

RHICf-II discussion

STAR Spin/Cold-QCD PWG Meeting

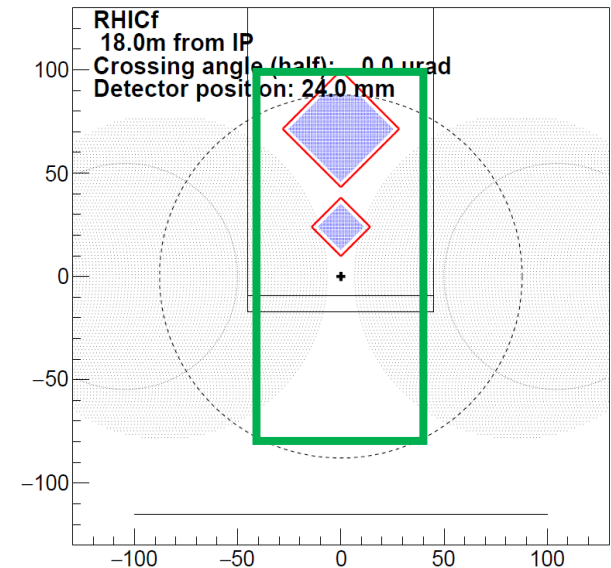
Apr. 13, 2022

Yuji Goto (RIKEN)

for the RHICf-II Collaboration

RHICf-II proposal

- We have proposed a second run for RHICf in 2024 (RHICf-II)
- RHICf-II Lol was discussed by the PAC in 2020.9
 - Parasitic beam-time
- We're collaborating with ALICE-FoCal group to use the FoCal-E technology
 - 8cm x 18cm detector
 - Kakenhi-Kiban-A (2021-2024) + RIKEN budget
 - The detector have enough radiation hardness to work for a small β^* and normal luminosity



STAR Spin/Cold-QCD PWG

- 2022.1.26
- ZDC performance issue
 - 9 o'clock blue-beam Snake failure
 - Luminosity measurement
 - Local polarimeter performance
- Peoplepower issue
 - BNL peoplepower necessary for installation and safety
- DAQ requirement
- Available space
- List of tasks
 - Simulation tasks

Collision system & Polarization	Science goals & objects	Measurement time, luminosity or number of events	Trigger rate / DAQ requirement
p+p Radial polarization	High- p_T π^0 , K^0_S , Λ SSA	1 pb ⁻¹ , a few hours with 200 Hz rare trigger	200 Hz rare trigger for high- p_T π^0 , K^0_S , Λ with no-prescale & high efficiency
p+p Vertical polarization	K^0_S , Λ Spectrum	10 ⁸ events, about a week with 200 Hz shower trigger (with prescale)	200 Hz shower trigger (with prescale)
p+A Radial polarization	High- p_T π^0 SSA nuclear dependence	Similar to p+p Radial polarization	200 Hz rare trigger for high- p_T π^0 with no-prescale
p+A Vertical polarization	Photon, π^0 , neutron Spectrum	< 10 ⁸ events, < 1 week with 200 Hz shower trigger (with prescale)	200 Hz shower trigger (with prescale)

ZDC performance issue

- Luminosity measurement
 - No effect found in 2017 Vernier scan data
 - *Can we understand this?*
 - Calibration by Vernier scans if necessary
- Polarization measurement
 - Especially, problematic blue-beam snake failure requires a stable measurement
 - How stable we can monitor & evaluate polarization of the blue beam?
 - With shifted threshold energy of ZDC by our detector
 - *We're studying the effect of additional material in front of the ZDC, or W+ZDC by simulation.*
 - *We'll consider to study it with existing data in 2022.*

Peoplepower issue

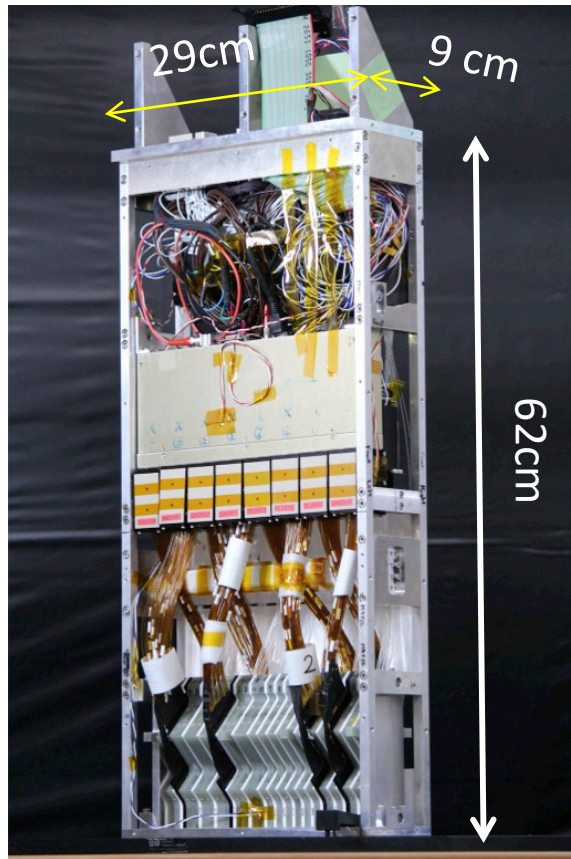
- BNL's peoplepower necessary for installation and safety
 - We will do everything we can to support this.
- Hardware design and fabrication to be done by the RHICf-II collaboration
 - Remote manipulator in front of the ZDC
 - Other materials and supplies
- Participation in the STAR shift from 2023
- New collaborators in the US
 - Stony Brook Univ, Kansas Univ
- Other new collaborators
 - Sejong Univ

