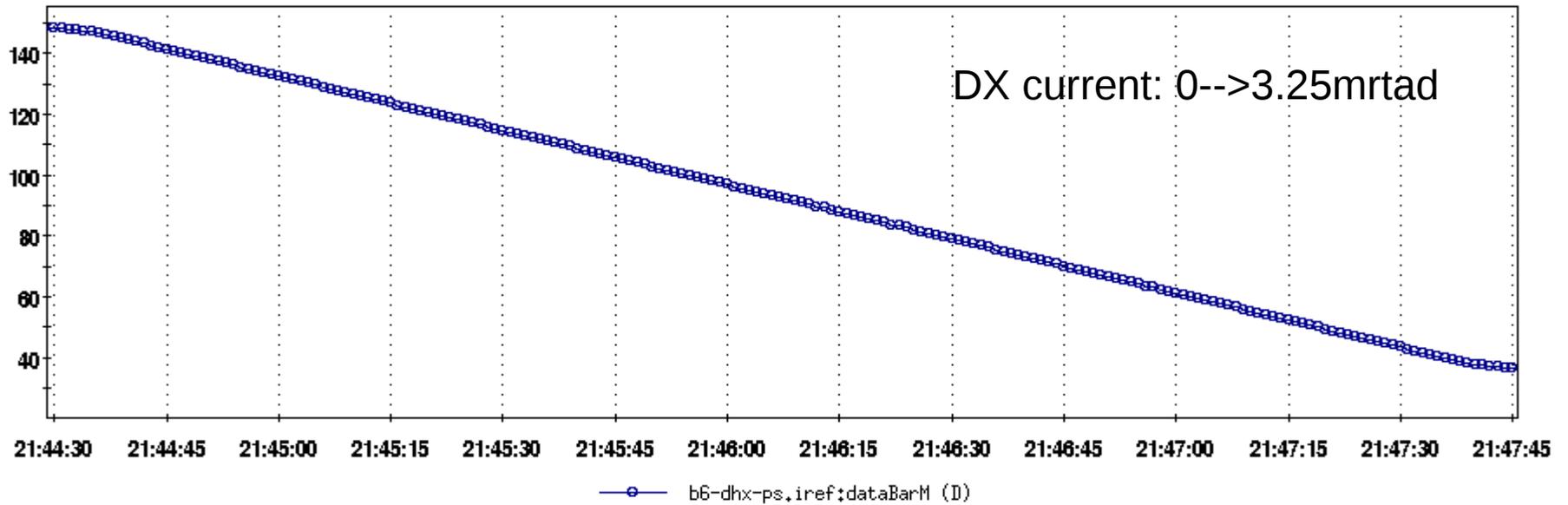


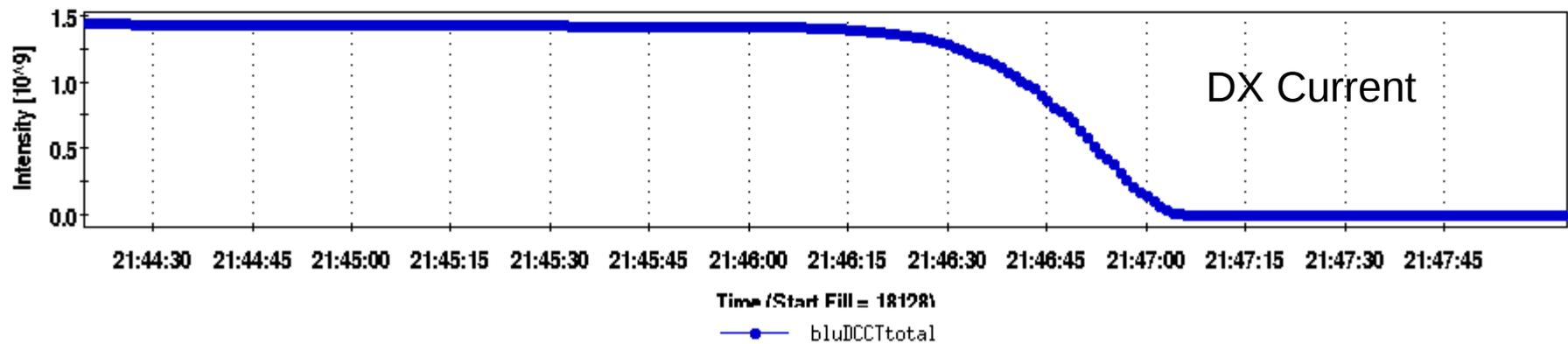
