JLAB12 Collaboration Meeting
Rome, October 18-19

EG6 Status Report

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(for R.De Vita)
Istituto Nazionale di Fisica Nucleare
Genova - Italy

Scheduled to run in Hall B

from October 2nd to December 23rd

Two experiments during the eg6 run:

E-07-009 - "Meson spectroscopy in the coherent production off ^{4}He with CLAS"

Approved by PAC-31 for 45 days with "A" rating

E-08-024 – "Deeply Virtual Compton Scattering off 4He"

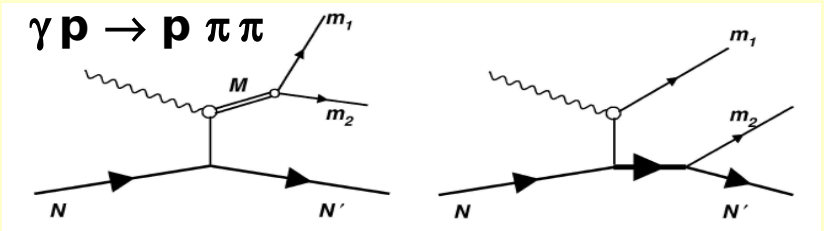
Approved with by PAC-33 for 45 days with "A" rating

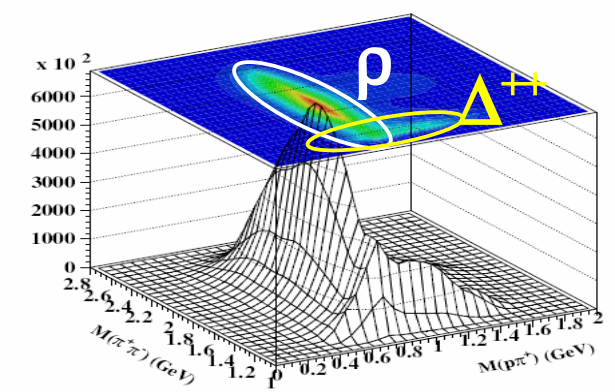
Groups Involved:

ANL, INFN-Genova, JLab, LPSC, ODU, OU, UNH, YerPhI

Coherent meson production on nuclei

☆ **Eliminate *s-channel* resonance background**



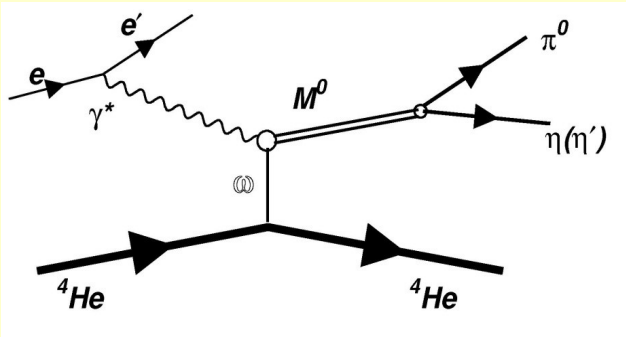


☆ **Simplify PWA: S=I=0 target acts as spin and parity filter for final state mesons**

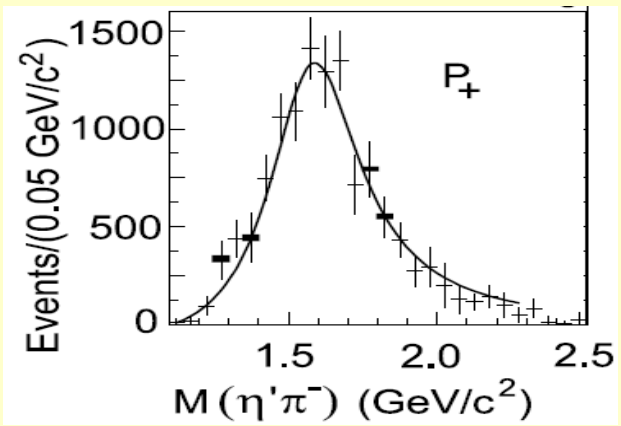
☆ **Production cross section expected ~ $e^{-bt}|A\,F_A(t)|^2$ → low -*t* kinematic**

Meson spectroscopy on ^{4}He

$\gamma\,^4\mathrm{He} \rightarrow {}^4\mathrm{He}\,\pi^0\eta$ $\gamma\,^4\mathrm{He} \rightarrow {}^4\mathrm{He}\,\pi^0\eta'$



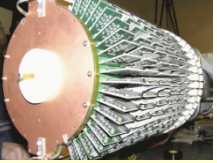
Detection of recoiling nucleus:
- low -*t* (p~0.2-0.5 GeV)
- thin (gas) target (~10^{-3} g/cm^2)



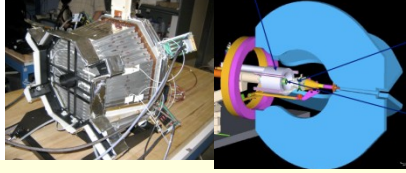
☆ **Strongest evidence of $J^{PC}=1^-$ $\pi_1(1400)$ exotic meson $\pi^-p \rightarrow n\eta\pi^0$ in E852-Brookhaven**

☆ **Search for a resonance in P-wave in $\pi^0\eta$ and $\pi^0\eta'$**

☆ **Known (non-exotic) resonances can be used as a benchmark (e.g. $J^{PC}=2^{++}$ $a_2(1232)$)**



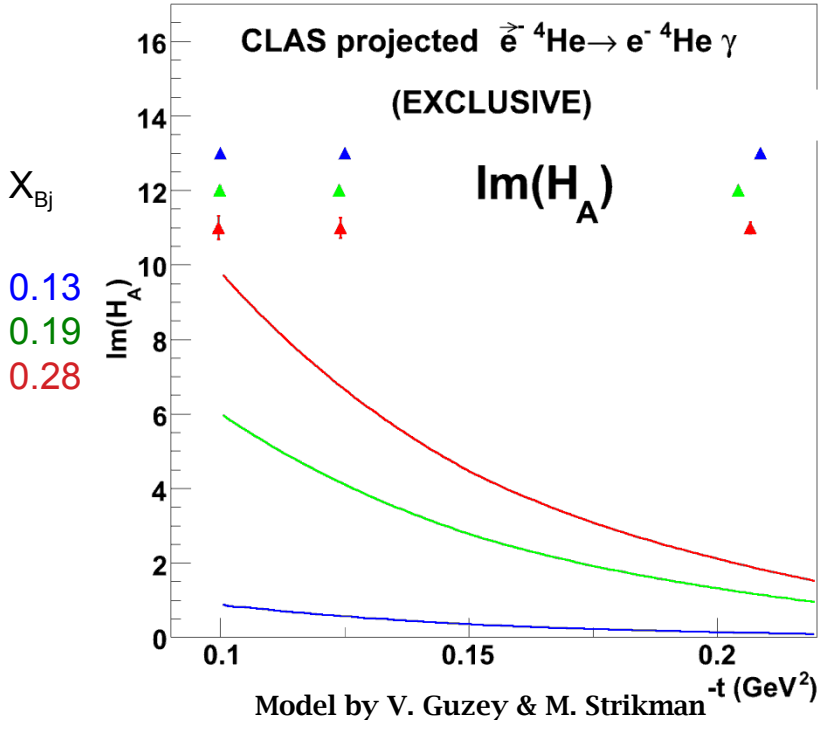
Deeply Virtual Compton Scattering off ^{4}He

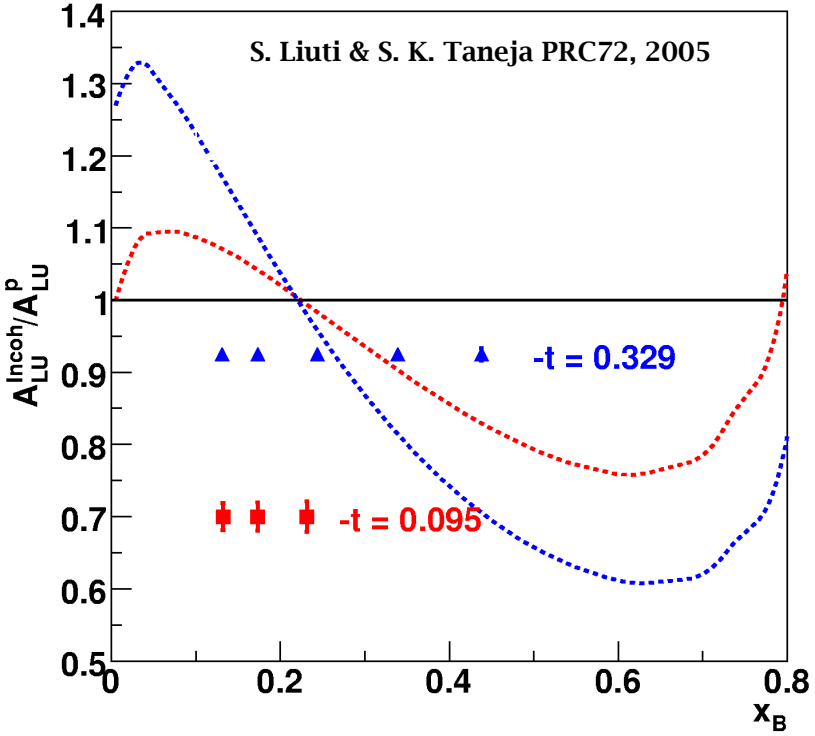


Experiment: Measure Beam Spin Asymmetry (BSA) in DVCS off ^{4}He: $A_{LU}(^4He)$ for coherent ^{4}He $(e,e'\gamma\,^4He)$ and incoherent ^{4}He $(e,e'\gamma p)$ channels

