

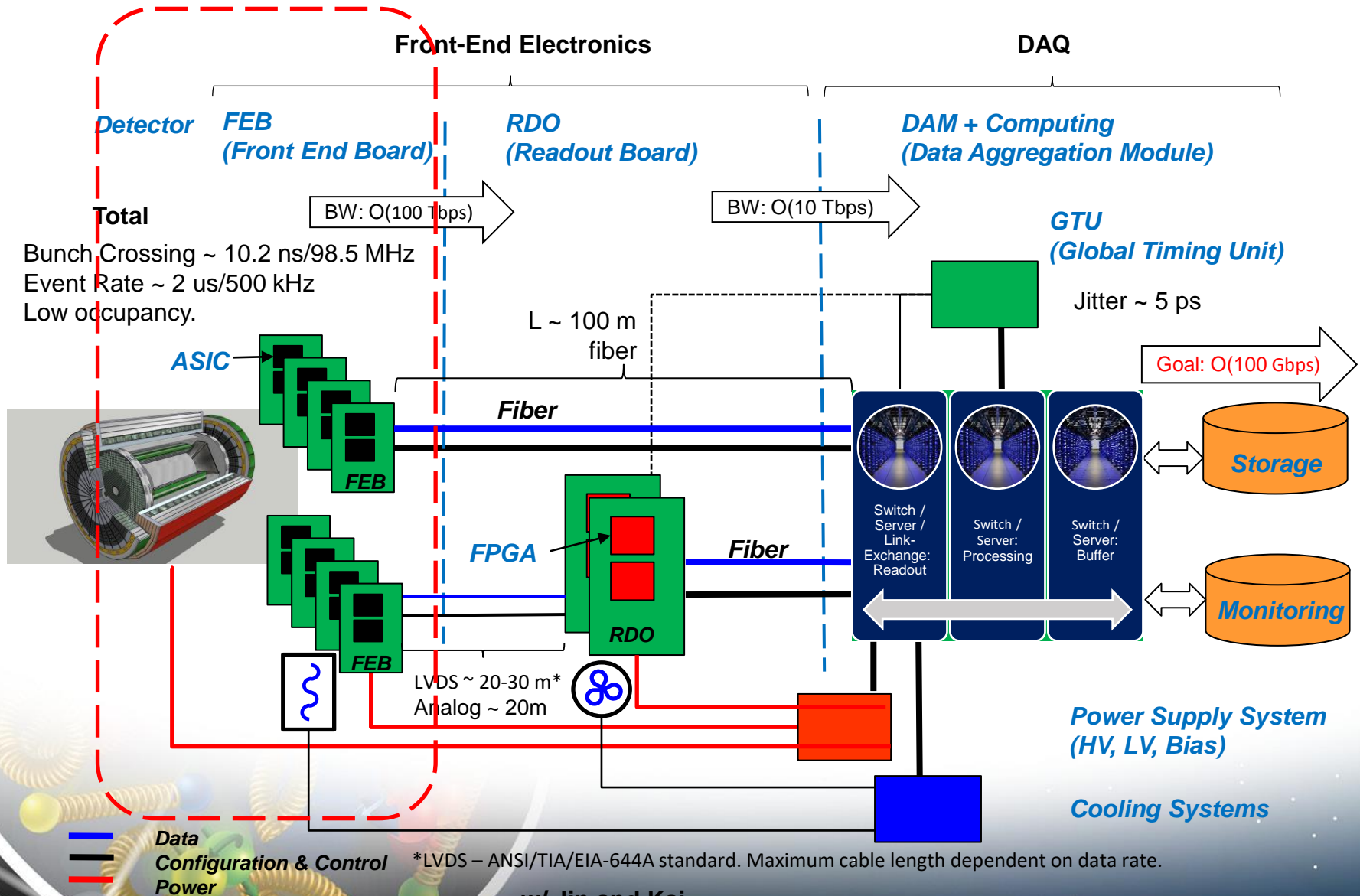
EIC User Group Meeting Electronics – Status

