

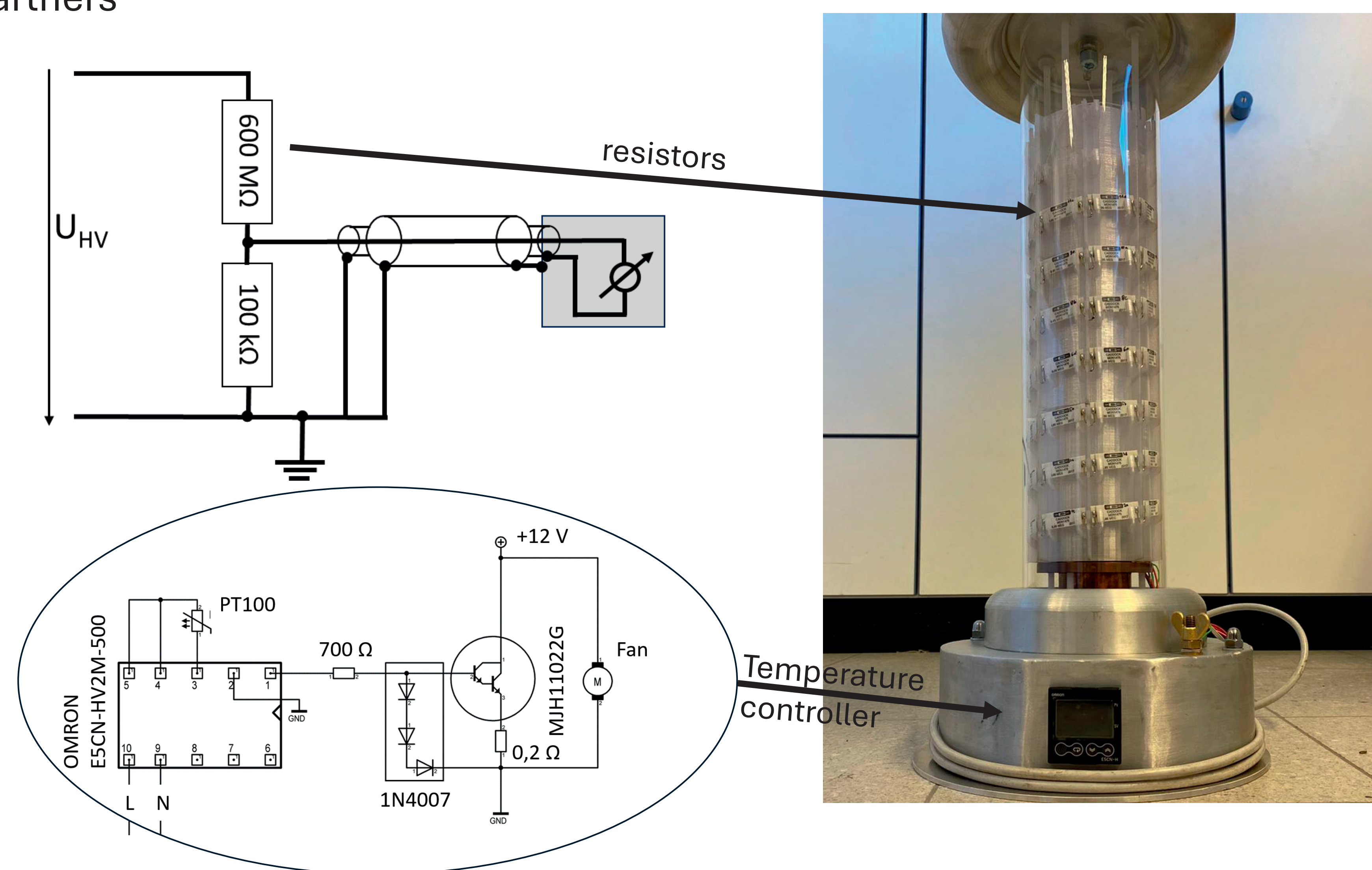
3D-Printed Precision Voltage Divider for Ultra-Stable High-Voltage Measurements in Experimental Physics

Introduction:

- High voltage precision divider designed for fast-beam collinear laser spectroscopy in high-voltage nuclear physics experiments
- Innovative voltage divider: A thermally stable, ultra-precise voltage divider for DC voltages up to 60 kV, featuring a 3D-printed structure
- Exceptional Stability and temperature dependence: overall uncertainty 2 $\mu\text{V/V}$

