DIRAC status report

10/31/2012 3:37:44 nach

I. RUN 2012

1. The strength of magnetic field decreased by less than 0.5 % during 4 months work with the proton beam intensity of $3 \cdot 10^{11}$ protons/spill and with 100 μm Be target (see Fig. 1-9).

2. The beam position on the target in *Y* (vertical) direction is deflected from the optimal position by less than 0.5 mm during the 2012 run (see Fig. 10). The optimal distance between proton beam axis and the edge of *Pt* foil equals 7.5 mm. A 0.5 mm reduction of this distance excludes interaction of the proton beam halo with *Pt* foil edge.

3. The number of spills delivered to DIRAC from July to October 18 is 6.14×10^5. If the DIRAC has 3 spills/supercycle thereafter, the expected total number of spills during the 2012 run will be around 7.3×10^5.

4. The data from July up to September 28 (5.05×10^5 spills) is processed at the present time. The full number of $A_{2\pi}$ (N_A=5700±500) was obtained from the Coulomb $\pi^+\pi^-$ pairs analysis. In accordance with M.C. simulation the corresponding number of atomic pairs after long-lived $A_{2\pi}$ breaking in *Pt* foil will be n_a=130±12. For the total number of spills 7.3×10^5 in the 2012 run the expected signal from the atomic pairs will be at the level of more than 6σ.

II. RUN 2011

1. All experimental data was preselected and ntuples were prepared.

2. Multiple scattering measurements.
Events with only one track in each projection are selected in the present analysis.
For these events, analysis for *Ni* targets with 100 μm and 150 μm thickness (see Fig. 11, 12) was performed. The preliminary precision of multiple scattering angle measurement for each target is 0.7 %. This is better than 1 % precision in the 2003 run. In the 2003 run all events were used for the analysis. The precision of multiple scattering angle measurement in the 2011 run with full statistics is expected to be better than 0.5 % for each target. This measurement continues in the 2012 run.

III. *ππ* atoms (RUNS 2008, 2009, 2010)

The analysis of the systematic errors is performed on the 2008 data after e^+e^- background subtraction. The number of atomic pairs is obtained for the events with low level of background in SFD, using distributions of pairs over Q, Q_l and Q_l-Q_t. The difference between number of atomic pairs was due to the systematic error related to the new SFD planes. After reduction of the systematic error, the number of atomic pairs are 3455±163 (Q), 4059±270 (Q_l) (see Fig.13,14) and 3601±162 (Q_l–Q_t). The atom breakup probability P_{br}=(45.6±3.4)%(Q_l) is the same as P_{br}=(44.6±0.9)% obtained in the 2001-2003 runs. The way to decrease the systematic error is known. The total number of atomic pairs detected in the 2008-2010 runs will exceed 21000.

IV. π^-K^+ and π^+K^- atoms (RUNS 2008, 2009, 2010)

The multiplicity in all detectors for ππ and π*K*-triggers is the same.

Therefore suppression of the systematic error applied in the $\pi\pi$ atom analysis can be also used in the πK atom analysis. The preliminary results of analysis of the produced πK atoms and πK atomic pairs are expected to be ready in April 2013. This analysis will take into account the non point-like π and K meson production. The total number of πK atoms detected in the 2008-2010 runs will be around 600.

V. The new ionization hodoscope

The existing ionization hodoscope (IH) has 4 planes with S=108x108 mm^2 assembled from 16 slabs with thickness of 1 mm.
Each slab is connected to PM photocathode by lucite light guide.
Each plane of the new IH has 32 slabs.
The increased granularity allows to decrease the signal overlapping and dead time of electronics.
The new IH is presented in the Fig. 15-17.
This detector is installed in the beam and will be investigated during October 2012.

VI. DIRAC dismantle

The DIRAC setup dismantle will be finished before June 2013 in accordance with the plan prepared by CERN and DIRAC collaboration.

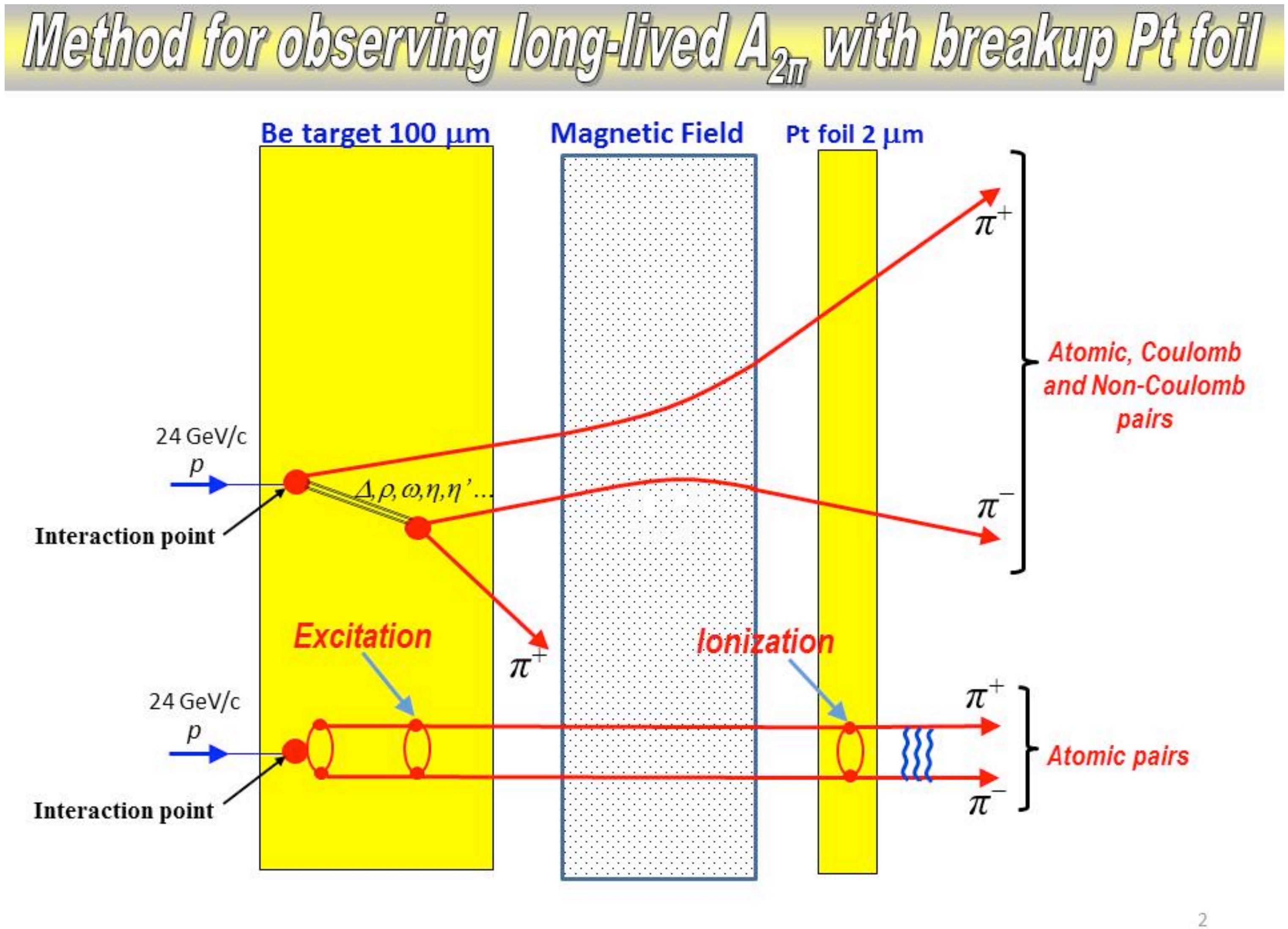

Method for observing long-lived $A_{2\pi}$ with breakup Pt foil
Be target 100 μm
Magnetic Field
Pt foil 2 μm
24 GeV/c
p
Interaction point
Δ,ρ,ω,η,η'…
π^+
π^-
Atomic, Coulomb and Non-Coulomb pairs
Excitation
Ionization
24 GeV/c
p
Interaction point
π^+
π^-
Atomic pairs
2