Fernando Barbosa (JLab)
28 July 2023
Warsaw, Poland

Electron-Ion Collider

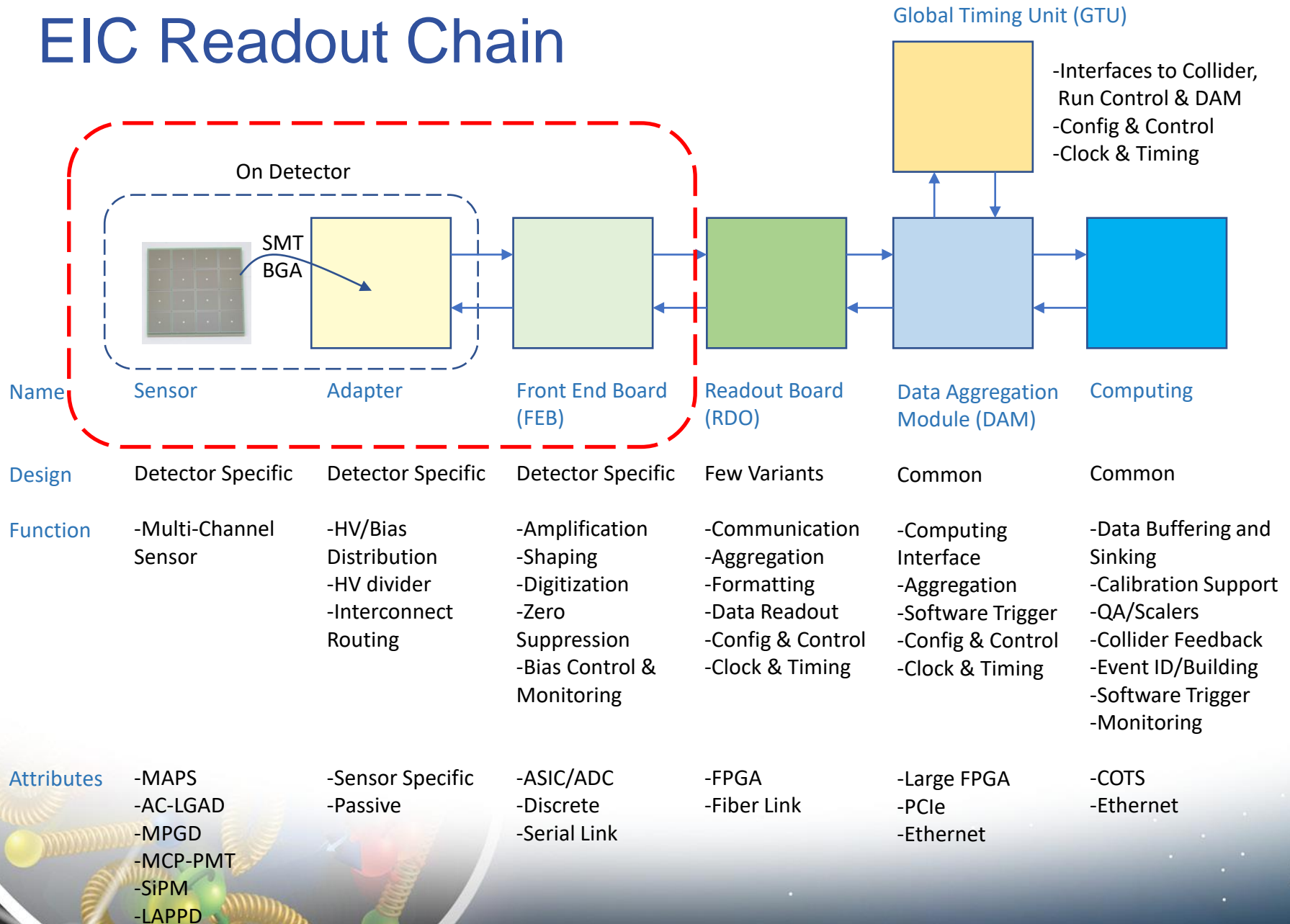


EIC Streaming Readout Architecture



w/ Jin and Kai

EIC Readout Chain



ePIC Readout Channels (w/ Project P6 updates)

Standardization of detector nomenclature?

Detector System	Channels	Nominal Readout Technology	eRD109 Initiatives
Si Tracking: 3 vertex layers, 3 sagitta layers, 4 backward disks, 5 forward disks	7 m ² 32 B pixels 5,200 MAPS sensors	MAPS – ITS-3	
MPGD tracking: 3 layers	100k	Strips	SALSA
Calorimeters: (in P6) Forward: LFHCAL pECAL Barrel: HCAL ECAL Backward: ECAL nHCAL	31640 19000 1536 5760 3256 3240	SiPM	Discrete/HGCROC
Far Forward: B0: 3 MAPS layers 1 or 2 AC-LGAD layer 2 Roman Pots 2 Off Momentum ZDC: Crystal Calorimeter 32 Silicon pad layer 4 silicon pixel layers 2 boxes scintillator	3x20cmx20cm (300M pixel) 300k or 600k 1M (4 x 135k layers each) 650k (4 x 80k layers each) 400 11520 160k 72	MAPS – ITS-3 AC-LGAD AC-LGAD AC-LGAD APD Si PMT/SiPM	EICROC EICROC EICROC Discrete/HGCROC HGCROC Discrete/HGCROC
Far Backward: Low Q Tagger 1 Low Q Tagger 2 2 Calorimeters	1.3M 480k 700	AC-LGAD AC-LGAD PMT/SiPM	EICROC EICROC Discrete/HGCROC
PID-TOF Barrel TOF CTTL Hadron Endcap TOF FTTL	3M-50M	AC-LGAD	EICROC
PID-Cherenkov: dRICH	5376	SiPM	ALCOR
pfRICH	69632	HRPPD	EICROC
DIRC	69362	HRPPD	EICROC

