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European network
for developing new horizons for RIs

Detector School — July, 17–28, 2023

for training young scientists on state-of-the-art particle detection technologies in the fields of particle-, heavy-ion- and neutron-physics

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EURIZON detector school

Introduction to: EURIZON project, lectures, hands-on exercises, science communication

July 17th 2023

Lucie Linssen

The EURIZON project

https://www.eurizon-project.eu

EURIZON is a European network for **R**esearch **I**nfrastructures (RI).
It receives funding from the European Union within the "Horizon2020" funding cycle.

Research **I**nfrastructures covered are:
heavy ions, neutrons, synchrotrons, lepton colliders, high-power lasers, particle detectors.

The project started in February 2020 under a different name: CREMLINplus
with the aim of enhancing collaboration between Europe and Russia on RI's (mutual access, common practices, etc.).
CREMLINplus was stopped in March 2022, and continues under the name EURIZON with its non-Russian partners only.

For EURIZON new work objectives were added, to strengthen the RI landscape in Ukraine and e.g. to support individual displaced scientists from Ukraine

Why a particle detector school ?

Constant progress in particle detector technologies is absolutely fundamental for making progress with our physics observations and interpretation.

A large diversity in detector technologies is needed, often with complementary roles, in order to cover the broad span of physics aims.

Detectors have to become ever more accurate (space, time, energy, etc) and faster.
Millions/billions of readout cells are required in order to maximise information and to feed ever more powerful algorithms for reconstruction and interpretation.

Particle detectors are important for society applications (medical, material science, space)

Generally, there is no university curriculum that trains students specifically for the detector field. Some University courses are indeed given, but the coverage is often too slim.

We normally have to get most of our training “on the job”.
A detector school therefore conveniently helps “filling the gap”.

The lecture series 1

The particle detector field is very broad !

We have chosen to organise the lectures according to the following categories:

- Overall detection functionality
  - Tracking, calorimetry, particle identification, neutron detectors
- Detection technologies
  - Gas detectors, silicon detectors, photodetectors
- Readout, trigger and data-acquisition
- Characterisation of detectors
- The life/evolution of a large detector system

We added a broader look by including:

- Quantum sensing
- Non-collider detectors
- Environmental sustainability of basic research

The lecture series 2

Focus of the school: PhD students working on particle detectors

Basic level and idea behind the lectures:

- Teaching first principles and introducing concepts with basic formulas where possible.
- Instead of a fully comprehensive overview, the lectures are limited to a selection of relevant topics, giving the students enough time to absorb the information.
- If applicable, some info on detector requirements for future experiments is included.

Lectures are scheduled for 1 hour:

- 45 min presentation
- 15 min questions and a short break

Please ask lots of questions !

Hands-on exercises 1-6

Exercise	Activity	Room	# students	Action
1	Drift tube characterisation	D11.04	4	Characterise a drift tube (gas detector) with a cosmics and a radioactive source, and derive the gas gain factor from the data
2	Micro-pattern gas detector, measure mu-RWELL efficiency	D11.09	4	Measure mu- RWELL performance with a cosmic-ray telescope
3	Cosmo boxes	F13.11	8	Set up of a scintillator array and readout, and determine cosmic muon features
4	Microchannel plate photomultipliers (MCP-PMT) with delay-line anode	G11.10	4	Learn how to measure with a MCP-PMT, and determine its time resolution and spatial resolution
5	Silicon photomultiplier (SiPM)	G11.05	6	Find out about core features of a SiPM avalanche photo-detector and see single photo-electrons
6	Silicon pixel detector	G11.24/05	4	Learn basics about a silicon pixel detector, calibrate the device and measure photons and ionising particles using a radioactive source.

