6-July-2007,
3rd J-PARC PAC

SKS Status Report

Tomofumi Nagae,
Spokesperson of E05

Outline

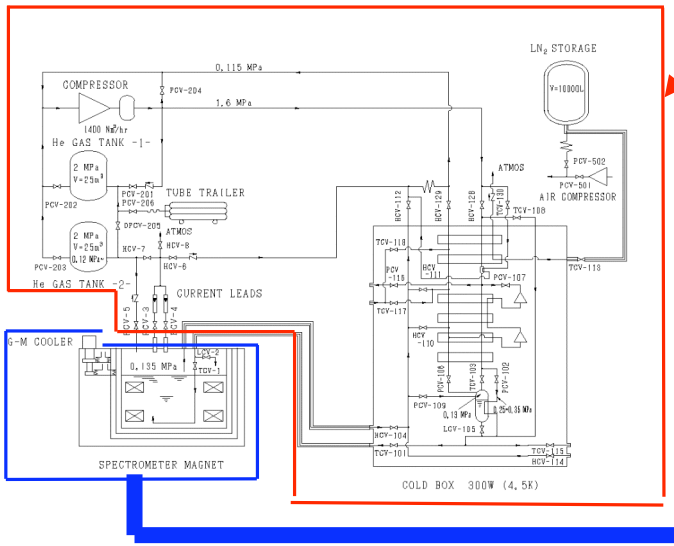
- SKS Magnet & Ref. System
- New Dipole Magnet
- Beamline MWPC & Readout system
- SKS Detectors
  - SKS, SKS+, SKS- Configurations
- Collaboration

SKS Magnet

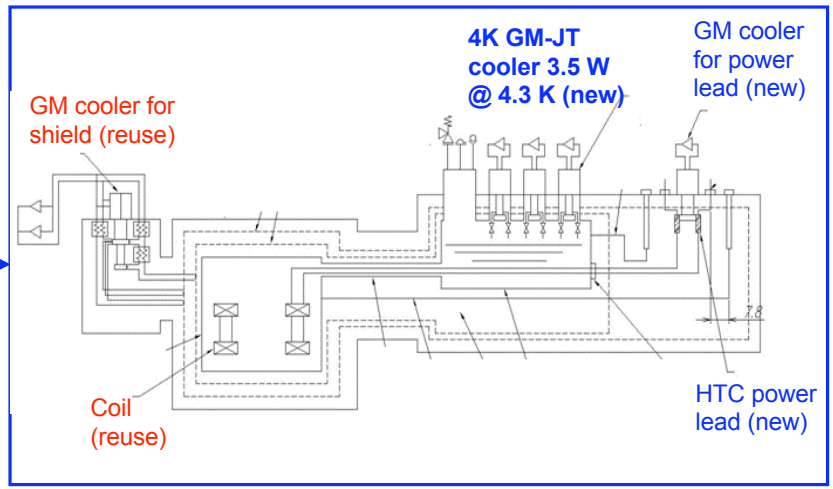
Modification of Cooling System

Before reconstraction

Not to be used



After reconstraction



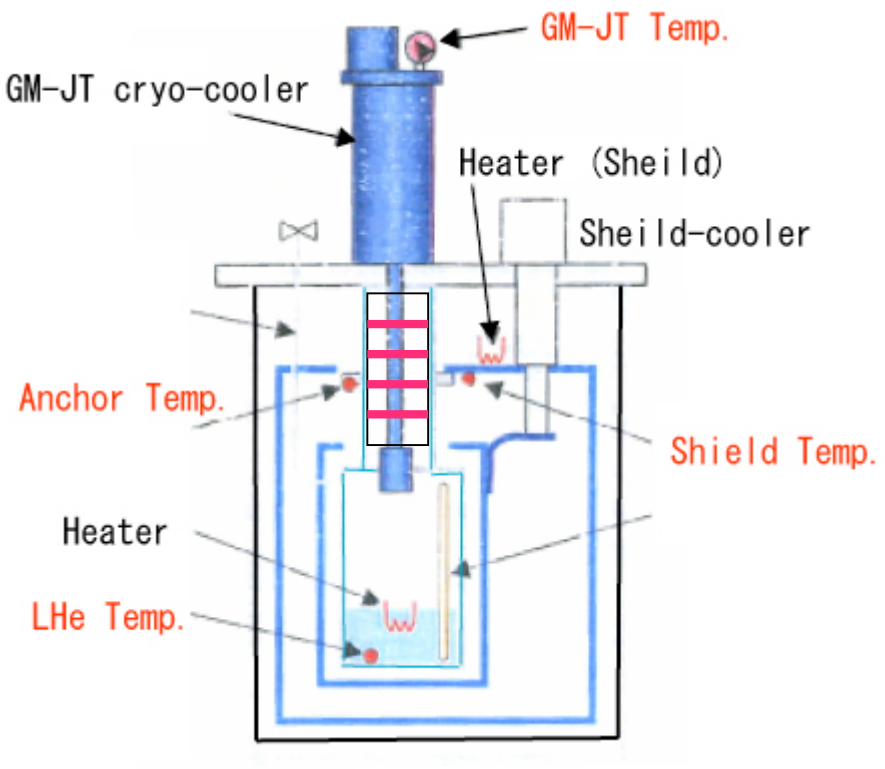
- 300W He refregirator
  - Cold Box
  - (Medium) Compressor
  - He Transfer line
  - LN_2 storages
  - etc...
- Cu current leads

Head load (operation) ~ 5W

- 3.5W GM-JT cryo-cooler x 3
  - shield cooler
- HTC current leads with GM cryo-cooler

can maintain liquid state of He

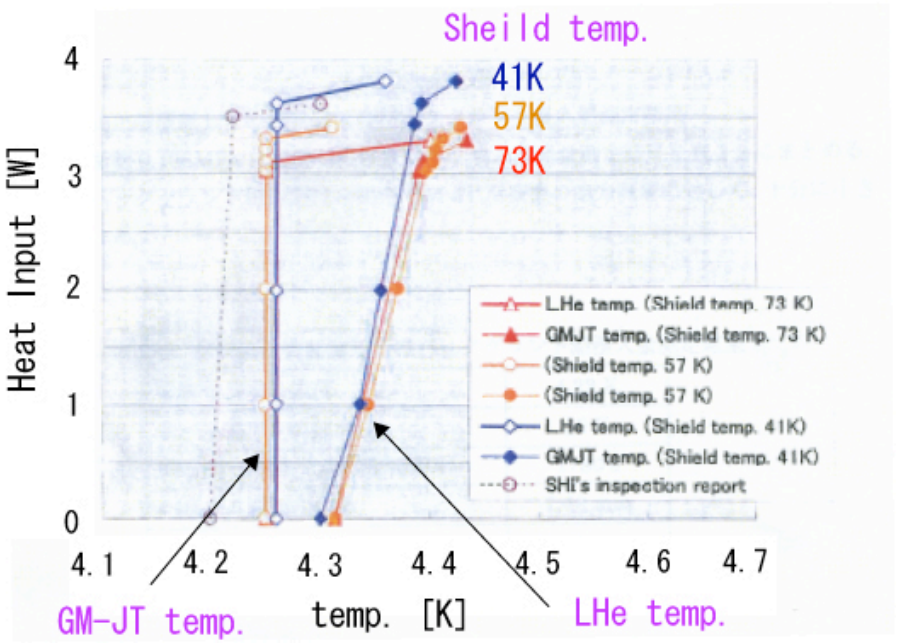
Measurement of cooling power of GM-JT cryo-cooler (FY2006)



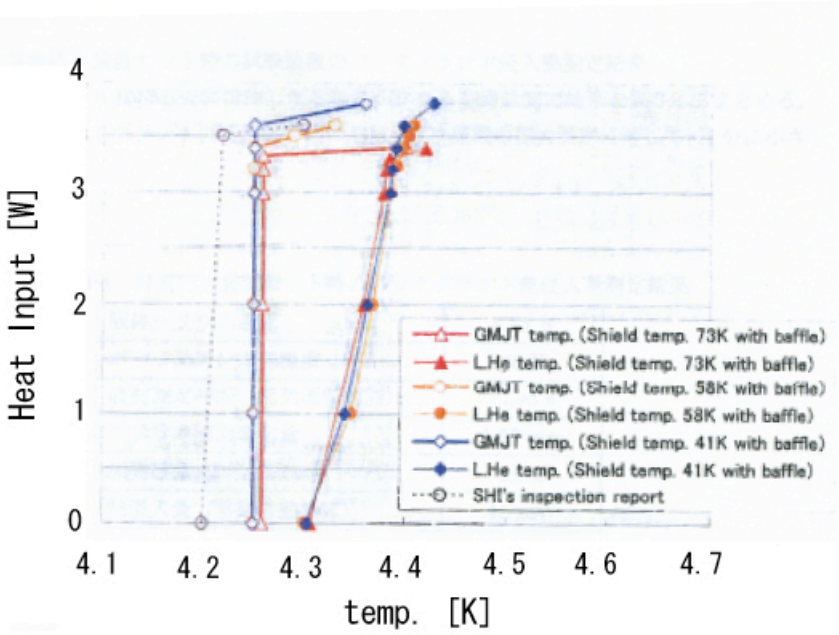
- Cooling power of GM-JT
  - vs shield temp
  - w or w/o
    anti-convection device

