REPORT ON WIRE CHAMBER PRODUCTION

D.Allen, Yu.Davydov, V.Torokhov

As of today, 47 DC planes, 4 PC and 4 PC target (PCT) planes have been strung and are on different stages of construction or in use.

Each DC plane has 80 sense wires of 15 μm diameter and two guard wires (diameters 25 and 50 μm) on each side with a wire spacing of 4 mm. The PC and PCT planes have 160 and 48 sense wires, respectively, with a wire pitch of 2 mm and three guard wires (diameters 25, 50 and 75 μm) on each side. During chamber production wires of 15, 25, 50 and 75 μm are loaded with weights of 35g, 50g, 80g and 100g respectively.

When the plane is strung, the tension of each wire is measured before moving the plane from the winding table in order to avoid leaving wires with loose tension. Fortunately we had to replace just one wire at this production stage over all DC and PC planes.

One of the best examples of a wire tension scan and a tension distribution for the sense wires of plane 022DC is shown on **Figure 1**. The mean value of the tension is less than the applied weigth due to the friction of the wires on the surface of the winding tool. Normally the r.m.s. of a wire tension distribution for each individual plane is in the range of 0.3-0.7g, but in some cases we have had an r.m.s. of up to 1.7 g! This has happened mostly when new people produced their first planes.

Figure 2 shows the tension of the sense wires for all 47 DC planes. The distribution of the first 25 and last 22 planes are shown as well. One can see that the mean value of the tension for the last planes has decreased by about 1g. The most likely cause of this is increasing friction on the pulley.

The tension of sense wires for PC and PCT planes are shown on **Figure 3**.

The position of wires in the X and Z directions are measured using ACU-RITE system with two CCD cameras. We can measure wire positions on both ends of the chamber (on READOUT SIDE and PAD SIDE) at about 10 cm from the chamber center. During the wire position measurement the plane rests free on a horizontal granite table. **Figure 4** shows a typical (at least for X) example of X and Z scans and residuals for the pad side of plane 018DC (sense and guard wires). Wire coordinates in both X and Z directions have been fitted by linear functions and residuals from the best fit are shown on the left frames for X and Z. The wires are very precisely positioned in the X direction (σ=2.4μm). Do not pay too much attention to the σ of Z residuals because it does not reflect the real situation. The glass frame has a gravitational sag of about 20μm in the center between the two citals when it rests free on the horizontal surface (it was estimated long time ago by V.Selivanov et al.), and this sag is seen on the bottom left frame of Figure 4. Also, the guard wires have bigger diameters and therefore rise above the sense wires because all the wires lie on the same glass ruler surface during chamber production. In real life, the residuals of the Z scan have more complicated forms due to bended glass frames. It is believed it disapears when the planes are compressed in the vertical position (wires are fixed on glass frame with winding table in vertical position).

The precision of the wire positioning includes a measuring system error and a "human" factor (operator decides where the wire center is when looking at the wire image on the monitor). The human error of the wire position measurement is shown on **Figure 5** for the same pad side of plane 018DC. The position of each wire is measured twice, once forwad and once backward (for DC and PCT planes). The distribution of the difference of the two measurements for each wire is plotted on figure 5. Typical error in the measurement of the wires X coordinate is about of 1 μm. It is about of 2 μm for the Z coordinate.

The residual X scan of the wires for plane 033DC is presented on **Figure 6**. The coordinates of each wire in the center has been calculated by placing the first sense wire at 0 on both ends (and in center automatically) and using the coordinate of each wire relative to the first one. The coordinate of each wire in the planes center, for example, can be expressed as X_n=3.99996n$\pm$0.00239 mm, where n=0,1,...79.

A number of wires have been broken due to the cleaning of the planes and/or due to the scimming of glue and soldering pads. Broken wires are replaced with high precision (normally better then 10 μm) using a very simple method. Wire positions are measured again after replacing the broken wires. **Figure 7** presents two measurements of the wire's X positions on the readout and pad sides for 014DC plane. Those who have colour monitors can see the original measurement (blue) and the new measurement (green) and the replaced wire #20 (red). These plots demonstrate the reproducibility of the measurement as well.

The precisions of wire positioning (σ) on the readout and pad sides and in the center of the chamber (calculated as it was mentioned above) for 39 DC planes are shown on **Figure 8**.

Finally, **Figure 9** and **Figure 10** present examples of X and Z scans of the PC and the target PC planes, respectively. The σ's of X positioning of the PC planes wires are in a range of 2.9-4.0 μm and the PC target planes wires are in a range of 3.0-4.0 μm.

Graphs of wire tension and the X and Z positioning of individual wire planes are available on the E614 data base website (https://e614db.triumf.ca/e614db/).