Detailed descriptions and work plans of all exercises can be found here: link

Hands-on exercises 7-12

Exercise	Activity	Room	# students	Action
7	Silicon strip detector, Landau distribution	G11.04	4	Set up a silicon strip detector with its readout chain, and reconstruct the Landau charge distribution using a radioactive source
8	Do-it-yourself particle detector	D11.12	6	Build your own silicon pixel detector and see signals from daily-life sources
9	ROOT tutorial	F13.15	8	Learn how to use ROOT for your data analysis and presentation of results
10	Geant4 tutorial (bring own laptop)	F13.17	8	Learn how to use Geant4 for modeling your experiment and for simulating particle interactions in your detector
11	Simulation of silicon pixel detector and spatial resolution	D11.01	6	Simulate detailed signal formation in your silicon pixel detector, and determine its performance as a function of detector features
12	Analysis of silicon pixel test beam data	D11.01	6	Analyse a set of test-beam data to characterise your pixel sensor and determine its performance

Detailed descriptions and work plans of all exercises can be found here: link

Your instructors for the hands-on exercises

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Exercise	Activity	Instructors
1	Drift tube characterisation	Brunella D'Anzi, Nicola De Filippis, Edoardo Gorini, Francesco Gravili, Matteo Greco, Margherita Primavera, Francesco Procacci
2	Micro-pattern gas detector, measure mu-RWELL efficiency	Gianni Bencivenni., Gianluigi Cibinetto, Daniele Di Bari, Matteo Giovannetti, Stefano Gramigna
3	Cosmo boxes	Jannis Pawlowsky, Jhonatan Pereira de Lira, Mustafa Schmidt
4	Microchannel plate photomultipliers (MCP-PMT) with delay-line anode	Mustafa Schmidt, Marc Strickert
5	Silicon photomultiplier (SiPM)	Leena Diehl, Lucie Linssen, Eva Sicking, Philipp Zehetner
6	Silicon pixel detector	Justus Braach, Dominik Dannheim, Leena Diehl
7	Silicon strip detector, Landau distribution	Naomi Davis, Finn Feindt, Simon Spannagel, Gianpiero Vignola
8	Do-it-yourself particle detector	Oliver Keller, Leonard Welde
9	ROOT tutorial	Mustafa Schmidt
10	Geant4 tutorial	Mustafa Schmidt, Vincent Wettig
11	Simulation of silicon pixel detector and spatial resolution	Naomi Davis, Finn Feindt, Simon Spannagel, Gianpiero Vignola
12	Analysis of silicon pixel test beam data	Naomi Davis, Finn Feindt, Simon Spannagel, Gianpiero Vignola

How to register for hands-on exercises

Hands-on exercises take place on 8 afternoons.

Put your name on the exercise of your choice.

The inscription form is posted in room G11.01.

A new form will be put up daily, for the next day.

Don’t inscribe multiple times for the same exercise.

Make new friends by choosing a new team every day.

Monday July 17 **14:00 to 18:00 hrs** **hands-on exercises**

Please inscribe !

Exercise	Activity	Room	# student	Student names (first name, family name)							
1	Drift tube characterisation	D11.04	4								
2	Micro-pattern gas detector, measure mu-RWELL efficiency	D11.09	4								
3	Cosmo boxes	F13.11	8								
4	Microchannel plate photomultipliers (MCP-PMT) with delay-line anode	G11.10	4								
5	Silicon photomultiplier (SiPM)	G11.05	6								
6	Silicon pixel detector	G11.24	4								
7	Silicon strip detector, Landau distribution	G11.04	4								
8	Do-it-yourself particle detector	D11.12	6								
9	ROOT tutorial	F13.15	8								
10	Geant4 tutorial	F13.17	8								
11	Simulation of silicon pixel detector and spatial resolution	D11.01	6								
12	Analysis of silicon pixel test beam data	D11.01	6								

“Making engaging scientific presentations”

Organiser: Dave Barney, CERN

Classroom sessions, on afternoon 24/7, 25/7, 26/7; ~20 students each, (room G11.24)

The sessions focus on presentation skills. Students get actively involved, working together in the classroom. Opportunity to present something (their work or something else). Improve through comments from the group. *No preparation needed*.

Plenary Student Presentation session on Thursday afternoon 27/7:

Will be initiated during the above classroom sessions.