Objectives:

- Model independent extraction of the real and imaginary part of the Compton Form Factor (CFF) $\mathcal{H}_{4He}(x_B, t)$ from coherent ^{4}He $(e,e'\gamma\,^4He)$ channel
- Determine the x_B and t dependences of the "generalized EMC ratio" $R(^4He) = A_{LU}(^4He)/A_{LU}(p)$ for spin zero target for coherent ^{4}He $(e,e'\gamma\,^4He)$ and incoherent ^{4}He $(e,e'\gamma p)$ channels





Coherent production on ^{4}He

- **Both experiments require detection of recoiling He nucleus, α-particle, to ensure coherent scattering**
- **Measurements should be carried out at small $|t|$ to keep recoiling ^{4}He intact**
- **Detection of low energy α-particles requires ^{4}He gas target with thin target cell walls and RTPC [BoNuS]**
- **Both experiments require detection of forward going (multiple) photons**

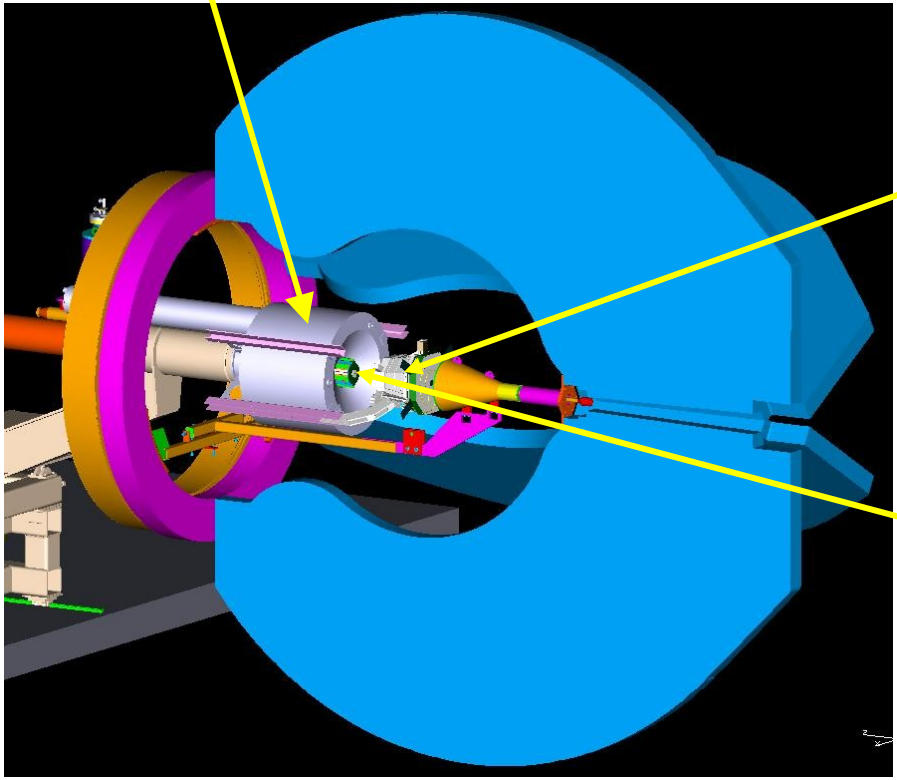
Eg6 will use:

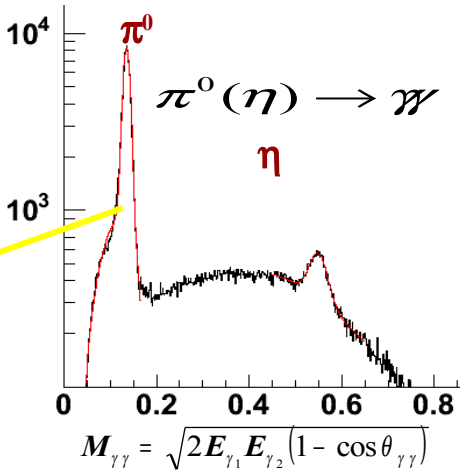
- **6 GeV polarized electrons**
- **4He gas target**
- **RTPC for detection of recoiling nucleus (Ne-DME, 1atm)**
- **IC + Hodoscope to increase acceptance for photons**

Experimental setup

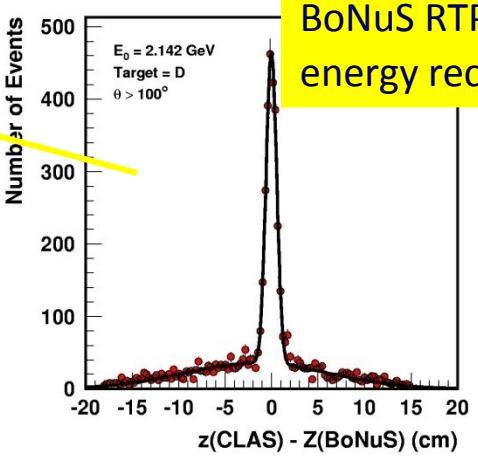
DVCS solenoid magnet will provide field for tracking in RTPC and will be used as Moller shield

DVCS IC for detection of photons at small angles





BoNuS RTPC for detection of low energy recoiling α-particles (^{4}He)

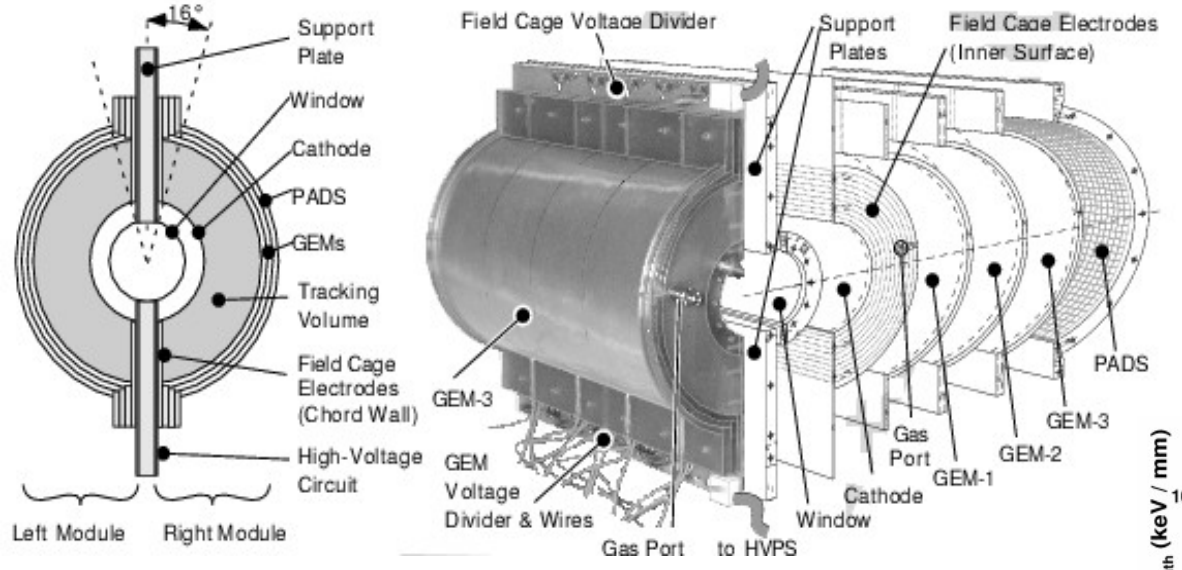


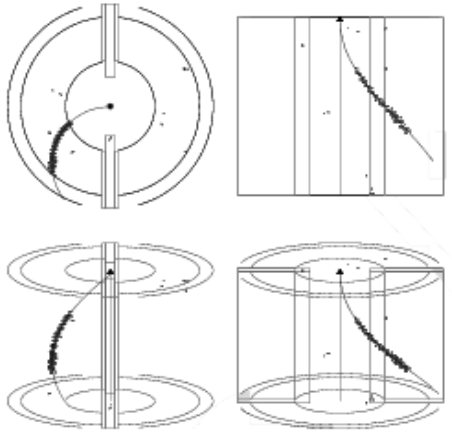
Coherent meson production on nuclei

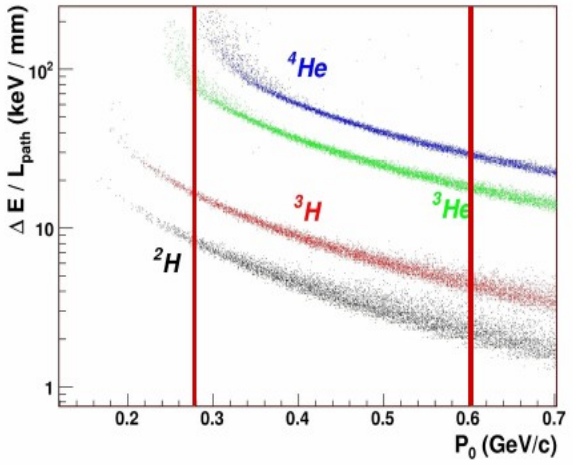
Low -t requires low momentum α detection ($-t > 0.07$ GeV$^2 \Leftrightarrow p > 0.25$ GeV)

Active gas-target (TPC-like)