Figure 1

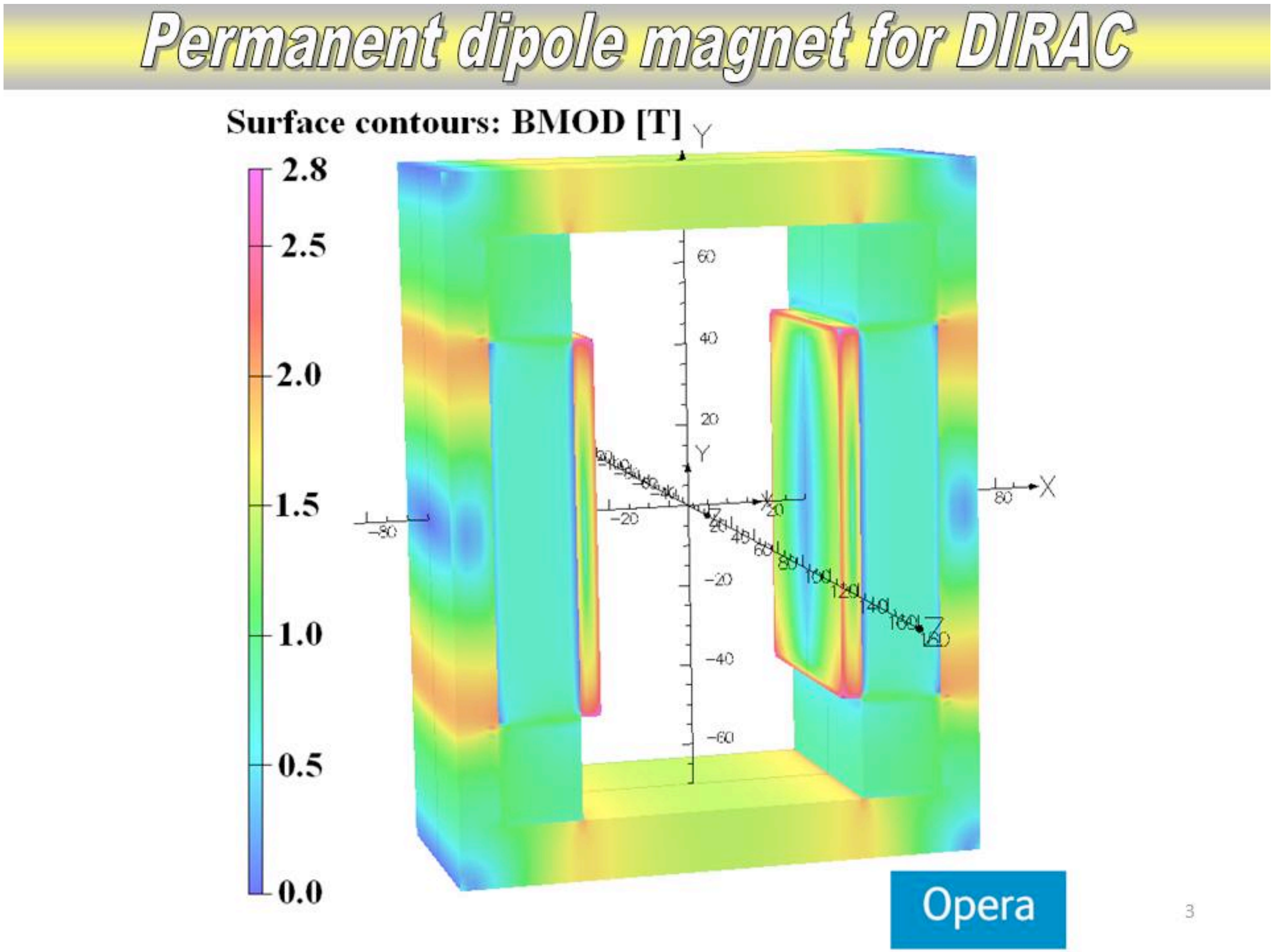

Permanent dipole magnet for DIRAC
Surface contours: BMOD [T]
2.8
2.5
2.0
1.5
1.0
0.5
0.0
Y
X
Z
60
40
20
-20
-40
-60
-80
80
Opera
3

Figure 2

Magnet main parameters

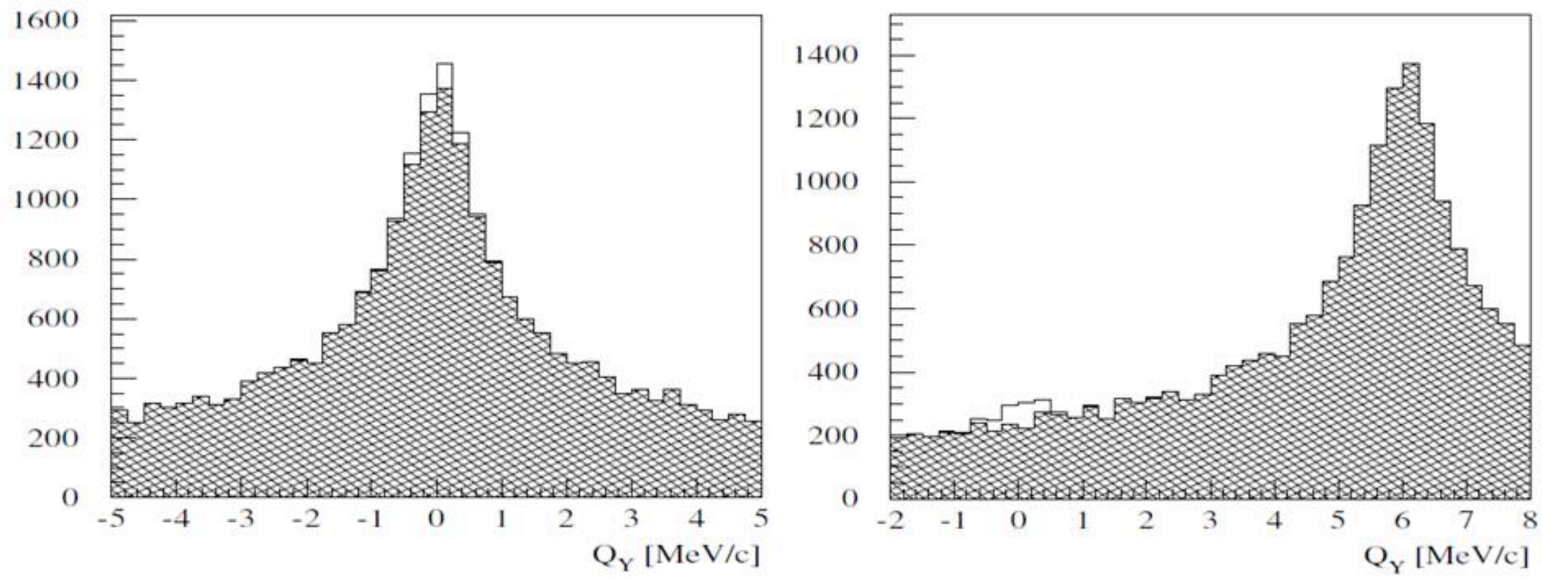
Magnet Type	Permanent Magnet Dipole
Quantity	1+1 (spare)
Magnet Height × Width × Length	170 mm × 130 mm × 66 mm
Magnet mass	8.6 kg
Full horizontal aperture	60 mm
Good Field Region(GFR) Horizontal × Vertical	20 mm × 30 mm
Magnetic field characteristics	
Nominal integrated horizontal field $\int B_{x(0,0,Z)}dz$	**24.6×10^{-3} T×m**
Horizontal field in magnet center $B_{x(0,0,0)}$	**0.255 T**
Magnetic length $\int B_{x(0,0,Z)}dz \ / B_{x(0,0,0)}$	96.5 mm
Integrated field homogeneity inside GFR $\Delta\int B_x dz \ / \int B_{x(0,0,Z)}dz$	$< \pm 2\%$
Components	
Permanent magnet blocks	Sm_2Co_{17} "Recoma 30S" or equivalent
Pole and Return Yoke	Low carbon steel: AISI 1010
Central inserts	Stainless steel: 316L+N
Cover plates	Aluminum: EN-AW-6082

