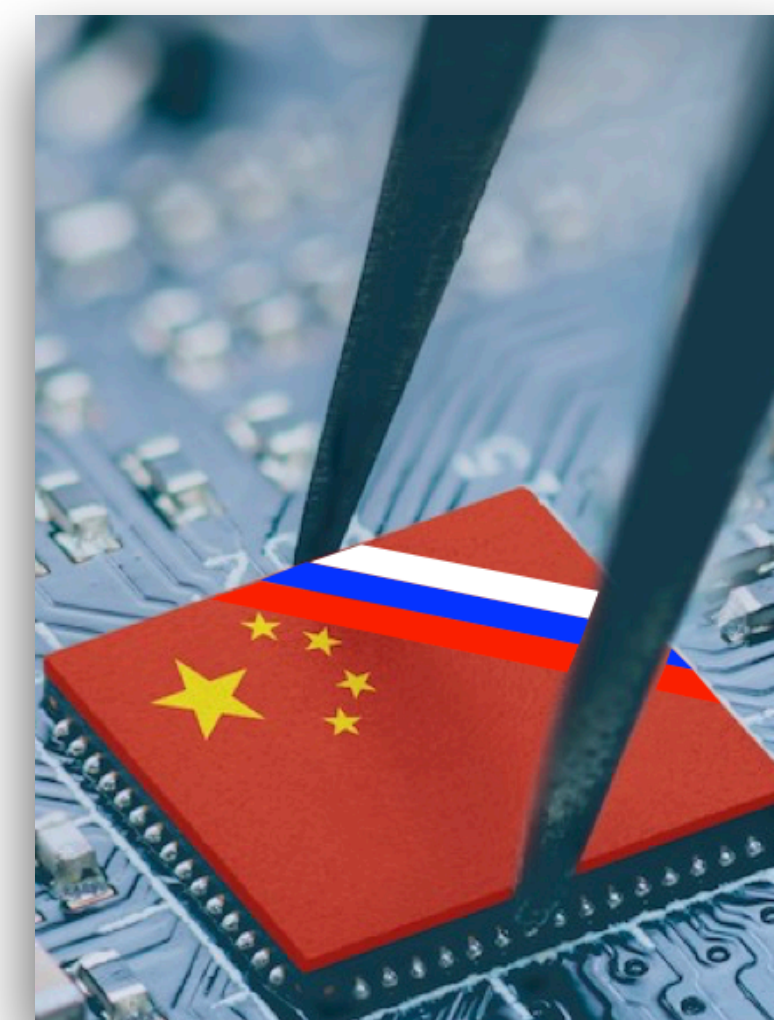




Cooperation on the development and production of state-of-the-art microelectronics.

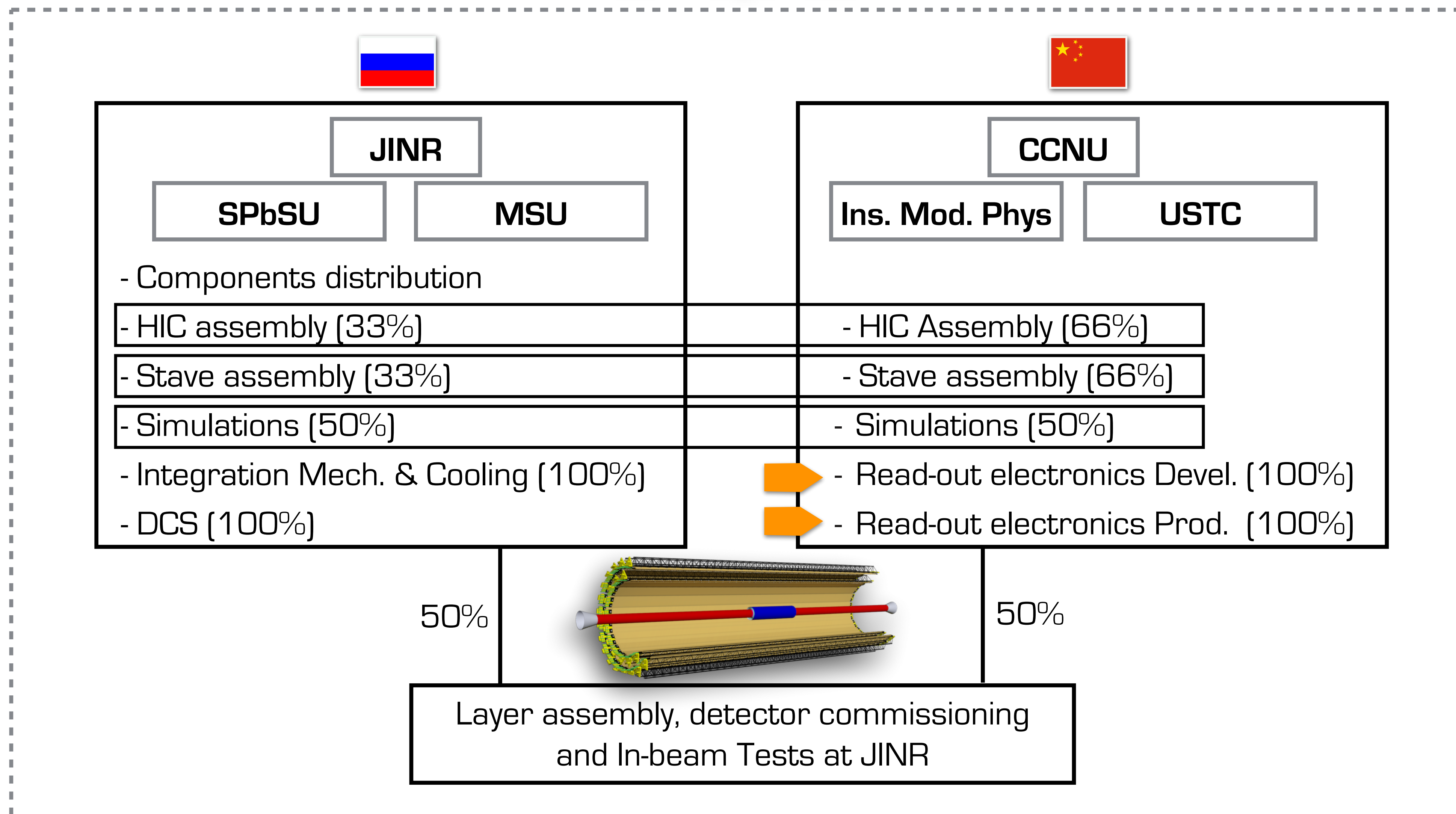
Ю.А.Мурин, С.Себаллос.



совещания по научно-техническому сотрудничеству с КНР - 2022.10.13

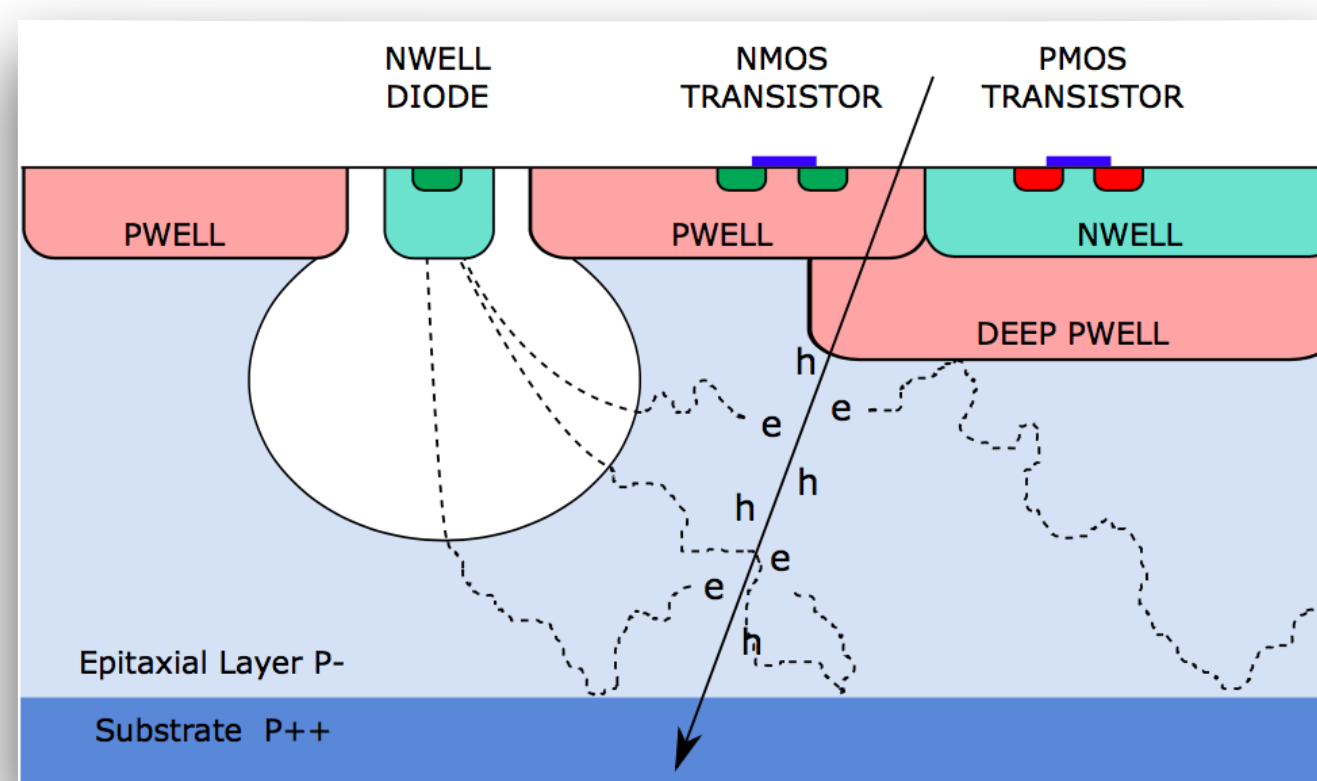
- **Cooperation background**
- **Current work**
- **Future collaboration**

CERN supervision



TowerJazz 0.18 μm CMOS pixel sensor

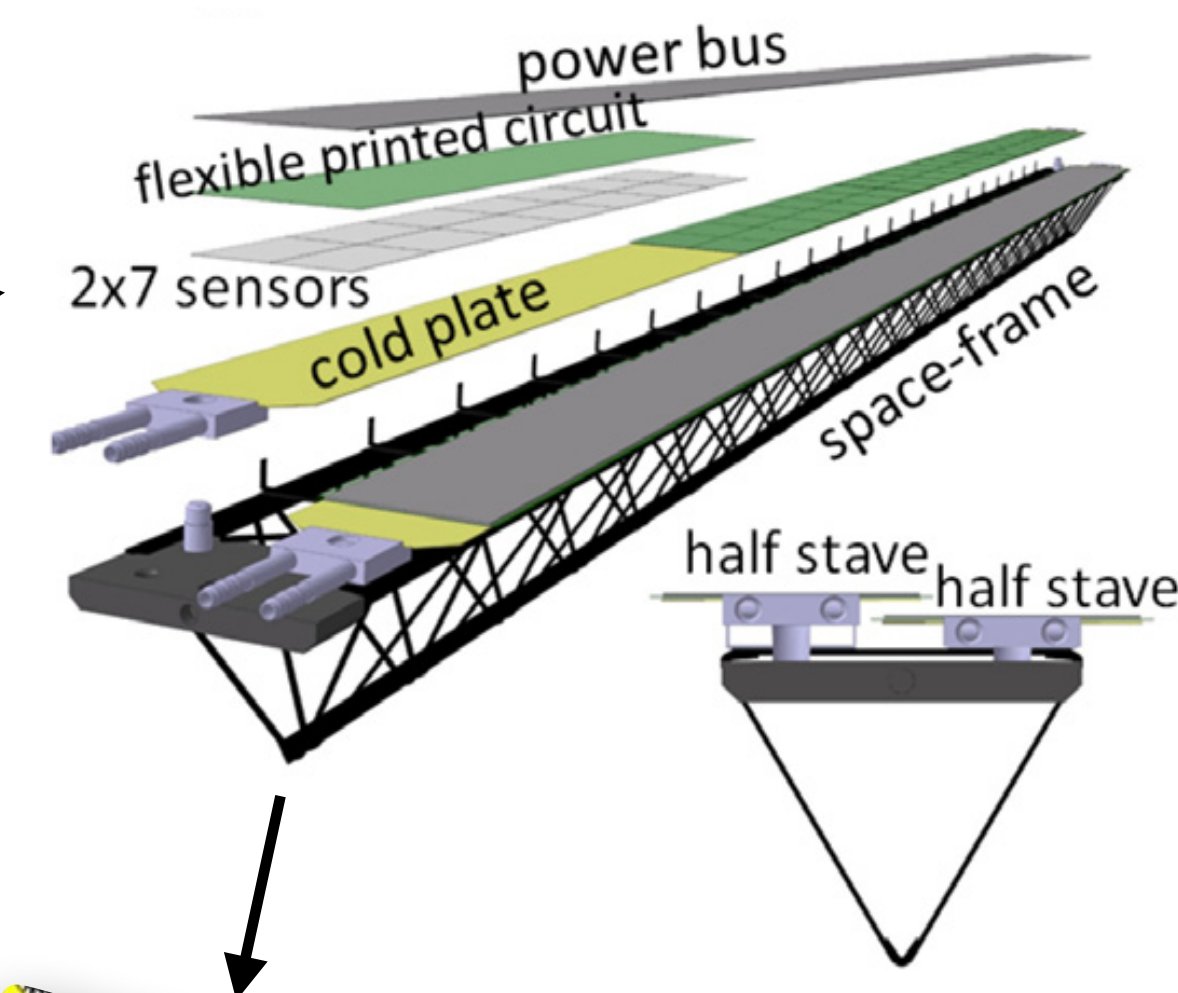
- » High-resistivity ($> 1\text{k}\Omega\text{ cm}$) p-type epitaxial layer ($20\mu\text{m} - 40\mu\text{m}$ thick) on p-type substrate.
- » Small n-well diode ($2\text{-}3\ \mu\text{m}$ diameter), ~ 100 times smaller than pixel \Rightarrow low capacitance.
- » Deep PWELL shields NWELL of PMOS transistors, allowing for full CMOS circuitry within active area.