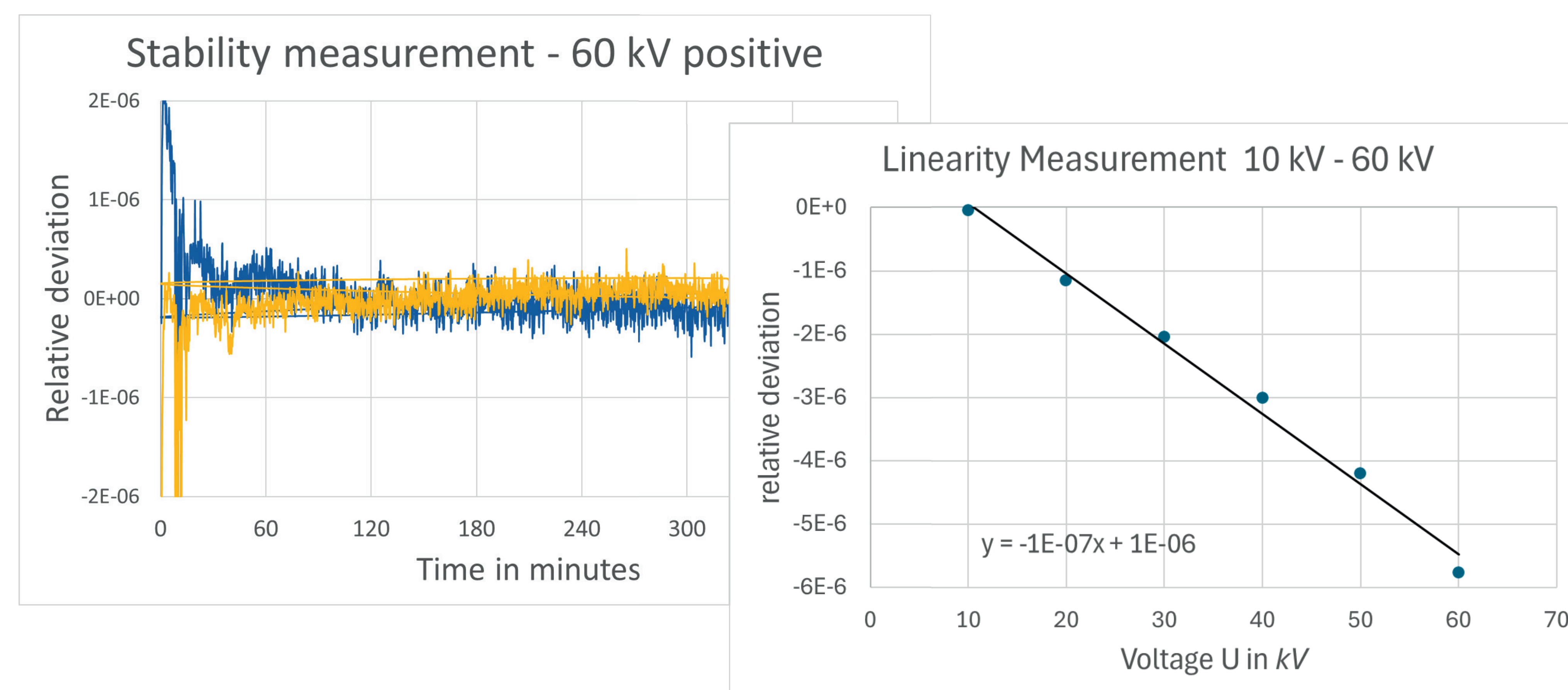
High voltage divider design

- 60x MDN1475 high precision resistors with less than 1 $\mu\Omega/\Omega/^\circ\text{C}$ temperature coefficient, 10 M Ω , 1000 V each.
- Temperature controlled design to less than $\pm 0,05^\circ\text{C}$
- Simple design process due to 3D printing allows for easy replication of all project partners



Measurement results

- Stability measurement with two dividers:
 - Initial drift less than 3 $\mu\text{V/V}$
 - Instability over 6 hours less than 0,5 $\mu\text{V/V}$
- Linearity Measurements:
 - Voltage dependency 1 $\mu\Omega/\Omega/\text{kV}$
 - Measurement uncertainty 2 $\mu\text{V/V}$



Conclusion

- 3D printing technology enables precise replication, enabling excellent measurement performance
- The divider has been successfully deployed in critical experiments at leading research institutions like CERN/ISOLDE and Argonne National Laboratory
- Calibration and performance testing demonstrate excellent stability, with minimal drift observed over extended measurement periods. This stability is essential for achieving the precision required in modern experimental physics.