Results

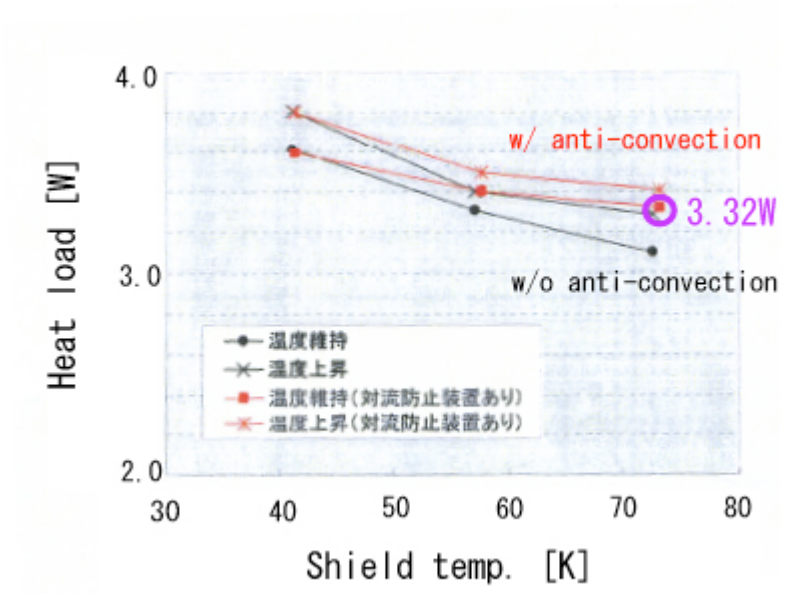
w/o anti-convection device



w/ anti-convection device



Summary



Cooling power depends on the shield temp.

- 3.1W(71K) –> 3.6W(41K)
- add a shield cryo-cooler

Anti-convection is effective.

- at high shield temp.

Cooling power > 3.32W

- Three GM-JT cryo-coolers

SKS magnet reconstruction plan 1

- Modification of cooling system and transportation to J-PARC (FY2007-2008)
  - 8/24 Bidding, 12/25(2008) Finish
  - Modification of cooling system and coil vessels
  - de-assemble of the yoke
  - re-assemble of the yoke and coil etc.
  - cooling test at the factory

168M Yen

- Fabrication of GM-JT cryo-coolers (FY2007-2008)
  - In preparation of doc. 4/25(2008)
  - 2 cyro-coolers and 1 compressor, etc..

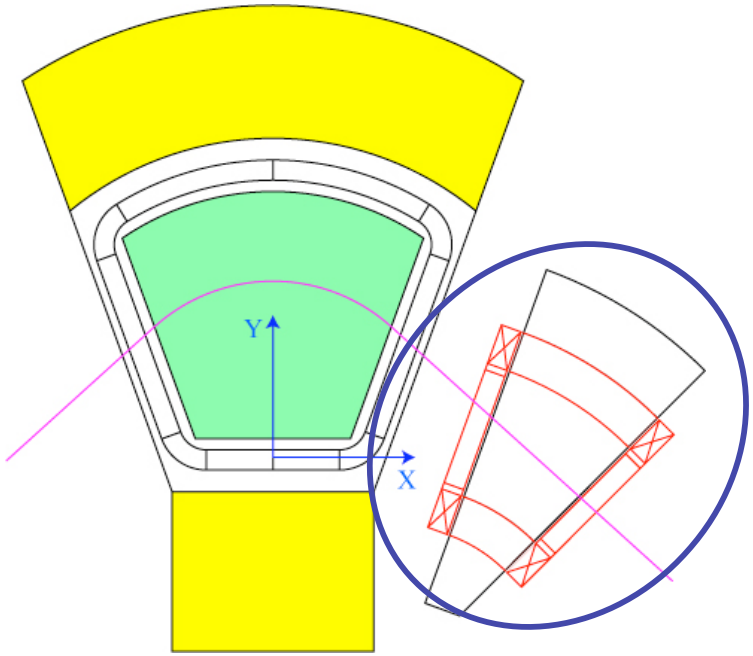
30M Yen

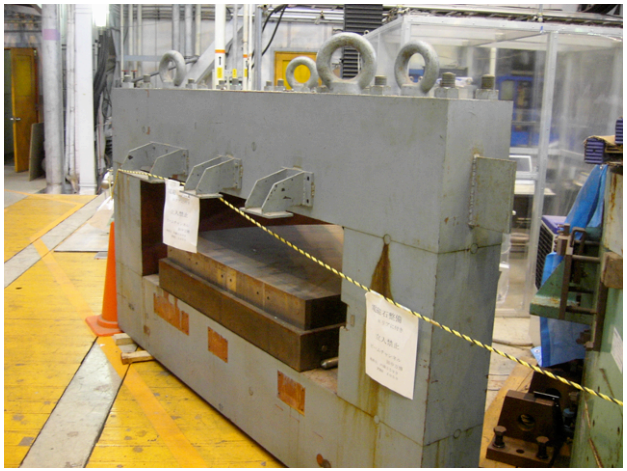
SKS magnet reconstruction plan 2

- FY2007
  - disconnection of power and monitor line, etc.
  - purchase of supplying goods (shield cooler,,)
- FY2008
  - connection of power, signal and gas lines
  - construction of interlock and monitor system
  - cooling and excitation test at J-PARC site
    (2008 Feb. – Mar.)

New Dipole Magnet

Dipole magent for SKS+





- Reused magnet yoke
- 20cm gap
- ~1.5 Tesla
- Window frame type

Additional dipole magnet may affect SKS coils and their support.

Estimation of electromagnetic force by “ANSYS” code

Results (w/o end-gaurd)

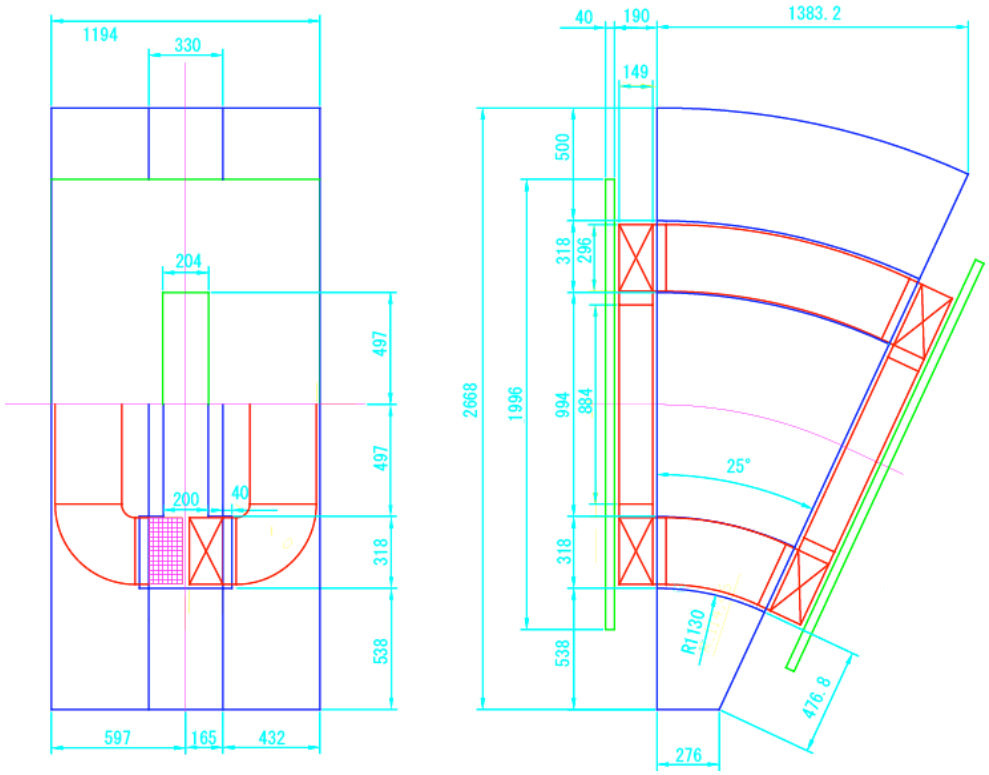
		SksDMag200A7 (1/2 Model)		SksDMag200A8 (1/4 Model)		TOSCA (Toshiba)	
		Fx [ton]	Fy [ton]	Fx [ton]	Fy [ton]	Fx [ton]	Fy [ton]
Only SKS	Coil	1.46	12.11	0.00	22.82	0.54	18.75
	Yoke	1.67	−18.32	0.00	−19.57	0.39	−25.74
	Total	3.13	−6.21	0.00	3.26	0.92	−6.99
No Excitation	Coil	1.43	12.00	0.50	22.72	−1.26	1772
	Yoke	1.88	−18.30	0.02	−19.55	1.11	−30.12
	Total	3.31	−6.30	0.52	3.17	−0.15	−12.40
	dC	−0.03	−0.11	0.50	−0.10	−1.80	−1.03
	dY	0.21	0.02	0.02	0.01	0.72	−4.38
	dT	0.18	−0.09	0.52	−0.09	−1.08	−5.41
Excitation	Coil	0.33	12.87	−2.12	23.60	−2.56	18.46
	Yoke	1.38	−18.31	0.22	−19.57	0.82	−30.06
	Total	−1.42	0.77	−1.90	0.77	−1.74	−11.60
	dC	−1.13	0.76	−2.12	0.78	−3.10	−0.29
	dY	−0.29	0.01	0.22	−0.01	0.43	−4.32
	dT	−1.42	0.77	−1.90	0.77	−2.66	−4.61

Results (w/ end-guard)

		w/o EG		w/ EG(4cm)	
		Fx [ton]	Fy [ton]	Fx [ton]	Fy [ton]
Only SKS	Coil	–5.96	41.52		
	Yoke	0.85	–21.38		
	Total	–5.11	20.14		
No Excitation	Coil	–5.97	41.39	–5.87	41.28
	Yoke	1.07	–21.36	1.29	–21.38
	Total	–4.90	20.03	–4.58	19.90
	dC	–0.01	–0.13	0.09	–0.24
	dY	0.22	0.02	0.44	0.00
	dT	0.21	–0.11	0.53	–0.24
Excitation	Coil	–7.07	42.30	–6.43	41.88
	Yoke	0.56	–21.35	0.84	–21.40
	Total	–6.51	20.95	–5.59	20.48
	dC	–1.11	0.78	–0.47	0.36
	dY	–0.29	0.03	–0.01	–0.02
	dT	–1.40	0.81	–0.48	0.34

End guard can reduce the force to ~½.

