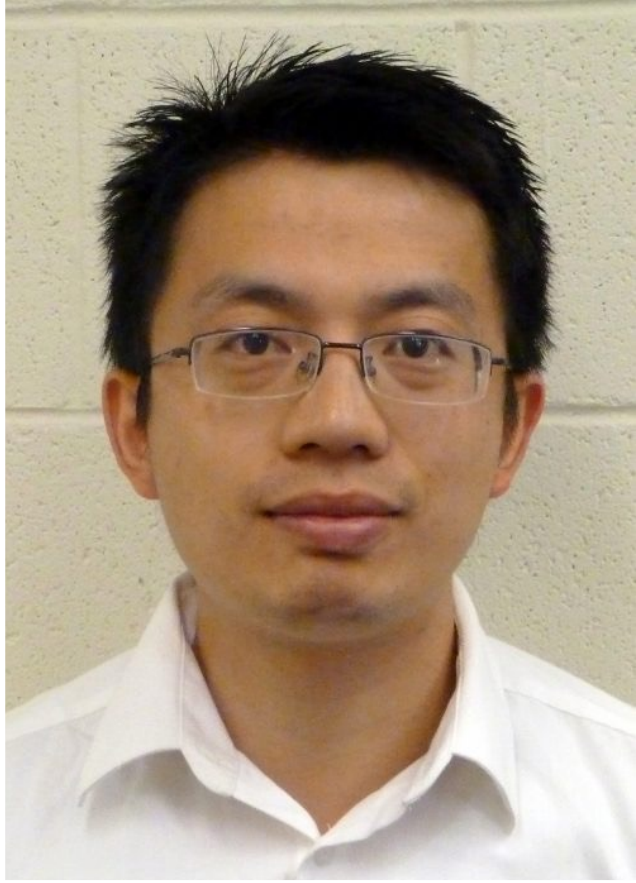


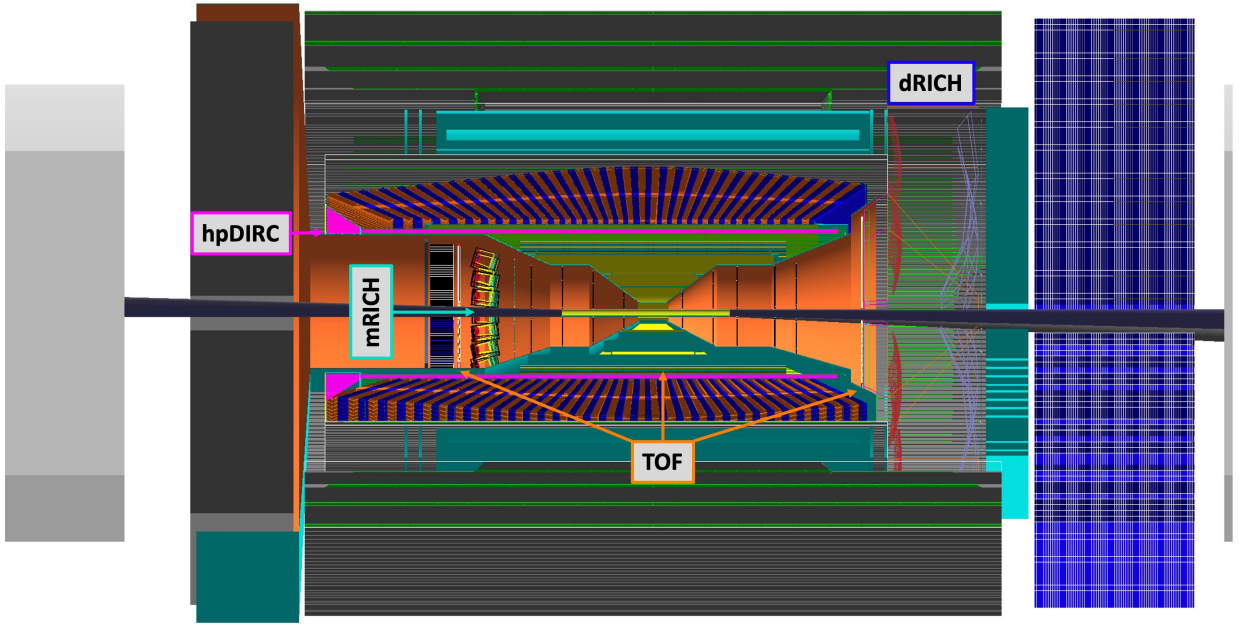



TOF PID Working Group Report

Constantin Loizides (ORNL), Franck Geurts (Rice), Wei Li (Rice), Zhenyu Ye (UIC)

