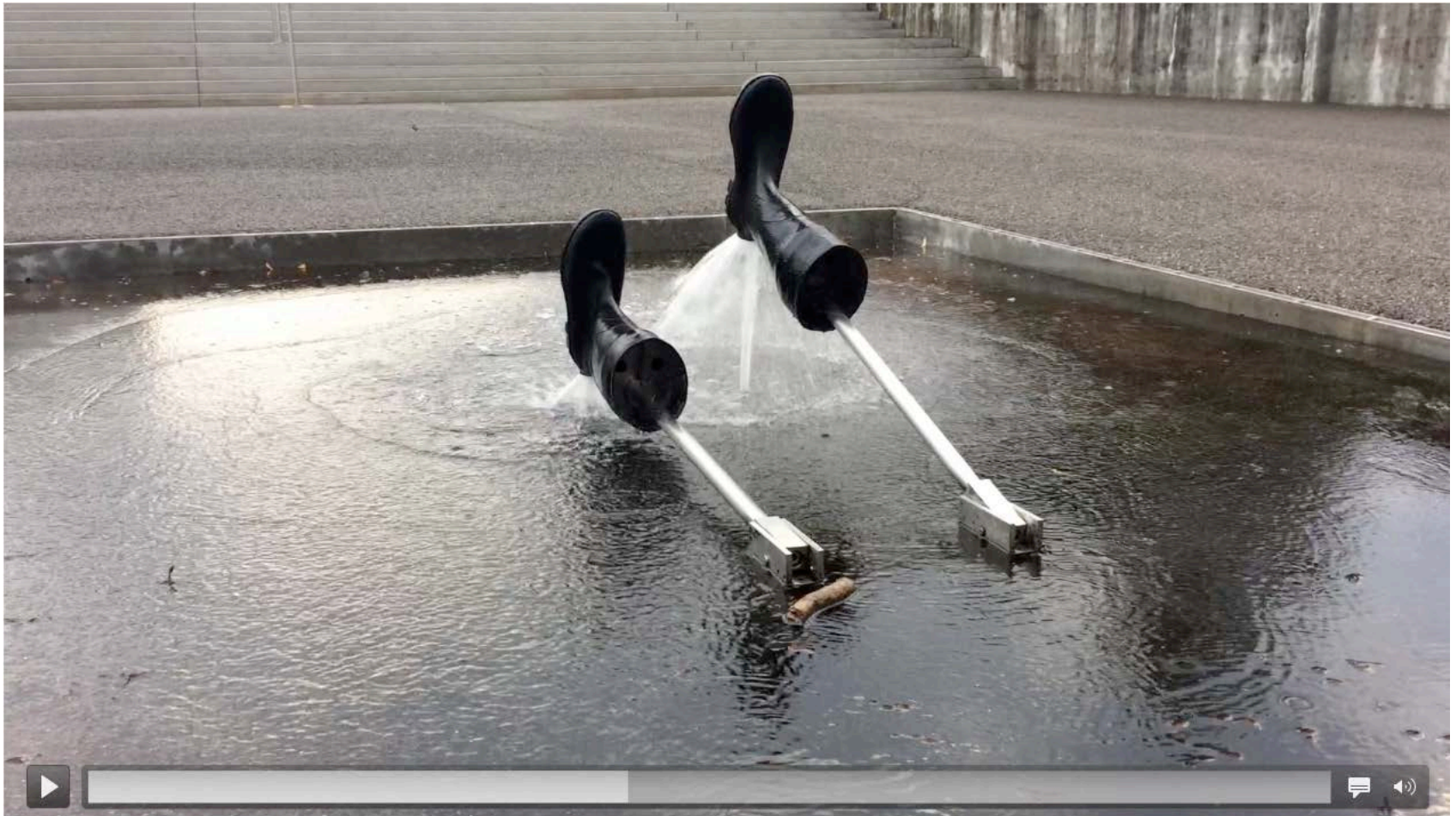




# Diamonds from 2 K to 500 K

Benjamin Kraus, Nikolay V Aksenov, Rugard Dressler, Robert Eichler,  
Erich Griesmayer, Dominik Herrmann, Patrick Steinegger, Andreas  
Türler, Christina, Weiss ... featuring H. Jansen et al.

PSI and CIVIDEC



# Introduction

- $0\text{ }^{\circ}\text{C} = 273.14\text{ K}$

# Measurements

- 2 K ... 300 K
- 300 K ... 500 K

# Part 1

- 2 K ... 300 K (H. Jansen, CERN 2013)
- 300 K ... 500 K

# **Chemical Vapour Deposition Diamond**

## **Charge Carrier Movement at Low Temperatures and Use in Time-Critical Applications**

Dissertation

zur

Erlangung des Doktorgrades (Dr. rer. nat.)

der

Mathematisch-Naturwissenschaftlichen Fakultät

der

Rheinischen Friedrich-Wilhelms-Universität Bonn

angefertigt bei der

Europäischen Organisation für Kernforschung, CERN, Genf, Schweiz

von

Dipl.-Phys. Hendrik Jansen

aus

Oberhausen

# Setup

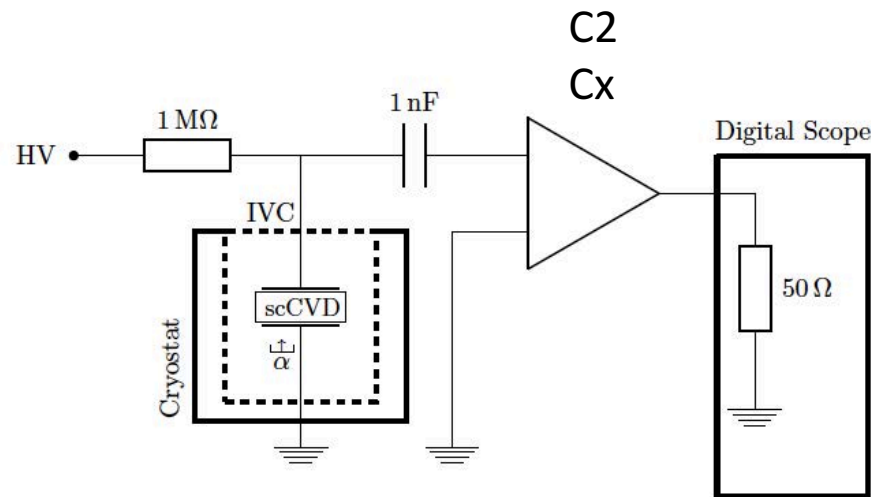
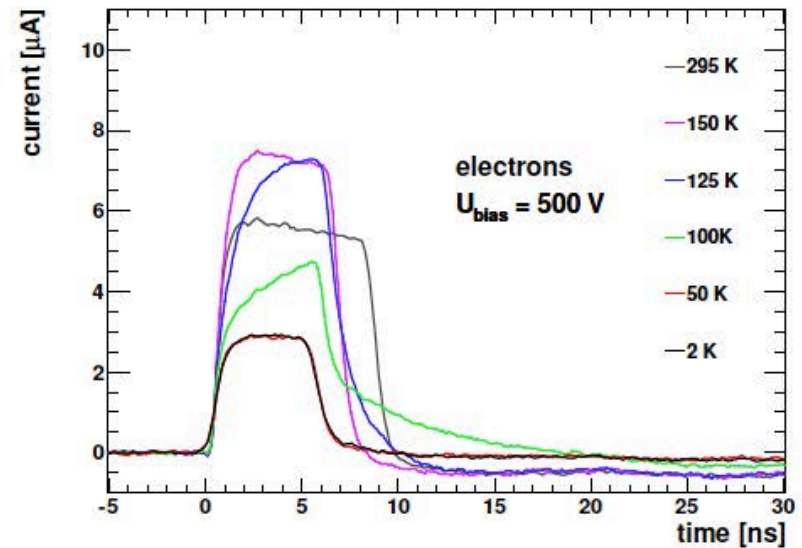
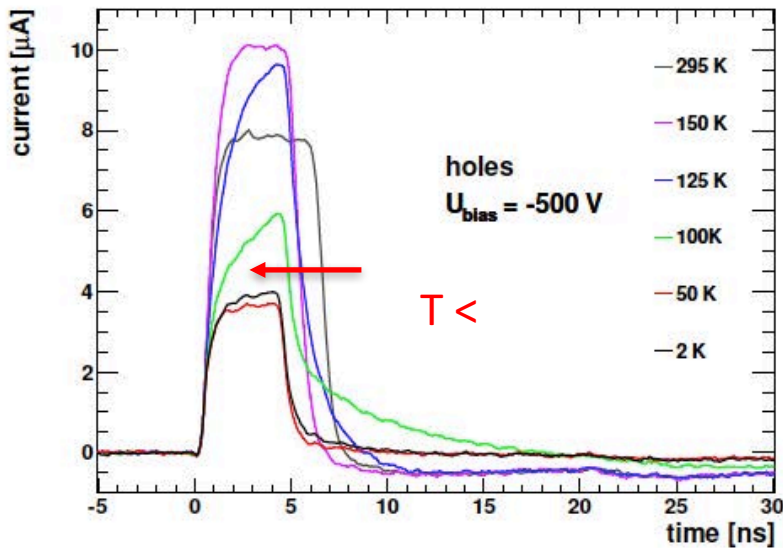


Figure 4.8.: The schematics of the  $\alpha$ -TCT set-up.

