

RHICf-II meeting

April 1 (Fri), 2022

FoCal Meeting

- 2022.3.30
- We mainly discussed the RHICf-II detector configuration issue.
 - Available space
 - Available hardware
- We cannot use the design shown in the meeting for the pixel layer readout.

Constantin's suggestions

- CAD study
 - How to fit two modules
 - Crude implementation, feasibility
- Ukraine situation
 - Second set of pixel layers by next year?
 - One pixel layer each module?
- List of needed tasks and materials
 - More RU necessary for more pixel layers
 - Or, simulation with one pixel layer
- Mechanical engineering with 7mm W
 - Mechanical support

List of Materials/Supplies

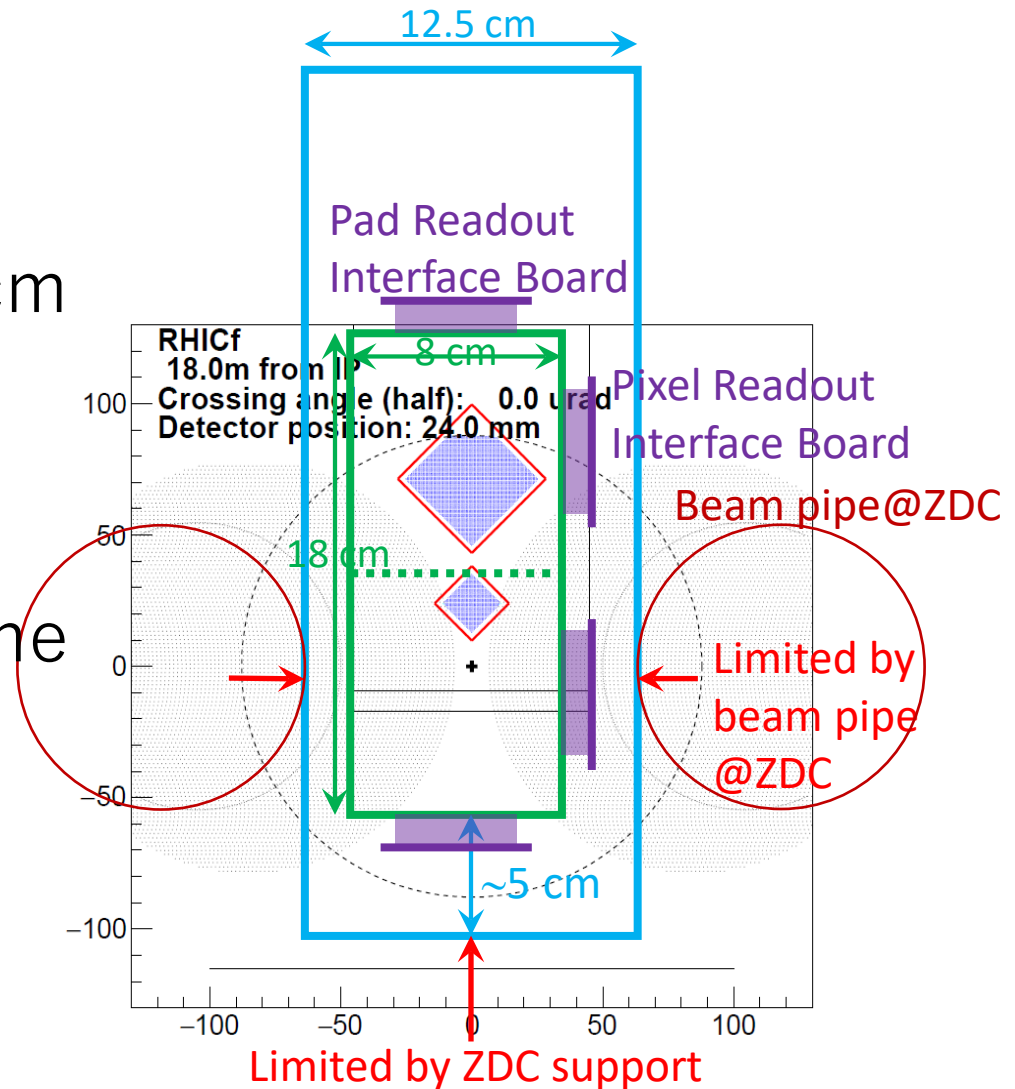
- RHICf-II second module as a copy of the SPS test beam prototype
 - Built in 2022-2023, to be installed in 2023-2024
- Pad sensor
 - p-type sensor to be produced in 2022
- HGCR0C
 - v2 or v3? Availability?
- Interface board & aggregator board
- Pixel sensor and readout
 - EPICAL?
- Trigger system
-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

