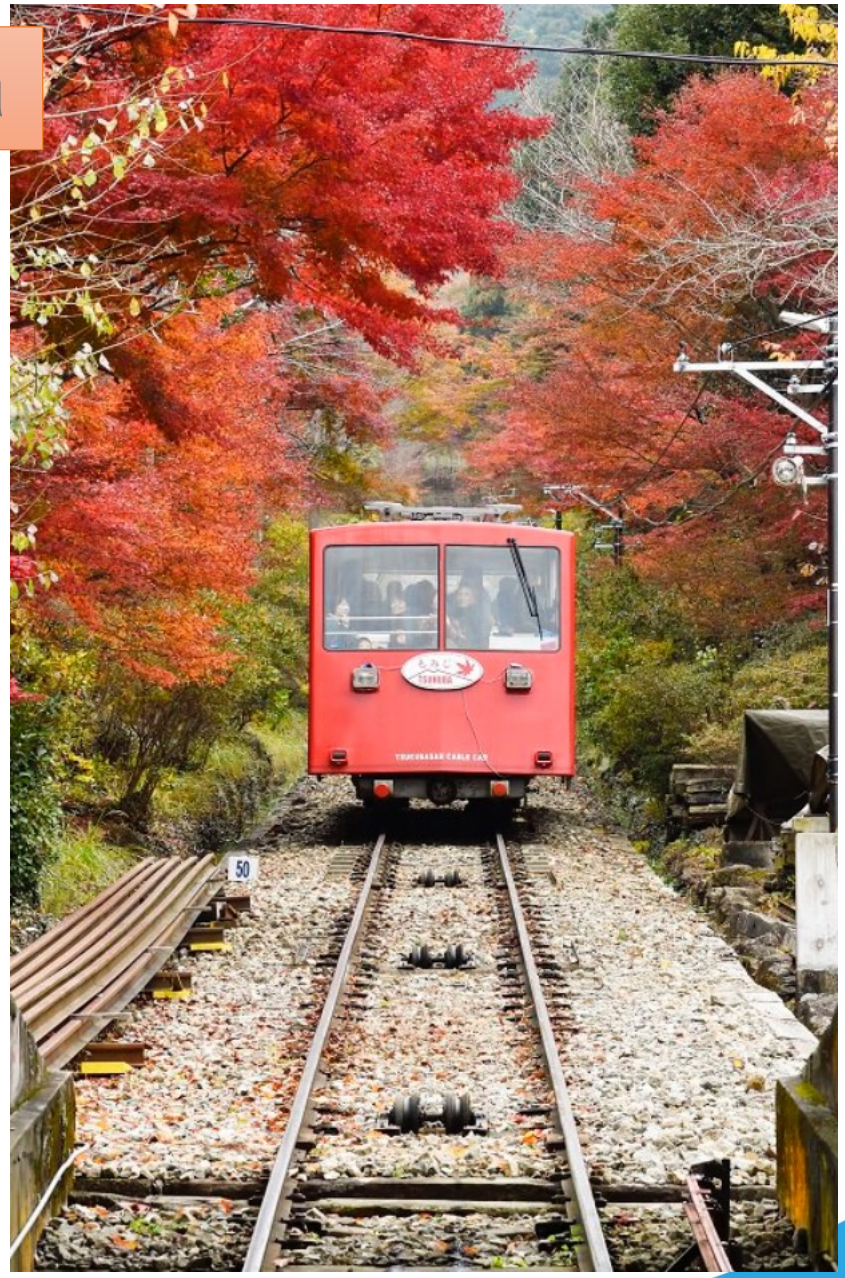
Welcome to KEK



Now　We have a good season.
You can enjoy on Tsukuba-san also in the city.
Autumn is also best season for food.

Shoji ASAI (KEK)

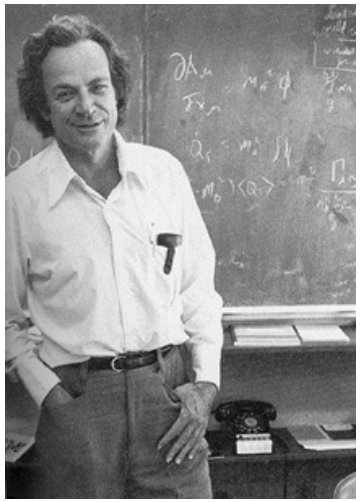
Insight through Accelerators.
KEK

Target of this workshop

What happen!!

