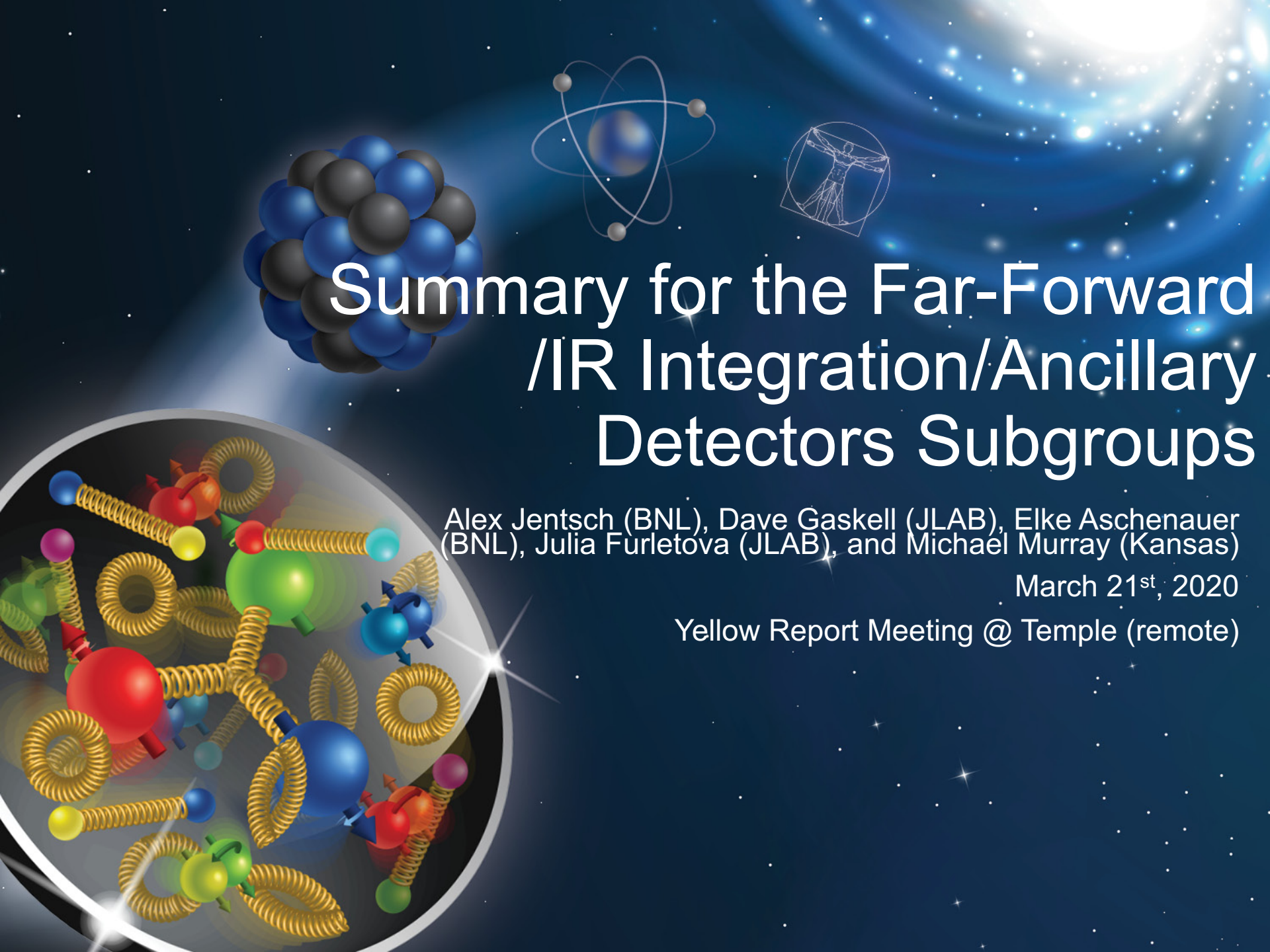


Summary for the Far-Forward /IR Integration/Ancillary Detectors Subgroups

Alex Jentsch (BNL), Dave Gaskell (JLAB), Elke Aschenauer (BNL), Julia Furletova (JLAB), and Michael Murray (Kansas)