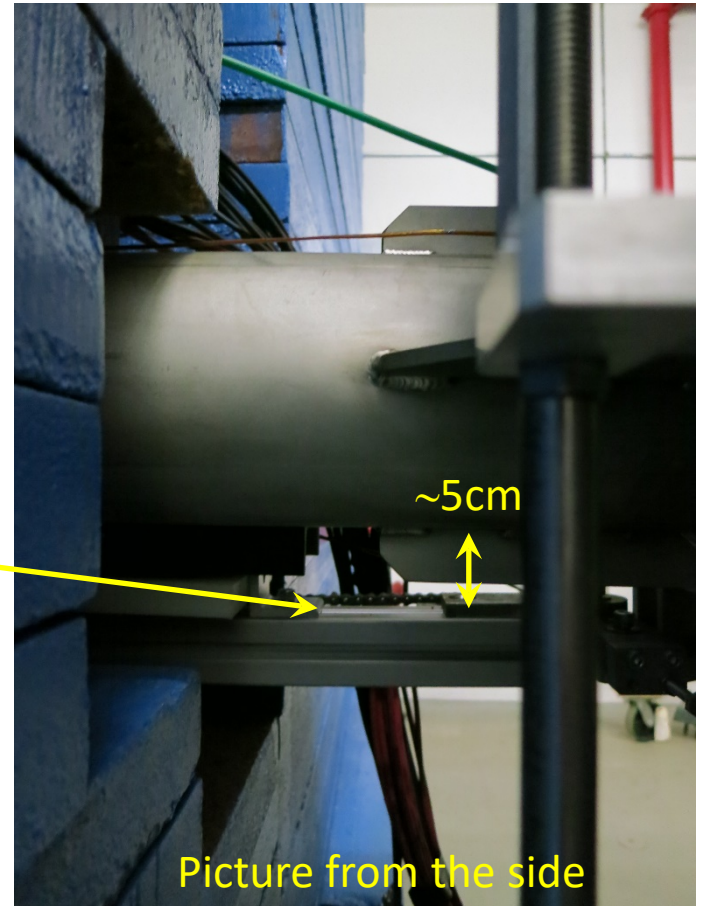
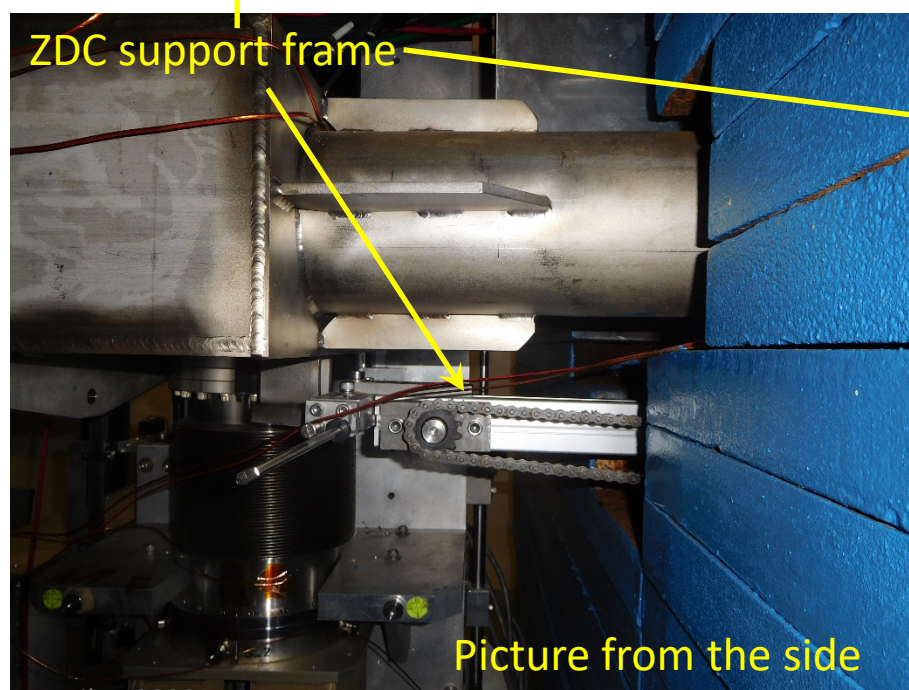
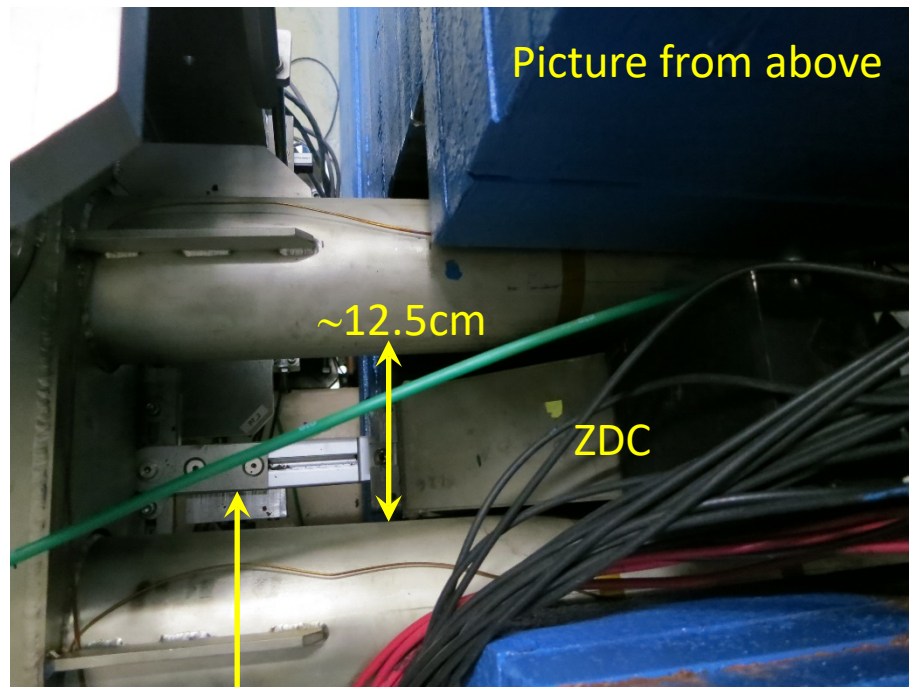
List of tasks