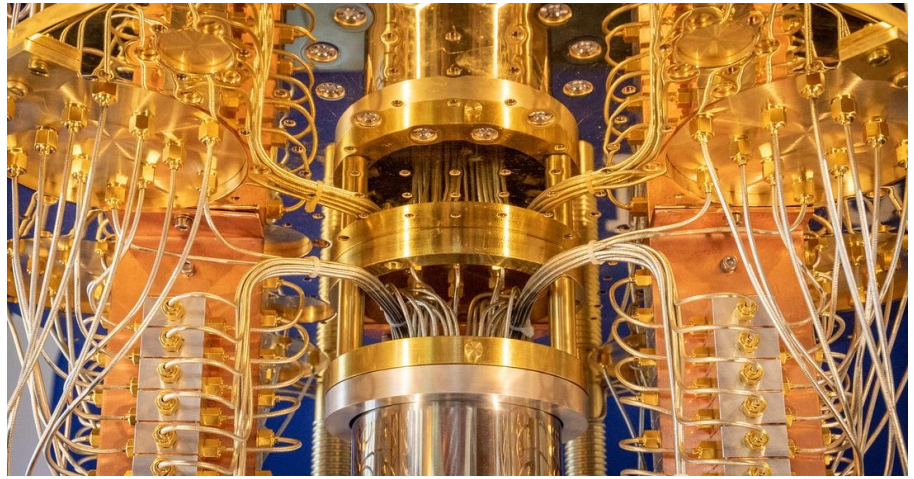
KEK  Riken

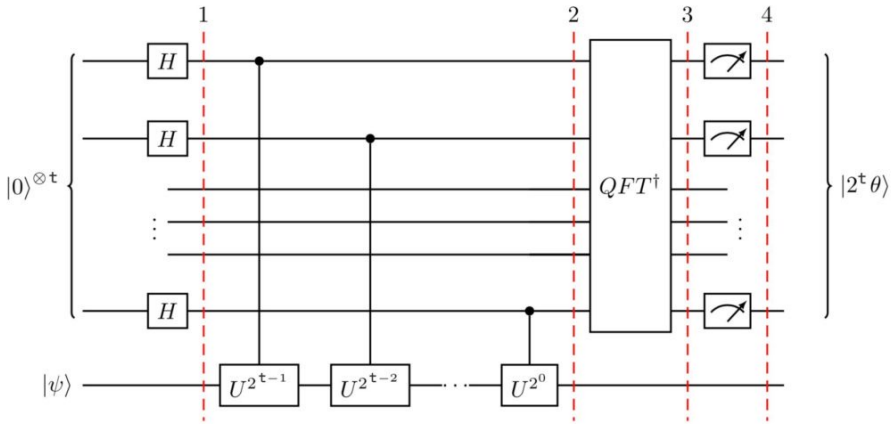
Particle Physics



X

Quantum technology





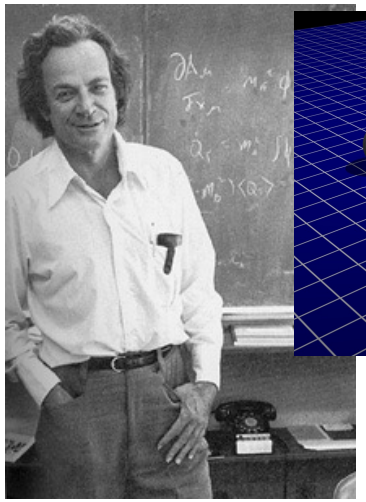
Insight through Accelerators.

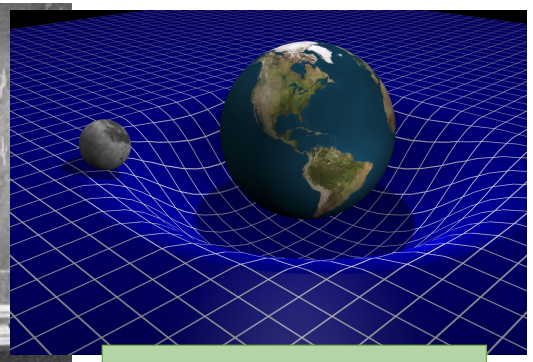
KEK

Target of this workshop

What happen!!

