TRIUMF Experiment E614
Technical Note #98

Direct Measurement of a Gap between Wire and Cathode Plane in DC4 Chambers

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A special tool has been designed and manufactured for a direct measurement of gap between wire and cathode plane in DC4 and PC2 chambers. Schematic view of the tool presented in Fig.1. Enlarged laser images were being observed on a display. Examples of the images are presented in Figs.1,2.

Accuracy of the above method is based on measured accuracy of wire pitch ($4mm \pm 5\mu m$) and $\pm 5\mu m$ accuracy of relative wire positions in orthogonal to wire plane direction. Accuracy of $\pm 20\mu m$ is, with a high probability, maximal error of the method. It corresponds to $\pm 40\mu m$ in Fig.1, for example. The tool has been calibrated using a small Cital insert with thickness of 1.997mm covered by $6\mu m$ mylar and placed on winding table surface. A DC4 frame without cathode plane has been placed from above.

Measured maps of deviation between wire and cathode plane are presented in Figs.4-7 for 4 planes. Frame 2DC0 and 1DC0 are first made frames. Frame 012DC and 041DC are spare frames repaired by Wayne. They were working planes according to https://tw04.triumf.ca/e614db/. One can see that a deviation reaches more than $400\mu m$. Mean of deviation and RMS presented in Table 1 for the all planes.

Table 1: Mean deviation and RMS values in μm of gap between wire and cathode plane for measured planes 2DC0, 1DC0, 012DC, 041DC. Index "P" means permanent cathode, "R" - removable cathode.

Frame	2DC0	1DC0	012DC	041DC
Mean	-14	43	0	-300
RMS	18	44	60	68
Index	P	R	R	R

Let me conclude that the measured deviations can introduce big systematic errors to Michel parameters. We have to take into account the deviation values extracting Michel parameters.

Thank you very much to Wayne for his help during design and manufacturing of the laser tool.