March 21st, 2020

Yellow Report Meeting @ Temple (remote)

Overall Goal and Status of the FF/IR Integration Group

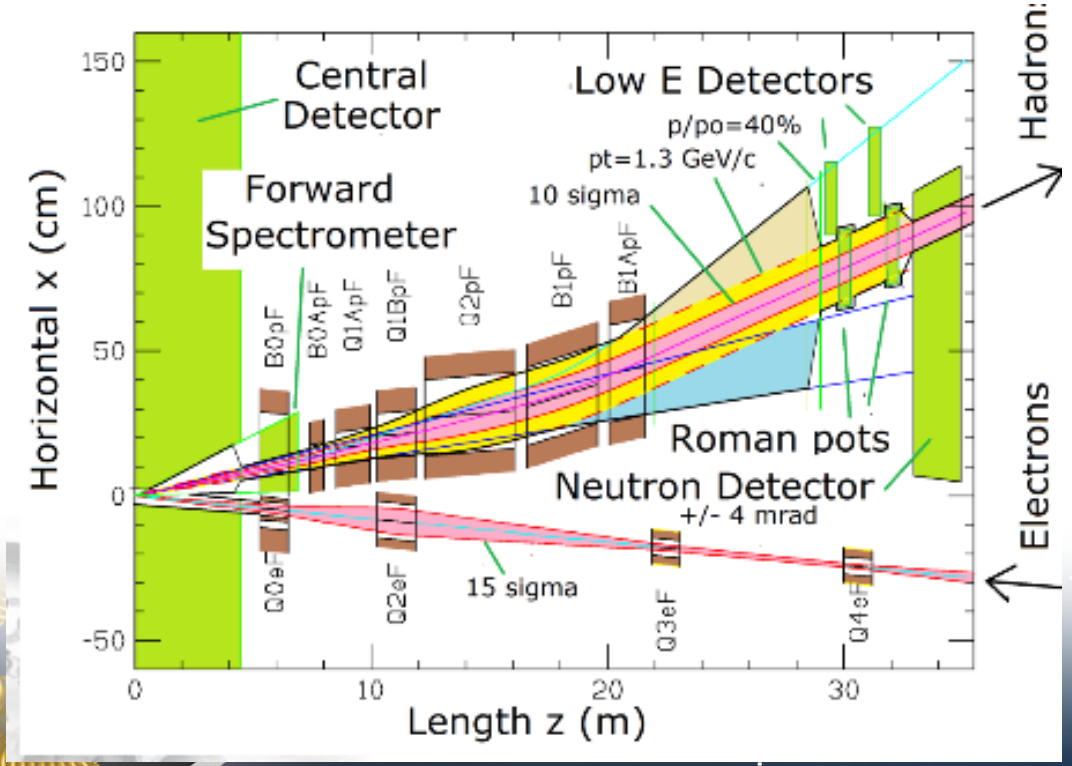
1. Establish the baseline acceptances and constraints related to the IR design.
2. Provide guidance on the possible detector technologies for Far Forward hadron detection and the impact on measurements.
3. Use 1 & 2 to provide concise guidance to/from the physics groups and to the machine group for any possible modifications to improve our capabilities.
4. Summarize these efforts in our report contribution.

Overall Goal and Status of the FF/IR Integration Group

1. Several physics MC samples have been processed through the IR.
   - More work to be done to include all of the realistic detector and beam–related effects.
2. Several eRD groups with detector R&D relevant to these studies.
   - Regular updates given at bi-weekly meetings.
3. Currently ~62 members on the mailing list
   - About ~20 active participants in a normal meeting.
4. Indico: https://indico.bnl.gov/category/284/