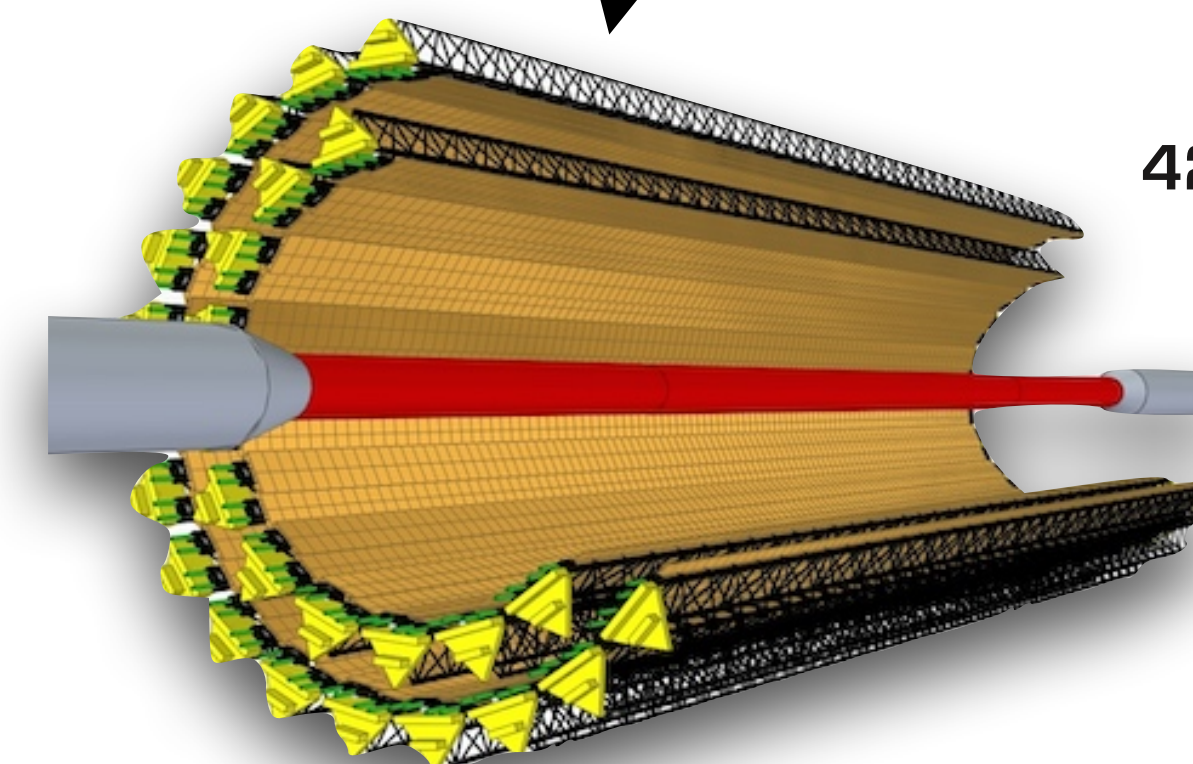
512 x 1024 pixels

Sensor architecture

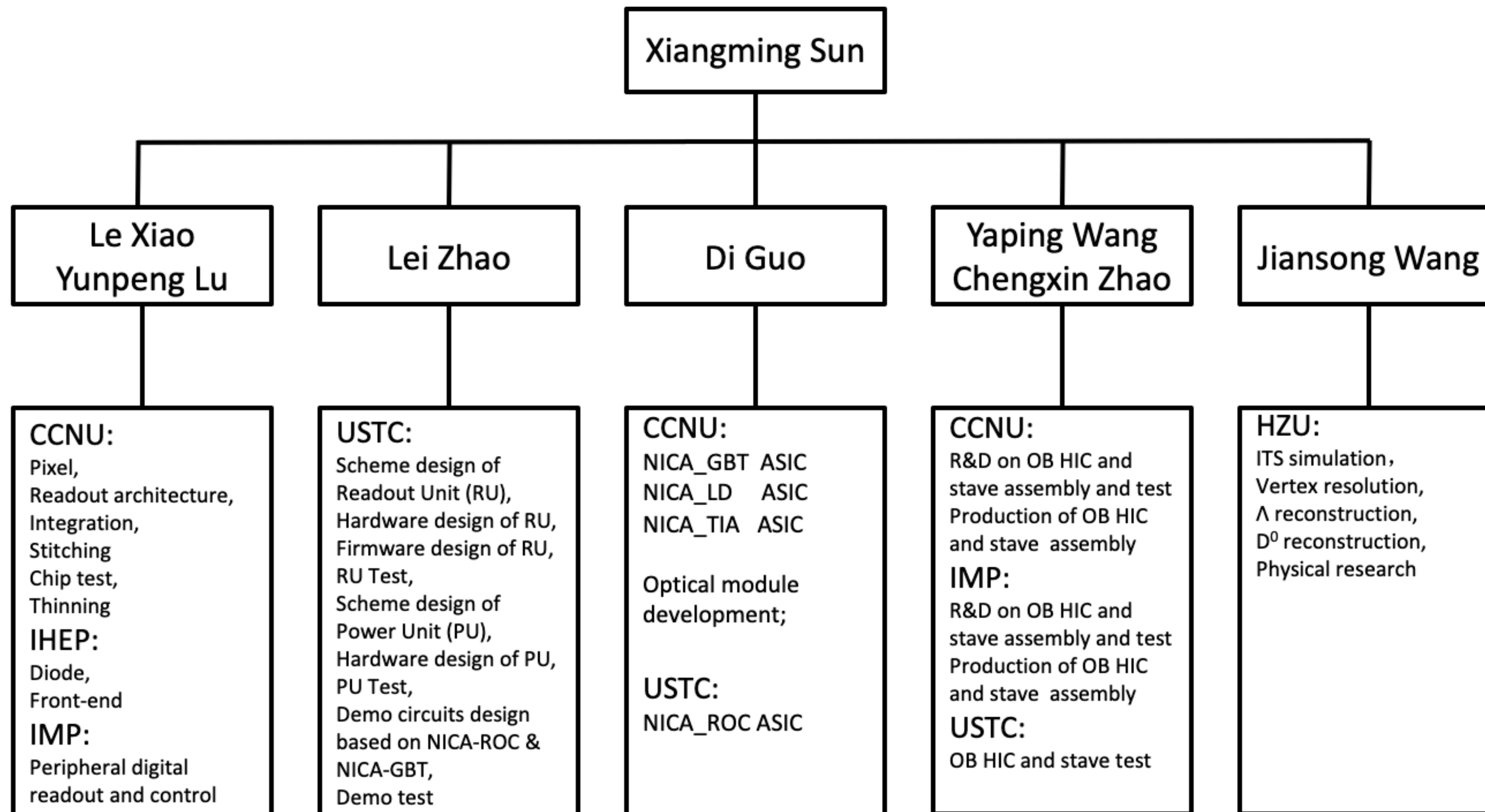
Size: 15mm x 30mm
Pixel pitch: $28\mu\text{m} \times 28\mu\text{m}$
Power consumption: $39\text{mW}/\text{cm}^2$
Dead area 1.1mm x 30mm



42 Staves



Chinese Group Members






MPD-ITS collaboration coordination

MPD - ITS



After a Pandemic-related interruption
the collaboration was resumed in Sept. 2020




MPD-ITS meeting for resuming Russia-China collaboration
Friday 25 Sep 2020, 09:00 → 10:05 Europe/Moscow
Webcast (LBNL)

Description **Note: Meeting start time is Friday, Sept. 25, 9:00am Moscow / 14:00pm Beijing / 23:00pm (Thursday, Sept. 24) San Francisco.**

Zoom: <https://lbnl.zoom.us/j/7515309921>
Meeting ID: 751 530 9921
Passcode: 0604

09:05 → 10:05 MPD-ITS Collaboration Status	
Convener: Prof. Nu Xu	
09:05	Current Status of the NICA project Speaker: Dr Yuri Murin (JINR)
09:10	MPD-ITS current status Speaker: Dr Cesar Ceballos Sanchez (JINR)
09:25	MPD-ITS Structure and Management Speaker: Dr Yuri Murin (JINR)
09:35	PLAC - Capabilities for Vertex Detector Speaker: Dr Yaping Wang
09:50	MPD-ITS read-out plan Speaker: Prof. Xiangming Sun (CCNU)



2nd Meeting on China-Russia MPD IT System
16 Oct 2020, 18:00 → 17 Oct 2020, 23:55 Europe/Moscow
Webcast (LBNL)


Description **Note: Meeting start time is Friday, Oct. 16, 6h00 San Francisco / 17h00 CET / 18h00 Moscow / 23h00 Beijing.**
(The Agenda's timetable is in Moscow time)

Zoom: [Click here](#)

There are minutes attached to this event. [Show them.](#)

FRIDAY, 16 OCTOBER

18:00	Answers to Yaping's questions from last meeting Speaker: Dr Yuri Murin (JINR)
18:05	Working groups: Org Chart and Milestones Speaker: Prof. Xiangming Sun (CCNU)
18:15	MAPS for Inner Layers Speaker: Le Xiao (CCNU)
18:40	Readout Electronics Design for ITS of MPD in NICA Speaker: Lei ZHAO (University of Science and Technology of China)
19:10	ASIC R&D in NICA Readout Electronics Speaker: Di Guo (CCNU)
19:40	HIC-Stack Assembly and Tests Speaker: Yaping Wang (CCNU)
21:10	Round Table Convener: Dr Yuri Murin (JINR)
21:10	Detailed info on Budget, MPD-ITS readout design, timeline




MPD-ITS General Coordination meeting
Thursday 18 Feb 2021, 18:00 → 20:00 Europe/Moscow
Nu Xu (Central China Normal University(CCNU))

Description Start time: 7h00 (Berkeley) / 16h00 (CEST) / 18:00 (Moscow) / 23h00 (Beijing)

Zoom link: [Click here](#)

Passcode: 0604



MPD-ITS General Coordination meeting
Thursday 24 Jun 2021, 09:00 → 10:25 Europe/Moscow
Nu Xu (Central China Normal University(CCNU))

Description

Note: The starting time of the meeting is 9h00 (Moscow)/14h00 (Beijing)/8h00 (Geneva)/23h0023.June (San Francisco)

Zoom link: <https://lbnl.zoom.us/j/7515309921> // Passcode: 0604.



MPD-ITS Readout electronics coordination meeting
Friday 18 Dec 2020, 12:00 → 14:00 Europe/Moscow
Webcast (JINR)

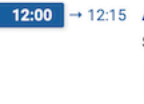
Description **Note: Meeting start time is Friday, Dec. 18, 04h00 (Havana) / 12h00 (Moscow) / 17h00 (Beijing).**

Zoom link: [Click here](#)

Meeting ID:

Passcode:

There are minutes attached to this event. [Show them.](#)



MPD-ITS Readout electronics coordination meeting
Monday 8 Feb 2021, 16:00 → 18:00 Europe/Moscow
Webcast (JINR)


Description **Note: Meeting start time is Monday, Feb. 8, 08h00 (Havana) / 14h00 (CEST) / 16h00 (Moscow) / 21h00 (Beijing).**

Zoom link: [Click here](#)

Meeting ID: 684 5796 9651

Passcode: 137401

12:00	→ 12:15 About MPD-ITS radiation environment. Speaker: Yuri Murin
12:15	→ 12:35 R&D for MPD-ITS RU Speaker: LEI ZHAO (University of Science and Technology of China)
12:35	→ 12:55 Test bench proposal for the readout of MPD-ITS. Speaker: Raul Arteche Diaz (CEADEN)
12:55	→ 13:10 A.O.B. Speakers: Aleksie Sheremetev (Joint Institute for Nuclear Research), Dmitrii Dementev (JINR LHEP), LEI ZHAO (University of Science and Technology of China), Raul Arteche Diaz (CEADEN), Xiangming Sun (Central China Normal University), Yuri Murin (JINR)



MPD-ITS Readout electronics coordination meeting
Monday 8 Feb 2021, 16:00 → 18:00 Europe/Moscow
Webcast (JINR)


Description **Note: Meeting start time is Monday, Feb. 8, 08h00 (Havana) / 14h00 (CEST) / 16h00 (Moscow) / 21h00 (Beijing).**

Zoom link: [Click here](#)

Meeting ID: 684 5796 9651

Passcode: 137401

16:00	→ 16:15 Readout Electronics Design for ITS of MPD in NICA Speaker: LEI ZHAO (University of Science and Technology of China)
16:15	→ 16:30 Test bench proposal for MPD-ITS readout Speaker: Raul Arteche Diaz (CEADEN)
16:30	→ 16:45 A.O.B. Speakers: Aleksie Sheremetev (Joint Institute for Nuclear Research), Dmitrii Dementev (JINR LHEP), LEI ZHAO (University of Science and Technology of China), Raul Arteche Diaz (CEADEN), Xiangming Sun (Central China Normal University), Yuri Murin (JINR)




MPD-ITS Workgroup meeting 2021.06.17 - Special Readout Edition
Thursday 17 Jun 2021, 10:00 → 12:00 Europe/Moscow
Bld. 216 (Room 120 & Webcast)
Yuri Murin

Description **Note: The starting time of the meeting is 9h00 (Moscow)/14h00 (Beijing)/8h00 (Geneva)/00h00 (San Francisco)**
(Please try to use a headphones/microphone set to avoid undesired noise)

Zoom link: [Click here](#)

Passcode: 311182

10:00	→ 10:15 Readout Electronics Design for ITS of MPD in NICA Speaker: LEI ZHAO (University of Science and Technology of China)
10:15	→ 10:30 Updates on NICA_GBTx/LD/TIA ASICs developments Speaker: Di Guo (Central China Normal University)
10:30	→ 10:45 NICA_ROC ASIC Design Progress Speaker: Jiajun Qin (University of Science and Technology of China)
10:45	→ 11:00 Test RU based on GBTxEmu board Speaker: Raul Arteche Diaz (JINR)
11:00	→ 11:20 The concept design of power supply system for MPD ITS Speaker: Aleksie Sheremetev (Joint Institute for Nuclear Research)



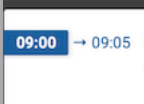
MPD-ITS General Coordination meeting
Wednesday 26 Jan 2022, 09:00 → 10:00 Europe/Moscow
Nu Xu (Central China Normal University(CCNU))

Description

Note: The starting time of the meeting is 7h00 (Geneva) / 9h00 (Moscow) / 14h00 (Beijing) / 22h00[25-Jan] (San Francisco)

Zoom link: <https://lbnl.zoom.us/j/7515309921>

Passcode: 0604




MPD-ITS General Coordination meeting
Friday 22 Apr 2022, 09:00 → 10:00 Europe/Moscow
Nu Xu (Central China Normal University(CCNU))

Description **Note: The starting time of the meeting is 9h00 (Moscow) / 14h00 (Beijing) / 23h00[21-Apr] (San Francisco)**

Zoom link: <https://cern.zoom.us/j/8444033669?pwd=bnJhQ2ZvOFFQdWhsb1hTUgk3d002UT09>

Passcode: 0329

09:00	→ 09:05 Update on ALTAI chips production status Speaker: Yuri Murin
09:05	→ 09:25 Milestones for 2022 Speakers: LEI ZHAO (University of Science and Technology of China), Xiangming Sun (Central China Normal University), Yuri Murin (JINR)
09:25	→ 09:35 Updates on the organization of the ALTAI mini-Workshop (Murin) Speaker: Yuri Murin (JINR)
09:35	→ 09:45 AOB Speaker: All




MPD-ITS General Coordination meeting
Friday 22 Apr 2022, 09:00 → 10:00 Europe/Moscow
Nu Xu (Central China Normal University(CCNU))

Description **Note: The starting time of the meeting is 9h00 (Moscow) / 14h00 (Beijing) / 23h00[21-Apr] (San Francisco)**

Zoom link: <https://cern.zoom.us/j/8444033669?pwd=bnJhQ2ZvOFFQdWhsb1hTUgk3d002UT09>

Passcode: 0329

09:00	→ 09:20 Assessment of the current situation of the MPD-ITS project and future steps. Speaker: Yuri Murin
09:20	→ 09:40 Discussion on the "Joint proposal for applications". Speakers: Yaping WANG (Central China Normal University), Yuri Murin (JINR)
09:40	→ 09:50 AOB Speaker: All



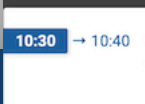
MPD-ITS General Coordination meeting
Thursday 4 Aug 2022, 10:00 → 11:40 Europe/Moscow
Room 120 (JINR-LHEP Build. 216)
Yuri Murin

Description

Note: The starting time of the meeting is 10h00 (Moscow) / 15h00 (Beijing)

Zoom link: [Click here](#)

Passcode: 658427



MPD-ITS General Coordination meeting
Thursday 29 Sep 2022, 10:00 → 11:00 Europe/Moscow
Room 215 - Conference room (JINR-LHEP Build. 215)
Yuri Murin

Description

Note: The starting time of the meeting is 10h00 (Moscow) / 15h00 (Beijing)

Zoom link: [Click here](#)

