

## **Program**

**15-17 Sept 2025**

# **8. Miniworkshop difrakce a ultraperiferních srážek**

ČVUT Děčín  
Pohraniční 1288/1 40501 Děčín

# Table of contents

## **1** Monday 15 Sept

Registration in the hotel	1
UPC	1
Dinner	1

## **2** Tuesday 16 Sept

Breakfast	2
Dark matter and Phenomenology	2
Lunch	3
Detectors	3
Coffee break	4
ALICE	4
Dinner	5

## **6** Wednesday 17 Sept

Breakfast	6
From the past to the future	6
Lunch	6

# Monday 15 September

16:00

## Registration in the hotel

**Break** | **Location:** ČVUT Děčín, Pohraniční 1288/1 40501 Děčín

17:00

## UPC

**Session** | **Location:** ČVUT Děčín, Pohraniční 1288/1 40501 Děčín | **Convener:** Marek Matas

17:00–17:20

### Welcome and news

#### Speaker

Štěpán Mayer

17:20–18:20

### Some historical remarks on photon-induced interactions for QCD (1/2)

#### Speaker

Jesus Guillermo Contreras

#### Description

I give a brief overview of the historical evolution of using photons to study the structure of hadrons. The story starts with the discovery of nuclei, protons and neutrons that lead to the need of a new force. The touch follows the parallel development of accelerators and the quest to understand the inner most structure of matter. It discusses at length results from HERA and the development of models to understand those measurements. It closes with a description of the first results achieved in modern heavy-ion facilities.

18:30

19:00

## Dinner

**Break** | **Location:** ARRIGO, Duchcovská 827/6

21:00

# Tuesday 16 September

08:30

## Breakfast

**Break** | **Location:** Coffee & Books, Pohraniční 3

09:30

09:50

## Dark matter and Phenomenology

**Session** | **Location:** ČVUT Děčín, Pohraniční 1288/1 40501 Děčín | **Convener:** Timea Szöllősová

09:50–10:10

### Dark Matter and how do we know it's there

#### Speaker

Marek Matas

#### Description

The nature of dark matter is one of the long-standing problems of modern physics. It is commonly believed that it is formed by a new particle species not yet in the Standard Model. But how can we claim such a specific statement without a direct observation? This will be answered in my talk on the topic.

10:10–10:30

### The influence of gravitational slingshot on the velocity distribution of dark matter

#### Speaker

Adam Červenka

#### Description

Dark matter remains one of the greatest mysteries in modern physics. This presentation explores how gravitational manoeuvres with different stellar objects can reshape the dark matter velocity distribution function (VDF). By incorporating realistic VDFs and working in the center-of-mass frame, the simulations uncover new pathways for studying this effect. The talk concludes with implications for direct detection on Earth, offering a fresh perspective on current experimental limits.

10:30–10:50

### Introduction to generalized PDFs

#### Speaker

Jan Čepila

#### Description

A very short introduction to generalised parton distributions will be given and it will be shown how it comes together with Balitsky-Kovchegov equation.

10:50–11:10

### Study of hadron structure using angular-dependent Balitsky-Kovchegov equation

#### Speaker

Štěpán Mayer

#### Description

While quantum chromodynamics (QCD) allows us to calculate processes governed by the strong nuclear interaction, applying the theory on complex systems, like nucleons, becomes problematic. In order to probe the inner structure of nucleons we use evolution equations. One such equation is the Balitsky-Kovchegov (BK) equation, which describes the evolution of gluon densities with decreasing values of Bjorken  $x$ . The BK equation allows us to calculate the scattering amplitude in the high-energy limit of QCD, which can be used to make further predictions about the structure of hadrons at such energies. Although obtaining the full solution to the BK equation is a numerically difficult task, even a partial solution provides accurate predictions about observable quantities, like the  $F_2$  structure function.

11:10–11:30

### Quantum Sensing: What is all the fuss about

**Speaker**

Marek Matas

**Description**

Quantum sensing is a rising field in physics. Its applications can have immense consequences for beyond-standard model discoveries as well as for our day-to-day life. This talk will introduce the concept, some of its most impactful consequences, and lay the foundation for the next talk, which will describe the individual devices and discoveries.

11:30-11:50

**Balitsky-Kovchegov equation at the NLO****Speaker**

Matěj Vaculčíak

**Description**

The Balitsky-Kovchegov equation at the NLO has been recently solved including the impact parameter dependence. This new results will be presented, explaining the method stabilising the numerical solution and pointing to a potentially problematic part of the evolution kernel.