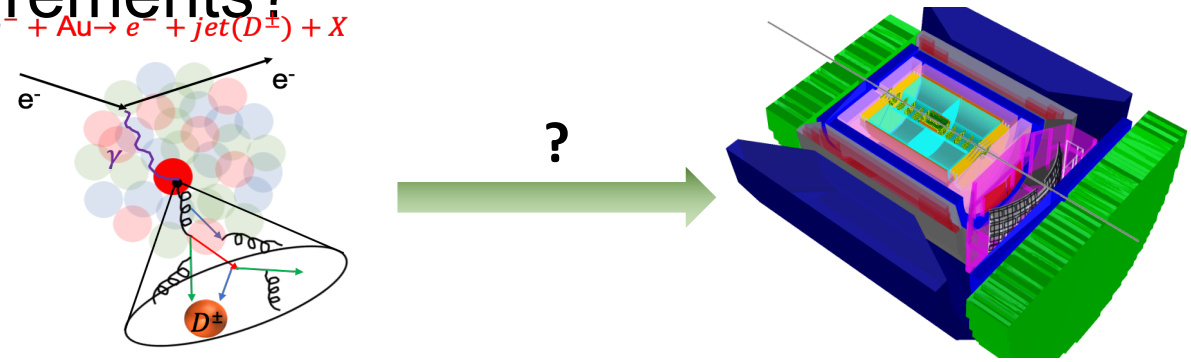
What was accomplished at this meeting?

- Presentation of detector technologies by Xuan (forward silicon), Alessandro (Roman Pots), and Yuji (ZDC), Michael (TOTEM)



Forward silicon tracking detector R&D status

- What detector techniques and design are needed to realize the proposed heavy flavor and jet measurements?

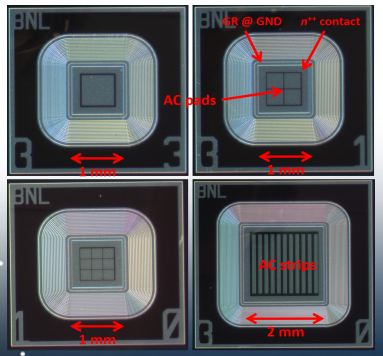


- Several advanced silicon sensor candidates have been determined and relevant characterizations and R&D will be carried out at LANL.

For example:

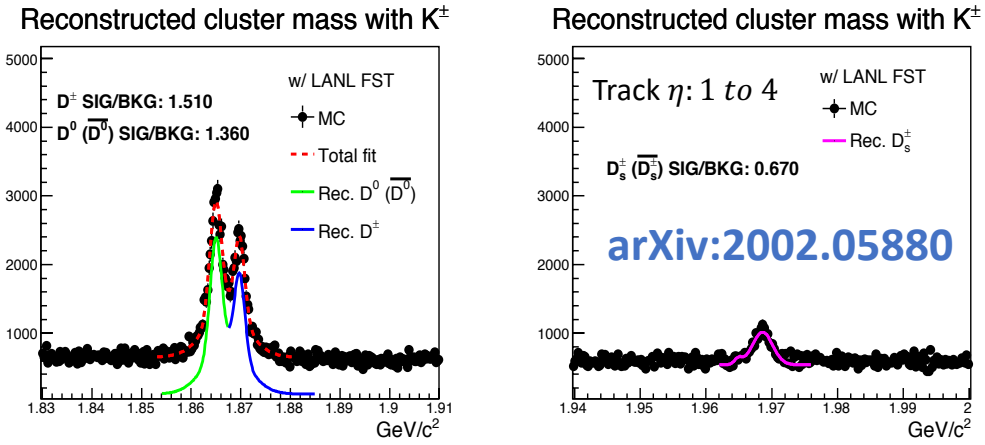
MAPS sensor

LGAD sensor

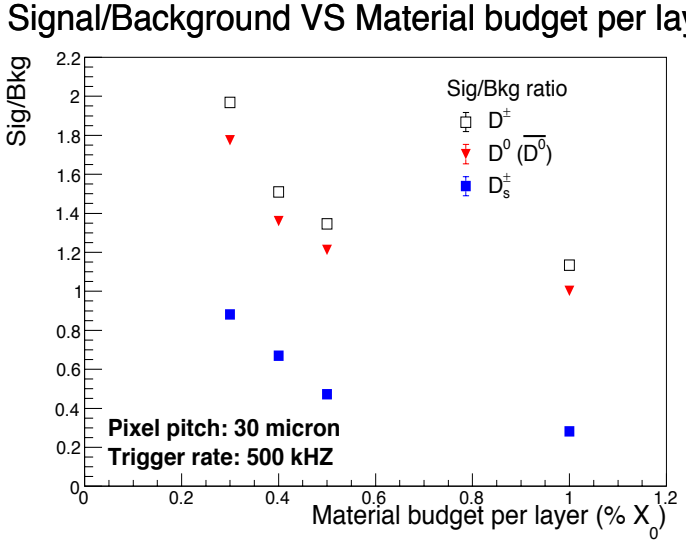


Impact on the physics by different forward silicon tracking detector choices

Reconstructed D-mesons

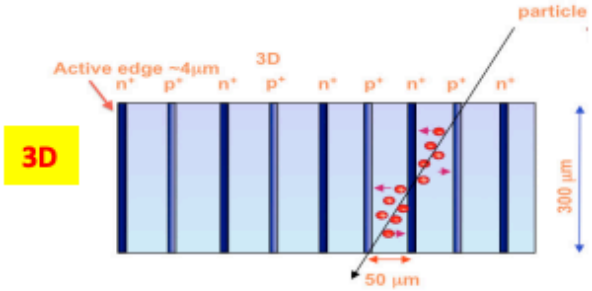


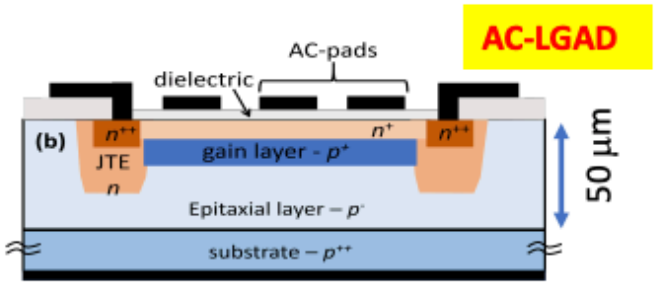
Dependence on detector options



- Analysis framework to evaluate the impacts on heavy flavor observables by different forward silicon tracking detector options has been setup.
- Need inputs on the IR design in the GEANT4 simulation.
- Need inputs from other sub-systems on the integration.
- Need inputs on the background evaluation for the detector studies.

3D – AC-LGAD sensor comparison





- **3D sensors are naturally with active edges**
- **3D are more rad-hard than LGADs** (unnecessary for RP at EIC)
- **3D require more complex and expensive processing with only few foundries**
- **Charge collection in LGADs and 3D:**
  - **3D** collects 80 e-/h pairs x 200/300μm ➔ ~ 16k e/h pairs
  - **LGAD** collects 80 e-/h pairs x 50μm x Gain (20) ➔ ~80k e/h pairs (Gain higher than 20 has been achieved)
  - ➢ **For a drift length of 50 μm for both, current signal is higher for LGAD**
  - ➢ **Larger pixels in 3D (e.g. 500 x 500 um^2) will induce larger jitter due to larger capacitance, while AC-LGADs are unaffected**
- **3D sensors have been used so far for tracking only as pixel detectors and need careful considerations when readout by fast amplifier and with large pixels (e.g. 500x500 um^2):**
  - Capacitance/Area is already much higher than for LGADs (~5x-10x) with 50x50 um^2
  - ➢ **Higher noise in 3D than AC-LGADs**
  - ➢ **Much higher current in preamplifier and higher power consumption in 3D than AC-LGADs**
  - ➢ **3D Timing resolution depends strongly on the cell size and track inclination (needs optimisation)**