eRD109 Status

- FY23 - Contract awards have taken much longer than expected.

	Detector/Technology	Discrete/ASIC	Group	Awarded
A	Calorimeter	Discrete	IUCF	April 2023
B	Calorimeter	HGCROC	ORNL	April 2023
C	dRICH	ALCOR	INFN	April 2023
D	AC-LGAD	EICROC	Omega/IN2P3	See below
		FCFD	FNAL	June 2023
		Barrel L-M Serv. Hybrid	ORNL	April 2023
		3 rd Party Evaluation	UCSC	Pending Legal
E	MPGD/ μ RWell	SALSA	CEA	May 2023
			USP	May 2023

- FY24 – Proposed and subject to DAC review 28-31 August 2023.

	Detector/Technology	Discrete/ASIC	Group
A	Calorimeter	Discrete	IUCF
B	Calorimeter	HGCROC	ORNL
C	dRICH	ALCOR	INFN –BO, TO
D	AC-LGAD	EICROC	Omega/IN2P3/ IJCLab/CEA/IRFU
		Barrel L-M Serv. Hybrid	ORNL
		High Precision Clock Dist.	BNL/Rice/UIC/ORNL
E	MPGD/ μ RWell	SALSA	CEA/IRFU
			USP

- IN2P3 and OMEGA have committed considerable resources to the design of the ROC ASICs to meet the EIC streaming readout needs.

ePIC Readout Electronics – Present Assessment

- EICROC and HGCROC *families* of ASICs have similar interfaces and follow similar developments at IN2P3/OMEGA/IRFU/IJCLab.
- Commitment by IN2P3 and OMEGA narrows the ASIC field, favors convergence:

Detector Group	Channels			
	MAPS	AC-LGAD, HRPPD	SiPM/PMT	MPGD
Tracking	32 B			100k
Calorimeters	50M		67k	
Far Forward	300M	2.3M	500	
Far Backward		1.8M	700	
PID		3M-50M + 140k	300k	
TOTAL	32 B	7.1M-54M	370k	100k

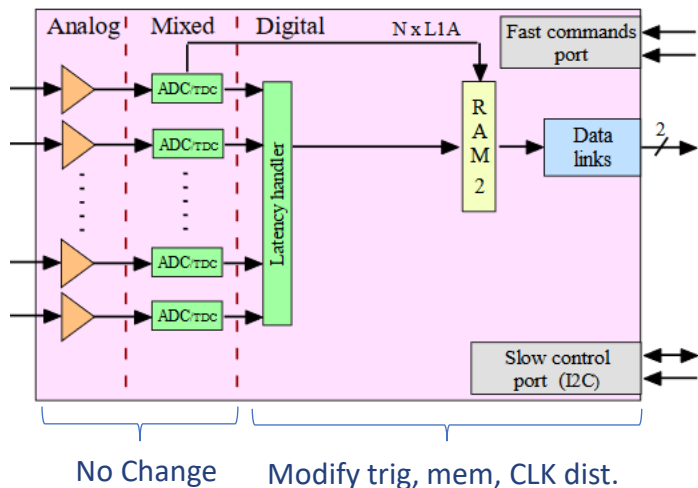
• HRPPD

ASIC	ITS-3	EICROC	Discrete/COTS HGCROC3 ALCOR-EIC	SALSA
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• eRD109

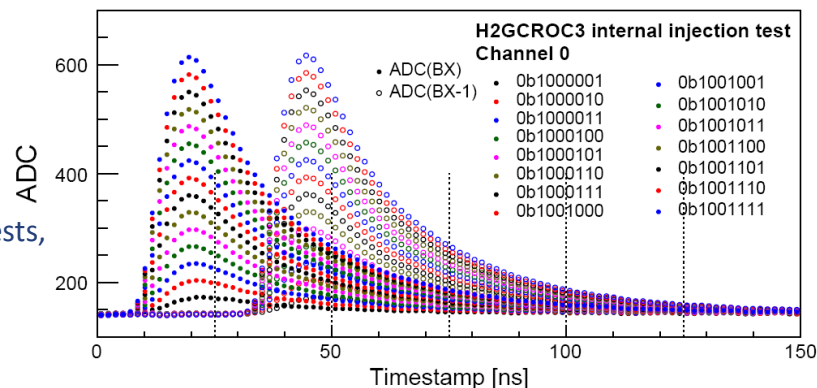
ROC ASIC Developments

Proposed HGCROC (based on H2GCROC3) – ePIROC?