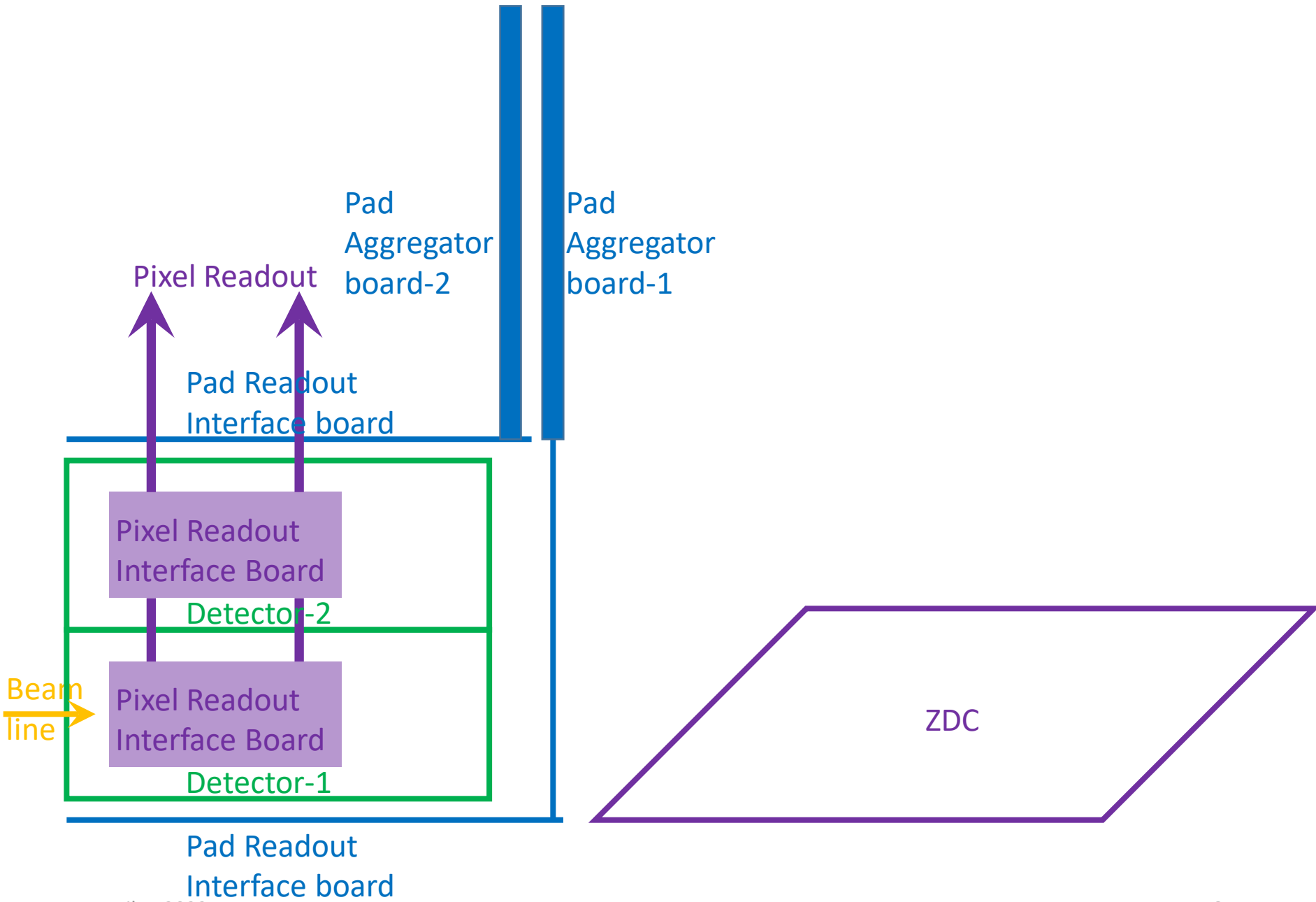
- Readout procedure of Pad and Pixel sensors
- Support structure and manipulator design
- CAD figure (crude implementation)
- Simulation tasks
 - ZDC + W simulation for luminosity measurement and polarimetry performance with shifted threshold energy of ZDC
 - $\Lambda \rightarrow n + 2\gamma$ background 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