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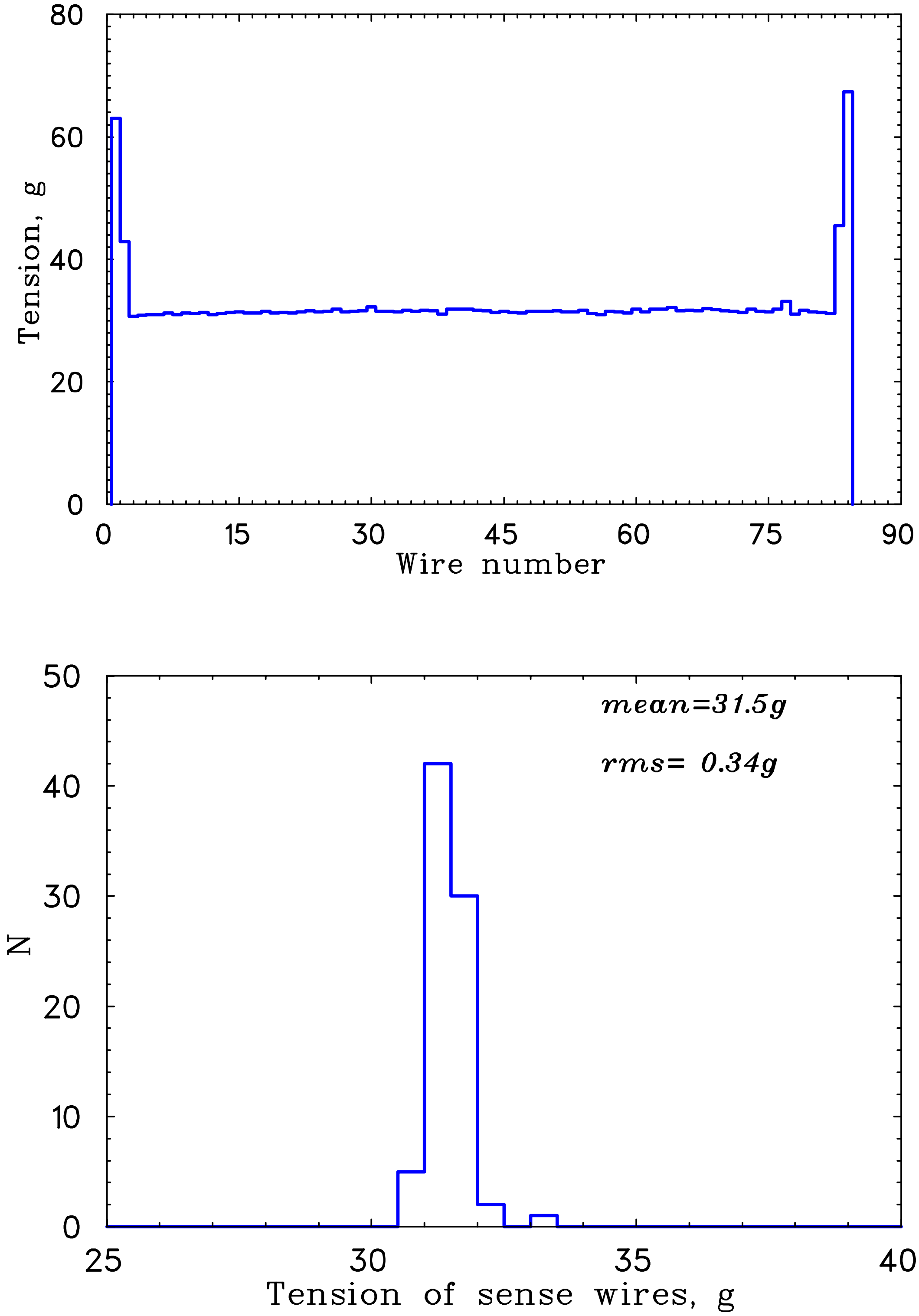

Figure 1: Tension of wires on plane 022DC.