4

Figure 3

Simulation of long-lived $A_{2\pi}$ observation

V. Yazkov



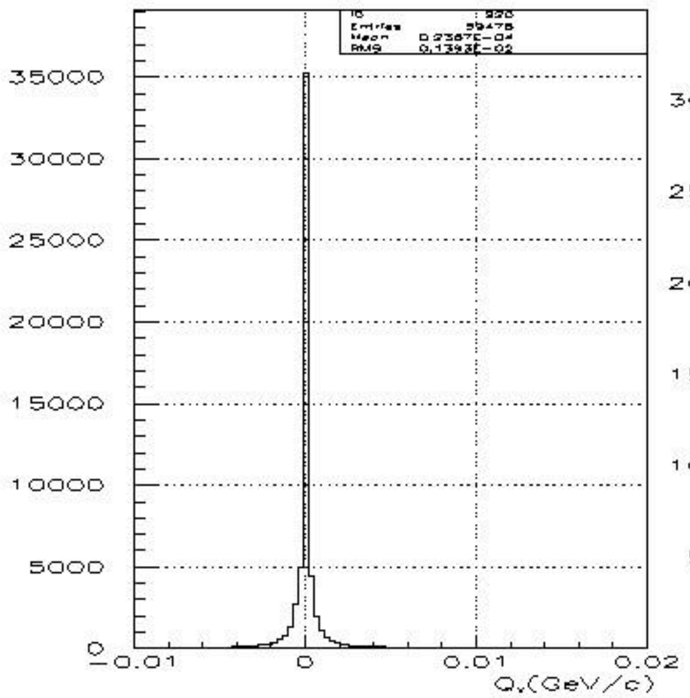
Without magnet

With magnet after Be target

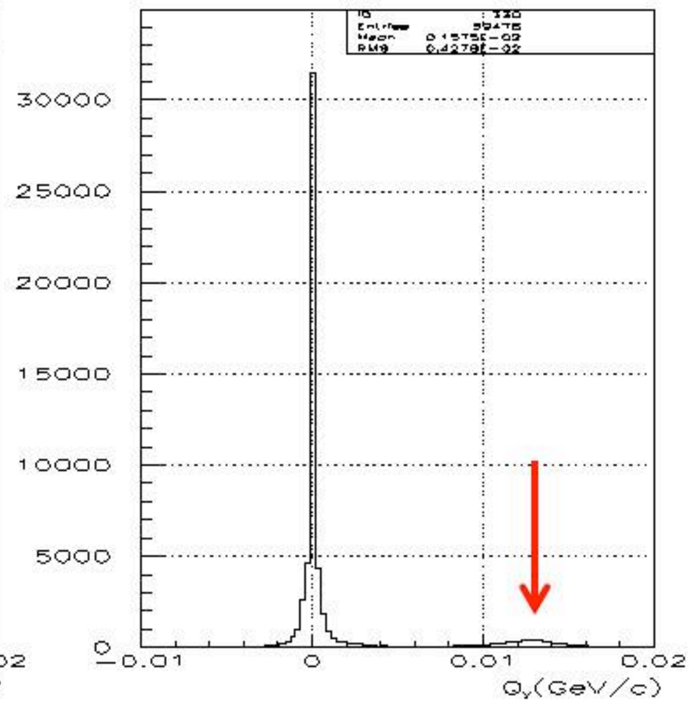
Simulated distribution of $\pi^+\pi^-$ pairs over Q_Y with criteria: $|Q_X| < 1$ MeV/c, $|Q_L| < 1$ MeV/c. "Atomic pairs" from long-lived atoms (light area) above background (hatched area) produced in Beryllium target.

Figure 4

Q_x and Q_y distributions for e^+e^- pair



Q_x distribution



Q_y distribution

Figure 5

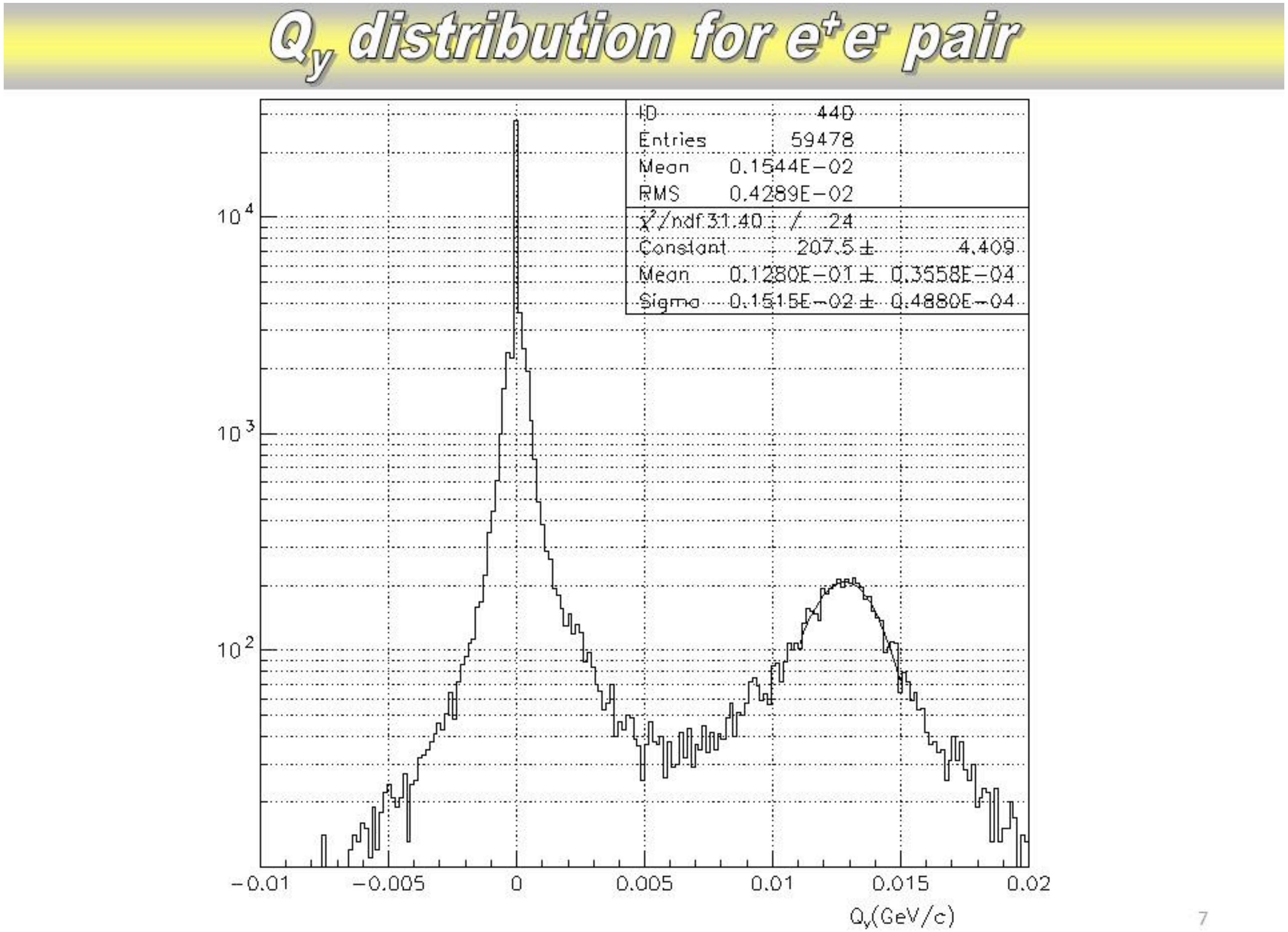
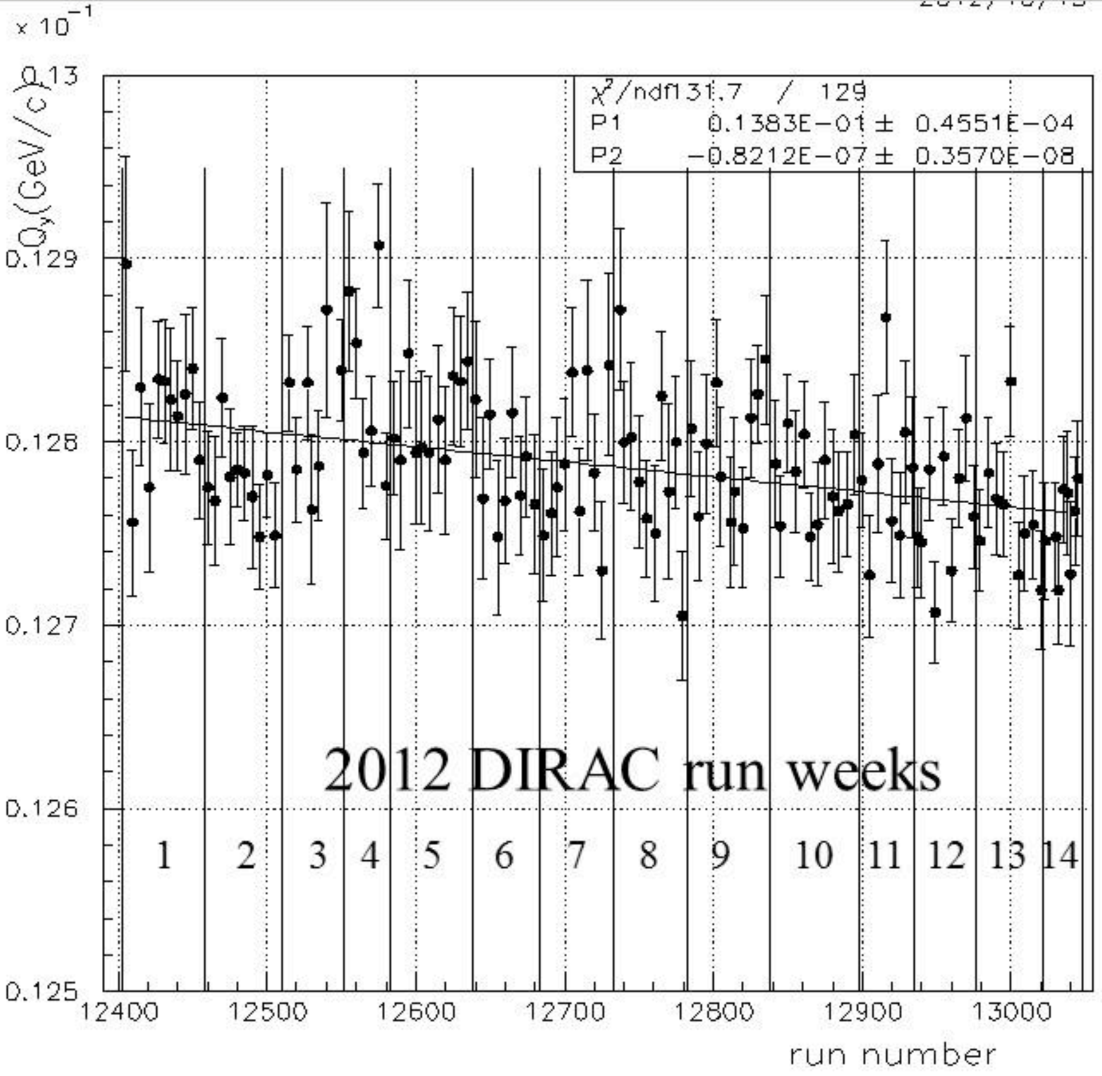