Very short presentations by a limited number of volunteer students.
The presentations will be max ~3 minutes, max ~3 slides.
Only very little material needed (e.g. a plot, a drawing, etc, of your work).

This session will include a leisurely “contest” aspect, with votes from the audience.
No big prizes, no performance awards !

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Organizational Matters

Christian Zeitnitz

on behalf of the organizing commitees

Locations

School Office and Coffee breaks: G.11.01

Lectures in „Hörsaal 4“ (F.10.01)

Lab Classes in G.11, D.11, F13

Lunch in Mensa ME.02

D11.04	Drift tube characterisation
D11.09	Micro-pattern gas detector, measure efficiency of mu-RWELL detector
F13.11	Cosmo boxes
G11.10	Microchannel plate photomultipliers (MCP-PMT) with delay-line anode
G11.05	Silicon-photomultiplier
G11.24	Silicon pixel detector
G11.04	Silicon strip detector, Landau distribution
D11.12	Do-it-yourself particle detector
F13.15	ROOT tutorial
F13.17	Geant4 tutorial (eigene Laptops)
D11.01	Simulation of silicon pixel detector and spatial resolution
D11.01	Analysis of silicon pixel test beam data
G11.24	Communication in science

Locations

School Office and Coffee breaks: G.11.01

Lectures in „

Lab Classes i

Lunch in Me

Room Names

- Letter(s): Building
- 2 digits: level
  - Main entrance at level 8
- 2 digits: room number
- Example: Building G, Level 11, Room 01

  → G.11.01

	measure efficiency of mu-
	ltipliers (MCP-PMT) with
	u distribution
	tor
	tops)
D11.01	Simulation of silicon pixel detector and spatial resolution
D11.01	Analysis of silicon pixel test beam data
G11.24	Communication in science

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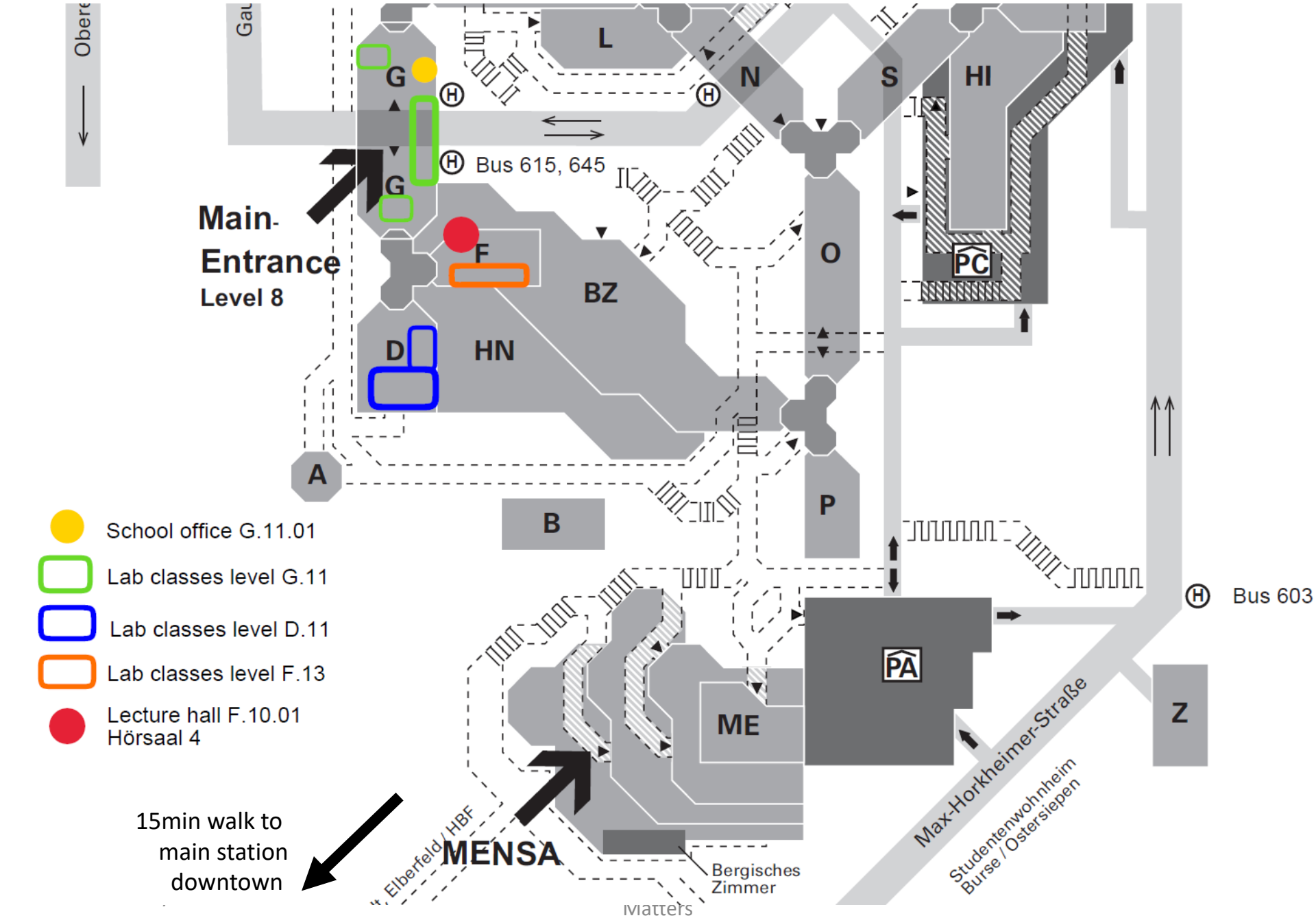
D11.01	Simulation of silicon pixel detector and spatial resolution
D11.01	Analysis of silicon pixel test beam data
G11.24	Communication in science