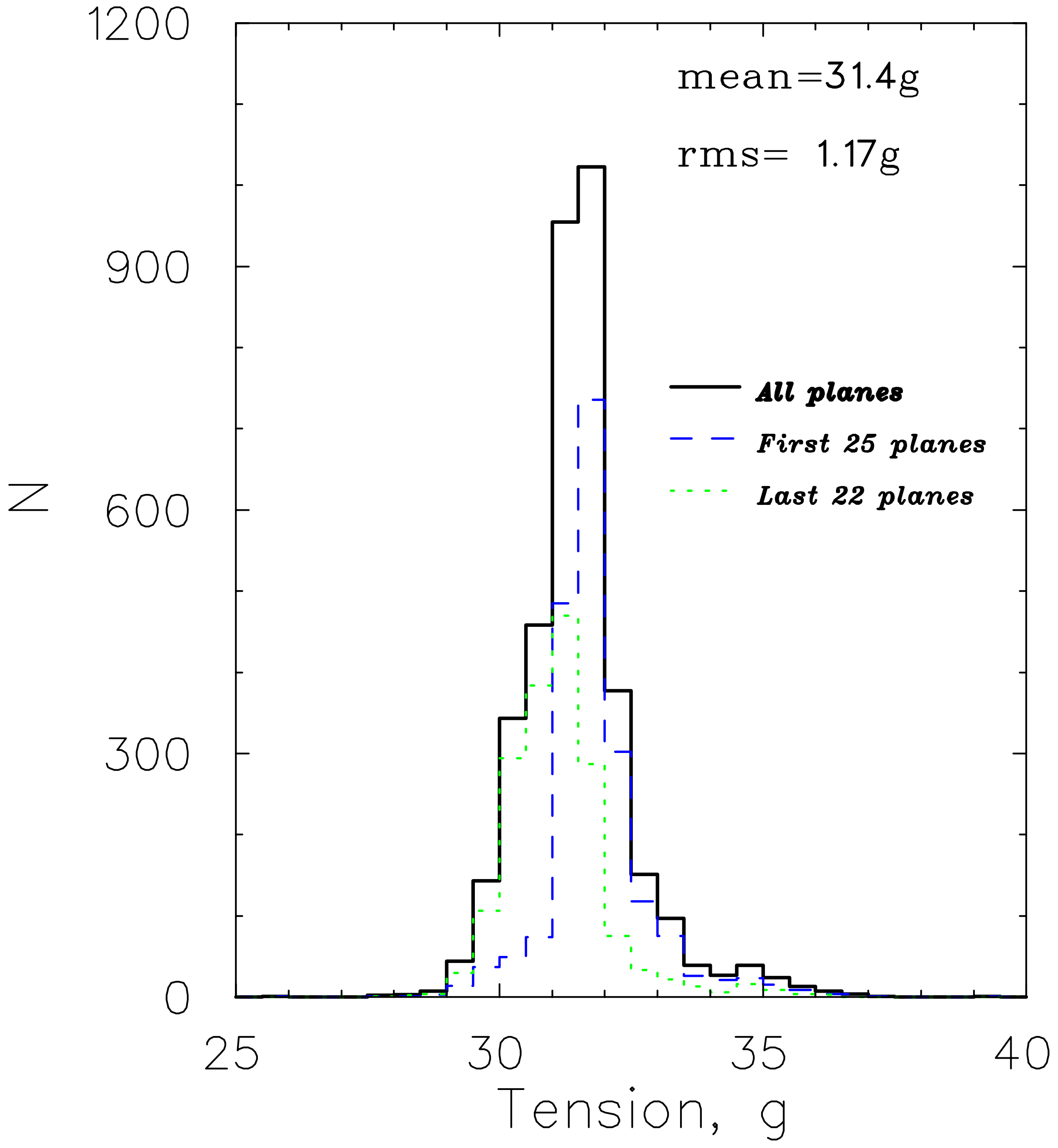

Figure 2: Tension of the sense wires over 47 DC planes (3760 wires totally)

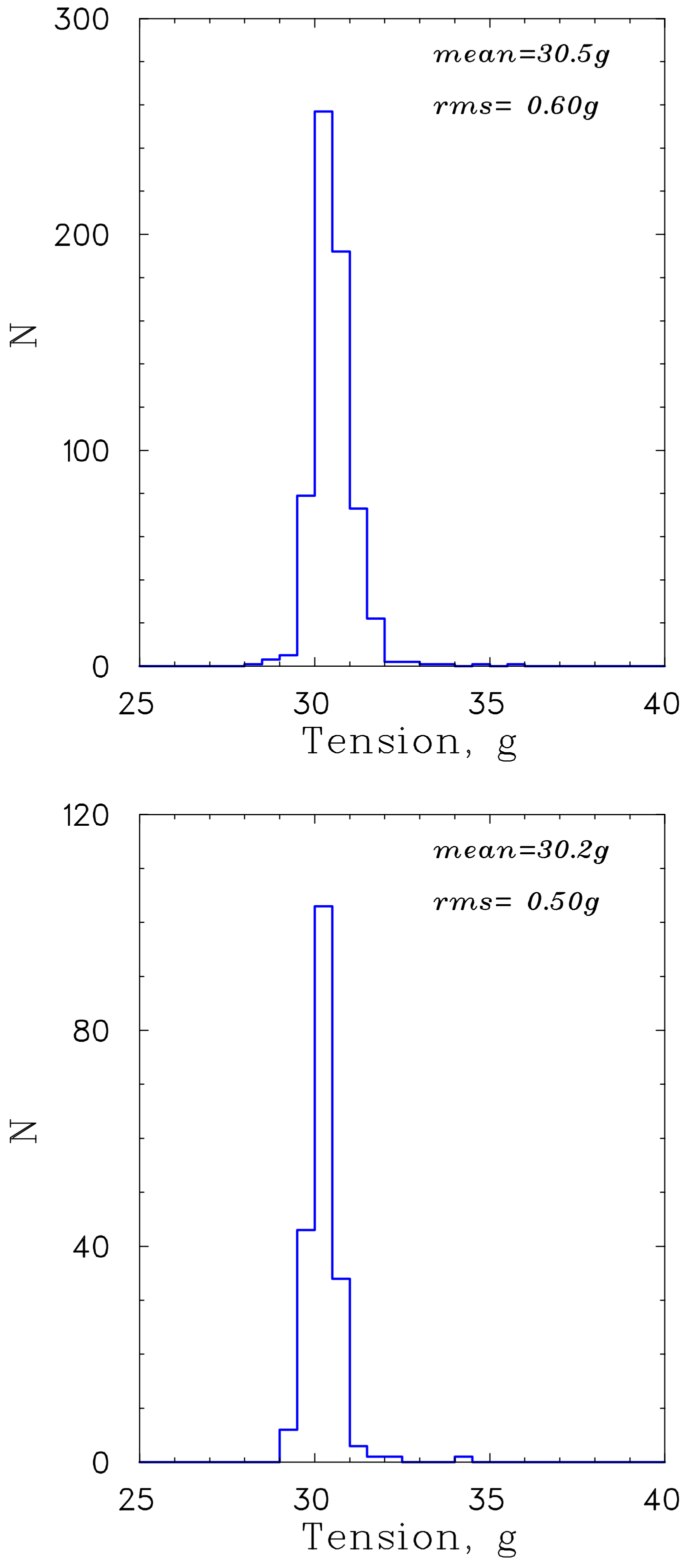

Figure 3: Tension of the sense wires of the four PC planes - 640 wires total (top frame) and four target PC planes - 192 wires total (bottom frame)