Present Design



Gap 20cm
96 turns/Coil
1.5 T @ 2000A

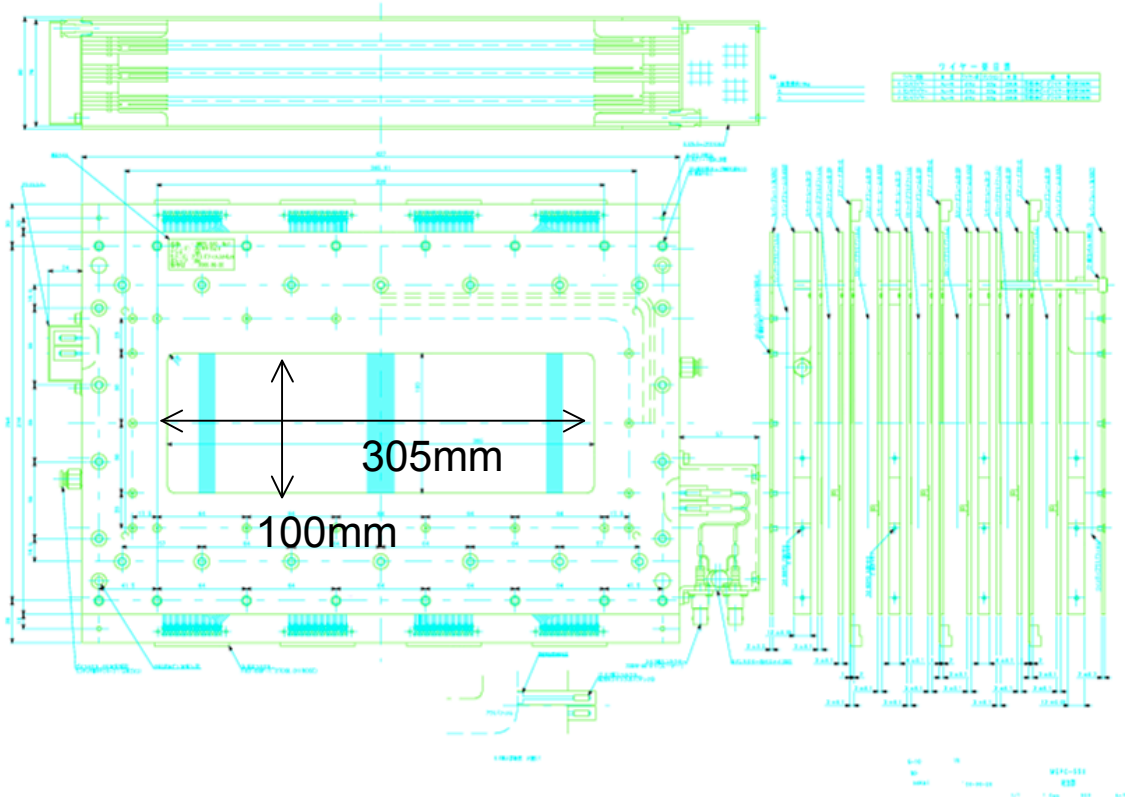
Power Supply
2000A-135V
(320kW)

Cooling water 7/Coil
230 L/min. @ 1.0MPa

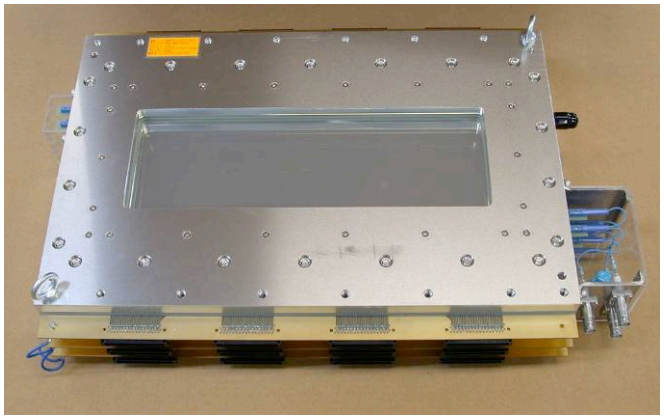
will be fabricated in 2007FY by Grand-In-Aid

Beamline MWPC

1mm MWPC



32ch. half-pitch readout connector



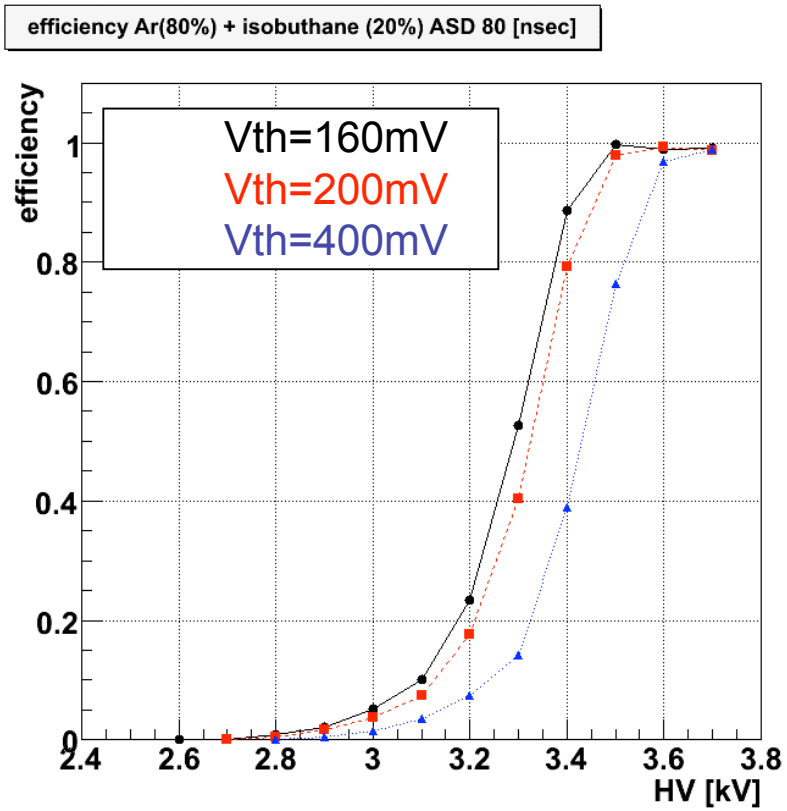
- 15μmϕ anode wire
- 1mm A-A spacing
- 3mm A-Cathode gap

- 256 ch./plane
- X-U-V (half-size)
- ±15°for U and V

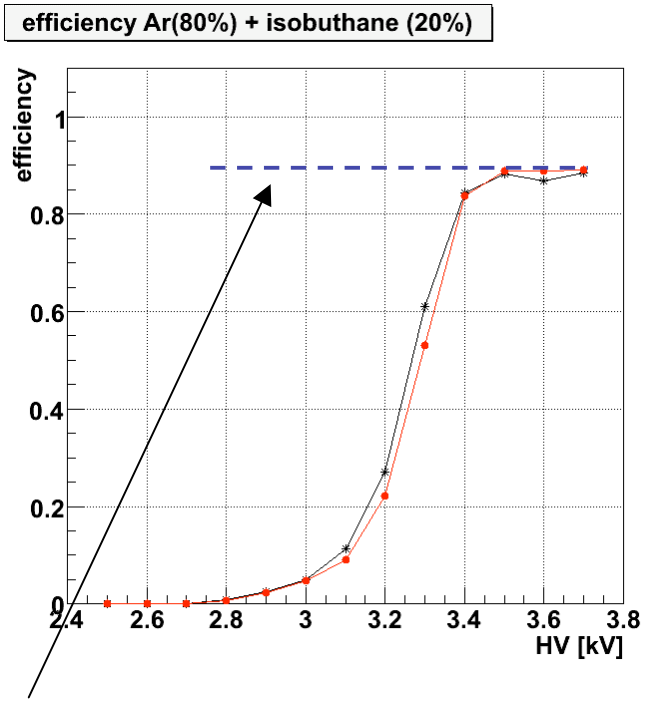
Efficiency measurements with ^{90}Sr/Y source

Ar(80):iso-C_4H_{10}(20) gas

ASD board with SONY-ASD(80ns)



