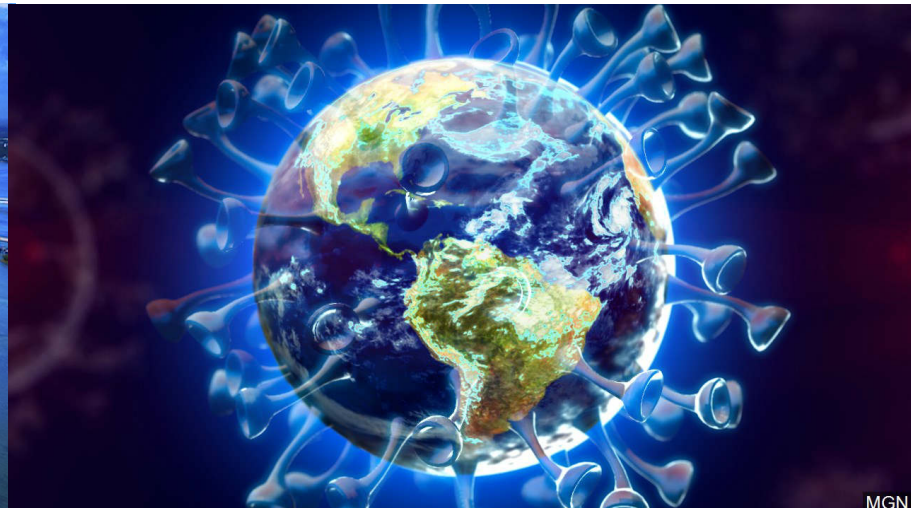
# Presentation of the Polish HEP Community Expressing Interest in the EIC Project at BNL

Mariusz Przybycień

AGH University of Science and Technology

(on behalf of the Polish EICUG community)

EIC User Group Meeting in "Miami", 15 – 17 July 2020



# Polish institutions currently interested in the EIC project

- AGH University of Science and Technology (AGH UST), Krakow:

  Experiment: L. Adamczyk, M. Przybycien, K. Piotrzkowski, M. Idzik
  Theory: P. Kotko

- Institute of Nuclear Physics Polish Academy of Sciences (IFJ PAN), Krakow:

  Experiment: J.J. Chwastowski, B. Pawlik, R. Staszewski, J. Swierblewski
  Theory: K. Golec-Biernat, A. van Hameren, A. Kusina, K. Kutak,
  W. Schafer, A. Szczurek

- Jagiellonian University (JU), Krakow:

  Theory: P. Korcyl, L. Motyka, W. Placzek, M. Praszalowicz,
  M. Sadzikowski, W. Slominski, T. Stebel



# Polish institutions currently interested in the EIC project

- National Centre for Nuclear Research (NCBJ), Warsaw:

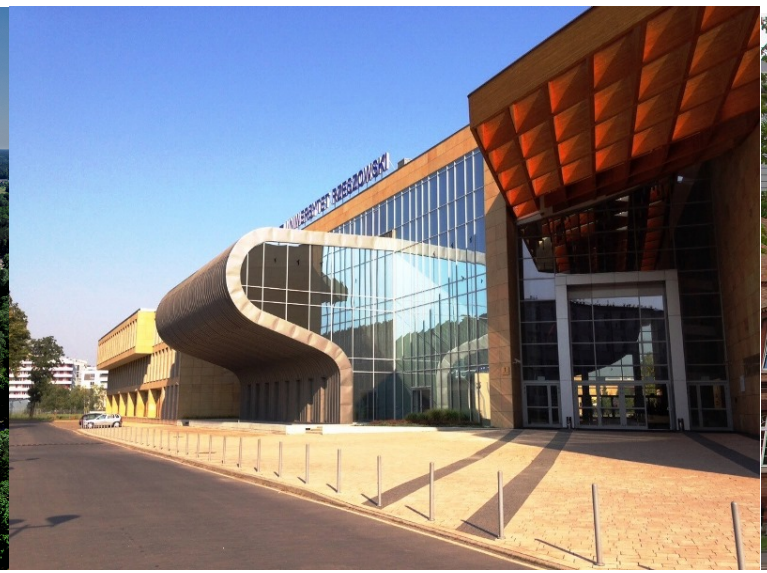
  Experiment: A. Sandacz
  Theory: T. Altinoluk, G. Beuf, P. Sznajder, L. Szymanowski, J. Wagner

- University of Rzeszow (UR), Rzeszow:

  Theory: M. Luszczak, A Cisek, A. Szczurek

- T. Kosciuszko Cracow University of Technology (CUT), Krakow:

  Theory: A. Luszczak



# Polish institutions currently interested in the EIC project

- University of Warsaw (UW), Warsaw:
  Experiment: B. Badelek

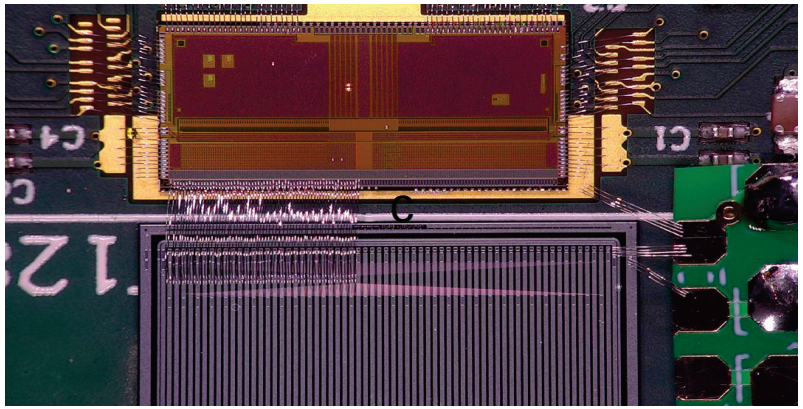
- Warsaw University of Technology (WUT), Warsaw:
  Experiment: D. Kikola