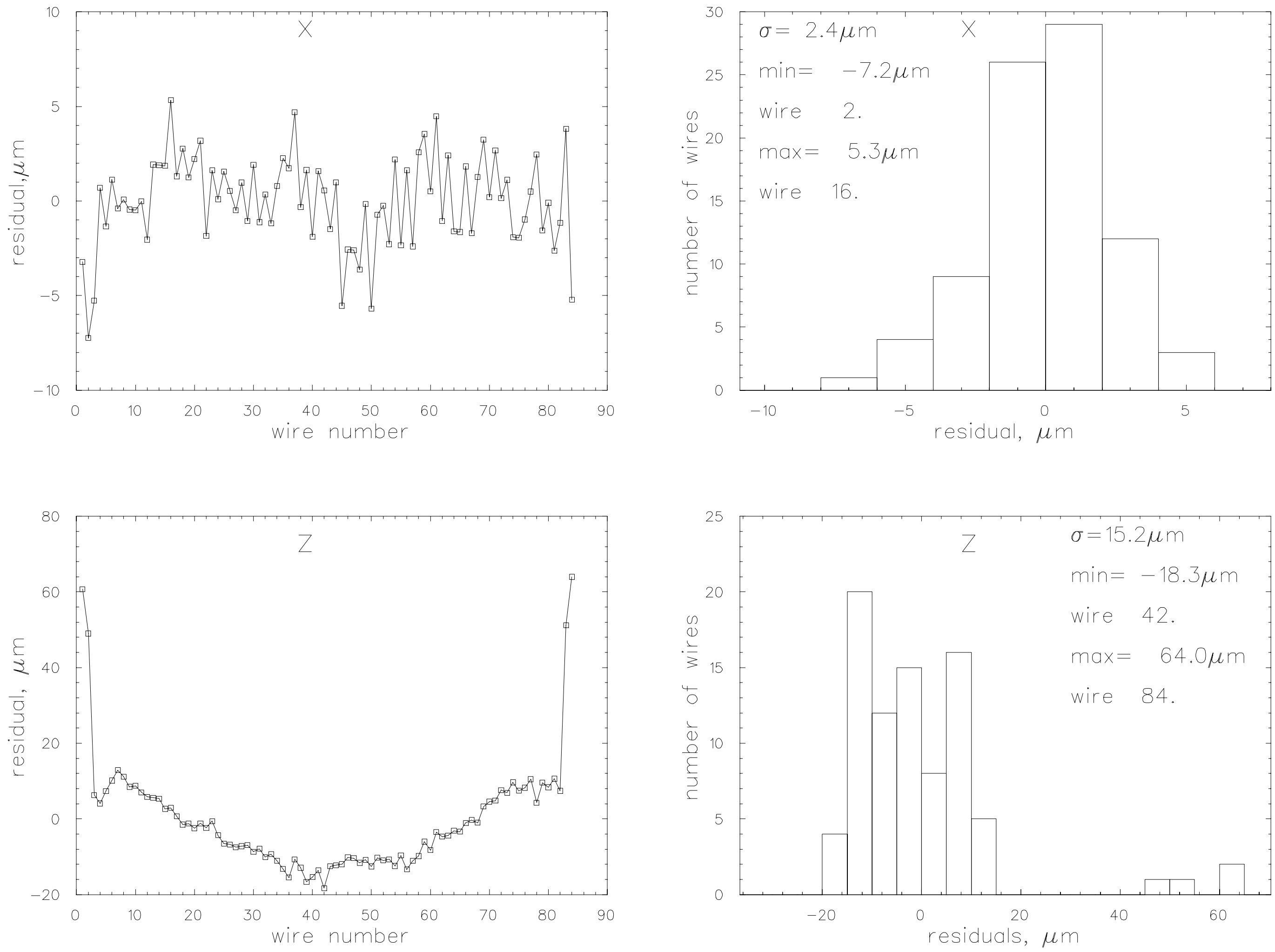

Figure 4: An example of X and Z scans of wires on the pad side of 018DC plane

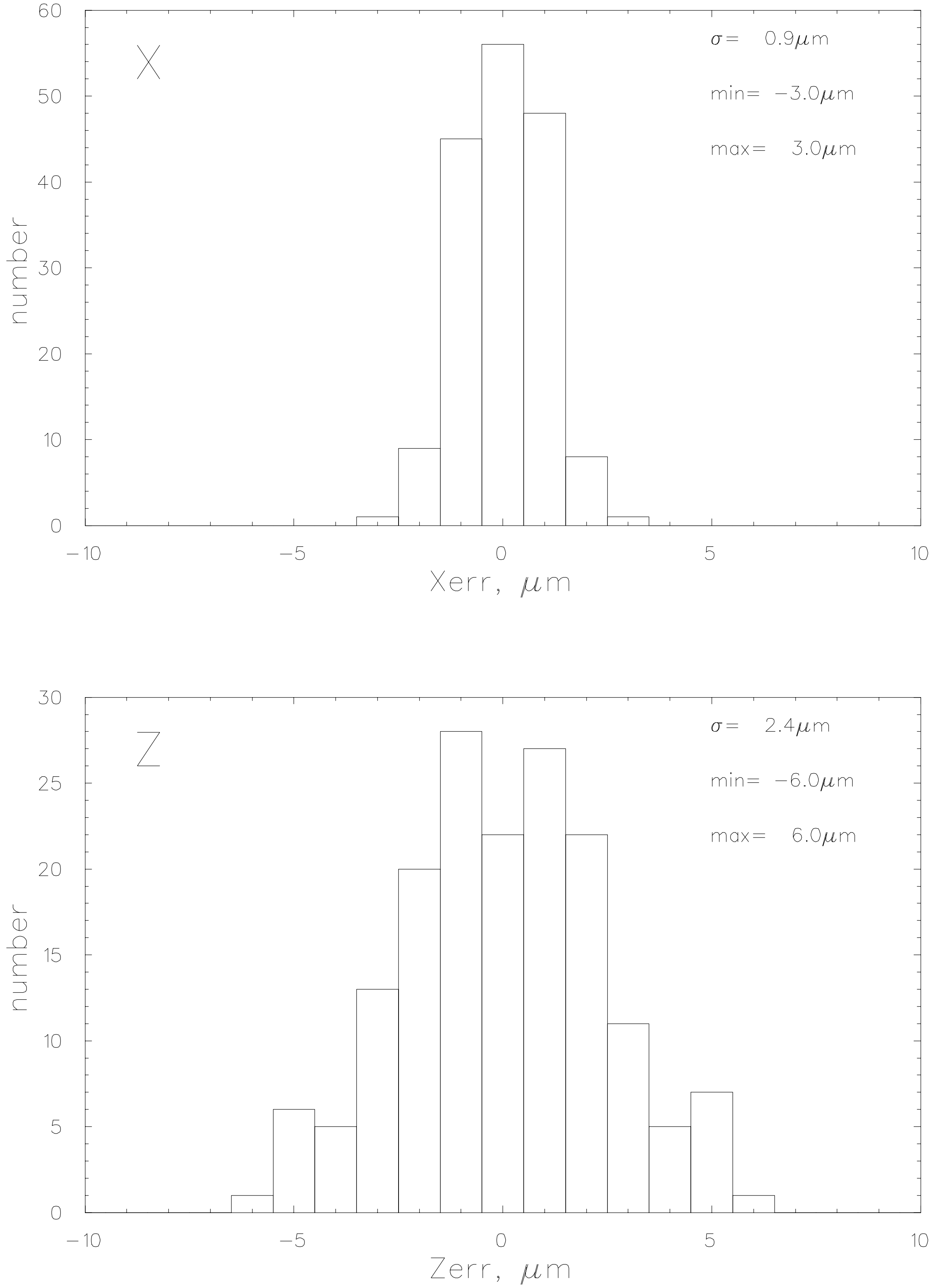

Figure 5: Error of measurement of wire positions (”human” factor) for pad side of 018DC plane. Typical error in measurement of the wire X coordinate is 1 μm