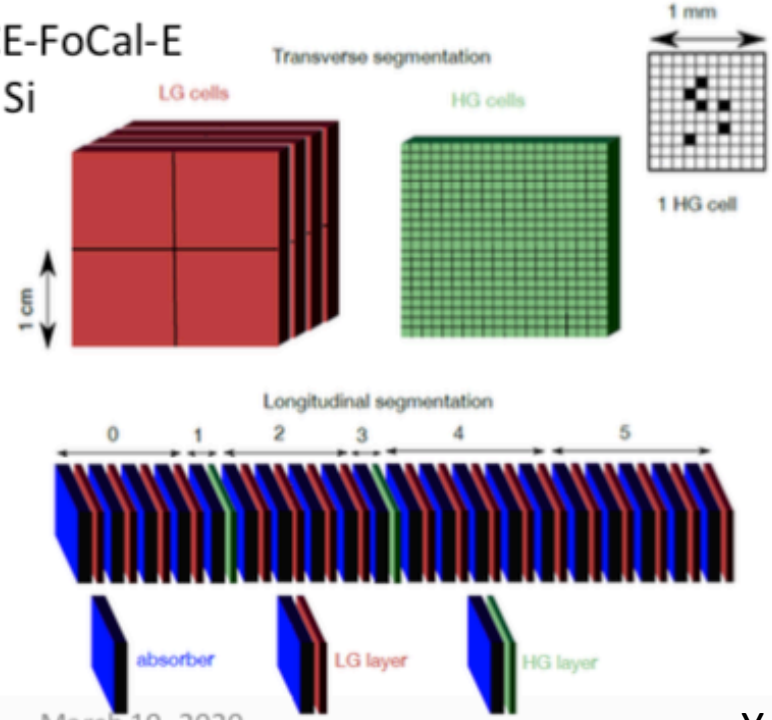
Position sensitive ZDC

- We're going to submit a proposal for EIC R&D of ZDC
  - We presented a Letter of Intent at the EIC R&D meeting in January, 2020
  - To be focused on the most important technical questions and what physics areas it will open
- Full-absorption photon detector
  - Required to identify diffractive process in e+A collisions
    - Rapidity gap & coherent (nucleus remains intact)
  - Requiring to identify the nuclear excitation states in addition to the neutron detection
  - Photon energy < 300 MeV
- Radiation hardness study for new technology
  - Kobe U. group is studying plastic scintillators
- We'll discuss collaboration with the calorimeter consortium
  - Crystal scintillators
  - Rad-hard glass scintillators

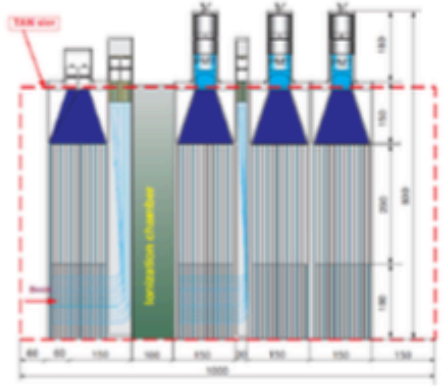
Position sensitive ZDC

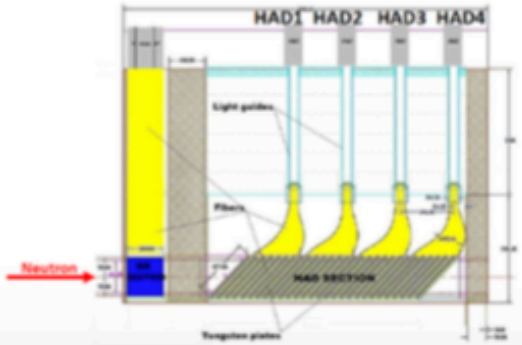
- EM + Hadron calorimeters
  - Required to have good enough p_T resolution for spectator tagging in e + d / ^{3}He collisions
    - Challenging to achieve 30MeV p_T resolution
    - Need to study if 50MeV p_T resolution acceptable
  - RIKEN group is considering collaboration with ALICE-FoCal
  - Kansus U. group is studying ATLAS & CMS ZDC technology