Available space in front of ZDC

- There is a ZDC support frame under the detector.
- Due to this limitation, there is only about 5cm space below the detector for the readout.
- The space between the beam pipes is about 12.5cm.

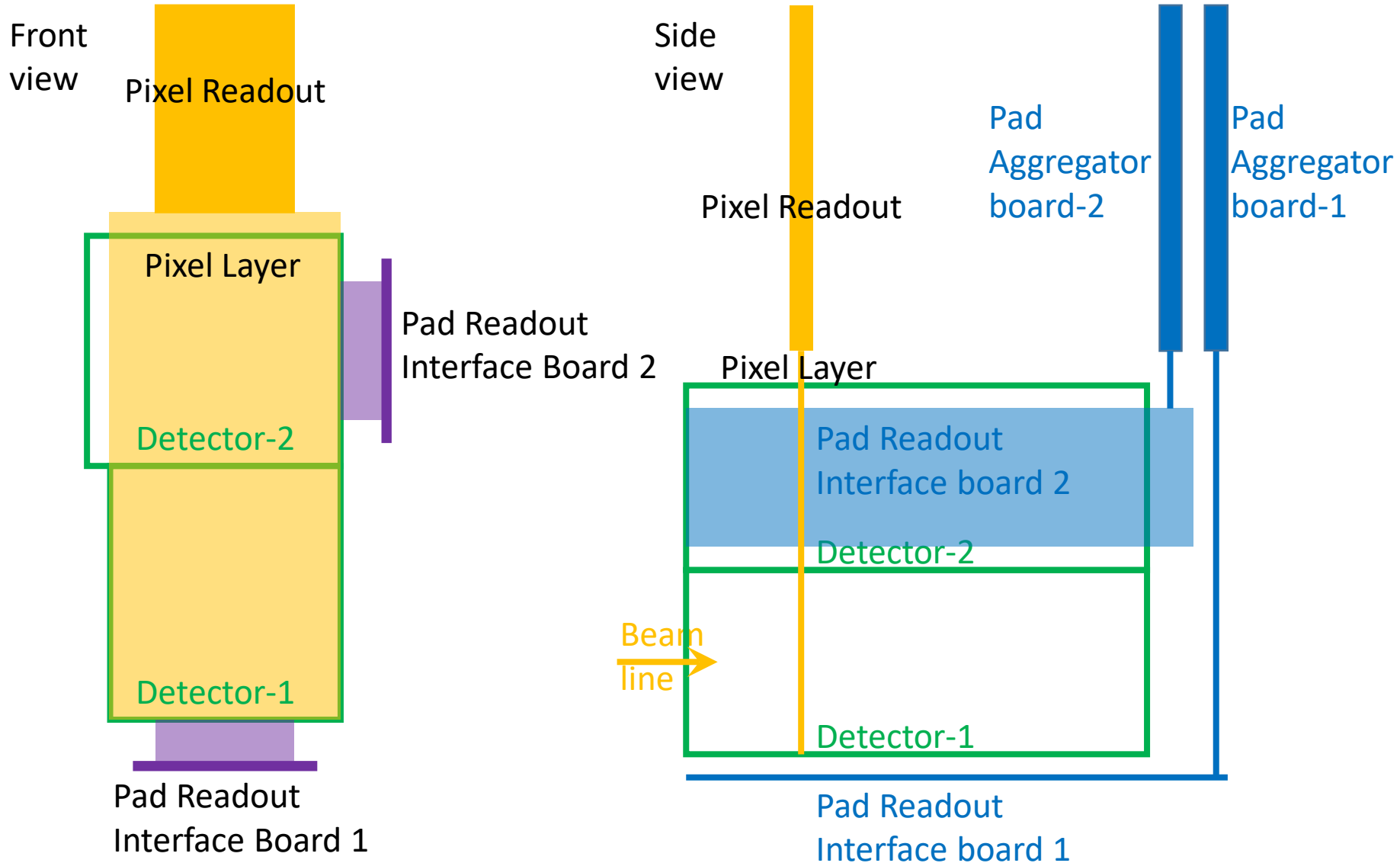






Detector configuration discussion

- Another idea



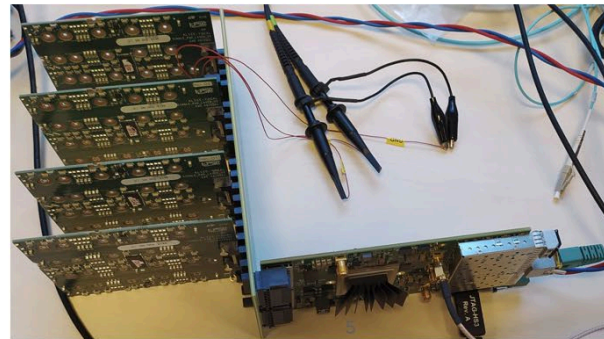