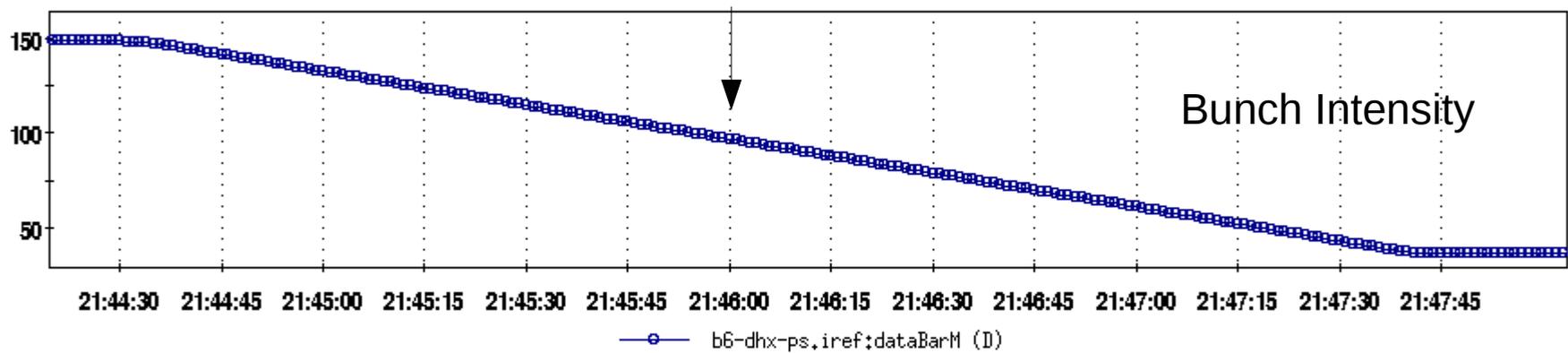
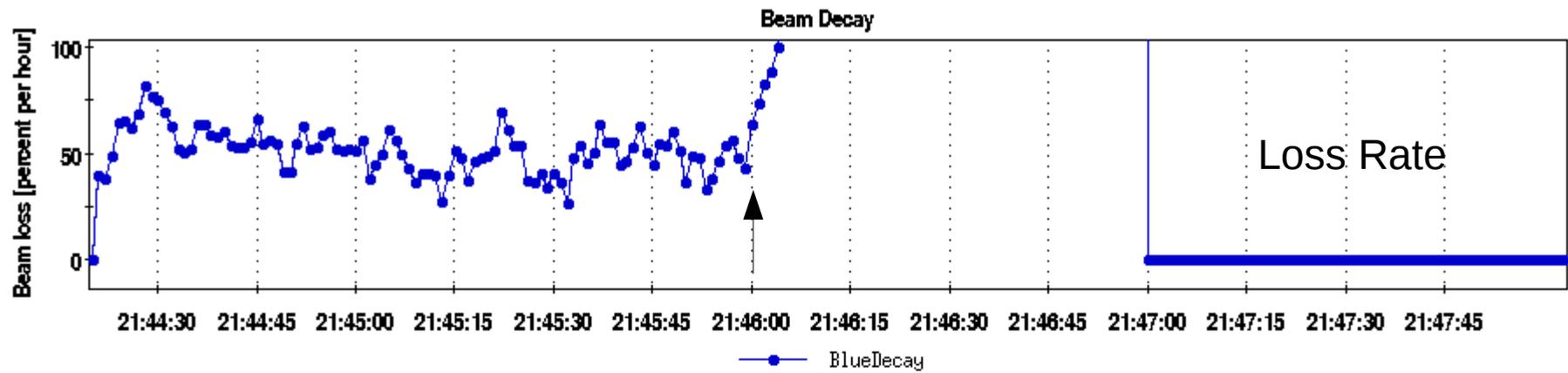
Data Taken