DAQ requirement

- STAR data recording with 200 Hz RHICf trigger
 - 10% TPC data recording if possible
 - Remaining 90% without TPC but all other STAR data recording for combined analysis of RHICf + STAR
- Standalone RHICf-II DAQ with independent data stream
 - Event correspondence between STAR DAQ & RHICf-II DAQ with event number sharing
 - Established in 2017 run

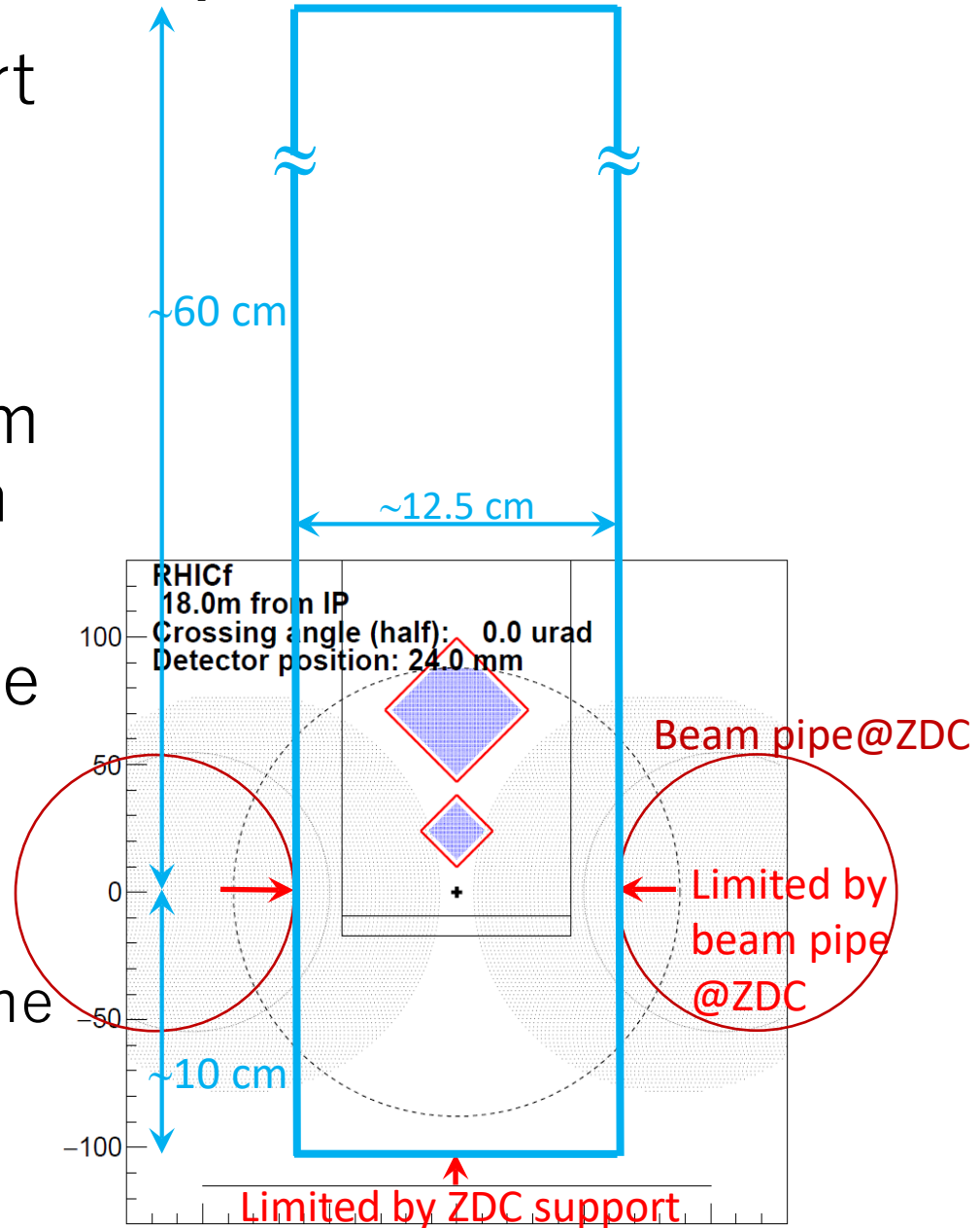
Available space

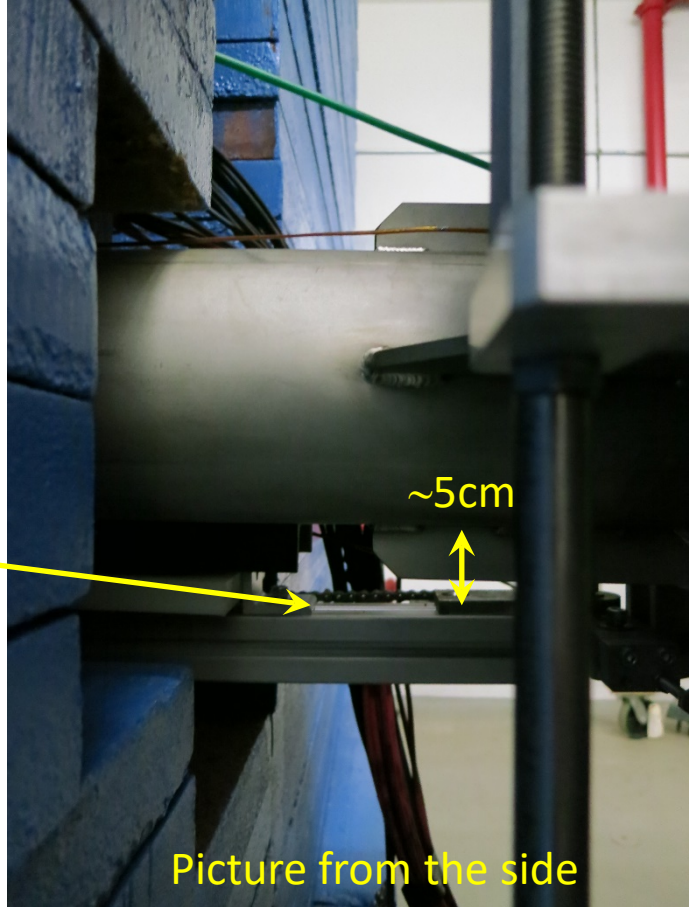
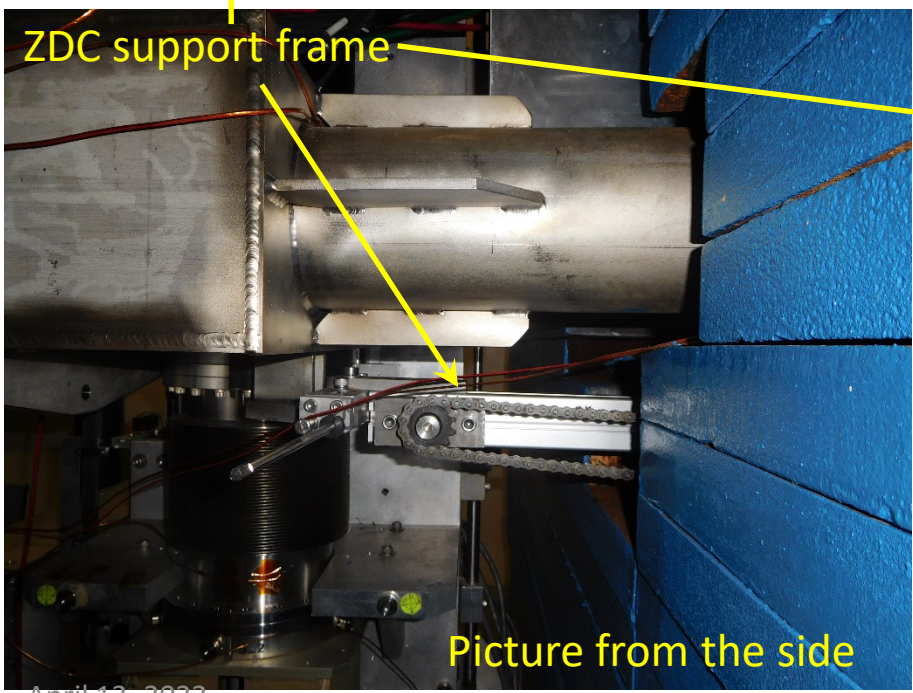
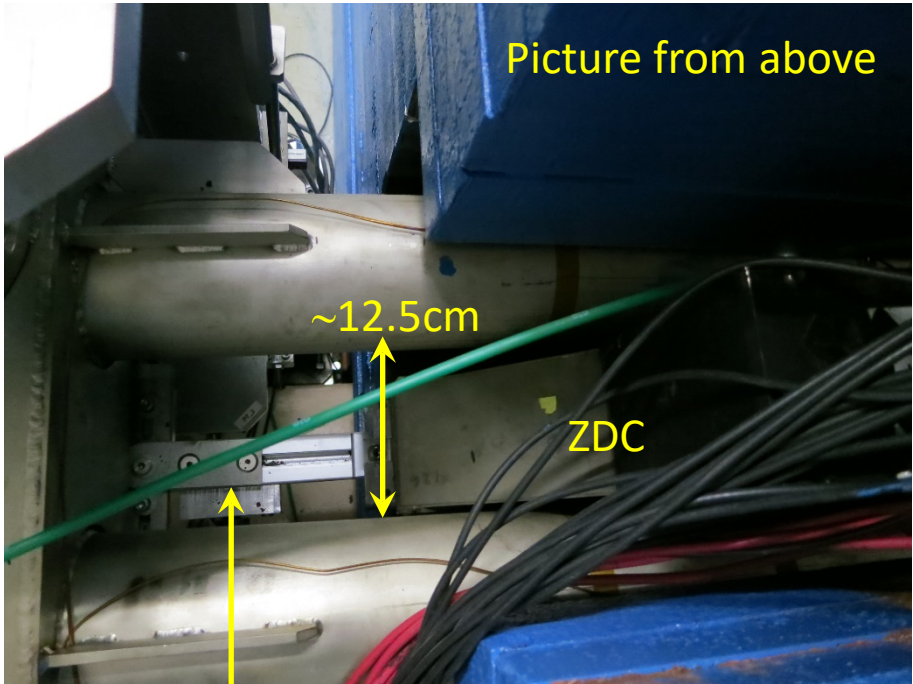
- We installed RHICf calorimeter (LHCf Arm-1 calorimeter) in 2017.
 - W:9cm x H:62cm x D: 29cm
 - by removing the top structure as shown in the right picture