CLAS BONUS-RTPC







Radial TPC performance

- Radial He-DME, GEM-based 2x1600-redout pads
- Resolution: σ_R~0.5mm,σ_z~1.2mm,σ_j~1.5 deg
- Run in 4T solenoid magnet
- Time and amplitude in ~10μs time-window
- Readout: 1kB events @ 500Hz (easily up to 1.5 kHz)

Improvements to the RTPC-Bonus setup

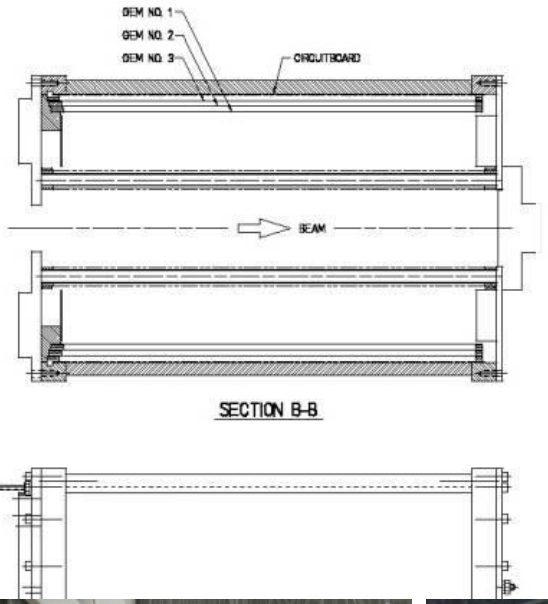
- Main improvement planned with respect to original Bonus setup related to **DAQ electronics**. Bonus-I had limitation in DAQ rate (<500 Hz) . EG6 aims to reach data rate of ~2kHz

- Analysis of Bonus data showed that PID capability of the RTPC was not satisfactory to separate ^{3}He and ^{4}He particles. Main reasons for poor PID:
  - Non-uniformity of gains of GEMs due to mechanical stress
  - Lack of reliable calibration

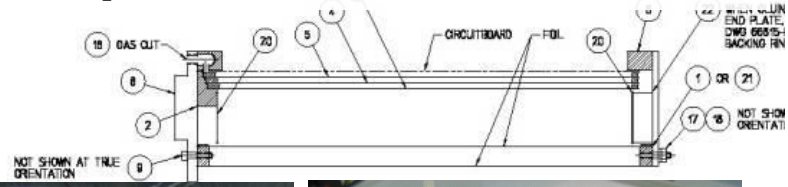
  New RTPC built from EG6 group to address both issues

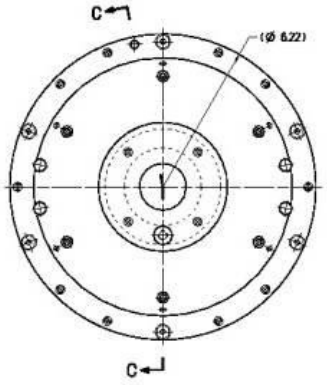
  - **Improved RTPC construction technique**
  - **New read-out electronics**
  - **New target cell**

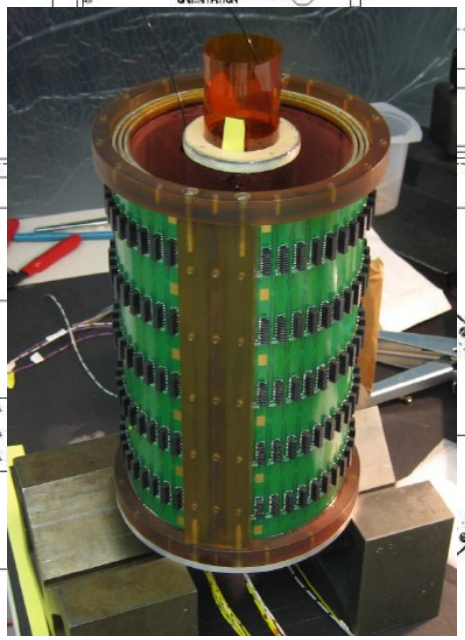
Target & RTPC assembly

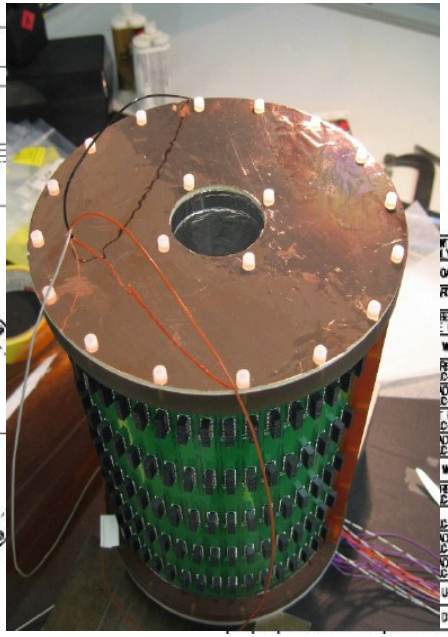


- GEM mounted around a cylindrical mandrel
- Single volume
- Read-out still split in 2 half-cylinders
- Wall thickness 4μm
- He pressure = 7atm