12:10

12:10

14:00

14:00

**Lunch****Break** | **Location:** Restaurace Fabrika, Oblouková 1413/3, Děčín, 405 02**Detectors****Session** | **Location:** ČVUT Děčín, Pohraniční 1288/1 40501 Děčín | **Convener:** Štěpán Mayer

14:00-14:20

**Quantum Imaging Techniques****Speaker**

Timea Szöllősová

**Description**

This talk will provide an overview of the principles of ghost imaging and quantum radar. These techniques allow detection in harsh environments and through turbulent media thanks to the entangled photon pairs. With this, it is possible to recreate an image with photons which never interacted with the observed object. Recent developments in this area promise revolutionary impacts not only in defence systems, but also in medical imaging and other applications.

14:20-14:50

**The MuonID project****Speaker**

Solangel Rojas Torres

**Description**

ALICE 3 is a new detector proposed to operate during the LHC Run 5 and 6. The Muon Identifier (MID) detector is one of the ALICE 3 subsystems; it is optimized to detect muons down to momenta below 1.5 GeV/c for rapidities  $|y| < 1.3$ . These muons will be used for the reconstruction of  $J/\psi$  vector mesons down to zero transverse momentum at midrapidity. The ALICE 3 tracker large-acceptance will offer access to rare charmonium and exotic states that decay to  $J/\psi$ , pions and photons. The MID detector will be installed outside the superconducting magnet and includes a magnetic steel absorber with variable thickness (70 cm to 38 cm). Given that the particle flux will be of the order of a few  $\text{Hz}/\text{cm}^2$ , plastic scintillator, multi-wire proportional chambers (MWPC), and resistive proportional chambers (RPC) technologies are being considered for the construction of MID.

This talk presents an overview of the detector and its physics goals. Emphasis is made on recent results from a beam test with plastic scintillators and MWPC, the status of the MID simulation, and the plans for the R&D of the MID detector.

14:50-15:10

**Construction of a Forward Diffractive Detector prototype with new light readout****Speaker**

Matěj Tonka

**Description**

During long shutdown 2, new detectors were installed in ALICE to achieve better performance in data measurement. Among these detectors was the Fast Interaction Trigger (FIT), which fulfills many roles among other ALICE detectors, such as centrality, luminosity, or vertex determination, to mention a few. Part of this detector is the Forward Diffractive Detector (FDD), a scintillator detector that helps determine key vertex and centrality of collisions.

During Run 4, we expect an increase in the interaction rate provided by the LHC in ALICE. These new conditions motivate the research for improved timing properties of the FDD. In this thesis, a different approach was investigated with regard to upgrading the detector.

Based on the geometry modification of the scintillator and its materials and replacing key components such as light guides or PMTs, this thesis accomplishes building and testing a new detector prototype to compare with its predecessor.

**15:10–15:30 Adaptive Signal Processing in the LHC Abort Gap Monitor****Speaker**

Karla Žertová

**Description**

The Abort Gap Monitor is one of the unseen guardians of the LHC, ensuring that stray protons don't put the machine at risk. In this talk, I will show how a new adaptive algorithm dynamically controls the detector settings to keep signals stable and safe. I will share what we learned from commissioning and measurements, how the system compares to the legacy monitor, and what challenges remain before it becomes the fully operational standard.

**15:30–16:30 Hands on****Speaker**

Solangel Rojas Torres

**Description**

Can a smartphone camera be used as a radiation detector?

Now a days we all have a smartphone in our pockets, which most of them have a high-quality camera sensor that could be sensitive to radiation. There is one app available that has been seriously tested to turn a your phone in to a geiger counter, lets try out!

<http://www.hotray-info.de/html/radioactivity.html>  
<https://www.nature.com/articles/s41598-021-92195-y>

16:30

16:30

**Coffee break**

**Break** | **Location:** ČVUT Děčín, Pohraniční 1288/1 40501 Děčín

16:50

16:50

**ALICE**

**Session** | **Location:** ČVUT Děčín, Pohraniční 1288/1 40501 Děčín | **Convener:** Karla Žertová

**16:50–17:10 Hadronic interaction studies at the LHC to understand Neutron Stars****Speaker**

Raffaele Del Grande

**Description**

Neutron stars are among the most compact and dense objects in the Universe. Their central densities can exceed nuclear density by several times. Under such extreme conditions, hyperons (i.e., baryons containing strange quarks) are expected to be produced for energetic reasons. According to state-of-the-art stellar models, however, the presence of hyperons should significantly reduce the maximum mass of stable neutron stars to values that are incompatible with astronomical observations. This discrepancy is known as the hyperon puzzle. These models, however, rely heavily on our scarce and limited knowledge of the strong interaction between hyperons and nucleons. In this contribution, I will show how data collected by ALICE at the LHC, analyzed using the femtoscopy method, can shed light on hadronic interactions and improve our understanding of neutron star composition.