Available space

- There is a ZDC support frame under the detector.
- Due to this limitation, there is only about 5cm space below the beam pipe.
- The space between the beam pipes is about 12.5cm in front of the ZDC.
 - (9.5 cm at the exit of the vacuum section)

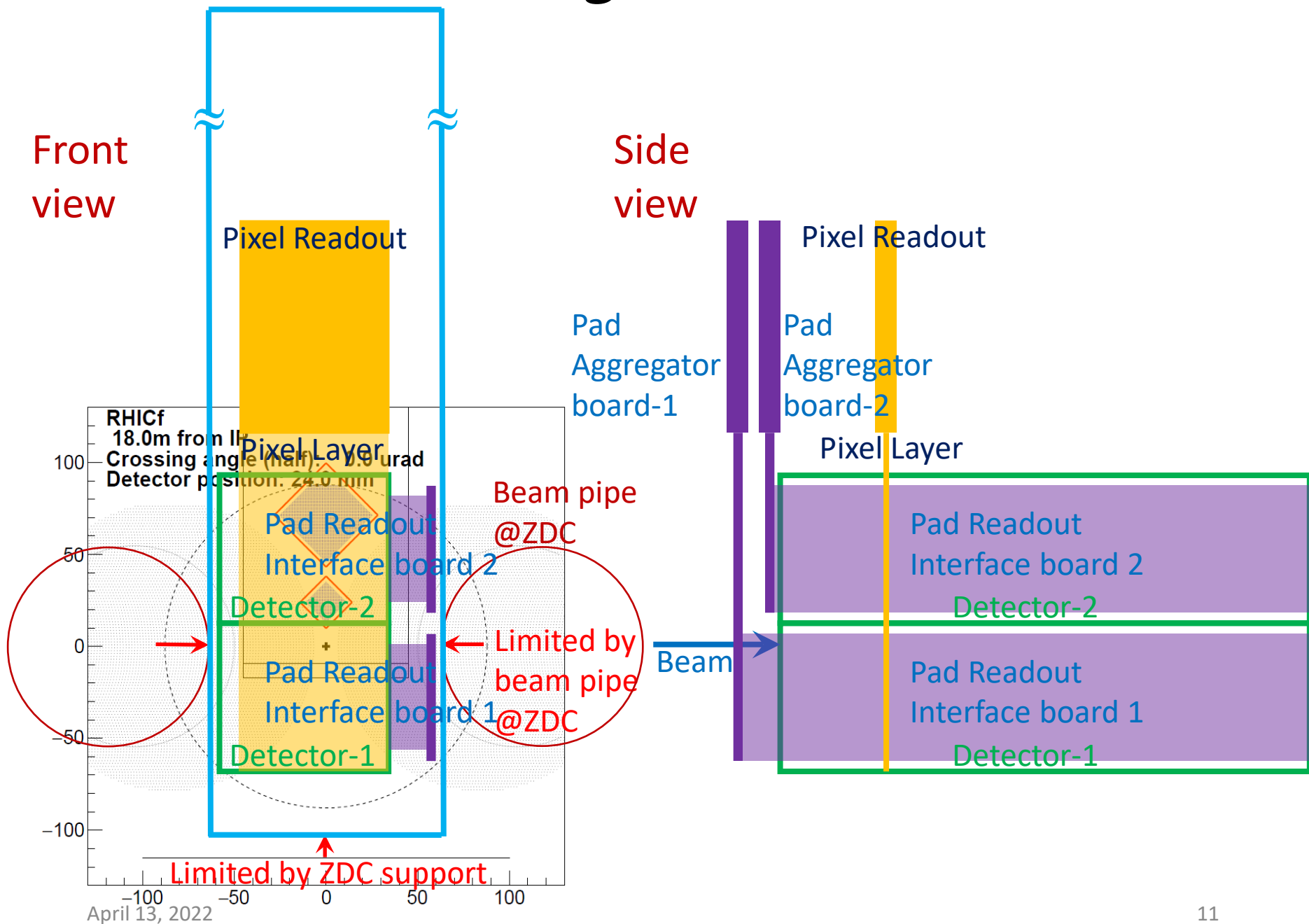




Configuration 1

Front view

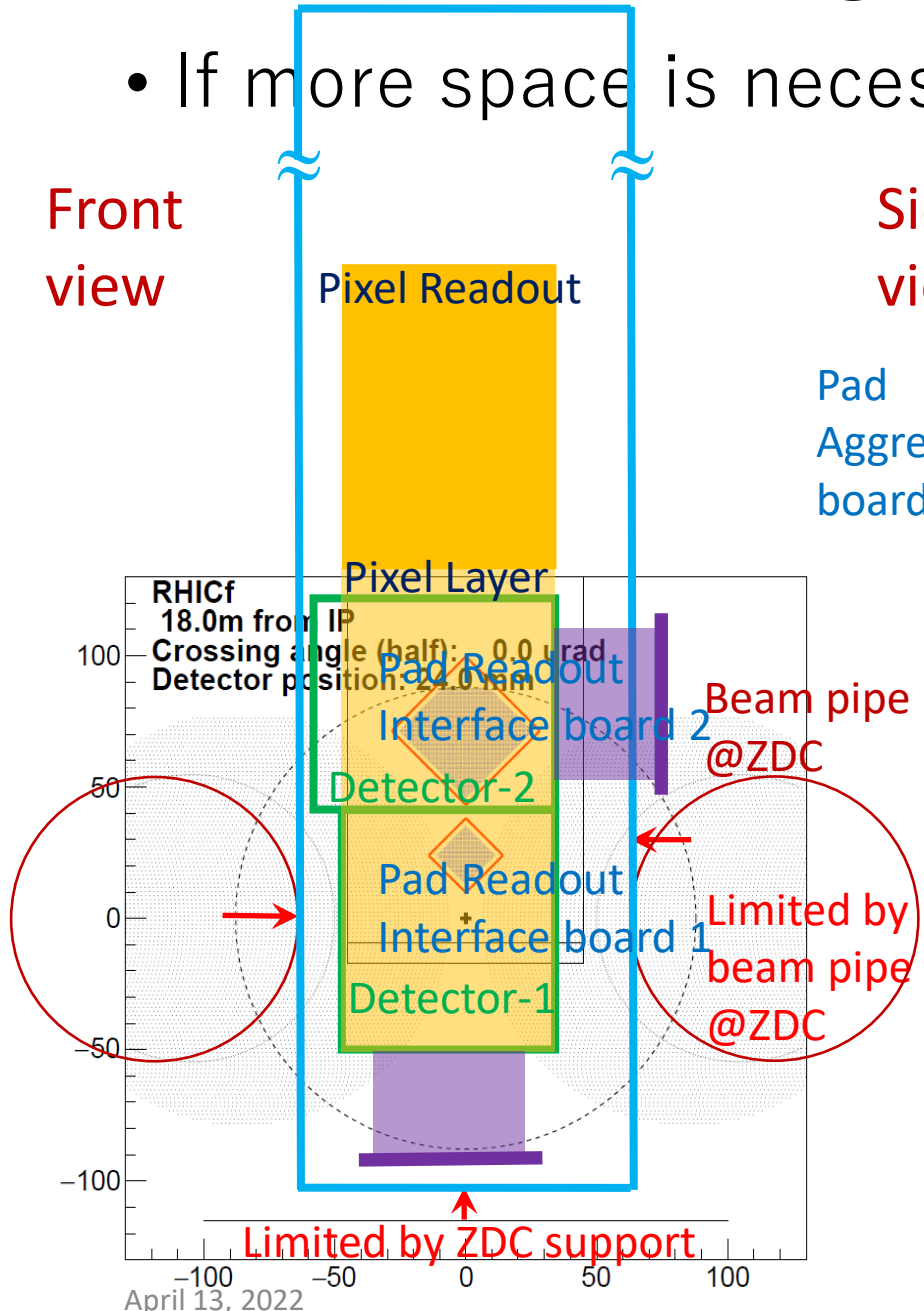