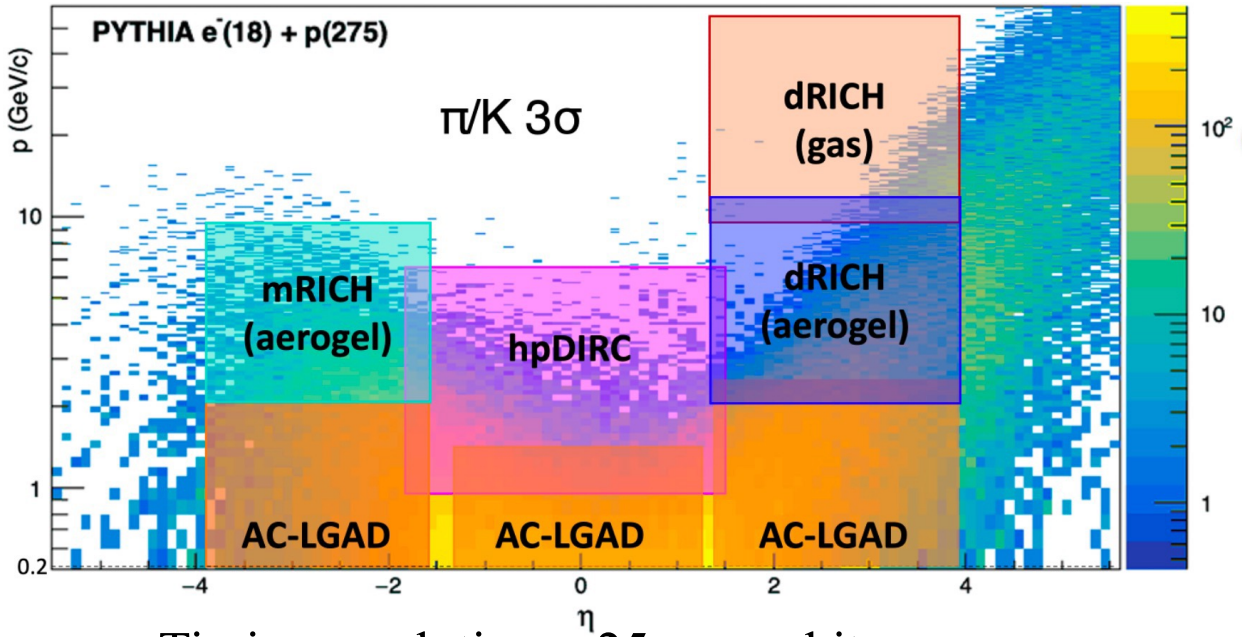
TOF PID (AC-LGADs) for EIC Detector-1

- AC-LGADs with nearly 4π coverage:
  - e/π/K/p PID at low-to-intermediate p range that sufficiently overlaps with Cherenkov PID
  - Provide a high spatial resolution point for tracking
- Explore novel technology (AC-LGADs) and leverage established designs (DC-LGADs by CMS/ATLAS) to minimize the cost and retain a fallback solution.



ECCE TOF coverage

- FTTL: 1.5<η<3.5, 0.15 < p < 2 GeV
- CTTL: |η|<1.4, 0.15 < p_T < 1.5 GeV
- ETTL: -3.7<η<-1.74, 0.15 < p < 2.5 GeV



- Timing resolution: ~25 ps per hit
- Position resolution: ~30 μm with 500 μm pitch
- Material budget: ~7.5% X0
- Total area: ~ 15 m^2

General Charges for the TOF-PID Working Group

- Identify non-trivial differences in the design between ECCE and ATHENA
  - Identify need of further optimization
  - Prepare pro/con list accounting for technical performance, risks and costs
  - Decision on non-trivial differences will be done in consultation with the Project

- During the optimization process: continuous validation of performances for physics

- Work closely with the Project towards the technical design
  - Considering global integration
  - Layout in CAD for detailed design of support structures, front-end electronics, services

Charges and Tasks (based on Reference Design)

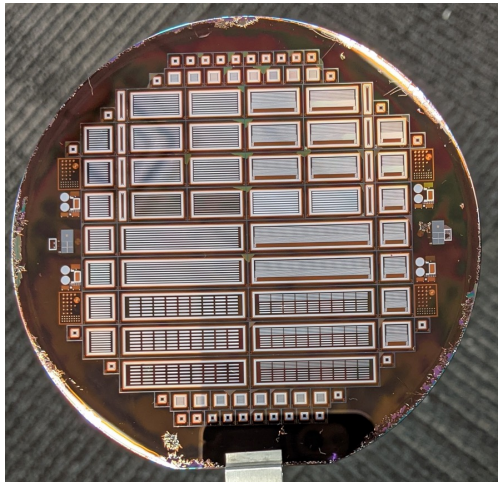
- Finalize requirements on timing and spatial resolutions based on physics requirements and performance (engage with Physics, Tracking and Cherenkov-PID WGs): optimal and minimal scenarios
- Study and determine maximal material budget allowed without affecting other detector system performance (energy resolution of scattered electrons, Cherenkov-PID, tracking)
- Investigate the pros and cons of pixel vs strip sensor options to arrive at the optimal design (engage with far forward WG to seek for a common solution if possible)
  - O(mm) vs O(cm) in length
  - Bump bonding vs wire bonding
- Investigate the requirements/constraints on the mechanical support, cooling, service distribution, DAQ and integration
  - (engage with DAQ, integration WG)
- Consider upgrade and staging options, investigate feasible fallback options to reduce the risk

