



Flashtalk – IF07 Electronics/ASICS High Granularity, High Dynamic Range Readout – Tim Andeen, UT Austin

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High Granularity, High Dynamic Range Readout

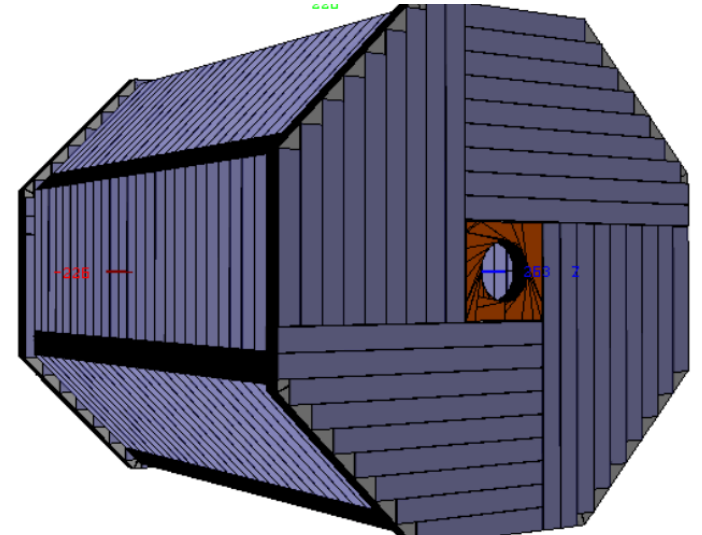
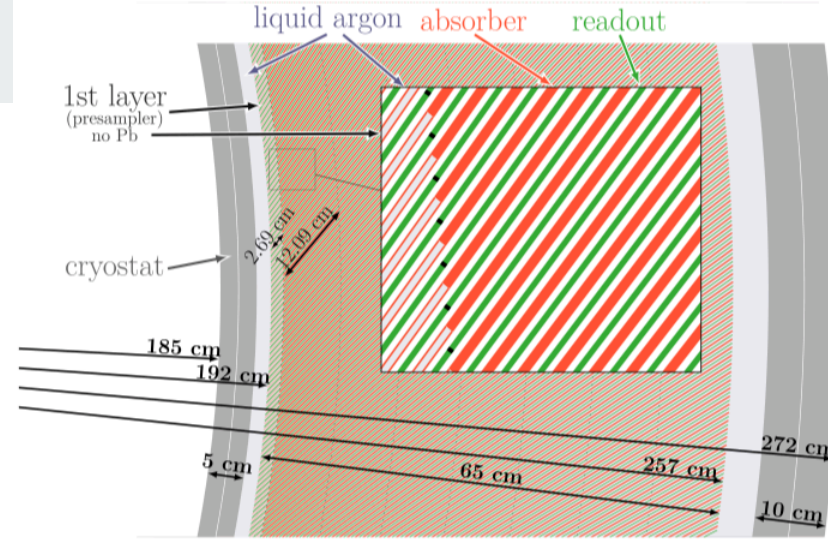
Nearly all detectors designed for the ILC, CLIC, CEPC, FCC-ee, FCC-hh, (etc.) includes high granularity detectors, particularly for calorimeters.

Ex: FCC-hh LAr calorimeter (top), CEPC (bottom) Si-W calorimeter

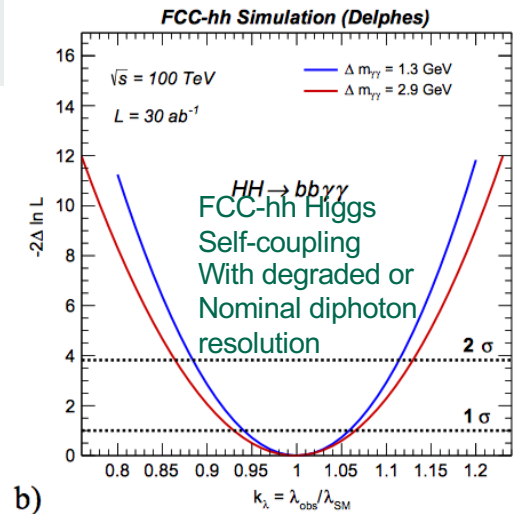
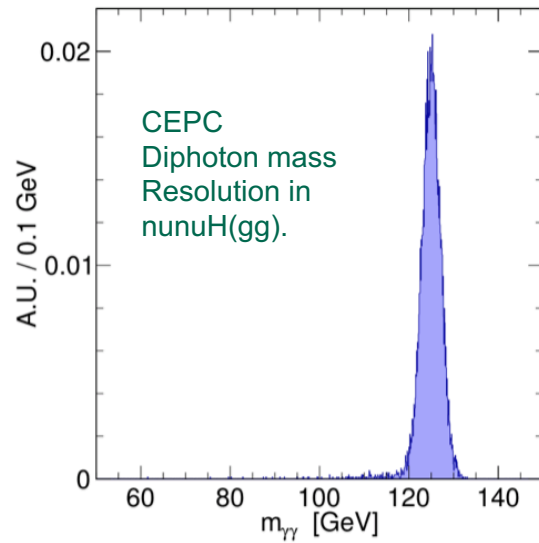
Driven by :