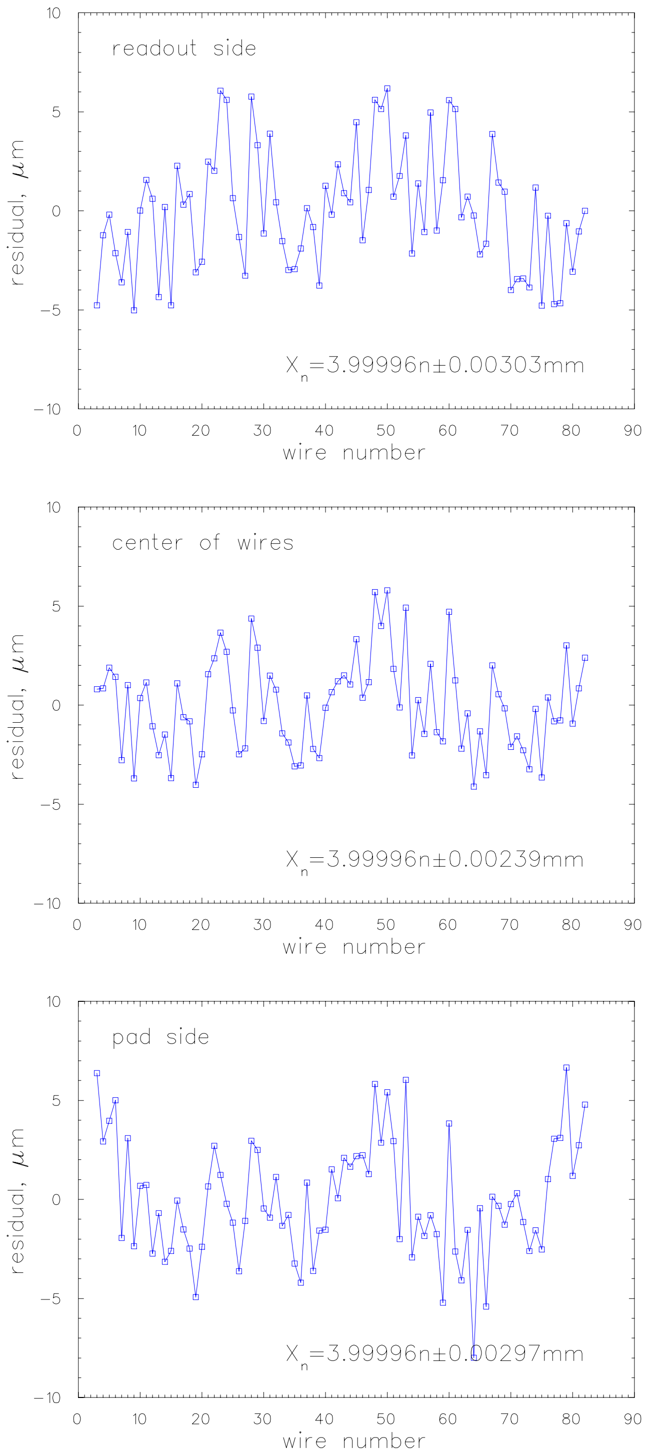

Figure 6: X scans of wires from plane 033DC for readout and pad sides and for center of chamber

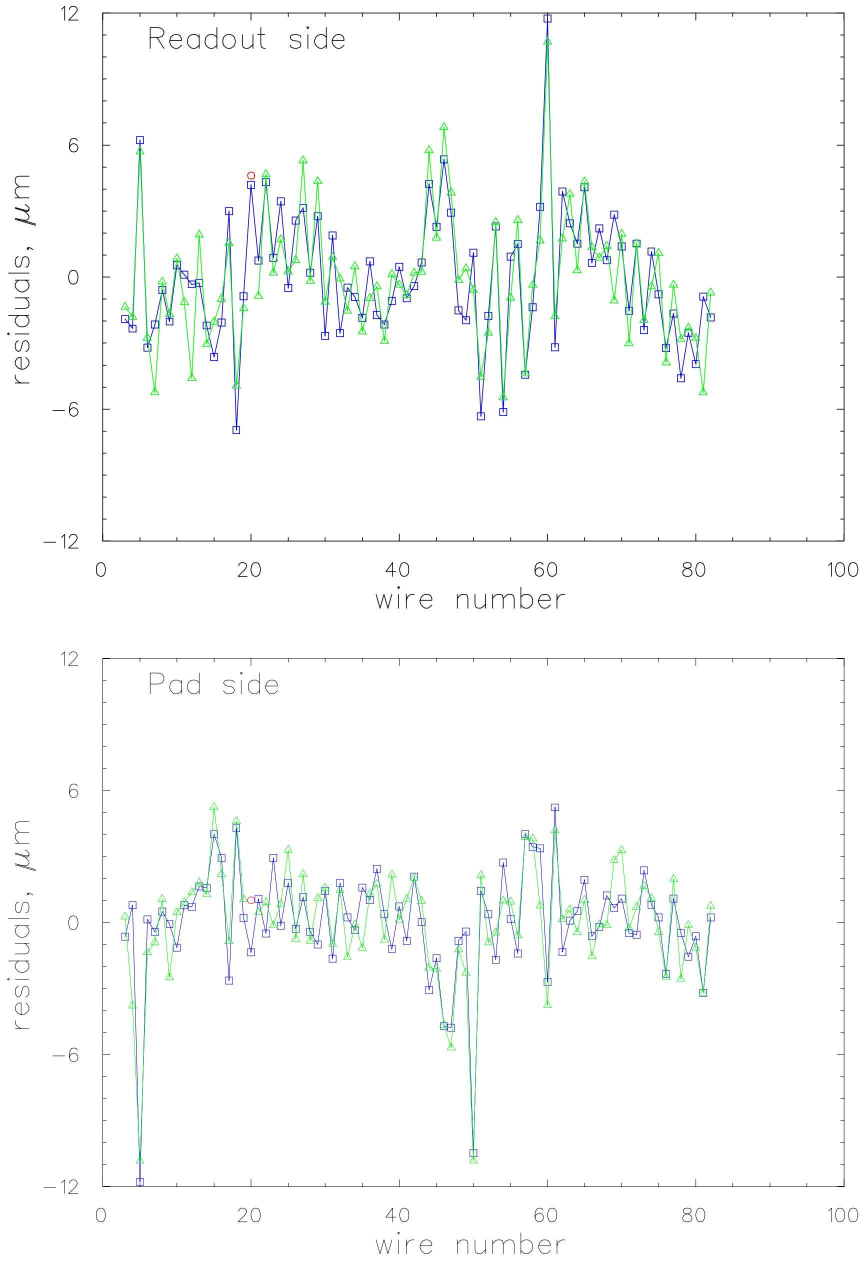

Figure 7: X scans of sense wires of 014DC plane for readout and pad sides. Those who have colour monitors can see the original measurement (blue) and the new measurement (green) and the replaced wire #20 (red).

