NICA Days 2019
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TPC electronics cooling design status

Prezentd by V. Chepurnov
TPC electronics design

SAMPA chips (4500 pc): delivered

Pilot system – 512 ch

Eight cards pilot system

Status: tested

1) Trigger, clock, reset distr. board.
2) System controller.
3) 64-ch SAMPA- FEC.
4) HSSI (up to 2.5 GBps; up to 8 FECs).
5) Data/conf. full duplex HSSI port; clock 40 MHz, trigger, reset.

tests with FPGA
Aria X – in progress

Pilot readout system for few ROCs – proposal
TPC electronics: FE cards

- **FEC controller**
  - Bottom view
  - Top view

- **FEC assembly view**

- **SAMPA FEC**
  - Top view
  - Bottom view

Bottom view (padplane connected side)

Top view (service side)

**FEC noise estimate for cards 1,2,3,4**

ENC ~ 0.8 ADC (~ 500 e-)

**FEC slow control data**

- **Board LV:** 1.7V & 1.1V
- **SAMPA (2 pc):** P=2W
- **FPGA:** P=2W

**T_{SAMPA} = 57 degree**

**T_{FPGA} = 54 degree**

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ROC chamber

gate: 75 nm Cu-Be, 80 g
Cathode: 75 nm Cu-Be, 80 g
Anode: 20 nm W-Re, 50 g
Requirements:
- for minimization TPC end cap radiation length:
  - FE boards must be fixed parallel to ROC chamber surface;
  - material for cooling plate – aluminum instead Cu;
- TPC gas mixture temperature must be very stable: $T=\left( T_0 +/-0.25 \right)$ degree;
- length of flat cable “pad plane – FE card” must be minimal;
- total electrical power FE electronics – about 10 kW. FE cards consumption is about $2 \times 1 \text{W (SAMPA)} + 2 \text{W (FPGA)}$;
- FE cooling radiators must be with max efficiency (to prevent pad plane hitting);
- easy FE installation and reparation;
- easy access to connectors on board with FPGA.
ROC chamber + electronics integration: conceptual design

- Power cables
- Cable tray
- Optic cables
- 2 level FE cards
- Cooling tube
- Flat cable
- Chamber pad plane

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TPC electronics: FE cards integration and cooling (option 3)

Many radiators (8pc):
SAMPAs - cooling by radiator
FPGA – cooling by pad with tube

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TPC electronics: FE cards integration and cooling (option 3)

SAMPA cooling radiator

FPGA cooling radiator

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TPC electronics: FE cards integration and cooling (option 2)

Both FE cards cooling by tube
TPC electronics: FE cards integration and cooling
(base line option)

2 radiators (narrow and wide)
FE cards – no individual cooling

Status: in progress
Test set up for testing FE boards with ROC chamber
TPC electronics: power cables
Conclusion

1) According to requirements 3 options of FE cards cooling were designed;

2) Tests with prototype (option №3) shown, that construction is very complicated and not useful for mass-production;

3) Design with cooling tube around each 2 boards is ok but the number of tube connections to 2 water manifolds (N=124) is unacceptable;

4) Base line option with common radiator for narrow and wide ROC chamber parts seems will be ok. Prototype ordered and will be tested.

Thank You!