Passcode: 102977

10:30	→ 10:40 Current status of the ALTAI chips production Speaker: Cesar Ceballos Sanchez (JINR)
10:40	→ 10:50 Current Status of the MPD-ITS Mechanics Speaker: Yuri Murin (JINR)
10:50	→ 11:00 Current Status of Electronics (Russian Side) Speaker: Raul Arteche Diaz (JINR)
11:00	→ 11:30 Current Status of the Work (China Side) Speakers: Di Guo (Central China Normal University), LEI ZHAO (University of Science and Technology of China), Xiangming Sun (Central China Normal University), Yaping WANG (Central China Normal University)
11:30	→ 11:40 AOB Speaker: All



MPD-ITS General Coordination meeting
Thursday 29 Sep 2022, 10:00 → 11:00 Europe/Moscow
Room 215 - Conference room (JINR-LHEP Build. 215)
Yuri Murin

Description

Note: The starting time of the meeting is 10h00 (Moscow) / 15h00 (Beijing)

Zoom link: [Click here](#)

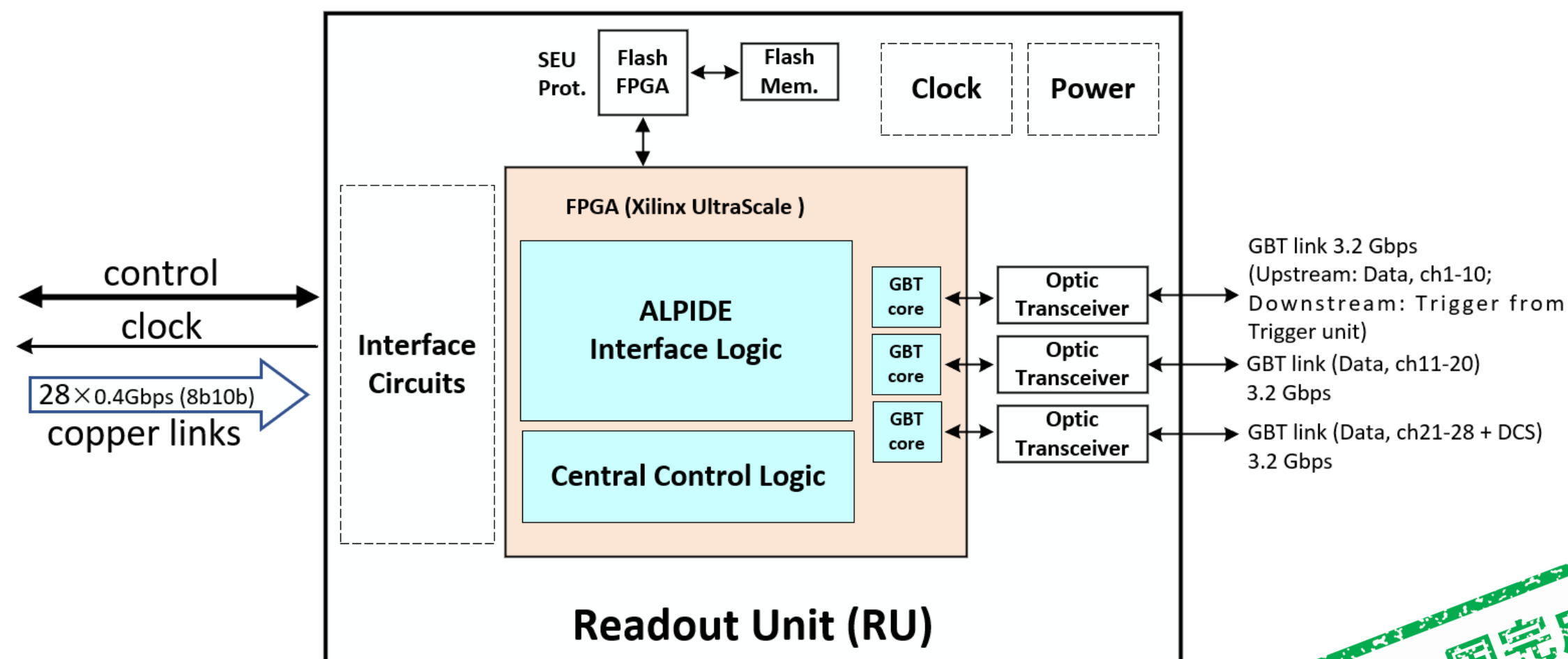
Passcode: 102977

There are minutes attached to this event. [Show them.](#)

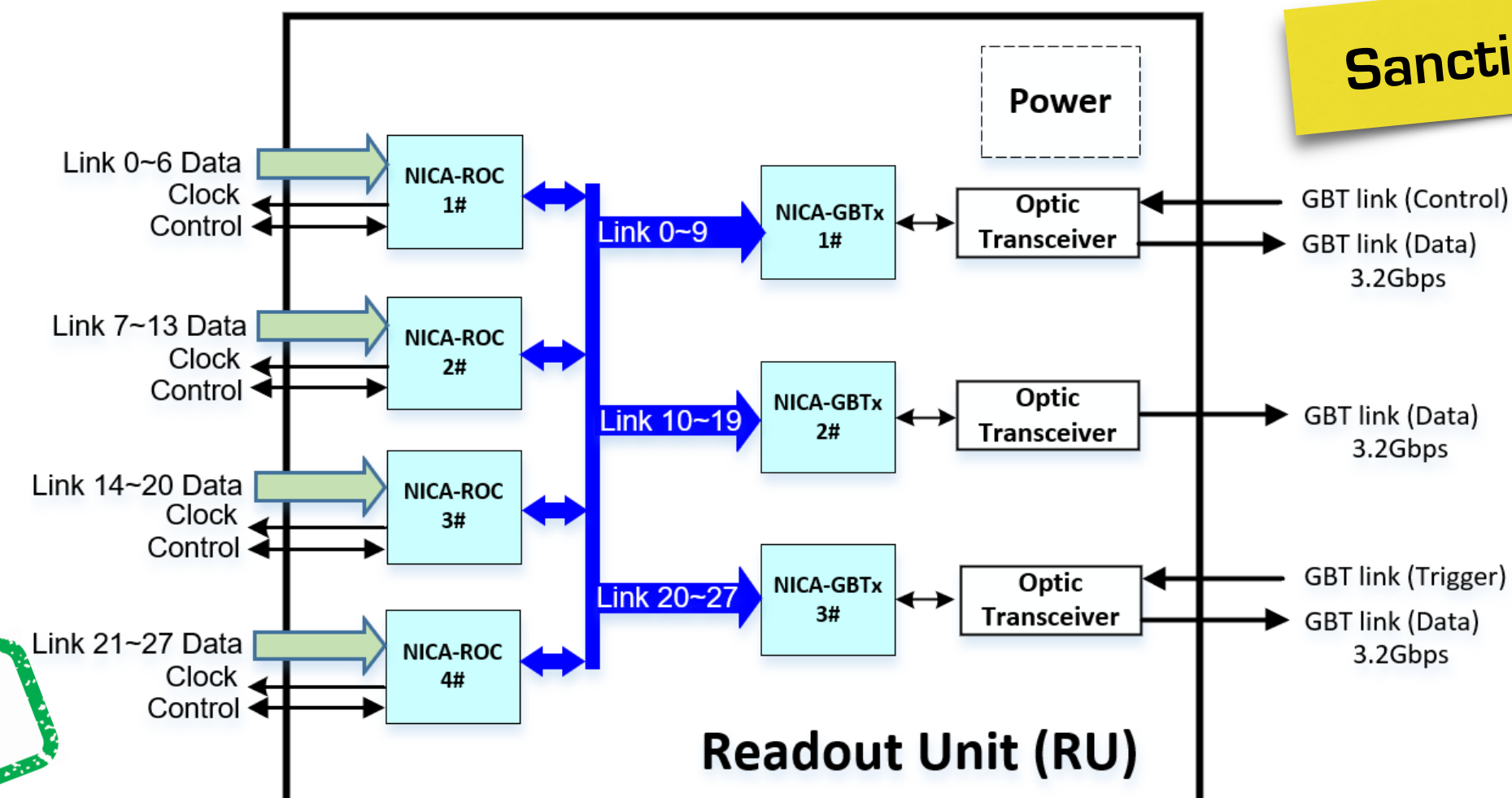
10:00	→ 10:10 Current Status of the Work (Russia Side) Speakers: Cesar Ceballos Sanchez (JINR), Yuri Murin
10:10	→ 10:30 Current Status of the Work (China Side) Speakers: Di Guo (Central China Normal University), LEI ZHAO (University of Science and Technology of China), Xiangming Sun (Central China Normal University), Yaping WANG (Central China Normal University)
10:30	→ 10:40 Discussion on import/export of components between Russia and China Speaker: Ekaterina Tsapulina
10:40	→ 10:50 Discussion on the possibility for the participation of JINR on the development and production of the Chinese version of MAPS Speaker: Yuri Murin (JINR)
10:50	→ 11:00 AOB Speaker: All

MPD-ITS RU design solutions.