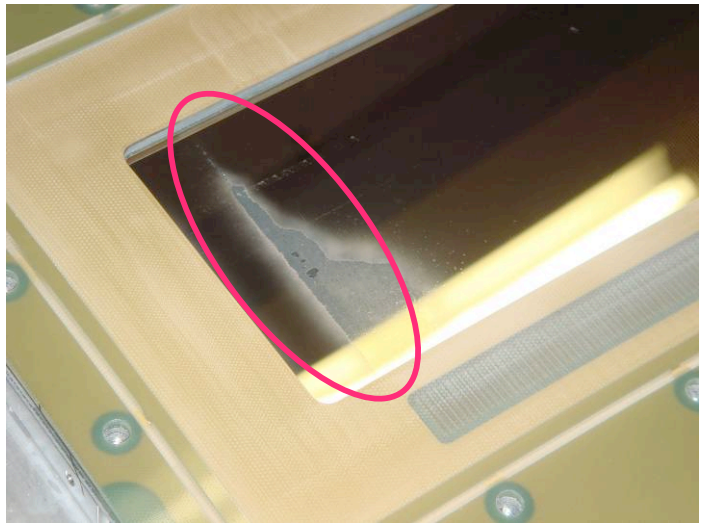
SONY-ASD(16ns)

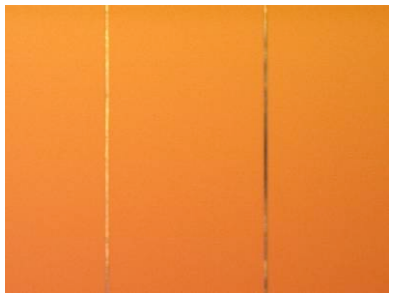


Geometry coverage
only 16 channels sum

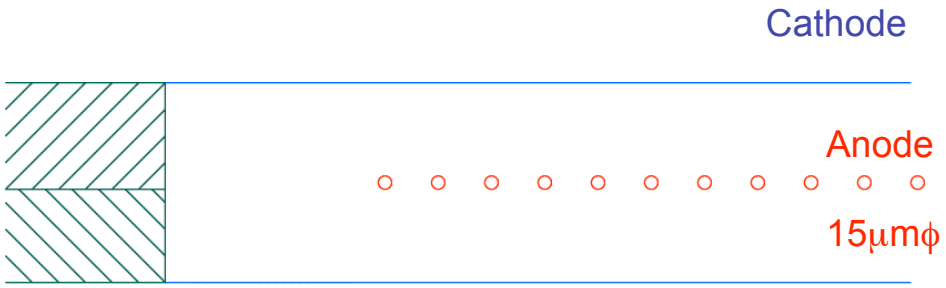
Discharge Problem

- Discharge occurs at the edge region around the plateau region ~3.0-3.5 kV.
- Once discharge occurs, the surface of cathode conductor is damaged.

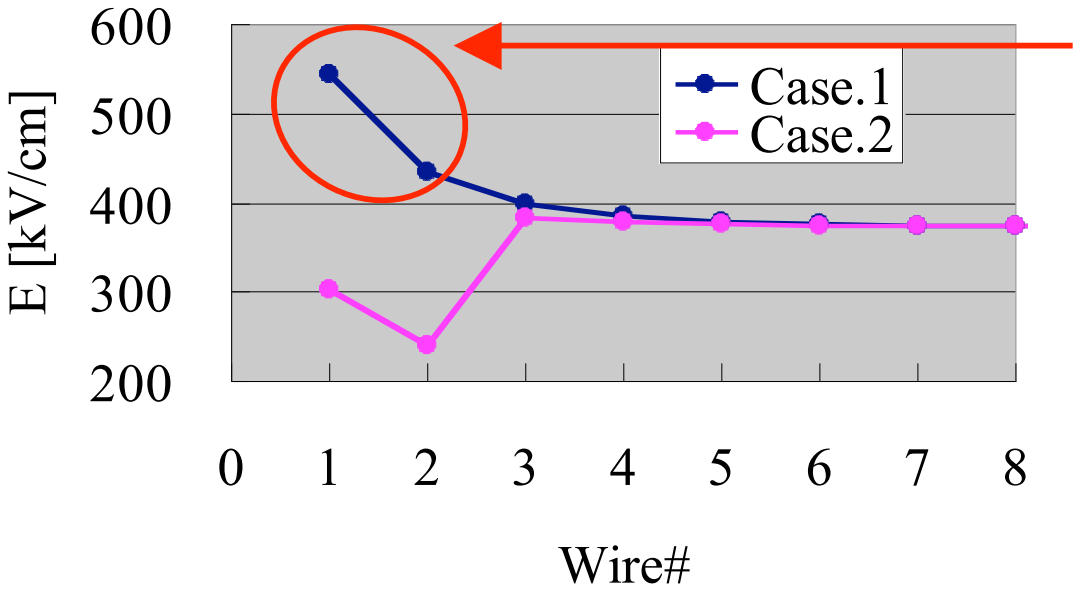




Discharge at the edge region



Field at wire surface



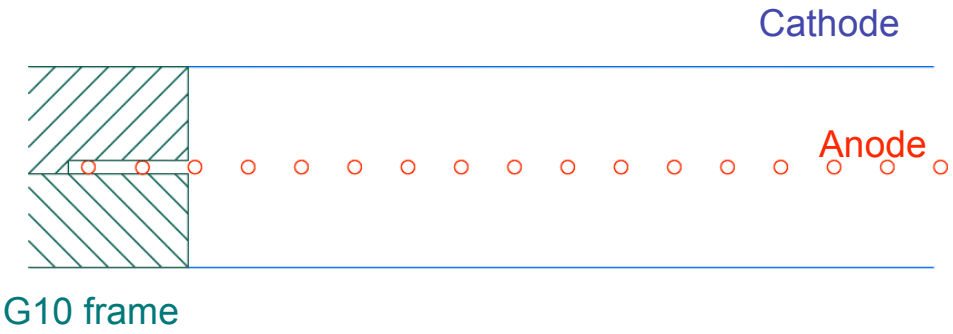
- Case.1
  All 15μmϕ

Very high field at the edge region

- Case.2
  30μmϕ for #1 and 2

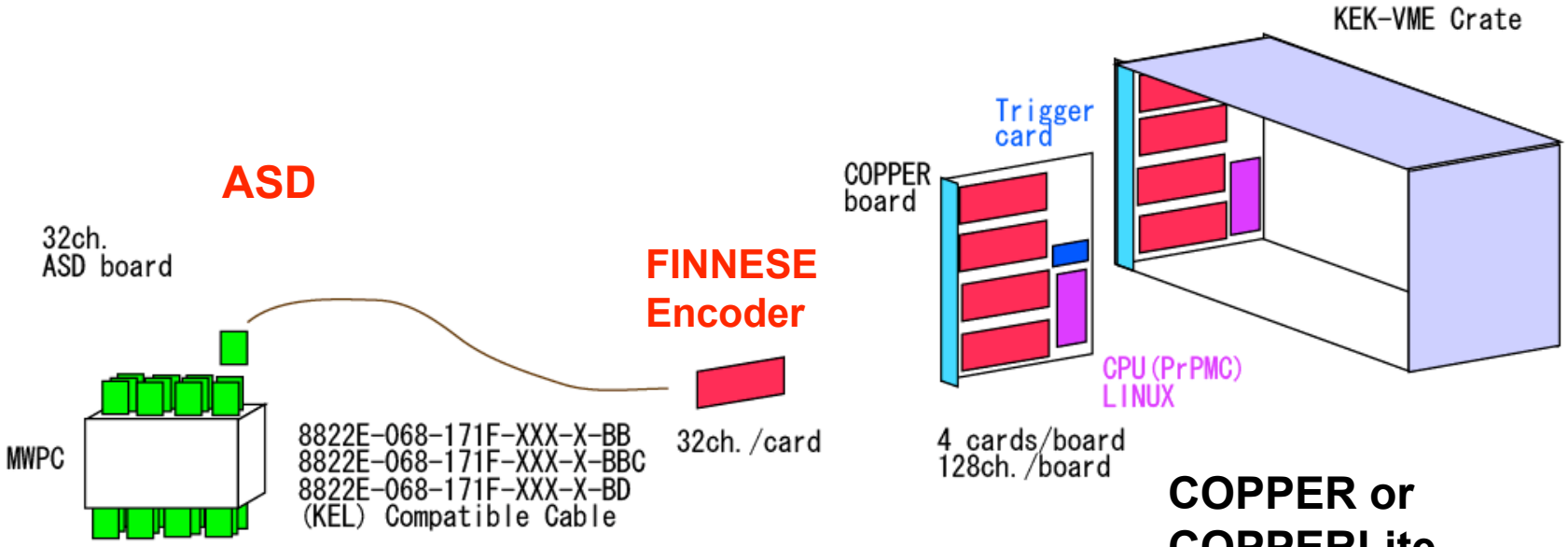
However discharge occurred !!