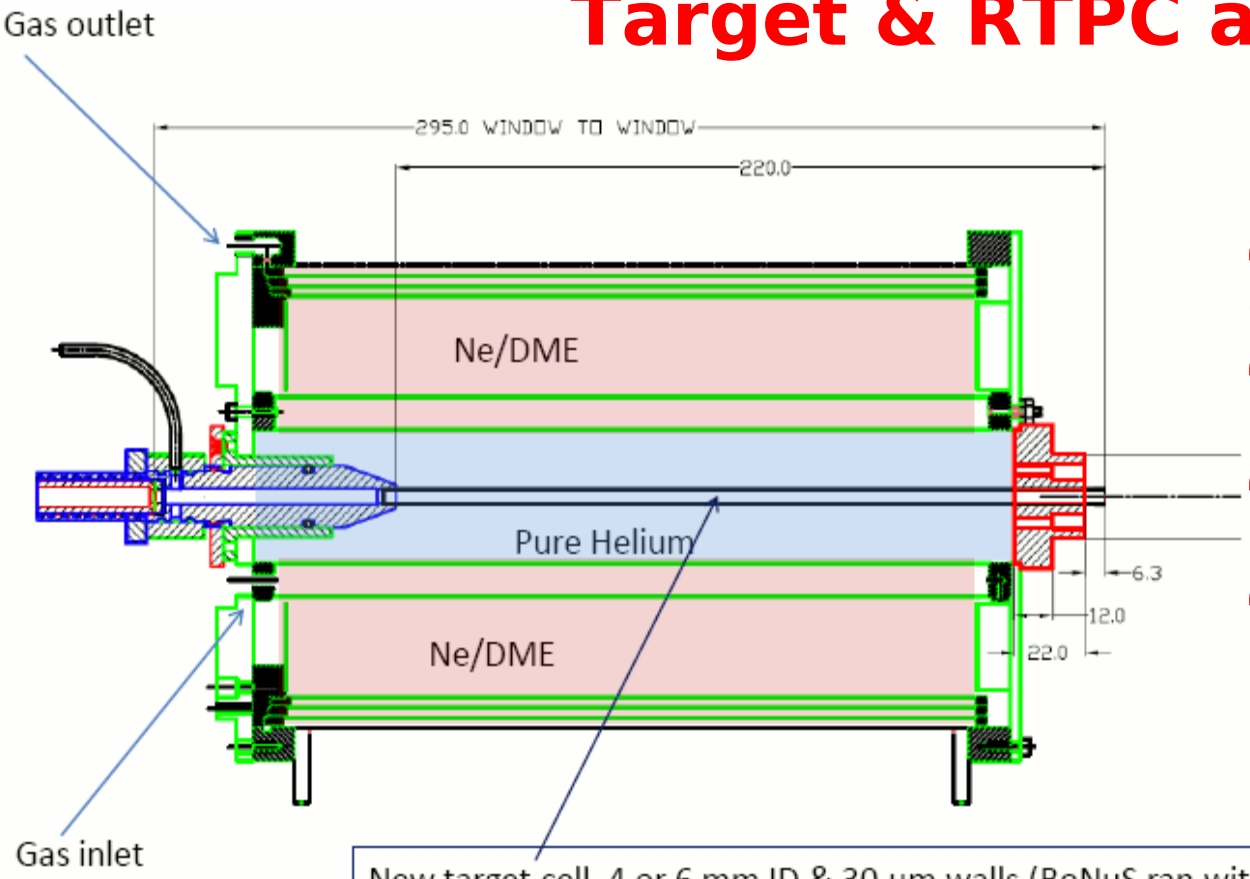






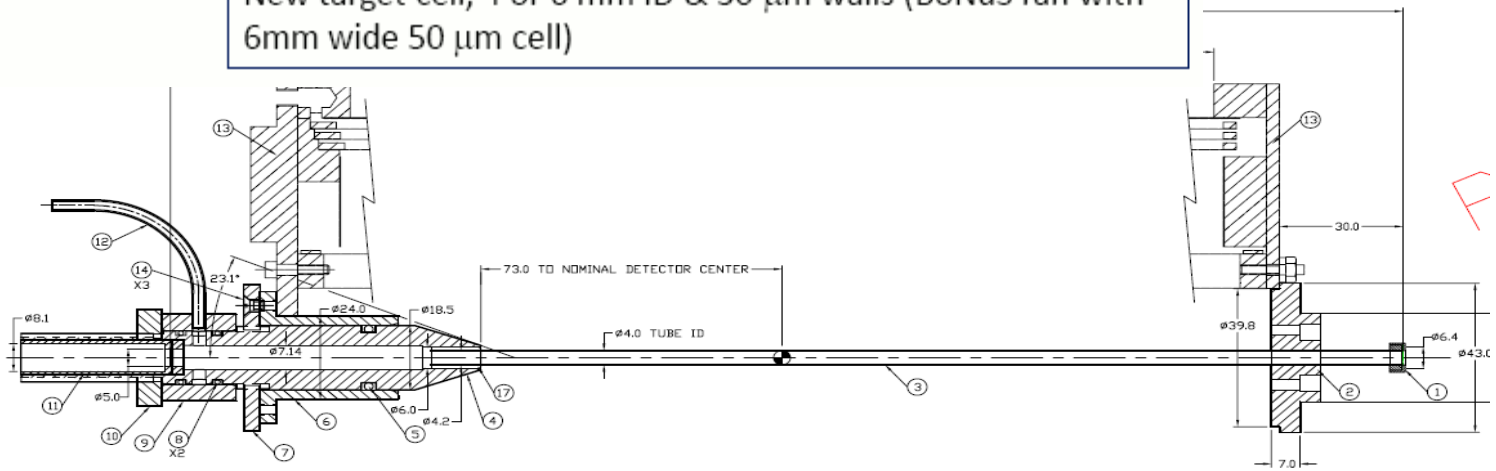


Target & RTPC assembly



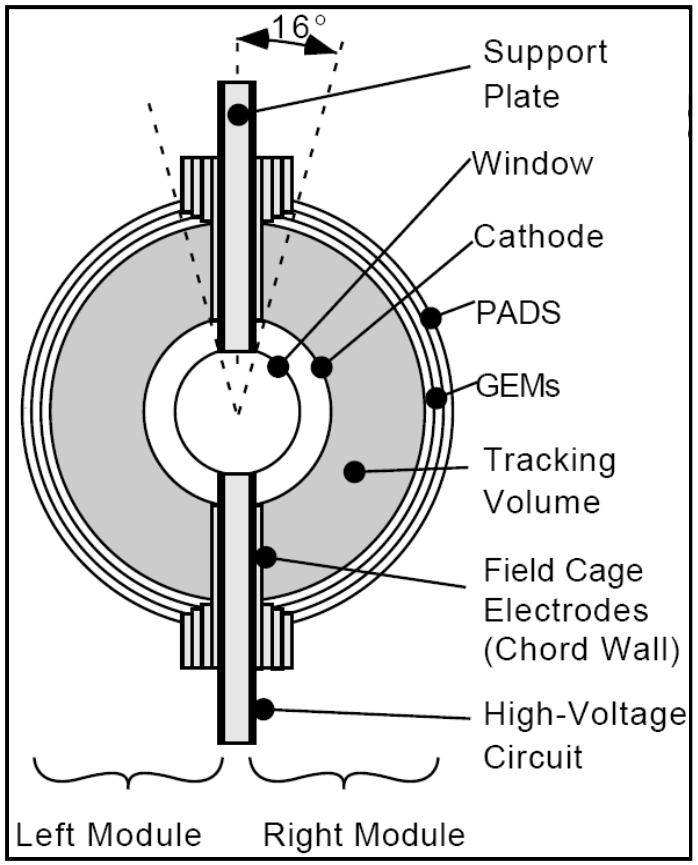
- **Kapton tube as target cell**
- **target wall thickness 35μm**
- **target lenght 23cm (17 active)**
- **He pressure = 7atm**

New target cell, 4 or 6 mm ID & 30 μm walls (BoNuS ran with 6mm wide 50 μm cell)



BONUS-I DAQ system

- **The electronic DAQ system is based on ALICE TPC readout cards.**
- **It follows the RTPC structure split in two independent and identical sectors. Left and Right.**



Boards per sector:

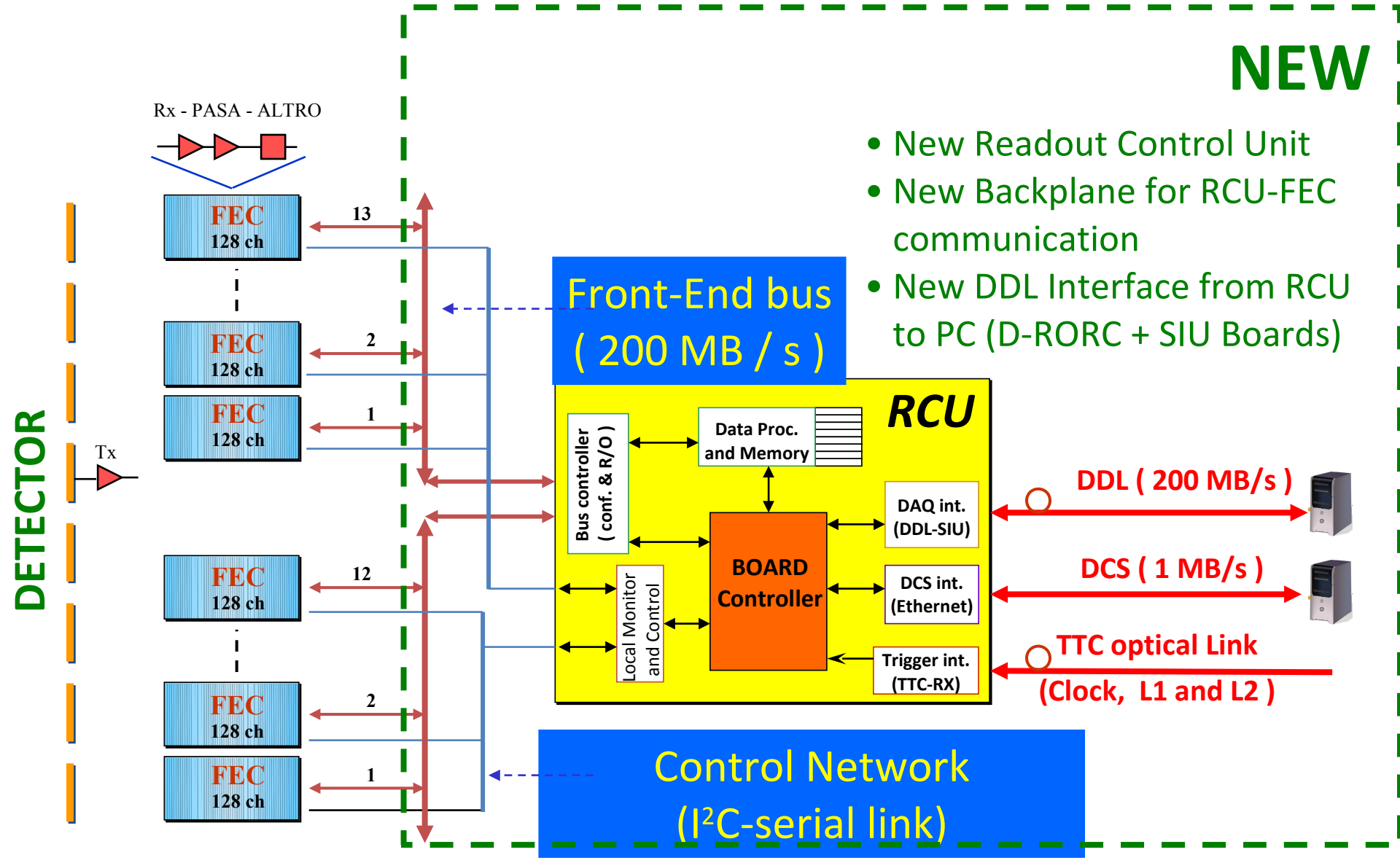
- **104 JLAB 16 chs preamplifier Tx/Rx cards capable of driving the RTPC signals across a ~6m long ribbon cable.**
- **13 FrontEndCards (FECs)**
  - **128 chs/FEC → 1664 channels/sectors**
- **Custom ALTRO 40 bits data bus and control bus backplane**
- **U2F readout controller**

- U2F readout controller:

NO MULTI-EVENT CAPABILITY

max. DAQ rate = 500 Hz in ROC-Lock Mode (1 trigger sent ↔ 1 event read)

DAQ with new Read Out Control board



DAQ Upgrade

- **New Readout Controller Unit from CERN with modifications**

(trigger signal from CLAS Trigger supervisor to RCU trigger chip and RCU busy signal to CLAS Trigger supervisor)

