



Towards specifications for AC-LGAD strip sensors for barrel TOF

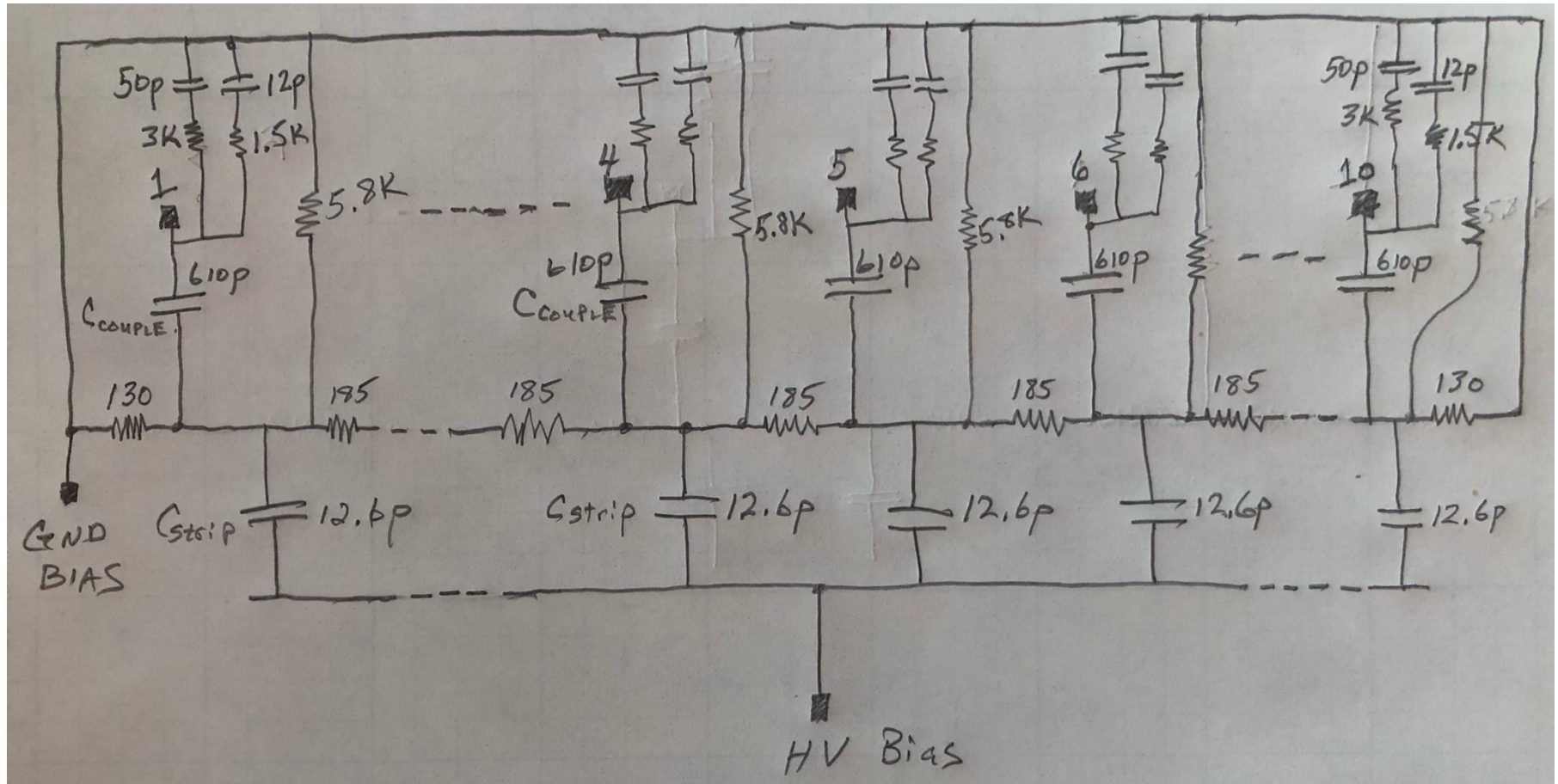
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FCFD design

- Performance of the FCFDv1 was studied in test beams and presented in ePIC meetings
- We found that AC-LGAD strip sensors have complicated RC-network characteristics that need to be specified precisely for designing the sensor
- We performed detailed studies of HPK AC-LGAD sensors
 - Hamamatsu 1 cm long strips, 50 μm thick sensor
 - 500 μm pitch, 50 μm wide metal strips
 - Sheet resistance 1600 Ω/square

Measurements of AC-LGAD sensors parameters

- A lot of detailed measurements, methodology will be documented in a separate paper/note

