

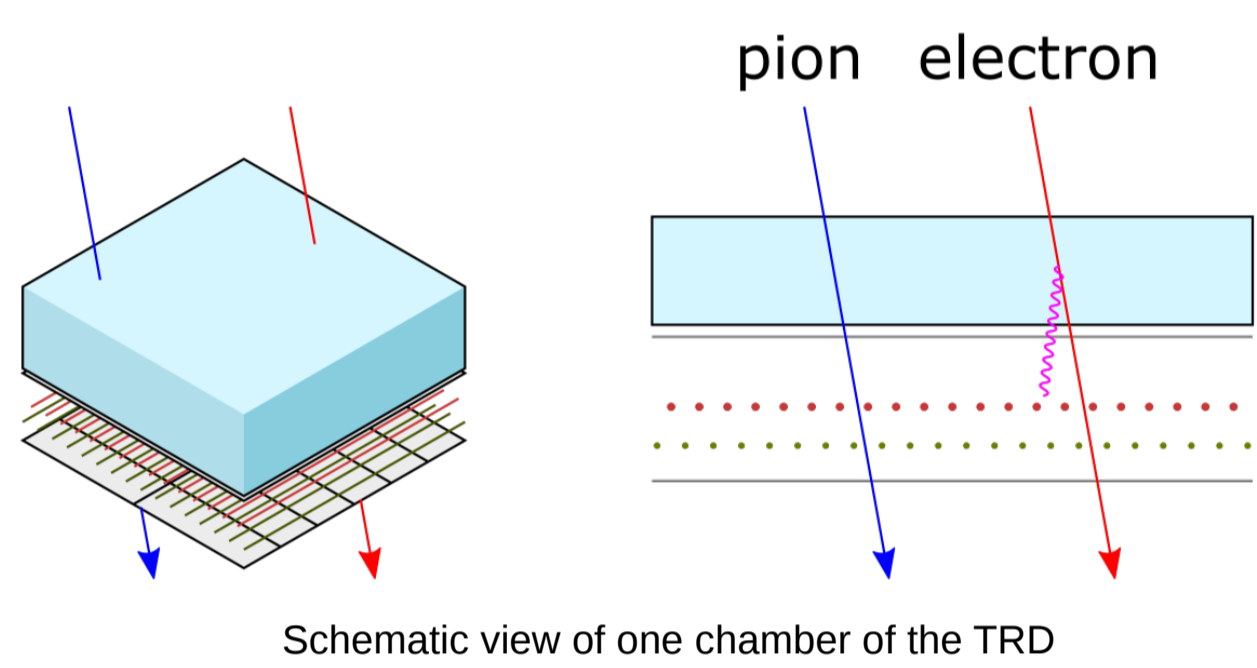
Implementation of an automated Position and Tension Determination of Wires in MWPCs

Murat Esen for the CBM collaboration
IKF - Goethe Universität, Frankfurt, Germany