# AGH University of Science and Technology (AGH UST)

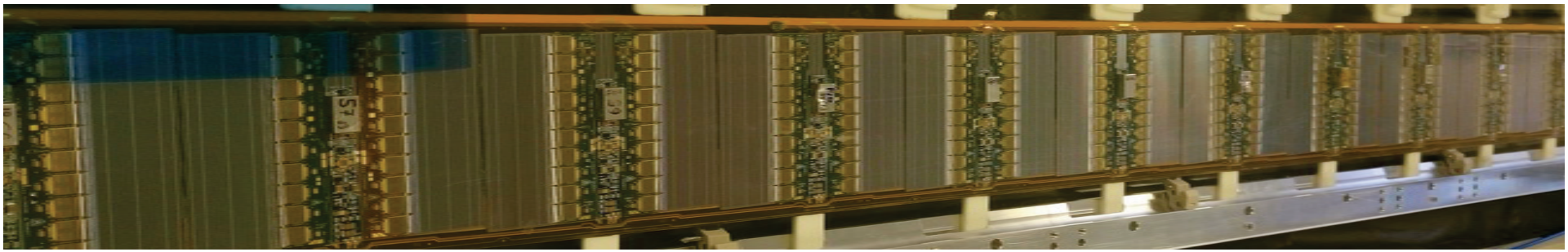
- AGH UST was established in 1919, and at present is the leading technical university in Poland. Close cooperation with industry and scientific institutions from around the world, allow to educate more than 22 000 students in 80 specializations at the highest level. An overview of the reasearch conducted at the AGH UST you can watch here.
- Strong HEP group at the Faculty of Physics and Applied Computer Science:
  - Current experiments: ATLAS, LHCb, STAR (physics and detector building/upgrade).
  - Previous experience: ZEUS (luminosity detector and measurement), DELPHI, OPAL.
- Main HEP interests of the current staff in physics subjects:
  - Deep inelastic $ep$ scattering: $F_2$, small $x$, jet physics, vector mesons, BFKL dynamics.
  - Photoproduction: total $\gamma p$ cross section, jets, $F_2^\gamma$, vector mesons.
  - Diffractive physics: $F_2^{\mathrm{diff}}$, vector mesons, exclusive production of particles and jets, elastic and total $pp$ cross sections.
  - Two-photon physics: $F_2^\gamma$, interactions of highly virtual photons, study of $\gamma\gamma$ collisions in $pp$ and in UPC of heavy-ions, muon pairs production and LbyL scattering.
  - Heavy-ion collisons: study of vector bosons production, jets production, study of Quark-Gluon Plasma, collective behaviour in large and small systems.
- Other experience of potential interest for the EIC project:
  - Members of the group were responsible (together with IFJ PAN) for the luminosity measurement in the ZEUS experiment at HERA.
  - Experience in detector simulation in the Geant4 framework.
  - Taking part in data acquisition and analyses of STAR and ATLAS experiments.

# AGH UST - R&D and detectors' building and testing

- On site: fully equipped Lab (including CleanRoom) and all necessary software tools (Cadence, Mentor Graphics, Synopsis, as well as Xilinx for FPGA programming) for development and testing of detectors and microelectronic devices.
- (LHCb upgrade) Leading role in developing and building of SALT readout ASIC for the readout of ∼500 000 channels for silicon strip detectors in Upstream Tracker.
  - SALT is a 128-channel ASIC built in CMOS 130 nm technology, with front-end and 40 MSps 6-bit ADC in each channel, followed by DSP and fast data transmission.
  - The chip is ready, and detector is under construction.



- (ATLAS upgrade) Significant contribution to development of ABC130/ABCStar ASICs for readouts of silicon strip detectors.
- Also, in cooperation with IFJ PAN, powering system for the silicon strips in the ITk including development of radiation tolerant DC–DC converters.

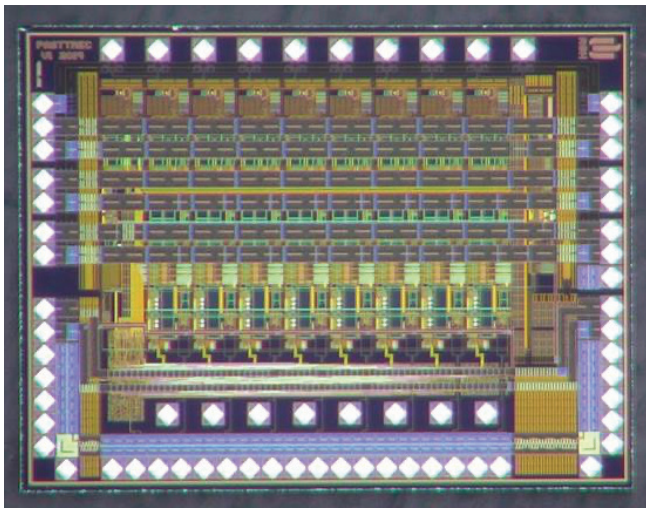


# AGH UST - R&D and detectors' building and testing

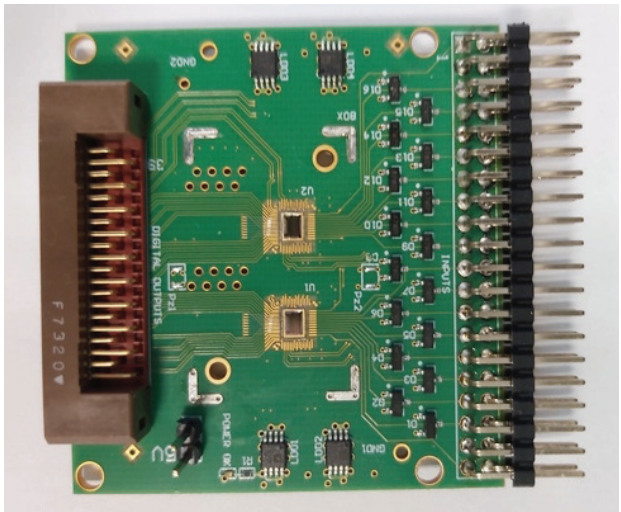
- (PANDA at FAIR) Leading role in building of dedicated read-out electronics for Straw Tube Tracker (STT) and Forward Tracker (FT). The central part of the read-out is the PASTTREC chip, fully developed and tested at different beams by the group members.
  - Cooperation with the JU (responsible for FT) and with FZ Jülich (STT).
  - PASTTREC chip is an 8-channel ASIC built in CMOS AMS 0.35 μm technology with integrated ToA and ToT, and an ion tail cancelation circuit.
  - AGH UST in collaboration with JU will provide readout electronics for ∼5000 straw tubes in the STT and for ∼15 000 straw tubes in the FT.
  - The chips are now being produced and the read-out electronics is being constructed.