Main-
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Level 8
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Bus 615, 645
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BZ
O
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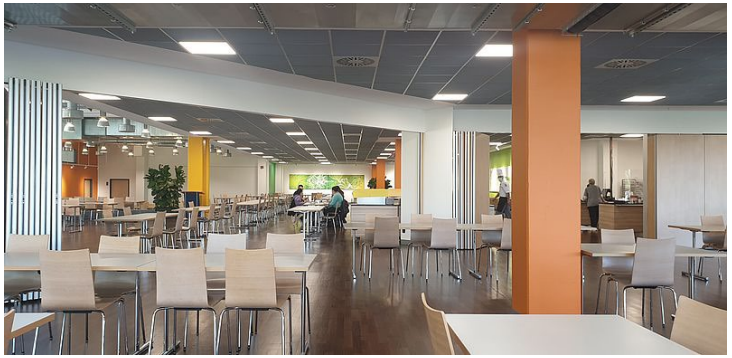
A
B
P
School office G.11.01
Lab classes level G.11
Lab classes level D.11
Lab classes level F.13
Lecture hall F.10.01
Hörsaal 4
Bus 603
PA
ME
Z
15min walk to
main station
downtown
MENSA
Elberfeld / HBF
Bergisches
Zimmer
Max-Horkheimer-Straße
Studentenwohnheim
Burse / Ostersiepen

Coffee/Tea and Lunch

Coffee/Tea/Water breaks

- Location: G.11.01
- Morning around 11:00
- Afternoon during hand-on sessions between 15:00 and 16:00

Lunch



- Mensa at ME.02
- Entrance from ME.03.80 downstairs
- What is free of charge?
  - 1 Meal
    - Most meals come with 1 or 2 side dishes (e.g. rice, salad …)
  - 1 dessert
  - 1 drink
- You need to show your name tag to the cashier

Social Events

- Wednesday July 19 – Dinner at „Wuppertaler Brauhaus“
  - Suspension railway „Schwebebahn“ station „Alter Markt“
- Sunday July 23 – Excursion to „Zeche Zollverein“
  - Bustransfer from Wuppertal
- Wednesday July 26 – Dinner at „Da Vince im alten Kuhstall“
  - Suspension railway „Schwebebahn“ station „Zoo“
- More details later this week

The School on Instagram

- Melike Konerding will cover the school on Instagram
- She will come by during the breaks and lab classes on Tuesdays and Thursdays
- What is planned?
  - Short interviews of participants
  - Pictures and short movie clips
- Please support her!