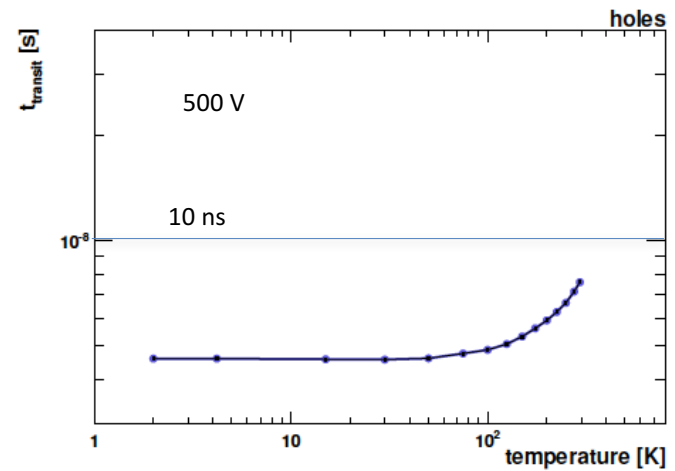
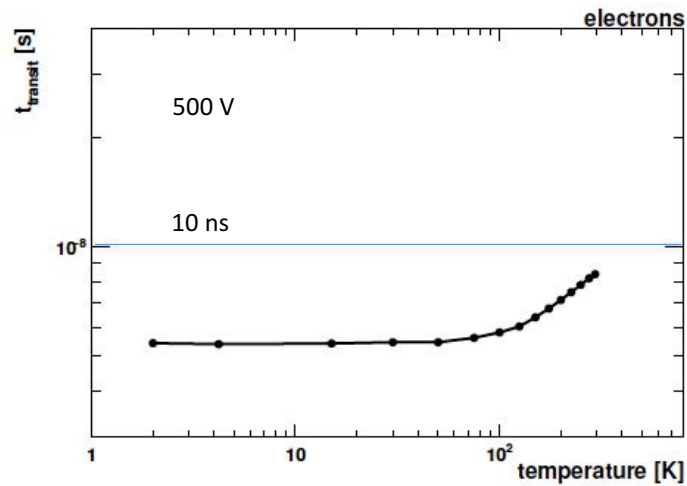
Courtesy H. Jansen

# TCT pulses



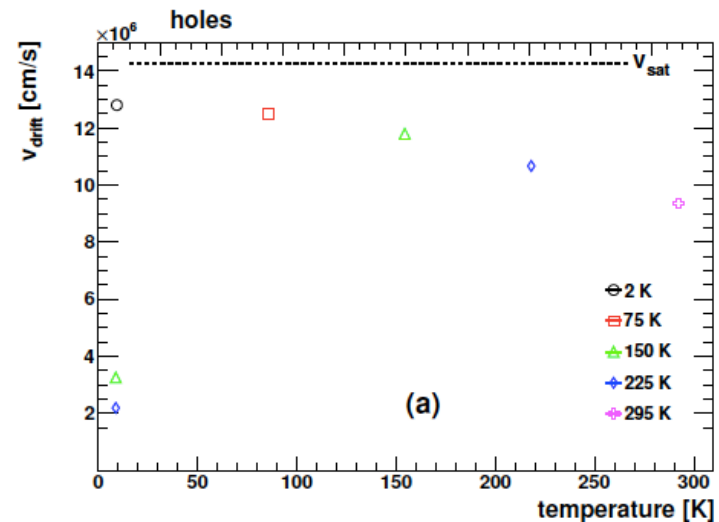
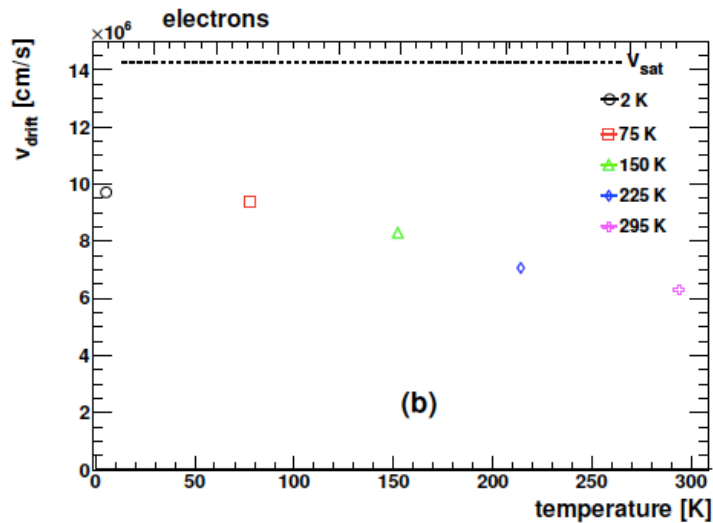
Courtesy H. Jansen

# Drift time



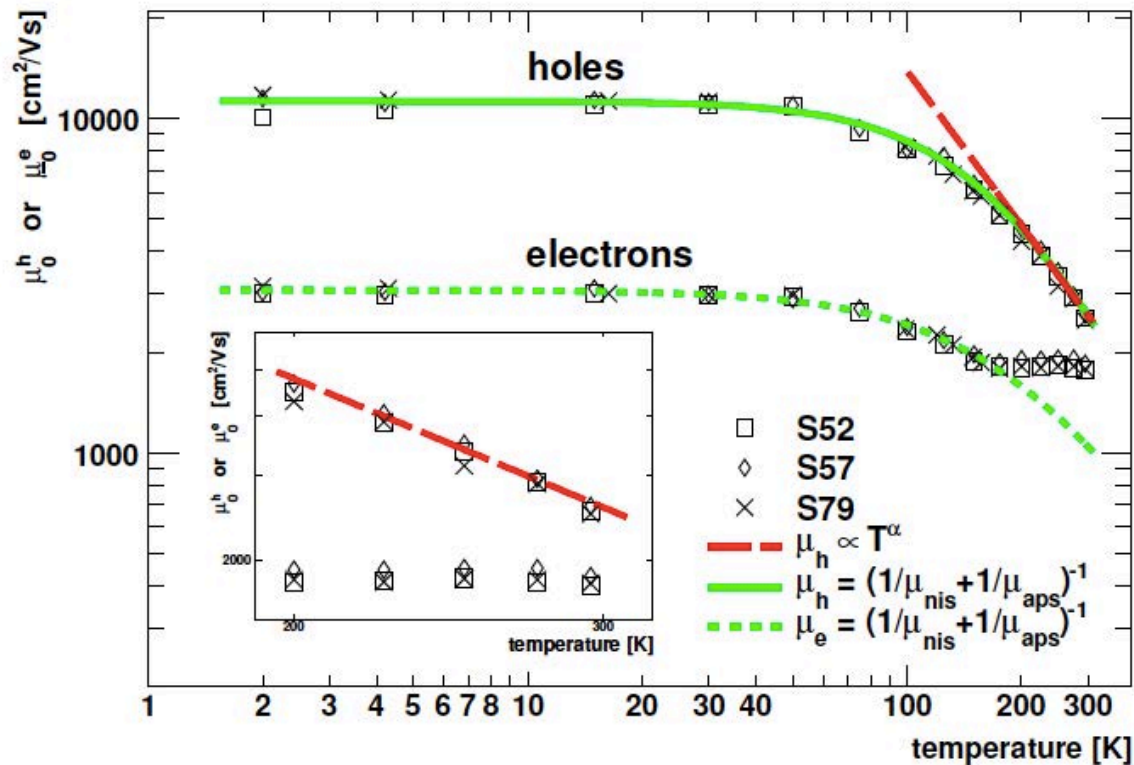
Courtesy H. Jansen

# Drift velocity



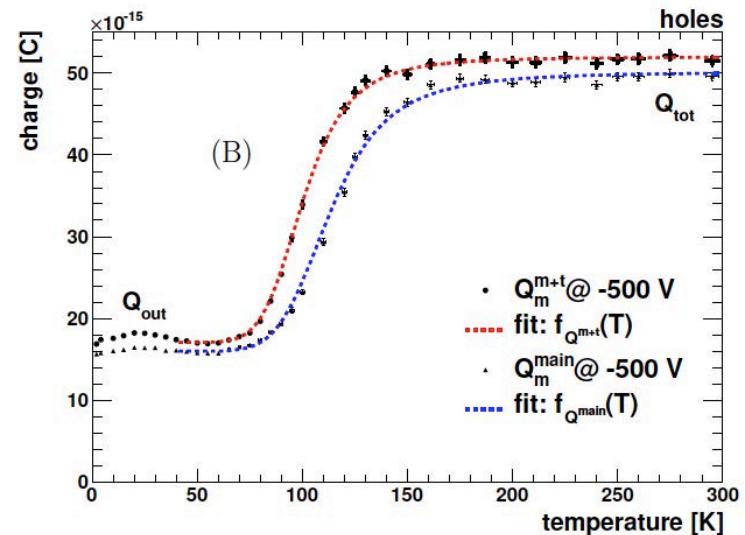
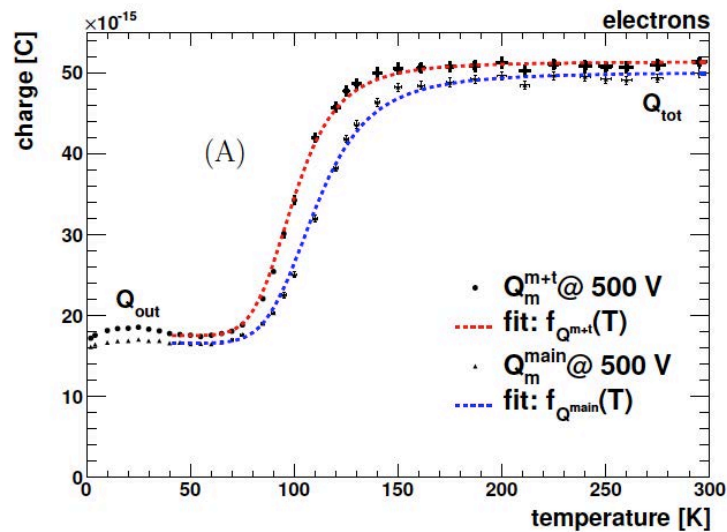
Courtesy H. Jansen

# Mobility



Courtesy H. Jansen

# Charge yield



Courtesy H. Jansen

## Part 2

- 2 K ... 300 K
- 300 K ... 500 K (PSI 2017, 2018)

Elsevier Editorial System(tm) for Nuclear  
Inst. and Methods in Physics Research, A  
Manuscript Draft

Manuscript Number:

Title: Charge Carrier Properties of Single-Crystal CVD Diamonds up to 473  
K

Article Type: Full length article

Section/Category: Gamma, X-ray and Charged Particle Detectors

Keywords: Alpha Spectroscopy; Diamond Detectors; Transient Current  
Technique; High Temperature; Single-crystal CVD Diamonds; Dark Current