Recent Progress

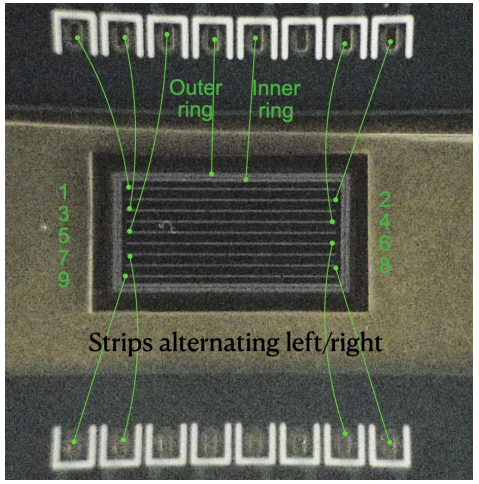
- Engage with Physics WGs – in progress
- Engage with Tracker and Cherenkov-PID WGs – in progress
  - Tracker WG liaison: Nicolas Schmidt (ORNL)
- Detector simulation – engage with software & computing WGs
  - Simulation liaison: Nicolas Schmidt (ORNL)
- Detector design considerations and choices – engage with relevant consortia
  - eRD112 AC-LGAD R&D
- Mechanical structure
  - evaluate ECCE design (ORNL engineer), look into ATHENA design for CTTL in simulation
- DAQ – engage with DAQ WG
  - DAQ WG liaison: Tonko Ljubicic (BNL)
- Integration, services – engage with the Project

Recent Progress

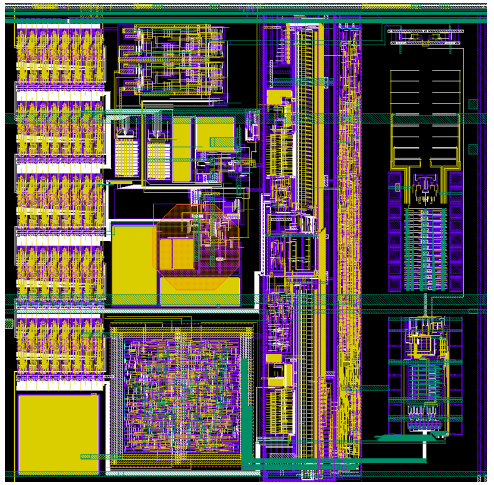
- Summary on TOF start time studies (ECCE)
  - "start-less" T0 based on particle timing measured by TOF with or w/o electron (link1, link2)
  - start time from machine clock - postponed
- Summary on material effects on EMC electron resolution in ECCE design (link)
  - good starting point to further investigate effects while improving support structure
- Initial thoughts on DAQ for TOF (link)
- On-going discussions on R&D for sensors and frontend ASICs (link1, link2)



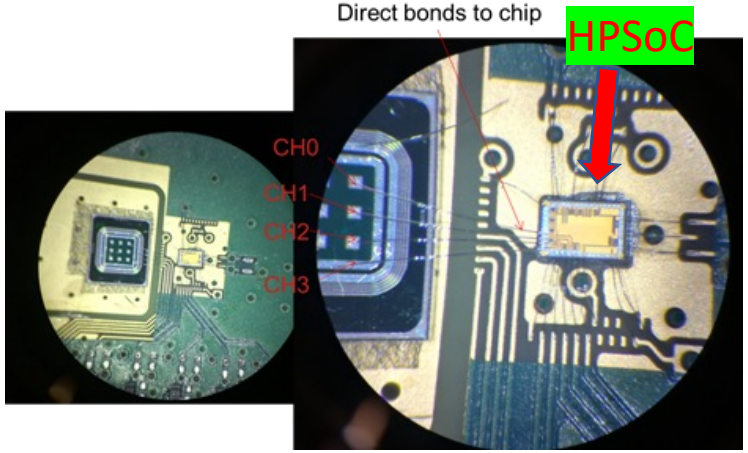
AC-LGAD Sensor Wafer for EIC by BNL



AC-LGAD sensor at Fermilab test beam in April 2022



Single pixel of EICROC0 Chip (IJCLab/Omega)



HPSoC (NALU Scientific)

TOF-PID Detector Working Group

A few relevant pointers for TOF-PID Detector Working Group

- Mailing list: eic-projdet-tofpid-l@lists.bnl.gov
  - Subscription information: https://lists.bnl.gov/mailman/listinfo/eic-projdet-tofpid-l
- Indico page: https://indico.bnl.gov/category/414
- Wiki page: https://wiki.bnl.gov/eic-project-detector/index.php/TOFPID
- Default meeting time: Monday 11:30am ET
- Convener's contact info:
  - Constantin Loizides (ORNL) – constantin.loizides@cern.ch
  - Frank Geurts (Rice) – geurts@rice.edu
  - Wei Li (Rice) – wl33@rice.edu
  - Zhenyu Ye (UIC) – yezhenyu@uic.edu

- eRD112:
  - Mailing list: https://mailman.rice.edu/mailman/listinfo/lgads-eic
  - Indico page: https://indico.bnl.gov/category/323/
  - Default meeting time: Wednesday 11:30am ET