

TASCA separator - first test with ^{30}Si beam

Main tasks:

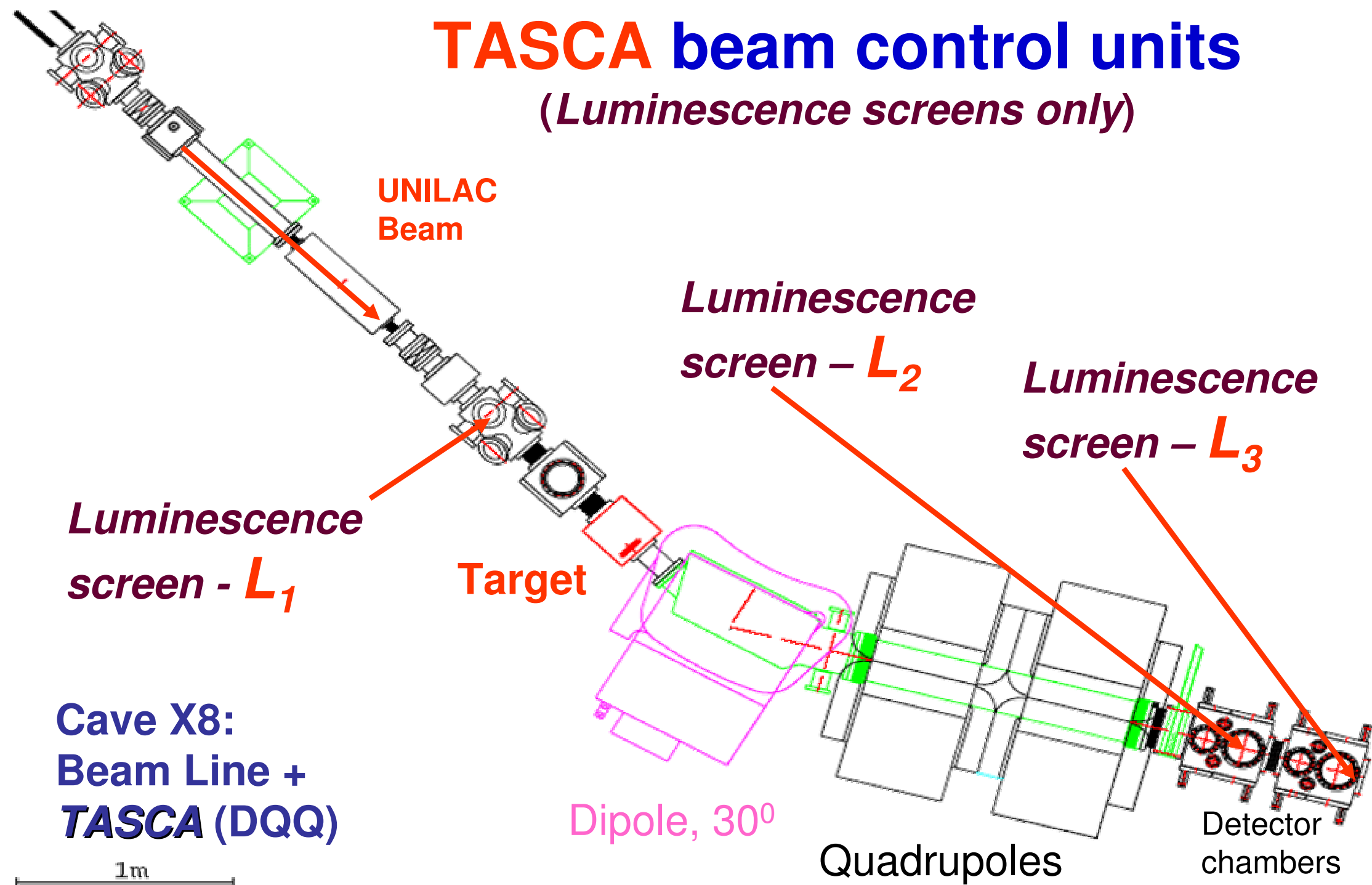
1. First transmission of the beam through TASCA
2. Comparison experimental results with KOMPOT model calculations
3. Study of ion-optical parameters of Large Transmission and Small Image size modes of separator:
 - horizontal and vertical magnification
 - momentum dispersion
 - momentum acceptance
4. Comparison with TRANSPORT calculations
5. Test of first version of Power supply control system

Main parameters of beams:

Parameter	First test	Second test
Particle	^{30}Si	^{30}Si
Energy	7.7 MeV/u	5.45 MeV/u
Total kinetic energy (TKE)	230.8 MeV	163.4 MeV
Charge state from accelerator	6 +	6+
Rigidity	2 Tm	1.7 Tm
Horizontal size in the target position	6 mm	6 mm
Vertical size in the target position	6 mm	6 mm
Maximum possible angular spread	< 3 mrad	< 3 mrad
Thickness of the Carbon foil	-	52 $\mu\text{g}/\text{cm}^2$
Total kinetic energy	-	162.8 MeV
Rigidity	-	1.68 Tm (6+)
Charge states	-	12+, 11+, 10+, 9+