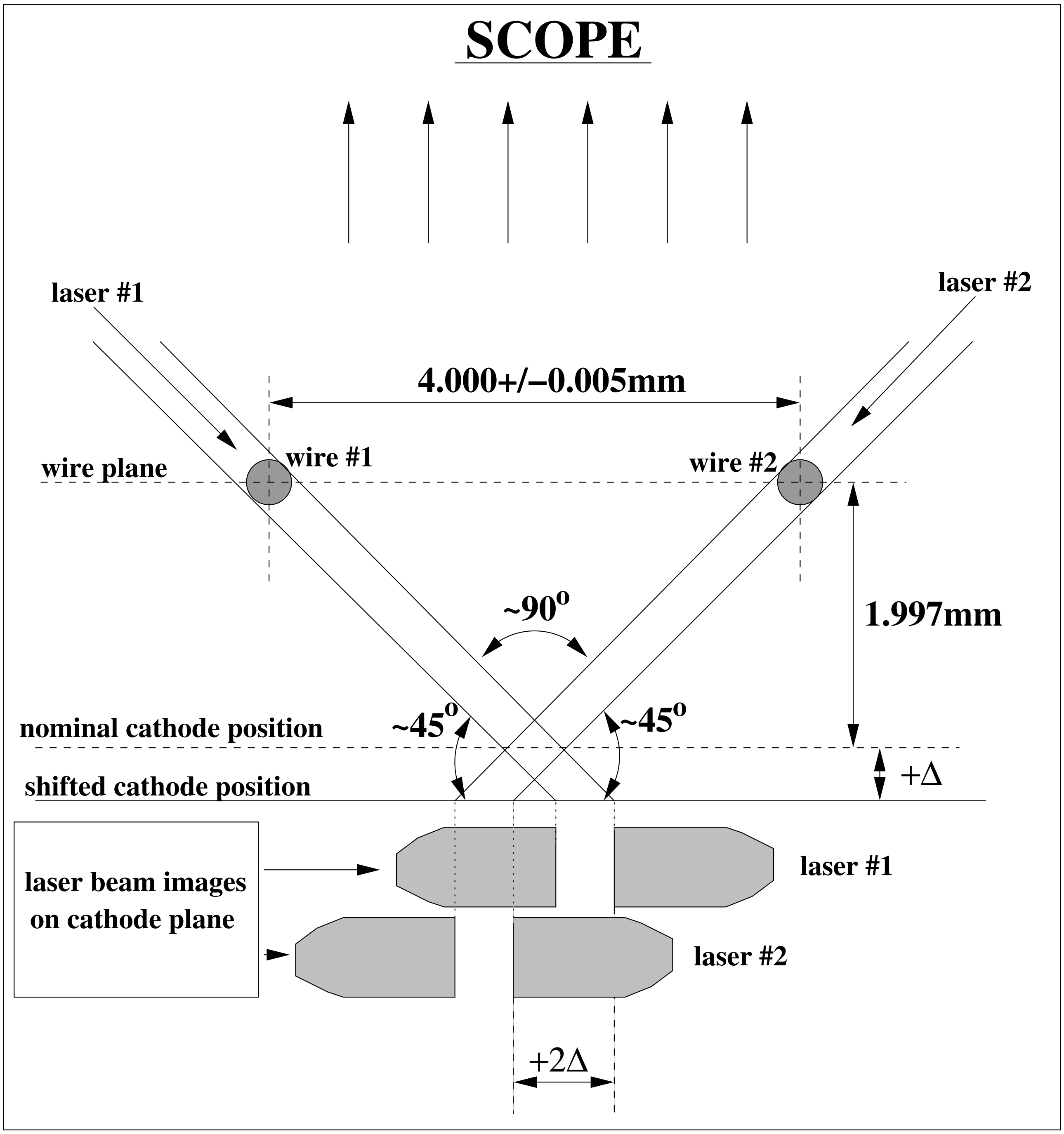


Figure 1: Schematic view of the tool. DC4 plane placed on winding table surface and fixed. Two lasers illuminate any two adjacent sense wires. Laser beam images and wire shadows are observed on cathode plane (aluminazed mylar). Distance between the shadows defines a deviation of the cathode plane from nominal value of 1.997mm. Both lasers can be moved together parallel with winding table surface in square of an inspected DC4 plane.

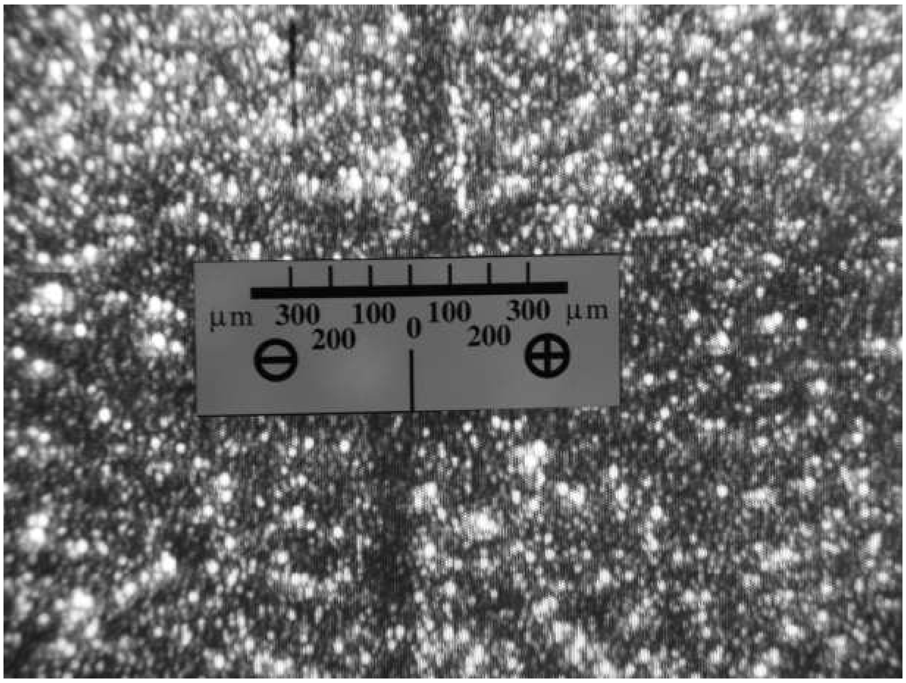


Figure 2: An example of the laser beam images on cathode plane. Distance between wire shadows is about $+120\mu m$. It corresponds to $+60\mu m$ deviation of cathode plane from nominal value of 1.997mm.