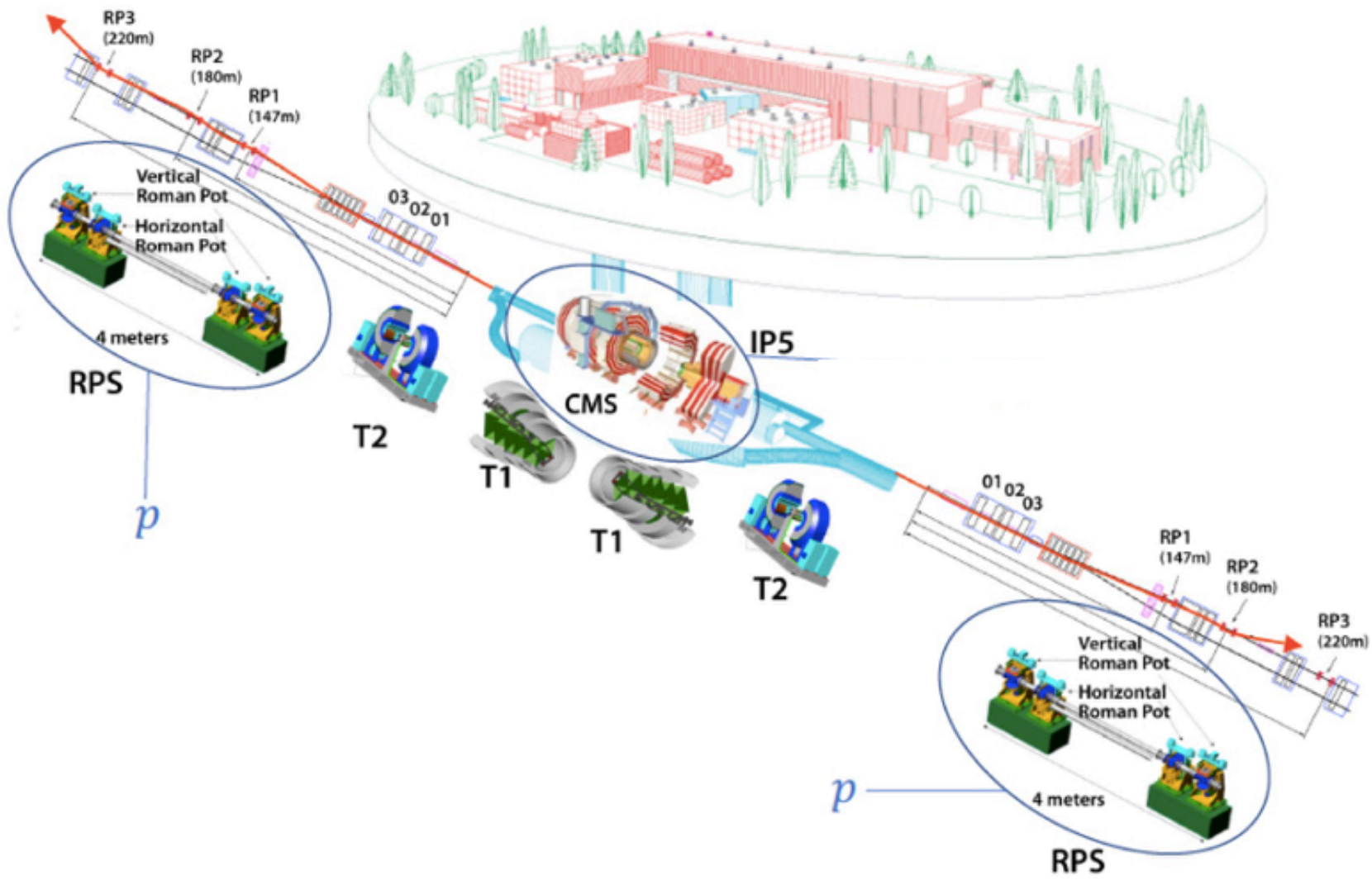
ALICE-FoCal-E
W + Si



ATLAS/CMS
W + quartz







Solutions for Roman Pot alignment and optics verification were reviewed. Several follow up items were identified for future study.

Polarimetry and Ancillary Detectors

Polarimetry and Ancillary Detectors YR WG

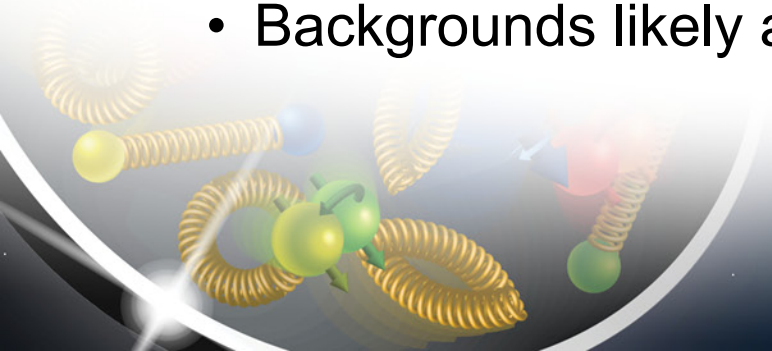
- Started monthly meetings – first was Feb. 4
- Agendas and talks from meetings on Indico:
  - https://indico.bnl.gov/category/280/
- This YR working group builds on earlier activities of Polarimetry Working Group