- **New data and low voltage backplanes designed in Genova**

S. Minutoli, P. Musico following Alice specifications

- **New boards for data transfer from RCU to PC**

SIU+D-RORC (Cerntech Inc.)max. data rate 96MB/s

- **New crates and DC power supply**

- **New FEC and RCU firmware to maximize readout rate**

zero suppression algorithm of ALTRO chip to reduce data payload

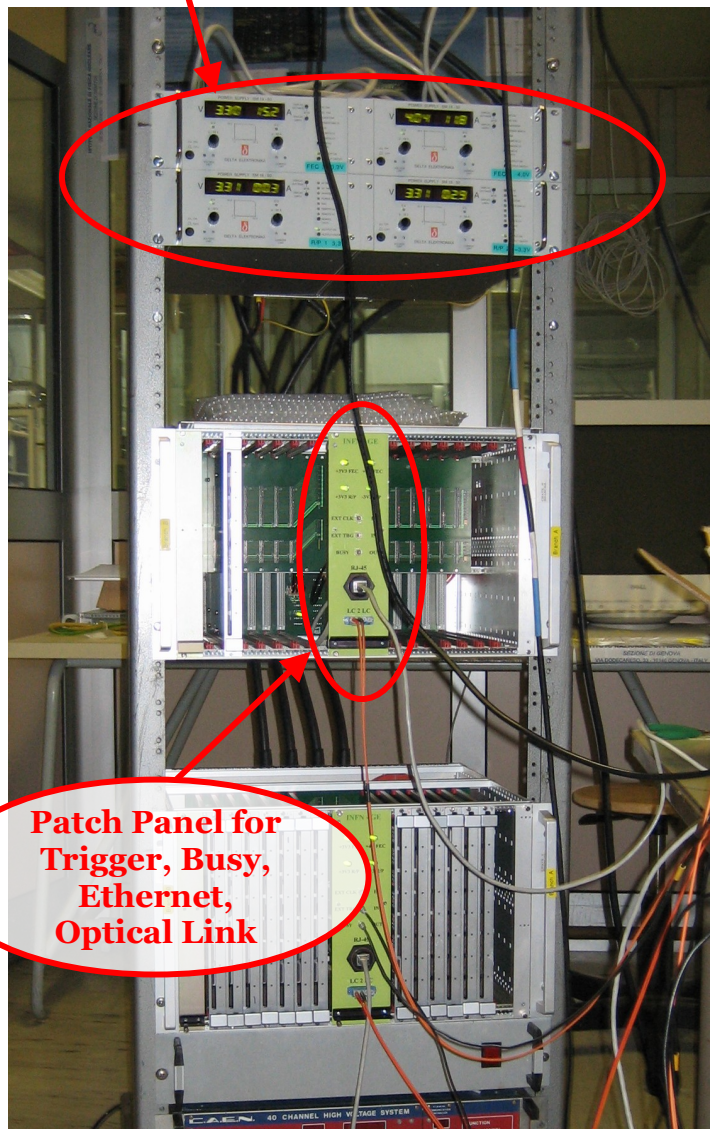
- **Concurrent FEC readout on 2 RCU Branches**

Full readout mode (all channels are readout)

- **minimal dead time (15 μs)**
- **24 FECs readout by 6 RCU to overcome channel handshake (700ns)**