FPGA-based



ASIC-based



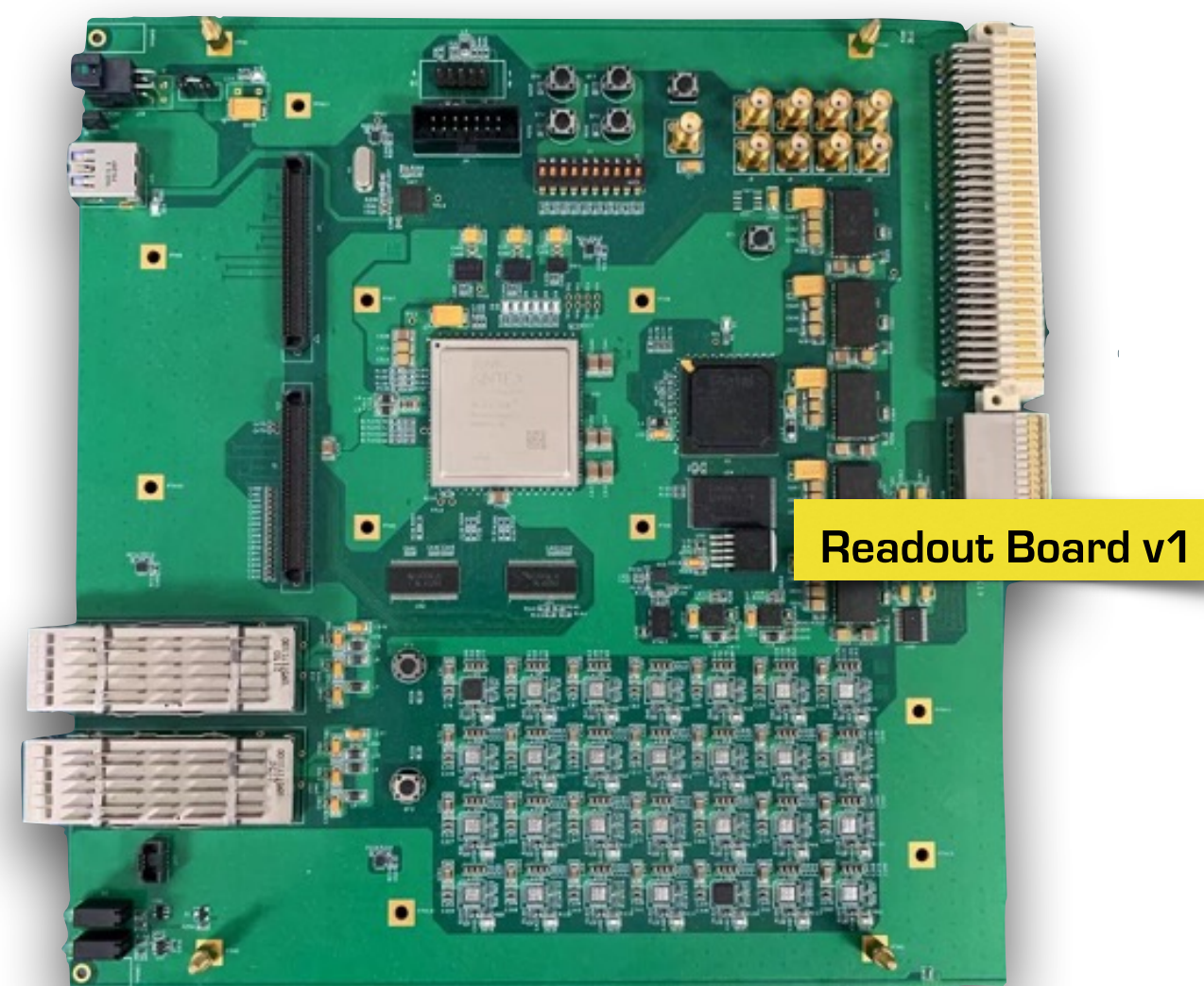
Sanctions-free ASICs

要在中国完成

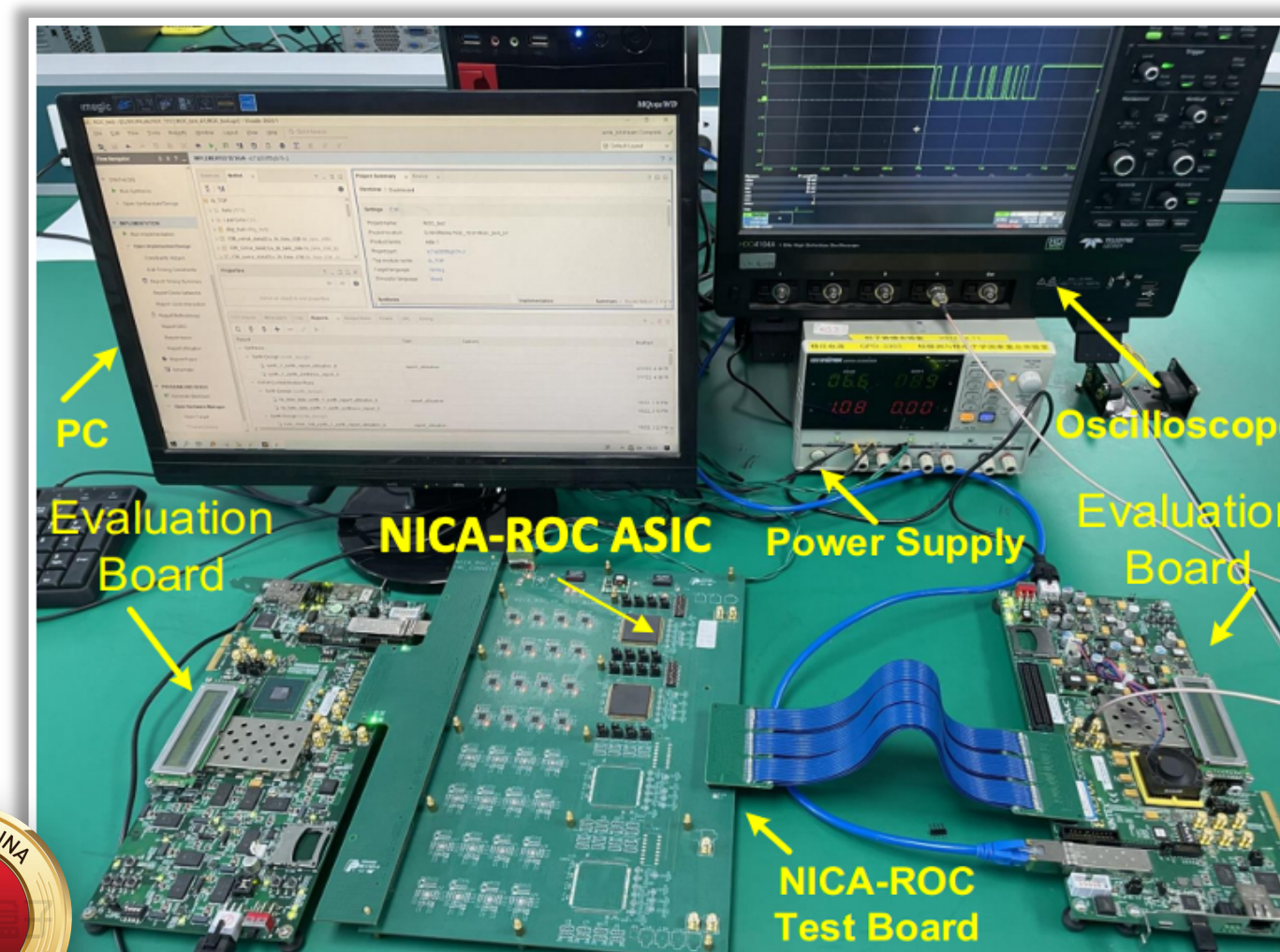
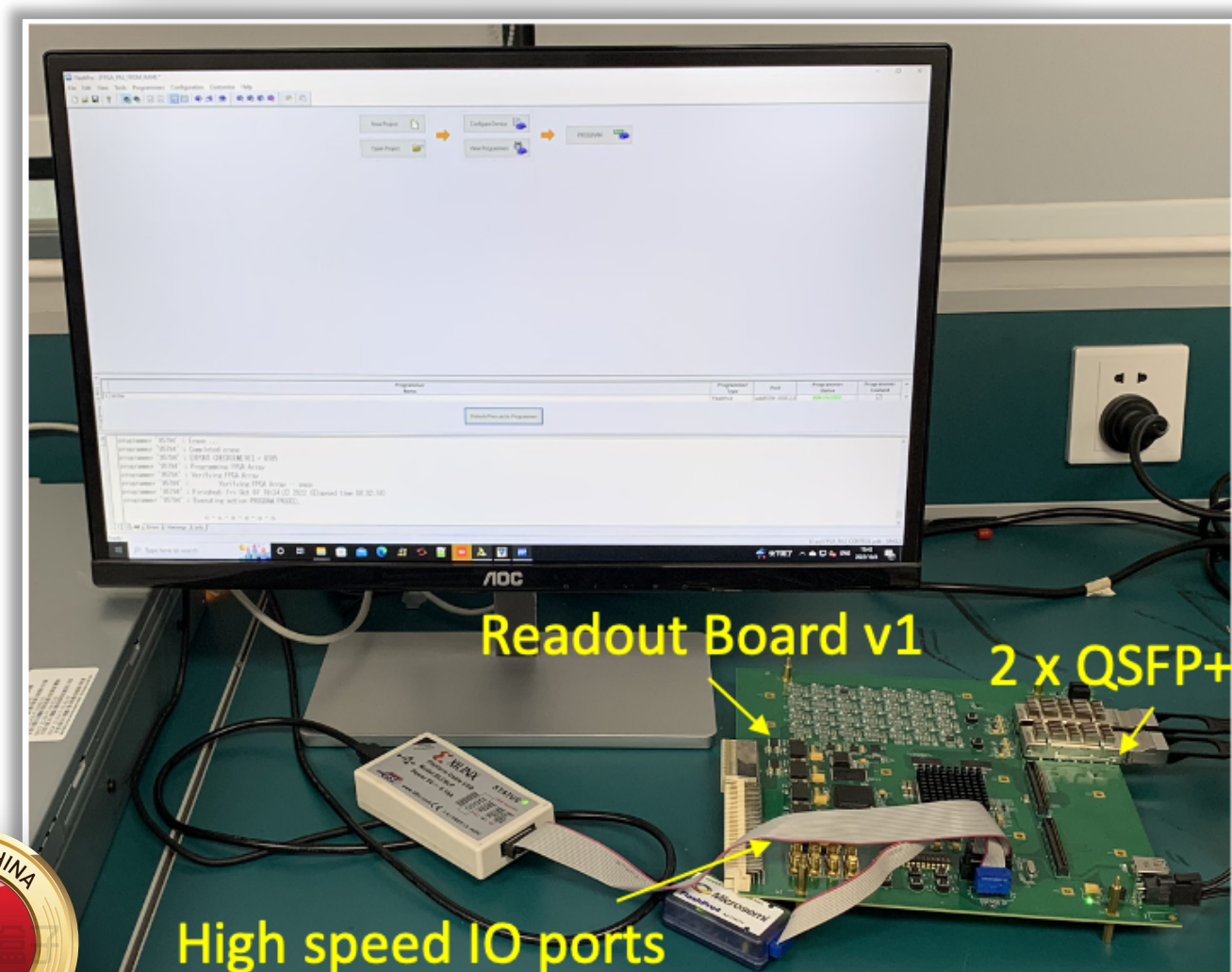
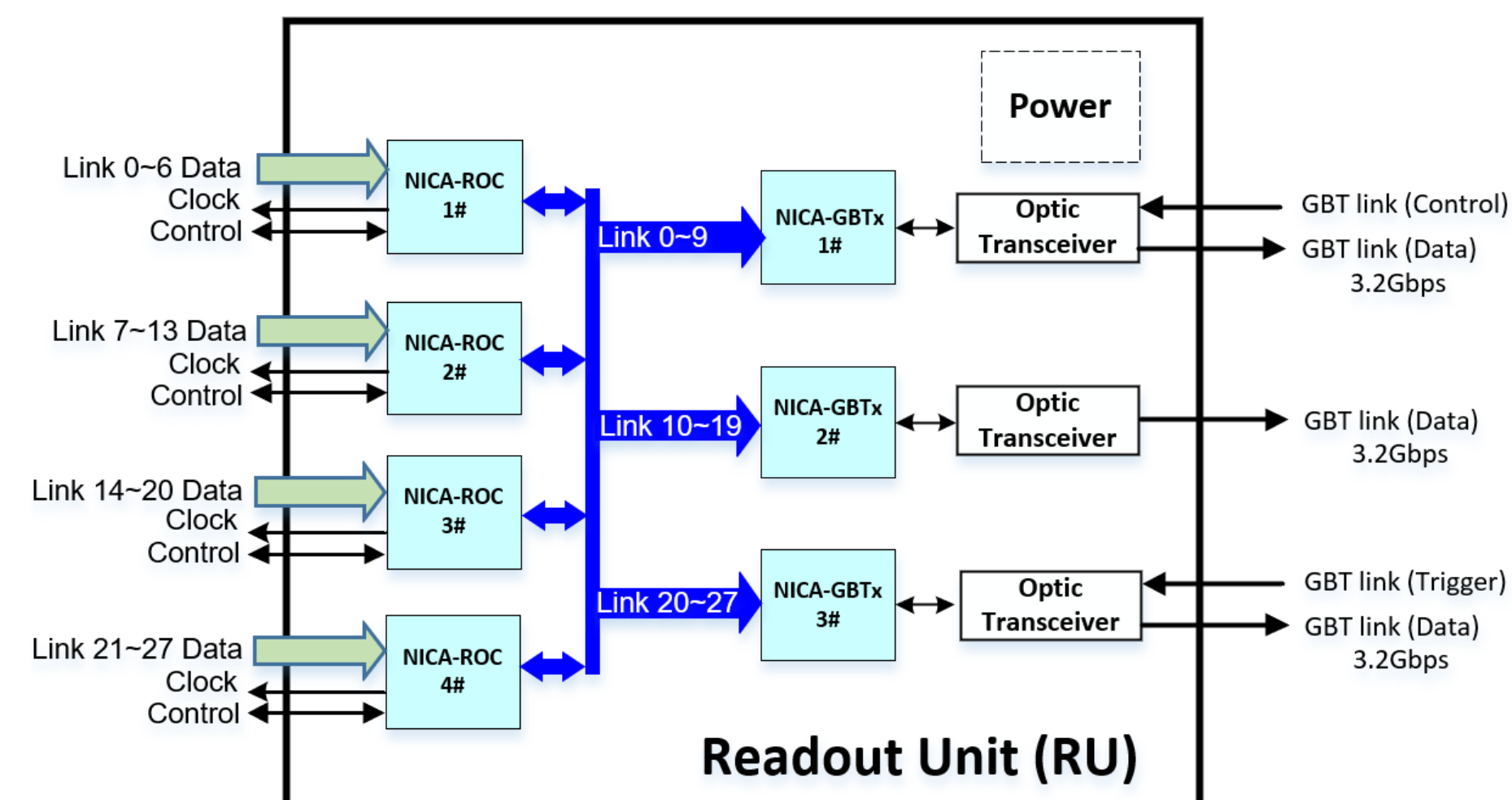
- **NICA_ROC**: Concentrates the output data of front-end ALPIDE chips and transfer the packaged data to the following NICA_GBTx ASIC. It also receives control commands, clocks, and trigger signals from the backend and distributes them to ALPIDE chips.
- **NICA_GBTx**: A high-speed bidirectional data interface ASIC for optical links.
 - It receives multichannel data from the front-end (NICA_ROC), performs scrambling, encoding, frame building and serializing as the main function for the up-link direction.
 - It receives high-speed serial data from the back-end, performs CDR (Clock and Data Recovery), deserializing, decoding and distributing to the front-end as the main function for the down-link direction.
- **NICA_LD (Laser Driver) and NICA_TIA (Transimpedance Amplifier)**: Are two analog ASICs that would be integrated together with the laser and PD (Pin Diode) in the customized optical transceiver module.
 - NICA_LD receives the high-speed up-link serial data from NICA_GBTx and amplifies the signal to driver the laser.
 - NICA_TIA receives the down-link serial signal from the pin diode, and amplifies the signal to NICA_GBTx, so that the data can be furthered processed in NICA_GBTx.

MPD-ITS RU design solutions.

FPGA-based

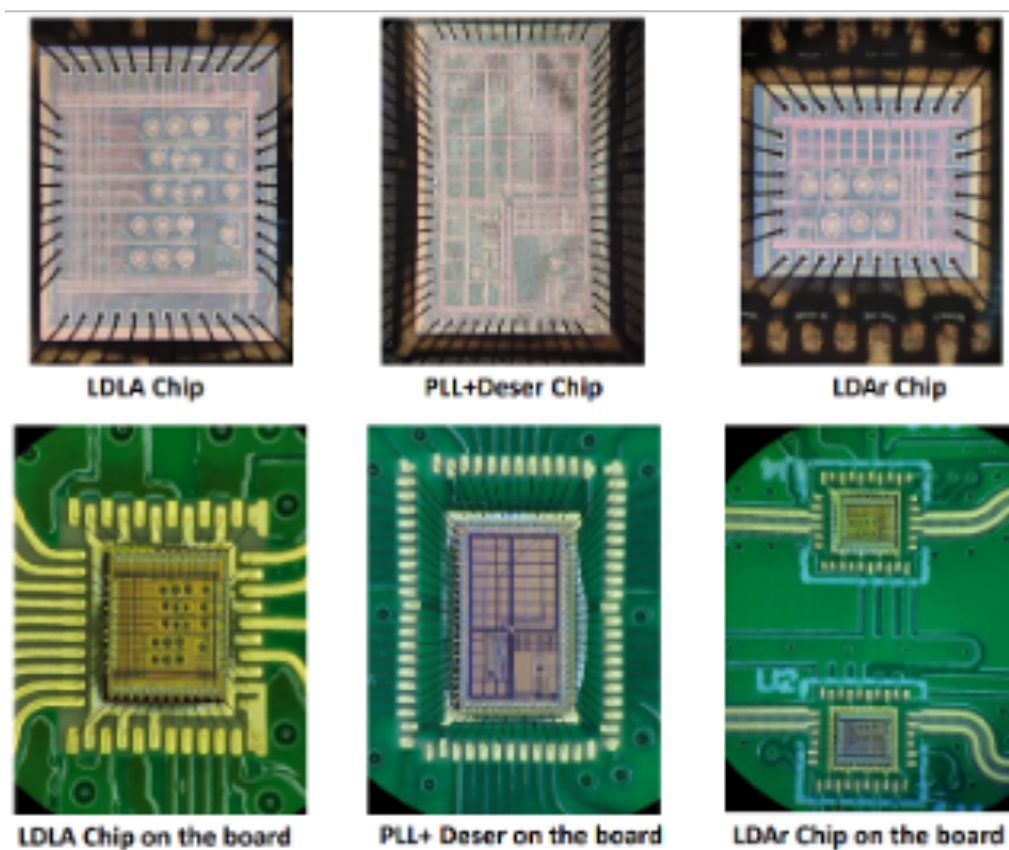


ASIC-based

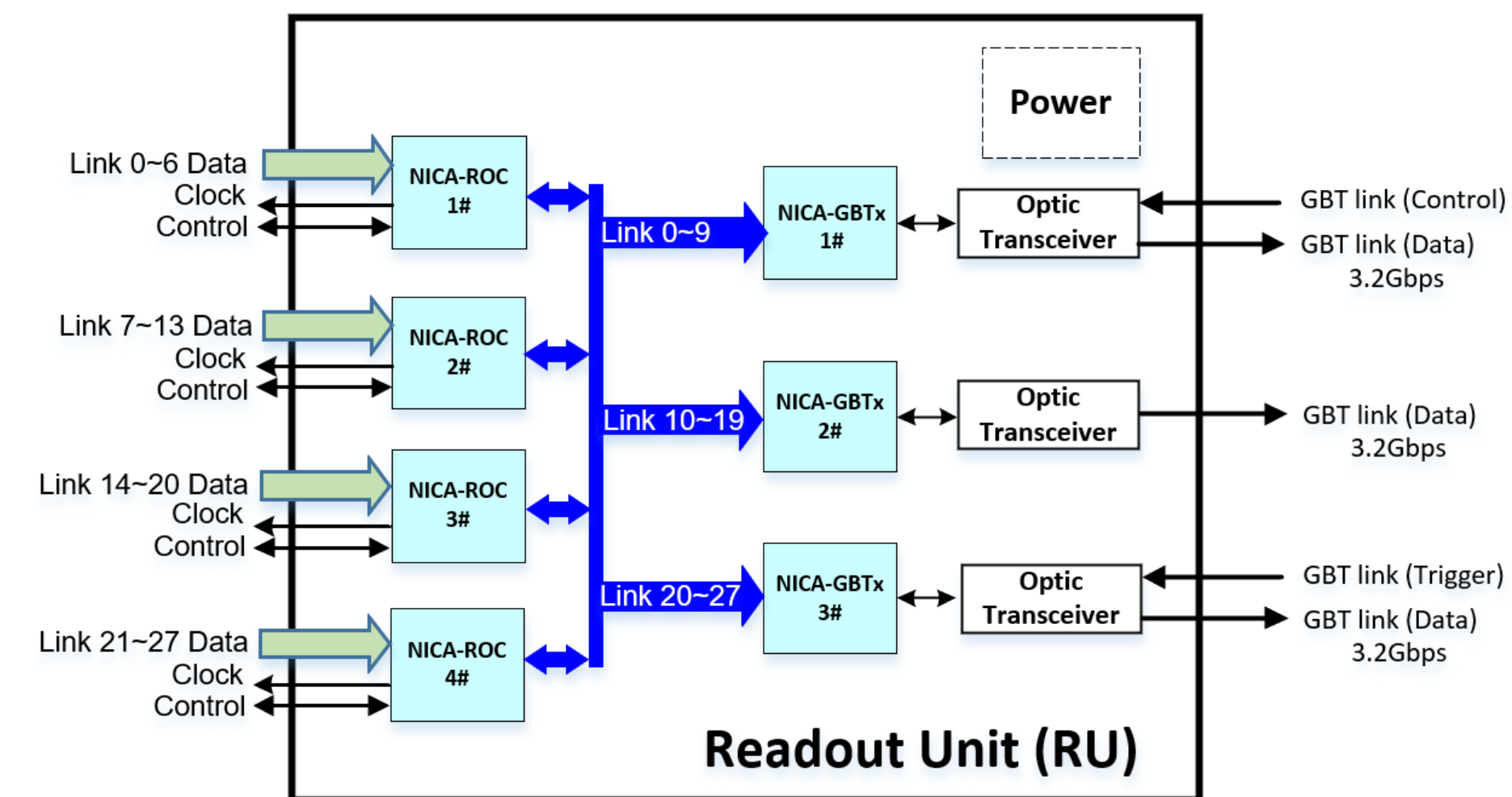
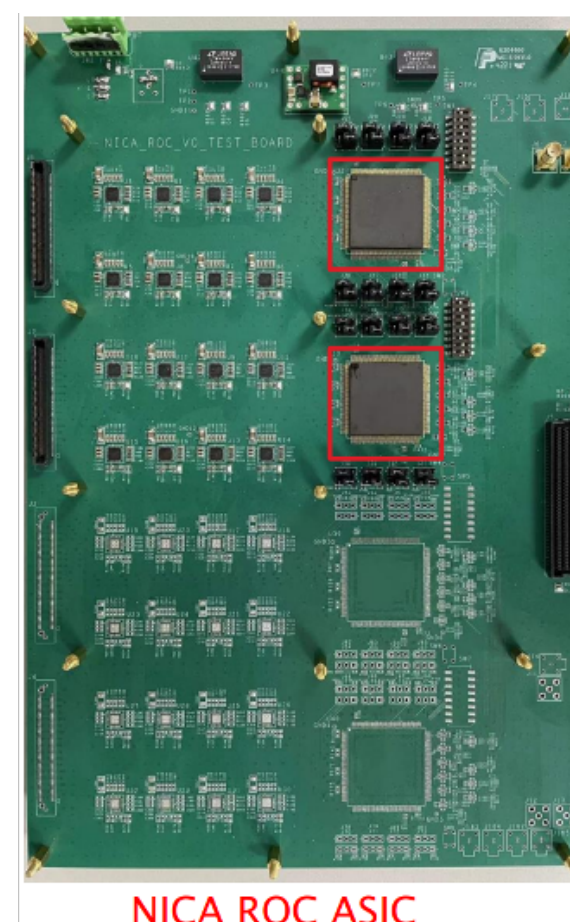