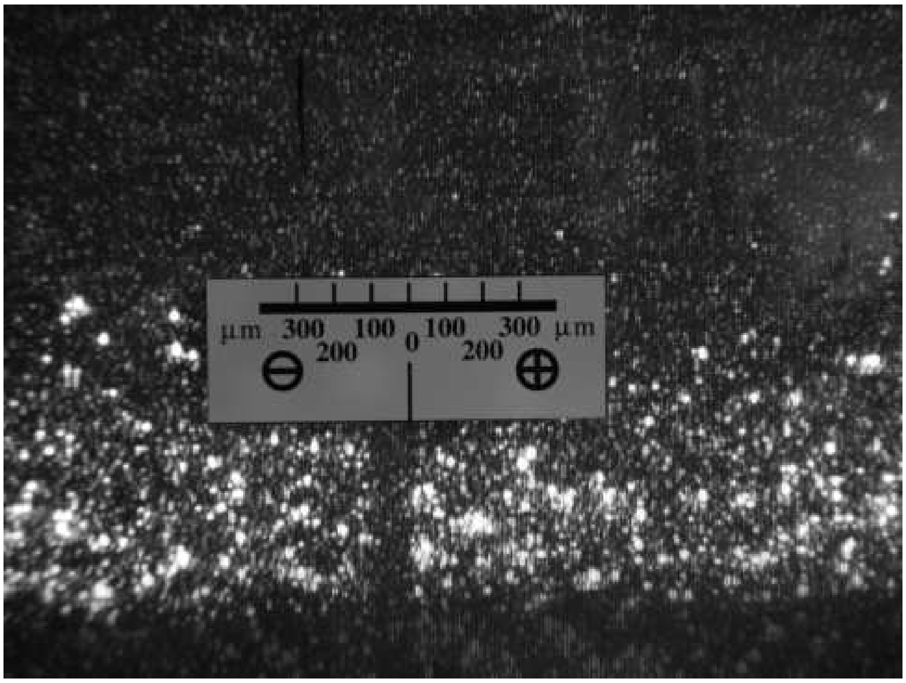


Figure 3: The same as Fig.2 but laser #1 is off.

Deviation cathode−wire plane (μm) from nominal setting 1.997mm

Signal output side, wire plane up.

X \ Y (cm)	−15	−12	−9	−6	−3	0	+3	+6	+9	+12	+15
−15				10	40	0	−20	−10			
−12			0	0	0	0	−20	−15	0		
−9		5	0	5	−15	−15	−25	−20	−25	−15	
−6	5	5	5	−10	−10	−10	−20	−20	−15	−10	−60
−3	0	5	10	5	20	−10	−15	−30	−30	−30	−60
0	10	10	5	0	−20	−10	−20	−25	−30	−40	−45
+3	10	15	5	−5	−30	−30	−25	−25	−30	−40	−40
+6	20	20	5	0	0	−30	−30	−40	−50	−30	−40
+9		0	−10	−20	−10	−30	−25	−40	−30	−40	
+12			−40	−30	−30	−20	−15	−30	−40		
+15				−50	−40	−30	−5	−30			

FRAME # 2DC0 **(permanent cathode)** 20/05/2005

mean=−14μm; RMS=18μ m; R_{max}=15cm

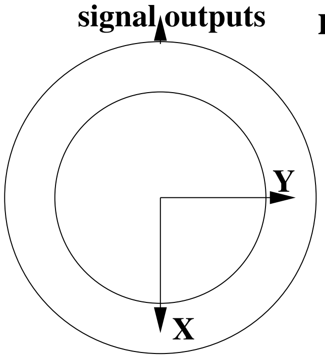


Figure 4: Map of cathode plane deviation for DC4 with permanent cathode.

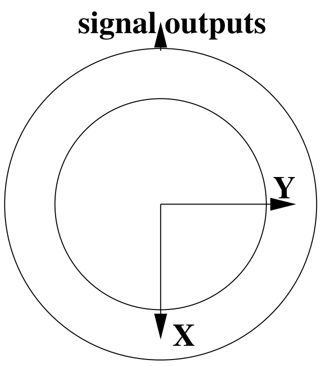
Deviation cathode−wire plane (μ m) from nominal setting 1.997mm

Signal output side, wire plane up.