Side view



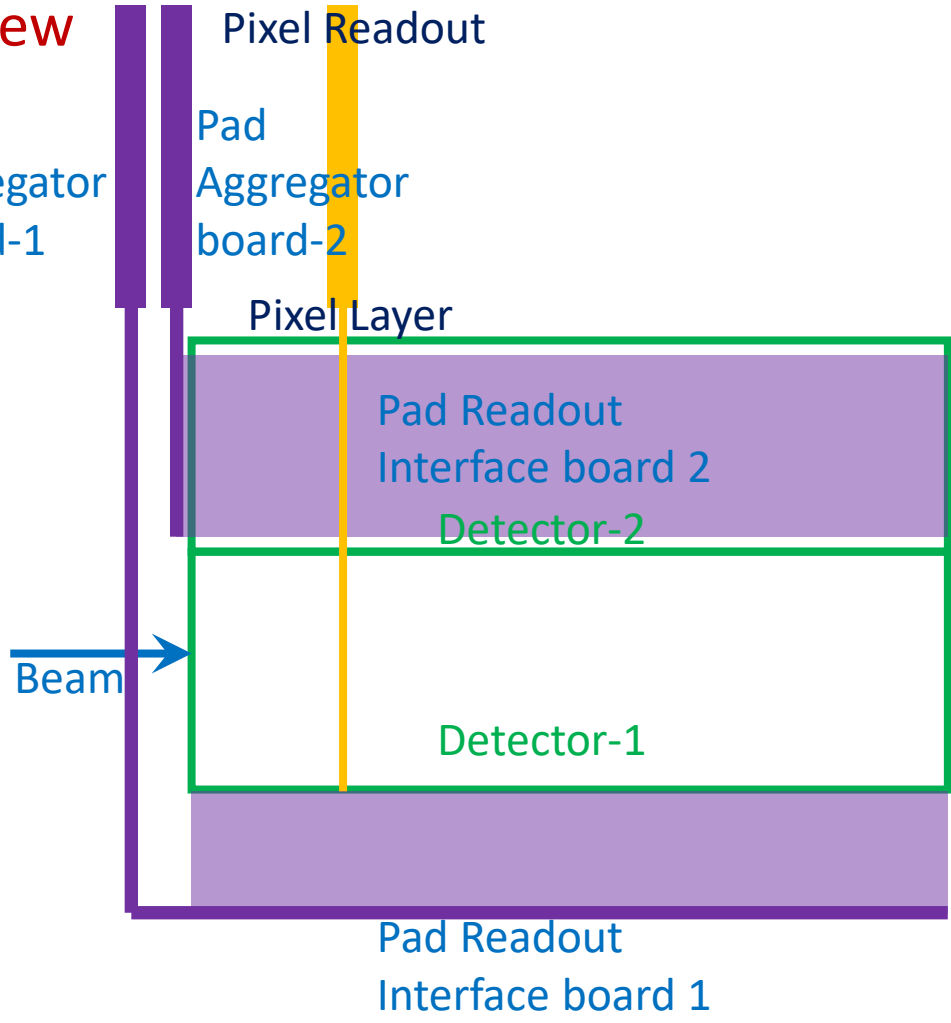
Configuration 2

- If more space is necessary for the Pad Readout

Front view



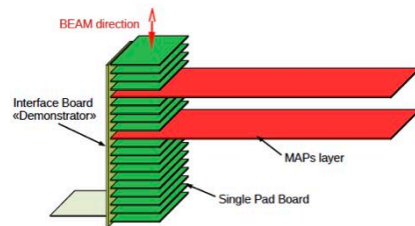
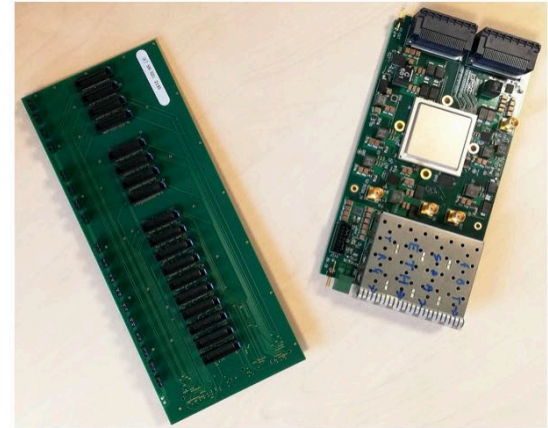
Side view



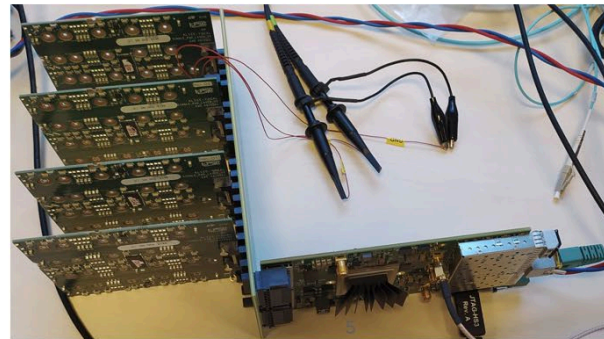
Aggregator and interface boards for 2022

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- For SPS test