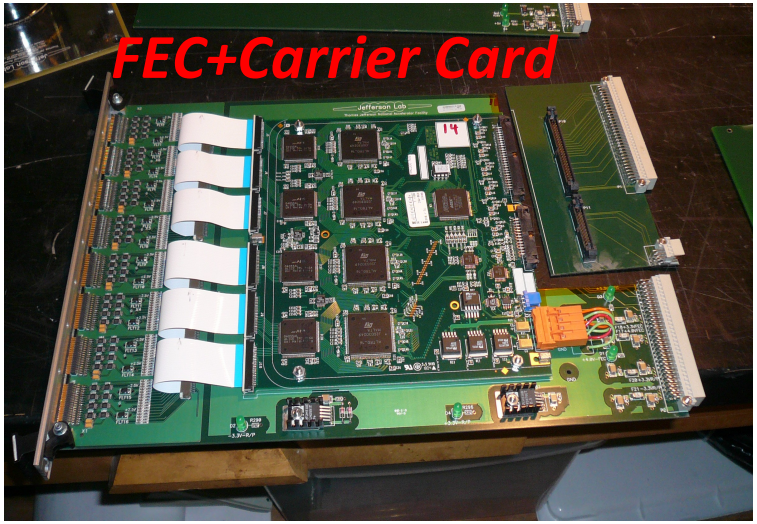
DAQ Upgrade

High-Linearity, low-noise DC power supplies

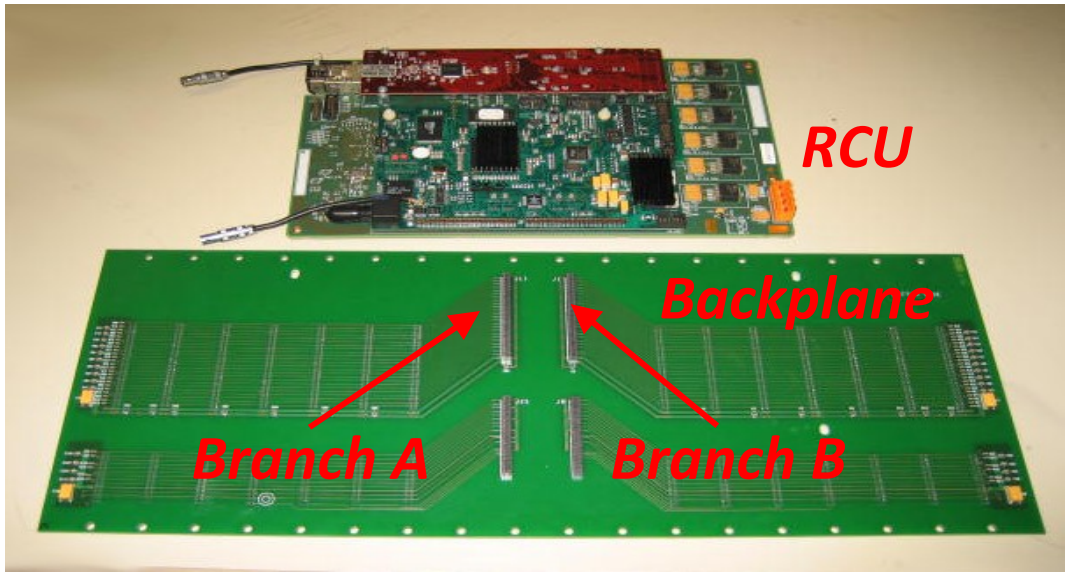


Patch Panel for Trigger, Busy, Ethernet, Optical Link

D-RORC



FEC+Carrier Card



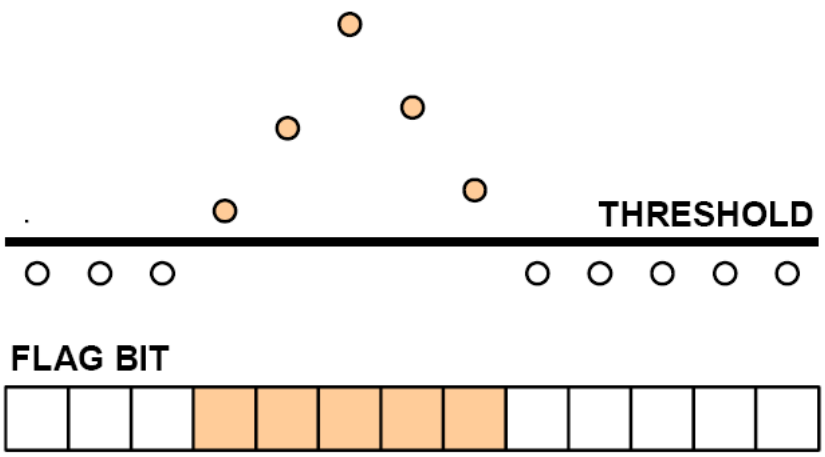
RCU

Backplane

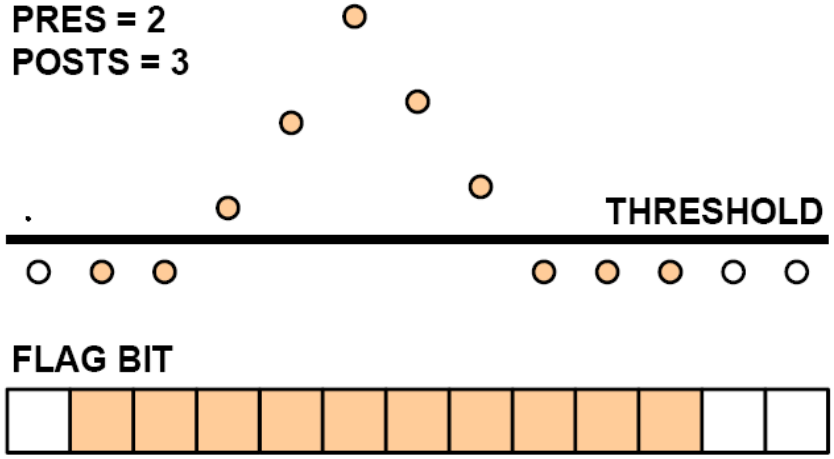
Branch A

Branch B

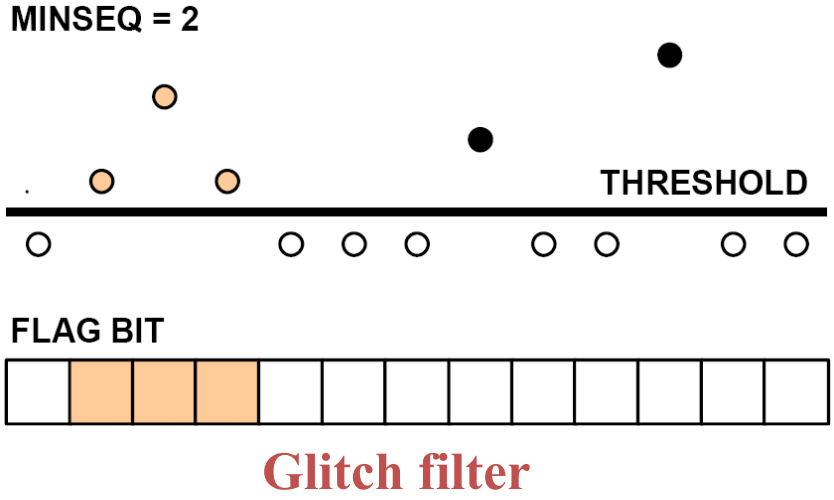
Zero Suppression



Basic detection scheme



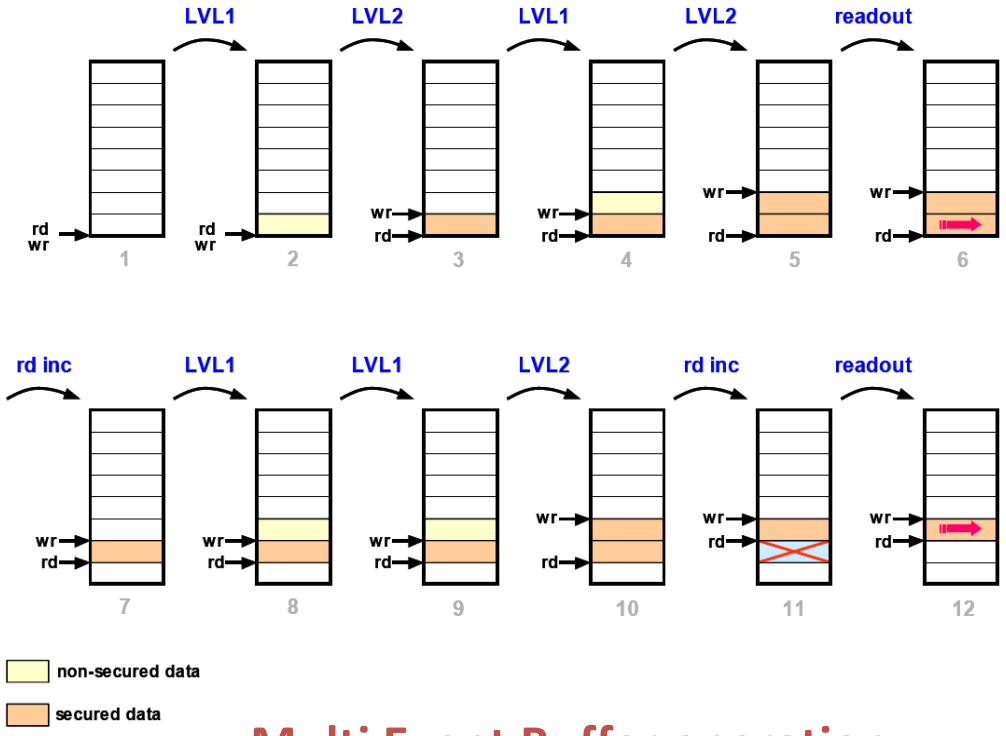
Feature extraction



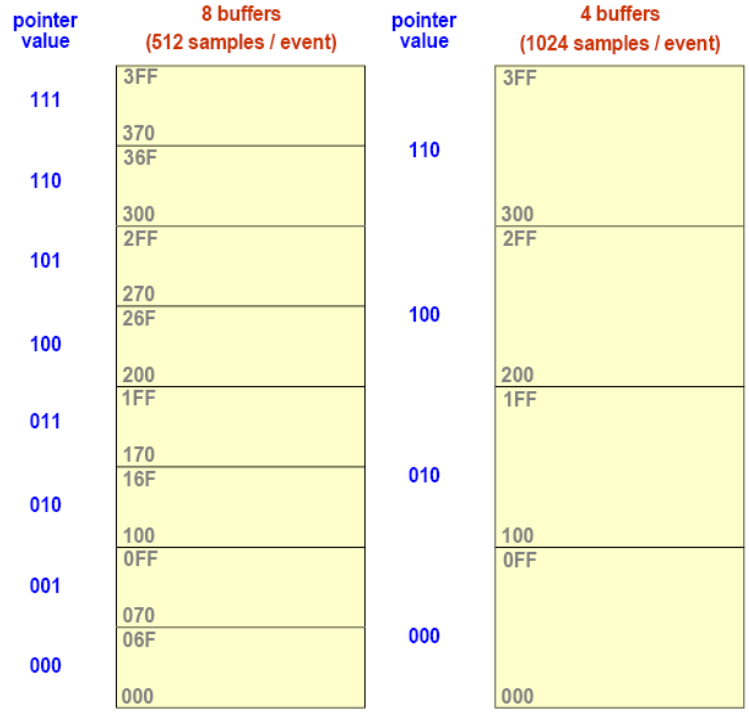
Glitch filter

- The ALTRO zero suppression features, provides extensive data compression capabilities
- Expect RTPC occupancy 1%
- With zero-suppression up to 99% of readout data eliminated.

Multi Event Buffer



Multi Event Buffer operation



Multi Event Buffer structure

DAQ Performances

- **24 FECs (128 ch/FEC) readout by 6 RCU ⇒ 512 chs/RCU**
- **100 samples/ch at 10 MHz sampling frequency**
- **1% channel occupancy**

- ALTRO MEB ➔ RCU FIFO
- DataBlockSize/ch = [100samples + 2 (time + block length)] : 3 = 34 words (32 bits long)
  - TotalDBS/ch = DBS/ch + trailer = 35 words
- RO_time/ch (empty channel) = 700ns(ch handshake) + (25ns * 1 word) = 0.725 μs
- RO_time/ch (full channel) = 700ns(ch handshake) + (25ns * 35 word) = 1.575 μs
- RO_time/RCU≈ (1.575μs * 506) + (0.725μs * 6) ≅ 370 μs

- Max_Event_Rate = 1/RO_time/RCU ≅ 2.7kHz
- Event Size/RCU ≈ 2.9 KB
- Total event size ≈ 17.6 KB
- Data Rate (2KHz trigger rate) ≈ 35 MB/s (<< DDL limit)

➤ **Expected performances confirmed by tests in Genova and at JLab**

➤ **First tests with CLAS DAQ confirm max. event rate of 2.5-3 KHz**

EG6 Index - SeaMonkey

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Home Bookmarks INFN - Istituto Nazio... Jefferson Lab Experi...

Hall-B/CLAS EG6 - E07-009 & E08-024

Logs, Links and Documentation

Contacts and Phone Numbers

- **CLAS phone/pager numbers**
- Operational and Emergency Contacts

Required Reading For Shift Takers:

- Conduc
- Radiati [pdf]
- EG6 Ex (ESAD)
- TOSP fo
- Hall-B I (ESAD)
- Hall B W
- Reques
- Genera

Docume

- Procedures for egb
- Shift Taker's Howto
- Shift Checklist
- Startup Procedures
- Required beam quality [pdf] [ps]
- Run Coordinator Duties
- Note on IC

WEB Based Monitoring Links:

- Logbook Entries
- CLAS Run Data Base
- End Station Status
- Online Time Histories (Hit reload if you get a blank page)
- Slow Controls Time Histories (EPICS)
- Jefferson Lab Beamtime Accounting system
- User Beam Accounting
- Online Calibration Database

Short-term Schedule

Current Run Coordinator:

Stepan Stepanyan

RC Cell Phone: 757-876-1797
Office Phone: x7578

- **Installation completed on Oct. 5**
- **First beam on Target on Oct. 6**
- **Trigger Studies completed**
- **Commissioning of RTPC in progress**
- **RTPC Readout implemented in CLAS DAQ**
- **RTPC-DAQ optimization in progress**

mack-up in place
- Install solenoid magnet, connect IC and hodoscope to the solenoid
- Install RTPC and the target
- Start commissioning of the RTPC

This page is updated by the run coordinator. These are the instructions on how to update this page.