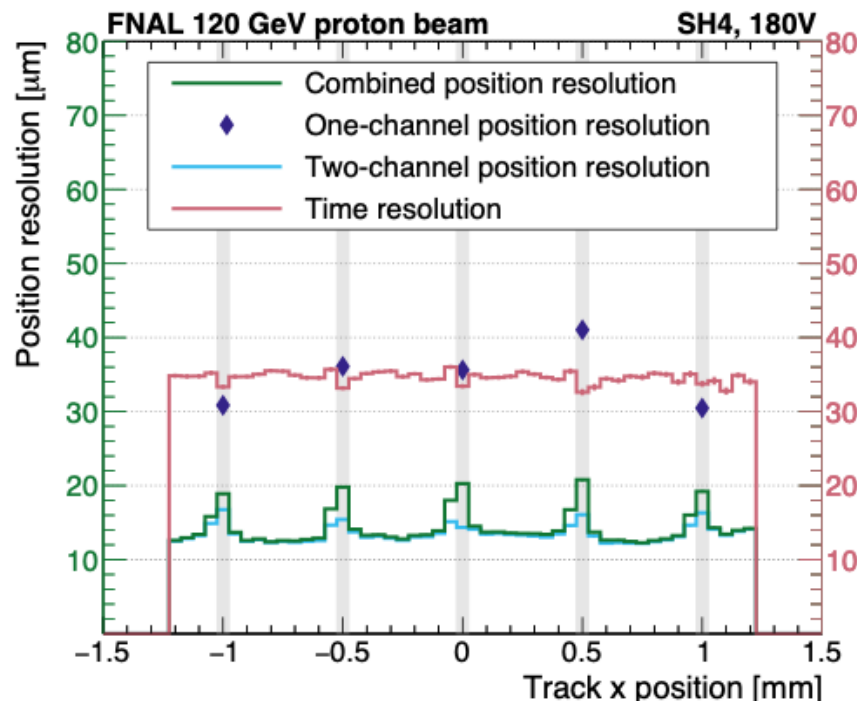


ASIC design specs

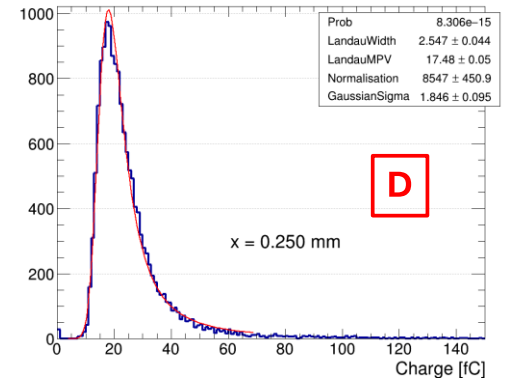
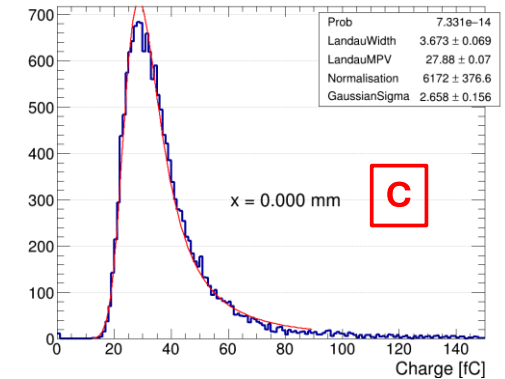
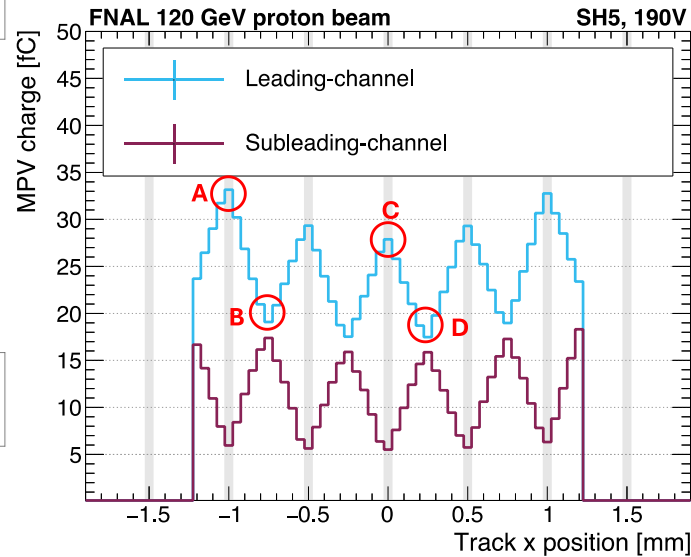
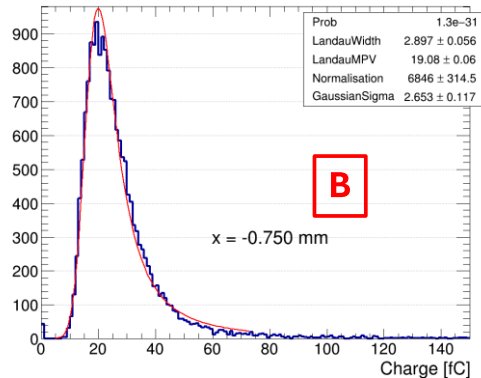
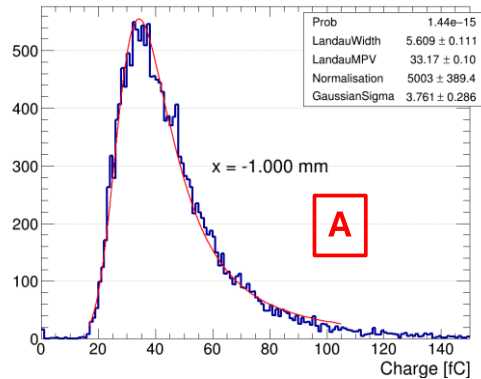
- The ASIC design needs to be optimized for the specific sensor that will be used with it
- We propose to use this HPK sensor's RC-properties as the specifications to optimize the FCFD v1.1
- We also need to define the input charge, dynamic range, and required amount of charge sharing
 - Propose to use the same HPK sensors that have been studied in test beams
 - Hamamatsu 1 cm long strips, 50 μm thick sensor
 - 500 μm pitch, 50 μm wide metal strips
 - Sheet resistance 1600 Ω/square
- In the next few slides will go over signal characteristics that we measured in the test beams and summarized in arXiv:2407.09928