**17:10–17:30 Flow of heavy flavor hadrons in Run 3 data**

**Speaker**

Alexian Marc Lejeune

**Description**

Collectivity in small systems can be summarized by a simple question : how can a collision that produces on average only a dozen of particles be described so well by hydrodynamics?

In this contribution, we explore this question by the studies of the flow of heavy-flavor hadrons through two-particle long-range correlations using ALICE experiment's forward detectors.

A focus will be done on the specificities of using forward detectors and particularly the Muon Forward Tracker (MFT) in the implementation of this analysis.

**17:30–17:50 Study of quantum interference using  $\rho^0$  photoproduction****Speaker**

Jakub Juračka

**Description**

The presented study investigates exclusive  $\rho^0$  photoproduction in ultraperipheral collisions. Emphasis is placed on quantum interference effects arising from the indistinguishability of the photon source in symmetric heavy-ion collisions. Together with the linear polarisation of the quasi-real photons facilitating the interaction, they produce observable modifications in the transverse momentum spectrum of the vector mesons and azimuthal angle distributions of their decay products. These effects are studied in Pb-Pb collision data at  $\sqrt{s_{\text{NN}}}=5.36$  TeV recorded by the ALICE detector in 2023.

**17:50–18:10 Incoherent  $J/\psi$  production****Speakers**

Vendulka Fílová, Vendulka Humlová

**Description**

In quantum chromodynamics, hadrons at high energies reach a dynamic balance between gluon splitting and recombination, a regime referred to as saturation. Diffractive photonuclear production of  $J/\psi$  vector mesons offers a powerful probe of the gluon distribution inside hadrons. The Mandelstam variable  $t$ , which represents the momentum transfer, provides access to the hadron structure in the impact-parameter plane, with different  $t$  ranges sensitive to gluon field dynamics at distinct spatial scales. In this talk, I present a measurement of the energy dependence of incoherent photonuclear  $J/\psi$  production off lead ions across several  $t$  intervals, measured with ALICE, enabling unprecedented tests of gluon saturation models.

**18:10–18:40****Pushing the limits with  $\gamma\gamma \rightarrow \tau^+ \tau^-$  reactions: one way to search for Beyond Standard Model physics experimentally****Speaker**

Roman Lavicka

**Description**

The anomalous magnetic moment of the tau lepton ( $a_{\tau}$ ) is a sensitive probe for the search for deviations from the Standard Model predictions and thus for new physics. This study investigates the feasibility of measuring  $a_{\tau}$  using ultra-peripheral collisions (UPCs) at the LHC, where photon-photon interactions ( $\gamma\gamma \rightarrow \tau^+ \tau^-$ ) produce tau lepton pairs. In this talk, we review the results from the LHC experiments and possible future developments.

18:40

19:30

21:30

**Dinner****Break** | **Location:** ARRIGO, Duchcovská 827/6

# Wednesday 17 September

08:30

## Breakfast

**Break** | **Location:** Coffee & Books, Pohraniční 3

09:30

10:00

## From the past to the future

**Session** | **Location:** ČVUT Děčín, Pohraniční 1288/1 40501 Děčín | **Convener:** Roman Lavicka

10:00–11:00

### Some historical remarks on photon-induced interactions for QCD (2/2)

#### Speaker

Jesus Guillermo Contreras

#### Description

I give a brief overview of the historical evolution of using photons to study the structure of hadrons. The story starts with the discovery of nuclei, protons and neutrons that lead to the need of a new force. The touch follows the parallel development of accelerators and the quest to understand the inner most structure of matter. It discusses at length results from HERA and the development of models to understand those measurements. It closes with a description of the first results achieved in modern heavy-ion facilities.

11:00–12:00

### Quantum Sensing: Where the wild meets the practical

#### Speaker

Marek Matas

#### Description

Quantum sensing is a rising field in physics. Its applications can have immense consequences for beyond-standard model discoveries as well as for our day-to-day life. In this talk, we will unravel what all this fuss is about.

12:00

12:00

## Lunch

**Break** | **Location:** Restaurace Fabrika, Oblouková 1413/3, Děčín, 405 02

14:00