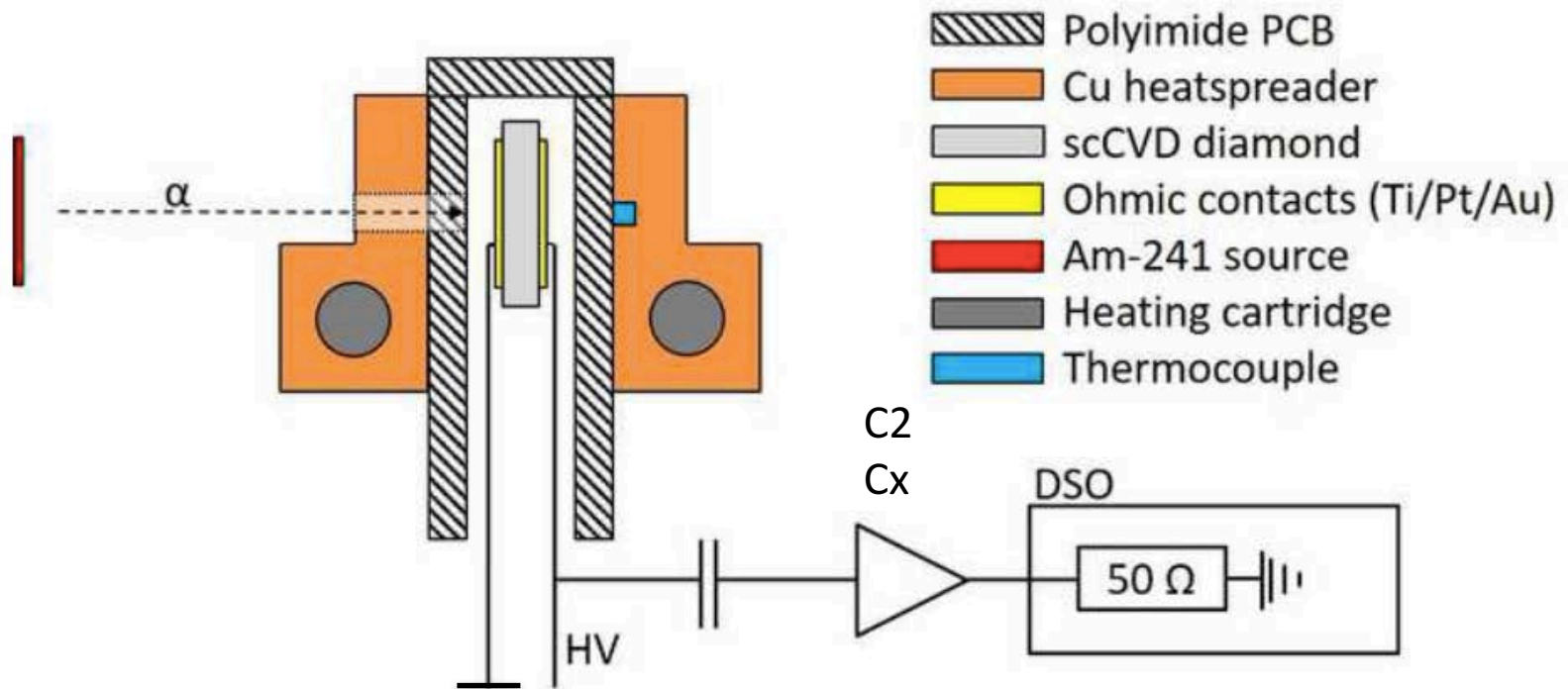
Corresponding Author: Dr. Patrick Steinegger, Ph.D.

Corresponding Author's Institution: Paul Scherrer Institute

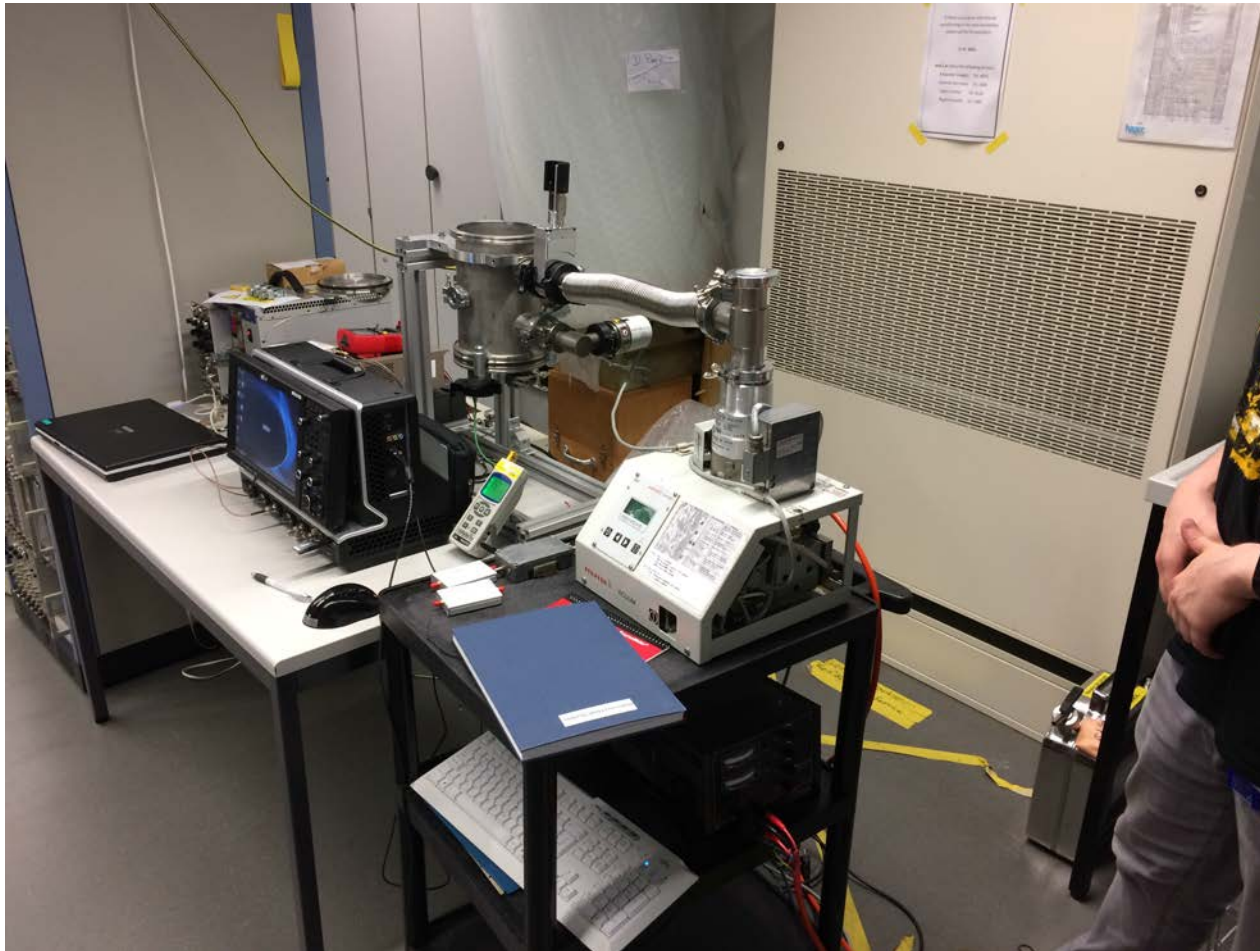
First Author: Benjamin Kraus

Order of Authors: Benjamin Kraus; Nikolay V Aksenov, Dr.; Rugard  
Dressler, Dr.; Robert Eichler, Dr.; Erich Griesmayer, Prof. Dr.; Dominik  
Herrmann; Patrick Steinegger, Dr.; Andreas Türlér, Prof. Dr.; Christina  
Weiss, Dr.