Straw Tube plane for FT

PASTTREC - 8-channel ASIC



16-channel front-end board

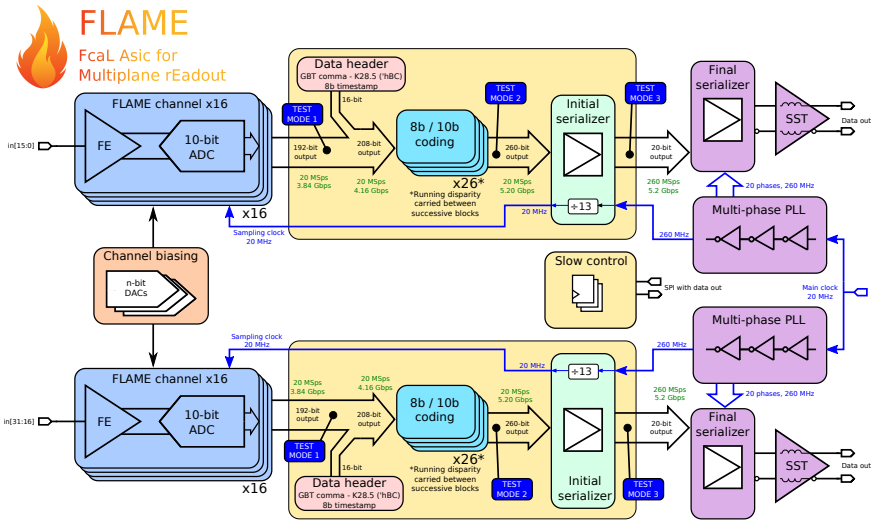


# AGH UST - R&D and detectors' building and testing

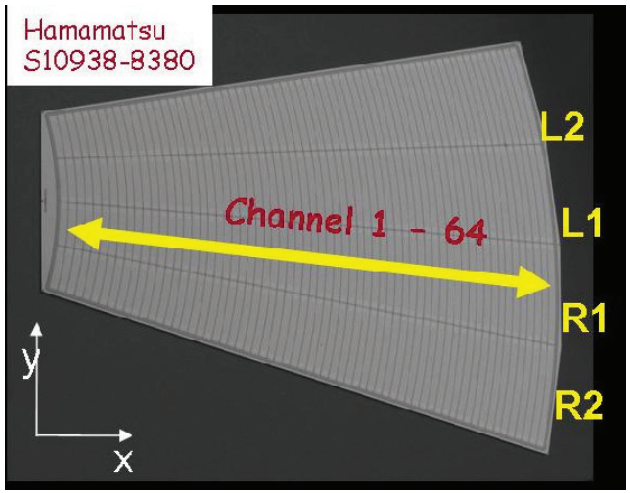
- FCAL Collaboration develops compact calorimeters for future linear collider.
- AGH UST is strongly involved in building of luminosity calorimeter LumiCal:
  - AGH UST is responsible for building of a dedicated readout electronics for the electromagnetic calorimeter (FLAME readout ASIC).
  - The readout is ready, tested and shown to work as expected.
  - The group is also responsible for DAQ, tests at beams and integration of the detector.
  - Silicon sensors have been made by Hamamatsu.