Qy distribution for e+e- pair
ID 440
Entries 59478
Mean 0.1544E-02
RMS 0.4289E-02
χ²/ndf 31.40 / 24
Constant 207.5 ± 4.409
Mean 0.1280E-01 ± 0.3558E-04
Sigma 0.1515E-02 ± 0.4880E-04
10^4
10^3
10^2
-0.01
-0.005
0
0.005
0.01
0.015
0.02
Qy(GeV/c)
7

Figure 6

Magnetic field stability measured by Q_y of the e^+e^- pair



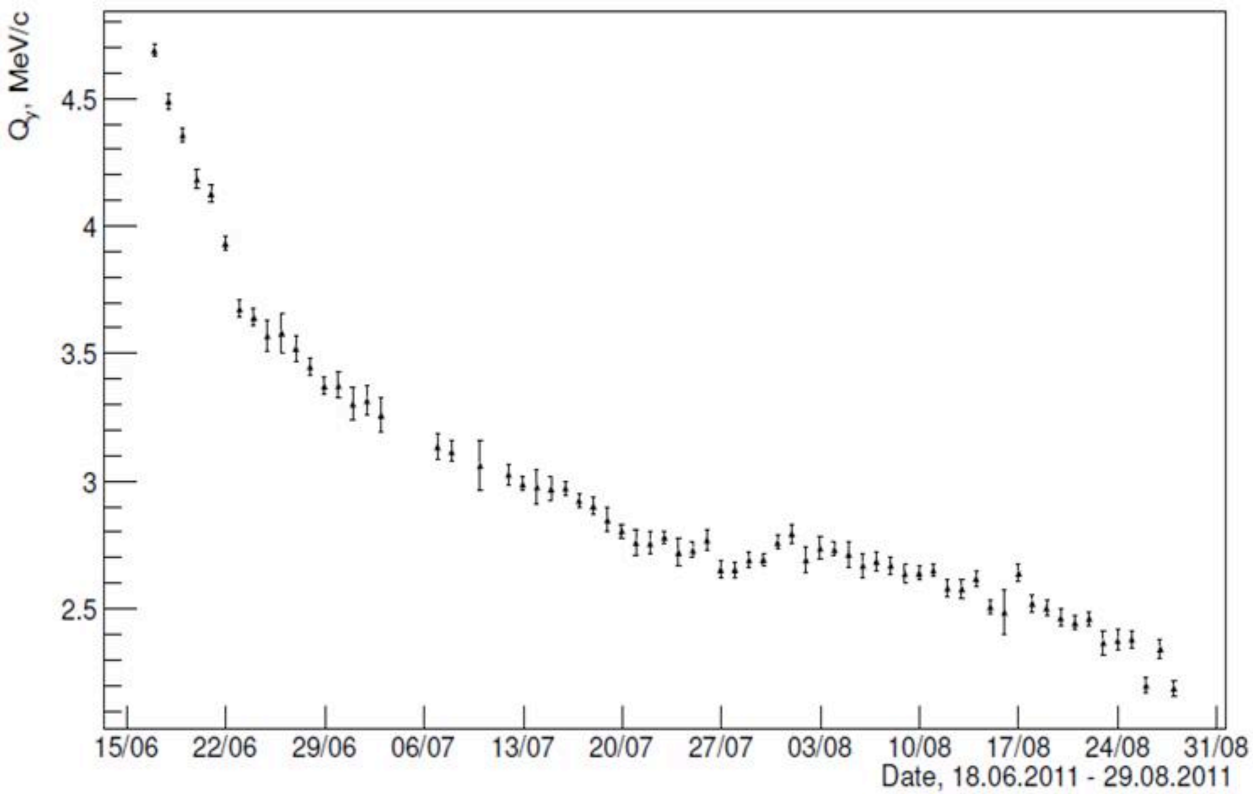
Sm_2Co_{17}

$$\frac{\Delta Q_y}{Q_y} = \frac{5}{1281}$$

$$= 0.4\%$$

Figure 7

Degradation of the old magnet in June-August 2011



Nd-Fe-B

$$\frac{\Delta Q_y}{Q_y} > 50\%$$

The position of second peak in Q_Y distributions of e^+e^- pairs versus dates.

