

# Developments of Long-pulse Klystron Modulator for KEK SCRF Test Facility

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# Of course you know KEK. Then, what is NICHICON?

Manufacturing Capacitors of various types;  
Manufacturing PowerSupplies of various types;  
for Appliances (NOT for Fire Engine), Industries,  
Vehicles, and Scientific Researches especially  
for Accelerators.

- Pulsed or DC Magnet Power Supply
- Pulsed or DC Electron Tube Power Supply
- Pulsed or DC High Voltage Power Supply

# NICHICON CORPORATION

Company Name	NICHICON CORPORATION
Established	August 1, 1950
Paid-in Capital	14,286 million yen
Sales	106,718 million yen (Consolidated) Mar.31.'06
Number of Employees	5,846 (Consolidated) Mar.31.'06



**HEAD OFFICE**  
Kyoto, JAPAN

## Product Lines

Aluminum, Tantalum, Film capacitors

Hybrid ICs, Positive Thermistors

Switching Power Supplies

Capacitors applied systems and equipment

# PRODUCT & TECHNOLOGY

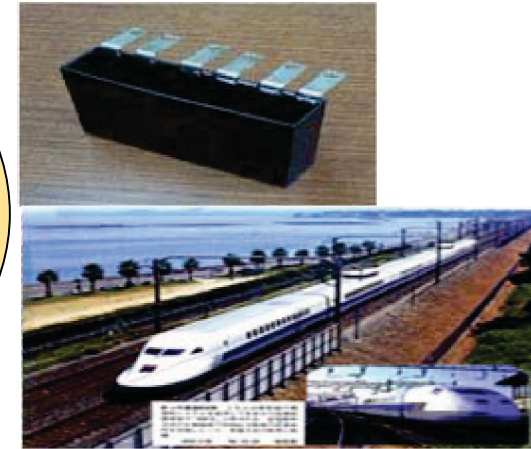
## NICHICON CORPORATION



### Aluminum capacitors

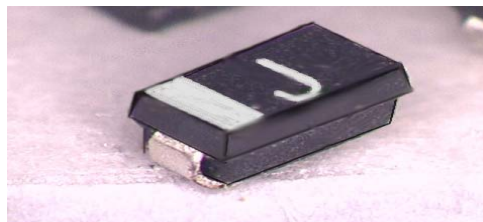


### Film capacitors



CAPACITORS  
FOR POWER &  
ELECTRONICS  
Power Supplies

### Tantalum capacitors



*Speed & Flexibility*



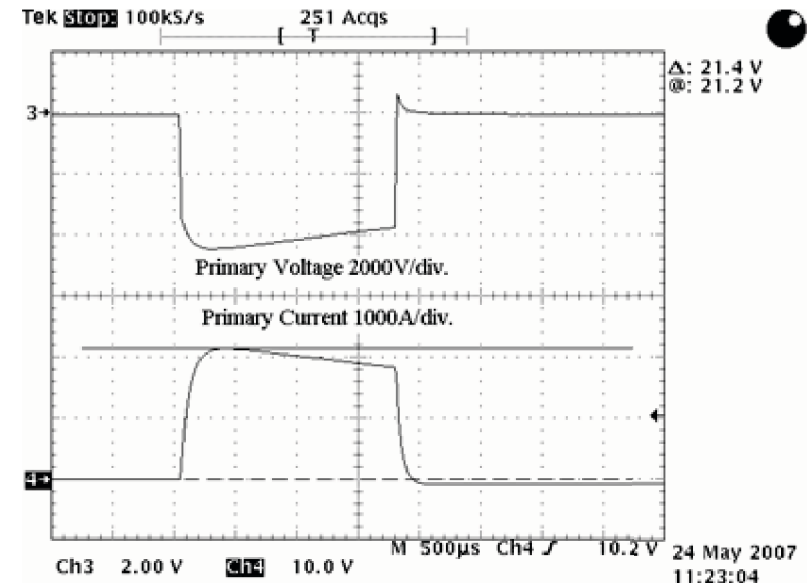
### Power Supplies



**nichicon**

# Novel Long Pulse Modulator

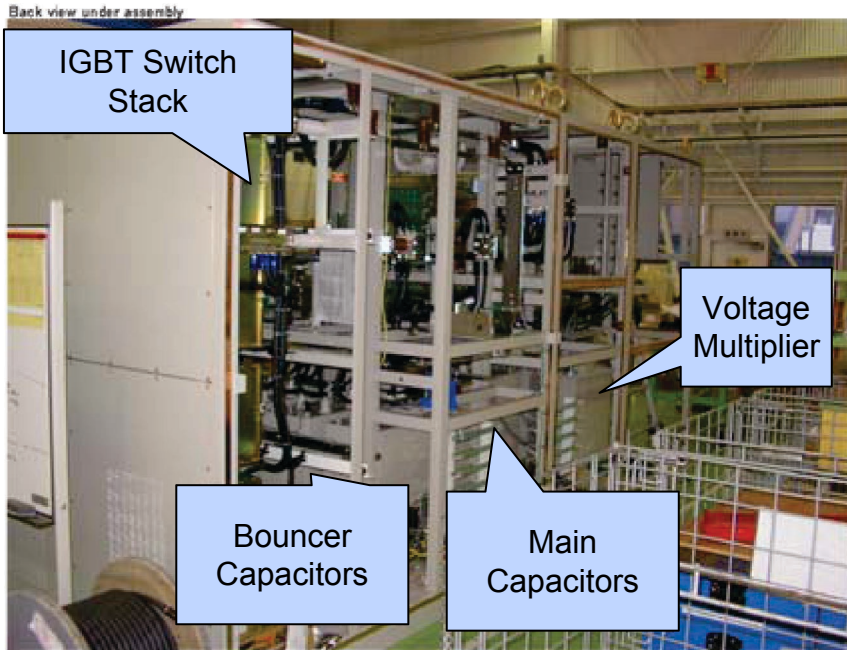
Crowbar-less system by highly reliable IGBT switch  
Compact and highly reliable Self-Healing capacitors  
Mass-Production oriented Transformer Design