Compressed Baryonic Matter experiment at FAIR

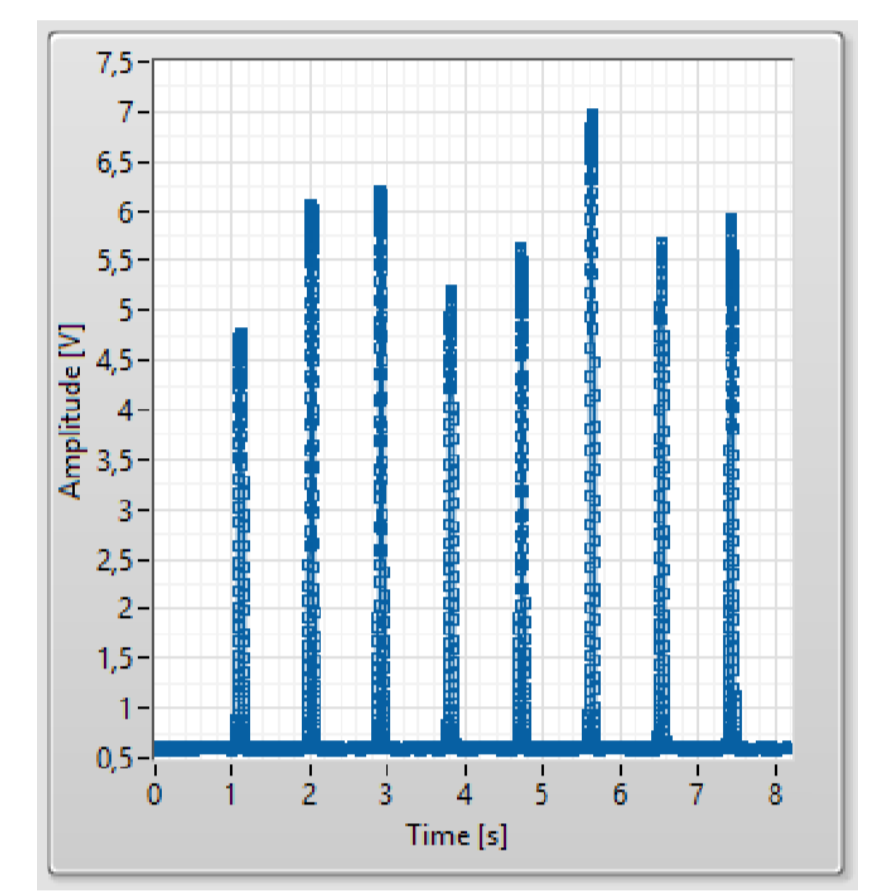
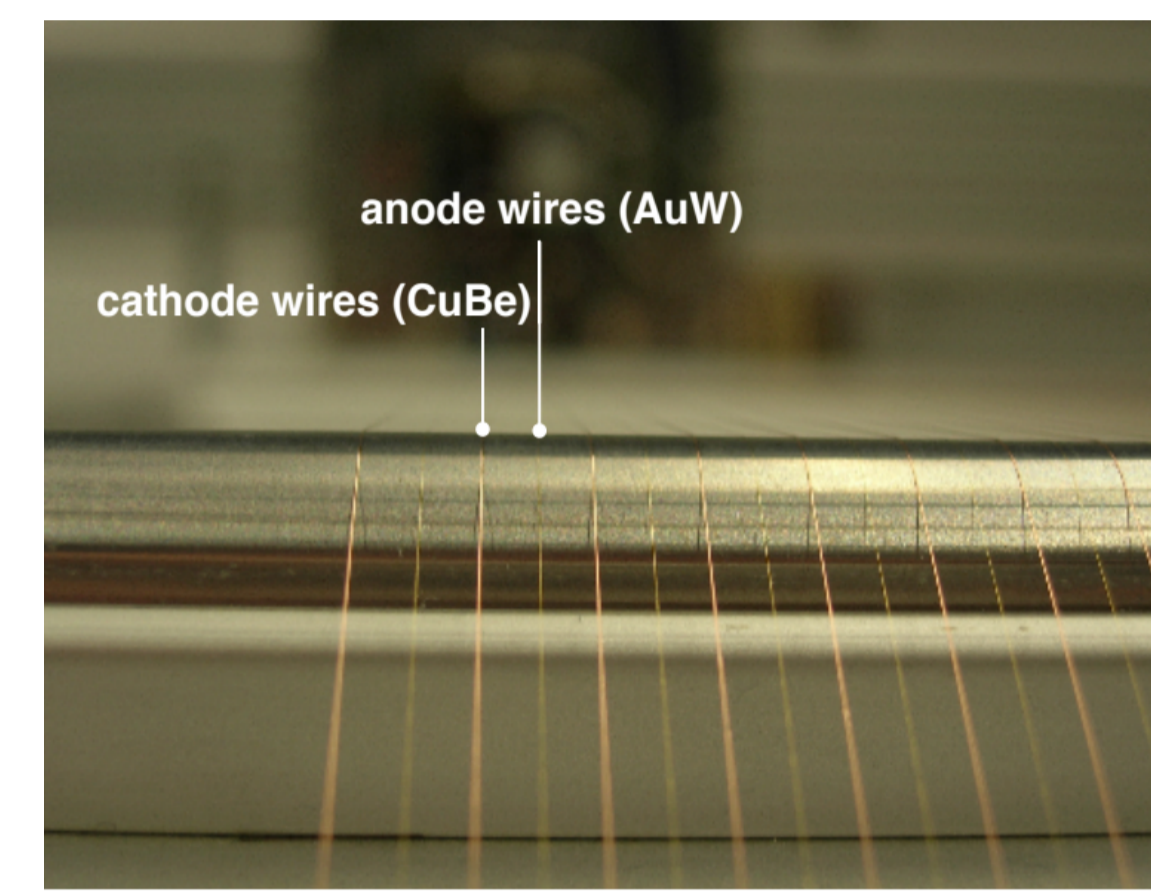