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Figure 8

Q_x distribution for e^+e^- pairs

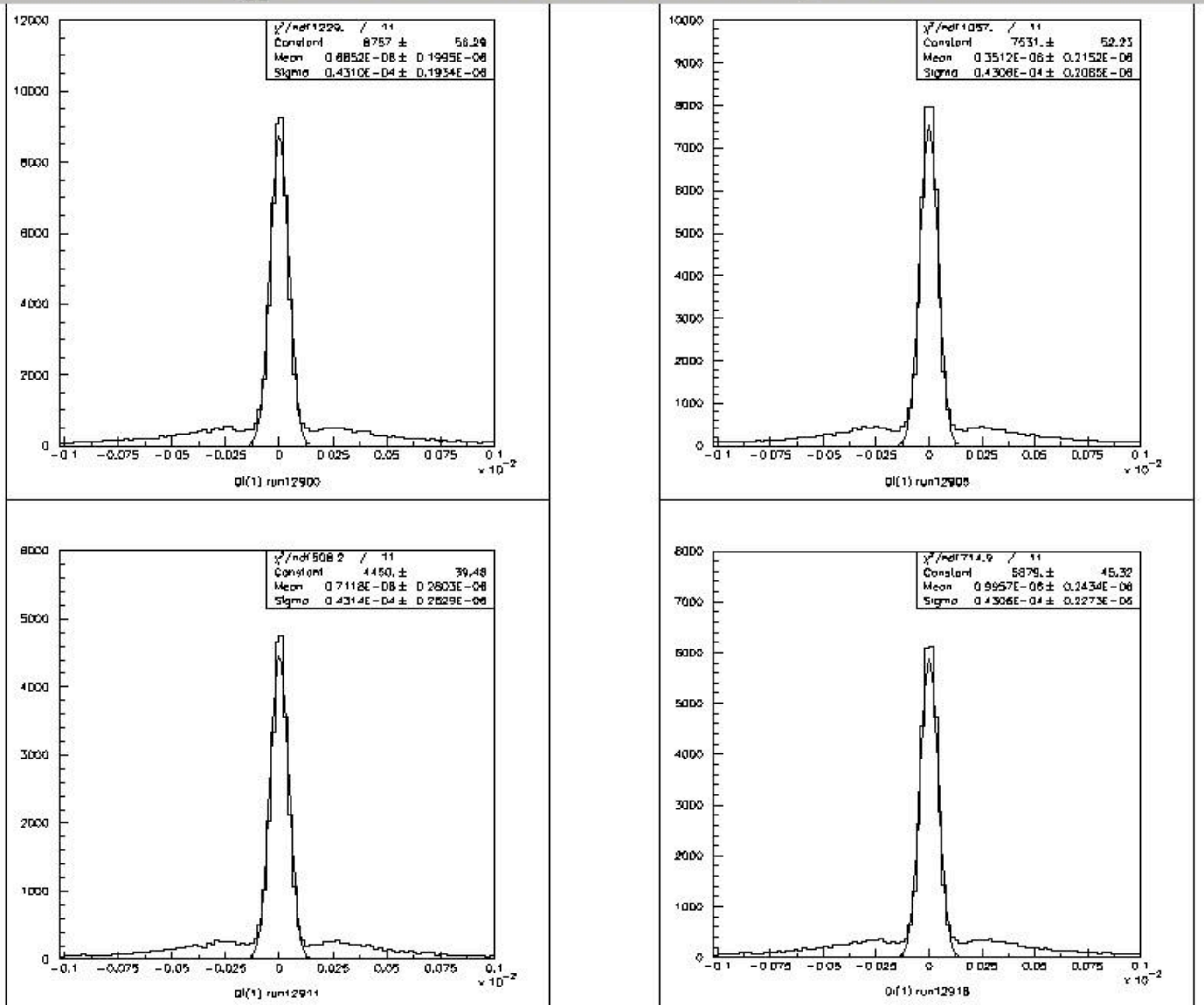
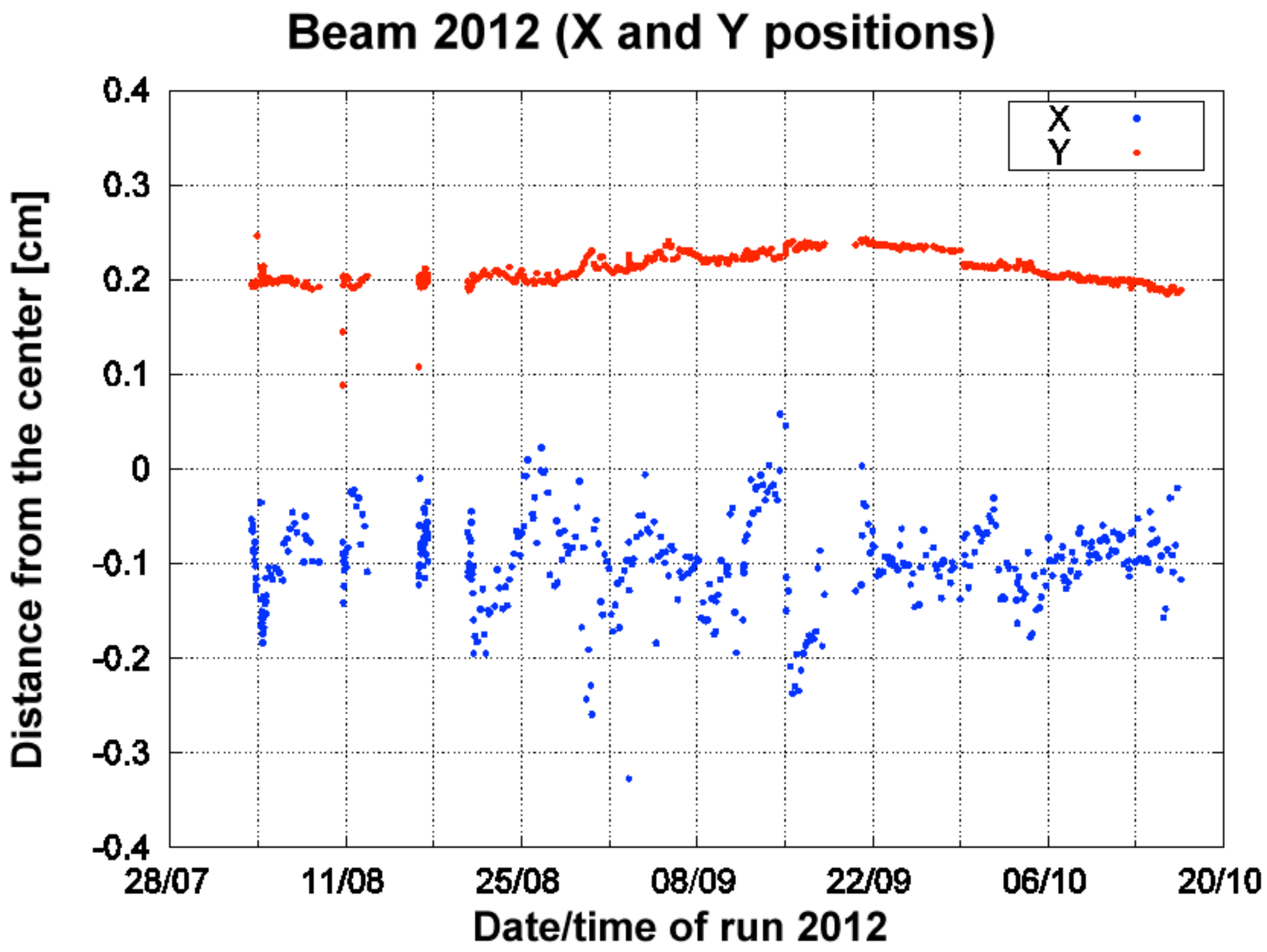


Figure 9



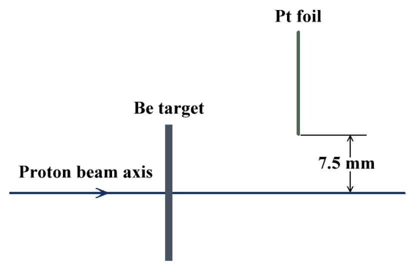


Figure 10. Beam 2012 (X and Y positions)