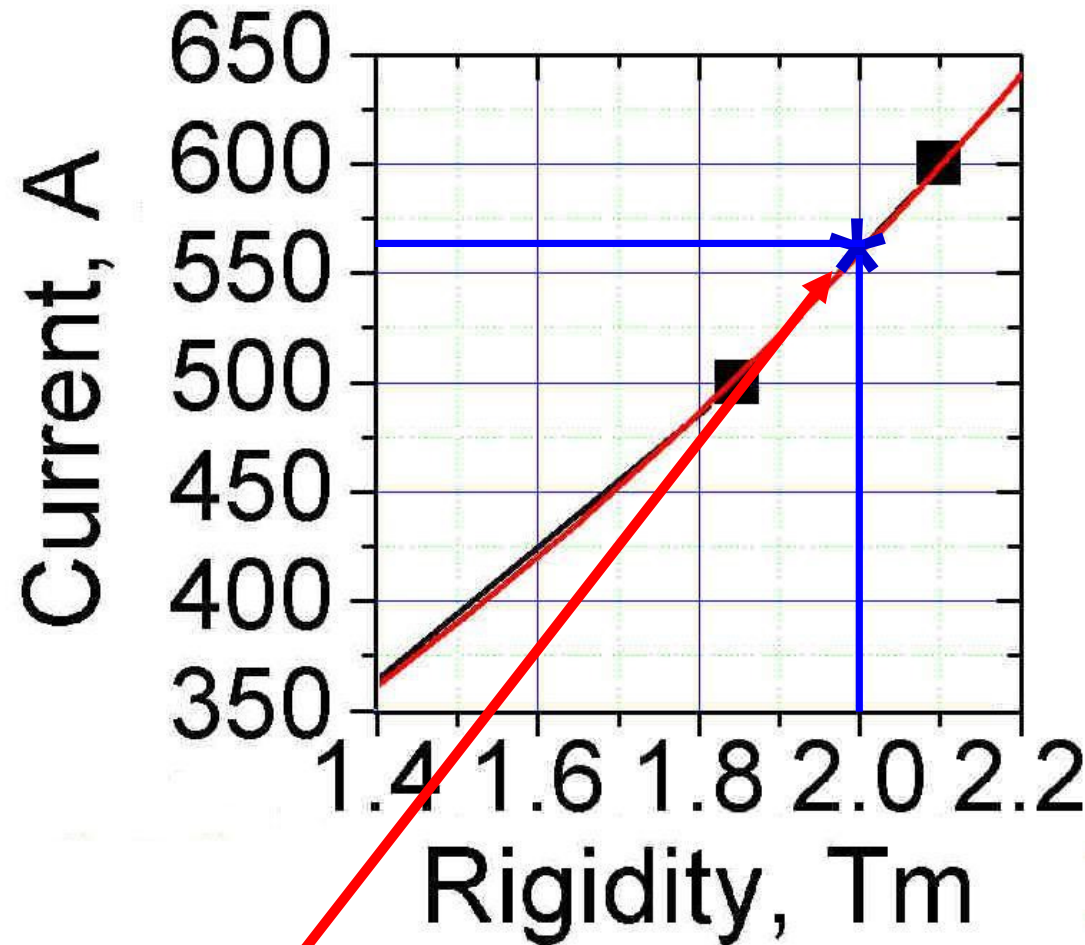
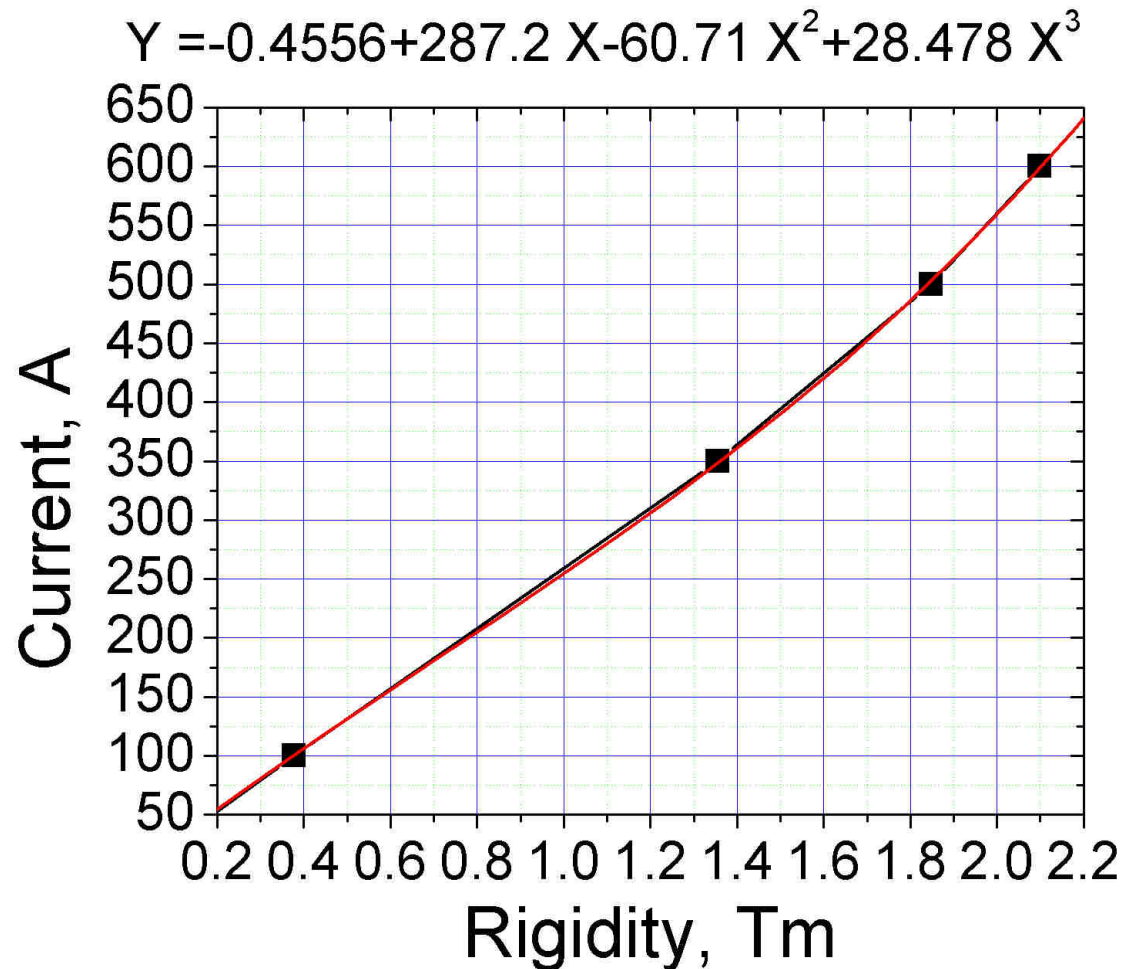
TASCA beam control units