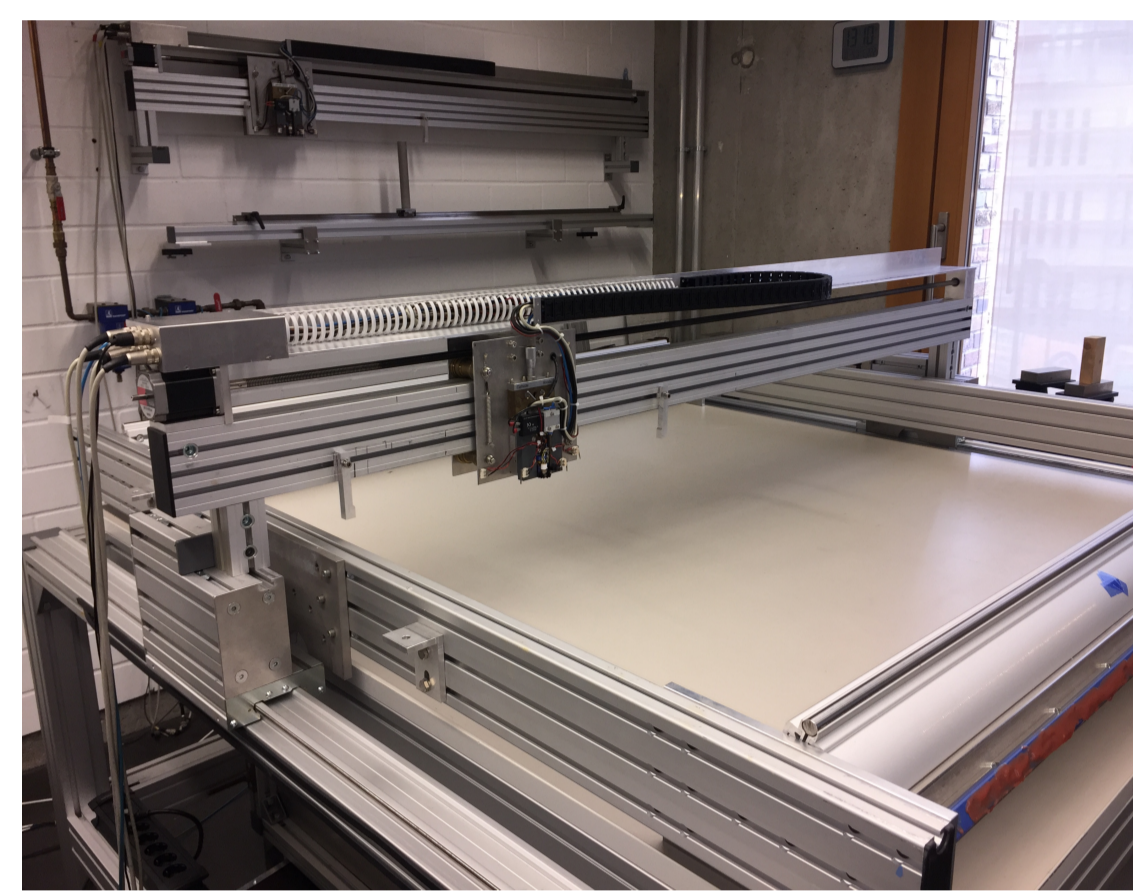
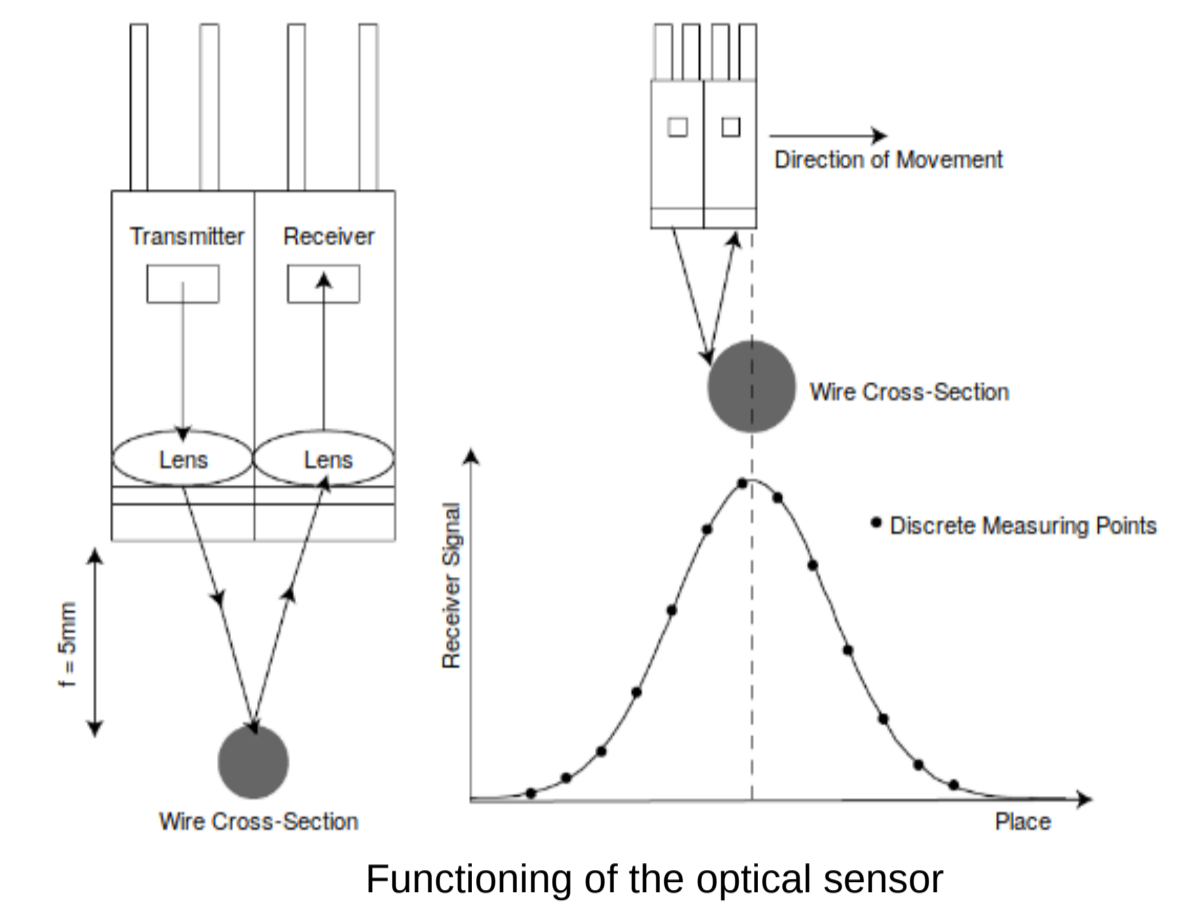
Motivation