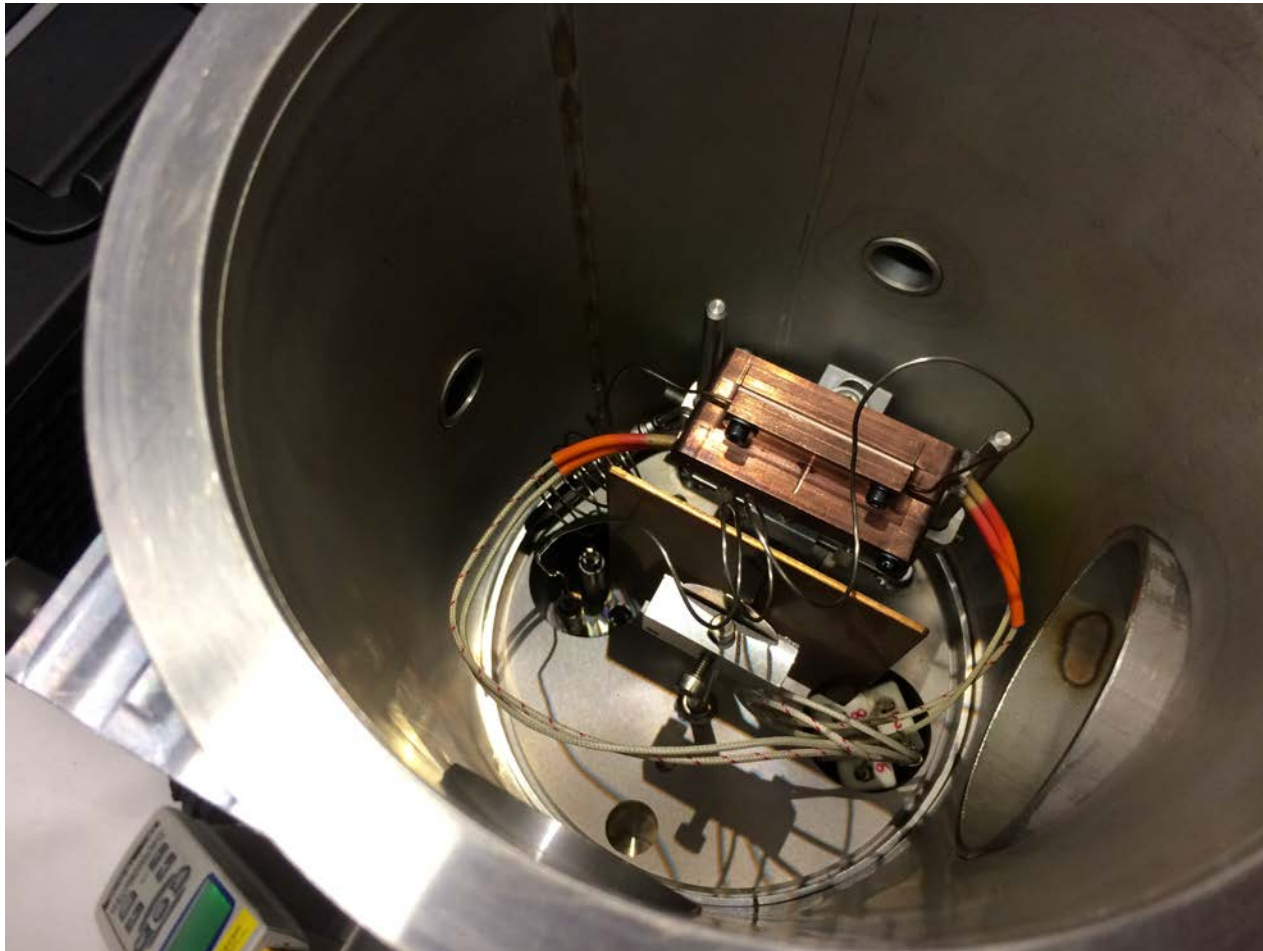
# Setup



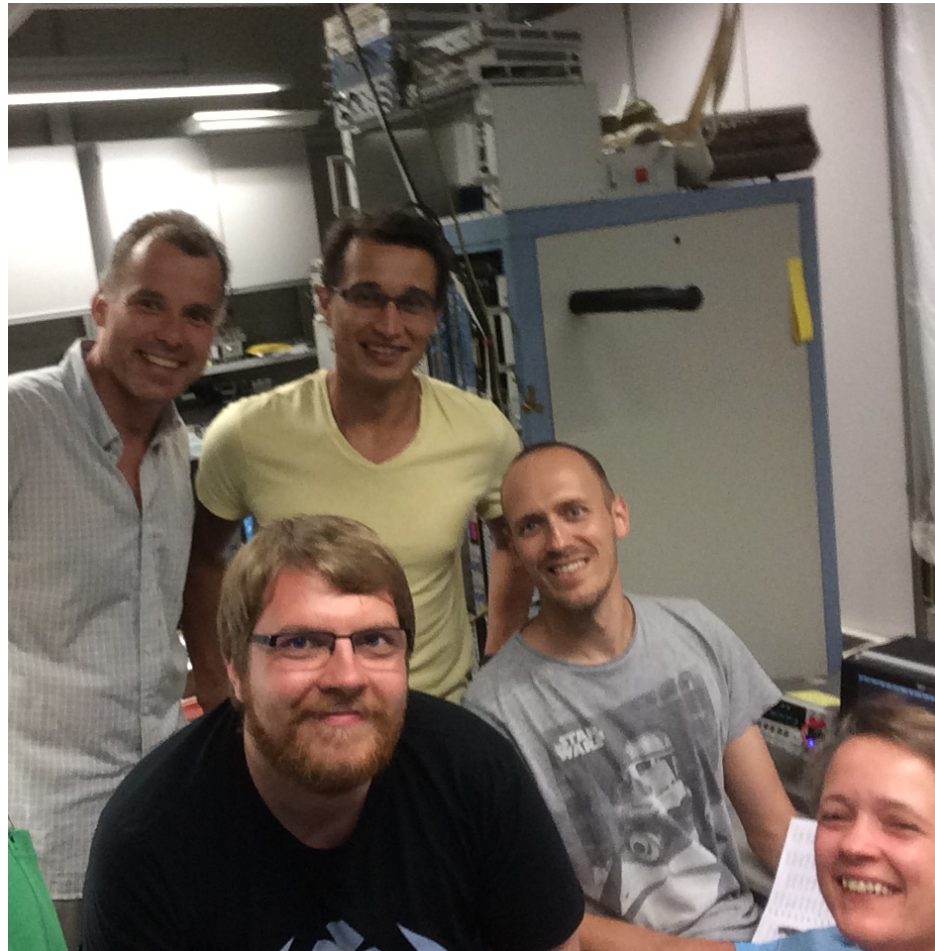
# Measurement setup



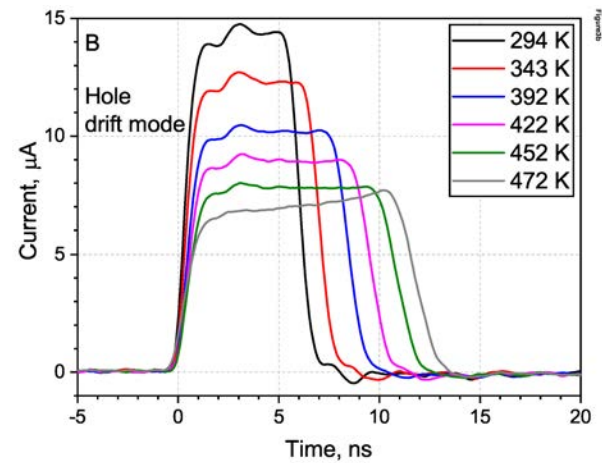
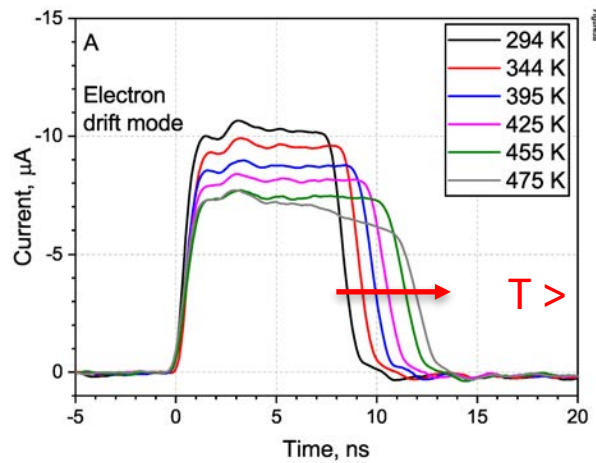
# Measurement setup



# The crew



# TCT pulses



# Drift time

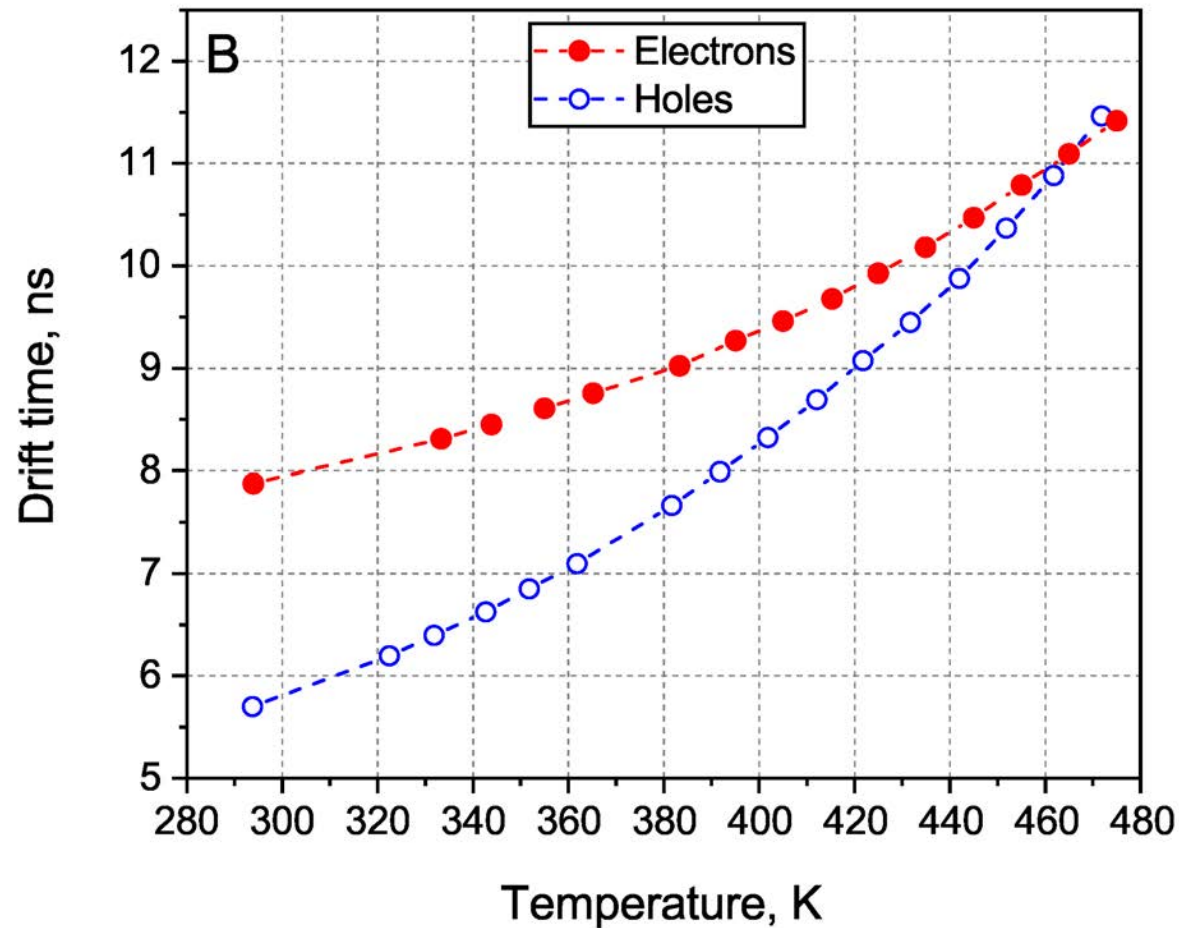
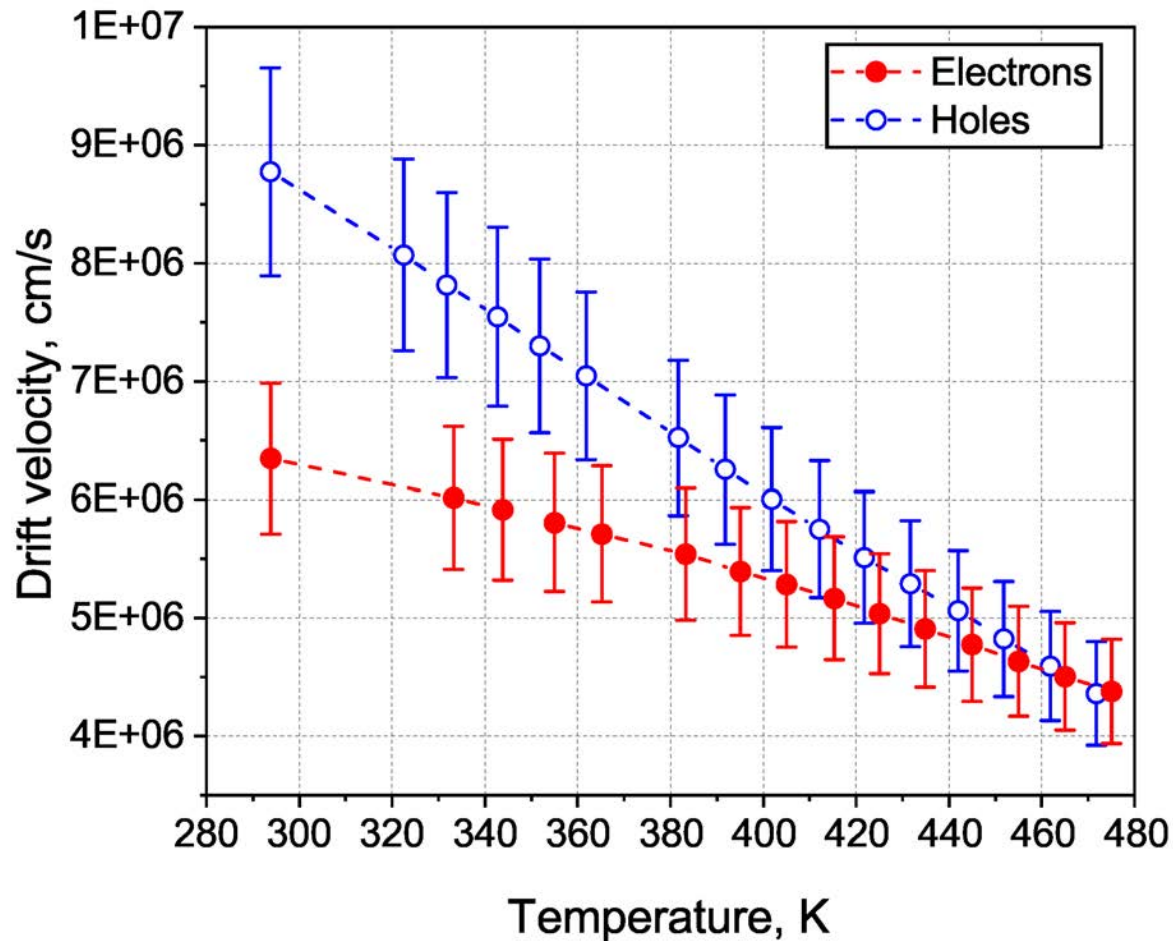