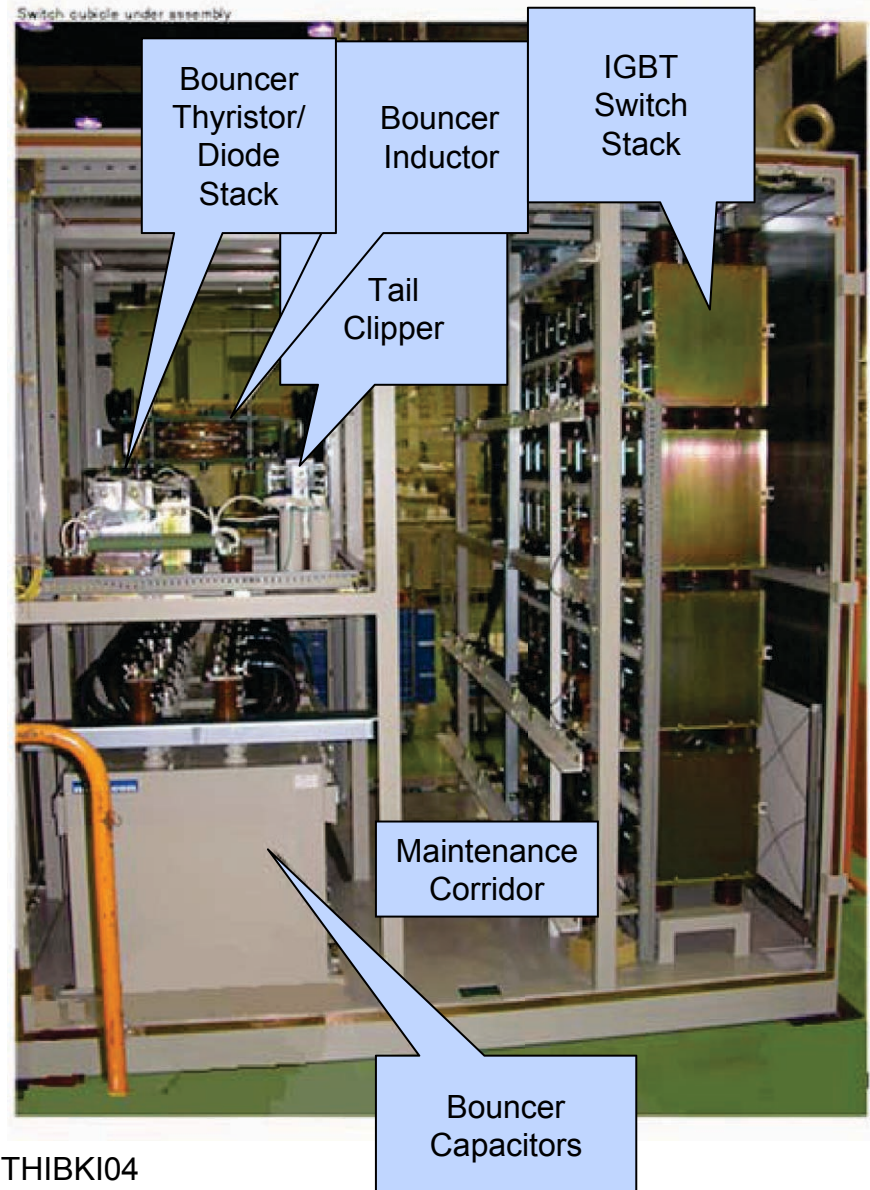


# Photos Inside the Modulator

Rear View



Front View of Switch Cubicle



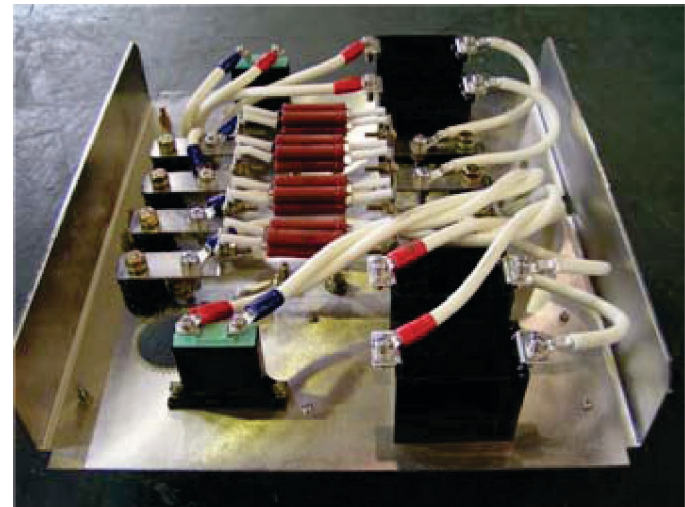
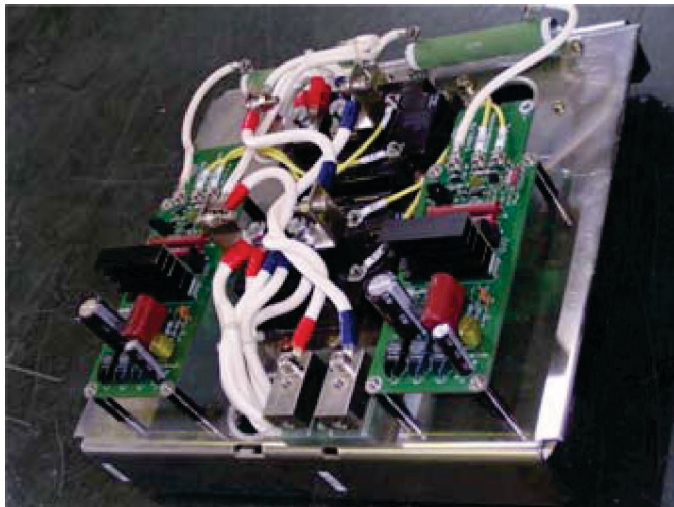
# Crowbar-less system by highly reliable IGBT switch