(*Luminescence screens only*)



TASCA test study with the ^{30}Si beam

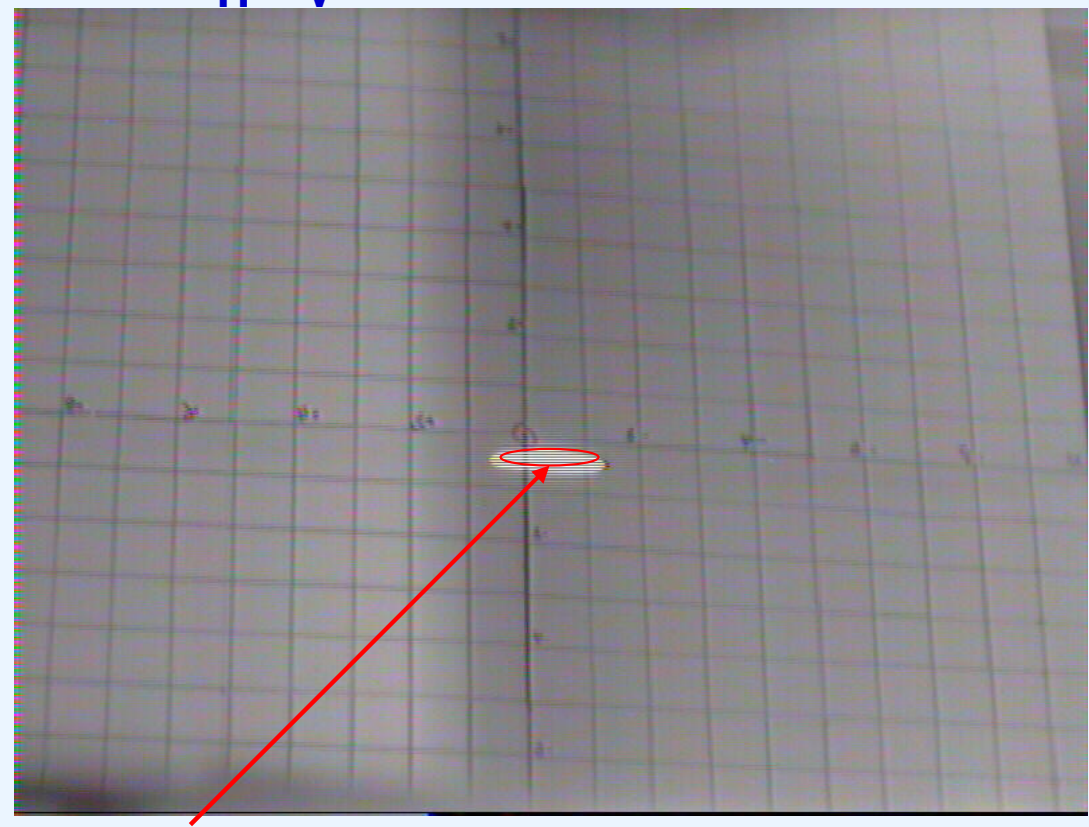
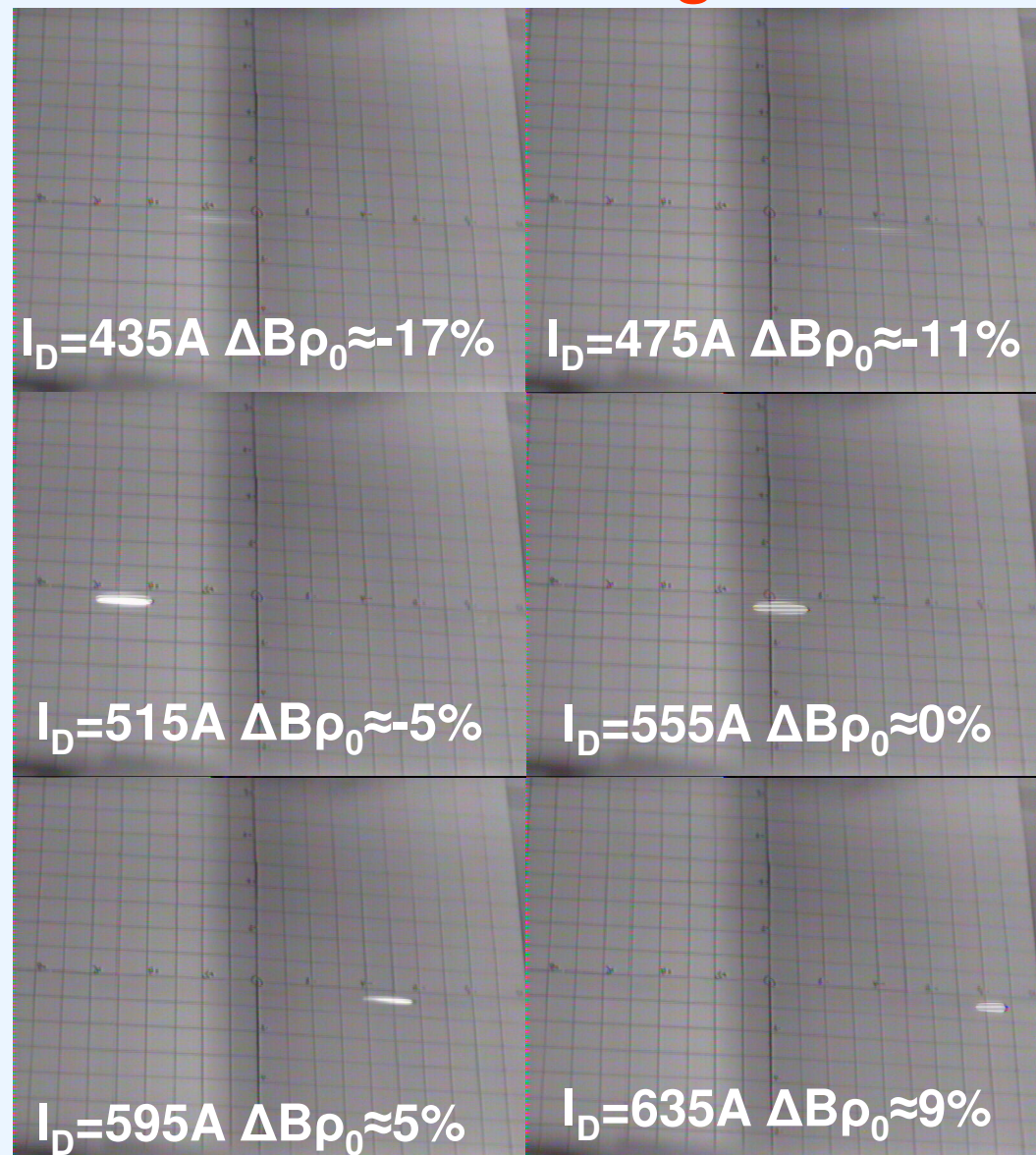
Calculated by KOMPOT Dipole currents for different beam rigidities



Simulated calibration curve for dipole magnet with error < 1%

$B\rho = 2\text{Tm}$ $I_{calc} = 559\text{A}$ $I_{meas} = 556\text{A}$

TASCA test study with a beam of ^{30}Si (6+) TKE= 230.8 MeV at L_3 in High Transmission DQ_HQ_V mode