Y ↓ / X →

(cm)	−15	−12	−9	−6	−3	0	+3	+6	+9	+12	+15
X −15				85	35	50	85	140			
−12			95	85	55	45	70	120	95		
−9		120	100	95	95	100	90	85	85	35	
−6	120	110	80	50	60	60	60	55	70	10	110
−3	110	20	60	55	40	60	50	20	60	60	110
0	55	35	50	10	35	50	40	50	55	25	110
+3	20	10	5	10	35	35	40	85	45	40	115
+6	5	50	20	5	5	10	5	25	50	50	60
+9		10	5	−5	−25	5	5	10	50	70	
+12			−20	−40	−40	−25	−20	−30	35		
+15				−50	−50	−45	−40	−40			

FRAME # 1DCO **(removable cathode)** 24/05/2005



mean=43 μm; RMS=44 μm: R_{max}=15cm.

mean=60 μm: RMS=37 μm: R_{max}=12cm.

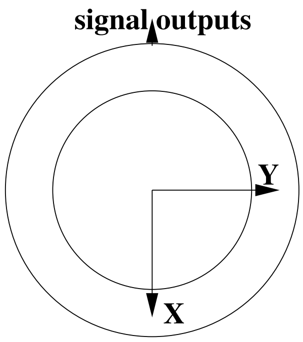
Figure 5: Map of cathode plane deviation for DC4 (#1DC0) with removable cathode.

Deviation cathode–wire plane (μm) from nominal setting 1.997mm

Signal output side, wire plane up.

X \ Y (cm)	−15	−12	−9	−6	−3	0	+3	+6	+9	+12	+15
−15				−60	−40	−40	0	0			
−12			−10	−20	−40	0	10	40	40		
−9		60	20	40	0	−30	10	10	30	50	
−6	120	100	50	40	0	0	0	20	30	60	90
−3	190	140	80	40	20	−20	0	0	30	80	110
0	210	140	90	50	20	−20	−20	0	−10	30	90
+3	230	130	80	30	−40	−40	−40	−30	−40	−10	80
+6	170	110	50	−30	−50	−90	−50	−50	−50	−50	−50
+9		60	0	−60	−60	−90	−100	−100	−100	−110	
+12			−60	−130	−110	−140	−110	−140	−40		
+15				−150	−170	−200	−170	−190			

FRAME # 012DC **(removable cathode)** 06.06.2005



mean=0; RMS=60 μm; R_{max} =15cm

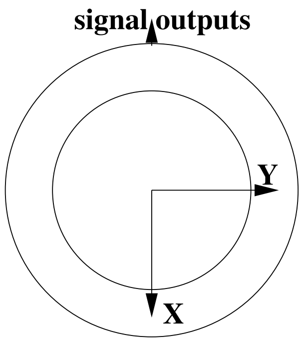
Figure 6: Map of cathode plane deviation for DC4 (#012DC) with removable cathode.

Deviation cathode–wire plane (μm) from nominal setting 1.997mm

Signal output side, wire plane up.

X \ Y (cm)	−15	−12	−9	−6	−3	0	+3	+6	+9	+12	+15
−15					−230	−250	−260				
−12			−200	−230	−230	−260	−280	−300	−310		
−9		−230	−230	−260	−240	−260	−270	−320	−330	−330	
−6	−280	−260	−240	−260	−240	−290	−300	−340	−360	−400	−440
−3	−390	−310	−300	−260	−250	−340	−340	−350	−390	−430	−440
0	−350	−300	−280	−270	−270	−280	−330	−360	−390	−420	−440
+3	−230	−210	−230	−240	−370	−300	−340	−350	−380	−360	−390
+6	−160	−180	−190	−210	−250	−300	−310	−360	−370	−330	−340
+9		−170	−160	−200	−220	−250	−280	−330	−350	−340	
+12			−160	−190	−210	−240	−260	−320	−370		
+15					−220	−240	−250				

FRAME # 041DC **(removable cathode)** 03.06.2005



mean=−300 μm; RMS=68μm; R_{max} =15cm.

Figure 7: Map of cathode plane deviation for DC4 (#041DC) with removable cathode.