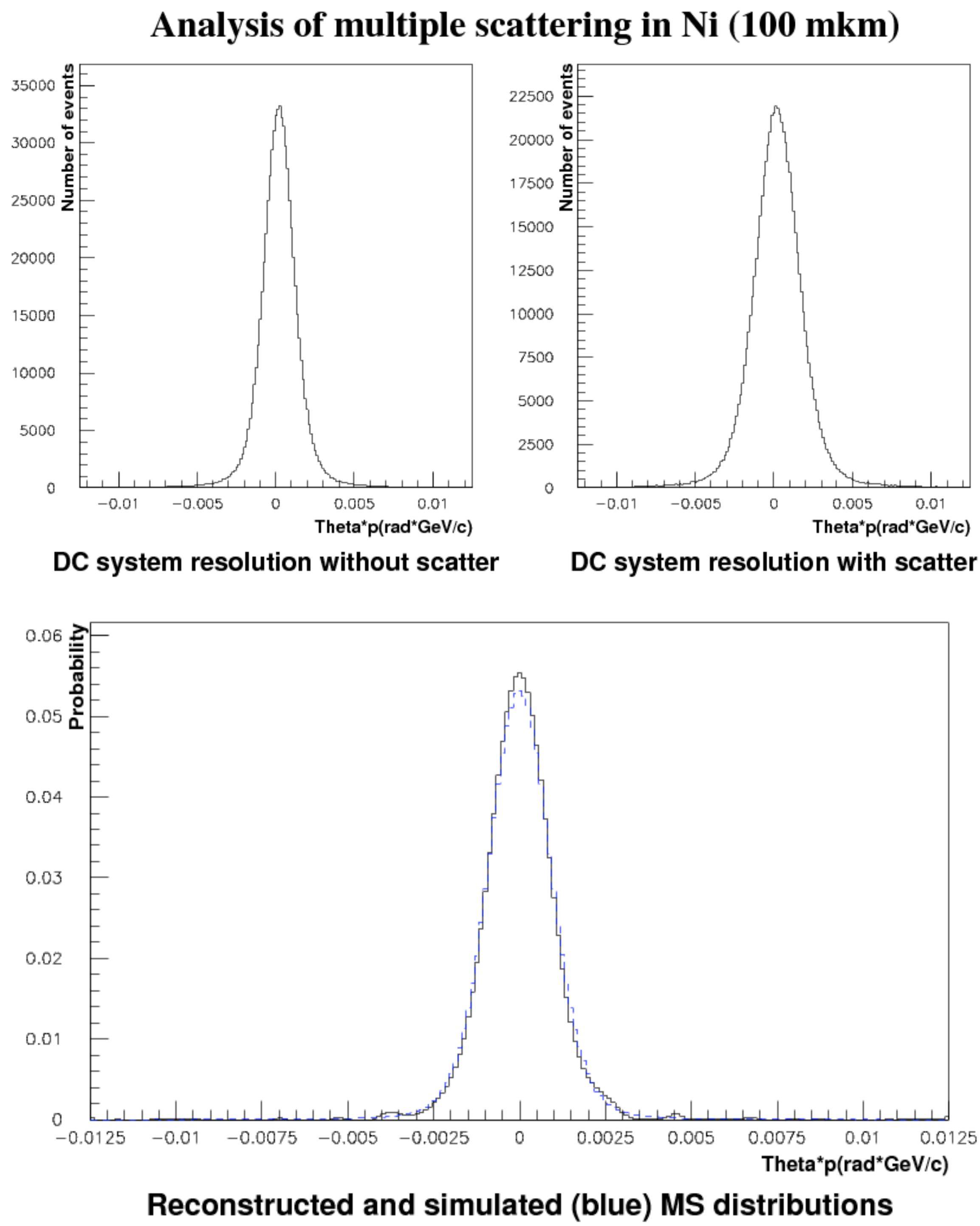


Figure 11. Run 2011. Analysis of multiple scattering in Ni (100 μm). Events with only one track in each projection were analyzed. $\delta\theta/\theta$ y 0.7 %. This value is expected to be less than 0.5 % after including full statistics into the analysis.

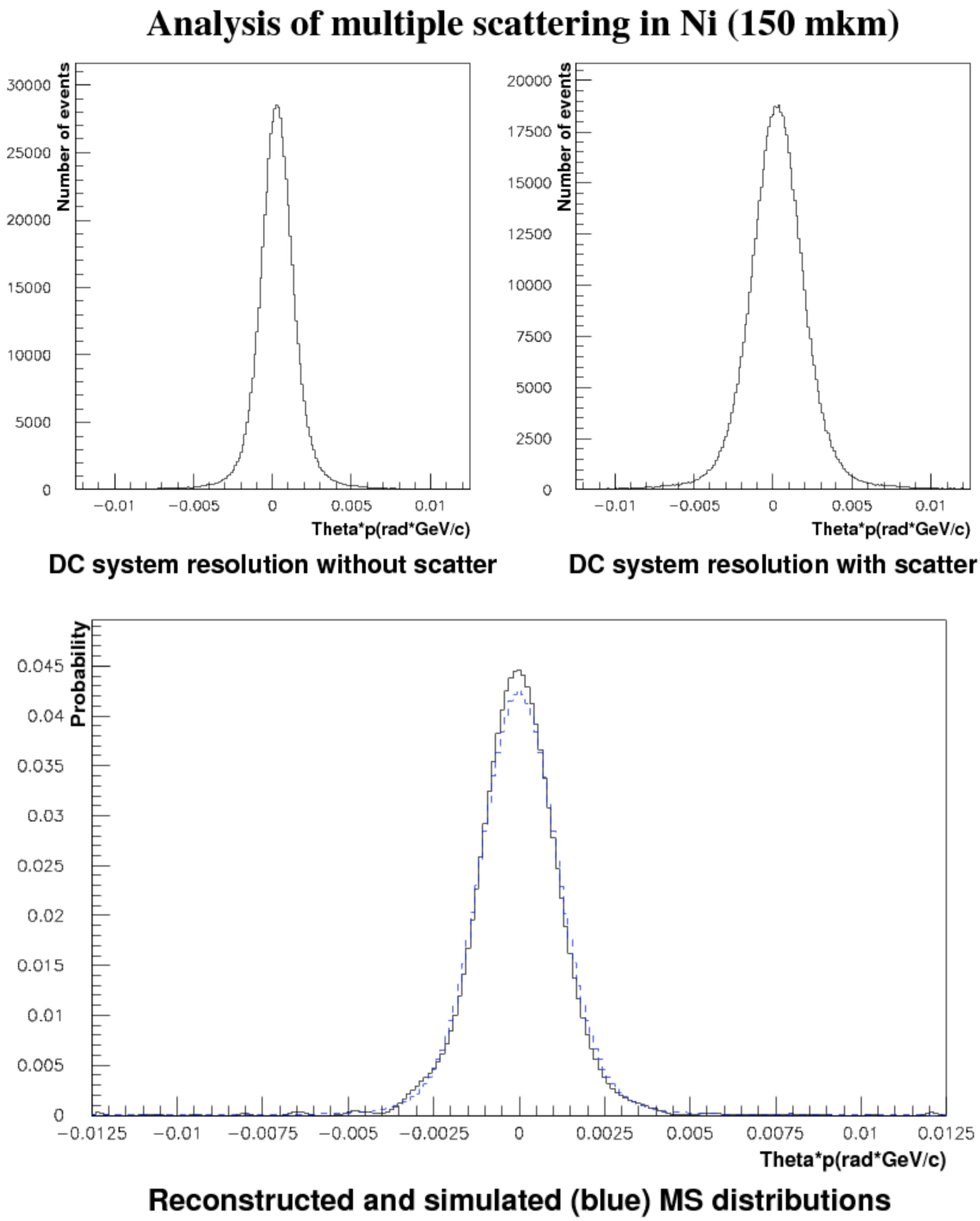


Figure 12. Run 2011. Analysis of multiple scattering in Ni (150 μm). Events with only one track in each projection were analyzed. $\delta\theta/\theta$ ץ 0.7 %. This value is expected to be less than 0.5 % after including full statistics into the analysis.