Prototype LumiCal

Block diagram of FLAME readout ASIC

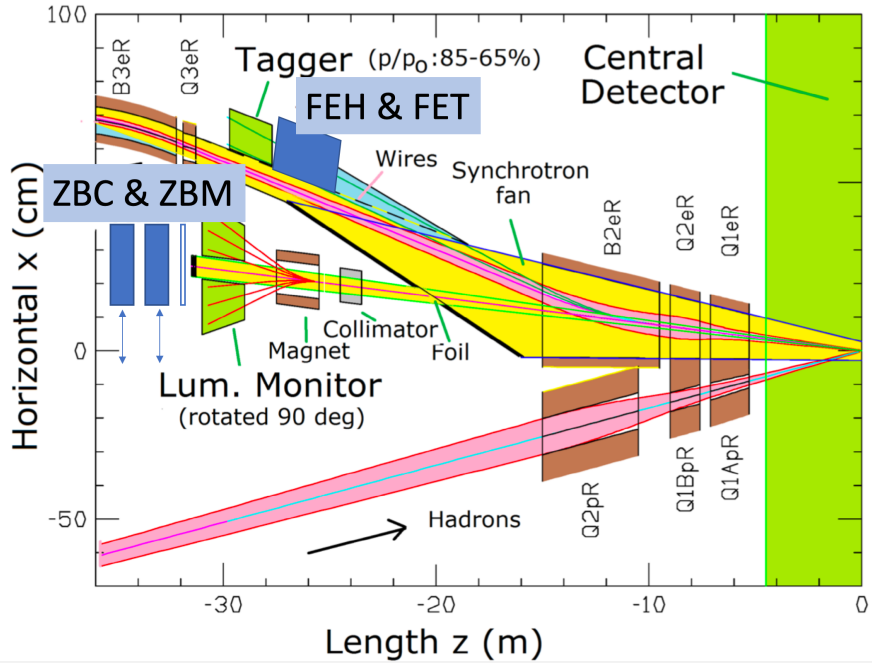



4-sector silicon sensor



# AGH UST - possible contribution to a detector for EIC

- Precise luminosity measurement at the EIC, with $\delta L/L < 1\%$, is both crucial to achieve main physics goals and very challenging ($ep$: $\sim 10$ hard bremsstrahlung photons every 10 ns; $e$+A: several thousands of such photons, for nominal luminosity).
- A forward electron detector will suffer from event pileup ($ep$: $\sim 3$ bremsstrahlung electrons every 10 ns, assuming its acceptance range $0.65 < E'/E < 0.85$. For the $e$+A collisions the event pileup will scale with $Z^2/A$
- We propose to complement the luminosity system with four additional detectors:
  - zero-degree high resolution calorimeter for unconverted bremsstrahlung photons (ZBC),
  - zero-degree energy flow monitor for unconverted bremsstrahlung photons (ZBM),
  - forward electron hodoscope (FEH), a mini-tracker with $>5000$ channels,
  - forward electron timing detector (FET).




- We are interested in building these, movable and highly segmented, ZBC and ZBM, as well as FEH and FET including their full front-end electronics.
- The project would be realized in cooperation with IFJ PAN and possibly other institues.
- Possible funding by the Polish Ministry of Science and Higher Education, BUT, needs a higher level (DoE - Ministry) agreement and expression of strong interest from BNL.

# Institute of Nuclear Physics Polish Academy of Sciences

- Established in 1955, presently the IFJ is the largest, out of 68 institutes of the Polish Academy of Sciences. Nowadays, IFJ employs 182 researchers, 120 engineers and educates 66 PhD students.
- The Institute's wide scope of interests includes theoretical and experimental research in the fields of: particle physics and astrophysics, nuclear and strong interaction physics, condensed matter physics (including nano-materials), as well as interdisciplinary and applied research (e.g. physics in medicine, biology, dosimetry, environmental protection, nuclear geophysics, radiochemistry, high-temperature plasma diagnostics, study of complex systems, such as the human brain, financial market or linguistics).
- The National Centre for Hadron Radiotherapy - Cyclotron Centre Bronowice (CCB), funded by the European Innovative Economy Operational Programme, is a flagship project of IFJ.
- The CCB is a unique infrastructure in Central Europe, serving as a clinical and research centre in the area of medical and nuclear physics. Since 2013, its cyclotron, Proteus C-235, delivers proton beams with energies of 70-230 MeV. CCB is a modern clinical cancer treatement centre with two experimental halls and three treatment rooms serviced by two rotating gantries with Pencil Scanning Beam as well as a horizontal line for eye treatment.

# Institute of Nuclear Physics Polish Academy of Sciences

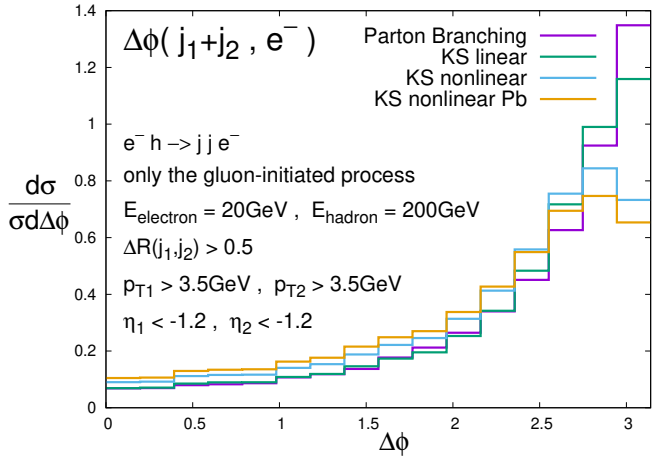
- Current experiments: ALICE, ATLAS, AUGER, Baikal-GVD, CREDO, CTA, HAWC, H.E.S.S., ICARUS T600, LHCb, Belle and Belle II, STAR, SUNLAB1, T2K and T2K-II – actions consider physics analyses and detector construction/upgrade.
- Previous experience: RHIC: PHOBOS, pp2pp, LEP: DELPHI, HERA: H1 and ZEUS (luminosity detector and measurement) and various (lepton)hadron-hadron experiments.
- Main HEP interests of the current staff in physics subjects:
  - CP violation, rare decays (LHCb, Belle, Belle-II).
  - Detection of ultra-high-energy cosmic rays (AUGER, CREDO).
  - Neutrino physics: astro-physical neutrinos (Baikal-GVD), neutrino properties and oscillations (ICARUS T600, SUNLAB1, T2K, T2K-II).
  - Proton-proton interactions: charged Higgs (ATLAS).
  - Ion-ion and proton-ion interactions (ALICE, ATLAS, STAR).
  - Forward physics: elastic scattering, soft and hard diffraction and exclusisve processes (ATLAS Roman Pots, STAR).
  - Astro-particle physics: supernova remnants, active galactic-nuclei, non-termic emission of the galactic disc, non-termic processes in cosmic plasma (H.E.S.S.,HAWC)
  - ALICE, ATLAS and LHCb detectors upgrade for HL-LHC.
  - Detector Control Systems (ATLAS).
  - Tigger and Data Acquisition Systems (ATLAS).
  - Feasibility studies related to ILC, CLIC and FCC.
  - Physics programme and hardware of the CTA.