Particle Physics

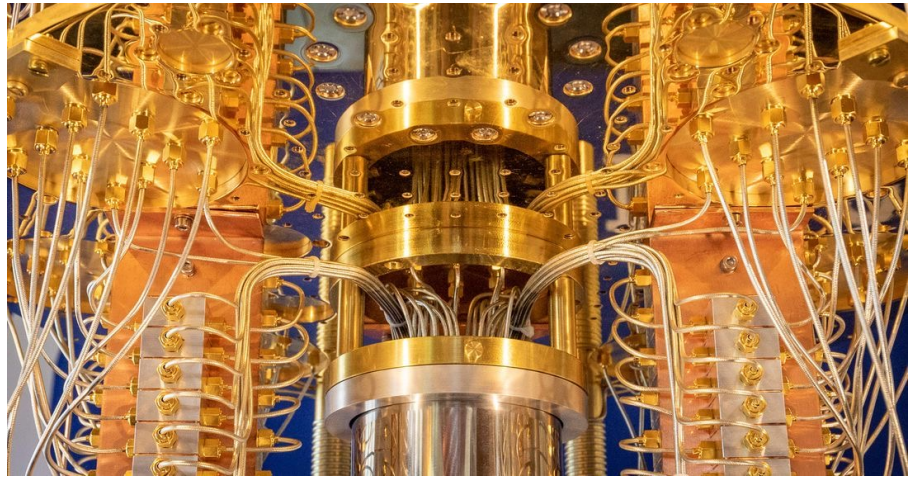


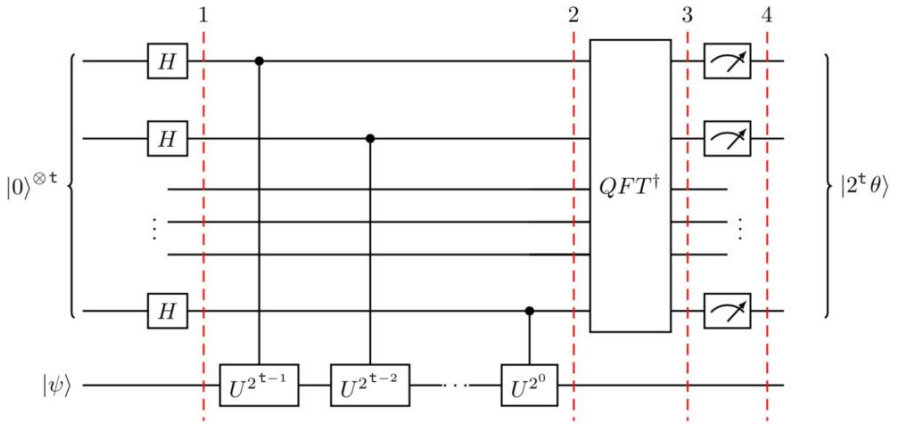


Entanglement in space-time?

x

Quantum technology





Insight through Accelerators.

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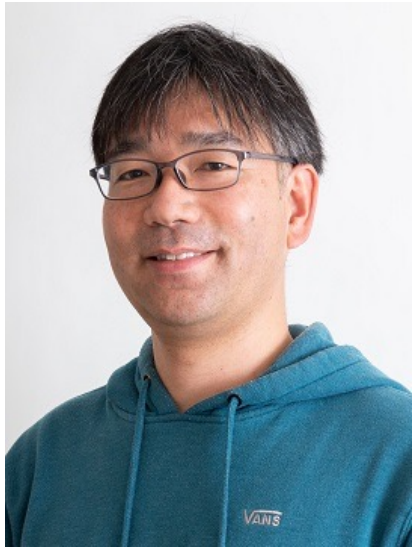
KEK is expert of Particle Physics, but a beginner of Q business.

1) Theory division has many talents for Q business.