Improved configuration to avoid discharge & cathode damages



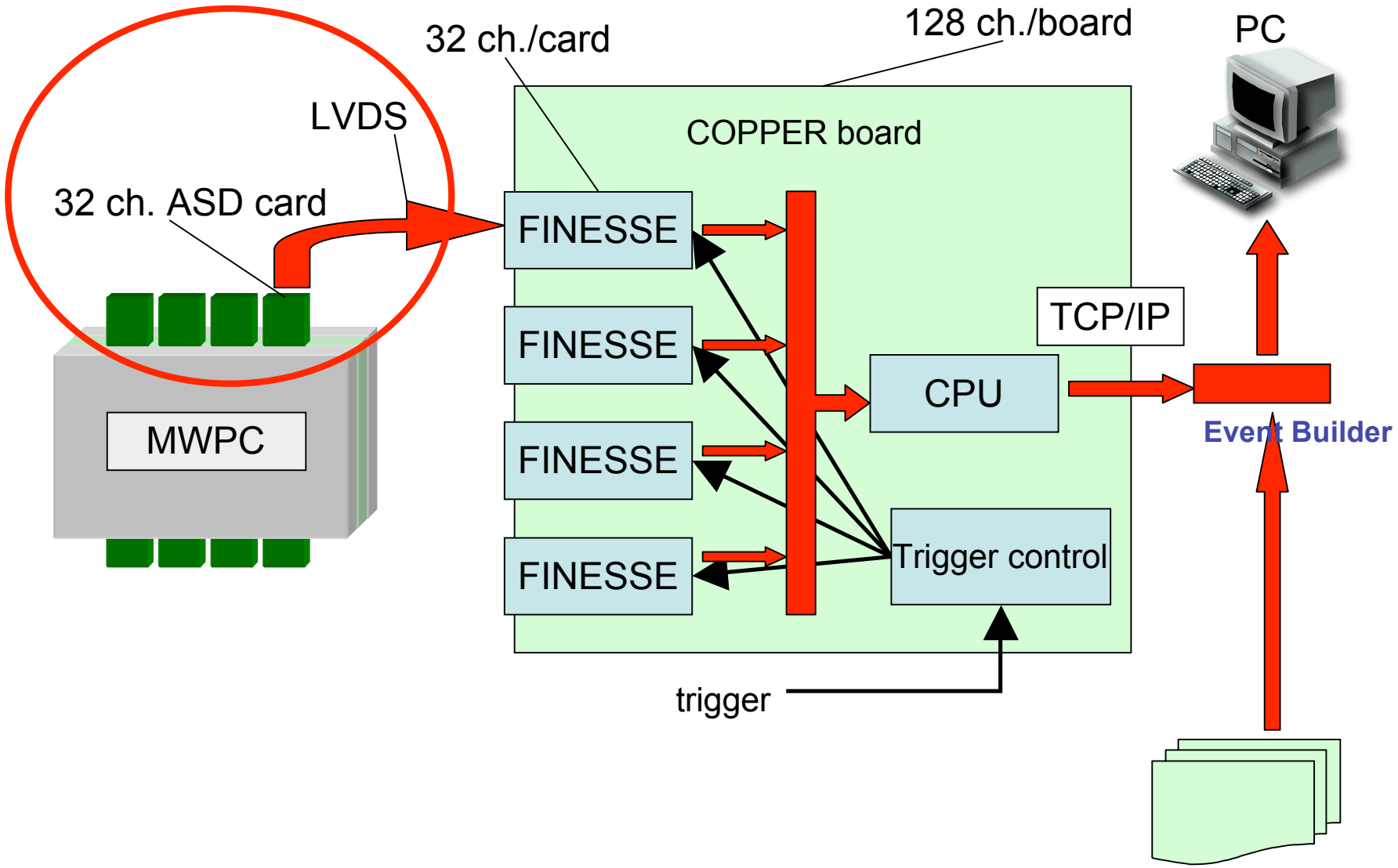
- The egde wire is covered by G10.
- Wire dia. 15μm –> 12.5μm
- Cathode material
  - Aramid(6μm)+Al (Present)
  - PET(12μm)+Al
  - PET+Carbon ?

MWPC Readout

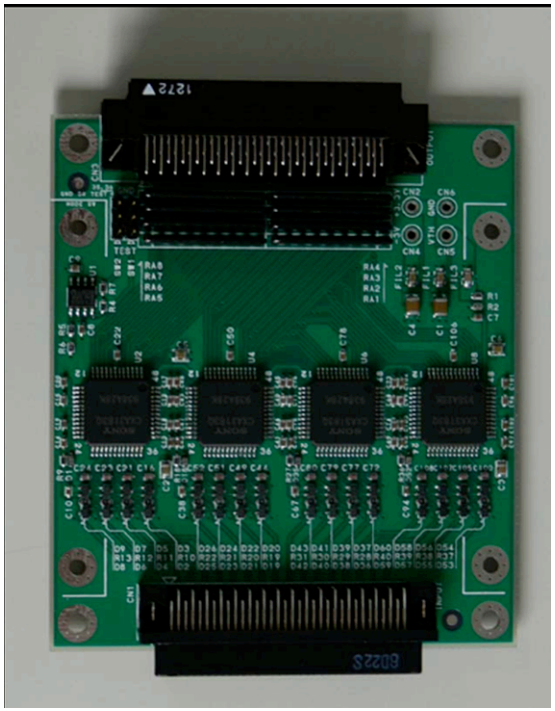


COPPER or
COPPERLite
COPPER + SiTCP

Readout System



ASD board



- 32ch./board
- SONY ASD chip with 80ns
- LVDS output
- +3.3V, -3.0V

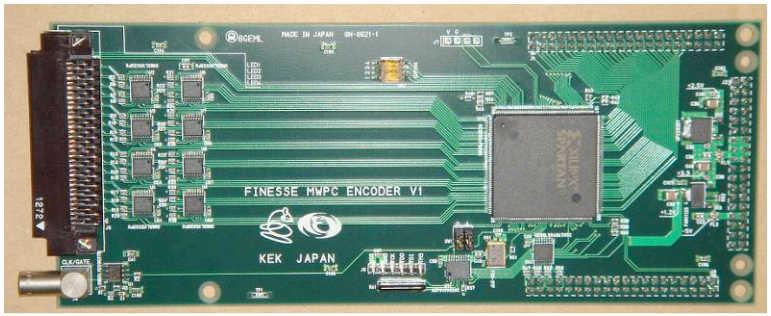
20 boards were fabricated for test.

1. We have enough number of 80ns chip
2. We will obtain 16ns chips (1.8K, 4.8Kch.) this year
3. Another ASD chips are under development by 測定器開発室

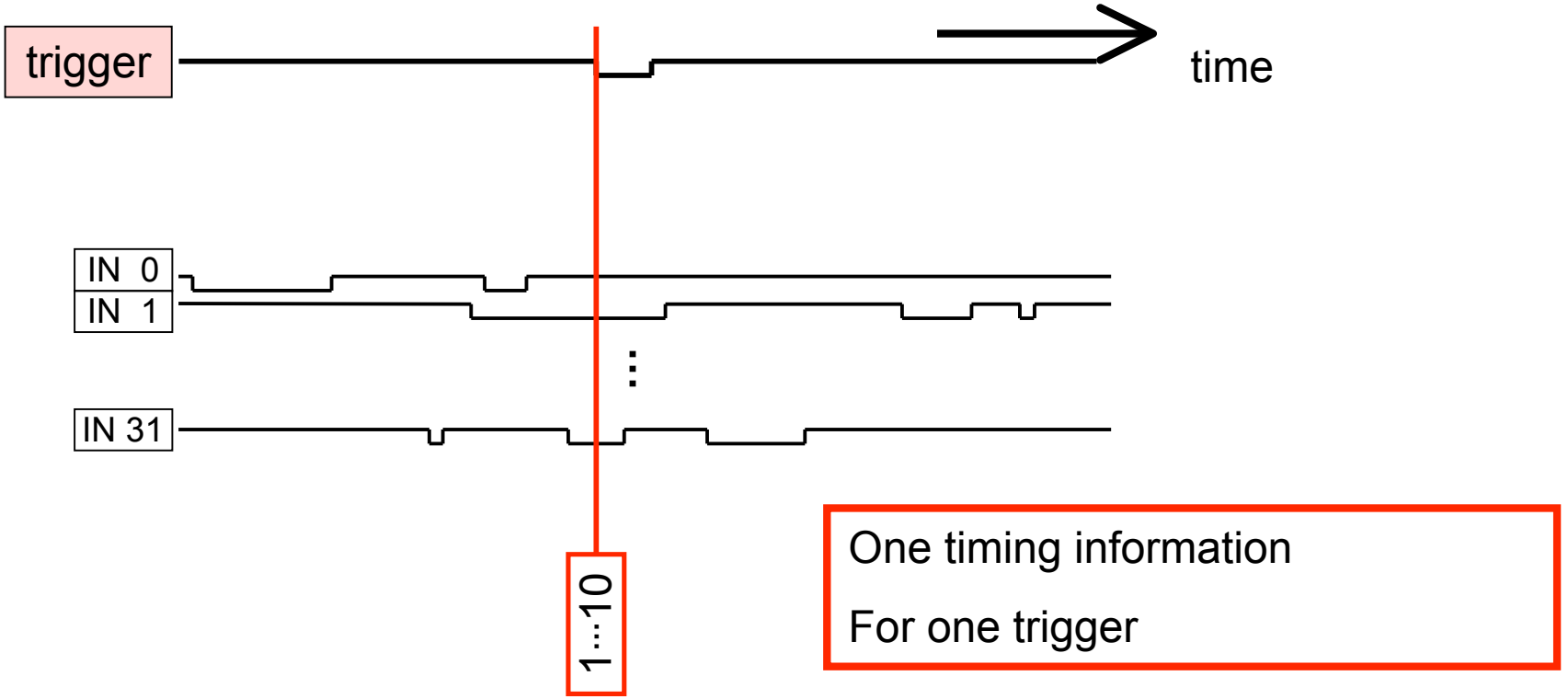
4ch./board
gain programmable
half-swing pECL output
+5V