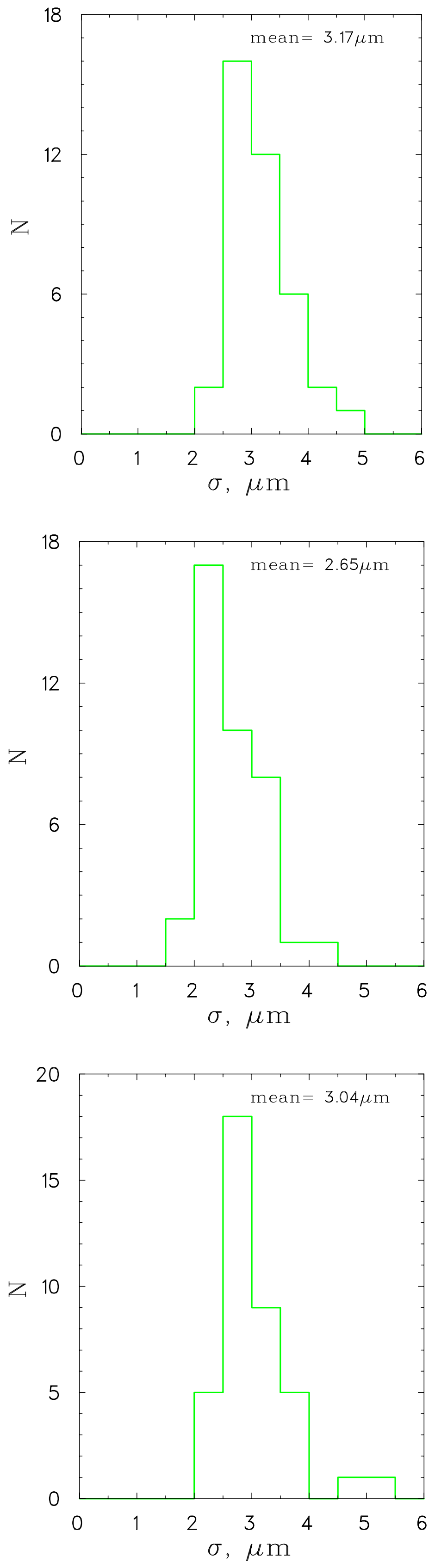

Figure 8: Precision of wire positioning in the readout (top frame) and pad (bottom frame) sides and in the center of planes (central frame) for 39 DC planes