- Current activities
  - Simulations and design of luminosity monitor
  - Layout, design, simulations of Compton at IR 12
  - Studies of improvements to existing RHIC hadron polarimeters
  - Discussion of “novel” approaches (e.g., elastic scattering for deuteron polarimetry)

Temple Meeting Agenda

- Technical requirements for the luminosity detector and the low-Q2-tagger (Jaroslav Adam)
- Technical requirements for the lepton polarimeter (Alexandre Camsonne)
- Technical requirements for the different hadron polarimeters (Oleg Eyser)

- Overlap with Far-Forward Working Group
  - Compton and low-Q2 tagger will require (fast) segmented (pixelated?) tracking detectors
  - Compton might require use of Roman Pots for electron detector
  - Backgrounds likely an issue for all



Plans and Workforce

- Workforce
  - At present, lots of activity at BNL on simulations of luminosity monitor/low-Q2 tagger and Compton, improvements to proton polarimeters (Jaroslav Adam, Zhengqiao Zhang, Ana Sofia Nunes, and more)
  - JLab ramping up involvement in Compton simulations
  - Interest from Stony Brook, JLab, UVa in design of Compton laser system
  - Stony Brook/JLab-community interest in elastic e-D
- Near term plans
  - Refine rate estimates for Lumi/low-Q2 tagger, Compton to inform detector choices
  - Examine tracking detector options in particular (HVMAPS, diamond strip, etc.)
  - Examine possibility of Compton near IR
- For Compton/RHIC polarimeters, path forward fairly straightforward
- Need to make sure we aren't overlooking any issues, solicit new ideas

CFNS Workshop – Polarization and Polarimetry

https://indico.bnl.gov/event/7583/ **June 29-July 1, 2020**

….The aim of this workshop is to bring together experts in electron and hadron beam polarimetry as well as experts in polarized beams in accelerators. The program will include several invited talks, but contributed submissions are also welcome. Abstracts may be submitted through the conference web site (https://indico.bnl.gov/event/7583/abstracts/) and will be accepted until May 1.

In the event that travel is still restricted in June due to the COVID-19 virus, we will plan to hold the workshop online. This way we can keep with the Yellow Report timeline, as established by the EIC Users Group, and provide timely impact on the EIC machine design.

Organizing Committee:

Elke Aschenauer (BNL), Dave Gaskell (JLab), Haixin Huang (BNL), Vasiliy Morozov (JLab), Vadim Ptitsyn (BNL), and Ferdinand Willeke (BNL),

CFNS Members: Ciprian Gal (Stony Brook)

What was accomplished at this meeting?

- Presentation of detector technologies by Xuan (forward silicon), Alessandro (Roman Pots), and Yuji (ZDC), Michael (TOTEM), etc.
- Presentations by Jarda (low-Q2 tagger), Alexandre (lepton pol.), and Oleg (hadron pol.), etc.
- Great joint session on the engineering for the IR and central integration (see the details in their summary).

What was accomplished at this meeting?

- Presentation of detector technologies by Xuan (forward silicon), Alessandro (Roman Pots), and Yuji (ZDC), Michael (TOTEM), etc.
- Presentations by Jarda (low-Q2 tagger), Alexandre (lepton pol.), and Oleg (hadron pol.), etc.
- Great joint session on the engineering for the IR and central integration (see the details in their summary).
- Joint exclusive, diffractive and FF detectors meeting was very productive as well.

Next Steps

- Continue studies of MC samples and include the realistic detector reconstruction smearing.
  - Compile all of this into a concise set of tables.
- Detail currently observed acceptances from the IR design.
  - Compile these details into a table, converse with physics groups and decide on iteration with machine group.
- Collect all up-to date information about beam-pipe (in both direction rear and forward), magnet parameters/fields and improve our understanding of the realistic detector size (acceptance) and constraints from detector R&D studies.
- We hope to have much of this typed into a draft of our YR contribution for Pavia.