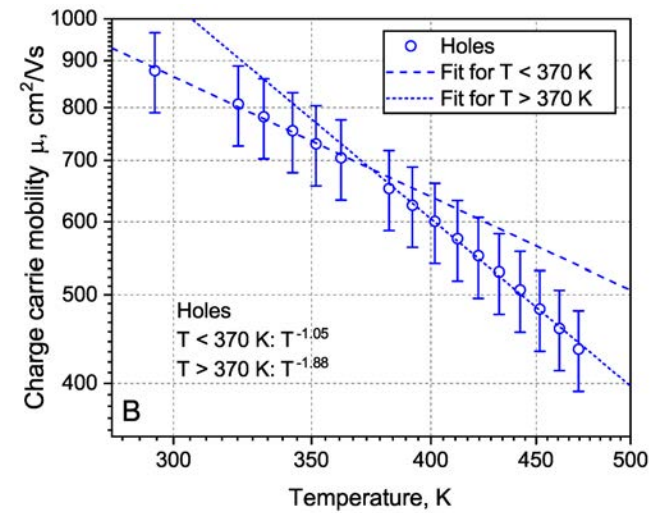
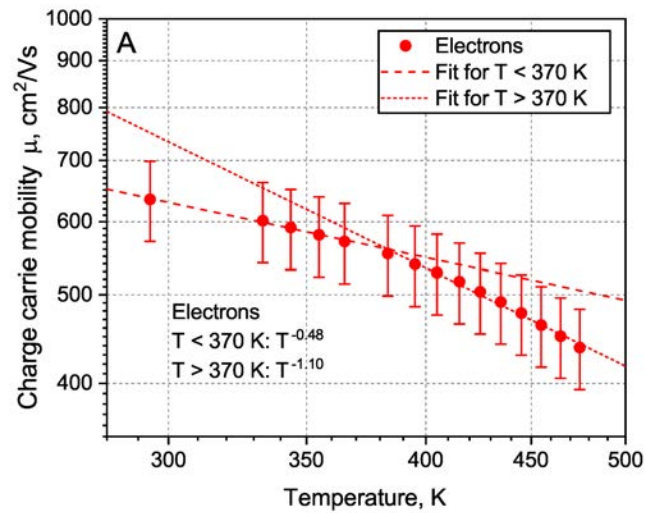
Figure 4b