MWPC Encorder

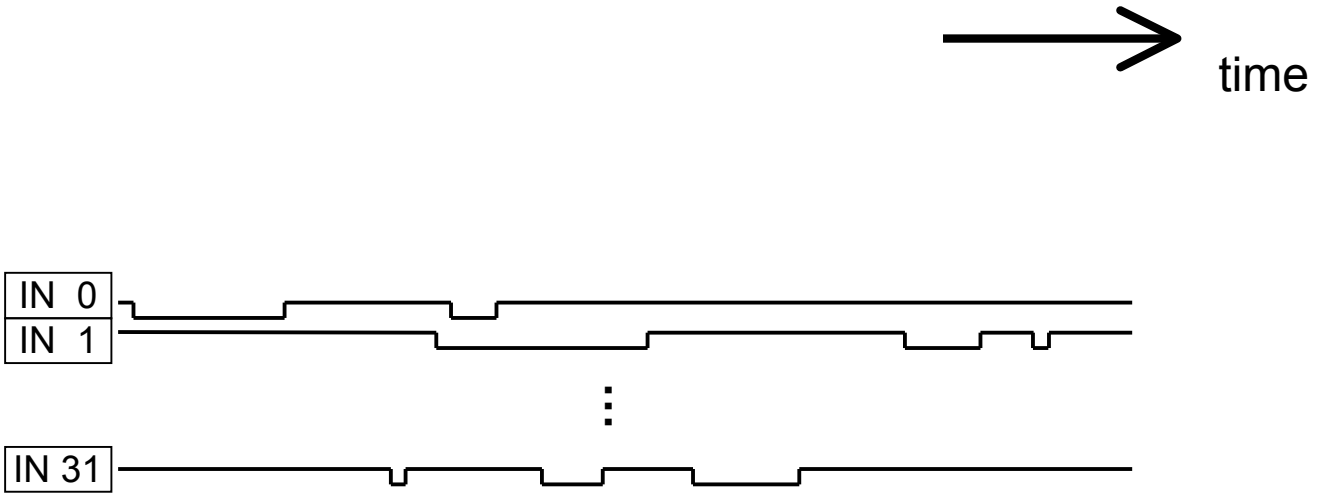
- 32ch. / card
- 4 cards / COPPER board
- acceptable signal
  - LVDS
  - ECL
  - pECL