beam in 2022, PCB v2, aggregator and interface board have been produced and largely programmed
- Logic tests are ongoing
- Built-up of cosmic test bench in progress
 - Grenoble group is preparing the firmware and online monitoring software

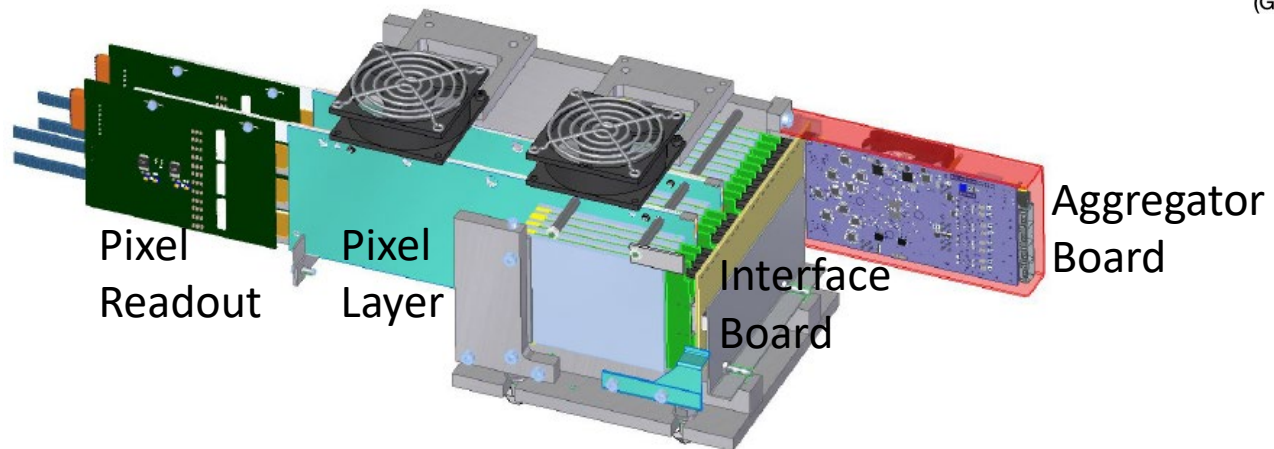


(Olivier Bourrion, Damien Tourres, Fatah Rarbi, Rachid Guernane and Grenoble LPSC CAD team)