# Drift velocity



Figures

# Mobility



# Noise

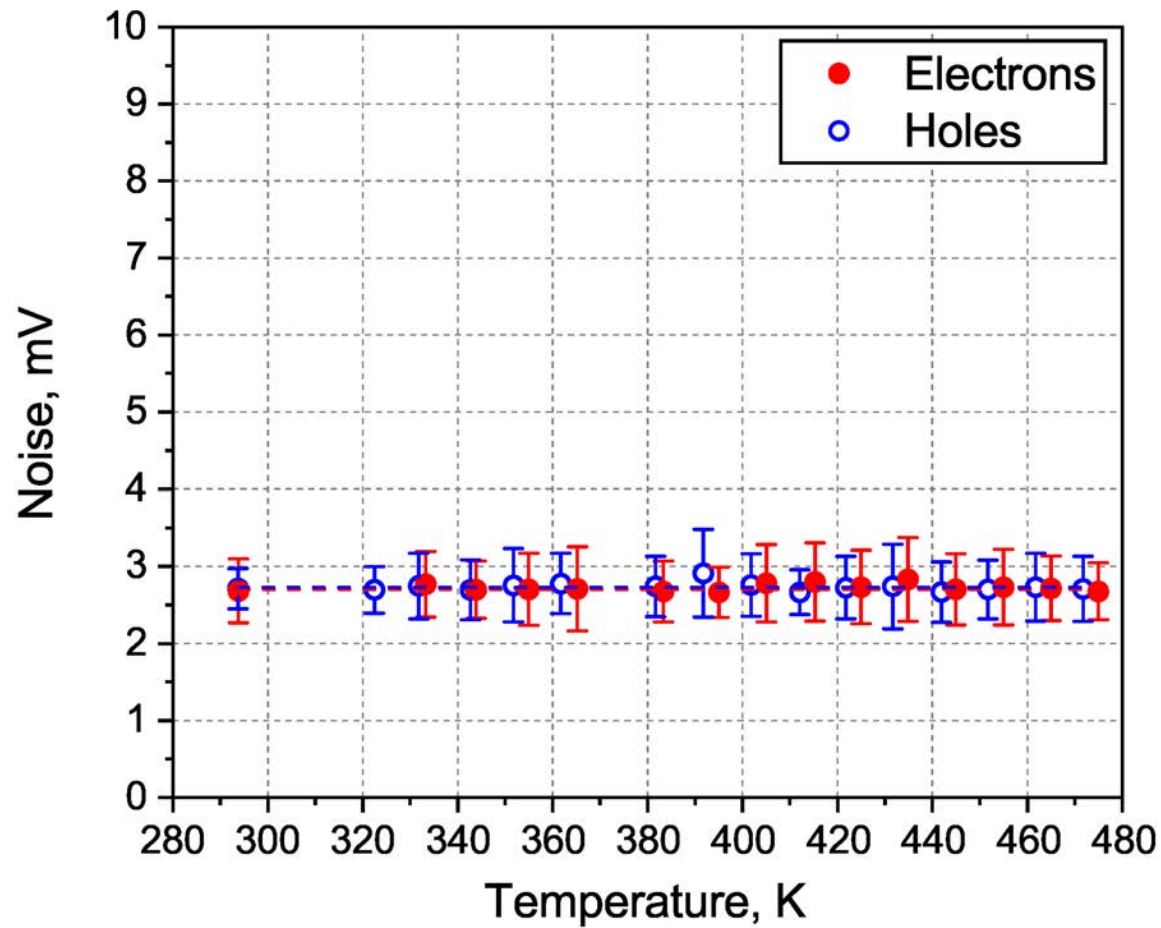


Figure 7

# Charge - TCT

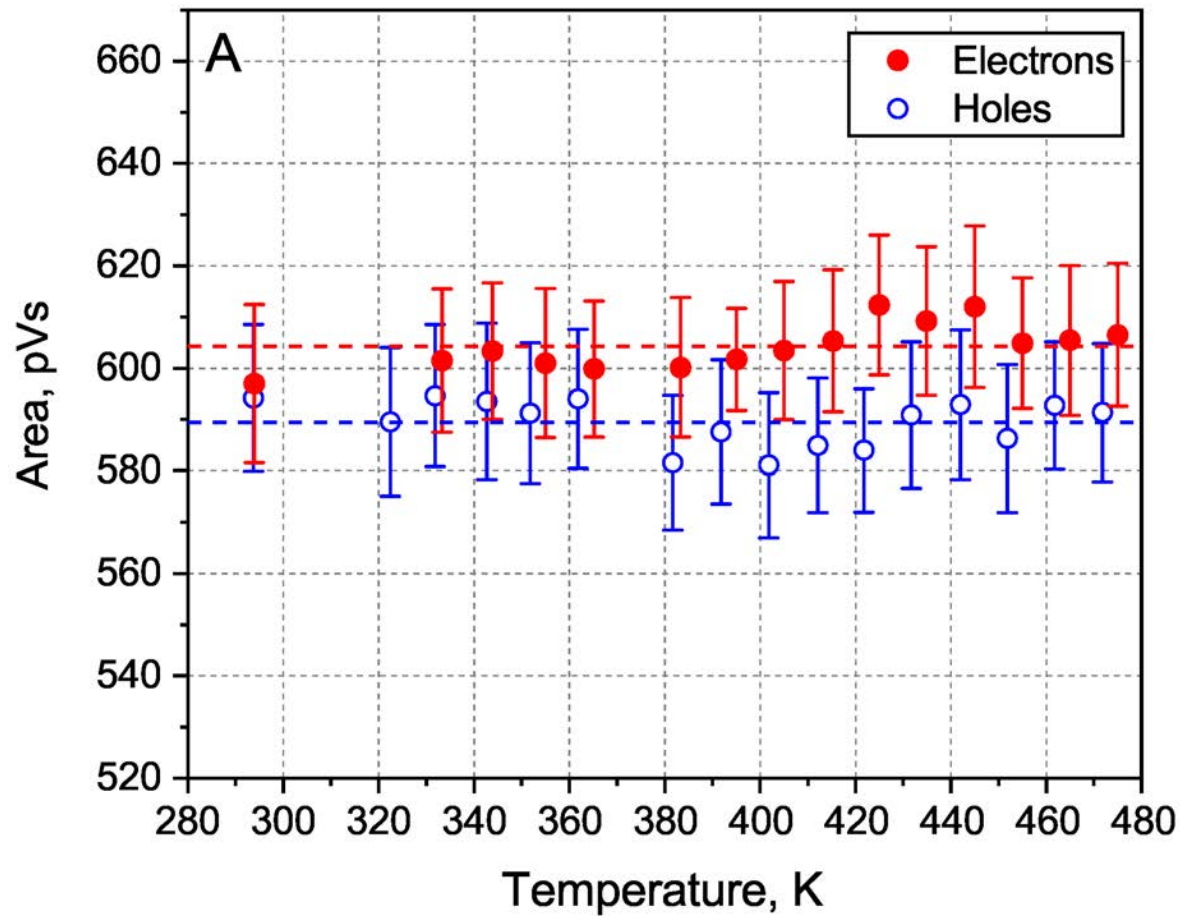


Figure 4a

# Charge - spectroscopic

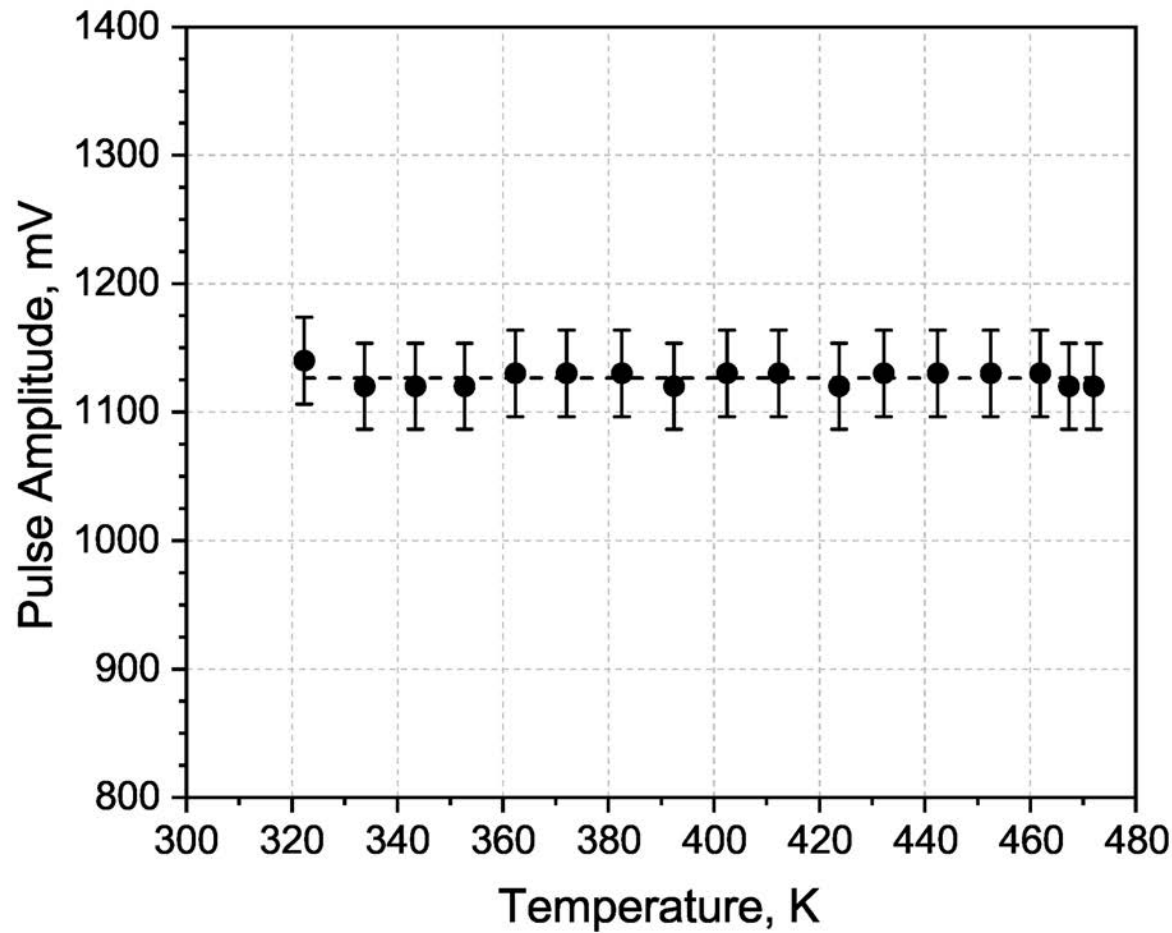


Figure 9

# Energy resolution

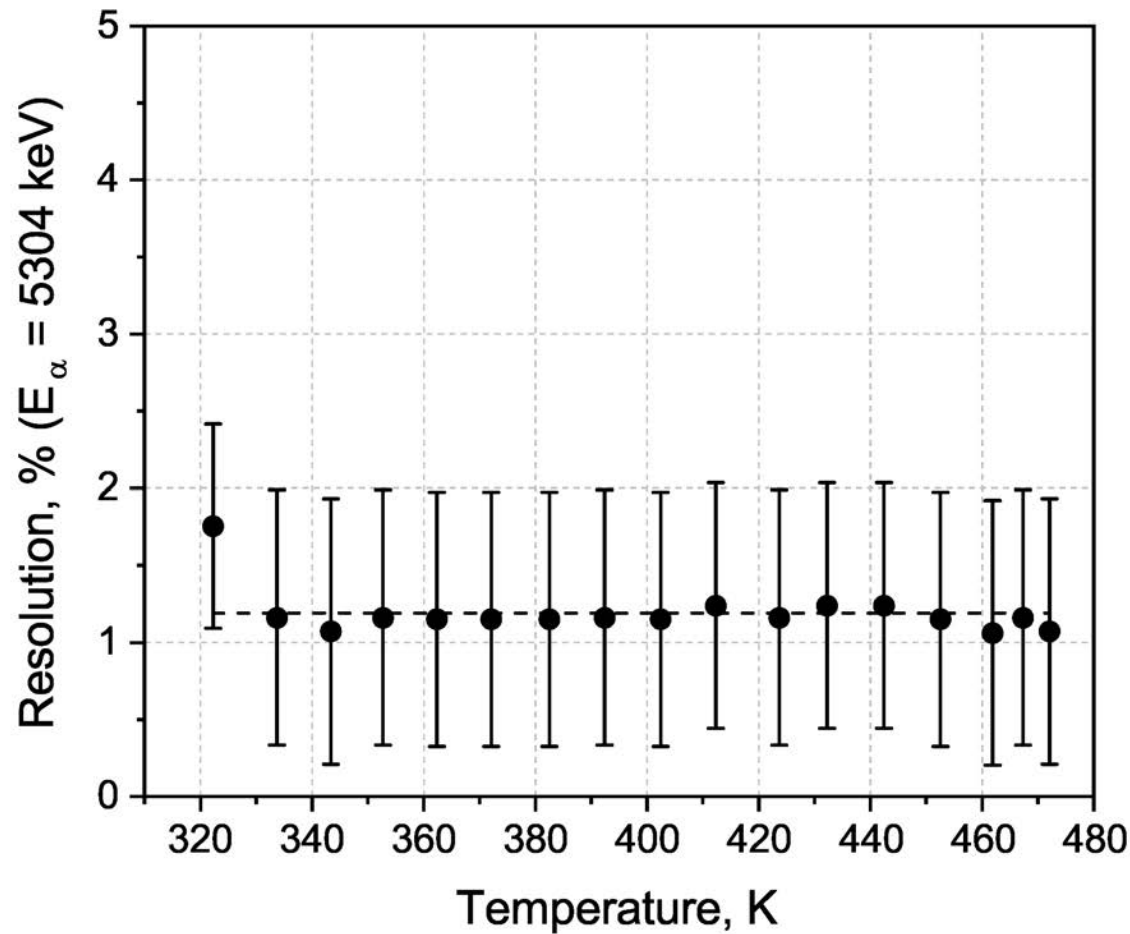
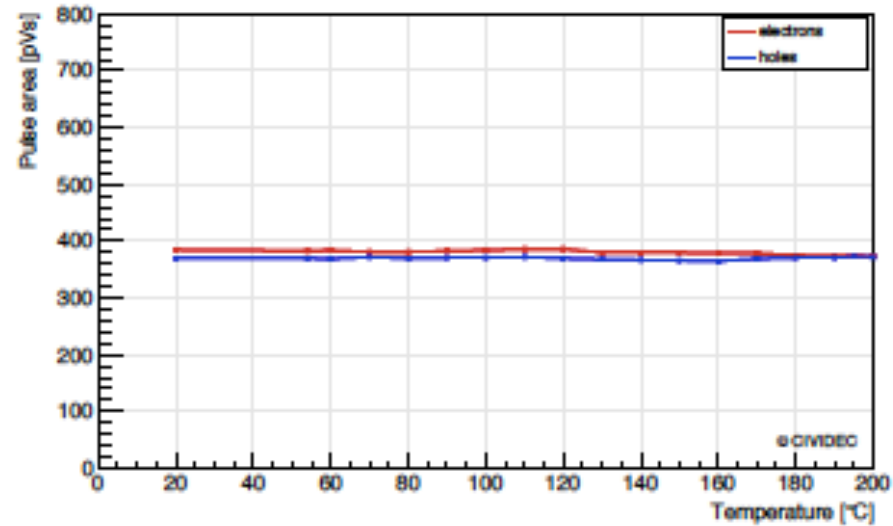