Hashimoto-san



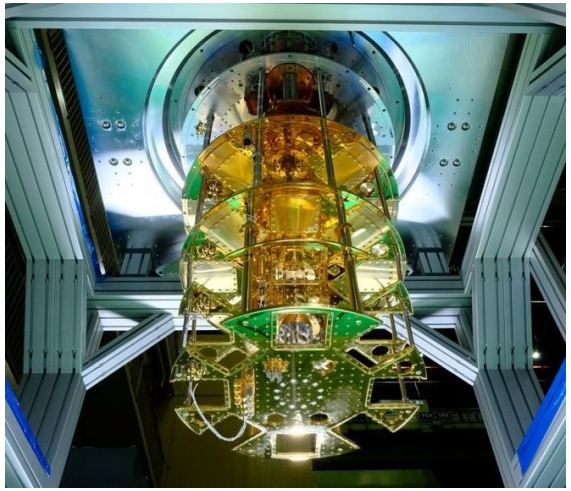
Kitano-san

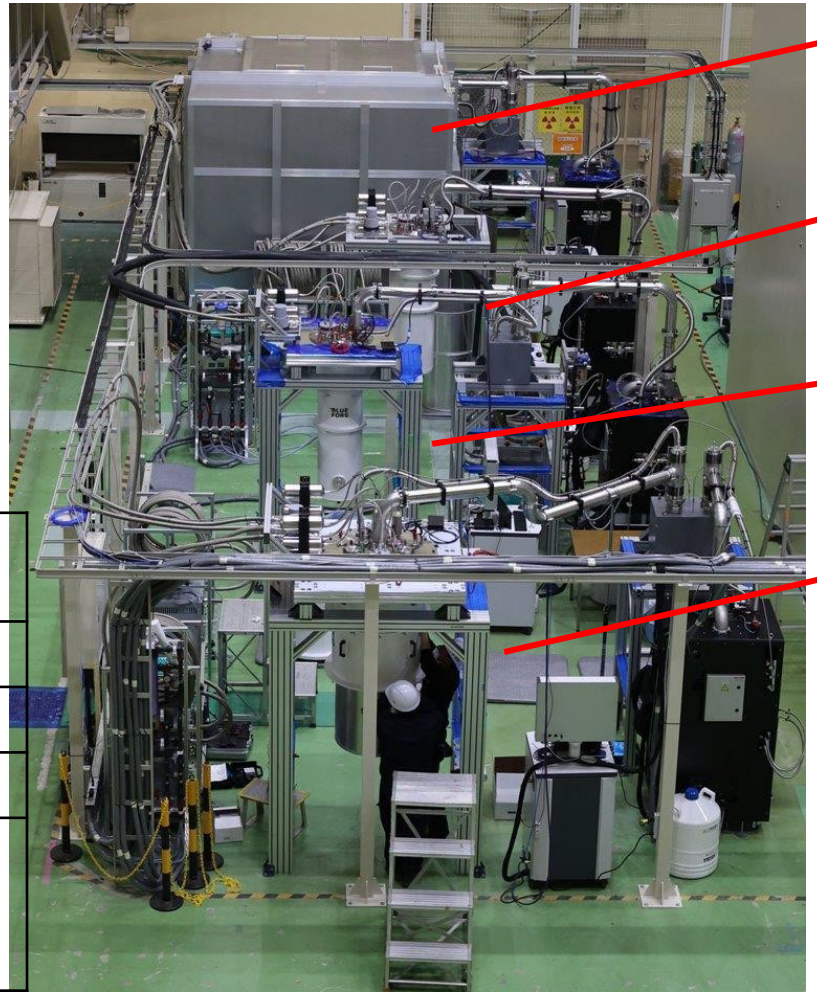
Now I am checking members for KEKQ

2) Cryogenic Facility

4 Cryogenic machines are ready.

Cryo-Facility @Fuji Hall (B4)





^{3}He-^{4}He dilution cooler BlueFors XLD/LD400	
Base temp.	<10mK
Cooling power	500μW @0.1K
Cables	DC/RF
Available options	Anti vibration stage He. battery Optical window etc…

DR4 (XLD400)
Development of SpaceTES for LiteBIRD

DR3 (LD400)
Verification of SpaceTES array for LiteBIRD

DR2 (LD400)
Optical TES / Axion Search

DR1 (XLD400)
Light Dark Matter Search (Kamioka-DM)