NICA_GBT, NICA_ROC, NICA_LD/Rx ASIC and customized Optical Module

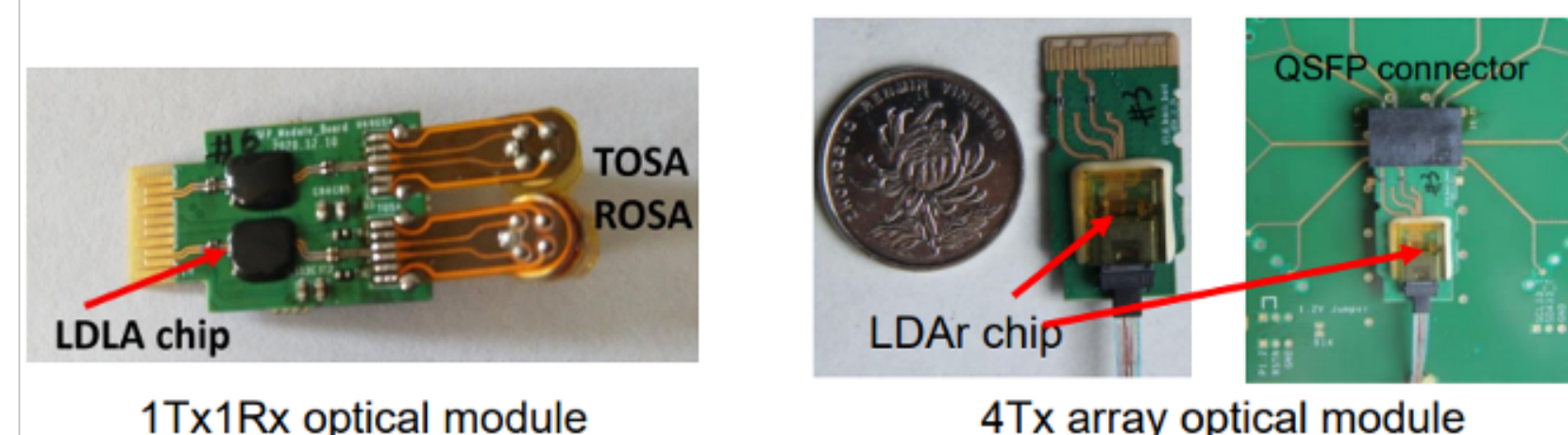
Several chips in a standard 55 nm CMOS technology have been tested and successfully verified.



First chips already under test



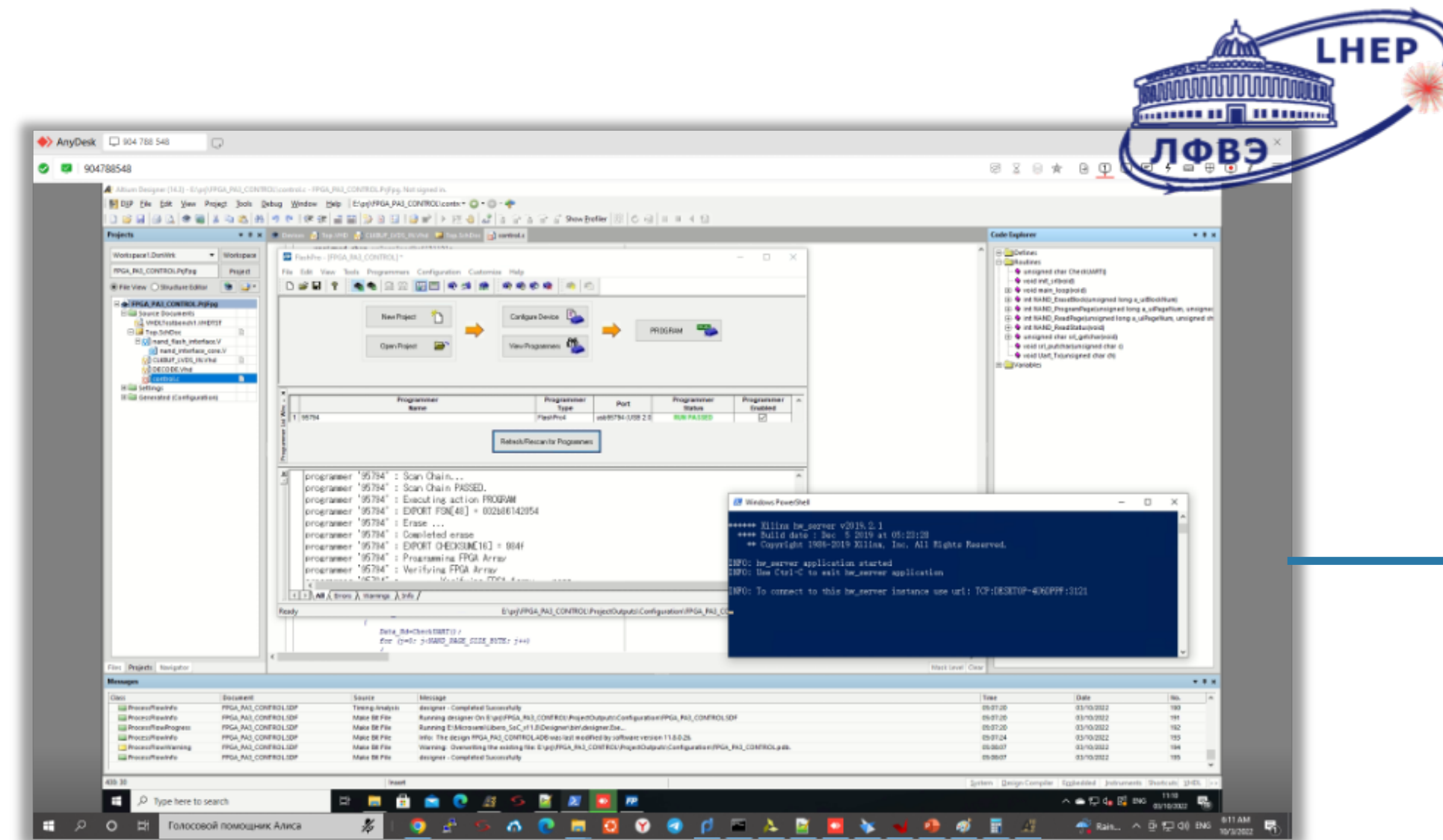
Two types of customised optical modules were developed.



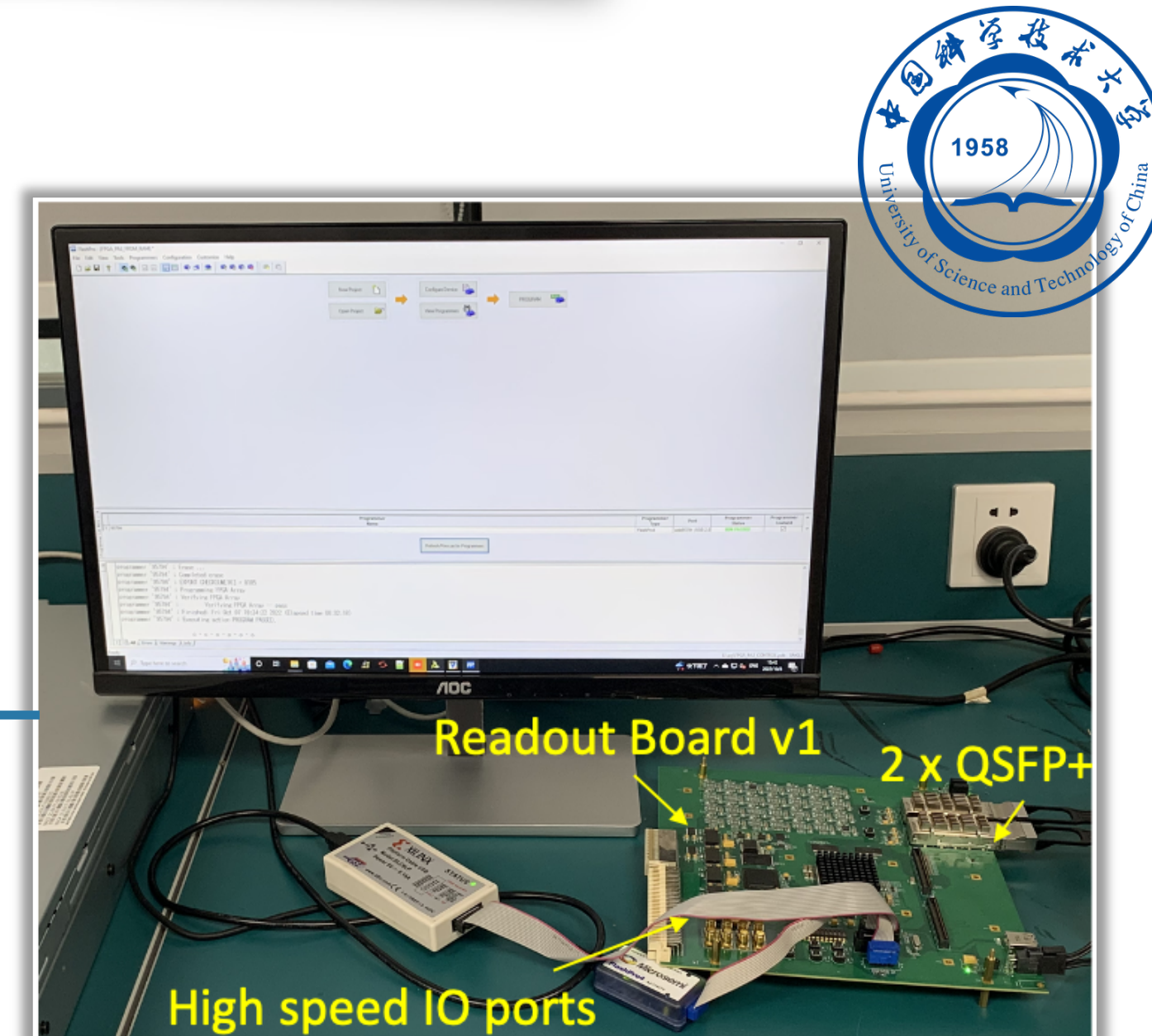
GET updated info on the GBTx!!!

Besides, the second version of NICA_LD and NICA_Rx (optical driver/receiver ASICs) was also included in the **MPW** run together with NICA_GBTx.

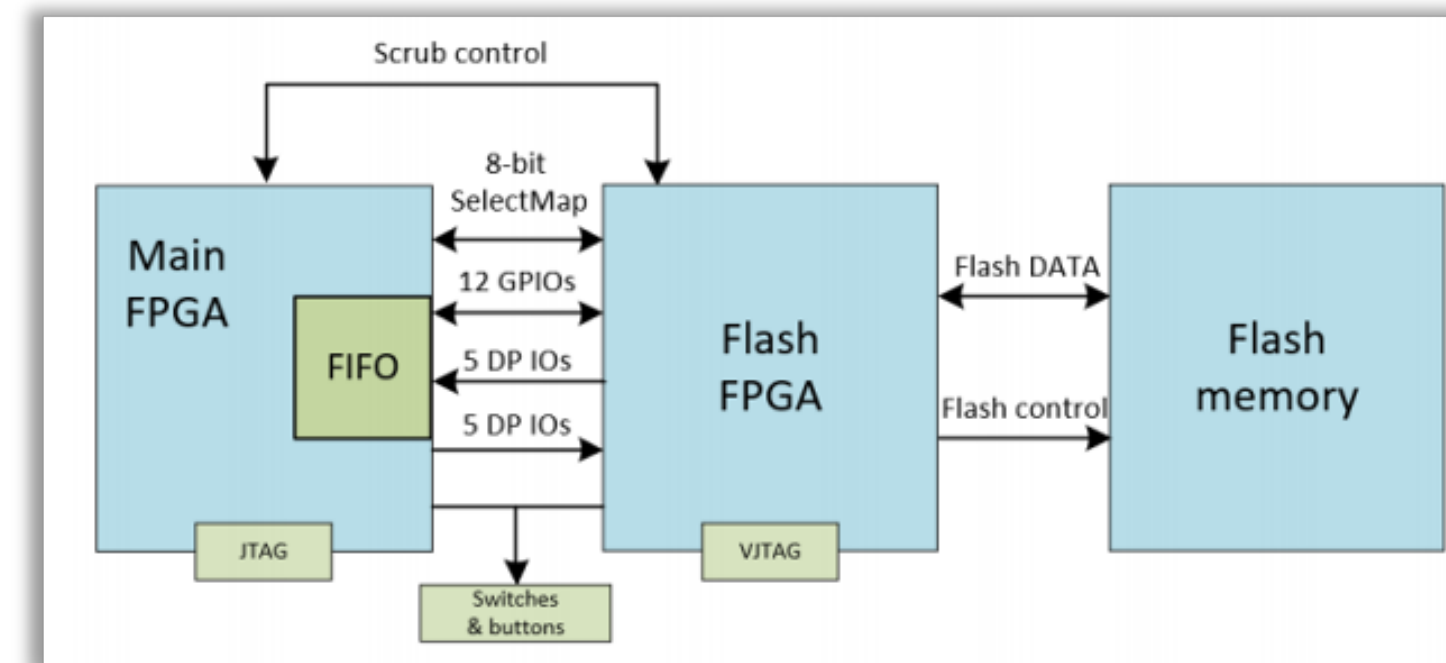
The RU firmware is being jointly developed by T. Yao (USTC) and R. Arteché (JINR)