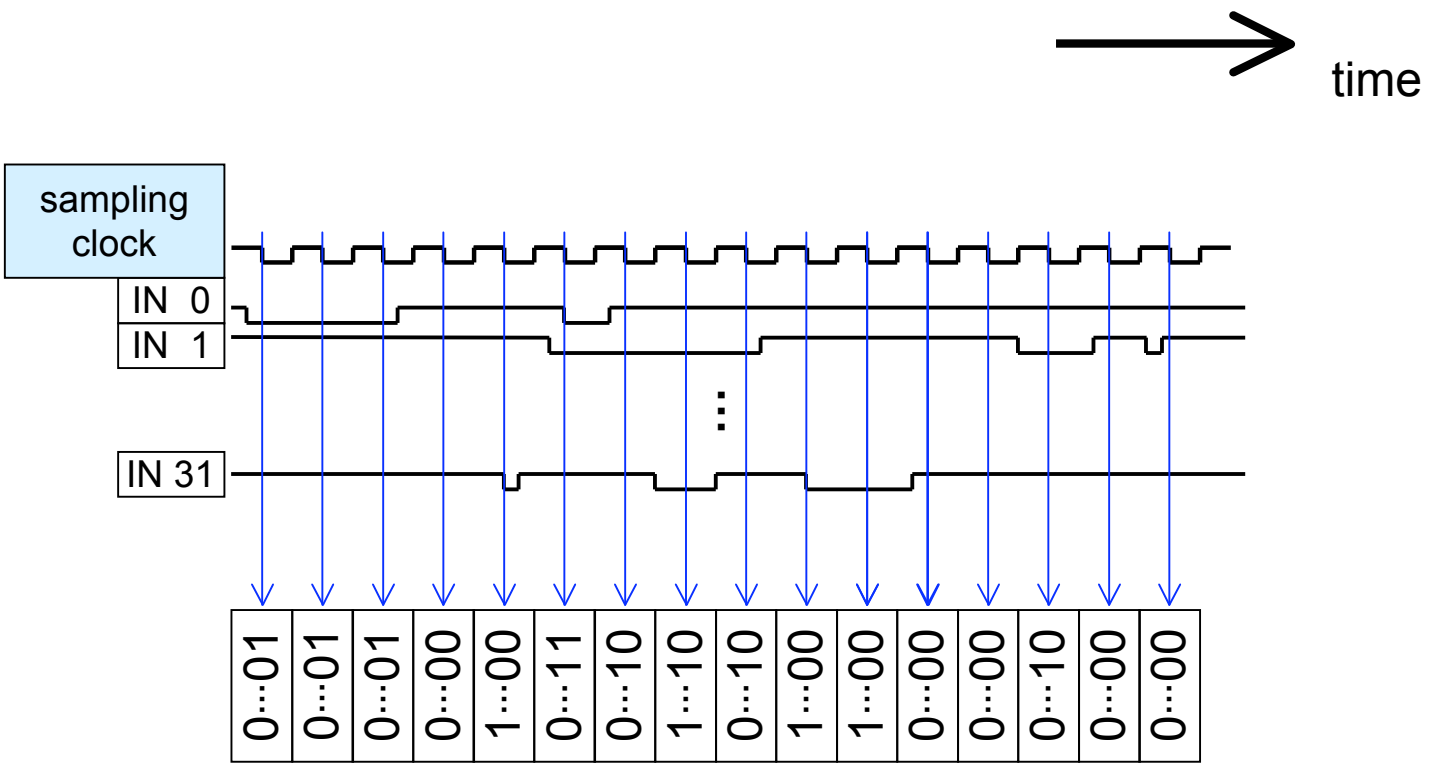
Traditional MWPC encoder scheme



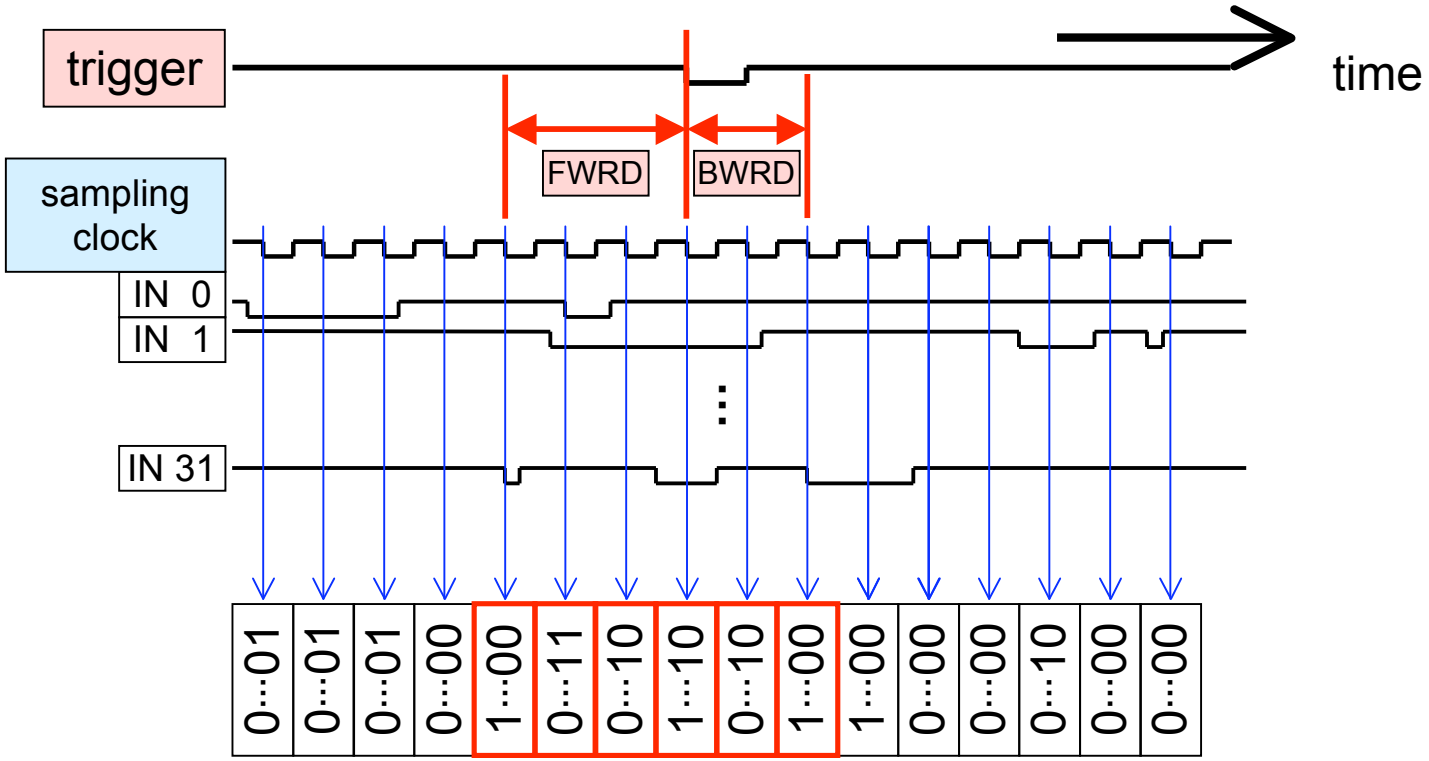
New MWPC Encoder Scheme



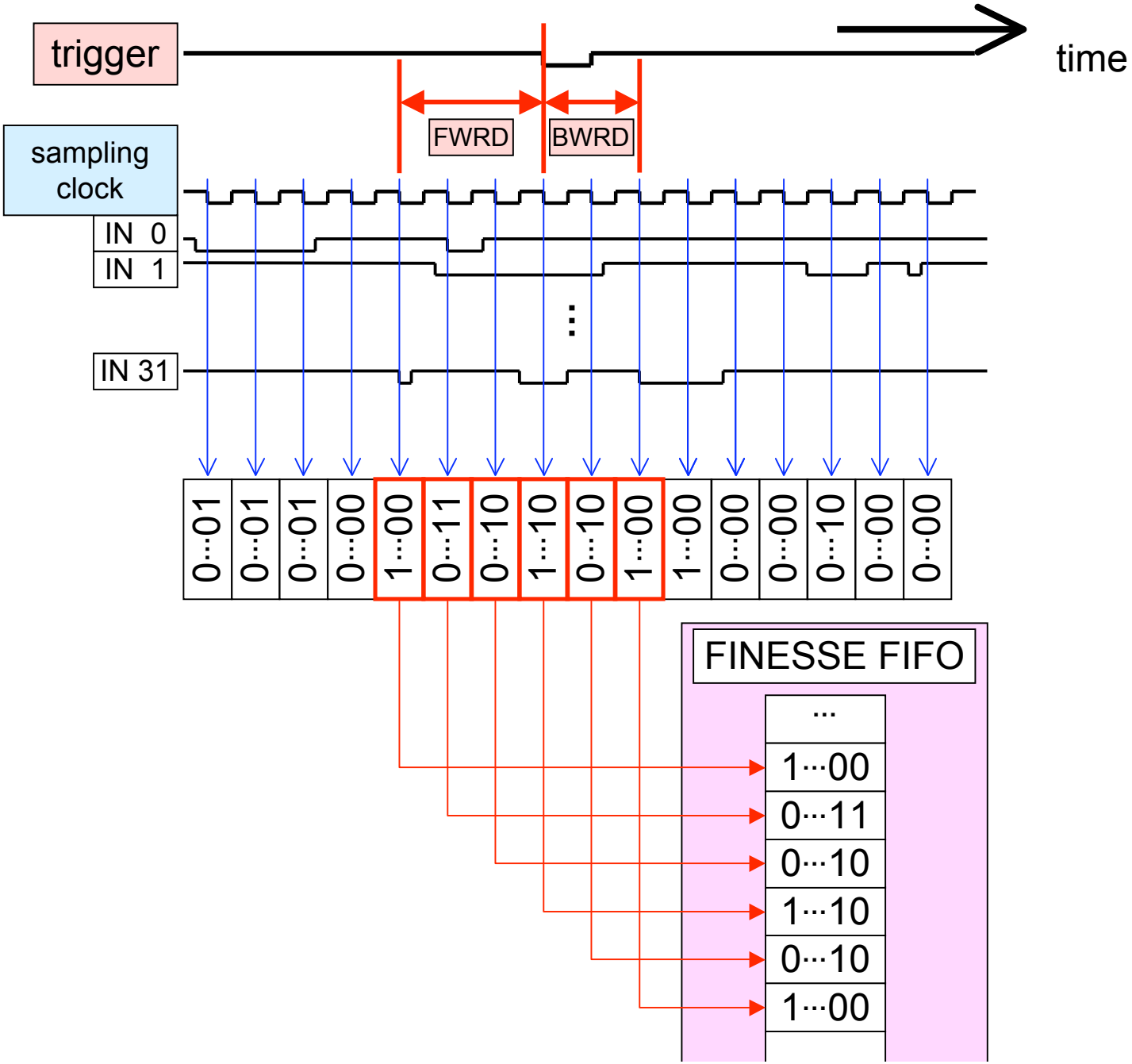
New MWPC Encoder Sceme



New MWPC Encoder Scheme



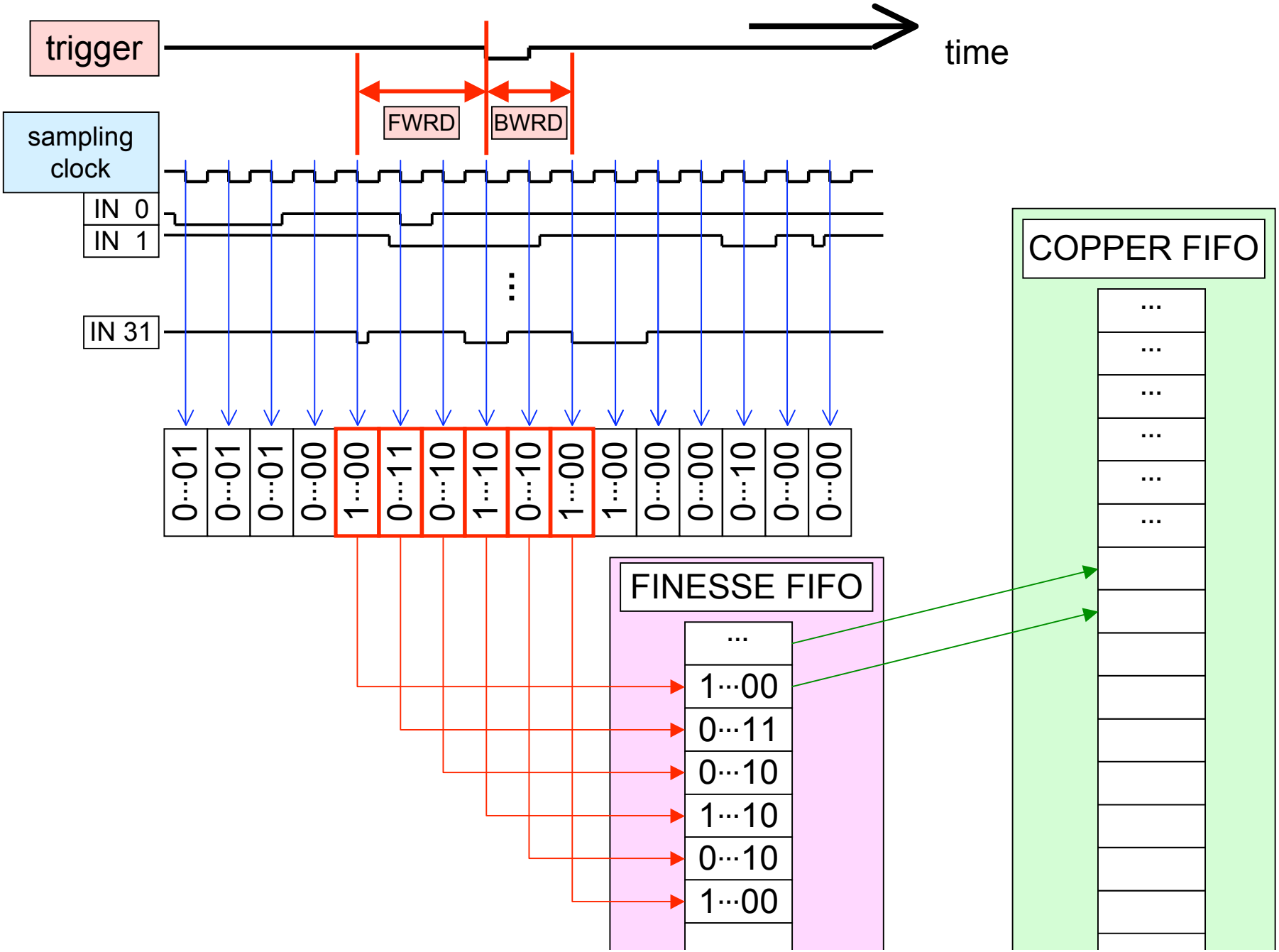
New MWPC Encoder Scheme



MWPC Readout Status

- Basic operation and performance were checked for encoder card.
- Beam test will be done July 10, 2007.
- Minor bug of the firmware was found.
- COPPER boards, FINNESE encoder cards, trigger board, and crates were already fabricated.
- CPU or SiTCP is needed. (not COPPER-Lite)

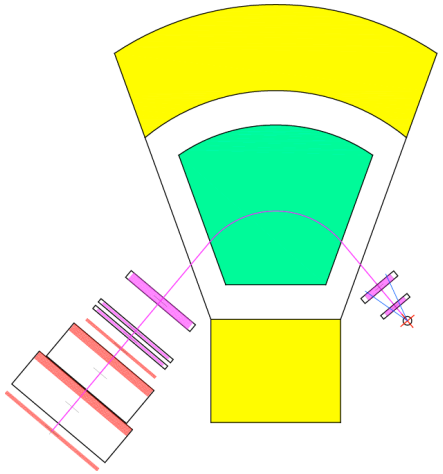
New MWPC Encoder Scheme



SKS Detectors

Three Modes of SKS

SKS

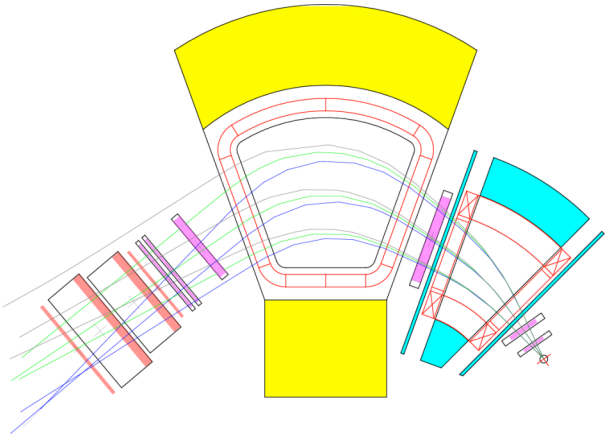


- Present configuration
- 100°bending angle
- ~900MeV/c max. momentum at 2.7T
- 100 msr solid angle
- best resolution was achieved at 2.2T