TRANSPORT calculated
beam size $13 \times 2 \text{ mm}^2$

Initial beam parameters:
 $X = Y = 6 \text{ mm}, X' \& Y' < 3 \text{ mrad}$

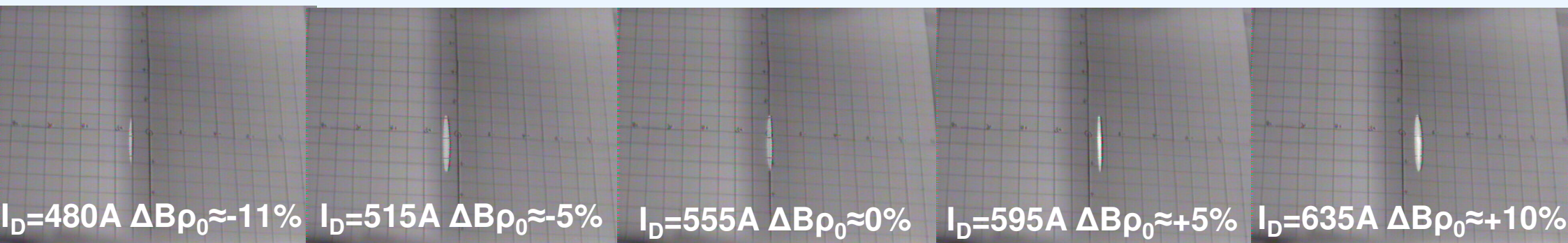
Separator magnification:
Horiz. – 2.5 , Vert. – 0.3

Dispersion:
calculated $\approx 0.9 \text{ cm}/\%$
measured $\approx 1 \text{ cm}/\%$

Momentum acceptance: $\pm 9\%$

Charge state +6 ($B\rho_0=2.0\text{Tm}$). Currents in Quads: $I_{Q1}=420\text{A}, I_{Q2}=450\text{A}$.

TASCA test study with a beam of ^{30}Si (6+) TKE= 230.8 MeV at L_3 Small image size - $DQ_V Q_H$ mode

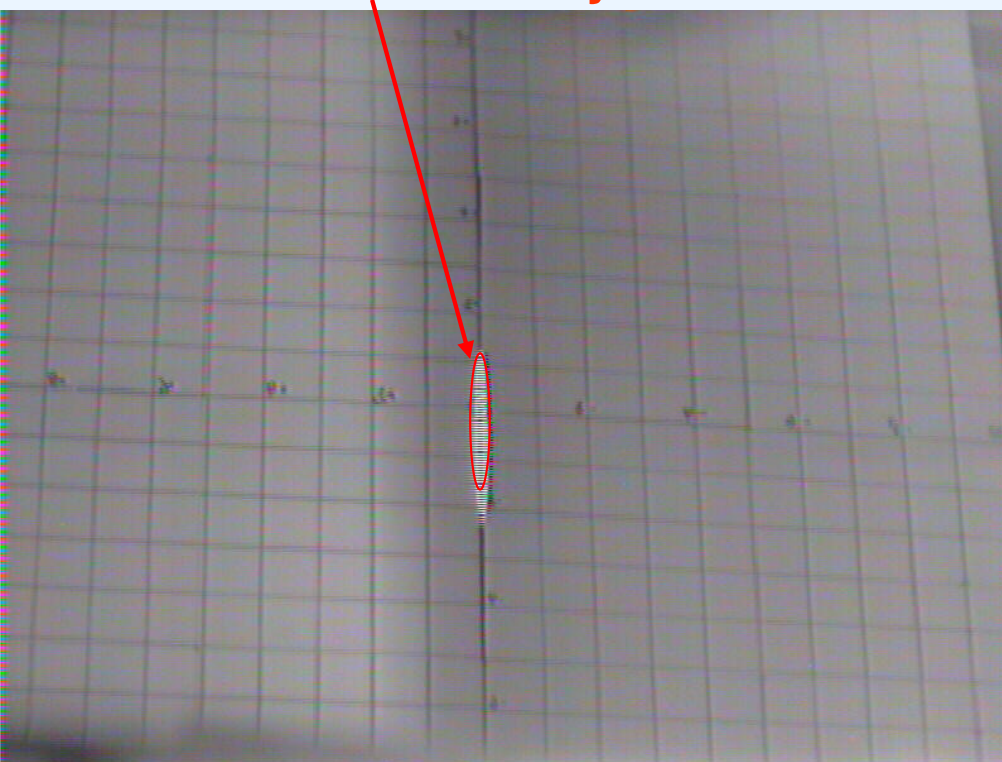


Luminophore grids step - 1 cm

Beam size calculated by TRANSPORT - $2 \times 13 \text{ mm}^2$

Charge state +6 ($B\rho_0=2.0\text{Tm}$).

Currents in Quads: $I_{Q1}=450\text{A}, I_{Q2}=490\text{A}$.