Time resolution measured in test beam

- Time resolution is measured by combining leading and sub-leading channels
- Measurements performed on dedicated readout boards using commercial amplifiers and with full waveform analysis
 - More details in the paper: [arXiv:2407.09928](https://arxiv.org/abs/2407.09928)



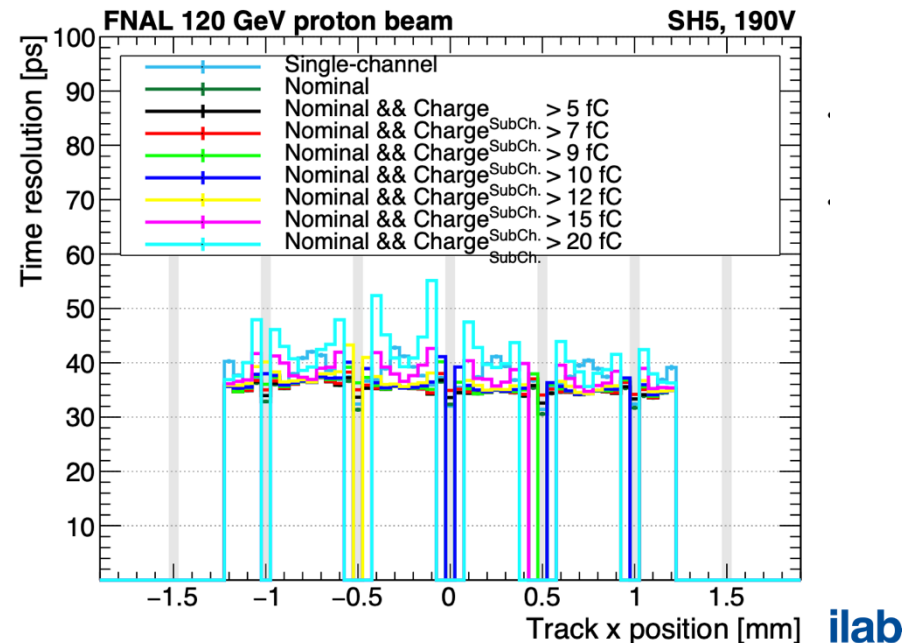
Signal characteristics



- Signal characteristics that went into plot on previous page
 - Dynamic range: 10 - 70 fC
 - Signal MPV : 25 fC
 - Jitter at MPV : around 20 ps

Position resolution

- The readout is designed as follows :
 - Configurable threshold to trigger the comparator
 - If the signal is above ~ 10 fC \rightarrow trigger readout of that strip, and the neighbor on each side (the 10 fC threshold is configurable)
- Studies from the test beam show that the combined time resolution improvement from using the neighborhood strips becomes negligible for charges below 10 fC



Next steps

- The ePIC production run of HPK sensors delivered recently
 - These sensors will need to undergo detailed characterization studies with beams and laser
- In order to proceed with the design of FCFDv1.1, the sensor spec needs to be agreed upon
- Proposal:
 - Proceed with the HPK existing sensors (from page 3)
 - We can then revise the specs (if needed) once the ePIC production is tested, validated, and deemed to be the choice for the detector
 - Use the signal specs presented on page 3-7