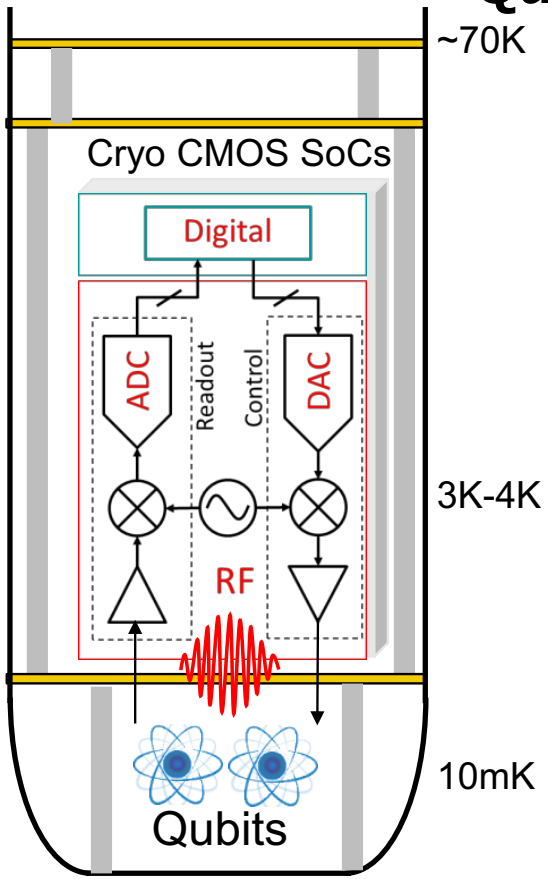
+

DR0 (Oxford Triton)
Multiplexing TES readout

DR5 (SD250) * To be installed
Verification of SpaceTES system for LiteBIRD

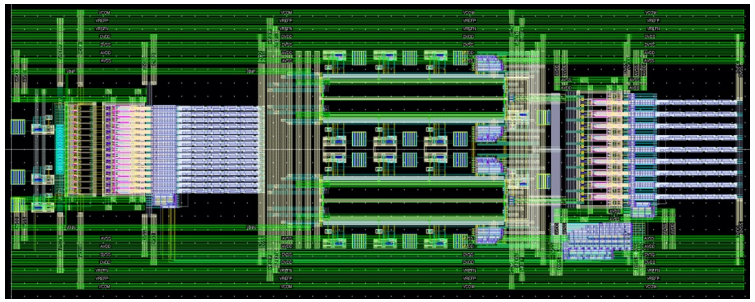
3) Cryogenic CMOS ASICs for Quantum Computing

Subject Goal: Implementing ASICs operating at a cryogenic temperature to control Qubits for quantum computing.

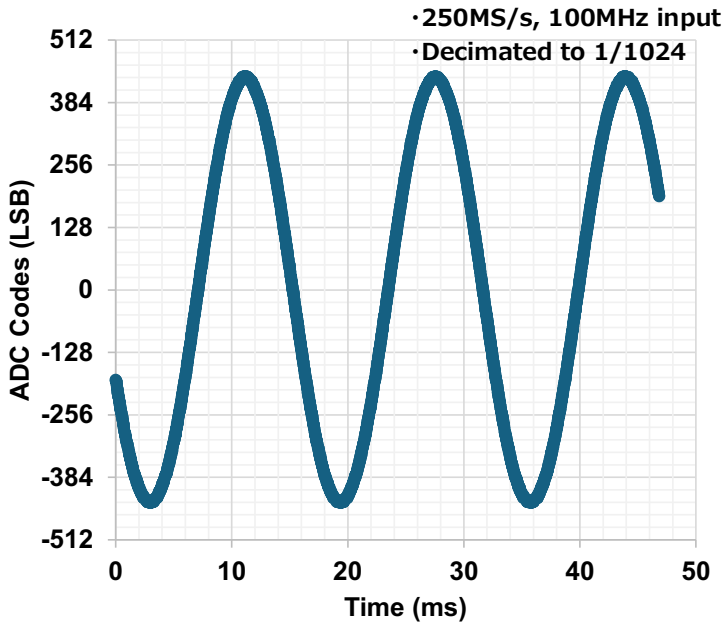


Cryogenic CMOS ASIC for Qubit control

- ✓ Highly integrated
- ✓ Low power
- ✓ Less heat inflow



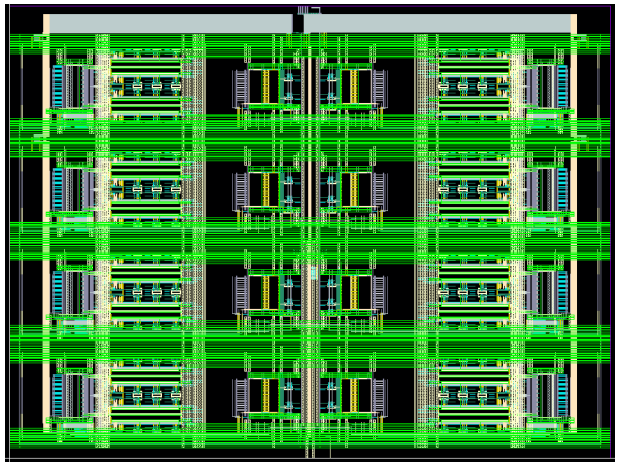
10bit Cryogenic ADC Layout (22nm CMOS)