$Id: run_plan.html,v 1.1 2009/09/07 22:48:08 stepanya Exp

Privacy and Security Notice

Long-term Schedule

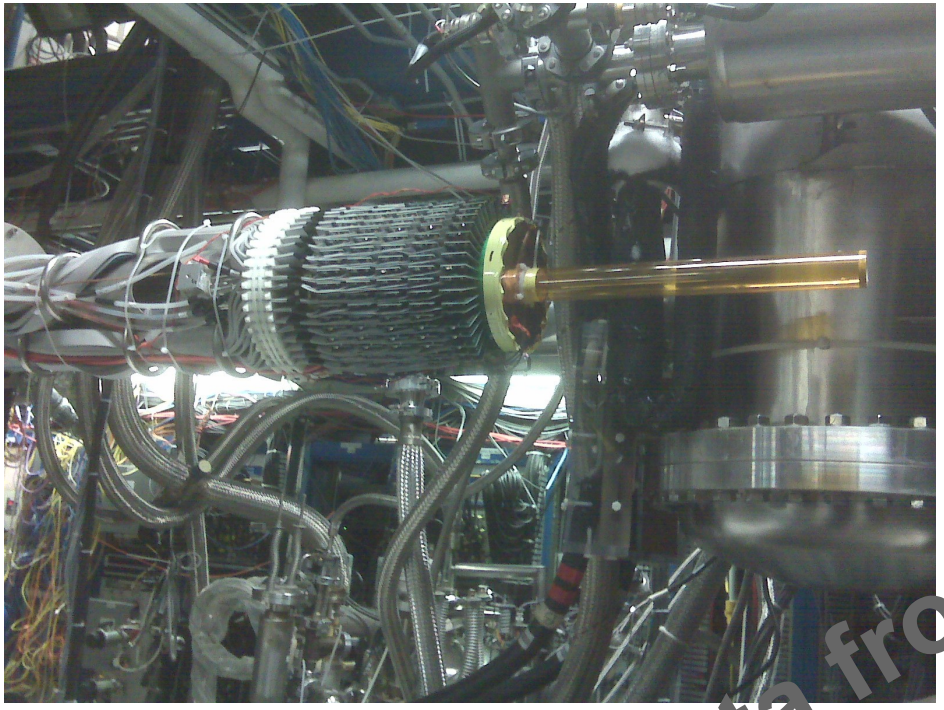
rdinator Schedule

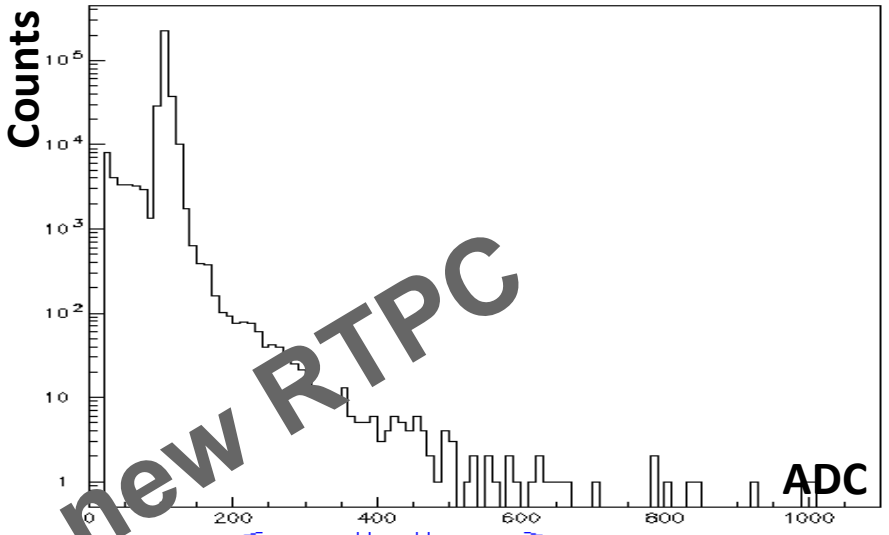
Dates	Run Coordinator
Sept 21 - Oct 7	Stepan Stepanyan
Oct 7 - Oct 14	Stephen Bueltmann
Oct 14 - Oct 21	Kawtar Hafidi
Oct 21 - Oct 28	Raffaella De Vita
Oct 28 - Nov 11	Eric Voutier
Nov 11 - Nov 25	Hovanes Egiyan
Nov 25 - Dec 2	Aji Daniel
Dec 2 - Dec 9	FX Girod
Dec 9 - Dec 16	Kawtar Hafidi
Dec 16 - Dec 23	Marco Battaglieri

Other Schedule and Reports

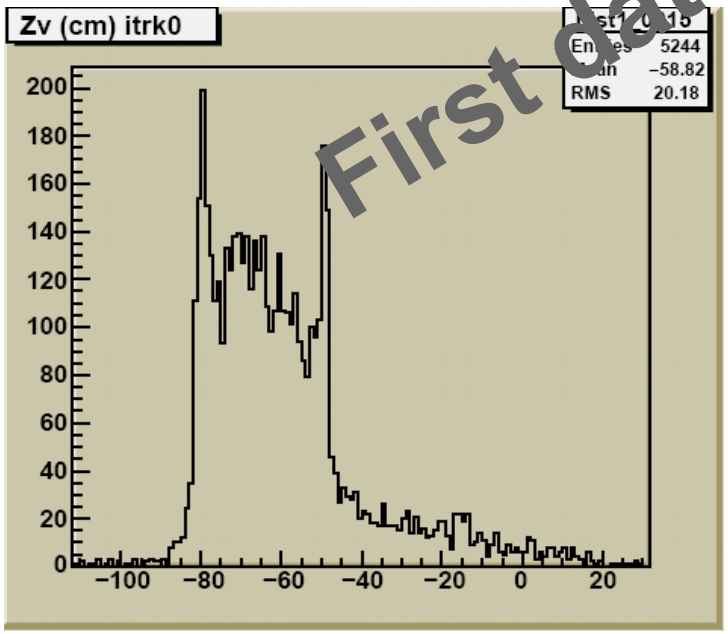
- Accelerator:
  White Board
  Schedule (available on-site only)
- The Weekly Run Coordinator Reports to scheduling meeting.
- You are welcome at the daily 8am meeting

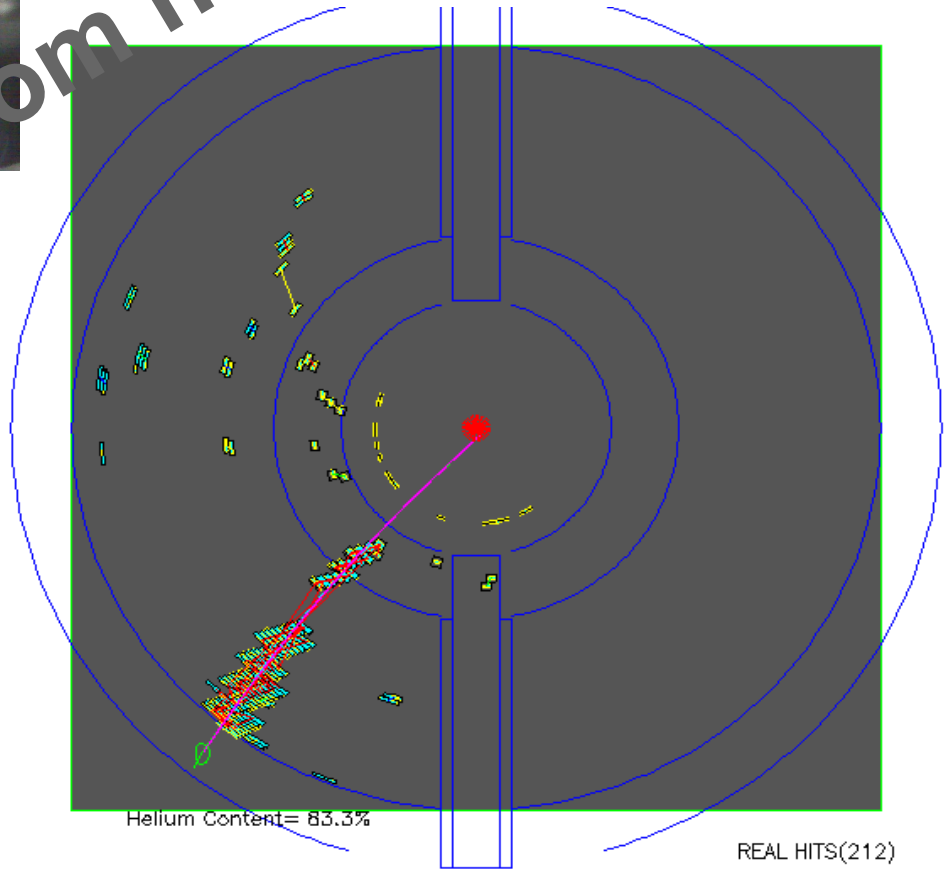
http://clasweb.jlab.org/shift/current/rtpc.jpg