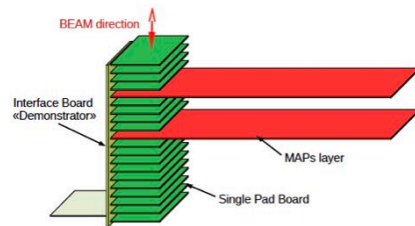
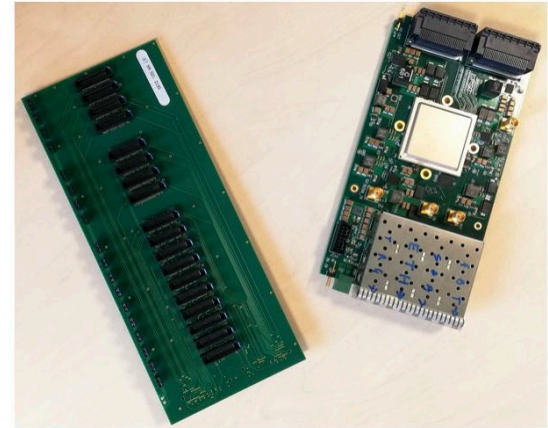
Detector configuration discussion

- 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.

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

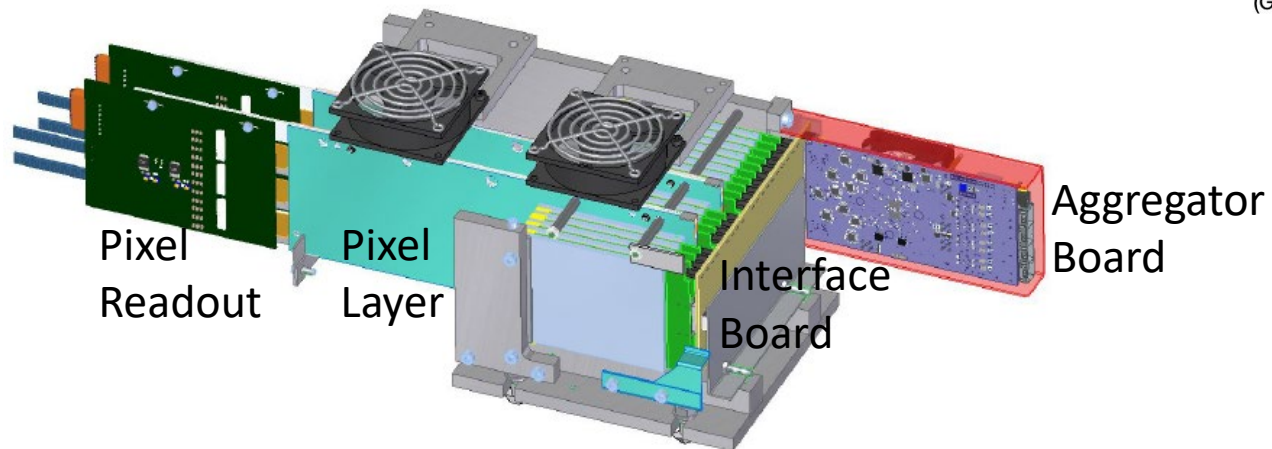


(Olivier Bourrion, Damien Tourres, Fatah Rarbi, Rachid Guernane and Grenoble LPSC CAD team)