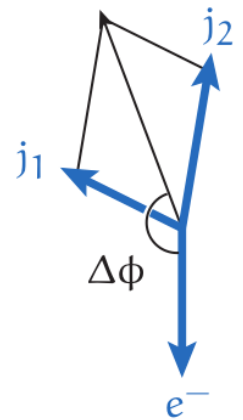
# Institute of Nuclear Physics Polish Academy of Sciences

- Experiences related to the accelerator infrastructue:
  - Members of the Division of Scientific Equipment and Infrastructure Construction gained their experience and expertise during the long term cooperation with CERN, DESY, CEA Saclay, Greifswald, F4E ITER, GSI Darmstadt. The carried out actions were/are related to: LHC, XFEL, ESS, ITER, T2K, CTA, CCT, Pierre Auger, ATLAS.
  - Assembly & installation of the systems (LAS, T2K, W7-X, SPIRAL 2, ESS),
  - Quality assurance (LHC, XFEL, ESS),
  - Engineering & prototyping of mechanical and electronic/electrical equipment (LHC, T2K, W7-X, CTA, ITER, CCB, HiLumi-LHC, Pierre Auger Observatory SSD)
  - Software engineering, LabView programming, web apps development (LHC,XFEL,ESS)
  - Tests of the accelerator components (RF cavities, magnets),
  - Vacuum (construction of a local clean-room),
  - Cryo: test of superconductors, Nb3Sn, Nb-Ti magnets, CRAB cavity, SC Link Demonstrator projects.
- Other experience of potential interest for the EIC project:
  - Members of the group were responsible (together with AGH UST) for the luminosity measurement in the ZEUS experiment at HERA.
  - Taking part in data acquisition and analyses of pp2pp, STAR and ATLAS experiments.
  - Staff of the Department of Diffractive Processes constitutes the core of the ARP component of ATLAS (physics programme, analyses, TDAQ, DCS).
  - Development of the GRID infrastracture and local computing facilities.

- Potential detector/machine contribution of the IFJ PAN to the EIC project:
  - Taking part in the lepton hemisphere initiative of AGH UST.
  - Very forward proton system (pots).
  - TDAQ and DCS systems.
  - Machine: the details have to be discussed (started) and decided.

- Theory and phenomenology for EIC:
  - Dense gluonic matter and jet physics; in particular applications of small $x$.
  - Improved Transverse Momentum Dependent (ITMD) factorization developed in JHEP 09 (2015) 106.
  - New results for unintegrated quark and gluon densities along the method proposed in JHEP 01 (2016) 181.
  - New sets of collinear nuclear parton density functions.
  - $\gamma^*\gamma$ processes (collaboration with UR).
  - Exclusive diffractive production of vector mesons.
  - Diffractive processes on nuclei (collaboration with CUT).
  - Photonuclear dissociation, incoherent production on nuclei.
  - Inclusive production of quarkonia.



# Jagiellonian University in Krakow

- Jagiellonian University (JU), established in 1364, is at present one of the top research universities in Poland. More than 35 000 students, 177 specializations, 3 800 teachers.
- Strong representation of theoretical particle physics and nuclear physics at the Faculty of Physics, Astronomy and Applied Computer Science ($\sim 200$ faculty members).
  - Current experiments: ATLAS, PANDA at FAIR, HADES (contributions both to hardware and data analysis).
  - Main interests: $\mathcal{O}(10)$ faculty members from Institute of Theoretical Physics with expertise and interest in theory of strong interactions and EIC physics:
    - Non-linear effects in QCD evolution at small $x$, multiple scattering and higher twist effects in nuclear inclusive and diffractive structure functions, nPDFs at small $x$.
    - Exclusive photo- and electroproduction of mesons and DVCS as probes of the three-dimensional structure of the proton and nuclei.
    - Transverse momentum dependent parton distributions in nuclei - models & lattice.
    - Heavy flavour and jet probes of nuclei at high parton densities.
- Active collaboration links to groups in USA involved in EIC physics: BNL (common projects, postdocs), Kansas University, Penn State University, besides also to DESY and Hamburg University, multiple scientific connections to University of Warsaw, IFJ PAN, NCBJ, AGH UST, both in theory and experiment.
- Lattice QCD group with active participation in large collaborations (CLS, RQCD) with dedicated studies of hadron structure functions.

# National Centre for Nuclear Research (NCBJ)

- NCBJ is one of the largest research institutes in Poland, operating nuclear research reactor MARIA. Its research activity covers elementary particle physics, nuclear physics, hot plasma physics, nuclear reactor studies, astrophysics, detectors characterization, detector and electronics systems development for industry and large scale experiments.
- International collaborations with largest laboratories in the world (CERN, DESY, Grenoble, JParc, FAIR, Jülich, ESS, JINR, T2K).
- HEP groups:
  - CMS Topics: (i) properties of Higgs boson; (ii) search for new physics (heavy stable charged particles).
    Hardware: The first stage (L1) muon trigger.
  - LHCb Topics: (i) CP violation in decays of $b$ and $c$ quarks; (ii) preservation of CPT.
    Hardware: Straw chambers for Outer Tracker.
  - ALICE Topics: (i) Multiplicity and spectrum of charged particles produced in $p-$Pb and Pb$-$Pb collisions; (ii) preservation of CPT symmetry by means of measurement of differences between masses of nuclei and anti-nuclei.
    Hardware: Calibration of the PHOS photon detector.
  - COMPASS Topics: (i) Nucleon structure (including the spin structure); (ii) hadron spectroscopy using beams of muons/hadrons.
  - NA61/SHINE Topics: (i) Studies of the properties of hadron production in collisions of relativistic ions with a variety of fixed nuclear targets for different beam energies. (ii) Measurements of hadron production in the $p-$C collisions for the T2K experiment.