- The Compressed Baryonic Matter Experiment (CBM) will investigate the properties of dense baryonic matter
- The Transition Radiation Detector (TRD) will provide electron identification for momenta above 1.5 GeV/c
- Every chamber requires specific and constant electric fields and gas gain
 - Constant wire gaps and tensions
- 216 chambers require a reliable automatic testing procedure
 - The Wire-Test-Device^[1] (WTD) was developed to measure the position and tension of wires



Reference run for position determination

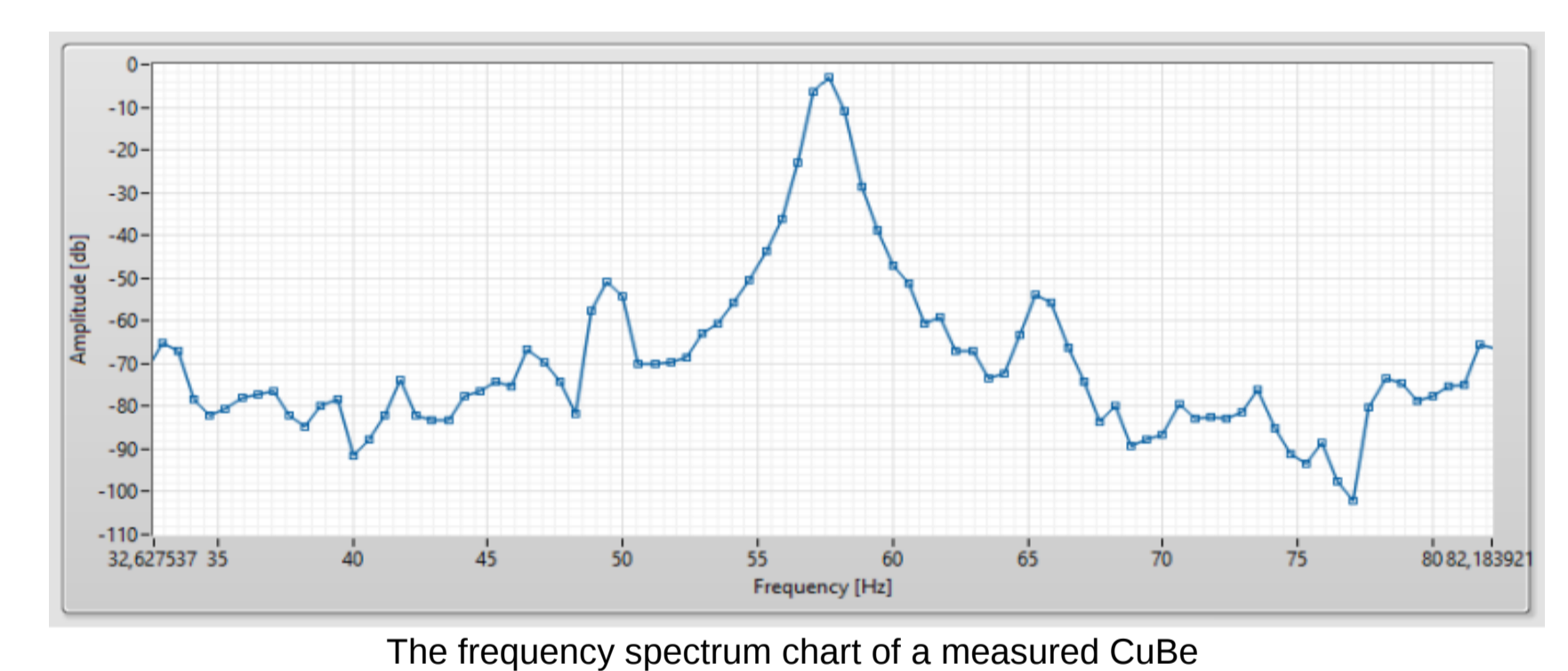
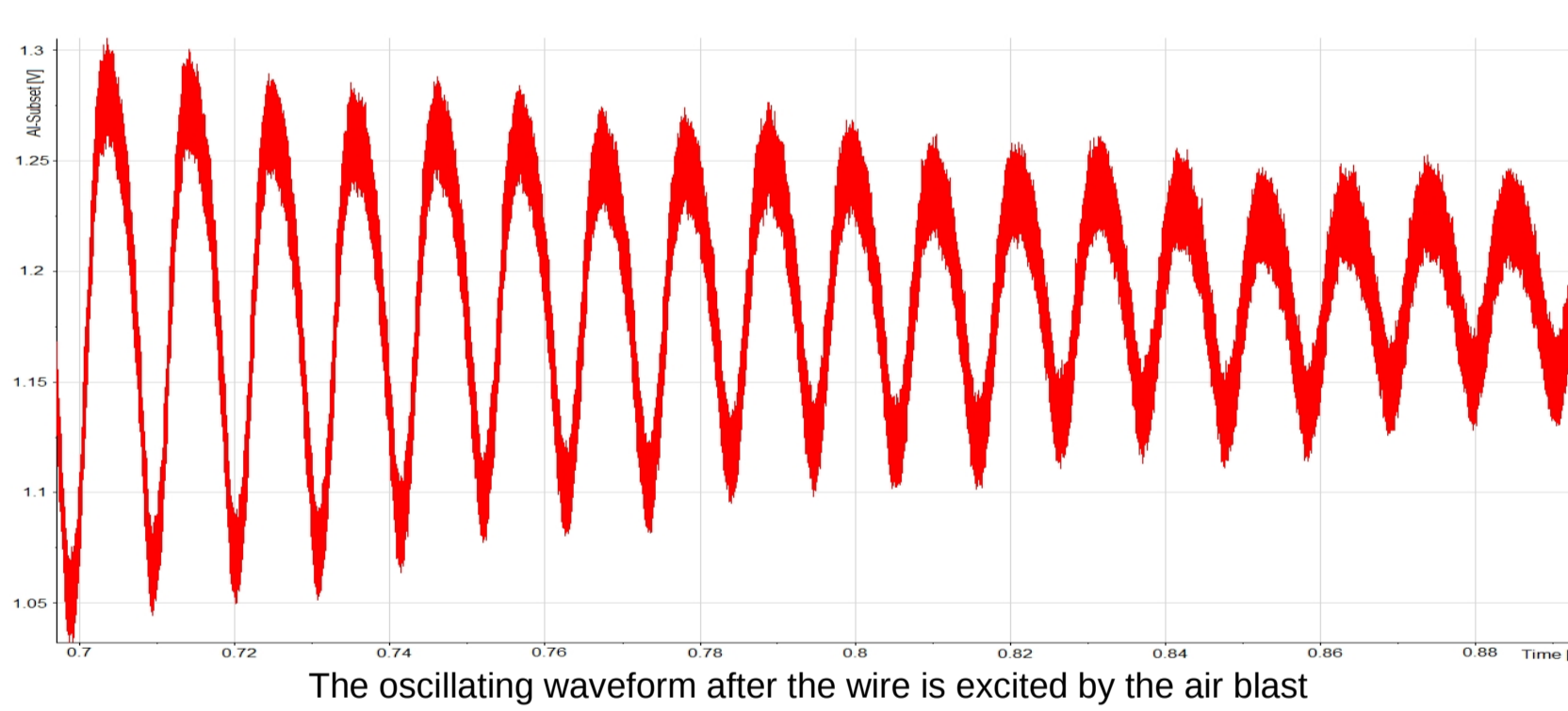
- An optical sensor is driven at a constant speed over the measuring range via a linear actuator
- The sensor measures the reflection on surfaces with a sampling rate of 1000 Hz
- Based on the recorded data of the reference run the position and the pitch of the wires can be calculated