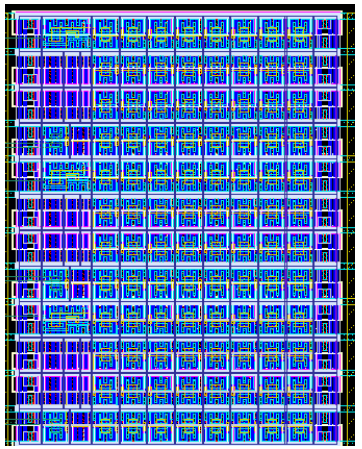
Sine wave input test of ADC @4.2K

Large N Qbit & complicated operation Becomes possible

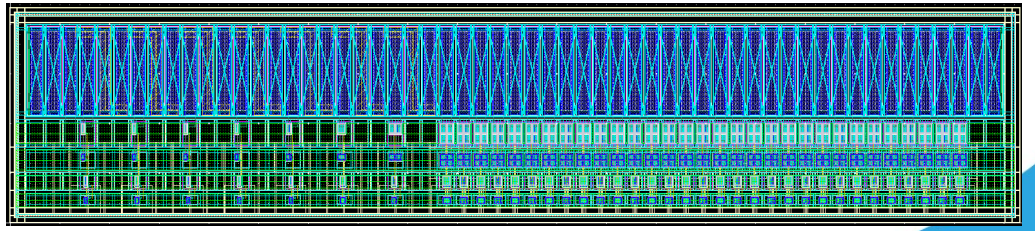
The 1st [illegible] properly operated in cryogenic environment. Various element circuits with further improved performance are under development.



10bit 2GS/s ADC



Oscillator



12bit 2GS/s DAC

Insight through Accelerators.

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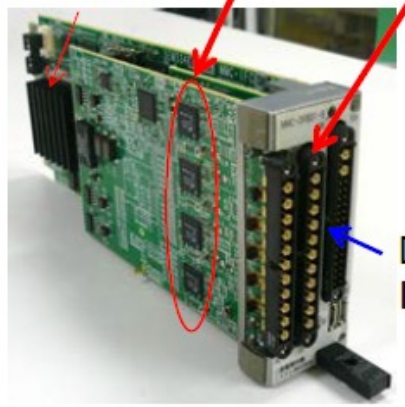
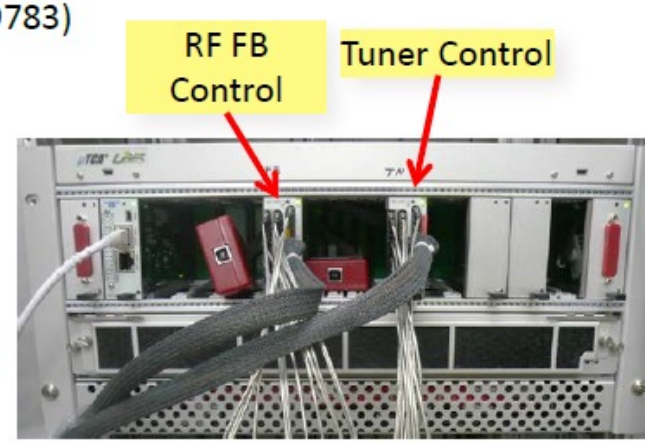
4) We are expert of RF

Digital LLRF System



AMC(Advanced Mezzanine Card)

(Mitsubishi Electric TOKKI Systems Co.,Ltd.)



MicroTCA

Total 11 boards are used for operation.

	BUN	Inj1	Inj2	Inj 3	ML1	ML2
RF FB board	FB0	FB1	FB2 (Vec-sum)		FB4	FB5
Tuner board	TN0	TN1	TN2	TN3	TN4	TN5

- Embedded Linux is working in the PowerPC on FPGA.
- Each board acts as an EPICS IOC.
- Data acquisition is performed through GbE bus on the backplane.

Both RF amplitude feedback and tuner control boards can be used to stabilize the cavity field by simply changing the internal circuit of FPGA.

Let's have tight collaborations

International Collaboration

Q-Sensor
Basic Science

Quantum
Material

Mat.Lab

Workshop
Lab.

PP Lab

ASPIRE

Powerful Q group
in ICEPP

fabrication

CryoCMOS
interface RF tech.
SC Cavity Q>10^{11}

Sensor for Basic Science
Gravity
Q-Connection
Dark Matter detection

Insight through Accelerators.

Let’s have fruitful discussions