- 1) The success of particle flow algorithms
- 2) The need to capture full EM and hadronic showers (of eg potentially many TeV electrons).

Electronic readout must be developed to accommodate high granularity, high dynamic range detector requirements.



Science Need

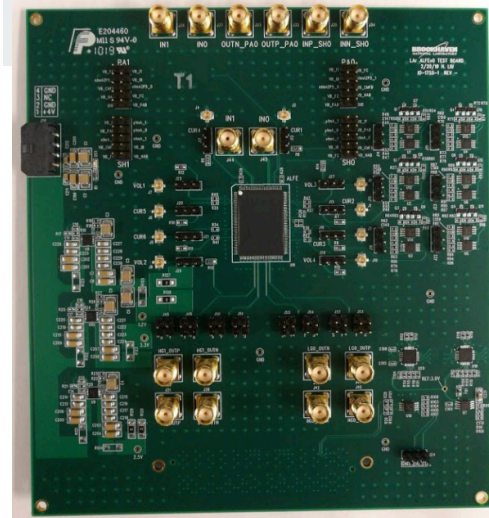
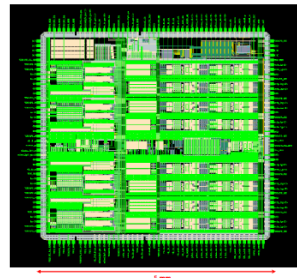


Physics drivers - The physics focuses are different for each detector, but Higgs physics with photons will continue to be driver (above [CEPC](#) and [FCC-hh](#)).

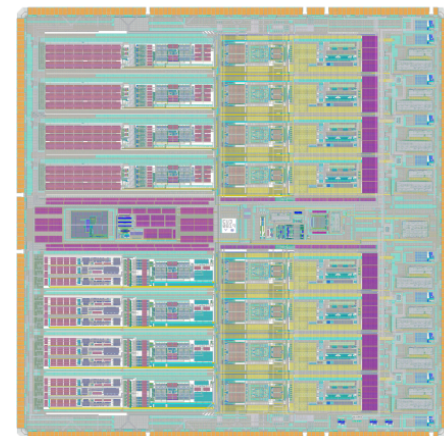
Technology opportunity - At the extreme end (100 TeV FCC-hh) the speed, precision, high density (channel count), high-dynamic range "low-power readout" ASICS needed do not exist in any technology. Creative system architecture is needed. For the ILC and CEPC electronics readout design is already well underway ([SKIROC](#) chip, [SPIROC](#) chip, respectively).

This work both develops technical expertise in instrumentation and engineering for detector design, and maintains detector design in physics community.

ALFEv1b



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Current effort

ASICS design and system architecture – determine specifications need, possible technological implementations, identify areas that require novel design work.

Team : Columbia U, BNL, UT Austin

Existing team involved in ATLAS LAr calorimeter electronics development. Current challenge is “high” dynamic range, “high” granularity (by HL-LHC standards) PA/S and ADC ASICS investigating novel “dynamic ranging enhancing” architectures.

New people and new ideas welcome!



Synergies

There is significant overlap with specific detector design groups. Important to connect with existing efforts in detector design, simulation, reconstruction.

Connects **IF6 Calorimetry**, and to some degree the rest of the IF groups.

Detailed electronics specifications for specific detectors are driven by (sometimes) a specific, single physics case (eg. Mass resolution in $n\nu(H \rightarrow \text{diphotons})$ process). Important to know what we are designing for, and possible area for students to participate in reconstruction and analysis details.

Connects to EF, probably most substantially to **EF01 Higgs properties**.



Conclusion

Future detectors and future calorimeters will need high-granularity. The extreme: A 100 TeV collider requires extraordinarily high-dynamic range readout, along with high-granularity to reconstruct electron showers at the EW-scale up to $O(10 \text{ TeV})$. Absolute need for new ideas for electronic readout of these detectors.

In any new detector electronics and ASIC development are natural areas for US to contribute. We need to be involved now.