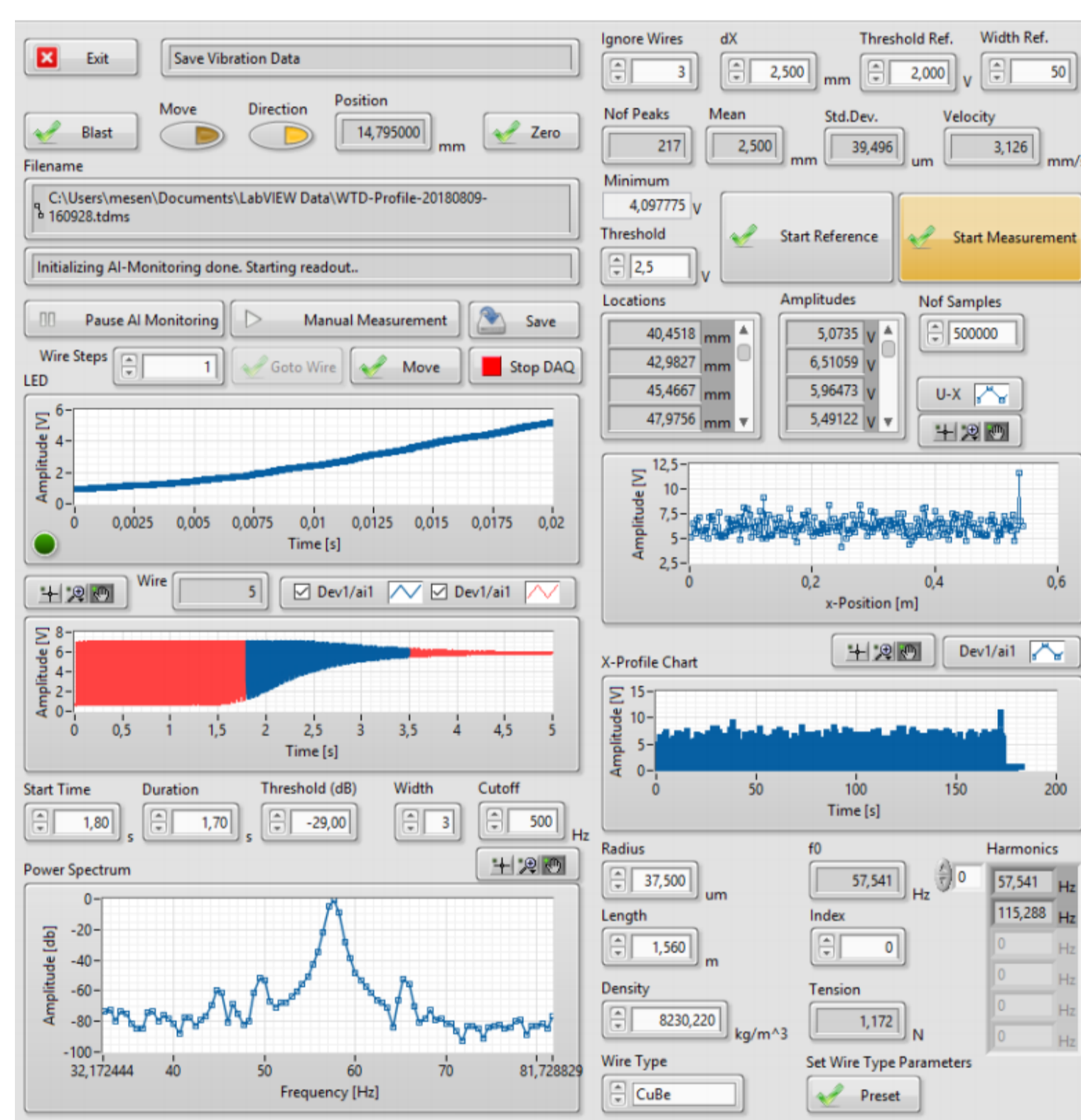
Wire tension measurement

- Each wire is approached and measured individually
- The photo sensor is positioned over a wire and then excited by a short air blast
- The oscillation of the wire is measured with the optical sensor
- By means of a Fourier transformation, the