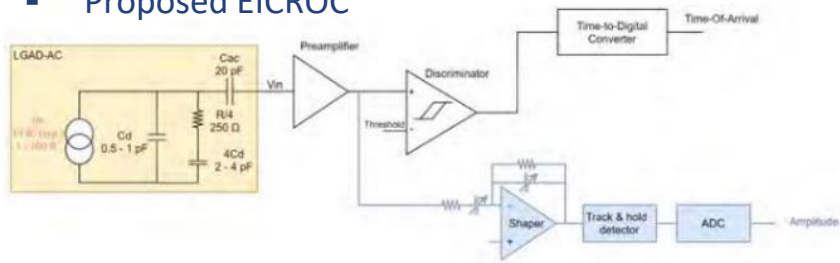


- Triggerless, to be checked w/existing chip.
- 40 MHz operation from external clock with BX 98.5 MHz.
- 1280 Mbps @ 40 MHz.

Triggered Tests,
N. Novitzky



Proposed EICROC



- Different input structure, similar interfaces as HGCROC.
- A few variants possible (direct attach BGA, interposer, IC package, # Pixels) to fit detectors.

HGCROC

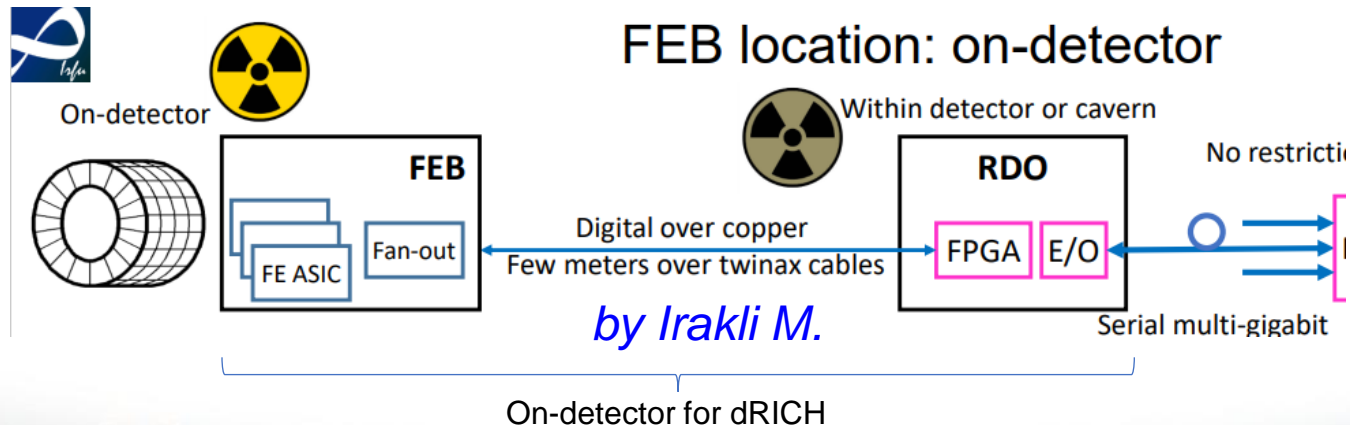
- 1D, 72 ch.
- C_{din} : 5-50 pF
- Dynamic Range: 1-10 pC
- Timing: 100-120 ps
- Power: 10-15 mW/ch

EICROC

- 2D, 32x32, 1024 ch
- C_{din} : 1-5 pF
- Dynamic Range: 1-50 fC
- Timing: 15-20ps
- Power: < 1 mW/ch

Summary

- Delays in awarding FY23 eRD109 contracts but good progress overall.
- FY24 eRD109 proposals submitted by 7 July 2023, DAC review late August 2023 – contracts to coincide with FY (October 2023). This will help better align projects with funds and will allow projects to continue uninterrupted.
- Gathering and refining detector requirements (ch rates, C_{din}, etc.) and services to inform electronics specifications towards final implementations, ~Fall 2023 – proposal by IN2P3/OMEGA/IRFU/IJCLab.
- Location/partitioning of electronics under consideration: space, power, radiation, cabling – overall performance:



- Project P6 Earned Value (EVMS) tracking is expected to start in August 2023.