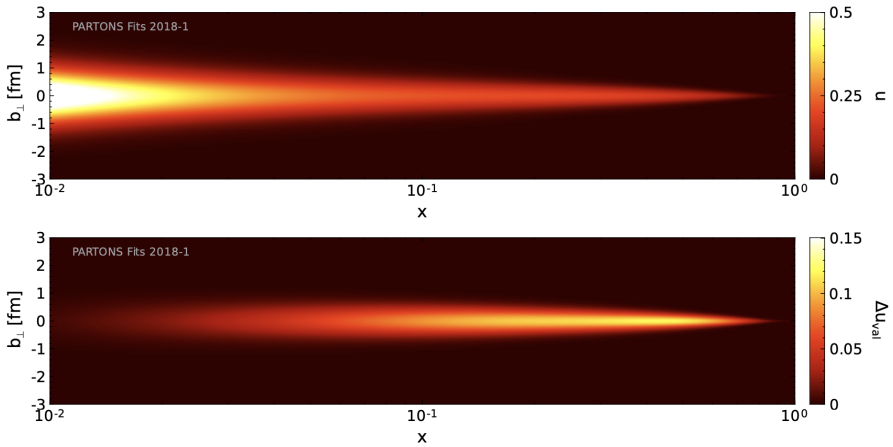
# National Centre for Nuclear Research (NCBJ)

- Neutrino physics:
  - T2K Topics: (i) oscillations of accelerator-produced neutrinos, including measurement of background for observations of electron neutrinos in T2K; (ii) measurement of cross sections for interactions of neutrinos with matter.
    Hardware: Side Muon Range Detector - a part of the Near Detector, ND280.
  - ICARUS/DUNE Development of liquid argon-based neutrino detection techniques.
- PARTONS software group (in collaboration with CEA Saclay):
  - Development of a modern framework for complex studies of GPDs in EIC era.
  - Development of a new MC event generator dedicated to exclusive processes $\Rightarrow$ no generic MC generator in the community so far, much needed for EIC.
  - Active participation in YR effort:
    - Evaluation of cross sections for experimentalist.
    - Guidance and help with the interpretation of obtained results.
- Division of Radiation Detectors and Plasma Diagnostics:
  - Construction and laboratory characterization of a demonstrator of COsmic Ray Detector for MPD @NICA (MCORD).
  - Design of the full MCORD detector, based on long and thin plastic scintillators with WLS fibers and silicon photomultiplier photodetectors (SiPM), for muons detection.
- Division of Nuclear Equipment:
  - Linac4 for LHC: buncher and 12 PI mode structures (PIMS).
  - GBAR at CERN: electron accelerator.

# National Centre for Nuclear Research (NCBJ)

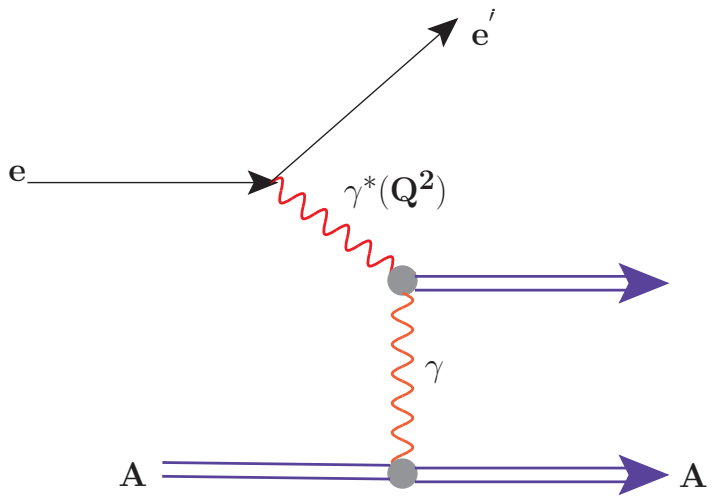
- Theory topics:
  - Exclusive physics: nucleon tomography, „mechanical" properties, OAM
    $\Rightarrow$ highlights of EIC physics proposal:
    - Global fits of GPD information.
    - PARTONS - modern framework for complex studies of GPDs in EIC era.
    - Description of new processes - new ways of accessing GPD information to maximise use of EIC data.
    - Increased precision of existing description (NLO, higher twists) $\Rightarrow$ important for proper interpretation of EIC data.

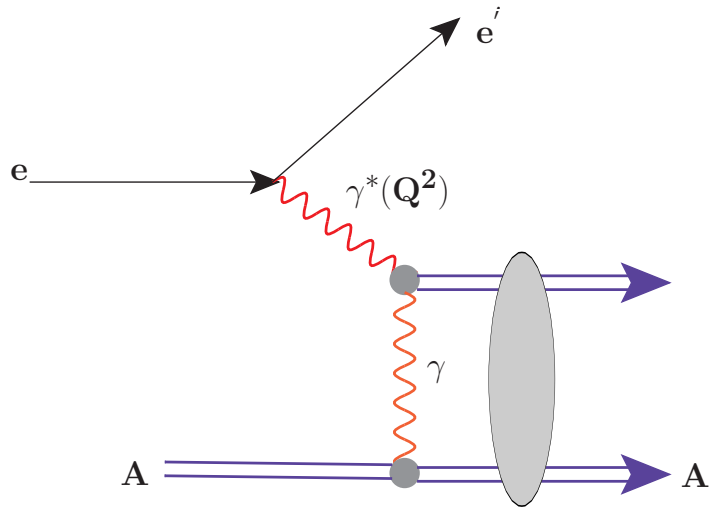
Nucleon tommography from fits




  - Low $x$ physics:
    - Crucial theory input for precise phenomenology at low-x at the EIC:
      - DIS structure functions with massive quarks at NLO,
      - Finite energy corrections to DIS dijet production at the EIC,
    - Improvement of UV regularization in Light-Front Perturbation Theory,
    - Unraveling the origins of angular correlations in small size systems,
    - Gluon TMDs from DIS dijet production at the EIC.

- Close cooperation with the IFJ PAN on theory and phenomenology.
- Our main interests in EIC physics include $\gamma^*\gamma$ fusion processes in $e$+A collisions:
  - Investigation of particle production in the strong Coulomb fields of heavy nuclei (Primakoff effect).
  - Possible use of $\gamma^*\gamma$ interactions to extract meson form factors, and investigate their dependence on $Q^2$.
  - Plan to calculate cross sections for production of various light and heavy hadrons, using different models and in particular the light-front formalism.
  - Plan to include effects due to absorptive corrections and also a low-energy electromagnetic dissociation of nuclei.