frequency f_0 of the oscillation can be calculated from the measured reflection
- Taking into account the material parameters wire radius r , density ρ and length l , the mechanical tension of the wire can be determined

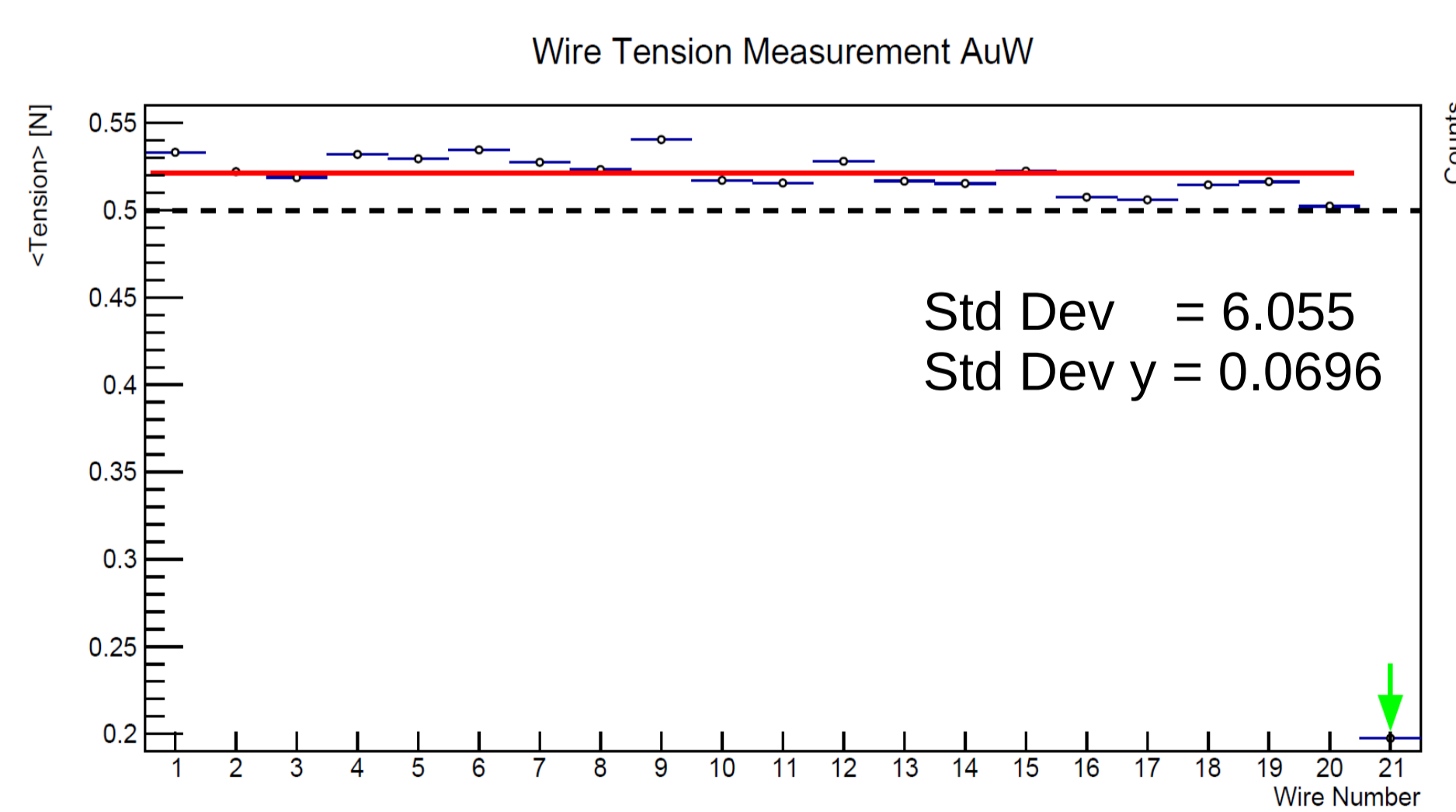
$$F = 4f_0^2 \cdot l^2 \cdot \rho \cdot \pi \cdot r^2$$