(Grenoble)

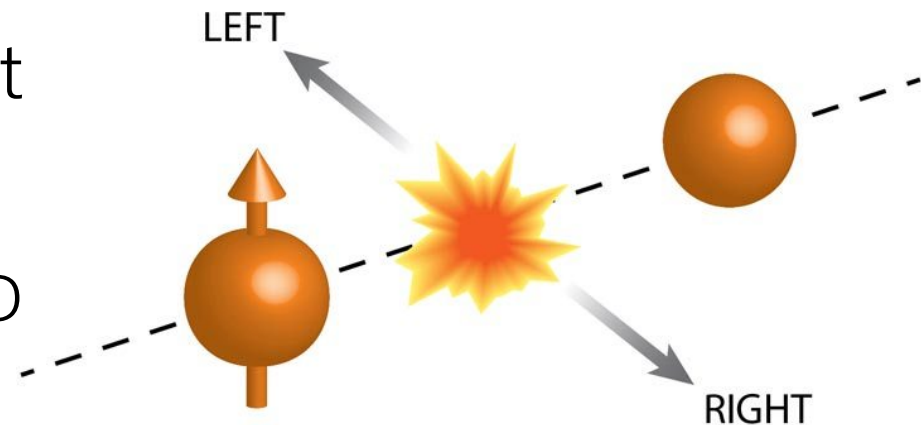
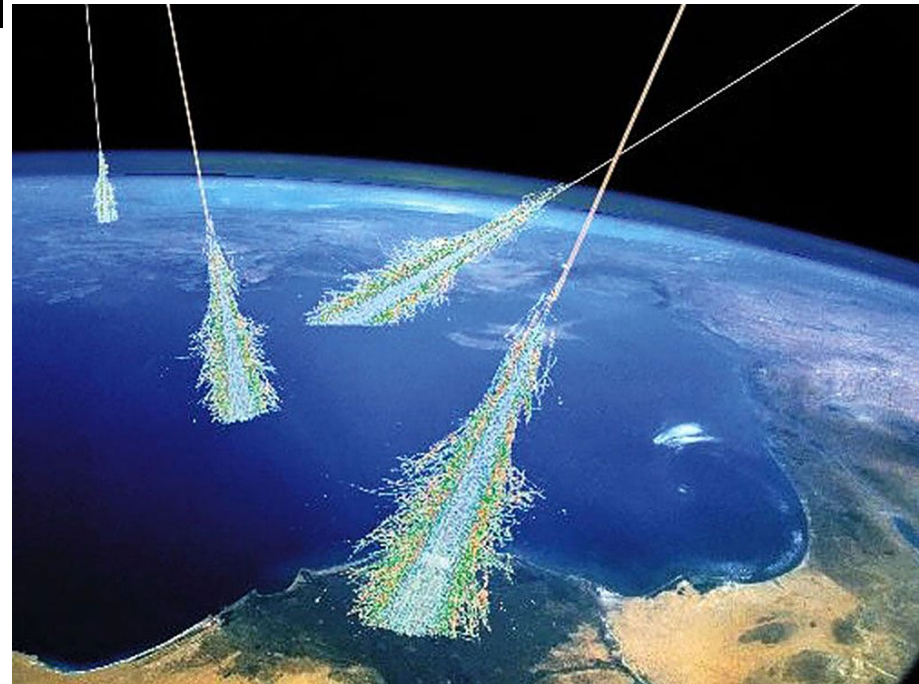
2022 SPS test beam setup