Wireless Network Connection

„Eduroam“ should work

You have no Eduroam account?

- Select „Uni-Wuppertal EAP“
- User: „t0225“
- Password „EU.RI.ZON-23“

Administrative Matters

Travel reimbursement via FAIR GmbH

THIS ONLY APPLIES TO lecturers, helpers who are reimbursed by FAIR, AND student who are supported by EURIZON

- Two forms are available on Indico (top level material list), which need to be filled out and signed
  - The actual reimbursement form, which states the costs for accomodation, travel
  - A tax related form, which you need to sign
- All receipts are required as an orginal. No scan or image
- If just a PDF exists, e.g. ticket for plane/train, that will do
- The original receipts and forms with your signature have to be (snail-)mailed to FAIR
- A digital copy to Christian Schmidt (c.j.schmidt@gsi.de)

Administrative Matters

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Facility for Antiproton and Ion Research in Europe GmbH
Planckstraße 1
64291 Darmstadt
www.fair-center.eu

To FAIR
Facility for Antiproton and Ion Research GmbH
Finanzabteilung
Planckstrasse 1
64291 Darmstadt
Germany

Compensation for travel expenses for the
Eurizon Detector School

First name, last name:

Affiliation (institute):
Bank details (IBAN, BIC):

The recipient of the payment has been informed that any possible tax obligation with respect to the payment of the reimbursement as indicated below remains solely with him/her.

Examples for reimbursable expenses are:

Cost for visa application, including travel to the embassy if needed, flight tickets, train tickets, lodging costs (if individually payed)...

Signature of payee .....
location, date, signature

Accounting period from to

Meeting Eurizon Detector School, Wuppertal

In the role as (lecturer, helper, student)

Cost center to be charged 471014

Die Finanzabteilung ist zur Zahlung angewiesen.

Sachlich richtig	
Kst.-Verantw.	
Datum	

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64291 Darmstadt
www.fair-center.eu

Travel costs (Cost for visa application, including travel to the embassy if needed, flight tickets, train tickets)	EUR	
Hotel lodging (assuming breakfast included)	EUR	
Other expenses (explain in notes below)	EUR	
Total		_____
Transfer in total	EUR	_____

Notes:

Please send the signed form together with documenting receipts and the acknowledgement of a potential tax obligation as originals to the FAIR financial department (address see above). Further, please do send this form together with the scanned receipts to Dr. Christian J. Schmidt (C.J.Schmidt@gsi.de). Reimbursement can be done upon reception of the original receipts only.

For questions, please do contact Mrs. Biedermann (finanzen@fair-center.eu).