(Grenoble)

2022 SPS test beam setup



List of tasks

- Simulation tasks
 - ZDC + W simulation for luminosity measurement and polarimetry performance with shifted threshold energy of ZDC
 - $\Lambda \rightarrow n + 2\gamma$ background simulation for reconstruction and resolution
 - Detector configuration and trigger scheme
 - **Minho Kim is working on the simulation studies**
- Blue beam snake failure
 - 2022 data analysis
 - **Hope someone can participate in 2022 data analysis**
- Timeline for the RHICf-II calorimeter construction
 - ALICE-FoCal-E prototype beam test at CERN-SPS in 2022 (September & November)
 - ALICE-FoCal-E prototype will be used as the first module of the RHICf-II calorimeter and commissioned at RHIC in 2023
 - The second module will be constructed in 2022-2023

Backup Slides

RHICf-II proposal

- Timeline for the RHICf-II calorimeter construction
 - ALICE-FoCal-E prototype beam test at CERN-SPS in 2022 (September?)
 - Under construction including DAQ
 - ALICE-FoCal-E prototype will be used as the first module of the RHICf-II calorimeter and commissioned at RHIC in 2023
 - The second module will be constructed in 2022-2023
- Detector configuration will be optimized to have similar radiation length & interaction length to those of the previous RHICf calorimeter
 - W plates should be about twice thicker
 - To be optimized by the simulation study
 - Need optimum trigger scheme as well

List of Materials/Supplies

- RHICf-II second module as a copy of the SPS test beam prototype
 - Built in 2022-2023, to be installed in 2023-2024
- Pad sensor
 - p-type sensor to be produced in 2022
- HGCR0C
 - v2 or v3? Availability?
- Interface board & aggregator board
- Pixel sensor and readout
 - EPICAL?
- Trigger system
- ALICE standalone DAQ
 - RU/CRU availability?
- Remote-controlled manipulator
- Cables