Backup Slides

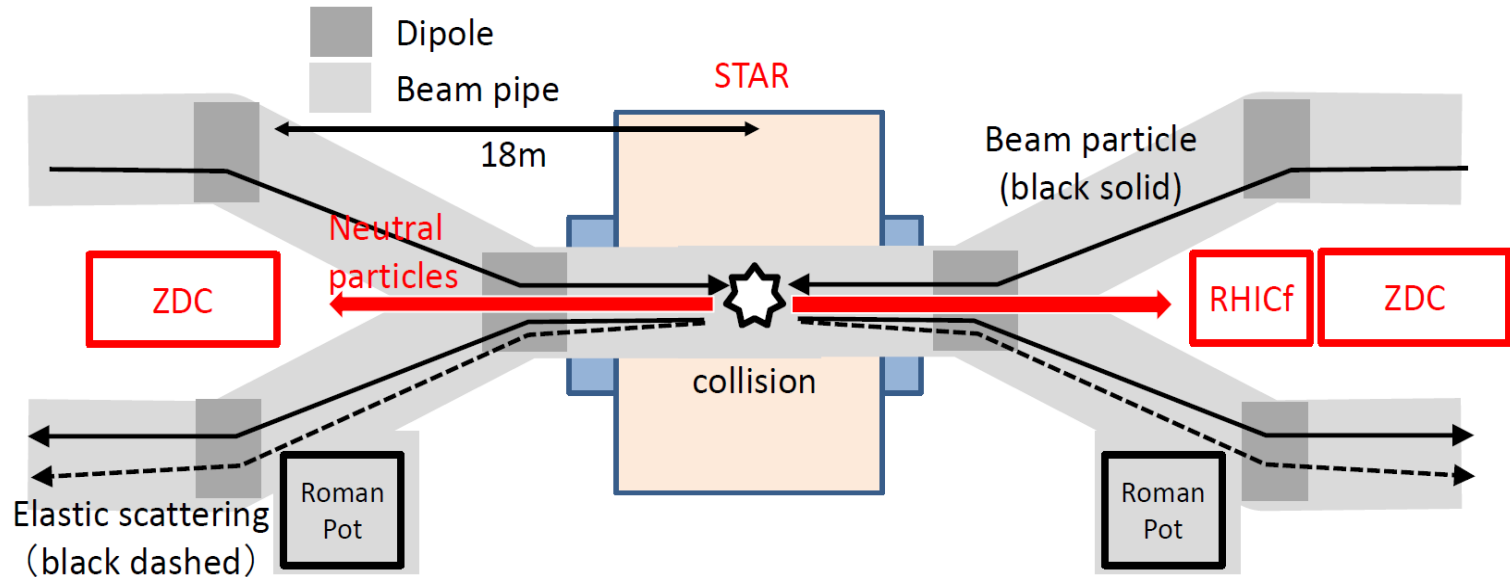
Physics at RHICf & RHICf-II

- Measurements of neutral particle production at zero degree with RHIC polarized proton collisions
- Cosmic-ray study
 - Cross section measurement to understand ultra-high energy cosmic rays
- Asymmetry measurement
 - To understand the hadronic collision mechanism based on QCD



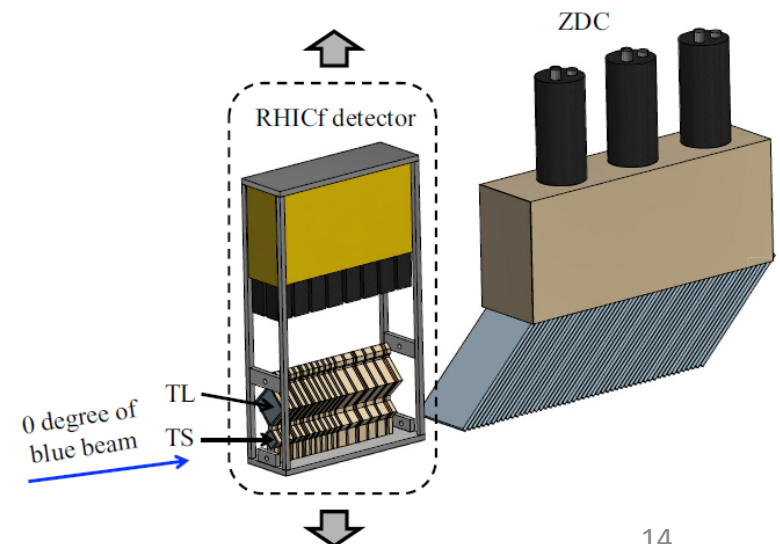
RHICf at STAR in 2017

- EM calorimeter (RHICf detector) installed in front of the Zero-Degree Calorimeter (ZDC) of the STAR experiment