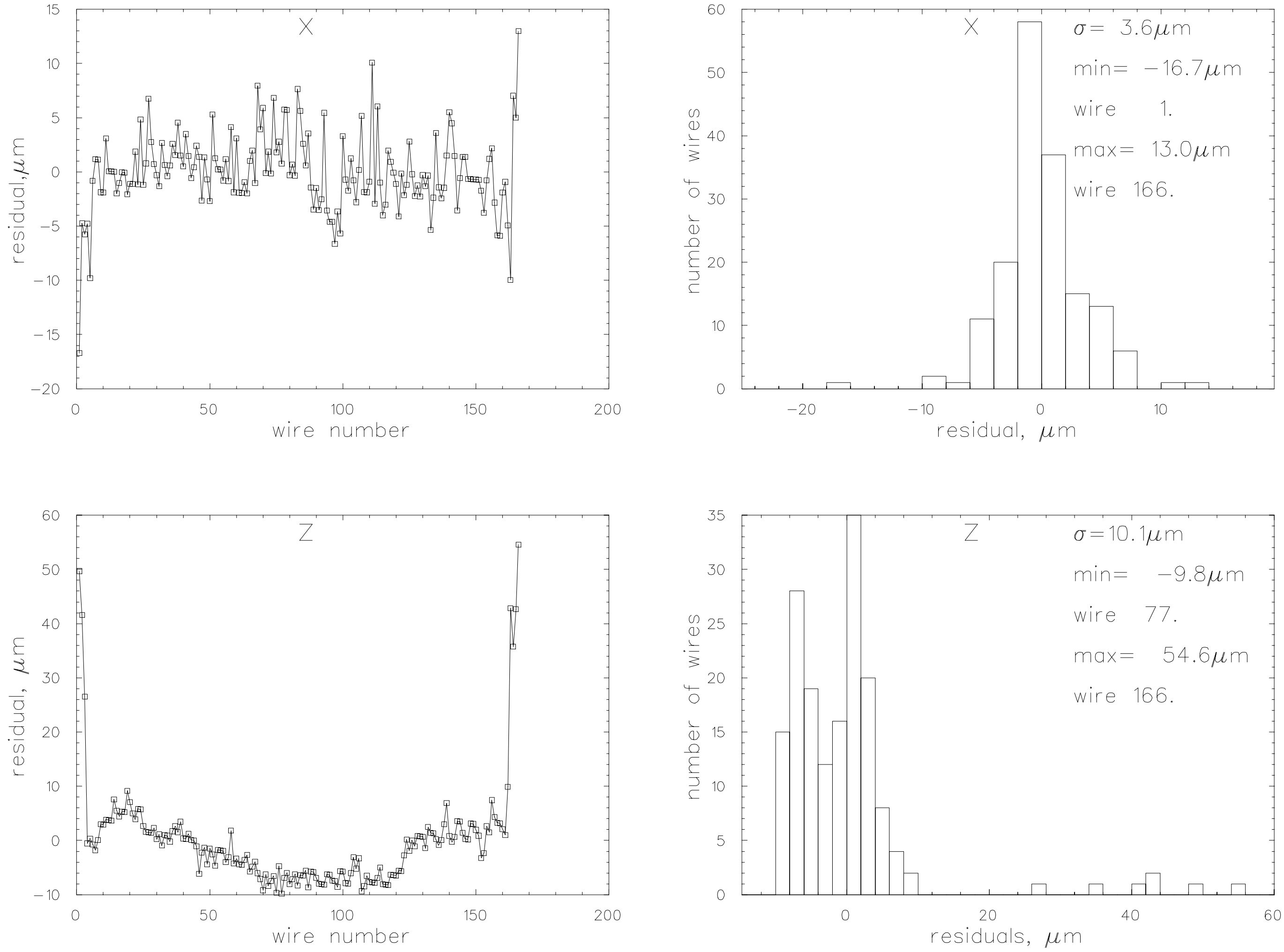

Figure 9: An example of X and Z scans of wires on the pad side of 152PC plane

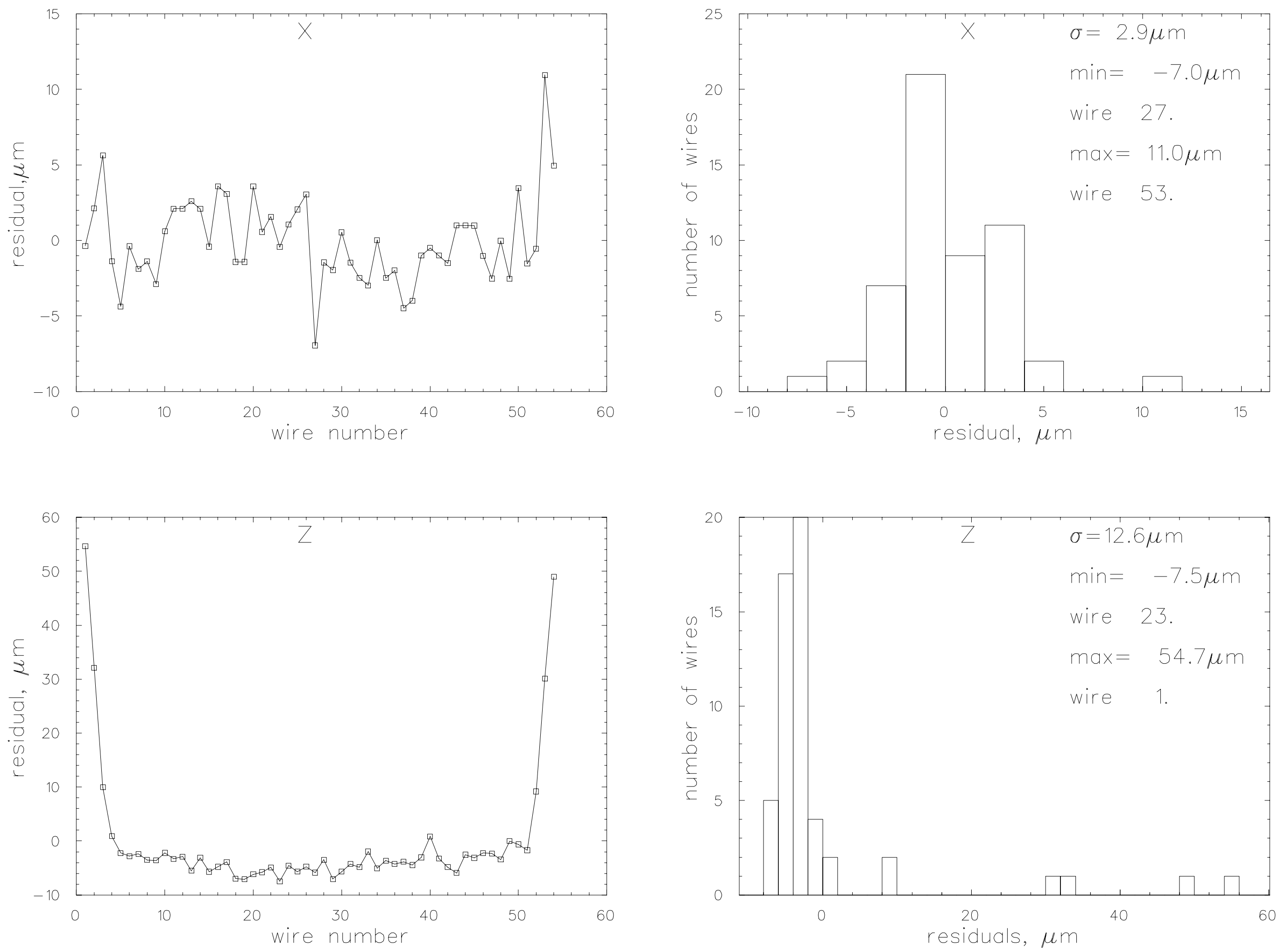

Figure 10: An example of X and Z scans of wires on the pad side of 194PC target plane