Figure 10

# Verification

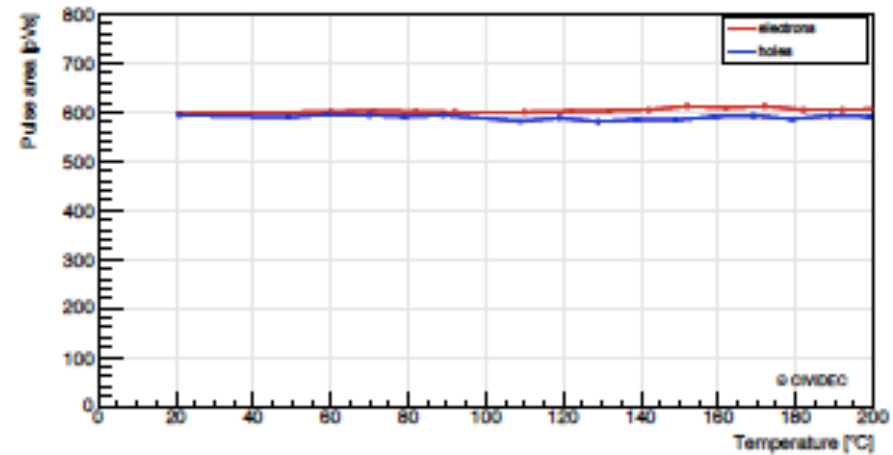
- CERN 2016

## 2 Pulse area



CERN

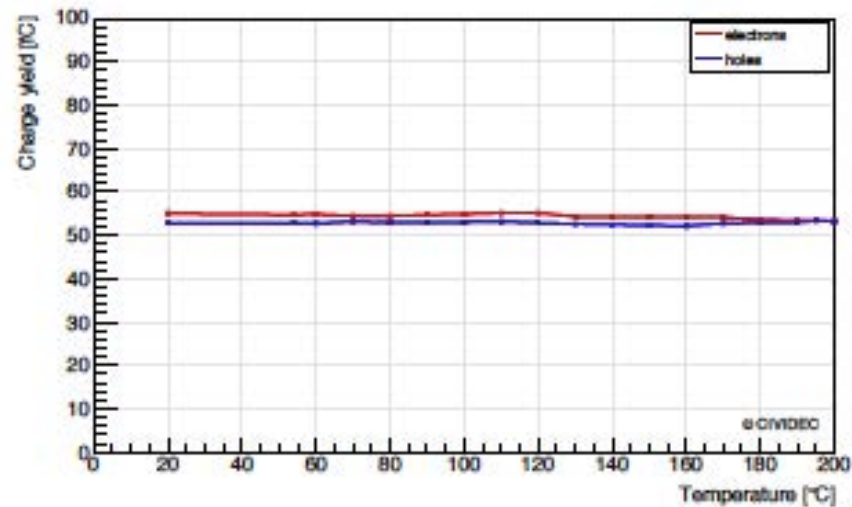
Figure 1: Pulse area vs. temperature, measured at CERN.



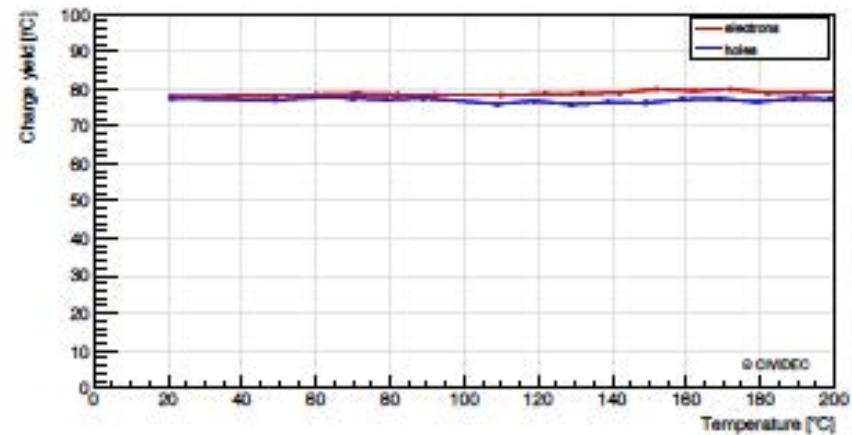
PSI

Figure 2: Pulse area vs. temperature, measured at PSI.

### 3 Charge yield



CERN



PSI

Figure 4: Charge yield vs. temperature, measured at PSI.

## 4 Drift time

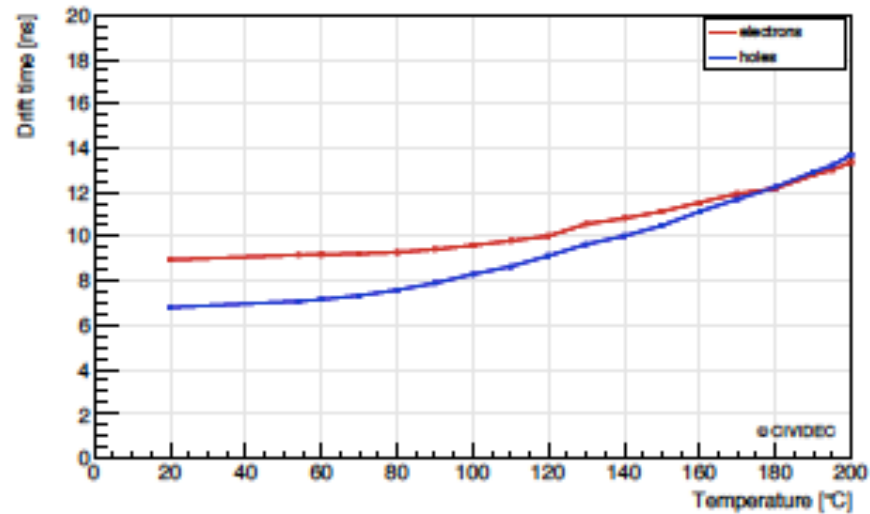


Figure 5: Drift time vs. temperature, measured at CERN.

CERN

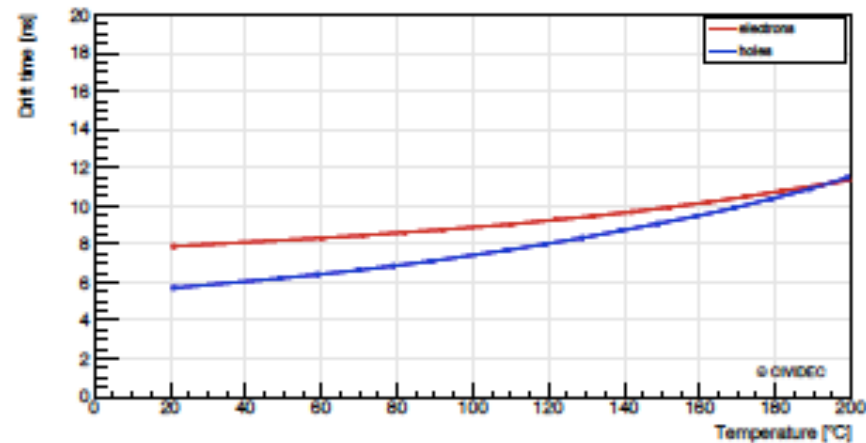


Figure 6: Drift time vs. temperature, measured at PSI.

PSI

## 5 Drift velocity

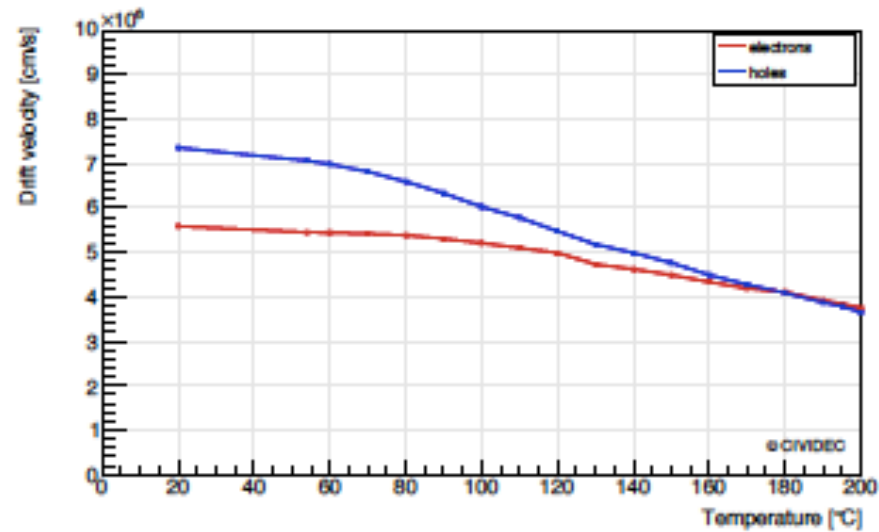


Figure 7: Drift velocity vs. temperature, measured at CERN.