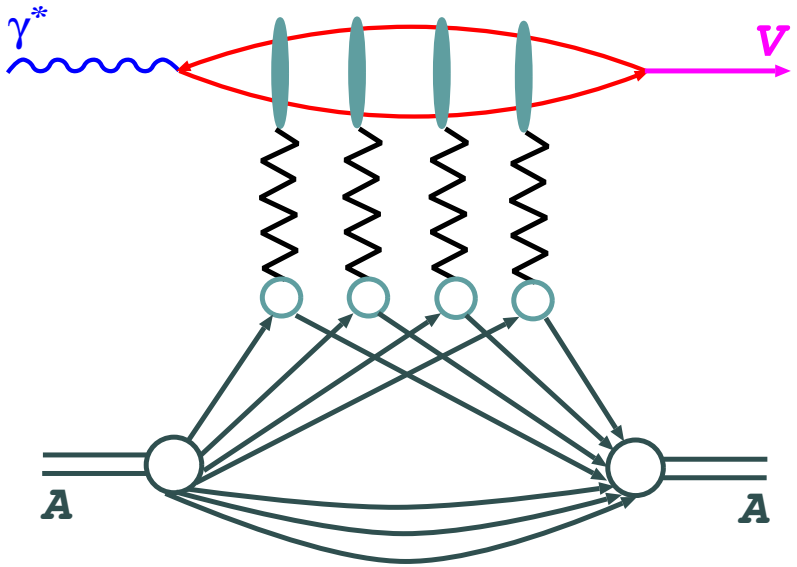


# T.Kosciuszko Cracow University of Technology (CUT)

- CUT (Polytechnic) was established in 1945 and currently employs 1 100 academic staff and educates 14 000 students at 8 faculties.
- HEP activities at the Institute of Physics, Faculty of Materials Engineering and Physics:
  - description of HERA DIS data at low $x$ and low $Q^2$ using QCD and dipole models,
  - participation in the `xFitter` project (QCD fit framework to extract PDFs and assess the impact of new data); determination of new PDFs from HERA and LHC data,
  - study of diffractive photoproduction of heavy quark pairs and exclusive (coherent and incoherent) photoproduction of vector mesons in $\gamma p$ and A+A collisions,
  - participation in the STAR @RHIC (till 2014),
  - investigations for Belle @KEK and LHCb @LHC (previously).
- Faculty of Mechanical Engineering: Accelerator Design Center, participation in the LHC and the FCC programmes:
  - design, development and construction of superconducting magnets,
  - optimization of connection zones between magnets including the system compensatory and structures of the so-called continuous cryostat,
  - design and optimization of superconducting lines and power modules,
  - development of modern accelerator assembly techniques and quality control,
  - design of ultra high vacuum systems for a proton beam,
  - optimal design of supporting structures for elementary particle detectors.

- Main interests in physics at EIC:
  - diffractive structure functions of proton and nuclei for transverse and longitudinal photons,
  - exclusive diffractive (and incoherent) electroproduction of vector mesons,




  - dijet production in the photon (or "current") fragmentation region.
  - For predictions we will use the dipole cross section and gluon distribution extracted in the paper: A.Łuszczak, H.Kowalski, Phys. Rev. D 95 (2017), as well as presented in: A.Łuszczak, W.Schäfer, Phys. Rev. C 97 (2018) and Phys. Rev. C 99 (2019).

# University of Warsaw

- University of Warsaw (UW), established in 1816, is Poland's largest and finest university and a leading research centre, offering numerous programs of studies and specializations within all fields of science. UW employs over 3 500 academic staff and educates over 43 000 undergraduate students, and 3 000 Ph.D. students (among them 1000/170 at the Faculty of Physics).
- Faculty of Physics (best in Poland) is 73rd in 2020 Shanghai Global Ranking of Academic Subjects.
- Longstanding tradition of DIS experiments: EMC, NMC, SMC, ZEUS, COMPASS.
- Experimental collaborations with numerous world labs:
  CERN, DESY, T2K/SUPER-K, JINR, MAMI, GSI, FAIR, TUNL, RIKEN,...
- Activities for EIC: phenomenology

  Extension of the $F_2(x,Q^2)$, $R(x,Q^2)$ and $g_1(x,Q^2)$ down to $Q^2 \approx 0$, necessary for the QED radiative corrections procedure. This will be an update of methods studied in:

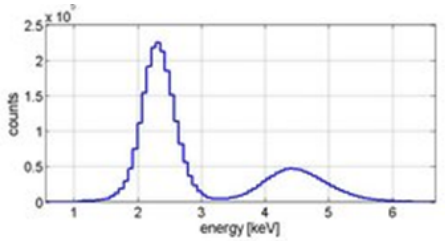
  ($F_2$) B. Badełek and J. Kwieciński, Phys. Lett. B295 (1992) 263;
  ($R$) B. Badełek, J. Kwieciński and A. Staśto, Z. Phys. C74 (1997) 297;
  ($g_1$) B. Badełek, J. Kiryluk and J. Kwieciński, Phys. Rev. D61 (1999) 014009.
- Activities within collider experiments:
  - LHC/CMS (readout system for RPC, OMTF for trigger; analysis)
  - NICA/MPD (gating grid HV for TPC; simulations)
  - CLIC, ILC (simulations)