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Datum	

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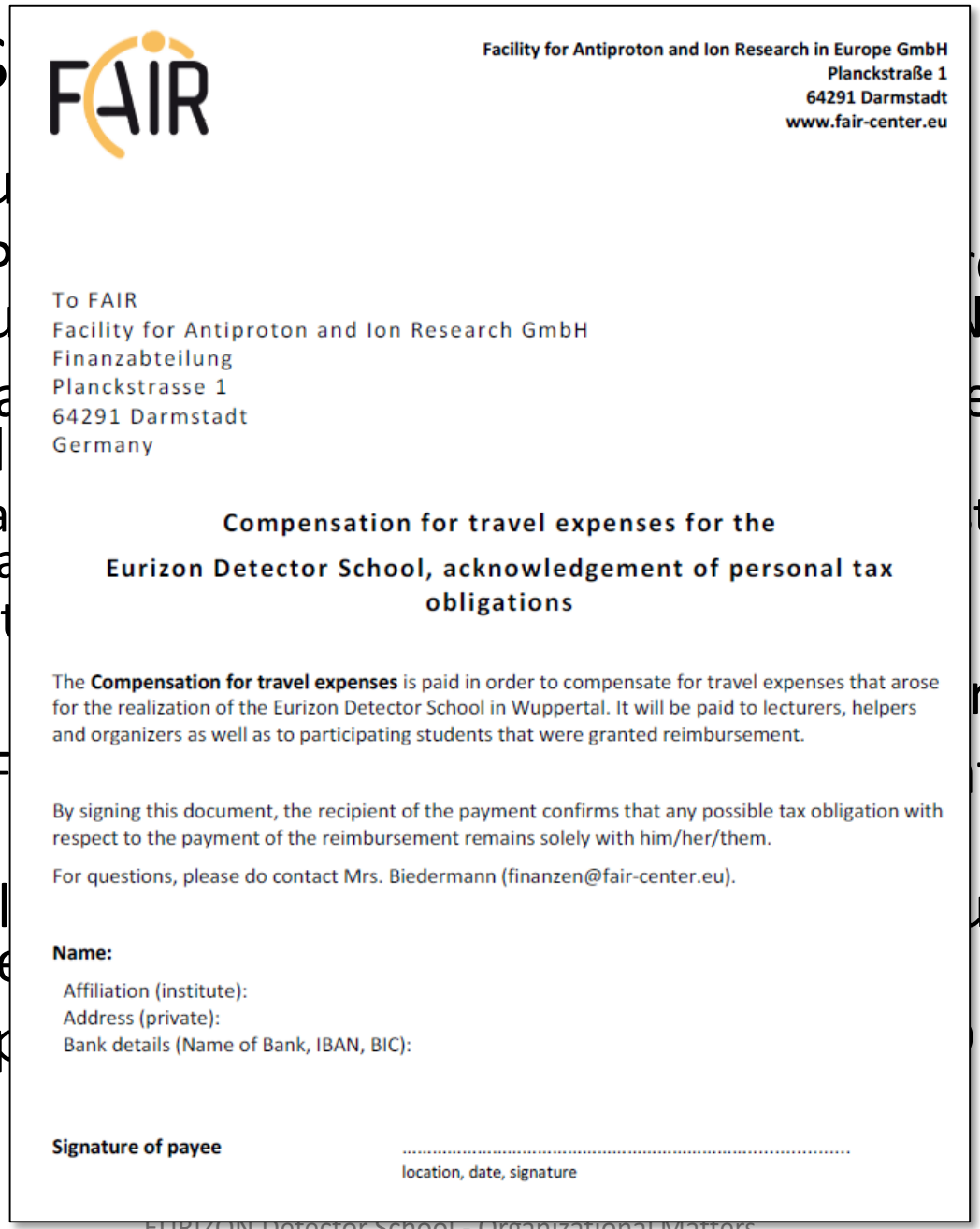

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To FAIR
Facility for Antiproton and Ion Research GmbH
Finanzabteilung
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64291 Darmstadt
Germany

Compensation for travel expenses for the Eurizon Detector School, acknowledgement of personal tax obligations

The **Compensation for travel expenses** is paid in order to compensate for travel expenses that arose for the realization of the Eurizon Detector School in Wuppertal. It will be paid to lecturers, helpers and organizers as well as to participating students that were granted reimbursement.

By signing this document, the recipient of the payment confirms that any possible tax obligation with respect to the payment of the reimbursement remains solely with him/her/them.

For questions, please do contact Mrs. Biedermann (finanzen@fair-center.eu).

Name:

Affiliation (institute):
Address (private):
Bank details (Name of Bank, IBAN, BIC):

Signature of payee .....
location, date, signature

BERGISCHE UNIVERSITÄT WUPPERTAL

Administrative Matters

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Need Help

- Everyone with red or blue dot on the badge can provide help
  - Red: local organizers
  - Blue: international organizers

- Help is available at most times in room G.11.01

- Ask for help via Discord

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Detector School Discord Channels

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