

# Welcome to the FarBackward Working Group:

## Luminosity measurement and low- $Q^2$ tagging in ATHENA

### FarBackward WG kick-off

 Wednesday 26 May 2021, 12:00 → 13:00 US/Eastern

 Jaroslav Adam (BNL) , Krzysztof Piotrkowski (UCLouvain & AGH UST)

Description Join ZoomGov Meeting  
<https://bnl.zoomgov.com/j/1606097140?pwd=bXpOOS95VGQzaExrOVVTbThlYW5Qdz09>

Meeting ID: 160 609 7140

Passcode: 893548

One tap mobile

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+16468287666,,1606097140#,,,,\*893548# US (New York)

**12:00** → 12:20 **Introduction and outlook** ¶

**Speakers:** Jaroslav Adam (BNL) , Krzysztof Piotrkowski (UCLouvain & AGH UST)

**12:20** → 12:40 **Discussion**

**12:40** → 13:00 **Synchrotron radiation and design of beam-pipe exit windows**

**Speaker:** Charles Hetzel (BNL)

We will meet weekly, at noon BNL time on Wednesdays:

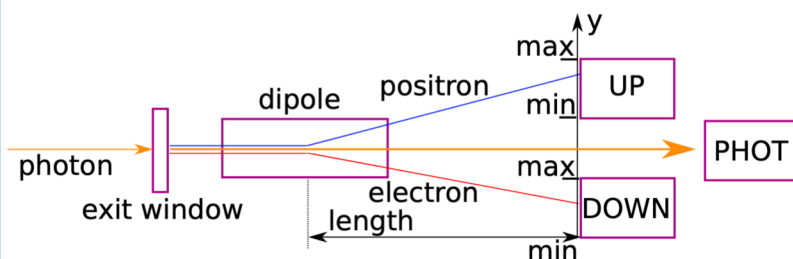
This is important not only for “formal” presentations and topical discussions but also to ensure proper information flow as well as just to keep in touch – our project is very challenging and we need to prepare a strong proposal in short time

<https://lists.bnl.gov/mailman/listinfo/eic-ip6-det-back-l> (19)

# FarBackward WG: First four meetings

Our first three meetings on **May 26<sup>th</sup>**, **June 2<sup>nd</sup>** and **9<sup>th</sup>** will be dedicated to gathering all “up-to-date” information about “boundary conditions” for this project.

→



**On June 16<sup>th</sup>** we plan to hold a meeting where the outline of the FarBackward project will be discussed and a very first workplan towards the FarBackward proposal presented

**May 26:**

Introduction

**June 2:**

Synchrotron radiation and beampipe design

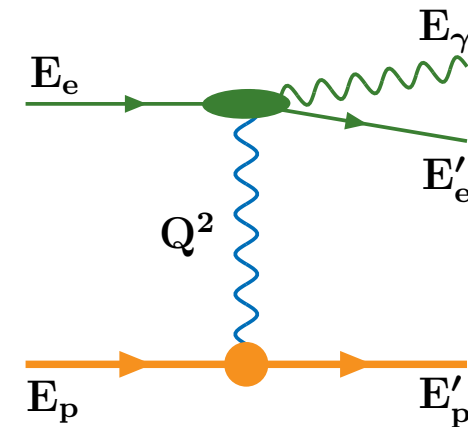
Event pileup issues and mitigations

**June 9:**

Framework for the FarBackward simulations (fast vs. full MC)

*Summary of the infrastructure/available space for our detectors*

Short summary of first ideas regarding the “spectrometer dipole”



# FarBackward WG: First organizational steps

FarBackward ATHENA detectors are very challenging and contributors to this project are very welcome – there are many important aspects to be covered!

Three candidates for representatives of the FarBackward WG to the ATHENA Proposal Group are proposed:

- Costing: Mariusz Przybycien (AGH)
- Integration: Jaroslav Adam (BNL)
- Editing: Krzysztof Piotrkowski (AGH)

## Open list of participants in various areas of the Far-Backward proposal

Integration with the EIC – J. Adam (BNL)

Electronics – Marek Idzik (AGH)

FarBackward system integration/technical coordination – Leszek Hajduk (IFJ)

Dipole magnet – NN (BNL), TBD

Spectrometer detectors – NN (BNL), TBD

Photon calorimeter – K. Piotrkowski (AGH)

Tagging – Bill Schmidke (BNL) and K. Piotrkowski (AGH)

Online data flow & processing – J. Adam (BNL) and K. Piotrkowski (AGH)

Software – J. Adam (BNL), Janusz Chwastowski (IFJ) and M. Przybycien (AGH)

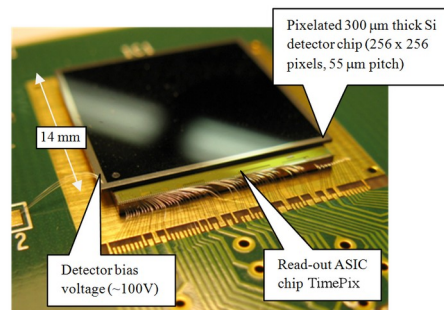
# Glasgow - Timepix4 in a Far Backward Detector

- We (Glasgow group) are already involved in EIC (ATHENA and ECC) 
  - But not yet focussed on any specific detector component

- Experience with detector development at Jlab, Mainz, Lund
  - Detector development, construction, slow controls
  - Data analysis, DAQ, simulation
  - Tagging

- Current projects with Timepix3
  - Polarimeter for lin pol photons
  - RFPMT for picosecond timing

- UK Infrastructures bid for EIC
  - Glasgow component:
  - to investigate Timepix4
  - for potential use at EIC



Timepix3

- Could timepix4 have a role in a far backward detector
- ..... or anywhere else at EIC?