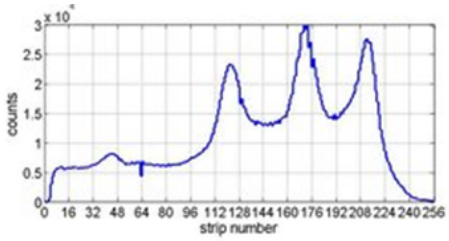
# University of Warsaw

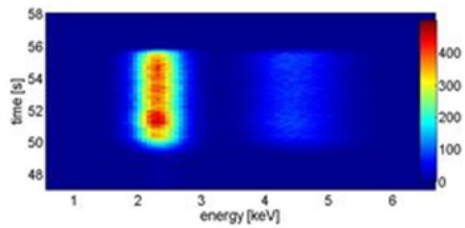
- Activities within fixed target experiments:
  - COMPASS (analysis)
  - NA61/SHINE (TPC maintenance + upgrade, trigger module + firmware; analysis)
  - MINOS+, T2K/SUPER-K (analysis)
  - MAMI/2POL (mechanical elements for Mott polarimeter; analysis, simulations)
  - GSI/HADES (analysis)
  - TUNL/HIgS (complete experimental setup with TPC, readout electronics + firmware; software for event reconstruction, simulations)
  - HH-IFIN/ELI-NP (as for TUNL/HIgS)
  - JINR/ACCULINNA-2 separator (experimental setup with an Active Target TPC, software for event reconstruction and physics analysis)
  - Several experiments: at GSI, ISOLDE, NSCL MSU, TAMU Texas, RIKEN, JINR, LNS INFN Catania (Optical TPC manufacturing with own concept of hardware, readout system, analysis)
  - Generic R&D on gas detectors operating at atmospheric pressure and low-pressure with GEM amplification structures.
- Hardware plans for EIC will be defined when possible funding by the by Polish Ministry of Science and Higher Education is assured.

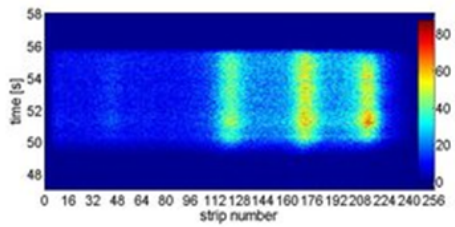
# Warsaw University of Technology (WUT)

- Electronics Laboratory for High Energy Physics, Institute of Electronic Systems, Faculty of Electronics and Information Technology:
- Advanced electronics systems for nuclear and high energy physics experiments.
- Selected recent projects:
  - Real-time plasma diagnostics at JET and WEST tokamaks (GEM-based systems).
- Our specialization:
  - Complex multichannel real-time systems design for soft X-ray spectra histograming (energy, topology).
  - GEM detectors construction (the sensor part is done by another institution). WUT designs: GEM pixels backplane (PCB), FE electronic boards, signal handling and analysis.
  - Complete FPGA development.
  - High speed signal streaming.



# Large scale computing infrastructure

In addition to local computing resources at each of the institutions, there are two large scale cumputing infrastructures, directly connected with our institutions:

- Academic Computer Centre CYFRONET AGH:
  - Offers access to high-performance computing clusters and large storage resources (over 5 PFlops of computing power and over 60 PB of storage space).
  - Prometheus, the fastest computer in Poland took 288th position on the TOP500 list.
  - Part of PLGrid infrastructure and WLCG.
  - Provides Tier-2 services for the LHC experiments: ALICE, ATLAS and LHCb.
- Computing Centre Świerk (NCBJ):
  - Resources: 1.5 PFlops in CPU+GPU servers, 200 TB RAM, 18 PB disk storage, 12 PB tape archive;
    Bandwidth: 10 Gbps general usage + 100 Gbps dedicated to demanding projects.
  - Participation in the EGI (European Grid Infrastructure) and collaborating with the WLCG (Worldwide LHC Computing Grid).
  - Provides Tier-2 services for two LHC experiments: LHCb and CMS.
  - Involvement in European XFEL.

# Research funding possibilities in Poland

- National Science Centre (NCN):
  - funding of fundamental research,
  - domestic and international (in cooperation with foreign funding agencies) calls,
  - not suitable for development/building of large apparatus ($\lesssim 120$k USD),
  - ideal for theorists, participation in smaller experiments including data analysis.
- National Centre for Research and Development - requires substantial contribution from industry - e.g. to commercialize outcomes of fundamental research.
- Ministry of Science and Higher Education (MNiSW):
  - funding of large national science infrastructure,
  - funding of participation of Polish scientific institutions in large international projects:
    - participation of Polish groups in the large LHC experiments, inluding detectors' upgrades,
    - contributions to large international scientific infrastructure (e.g. LHC and possibly EIC)
      - preferentially not directly financial, but rather to support leading role of Polish groups in R&D and construction of detectors at local institutions,
      - the infrastructure should be included in the Polish Map of Research Infrastructure - requires an agreement at appropriate level (e.g. DoE - Ministry).
- Polish National Agency for Academic Exchange (NAWA):
  - several programmes, for coming and doing research in Poland,
  - suitable for experienced researchers and also postdocs,
  - very competitive financial opportunities.
- Direct position openings at the Polish institutions (including visiting scientists and PhD)

Excellence Initiative - Research University: 10 best universities in Poland (AGH, UJ, UW)

# Summary of possible financing of the Polish contribution

- Financing of the Polish contribution to the machine development and detector construction for EIC is possible only through dedicated grants from the Ministry of Science and Higher Education (MNiSW).
- As a first step towards such grants, an agreement between DoE and MNiSW is needed.
  - To succeed, it is necessary to make a clear and convincing point on importance of the expected Polish contribution to the EIC project.
  - It can take long to finalize such agreement, so it is necessary to start the procedure as soon as possible.
  - The contact person in MNiSW has been identified and his name was already passed to DoE.
- Once this general agreement is signed, we can apply (success is not guaranteed) for grants financing our well defined contributions to the EIC accelerator and/or detectors based on direct mutual agreements with DoE/BNL.
  - MNiSW expects, that the projects will be realized mainly by the staff members of the Polish scientific institutions and, to an extent possible from the technical point of view, onsite at the institutions.
  - And, the projects themselves should be innovative and should allow to significantly expand the expertise of the Polish research groups.

# EIC oriented, international meetings in Poland

## 61 Cracow School of Theoretical Physics
`http://th-www.if.uj.edu.pl/school/`

- Every year devoted to another subject.
- Venue: Zakopane (Tatra Mountains) or on-line
- Date: June 2021

## EIC User Group meeting in 2021

- Venue: Faculty of Physics, University of Warsaw, Poland, or on-line
- Date: $1 - 7$ August 2021

Thank you for your attention!