List of tasks

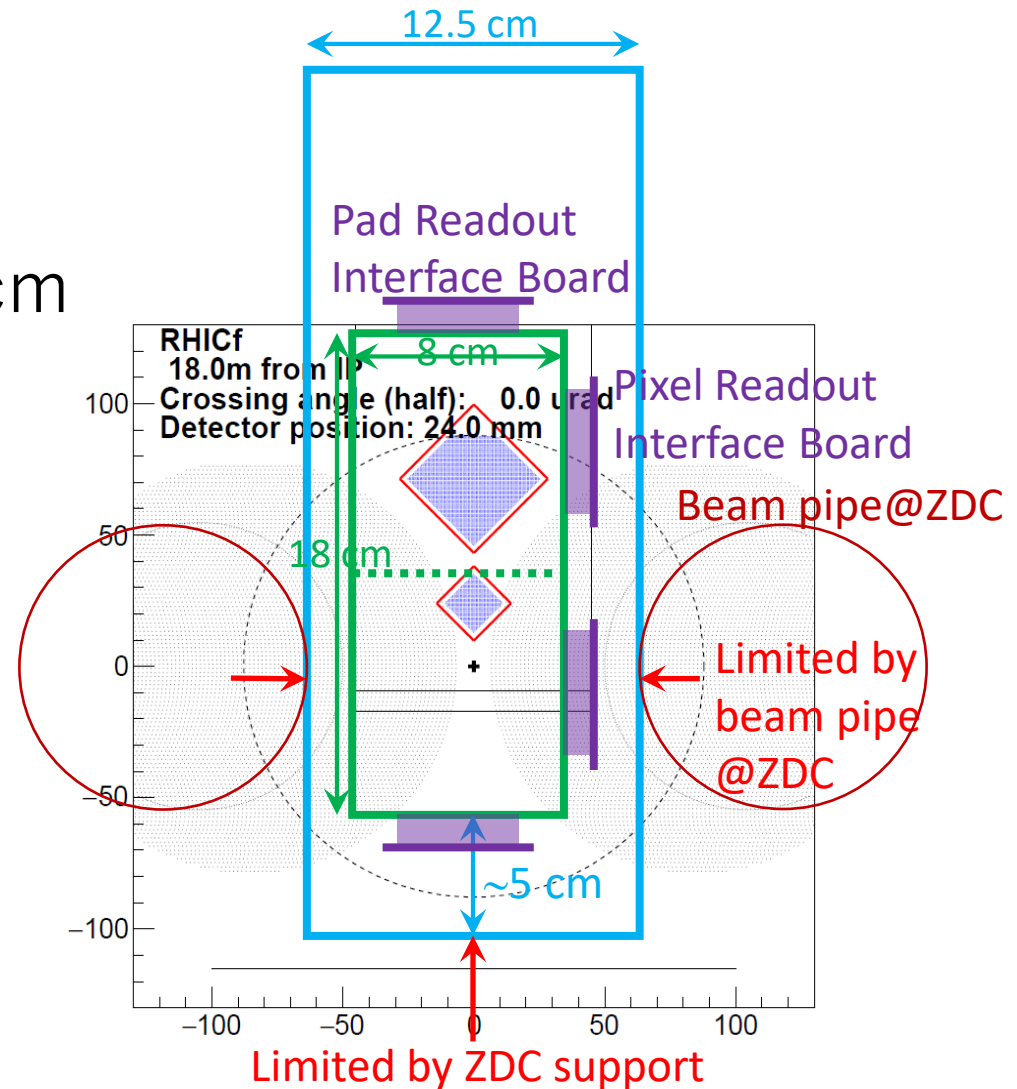
- Readout procedure of Pad and Pixel sensors
- Support structure and manipulator design
- CAD figure (crude implementation)
- Simulation tasks
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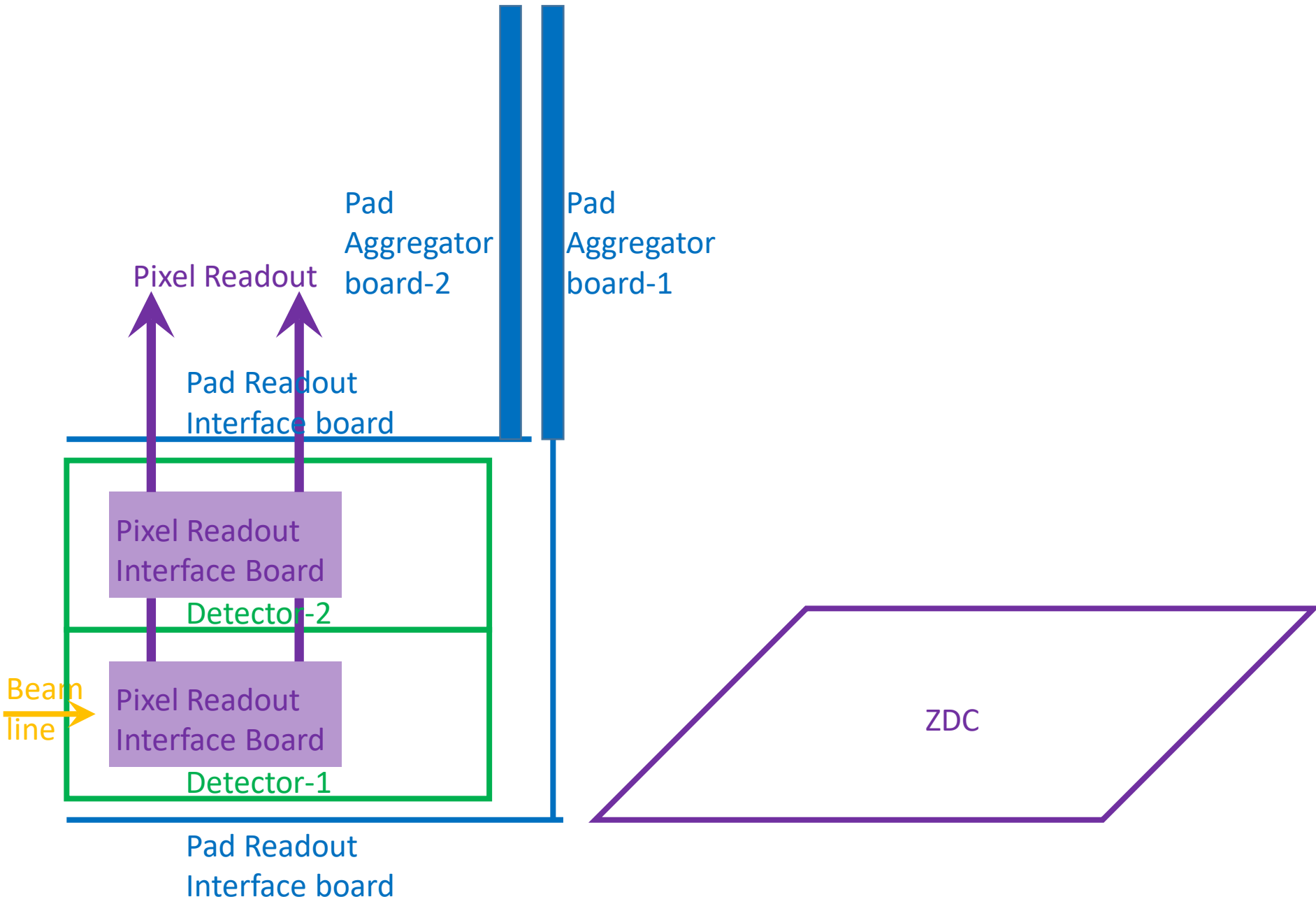
Detector configuration discussion

- We need new Interface Board for the new configuration with thicker tungsten and pixel layer location.
 - Can we design and produce the new Interface Board in Japan?
- There are 2 Aggregator Board at present.
 - Can we use it? Or, can we produce new ones?
- We need a pixel layer and readout with a new design
 - Get the required number of ALPIDEs.
- We need development of the self trigger.
 - It is sent to STAR.
 - The trigger from STAR is not used.
 - This development is also useful for the FoCal-E.

Available space in front of ZDC

- There is a ZDC support frame under the detector.
- Due to its limitations, there is only about 5cm of space.
- The spacing between the beam pipes is about 9-9.5cm.





Other issues

- Timeline for the RHICf-II calorimeter construction
 - ALICE-FoCal-E prototype beam test at CERN-SPS in 2022 (September?)
 - Under construction including DAQ
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