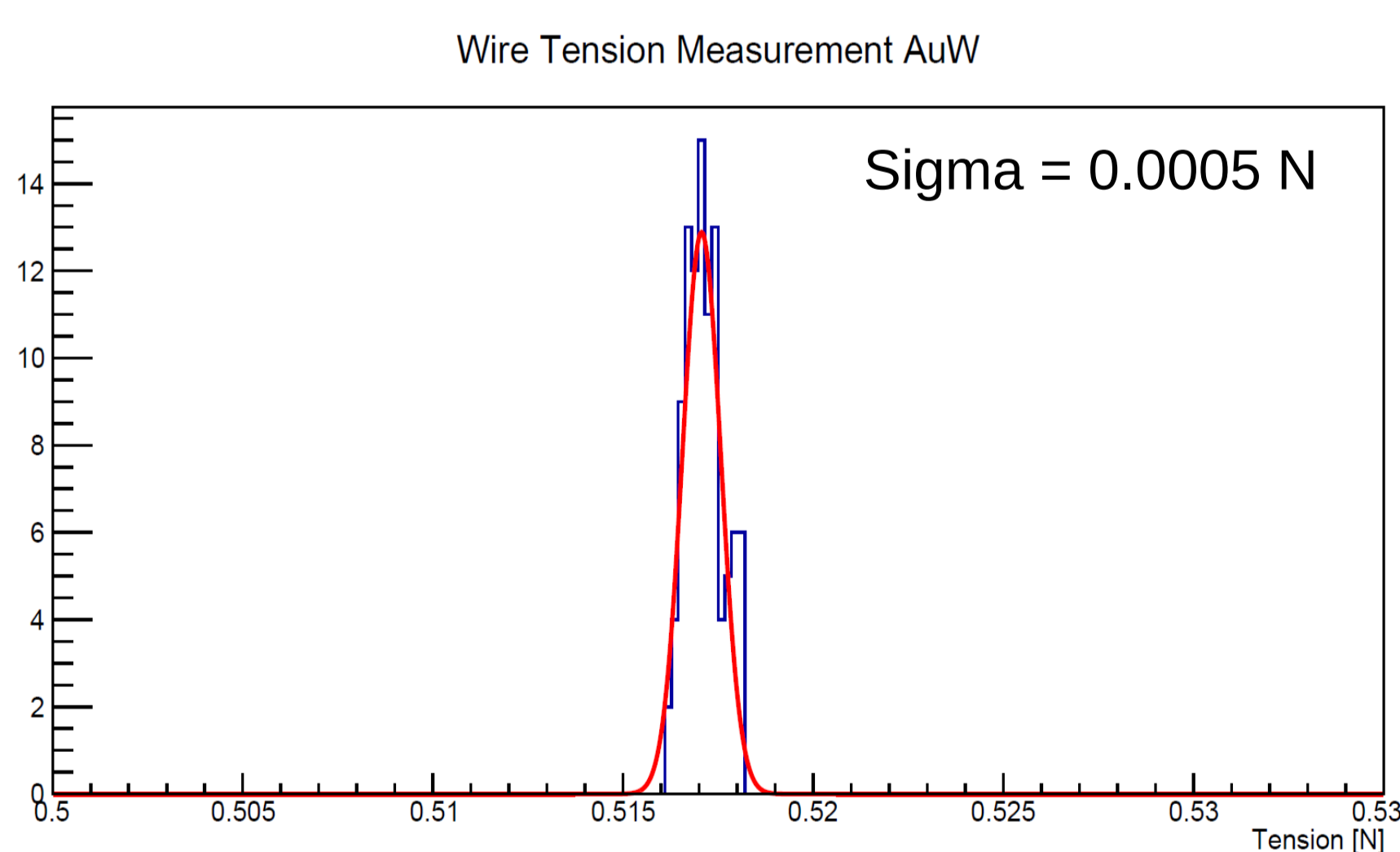
Graphical user interface



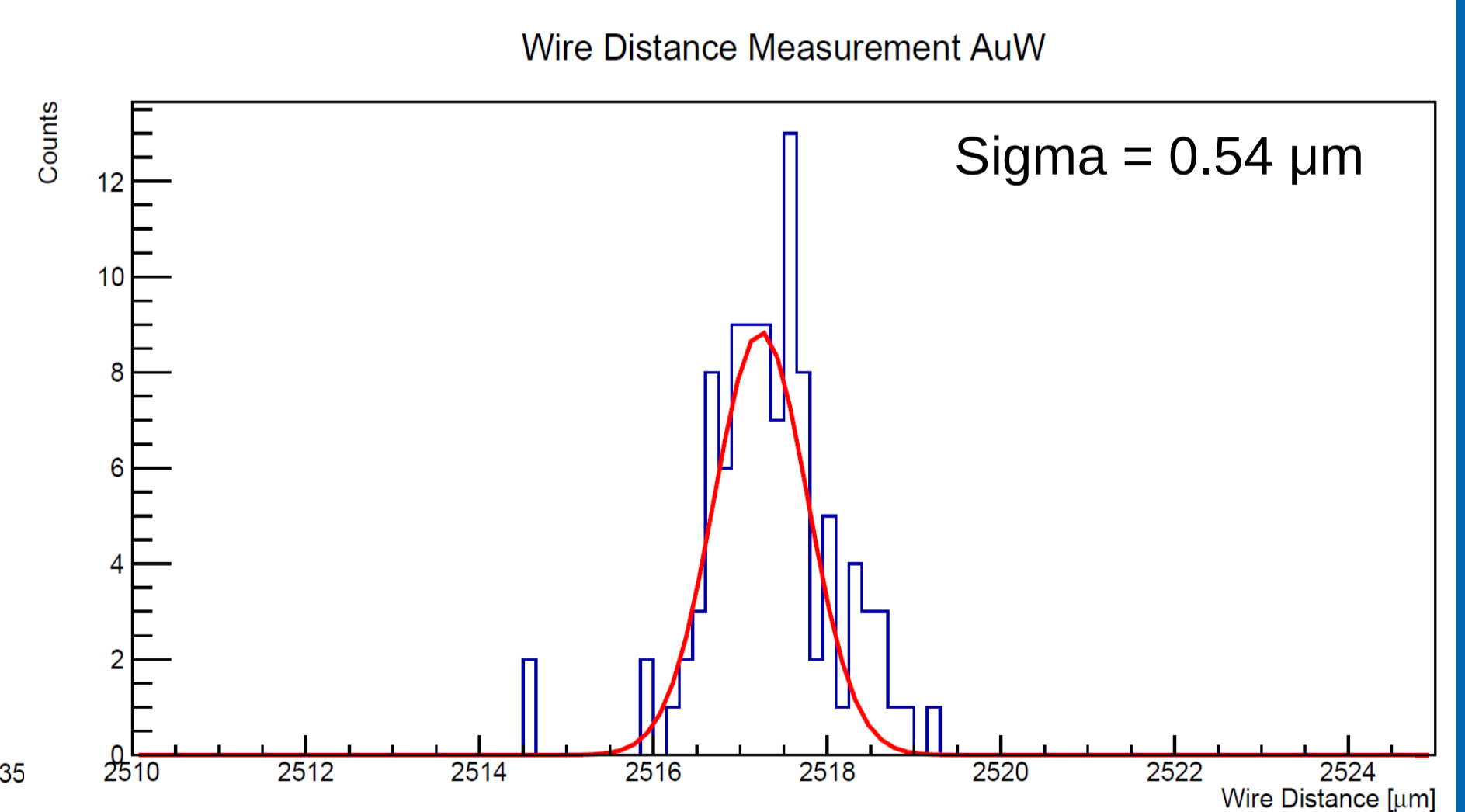
Results



- Test run of WTD
- 100 repeated measurements of 21 AuW wires
- Nominal tension from winding: 0.5 N
- Wire 21 (↓) manipulated (mechanically stressed)



- Tension distribution of a single AuW wire
- Result variation on the per mille level



- Wire spacing distribution of a single AuW wire
- Nominal wire spacing from winding: 2.5 mm
- Result variation on the per mille level

[1]: Entwicklung einer Apparatur zur automatisierten Positions- und Spannungsbestimmung von Drähten in Vieldrahtproportionalzählrohren by Holger Gottschlag (Westfälische Wilhelms Universität Münster – Institut für Kernphysik)