E19, E10-1

E10-2, E18

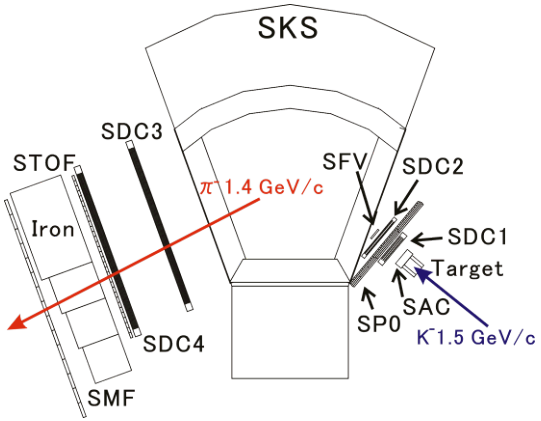
SKS+



- New dipole magnet
- 95°bending angle
- 1.1 – 1.5 GeV/c
- ~30msr

E05

SKS-



- No focusing property
- ~130msr@ 1.4 GeV/c

E13

Upstream Chambers

	SKS	SKS+	SKS-
1st Chamber	$250^{H}x120^{V}mm^{2}$	250^{H} $x120^{v}$ mm^{2}	$\sim 400^{H}x200^{V}mm^{2}$
# of layers	4 or 6	4 or 6	4 or 6
High rate	Yes(Ultra)	Yes	Yes
2nd Chamber	$400^{H}x200^{V}$ mm^{2}	$400^{H}x200^{V}$ mm^{2}	$\sim 550^{H}x200^{V}mm^{2}$
# of layers	6	6	4
High rate	Yes	Yes	Yes(Medium)
3rd Chamber		$1100^{H}x300^{V}$ mm^{2}	
# of layers		3 or 4	
High rate		No	

E03 (E07) requires a 400x250 mm^{2} high-rate chamber

Upstream Chambers

	SKS	SKS+	SKS-
1st Chamber	$250^{H}x120^{V}mm^{2}$	250^{H} $x120^{v}$ mm^{2}	$\sim400^{H}x200^{V}mm^{2}$
# of layers	4 or 6 **3mm DC**	4 or 6	4 or 6 **3mm DC**
High rate	Yes(Ultra) **1mm PC**	Yes **3mm DC(BC)**	Yes
2nd Chamber	$400^{H}x200^{V}$ mm^{2}	$400^{H}x200^{V}$ mm^{2}	$\sim550^{H}x200^{V}mm^{2}$
# of layers	6 **3mm DC**	6 **3mm DC**	4
High rate	Yes	Yes	Yes(Medium)
3rd Chamber		$1100^{H}x300^{V}$ mm^{2}	existing 5mm DC
# of layers		3 or 4	
High rate		No	

E03 (E07) requires a 400x250 mm^{2} high-rate chamber ??

Downstream Detectors

SKS

- Tracker
  1x1 m^2 x 2
- TOF Wall
  1.05x1 m^2
- AC x 2
  1.2 x 1 m^2
- LC Wall
  1.4 x 1.2 m^2

The present setup.

SKS+

- Tracker
- TOF Wall 1
- AC x 2
- TOF Wall 2
- Water Cherenkov

SKS- BD from BNL

- Tracker
  2 x 1 m^2 x 2

muon filter

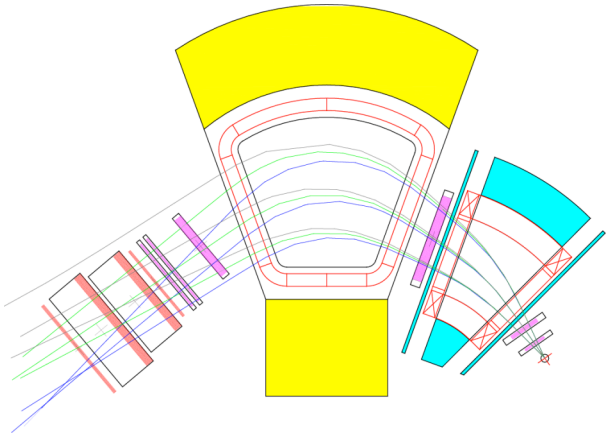
- scintillator wall 1

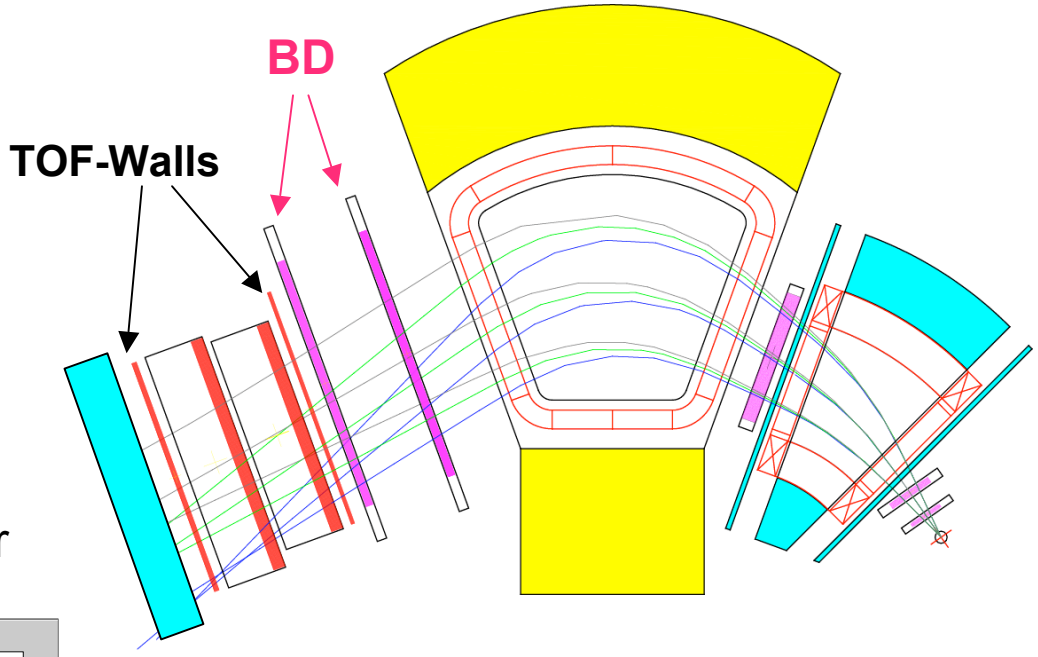
- iron block

BT from BNL

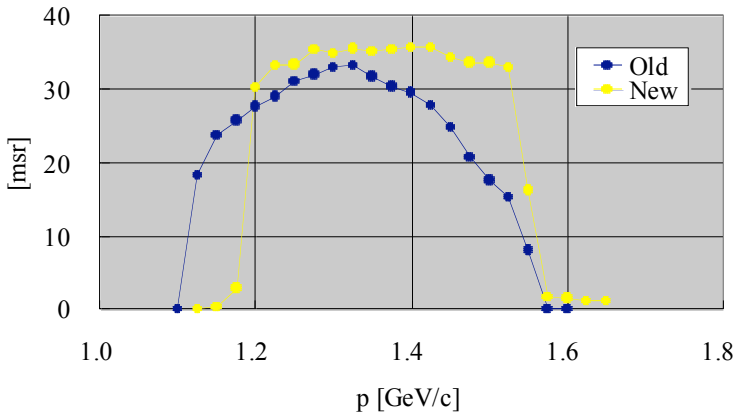
- scintillator wall 2

SKS+ Configuration with BDs





Acceptance 30 –> 35 msr



AC's should be enlarged.

Studies to use BD in SKS is underway.

Collaboration

Meetings

- 1st International collaboration meeting
  - Oct., 2006 at HYP06
- Collaboration meeting among various SKS experiments
  - May 10, 2007 at KEK
- 2nd International collaboration meeting
  - June 2, 2007 at NP@J-PARC in Tokai
- E05 Italy group meeting
  - June 24, 2007 in Varenna

Job Assignments (1)

- 1mm MWPC R&D and fabrication
  - KEK, Dubna
- MWPC readout – ASD and encoder –
  - KEK with help of electronics system group
- 3mm DC R&D and fabrication
  - Kyoto, KEK
- BH1
  - KEK, already fabricated
- BH2
  - KEK

Job Assignments (2)

- BD, BT modification and maintenance
  - Tohoku, Freiburg, MSU
- AC
  - T.B.A. (KEK? Osaka?)
- DAQ
  - KEK, RIKEN(E15) with help of electronics system group
- Water Cherenkov (E05)
  - Italy
- Dipole magnet, DC3 (E05)
  - KEK
- Muon filter, etc (E13)
  - Tohoku

Requests to KEK

- Support for Travel expenses to send people to J-PARC
- Budget allocation for Facility-oriented supports:
  - Trailer houses, Stock room service, Electronics pool, etc.
- Support for Experiment Preparation Area

Beam Request

- We will be ready for the first beam by April, 2009.
- We need test beams for detector checks from Jan. to March, 2009.

- We want to start the first physics data taking not later than September, 2009.