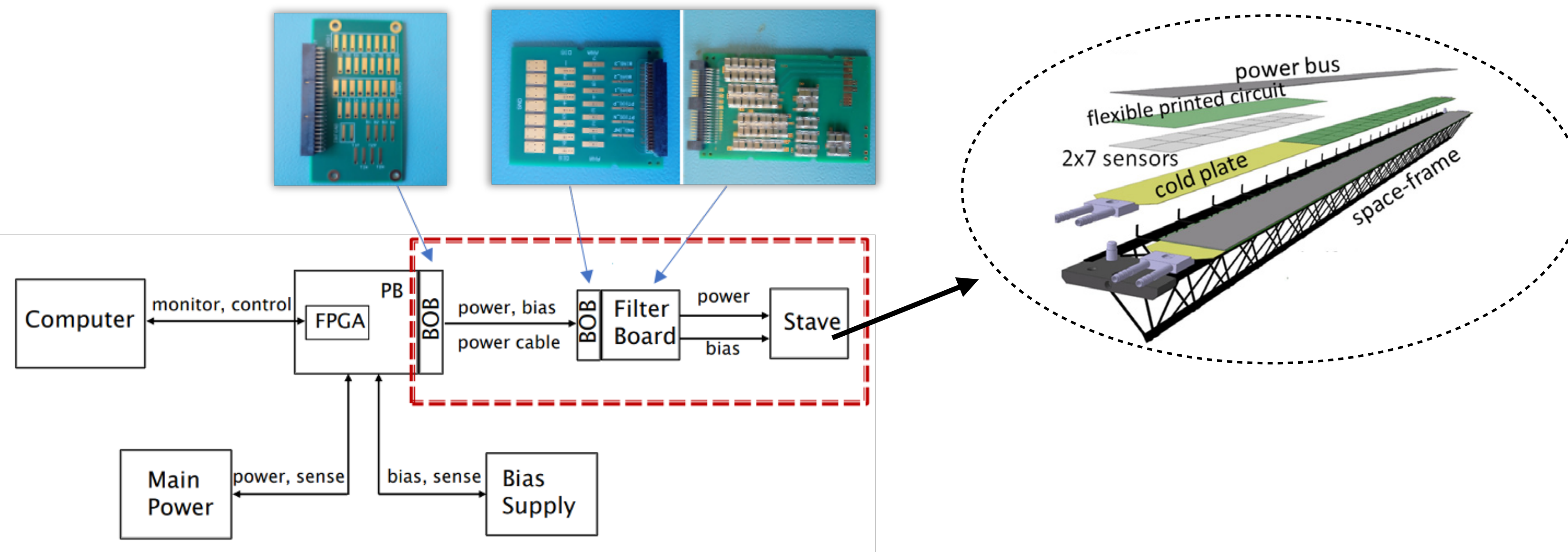


internet

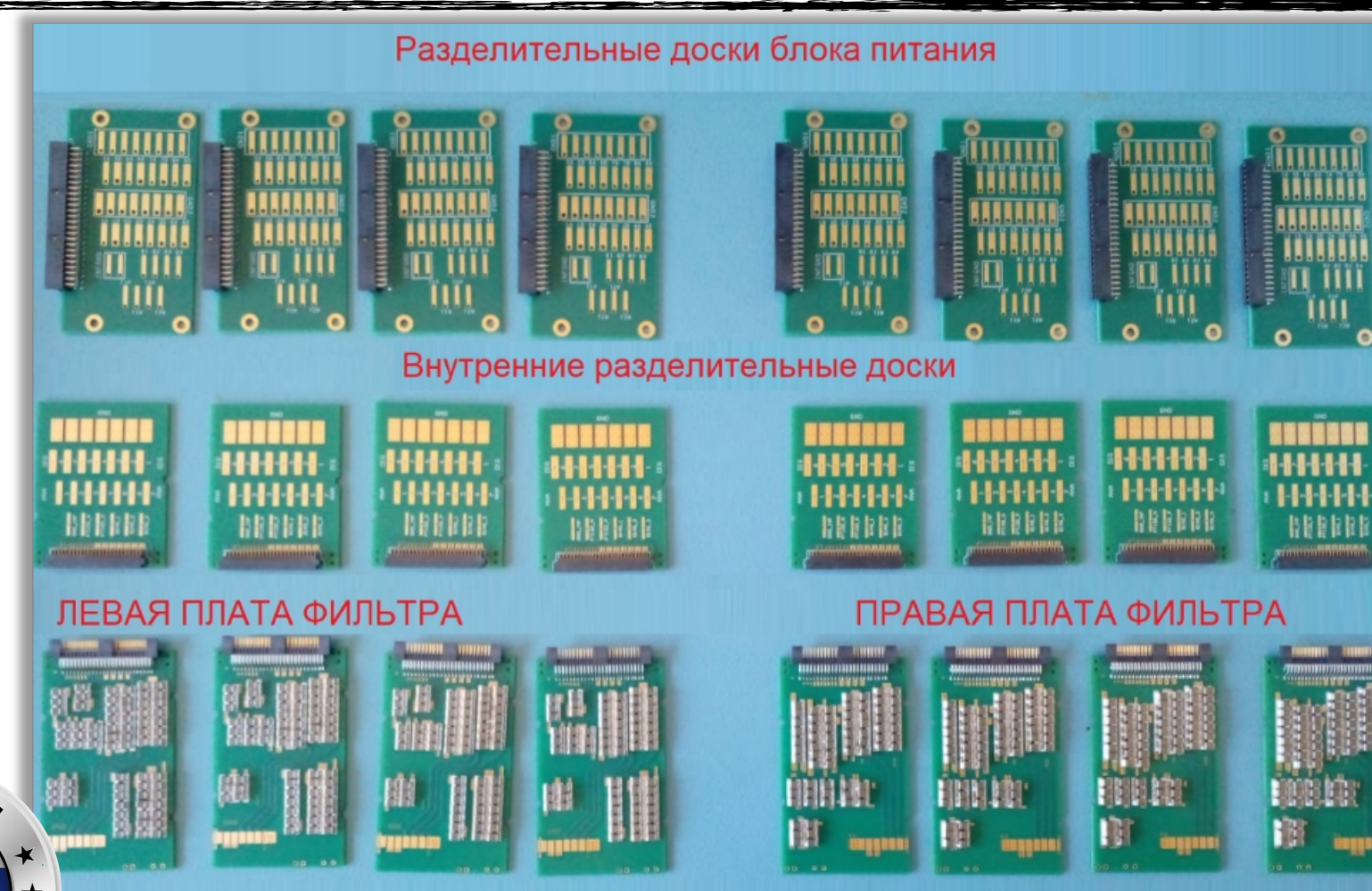


Arteché is remotely testing the firmware of the Auxiliary Flash FPGA that will be responsible of the booting, scrubbing, monitor and control of the main FPGA.





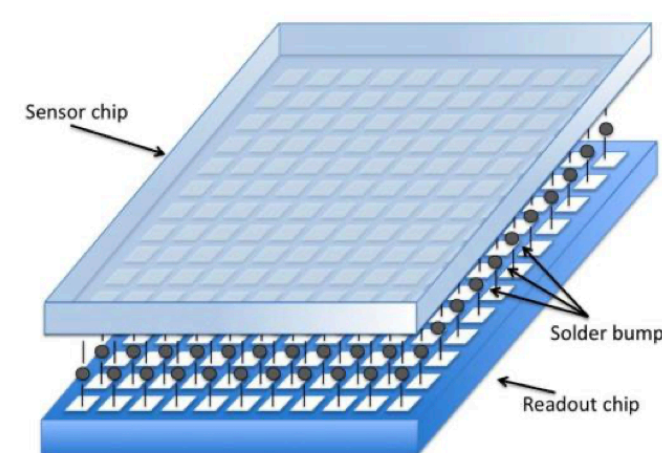
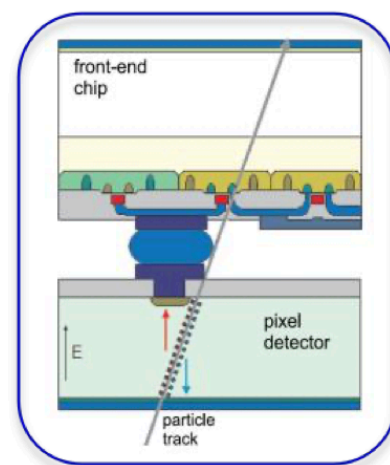
Four Set of Break Out Boards and Filter Boards will be exported to China



From Russia with Love

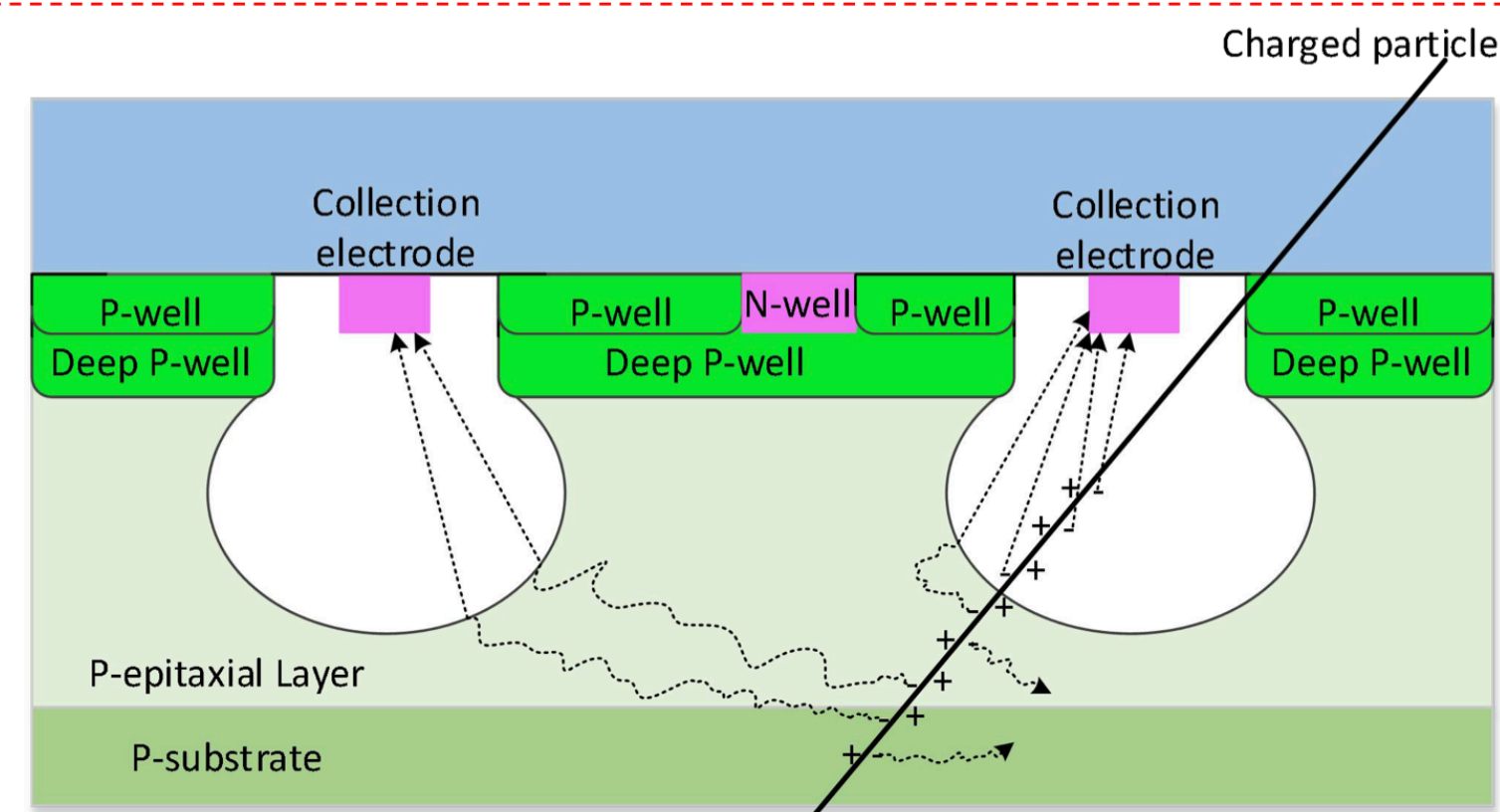


Technique scheme – MAPS VS Hybrid pixel detector



Hybrid pixel detector:

- The sensor and readout electronics are combined by flip chip bonding
- Fast readout rate
- Strong radiation resistance
- Large input capacitance
- High mass
- High cost



MAPS:

- The sensor and readout circuit are integrated on the same silicon chip
- Small input capacitance → Achieve low power consumption
- Low mass
- Low cost

Le Xiao (CCNU)

MAPS-based tracker technology is foreseen to become the new standard for fundamental and applied research.

MAPS are currently spinning off, targeting X-ray and synchrotron radiation applications in astrophysics, biomedical imaging, and spectroscopy.



First-ever full MAPS detector (10 m²)

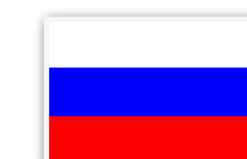
1. ALICE-ITS (LHC, CERN)



2. sPHENIX-MVTX (RHIC, BNL)

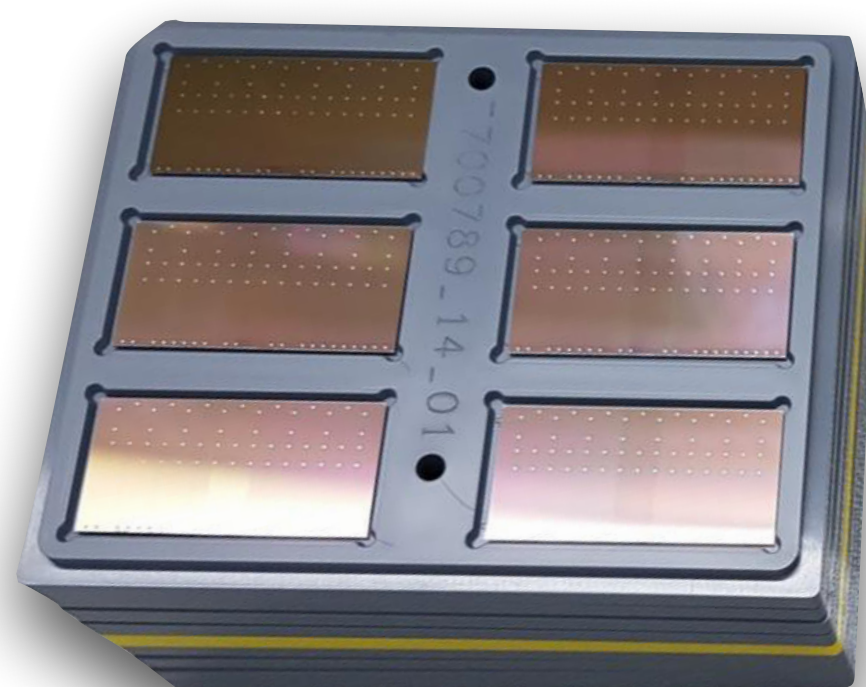


3. MPD-ITS (NICA, JINR)



To include:

- Current State (single chip and large-area) <=== Get updated info
- Possible contributions from JINR (To decided on Oct. 11th)



RSF-NSFC Cooperation: Possibility for Joint Russian-Chinese Project Proposals

2023-2025 Joint Project Description Template

A complete proposal in this competition consists of the joint project description (following this document) and the specific documents, necessary for both funding organizations respectively (for Chinese Scientists – following the NSFC rules, for Russian scientists – following the RSF competition documentation).

The proposal must be written in English. There is a strict limit of 20 pages for the joint project description (font size: 11 or 12, line spacing: 1.15). Applicants are obliged to ensure that the project description contains sufficient information for evaluation.