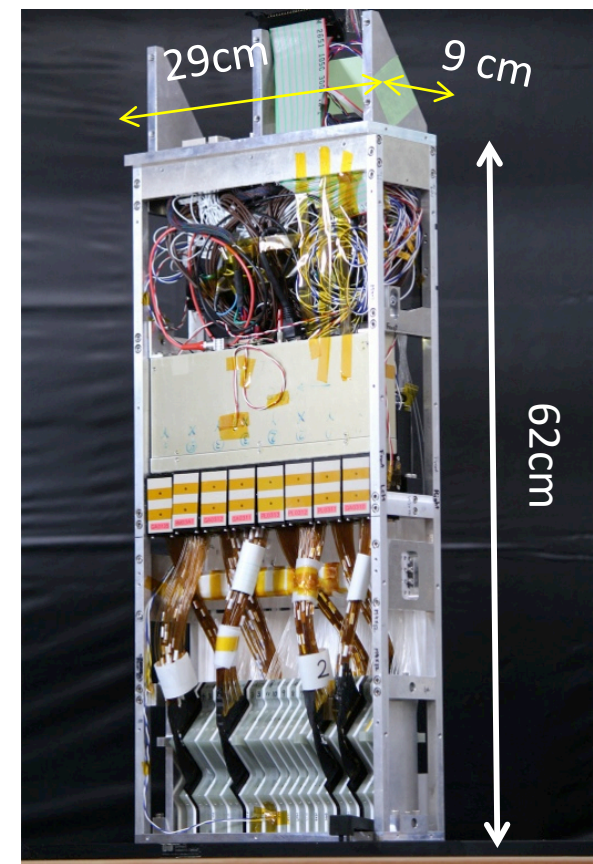
- Two position-sensitive sampling calorimeters

- TS (small tower): 20mm x 20mm
- TL (large tower): 40mm x 40mm
- Tungsten absorber ($44 X_0$, $1.6 \lambda_{int}$)
- 16 GSO sampling layers
- 4 XY pairs of GSO-bar position layers

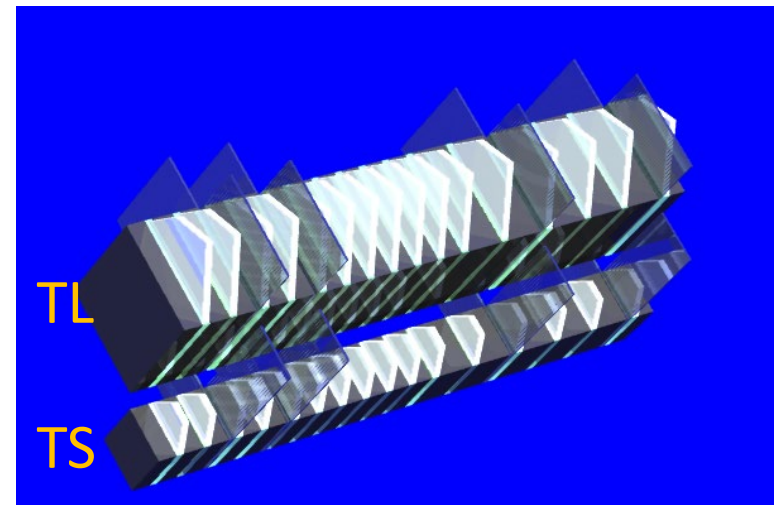


RHICf detector

- Two position-sensitive sampling calorimeters
 - TS (small tower): 20mm x 20mm
 - TL (large tower): 40mm x 40mm
 - Tungsten absorber ($44 X_0$, $1.6 \lambda_{\text{int}}$)
 - 16 GSO sampling layers
 - 4 XY pairs of GSO-bar position layers (MAPMT readout)

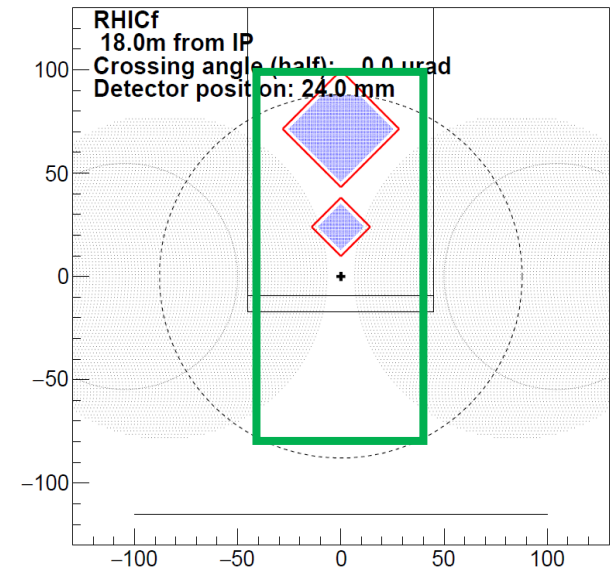


Sampling		GSO-plate
Position		GSO-bar hodoscope
Absorber		Tungsten



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



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

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
 - Collaborators in the US
 - Stony Brook Univ: Abhay Deshpande, Joanna Kiryluk
 - Kansas Univ: Michael Murray
 - ORNL: Constantin Loizides
 - Other new collaborators
 - Sejong Univ: Yongsun Kim
- Other issues
 - Available space
 - $\Lambda \rightarrow n + 2\gamma$ background simulation

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)