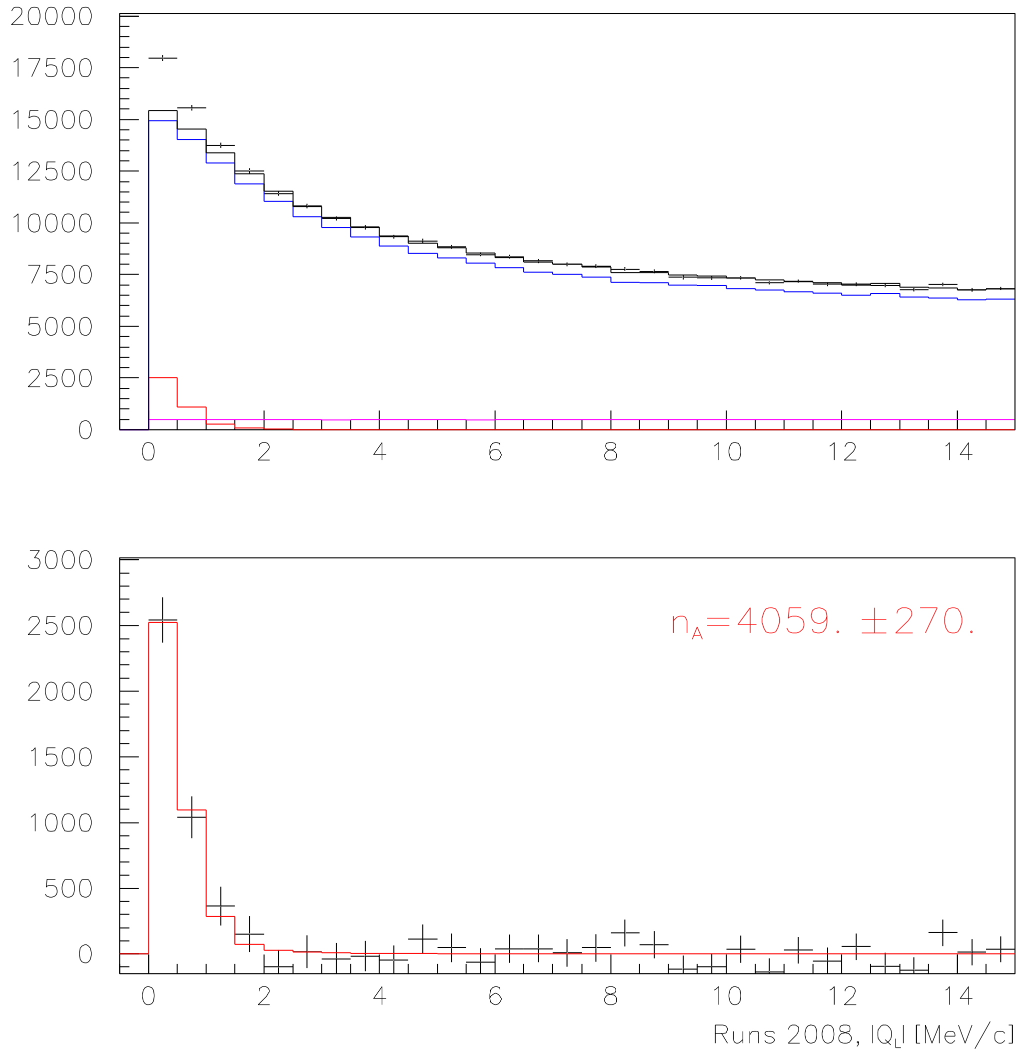
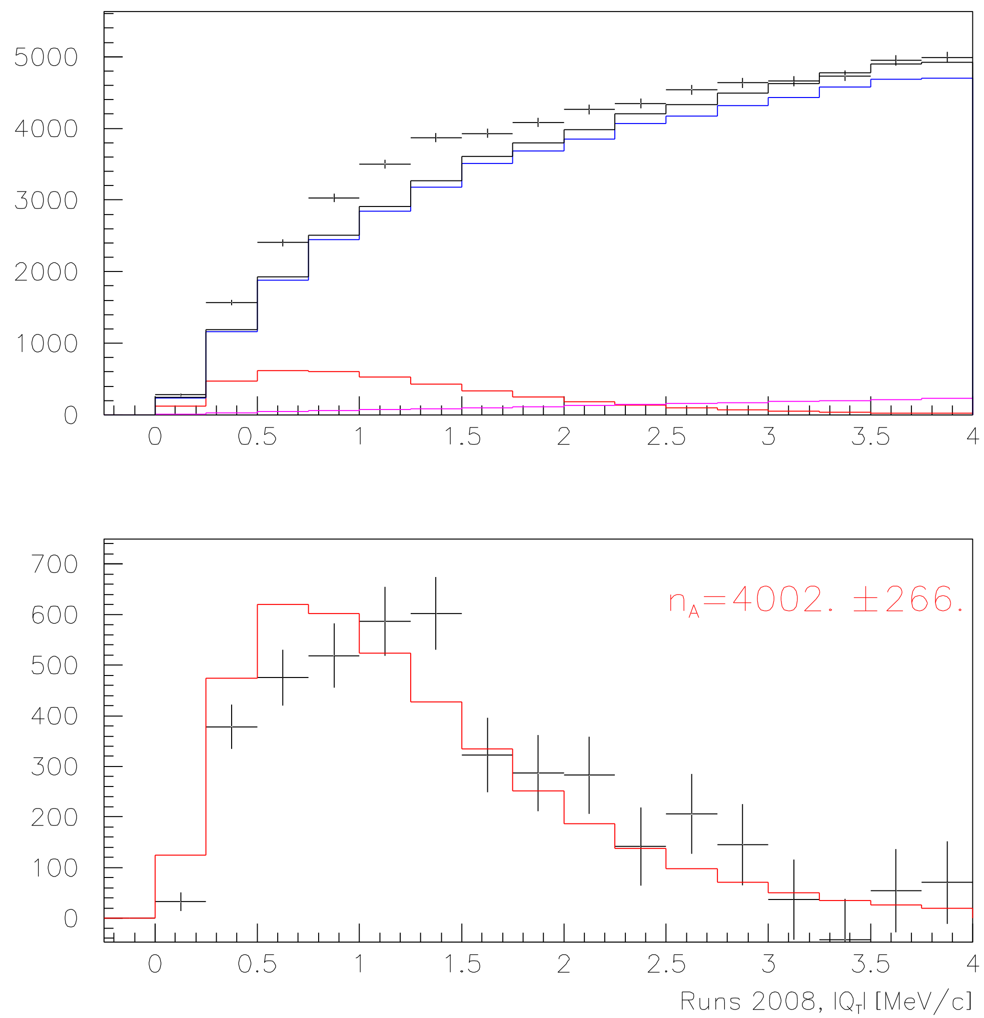

20000
17500
15000
12500
10000
7500
5000
2500
0
0
2
4
6
8
10
12
14
3000
2500
2000
1500
1000
500
0
n_A=4059. ±270.
0
2
4
6
8
10
12
14
Runs 2008, |Q_L| [MeV/c]

Figure 13



5000
4000
3000
2000
1000
0
0
0.5
1
1.5
2
2.5
3
3.5
4
700
600
500
400
300
200
100
0
n_A=4002. ±266.
Runs 2008, $|Q_T|$ [MeV/c]