Core data

Title of the Research Project

Title in English: **Fast data processing through real-time AI for NICA/MPD and future EicC detectors**

Title in Russian: **Быстрая система обработки данных на основе ИИ в режиме реального времени для MPD и будущих экспериментов на EicC**

Title in Mandarin: **应用于 NICA/MPD 和未来 EicC 探测器上基于实时人工智能的快速数据处理**

Project Partners

Name and affiliation of the Chinese Principal Investigator

Name (in both English and Mandarin), title: **王亚平, Yaping Wang, Professor**

Host Institution: **Central China Normal University (CCNU)**

Contact telephone number and E-Mail address: **86-13697332703,**

wangyaping@mail.ccnu.edu.cn

Name and affiliation of the Russian Principal Investigator

Name (including Patronymic name), title: **César Ceballos Sánchez, Staff Scientist**

Host institution: **Joint Institute for Nuclear Research (JINR)**

Contact telephone number and E-Mail address: **+7 9261486684, ceballos@jinr.ru**

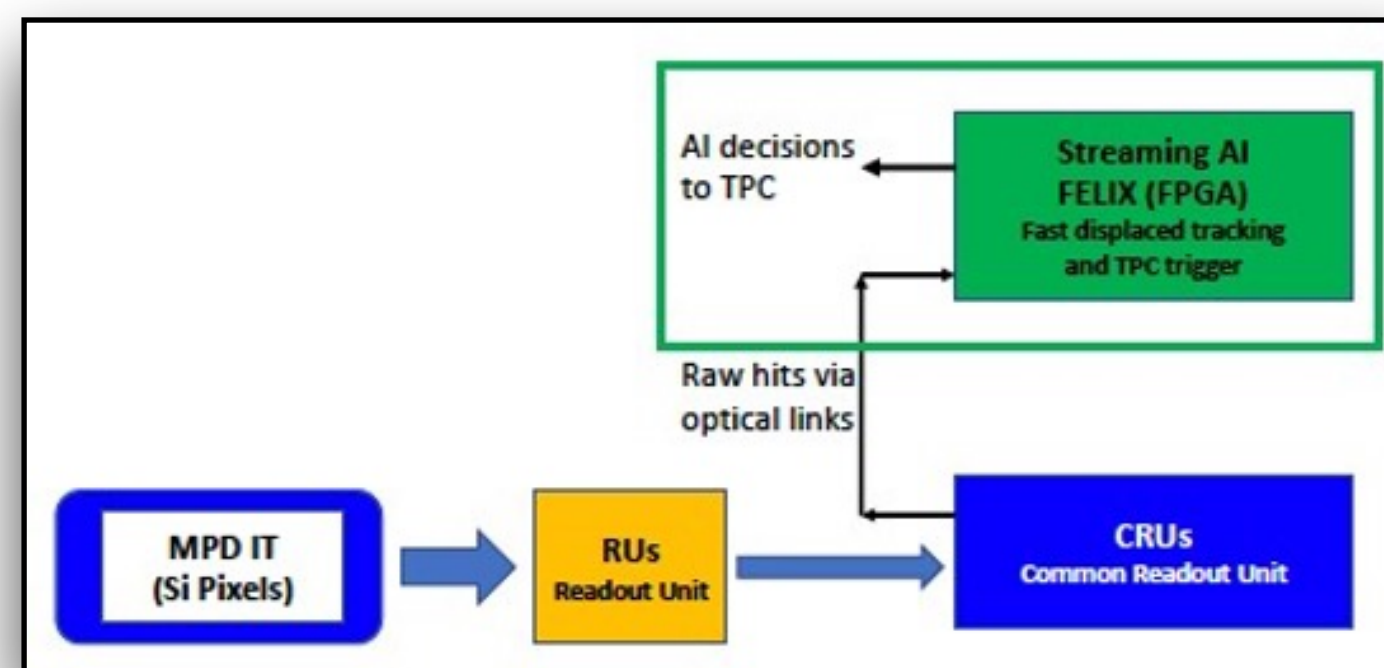
Motivation: Current and future major HEP experiments would face the challenge on how to deal with the large volume of raw data [> Tb/s] generated from sophisticated state-of-the-art detectors in high rate collisions.

Basis: most heavy flavour physics measurements can be performed solely based on tracking.

NICA Example:

- NICA can deliver proton beams at interaction rate around 4 MHz .
- The triggered readout rate of MPD is limited to 5 kHz by TPC readout.
- The MPD is limited to collect less than 1% of the total p+p (and p+Au) rate when using triggered readout

Proposed solution: To develop real-time artificial intelligence (AI) technologies implemented in the detector readout electronics loop that address these challenges (Selective Streaming Readout).



AI-trained FPGA, will identify tracks from heavy quark decays that are pointing away from the nominal beam center to trigger the readout of the much slower TPC detector.

Goal: To design and test a system for the MPD experiment to demonstrate the feasibility and performance, and later apply it to the EicC experiments.

There is a mutual interest on getting access to sanctions-free state-of-the-art microelectronics.

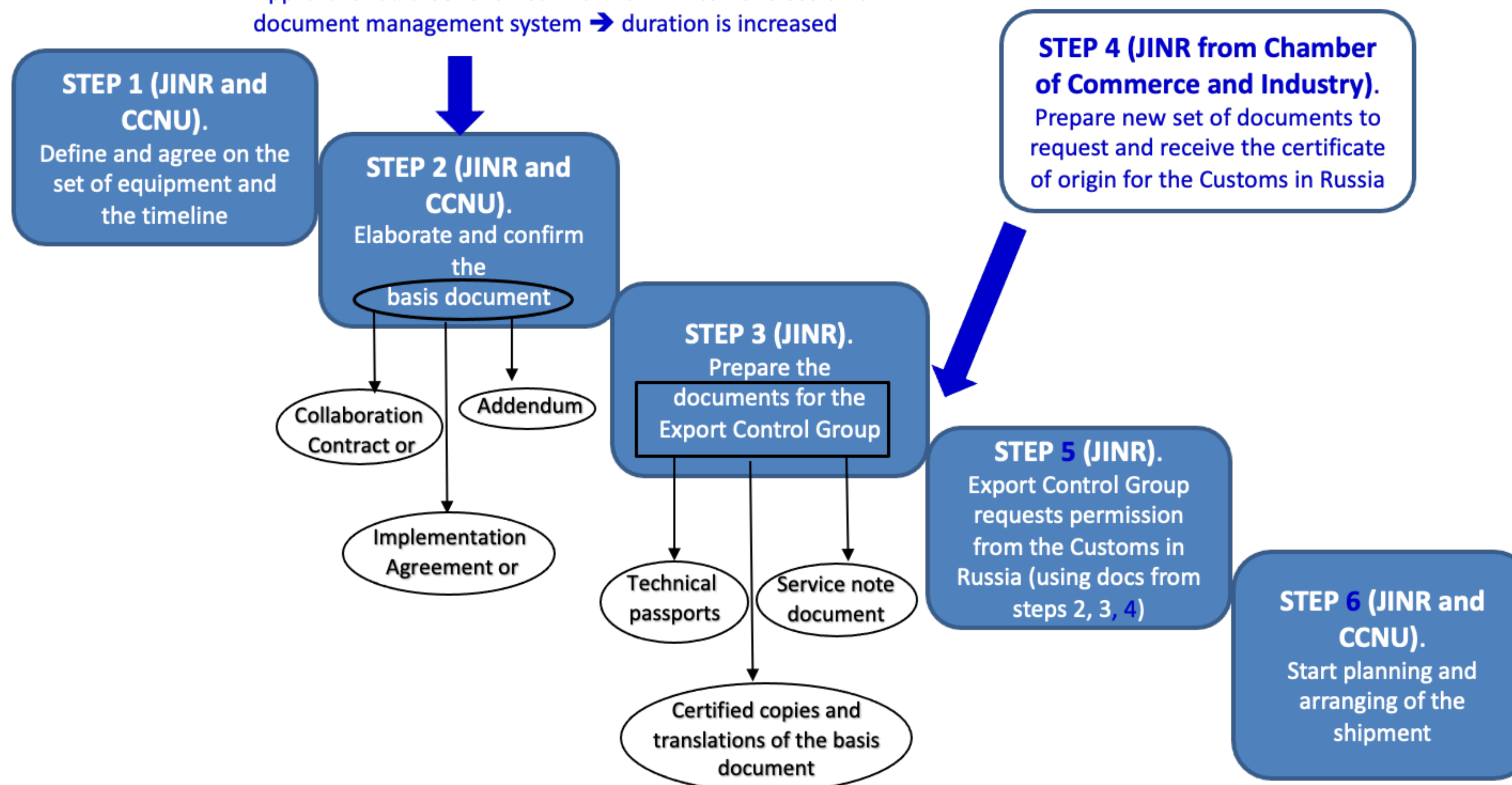
- The MPD-ITS project offers the opportunity to strengthen the collaboration with Chinese top-level scientific institutions (CCNU, HZU, IHEP, IMP, USTC).
- The current and future collaborations on microelectronics development and production will make available to Russia sanctions-free cutting-edge technologies.
- A special role is played by the joint development and production of Monolithic Active Pixel Sensors (MAPS) to be used on:
 - Current and future HEP experiments.
 - Other possible applications.
- Current and future enrolments on the collaboration with China:
 - Production of the Inner Tracking System of the MPD (Electronics, Mechanics, Assembly).
 - Developing and production of FPGA-based GBTx emulator readout units.
 - Developing and production of full ASIC-based readout units.
 - Developing and production of ALPIDE-like MAPS including large-area sensors.
 - Developing and production of an AI fast data-processing smart trigger system ITS-TPC.

It will be very difficult to implement serious and large-scale collaboration with China unless the current trading procedure won't be revised and restructure.

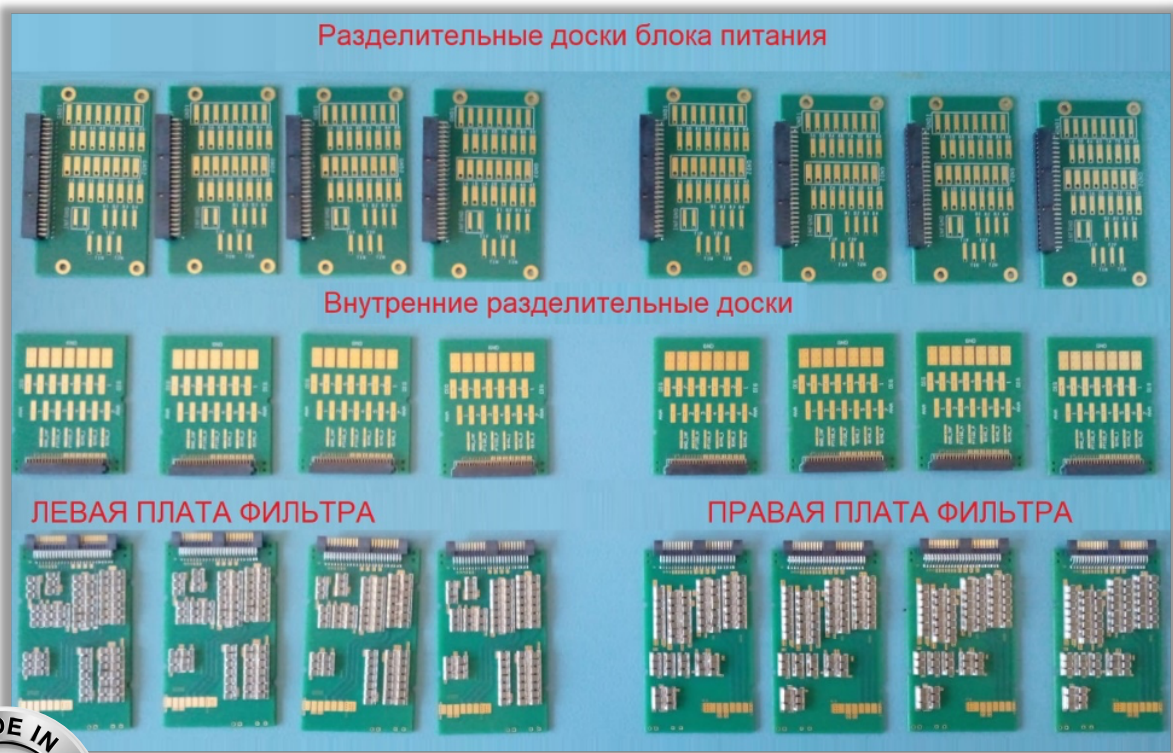
General paperwork procedure

Latest Updates to the procedure are in **blue**

Approval should be followed within JINR internal electronic document management system → duration is increased



From Russia with Love...а с большим терпением



Total time = ?
(Estimate 6 months)

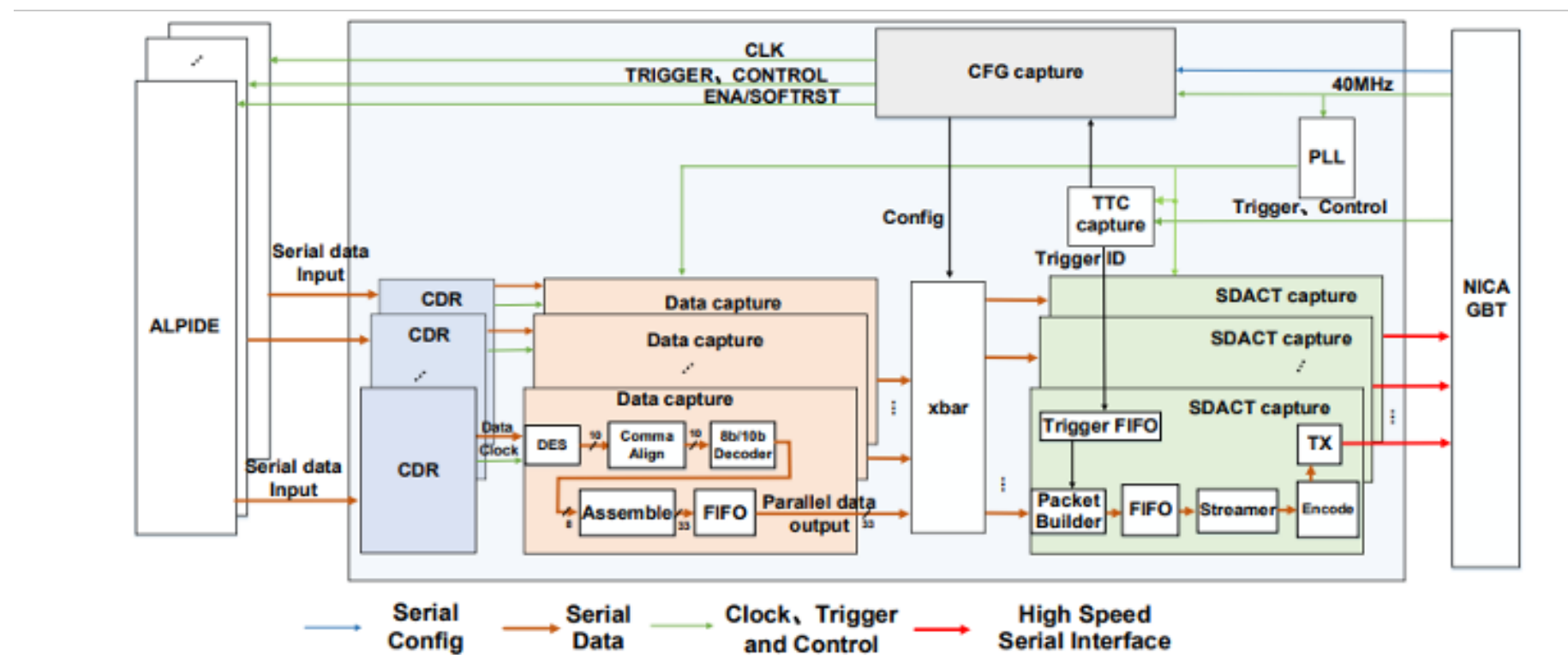
#	Task	Status	Timeline
1	Purchasing the components, elaboration of design and production of the set of boards by JINR	completed	Ready by 07.2022
2	Elaboration and approval of the Basis document (Addendum №2 to MoU_NICA_Wuhan) by both parties (JINR and CCNU) within JINR internal electronic document management system	completed	<ul style="list-style-type: none">started on 04.07.2022,completed on 09.08.2022
3	Elaboration and approval of the set of documents (technical passport, service note documents, certified translation and copies) for the Export control group	completed	<ul style="list-style-type: none">started on 04.07.2022,completed on 22.07.2022
4	Elaboration of the certificate of origin required by the Customs in Russia comprised of the following: 1.elaboration and approval of the contract between JINR and Chamber of Commerce and Industry – completed, 2.preparation / negotiation on details for the set of documents to apply for certificate based on rules from Chamber of Commerce – in-progress, 3.Signing the documents and getting the certificate of origin from the Chamber of Commerce	in-progress	<ul style="list-style-type: none">contract initiated on 23.08.2022 and completed on 04.10.2022,the first remarks on documents received on 05.10.2022
5	Requesting the permission for the export from Customs in Russia on behalf of JINR with the set of documents from # 2 – 4	not started	<ul style="list-style-type: none">
6	Plan the flight and send the package to China	not started	<ul style="list-style-type: none">

- The STS-Department has established collaborative links with specific Chinese scientific institutions.
- In addition to the current collaboration projects, there are clear proposals for future collaboration on the development and production of state-of-the-art microelectronics with a preliminary identification of our possible contribution to those projects.
- It is necessary to simplify the procedures for import/export from/to China, otherwise not a single serious project will be possible to be implemented in practice.