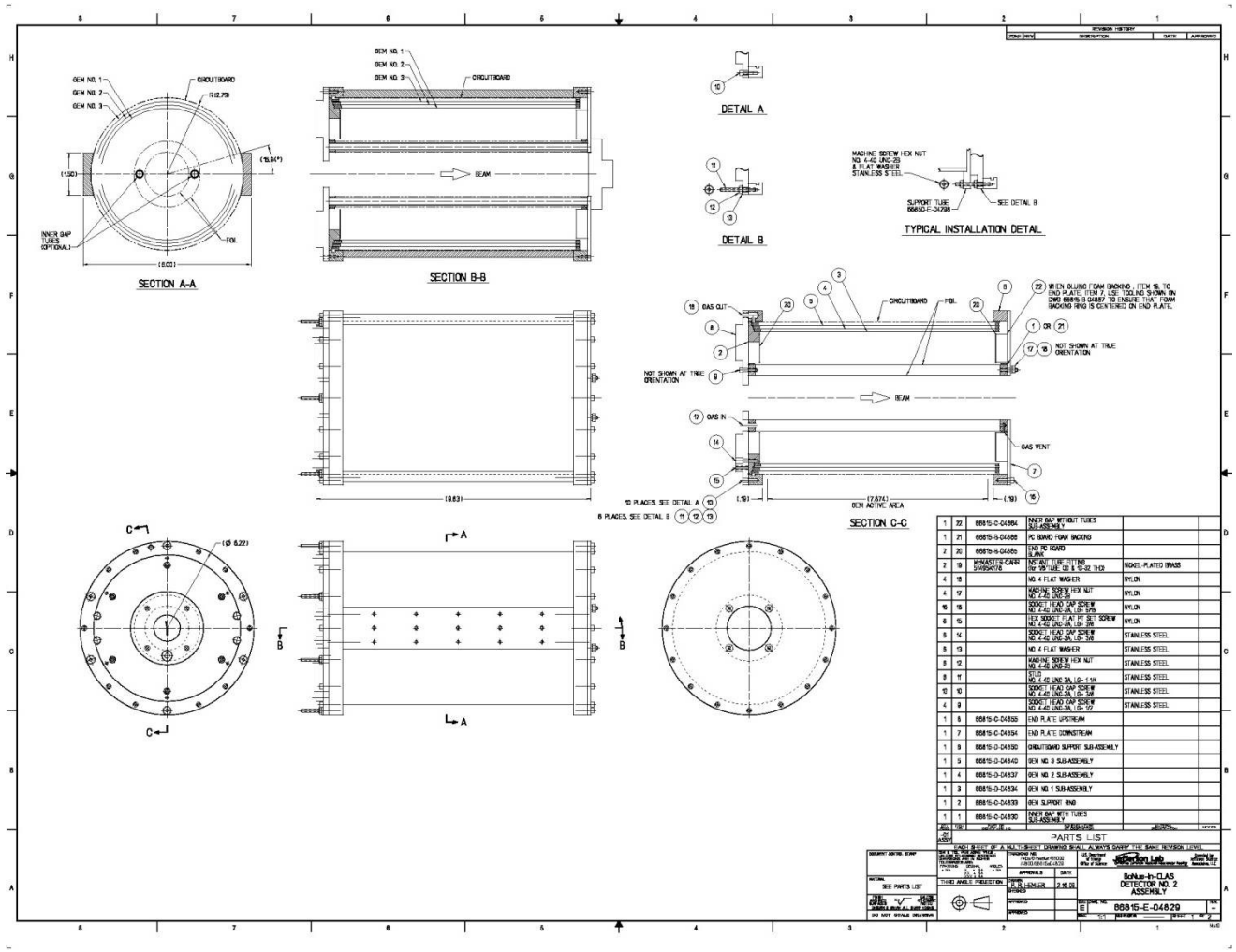
First data from new RTPC





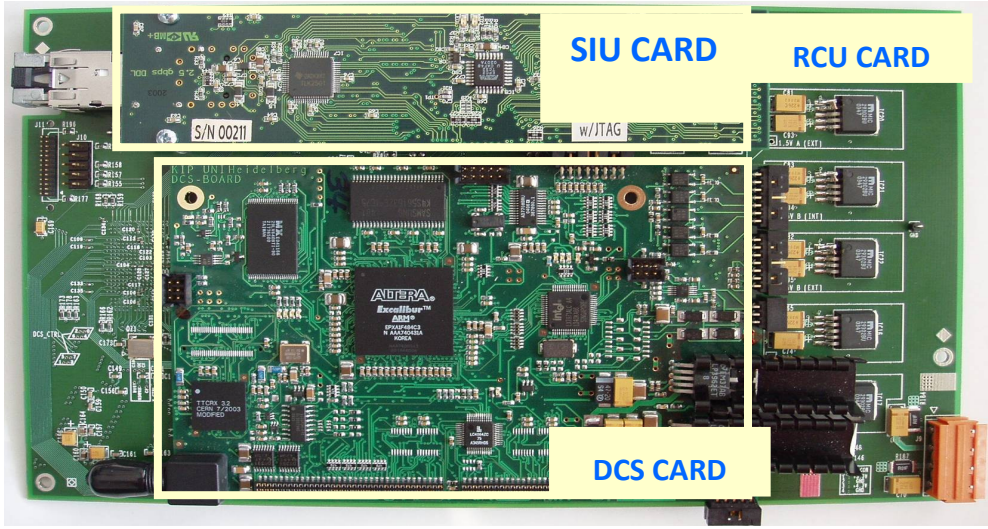
Backup slides

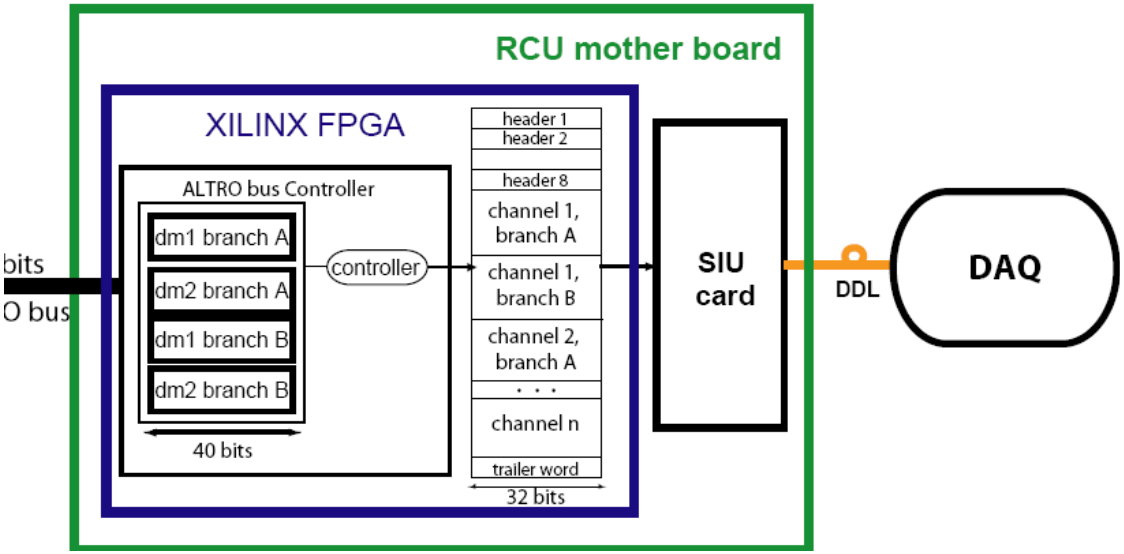
RTPC-II


SECTION A-A
SECTION B-B
DETAIL A
DETAIL B
TYPICAL INSTALLATION DETAIL
SECTION C-C
PARTS LIST
Bonus-in-CLAS
DETECTOR NO. 2
ASSEMBLY
6815-E-04629

RCU features

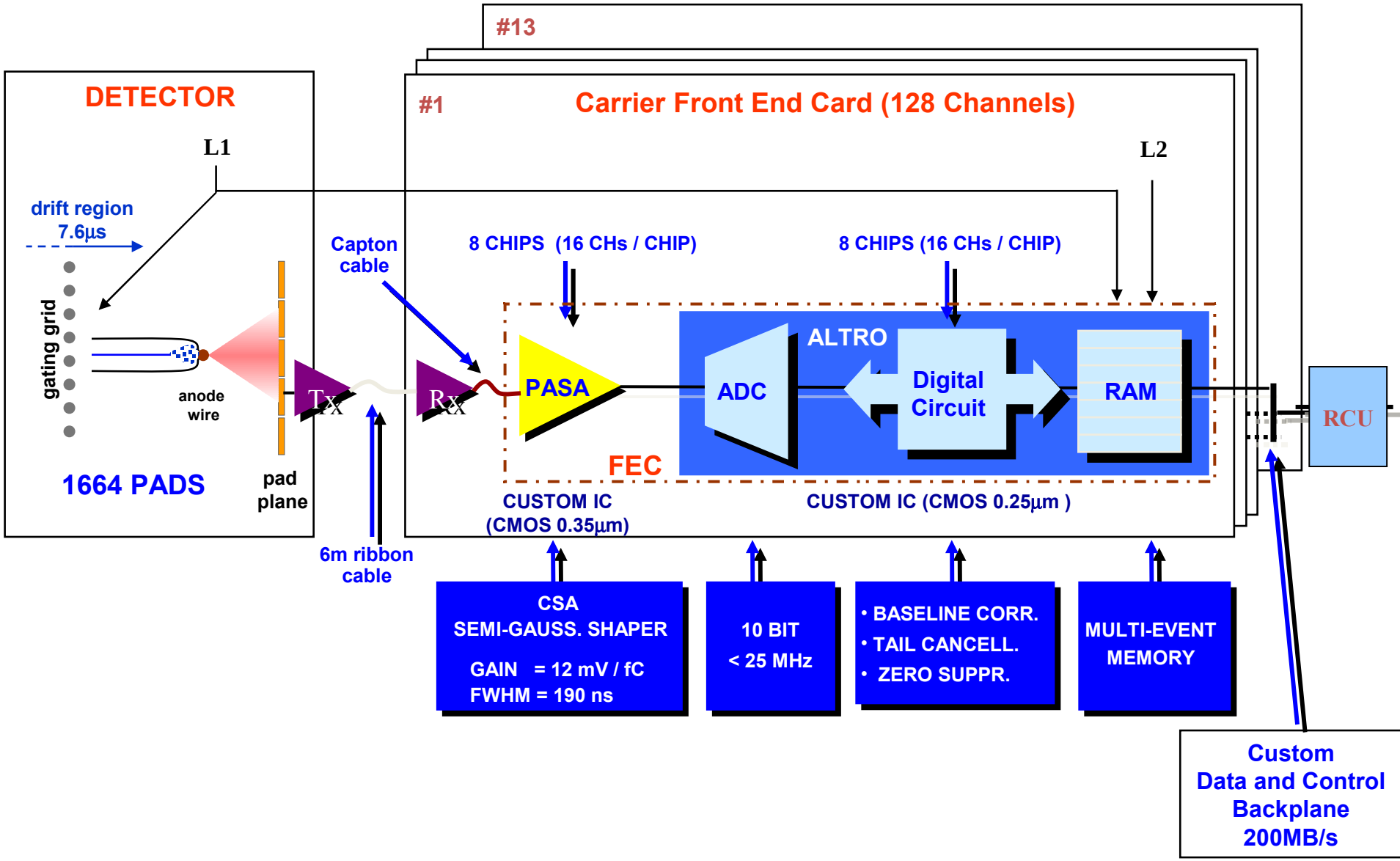
- Controls up to 32 FECs divided in 2 independent Branches
- Manage optical Serial Interface Unit
- Clock, Trigger distribution to FEC
- Data formatting and transfer to DAQ
- Handle FEC Configuration
- Multi-Event Buffer (8 events)





- 3 trigger sources
  - LHC TTC system
  - Software (debugging)
  - Hardware
- Safety module monitoring
- Linux Controller
  - FEC settings
  - Firmware update, check and reload
- Ethernet

FEC Overview



ALTRO Block Diagram