Fill# 18128



Zoom In





Summary & Plan

1. Full sets of data taken at injection

Measurement done at injection after a dipole QLI

2. Detailed data analysis is under way

likely beam began to loss at 1.6mrad (half of maximum)

3. May repeat this experiment once

→ one confirmation at injection

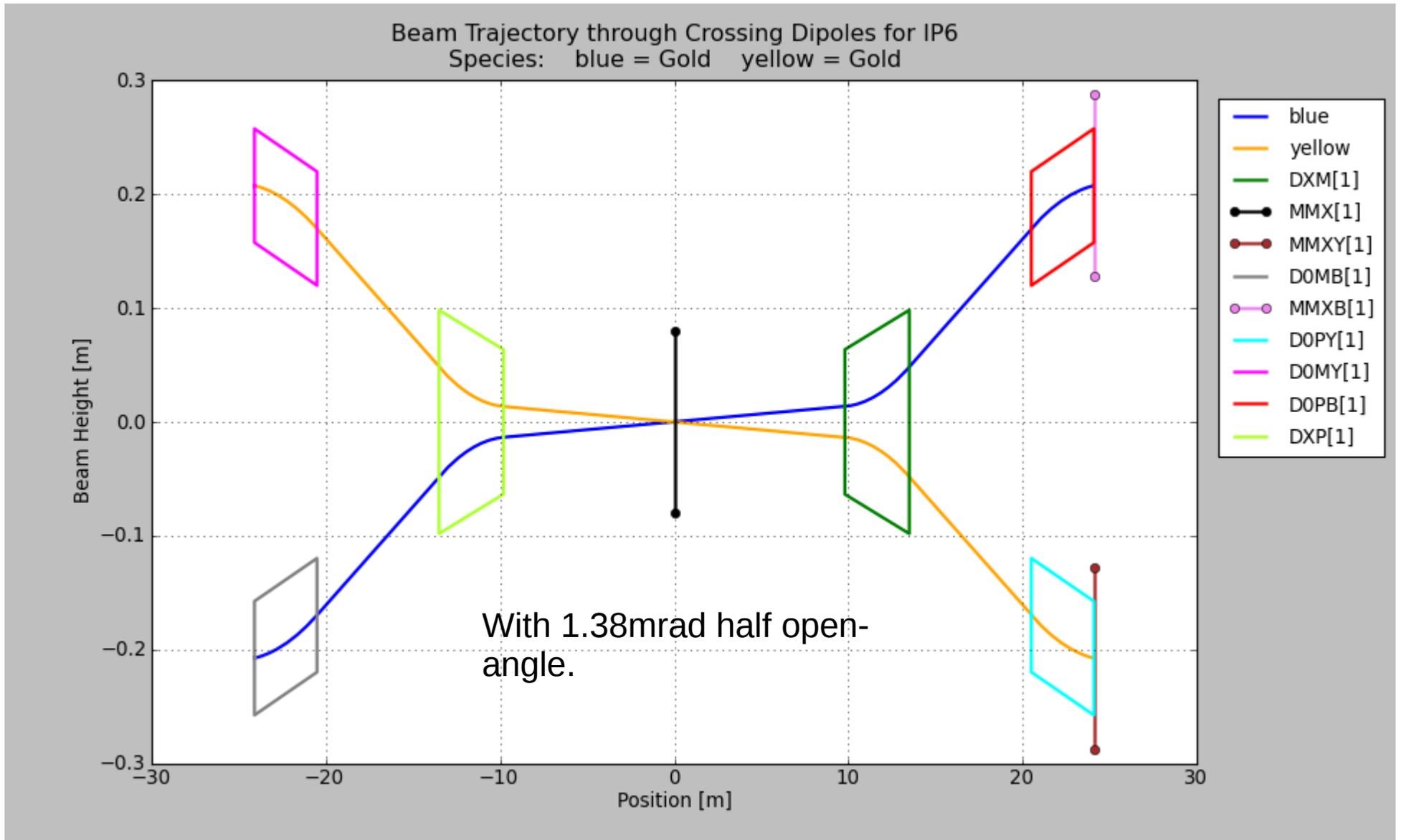
→ one confirmation at store

Appendix: Fine Data Analysis

IR	DX Max Current (A)	DX Min Current (A)	Blue Loss begin (A)	Yellow Loss Begin (A)	Orbit Angle w.r.t. axis (mrad)
IR8	146.66	35.10	97	→	1.45
				98	→
IR6	148.37	36.69	98	→	1.47
				101	→
IR2	148.87	37.12	93	→	1.62
				97	→

0 rad 3.25mrad

Discussion



blue		yellow				
Element	Occurance	Type	Position [m]	Height [m]	Angle [rad]	Path Length [m]
Start	0	Marker	-24.094351	0.207479	-0.003675	0.000000
D0MY	1	Dipole	-20.505647	0.169750	-0.017352	3.588930
OOO	1	Drift	-13.500000	0.048178	-0.017352	10.595633
DXP	1	Dipole	-9.800000	0.013524	-0.001380	14.295834
OOX	1	Drift	0.000000	-0.000000	-0.001380	24.095843
MMX	1	Marker	0.000000	-0.000000	-0.001380	24.095843
OOX	2	Drift	9.800000	-0.013524	-0.001380	33.895853
DXM	1	Dipole	13.500000	-0.048178	-0.017352	37.596054
OOO	2	Drift	20.505648	-0.169750	-0.017352	44.602757
D0PY	1	Dipole	24.094352	-0.207479	-0.003675	48.191687
MMXY	1	Marker	24.094352	-0.207479	-0.003675	48.191687

With 1.38mrad half open angle, the beam center is 48.18mm from axis, or 20.14mm away from DX beam pipe (68.32mm).

Assuming at injection:

$$\text{Emit} = 12 \text{ Pi.}$$

$$\text{Beta}_x \text{ at DX exit is: } 10 + 13.5 * 13.5 / 10 = 28.225$$

1 sigma beam size at DX exit is:

$$1 \text{ sigma} = 2.4 \text{ mm}$$

Beam center at 20.14 from the beam pipe wall at DX :

$$20.14 / 2.4 = \mathbf{8.4 \text{ sigma} .}$$

Interruption:

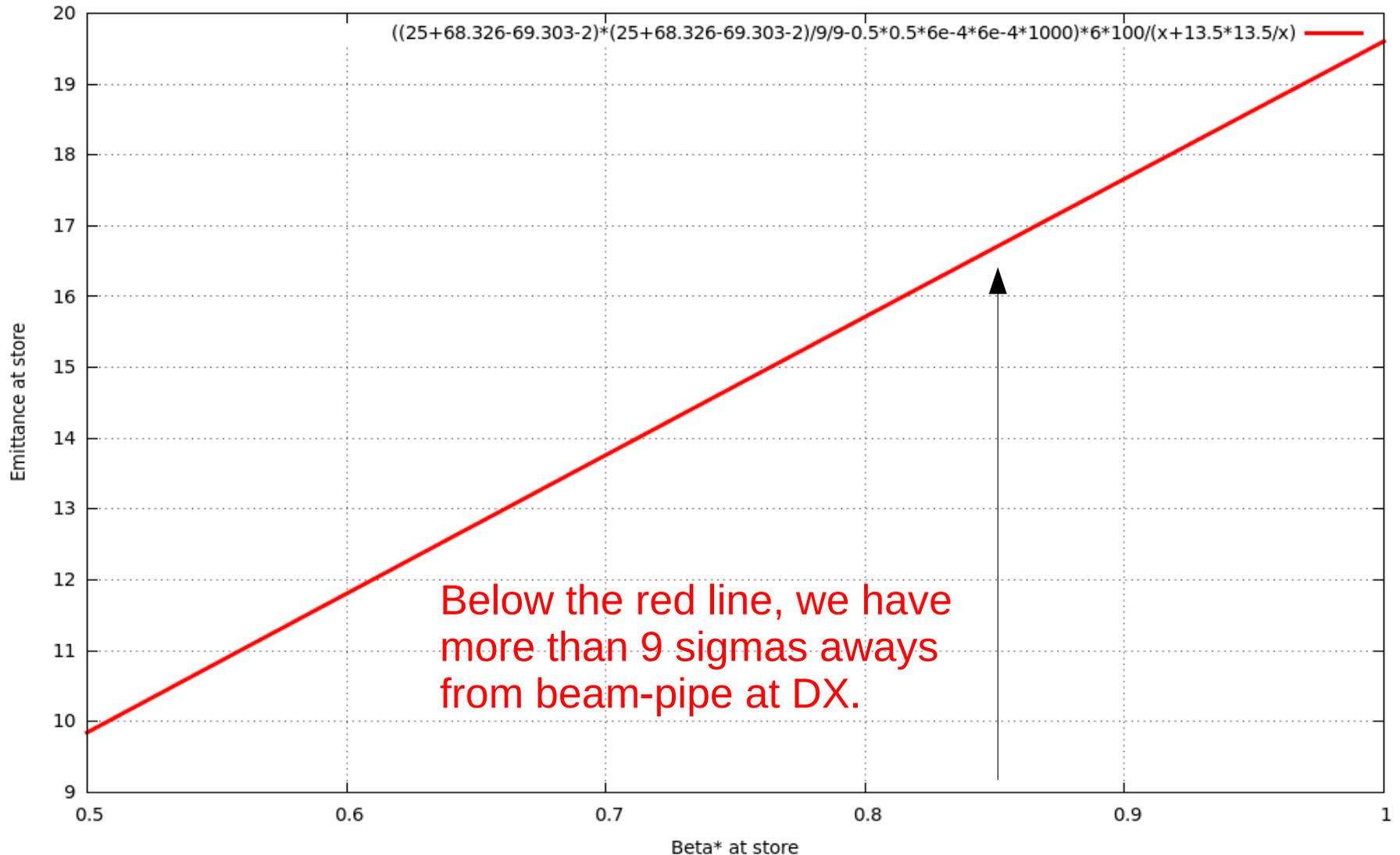
Run13 DX physical aperture measurement with position IR bump

Summary

- With run12 Blue ring lattice, we measured maximum beam center offsets are (-53mm,55mm) at IR12, (-53mm, 54mm) at IR2.
- The beta*s at IP12 and IP2 are 10.31m and 10.07m. The beta at the exit of DX is (28+/-0.2)m.
- One transverse rms beam size (1 sigma) was 1.66mm, with 15Pi mm.mrad 95% transverse emittance.
- The beam pipe radius at DX is 68.326mm. There were (68-54) = 14mm from the beam center to the wall, which corresponds ~8.5 sigmas.

8.5 sigmas

If DX magnet movement aways from beam pipe axis by 2.5 cm and beam center should be 9 sigmas aways from beam pipe wall



Closing This Experiment

- 1) The minimum distance between the beam pipe at DX and the beam center was measured through different way. Current method by adjusting DX and D0 strengths to generate a real tilt angle is more convincing.
- 2) Experiment results show that if the beam center is away from beam pipe by 8.5σ , the extra beam loss can be tolerated.
- 3) In the p-Au run, by moving DX magnets off from axis by 2.5cm, there is enough space to hold the beams with 3.58mrad common half orbit tilt angle.
- 4) The plot of emit vs. β^* shows that we could have β^* for p-Au run 0.85m, with maximum emittance at store 16 Pi for Au beam. From 2014 Au-Au run, at beginning it was 15 Pi mm.mrad .