Thank you.

BackUp

NICA_ROC test.



NICA_ROC ASIC

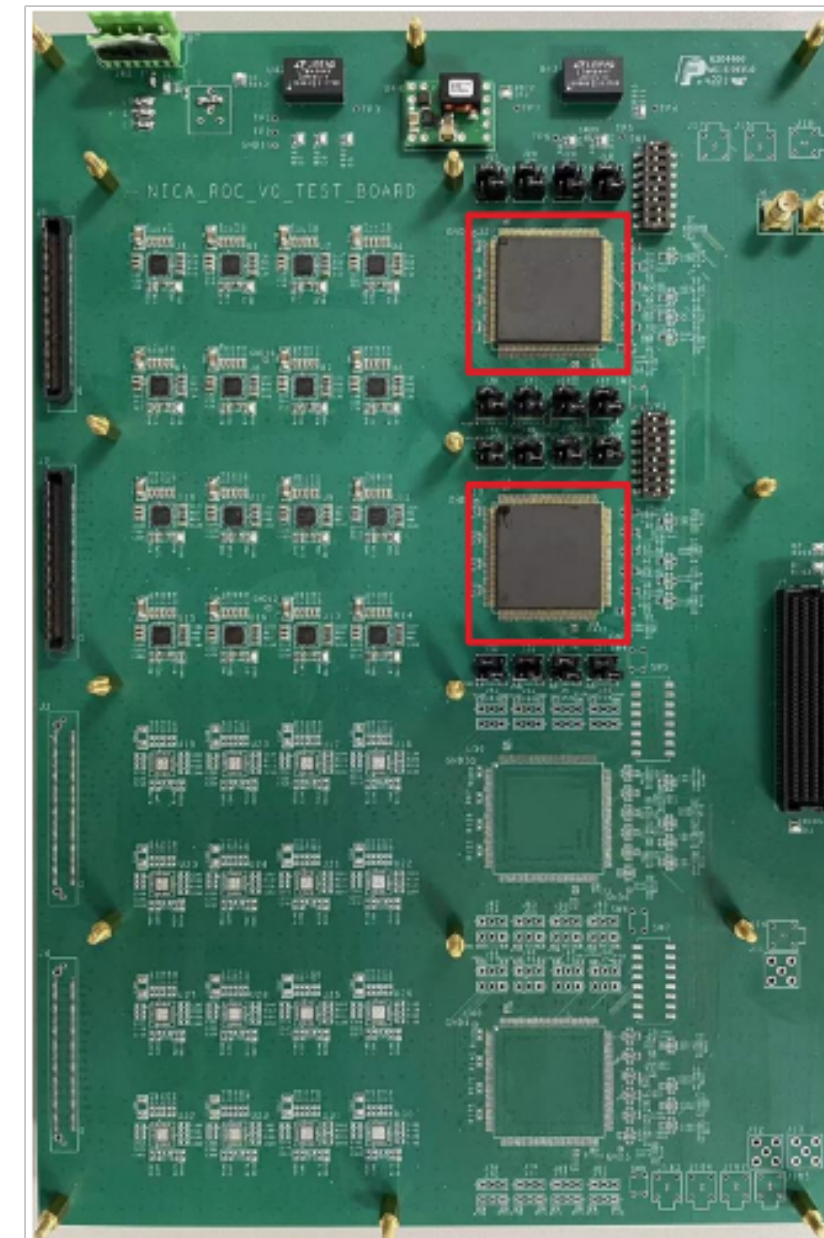
- Design based on the self-defined interface and data format
- Receives trigger/clock/control from NICA_GBT, and distributes to the front-end
- Receives and merges data from ALPIDE modules, reformats the data and send to NICA_GBT
- Receives trigger to reduce the number of events to transmit

Layout

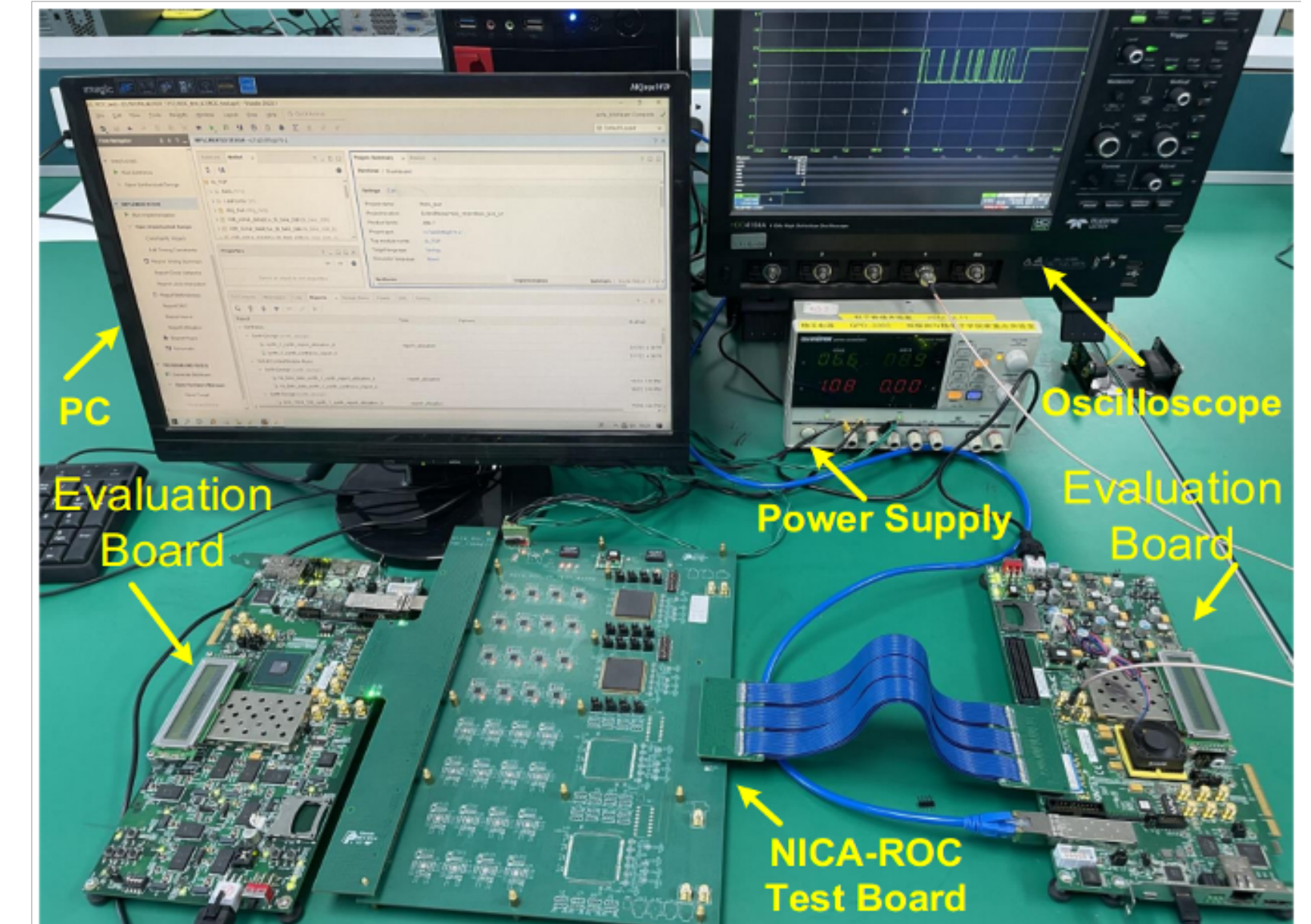


- Areas: 5.7 mm × 4.5 mm
- Pins: 247
- Package: QFP256

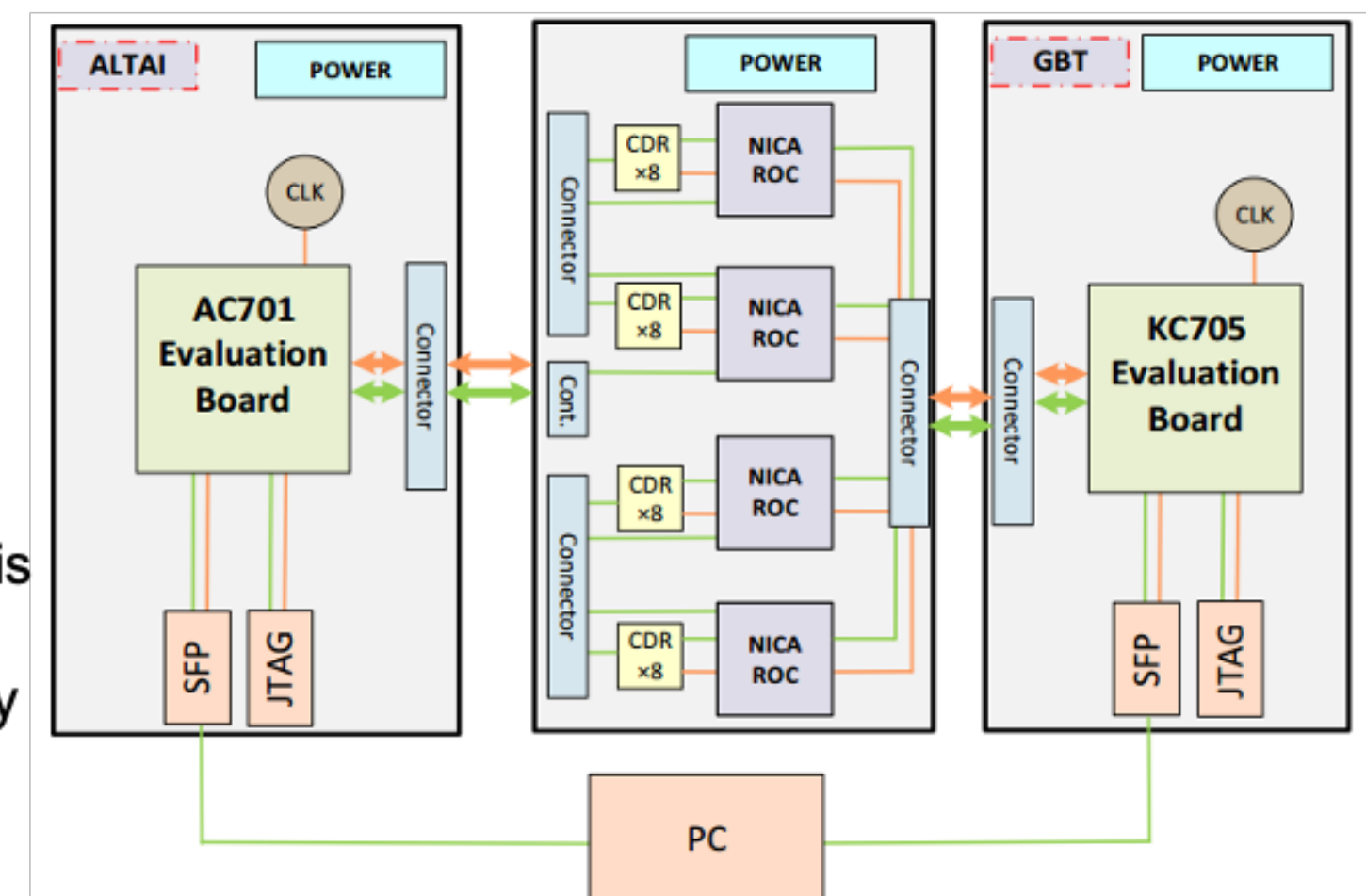
UNIVERSITY OF SCIENCE AND TECHNOLOGY OF CHINA



NICA ROC ASIC



- The KC705 FPGA evaluation board act as a substitute for GBT ASIC.
- The AC701 evaluation board simulates ALTAI function to generate data.
- The control commands received by the A7 is decoded and sent to PC.
- Data loopback test to verify that the link logic is correct (Tx and Rx).
- Compare and analyze data transferred directly to PC with data in NICA_ROC format



RSF-NSFC Cooperation: Possibility for Joint Russian-Chinese Project Proposals

2023-2025 Joint Project Description Template

A complete proposal in this competition consists of the joint project description (following this document) and the specific documents, necessary for both funding organizations respectively (for Chinese Scientists – following the NSFC rules, for Russian scientists – following the RSF competition documentation).

The proposal must be written in English. There is a strict limit of 20 pages for the joint project description (font size: 11 or 12, line spacing: 1.15). Applicants are obliged to ensure that the project description contains sufficient information for evaluation.

Core data

Title of the Research Project

Title in English: **Fast data processing through real-time AI for NICA/MPD and future EicC detectors**

Title in Russian: **Быстрая система обработки данных на основе ИИ в режиме реального времени для MPD и будущих экспериментов на EicC**

Title in Mandarin: **应用于 NICA/MPD 和未来 EicC 探测器上基于实时人工智能的快速数据处理**

Project Partners

Name and affiliation of the Chinese Principal Investigator

Name (in both English and Mandarin), title: **王亚平, Yaping Wang, Professor**

Host Institution: **Central China Normal University (CCNU)**

Contact telephone number and E-Mail address: **86-13697332703, wangyaping@mail.ccnu.edu.cn**

Name and affiliation of the Russian Principal Investigator

Name (including Patronymic name), title: **César Ceballos Sánchez, Staff Scientist**

Host institution: **Joint Institute for Nuclear Research (JINR)**

Contact telephone number and E-Mail address: **+7 9261486684, ceballos@jinr.ru**

Tasks

- Task 1 - Physics simulations, tracking and selective streaming system design and algorithm development: (1) Simulated data generation for selected physics; (2) Co-design of physics-aware artificial system to detect selected physics signal.
- Task 2 - AI model development based on Graphic Neural Network (GNN), and the GNNs are adopted for handling sparse detector images and identifying interesting tracks.
- Task 3 - FPGA board development for the Streaming AI Trigger System.
- Task 4 - Integrated selective streaming readout of the MPD/IT detector, the related electronics hardware development and the FPGA implementation of the machine learning algorithm.
- Task 5 – Built a standalone test station comprising the front-end electronics of MPD-ITS detector plus the streaming readout unit.

Partner A's work (China): Task 2, Task 3, Task 4.

Partner B's work (Russia): Task 1, Task 4, Task 5.