Initial beam parameters:

$X = Y = 6 \text{ mm}$, $X' \& Y' < 2 \text{ mrad}$

Separator magnification (calculated):

Horizontal – 0.3 , Vertical – 2.5

Dispersion:

calculated – 0.1 cm/%

measured – 0.1 cm/%

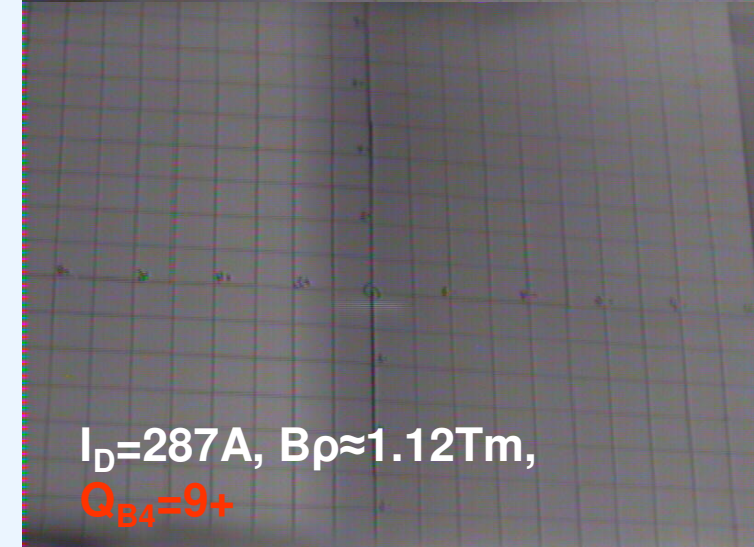