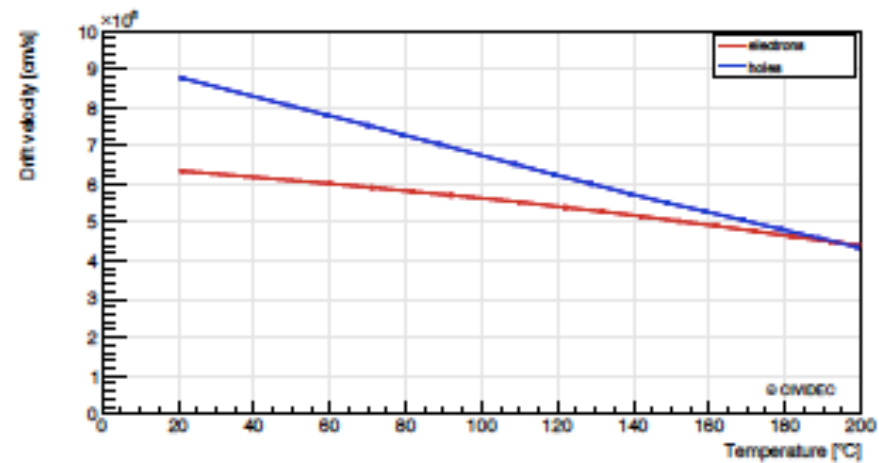


Figure 8: Drift velocity vs. temperature, measured at PSI.

CERN

PSI

## 6 Mobility

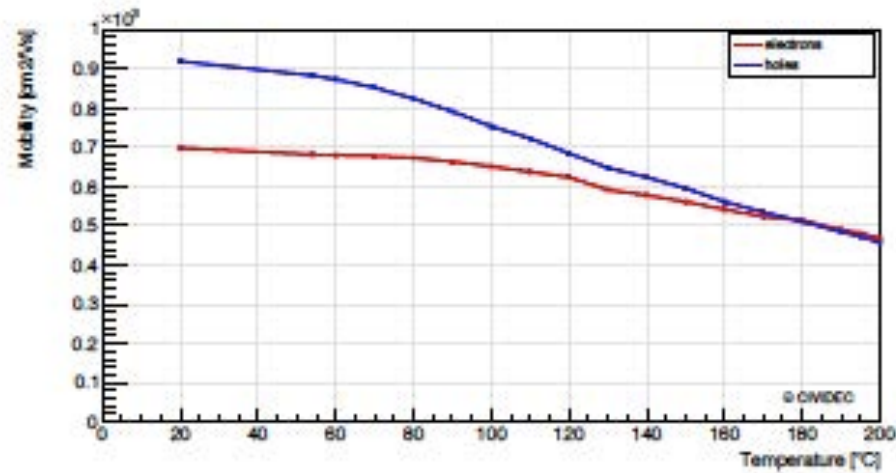


Figure 9: Mobility vs. temperature, measured at CERN.

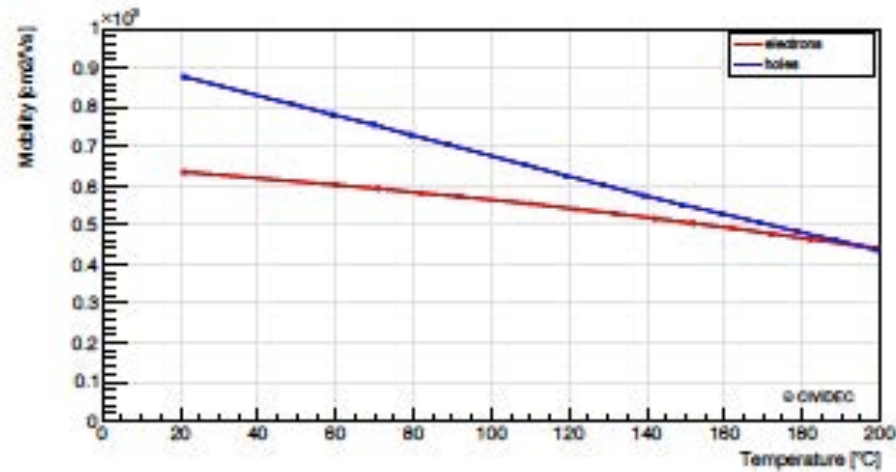


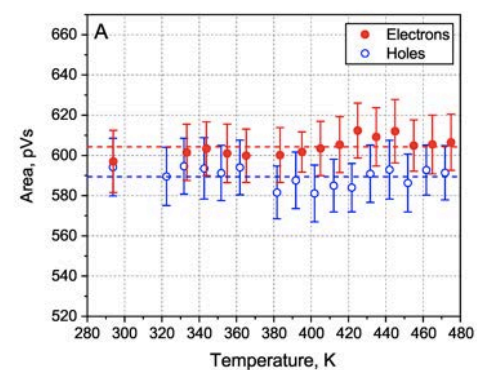
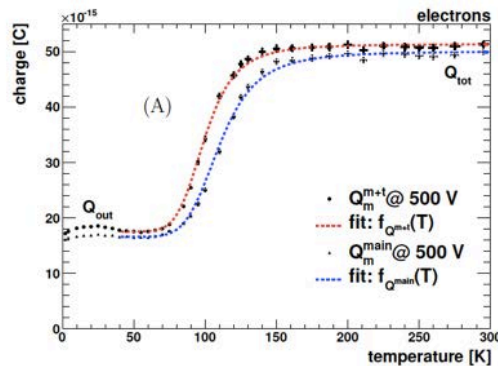
Figure 10: Mobility vs. temperature, measured at PSI.

CERN

PSI

# Conclusion

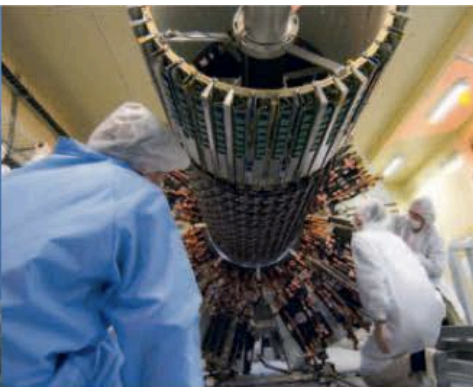
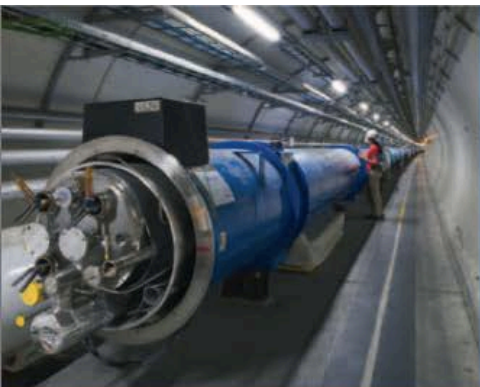
- CVD shows stable charge response from 2 K to 500 K.



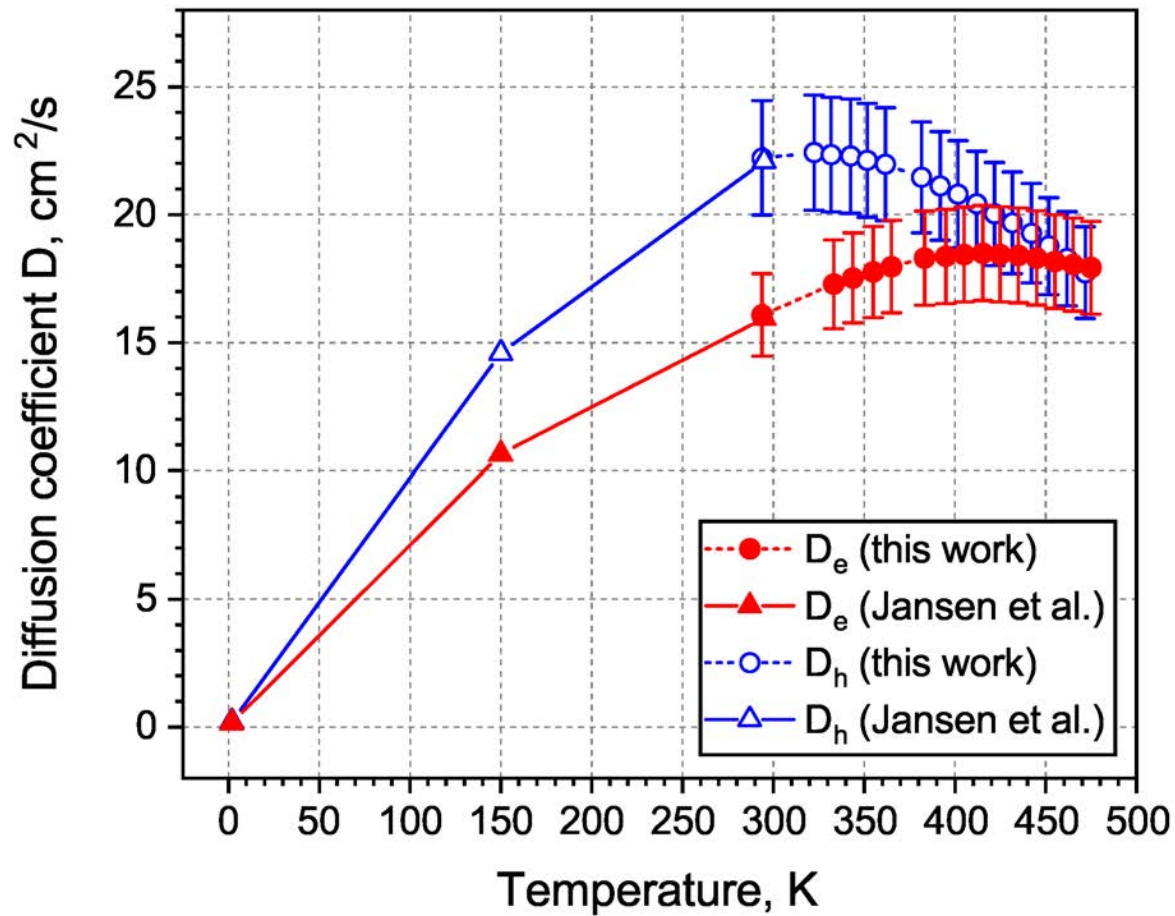
# Outlook

- In 2020 we go up to 500 °C.

[www.cividec.at](http://www.cividec.at)



# Diffusion



Figures