## Timepix3 vs Timepix4

Timepix4: A 4-side tillable large single threshold particle detector chip with improved energy and time resolution and with high-rate imaging

			Timepix3 (2013)	Timepix4 (2019)
Technology			130nm - 8 metal	65nm - 10 metal
Pixel Size			55 x 55 $\mu\text{m}$	55 x 55 $\mu\text{m}$
Pixel arrangement			3-side buttable 256 x 256	4-side buttable 512 x 448 <b>3.5x</b>
Sensitive area			1.98 $\text{cm}^2$	6.94 $\text{cm}^2$
Readout Modes	Data driven (Tracking)	Mode	TOT and TOA	
		Event Packet	48-bit	64-bit <b>33%</b>
		Max rate	0.43x10 <sup>6</sup> hits/mm <sup>2</sup> /s	<b>3.58x10<sup>6</sup> hits/mm<sup>2</sup>/s</b>
		Max Pix rate	1.3 KHz/pixel	<b>10.8 KHz/pixel 8x</b>
	Frame based (Imaging)	Mode	PC (10-bit) and iTOT (14-bit)	CRW: PC (8 or 16-bit) <b>10x</b>
		Frame	Zero-suppressed (with pixel addr)	Full Frame (without pixel addr) <b>5x</b>
		Max count rate	~0.82 x 10 <sup>9</sup> hits/mm <sup>2</sup> /s	~5 x 10 <sup>9</sup> hits/mm <sup>2</sup> /s <b>8x</b>
	TOT energy resolution			< 2KeV
Time resolution			1.56ns	<b>~200ps</b>
Readout bandwidth			≤5.12Gb (8x SLVS@640 Mbps)	<b>≤163.84 Gbps (16x @10.24 Gbps)</b>

# Glasgow - Timepix4 in a Far Backward Detector ?

- Q1 Which is the contributions you can bring to the Far-Backward activity towards the proposal **in the next months**?
  - Add Timepix4 / pixel detectors to simulation. (Already in progress – Simon Gardner)
- Q2 What are the most relevant and urgent questions in the Far-Backward sector?
  - Decide optimal position / track / timing resolutions ?
  - What is available space, radiation environment ?
  - Maximising angular acceptance at large eta
  - Costs
- Q3 How do you see globally Far-Backward project for Detector 1
  - Quasi real photon beam with high flux for meson photoproduction and spectroscopy
  - Suppression of backgrounds in hard exclusive photoproduction processes

## Currently involved:

Daria Sokhan (UK EIC infrastructure bid spokesperson), Ken Livingston (Timepix3 + DAQ development), Derek Glazier (Simulation and analysis)  
Simon Gardner (simulation, Timepix3 analysis tools), Dima Manuelaeski (Medipix and Timepix Guru)  
Daresbury Cross-community support group (Timepix3 readout and DAQ)

# BNL-ATHENA: Far Backward

Active members: J. Adam, E. Aschenauer, W. Schmidke

Q1: Which are the contributions you can bring to the Far-Backward activity towards the proposal in the next months?

- Members wrote Far-backward sections of CDR & YR, based on:
  - Developed: full Geant simulation far-backward detector system, bremsstrahlung MC generator (J. Adam)  
(<https://arxiv.org/abs/2105.10570>)
  - Participation with EIC design team since start:  
detector/IR integration (E. Aschenauer)
  - Extensive experience all aspects:  
ZEUS@HERA-II lumi spectrometer (W. Schmidke)
  - Older:  
EIC R&D eRD12: “Electron polarimeter, luminosity monitor, and low Q<sup>2</sup>-tagger”, (R. Petti, left group)

# BNL-ATHENA: Far Backward

Q2: What are the most relevant and urgent questions in the Far-Backward sector?

- Integration of backward system into IR, specify:
  - beam pipes, aperture limits
  - exit windows
  - synchrotron radiation field
- Define photon & electron apertures
  - ⇒ define beamline elements e.g. collimators, spectrometer dipole, ...
  - define detector locations, sizes, parameters

Q3: How do you see globally Far-Backward project for Detector 1?

- Extensive project experience in DOE framework,  
we are anxious to collaborate with interested institutions!

- **Members:**

AGH UST: Marek Idzik, Krzysztof Piotrzkowski, Mariusz Przybycien

IFJ PAN: Dariusz Bocian, Janusz Chwastowski, Leszek Hajduk, Rafał Staszewski

- **Which are the contributions you can bring to the Far-Backward activity towards the proposal in the next months?**

- Coordination of the efforts toward the FB proposal.
- EoI - EIC Forward Instrumentation in the Electron Hemisphere
- Experience from ZEUS@HERA (photon and electron tagging)

- **What are the most relevant and urgent questions in the Far-Backward sector?**

- Establishing the good conditions for the precise luminosity measurement and photoproduction tagging – minimizing the direct synchrotron radiation and optimizing the exit window designs.
- Establishing the optimal configuration of the luminosity detectors, for two complementary measurement techniques, including auxiliary detectors for calibration and diagnostics.
- Preparing a framework for evaluation of the expected luminosity errors, as well as the tagging performance, for different running scenarios and as a function of detector parameters and configurations.



- Proposing adequate detector technologies for the FB system.
- Defining tentative requirements for the readout and DAQ electronics, including data (pre-)processing aspects.
- **How do you see globally Far-Backward project for Detector 1?**
  - Precise luminosity measurements are central for the physics program at the EIC, but are very challenging – the FB system requires an optimal design and dedicated instrumentation and variety of diagnostic tools
  - Photoproduction tagging is an important part of the exclusive physics program, but it also poses very serious experimental challenges
  - Possible significant support from the Polish Ministry of Education and Science toward building the Far Backward detectors.