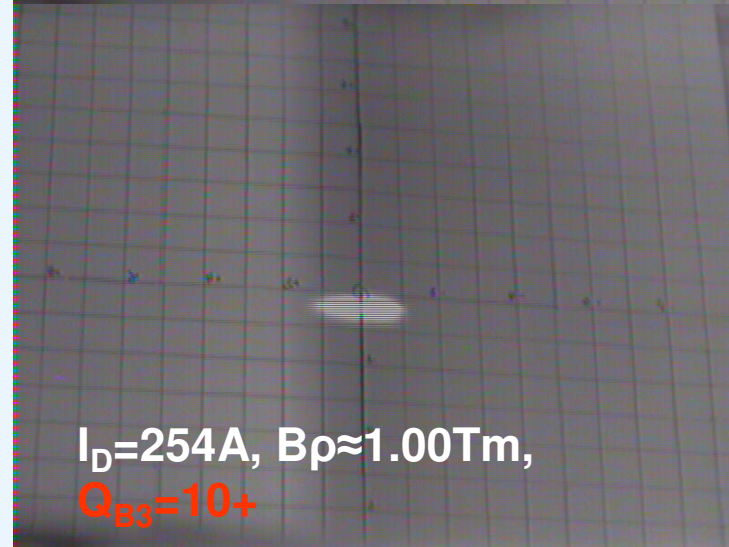
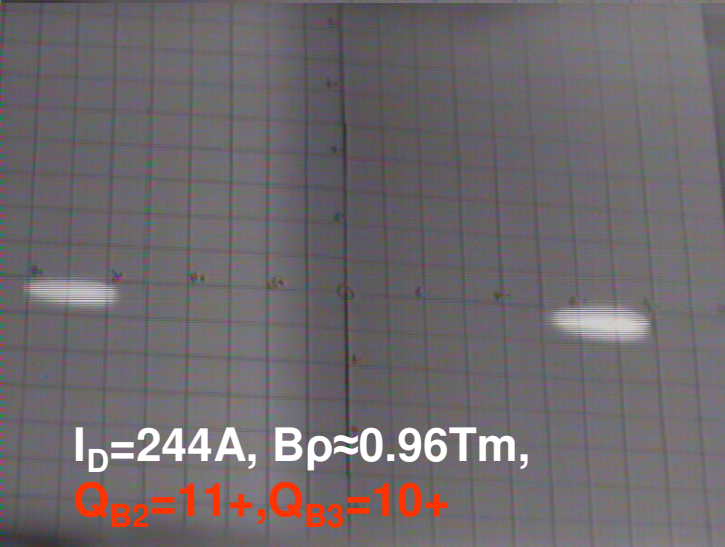
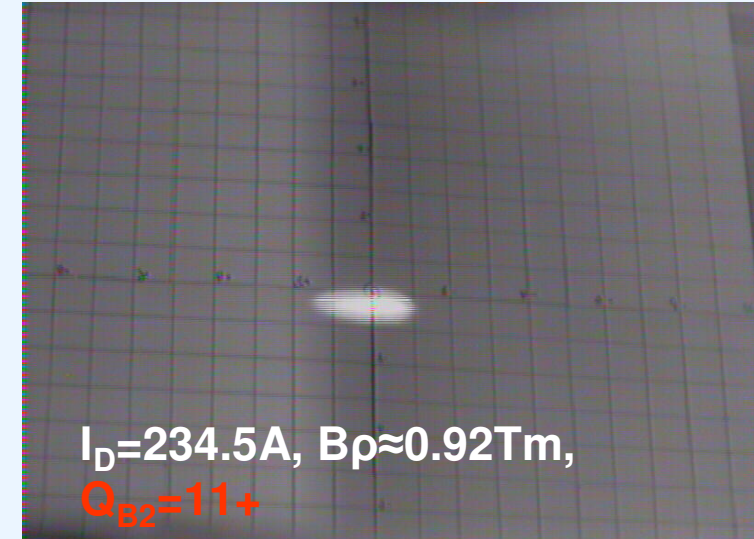
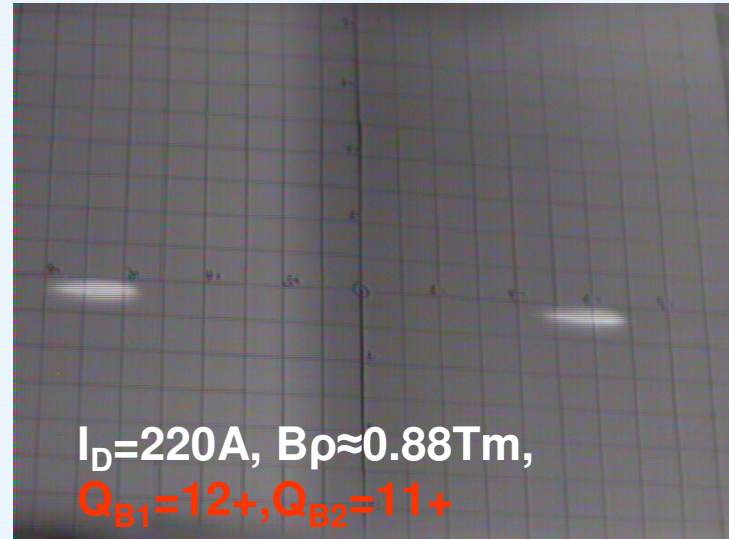
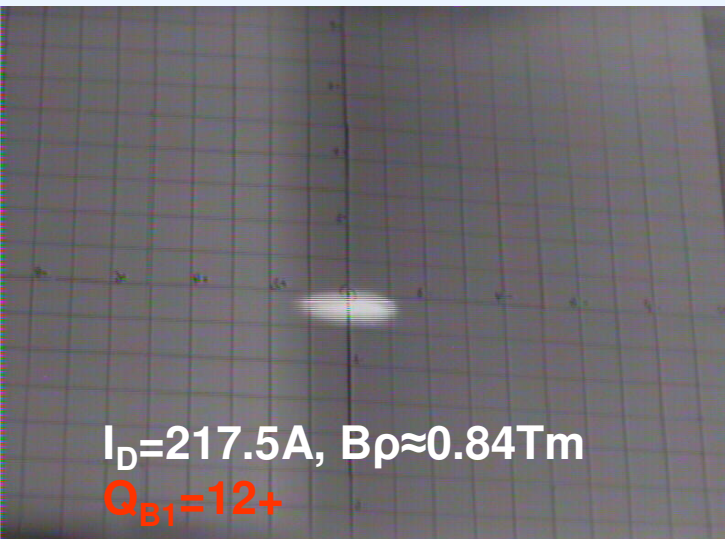
Momentum acceptance:

$\pm 10 \%$

TASCA test study with a beam of ^{30}Si , TKE = 162.8 MeV at L_3 .

Currents in Quads: $I_{Q1}=0\text{A}$, $I_{Q2}=0\text{A}$. Measured dispersion 1.4 cm/%.

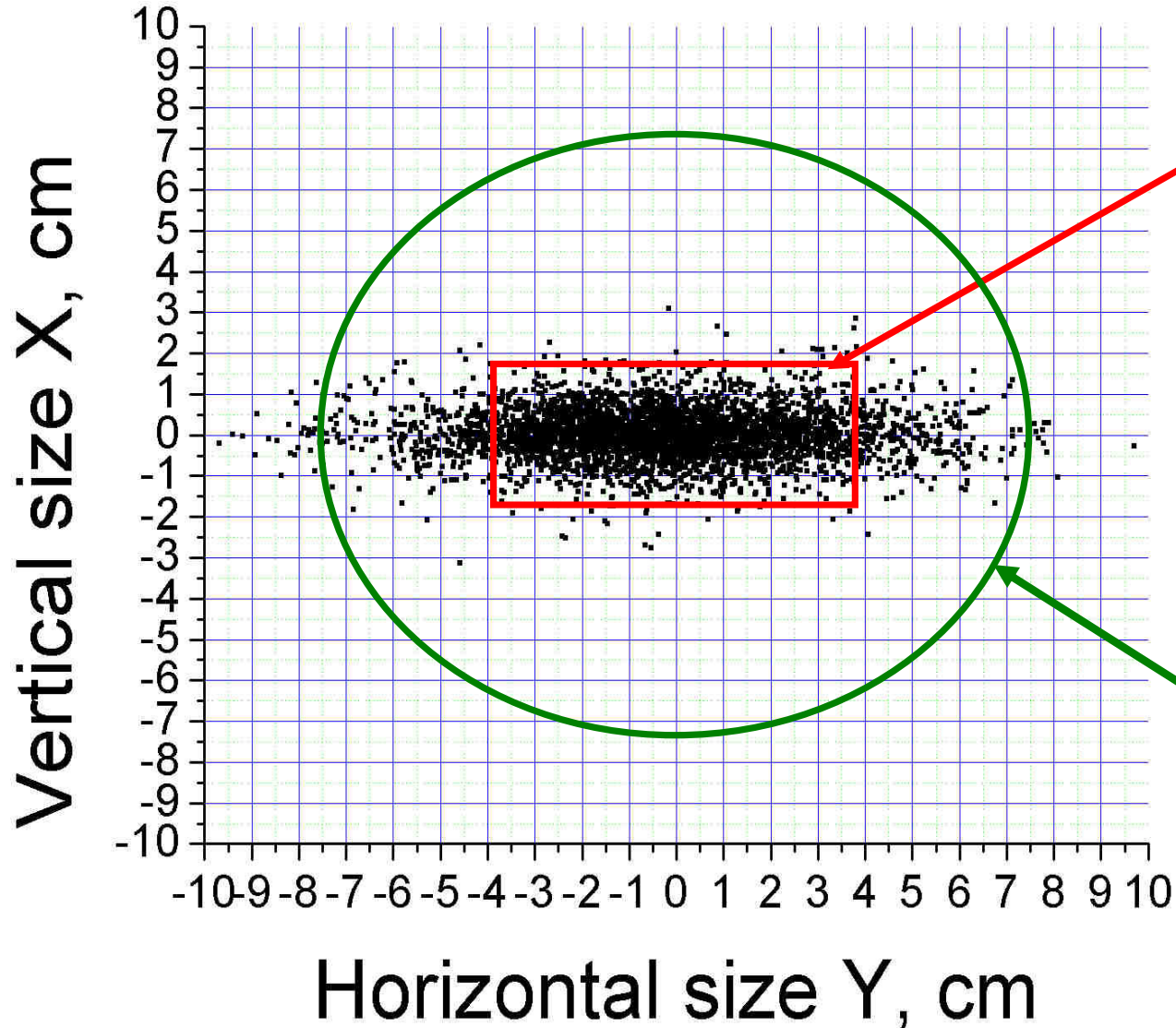
Different charge state magnetic rigidity measurements for charge states
12+, 11+, 10+, 9+.



Conclusions:

- both **High transmission** and **Small Image** modes of separator has been studied;
- **momentum acceptance** of separator is at least $\pm 9\%$ for both modes;
- in **Large Image mode** TASCA has **momentum dispersion** $\approx 1 \text{ cm}/\%$, which can be easily tuned based on the task;
- in **Small Image mode** TASCA has **momentum dispersion** close to $0 \text{ cm}/\%$, which can be easily tuned up to $0.2 \text{ cm}/\%$ depends on the task;
- studied parameters of **horizontal and vertical magnification** of the beam image is **close to calculated and simulated**;
- it is possible to use **directly calculated magnetic fields** from the KOMPOT model for **magnet current settings**. **Error** $< 1\%$.

^{30}Si (162.8 MeV CofT) + ^{181}Ta (400 $\mu\text{g}/\text{cm}^2$) \rightarrow ^{205}Fr + 3n,
 ^{205}Fr focal plane distributions



8*3.8 cm² FPD

**Monte Carlo
calculated
transmission
 $\approx 30\%$**

Ø15cm flange

TASCA test study with a beam of ^{30}Si , TKE= 230.8 MeV

Charge state (Q)	Rigidity, $B\rho$ (Tm) (LISE)	$\Delta B\rho = 100 * (B\rho_Q - B\rho_{Q-1}) / B\rho_{Q-1}$ (%)	Dipole magnet current (A) (KOMPOT simulations)
+14	0.86	-	219
+13	0.92	7.2	235
+12	1.0	7.7	255
+11	1.1	8.3	277
+10	1.2	9.1	306
+9	1.3	10.	342
+8	1.5	11.	390
+7	1.7	12.5	457
+6	2.0	14.	559

TASCA test study with a beam of ^{30}Si , TKE= 162.8 MeV

Charge state (Q)	Rigidity, $B\rho$ (Tm) (LISE)	$\Delta B\rho = 100 * (B\rho_Q - B\rho_{Q-1}) / B\rho_{Q-1}$ (%)	Dipole magnet current (A) (KOMPOT)
+14	0.72	-	185
+13	0.77	7.2	199
+12	0.84	7.6	215
+11	0.92	8.4	234
+10	1.00	9.0	256
+9	1.12	10.0	285
+8	1.26	11.1	322
+7	1.44	12.5	372
+6	1.68	14.3	445