Figure 14

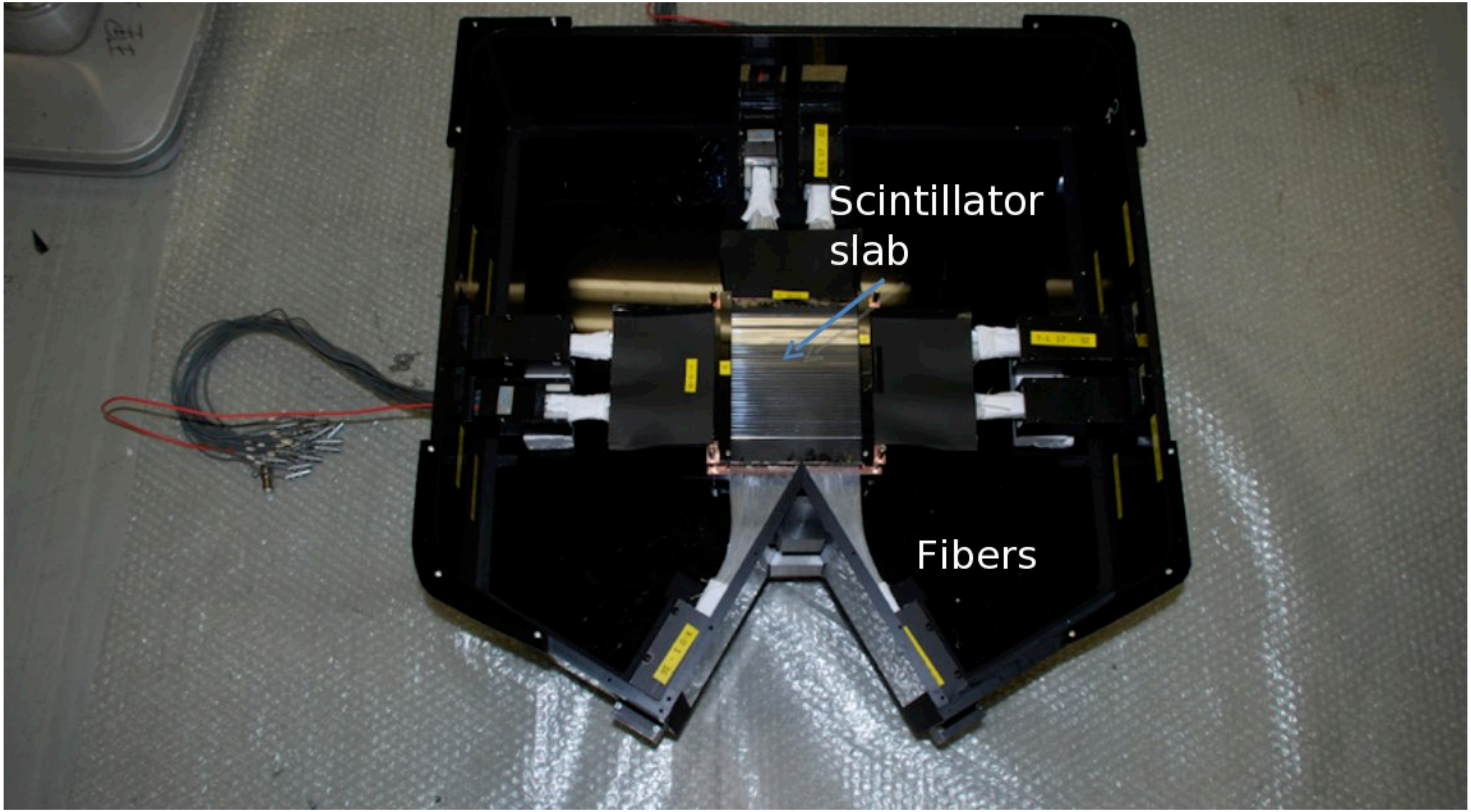


Figure 15. New IH outside

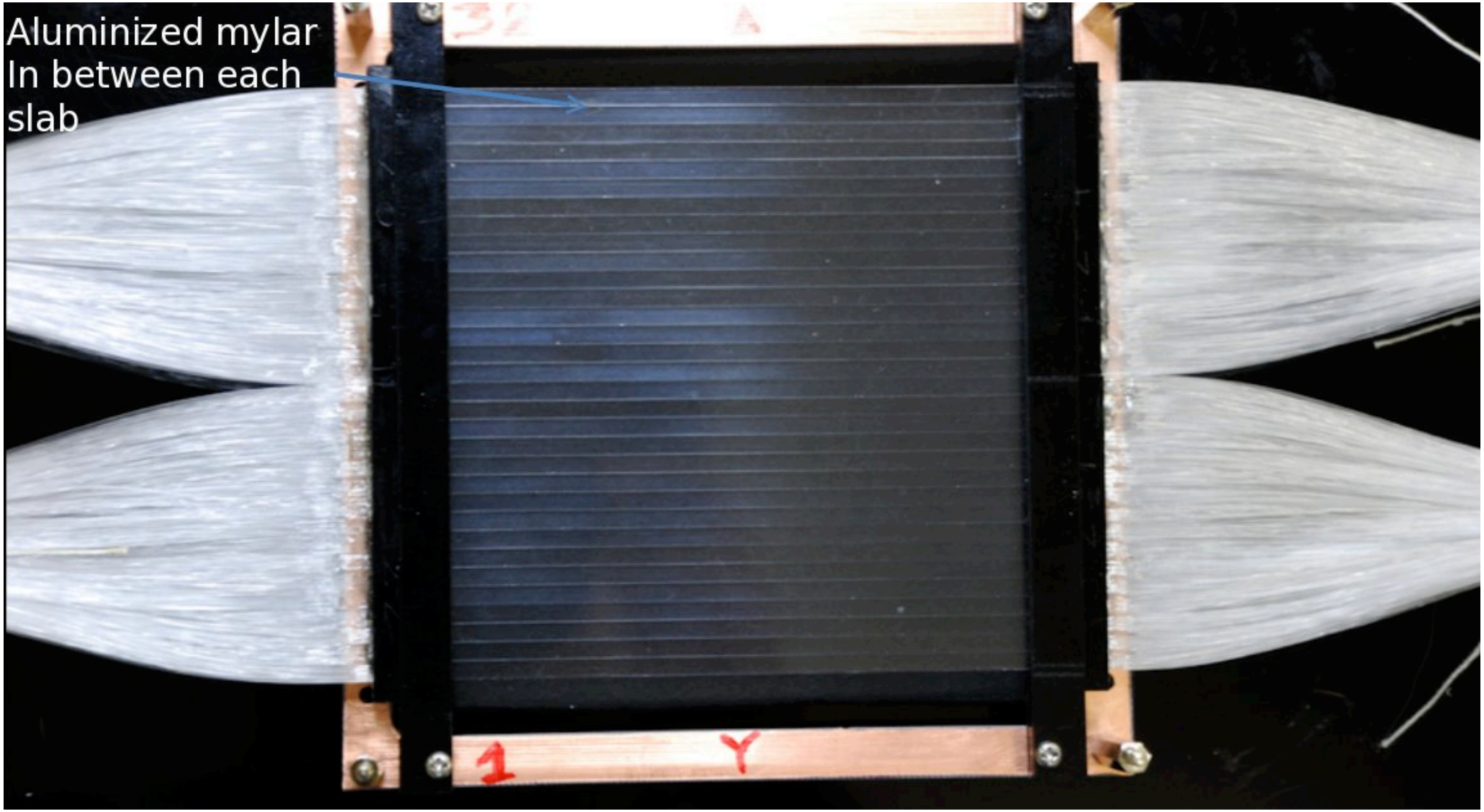


Figure 16. Scintillator plane of new IH

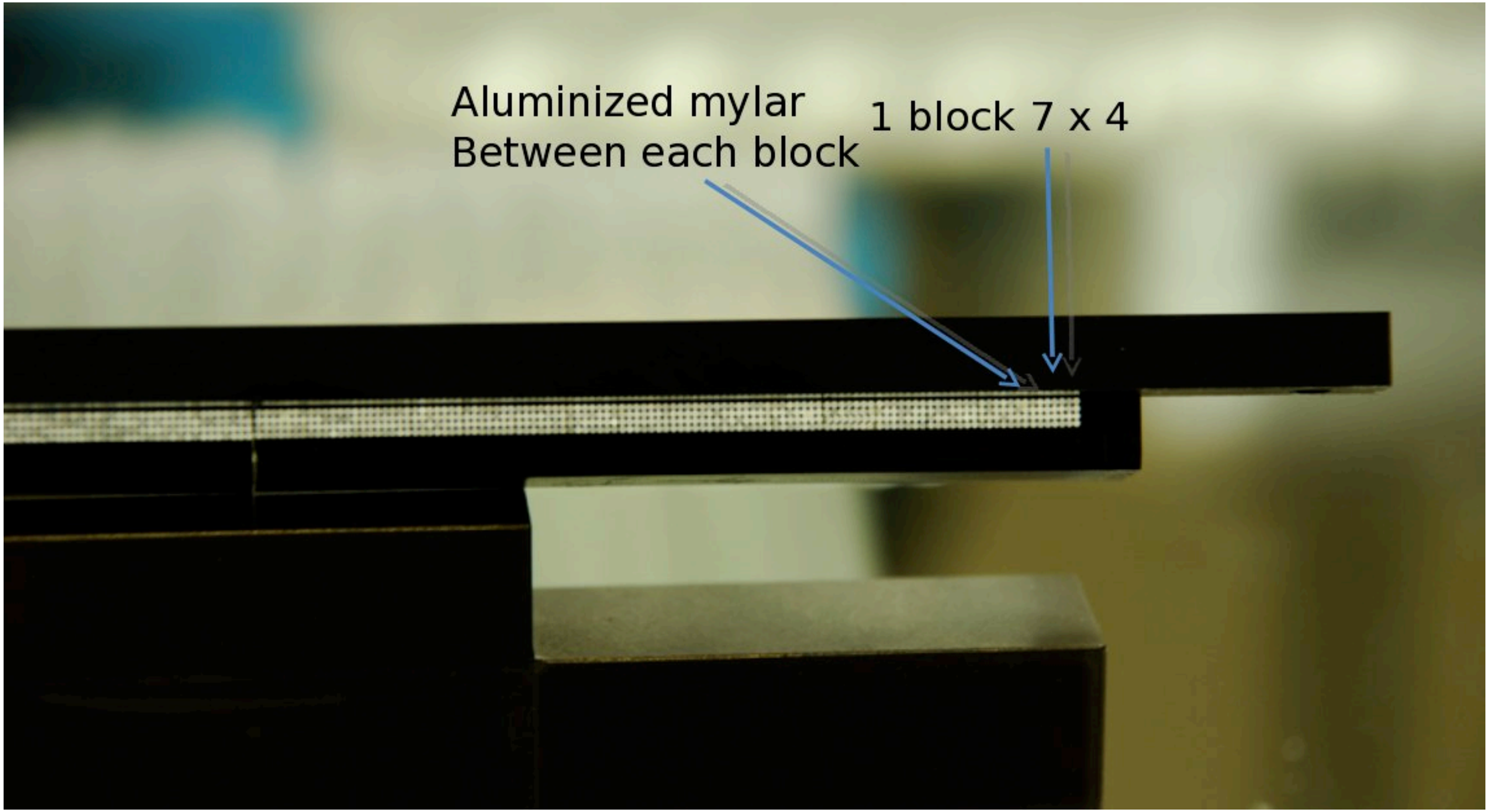


Figure 17. Clear fiber to scintillators