Long-term performance in Nuclear Fusion Experiments

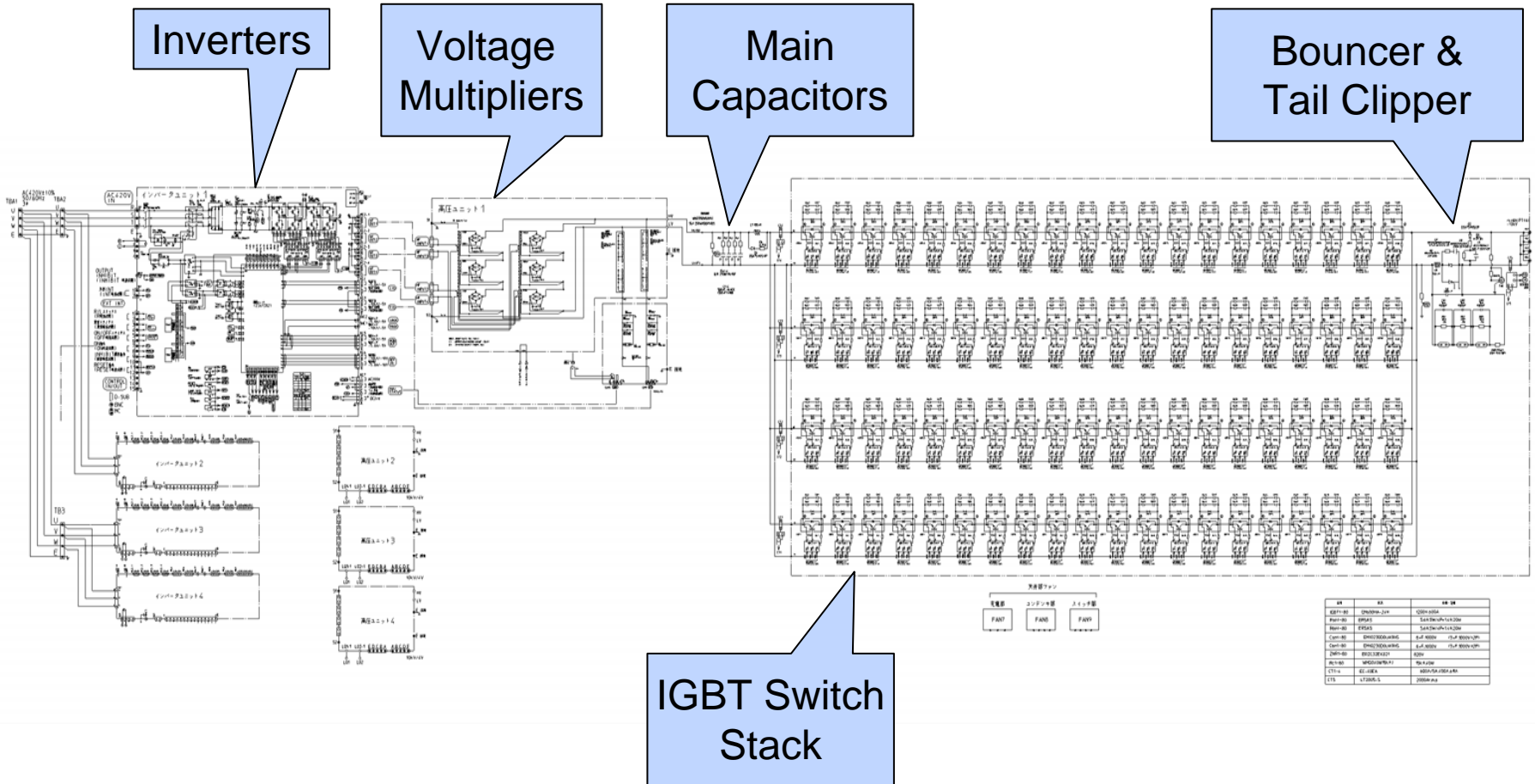
Optimal Snubber design

Two Optical fibers to control doubly and,

One Optical fiber to detect short-circuit of each IGBT module



# Modulator Schematic Diagram





# Compact and highly reliable Self-Healing capacitors

## Small Size and Higher Energy Density

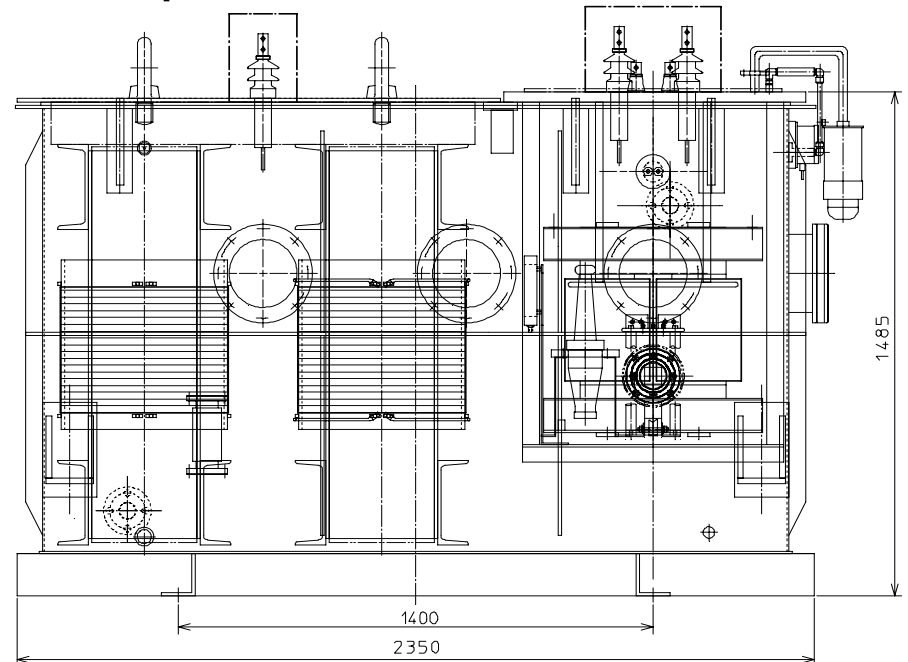
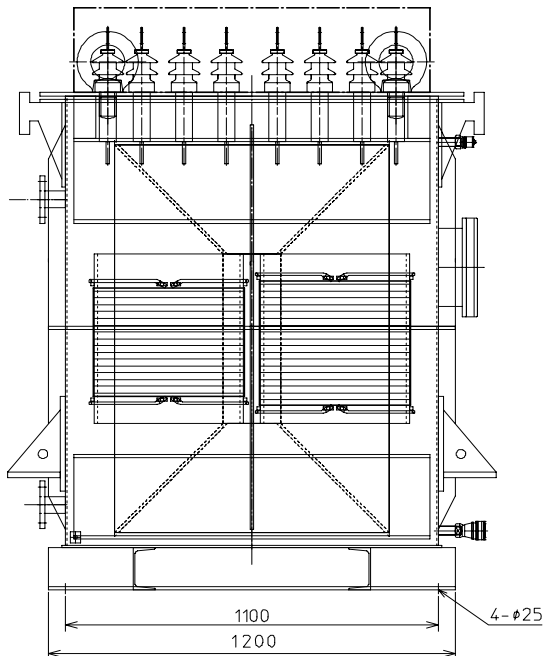
Comparison table of main capacitors for ILC Long-pulse Klystron Modulator

Supplier	NICHICON	GE	AVX
Capacitance (microF)	440	25	488
Cap bank no	4	56	3
Rated dc Voltage (kVdc)	11	12	12
Storage energy (kJ)	26.6	1.8	33.6
Weight (kg)	140	39	195
Volume/100kJ (m <sup>3</sup> /100kJ)	0.415	<0.75	<0.75
Weight /kJ (kg/kJ)	5.3	21.7	5.8
Life time (minimum) (h)	90,000	90,000	139,000

# Mass-Production Oriented Transformer Design

Divided into two transformers;  
one for full withstanding voltage and  
the other for half

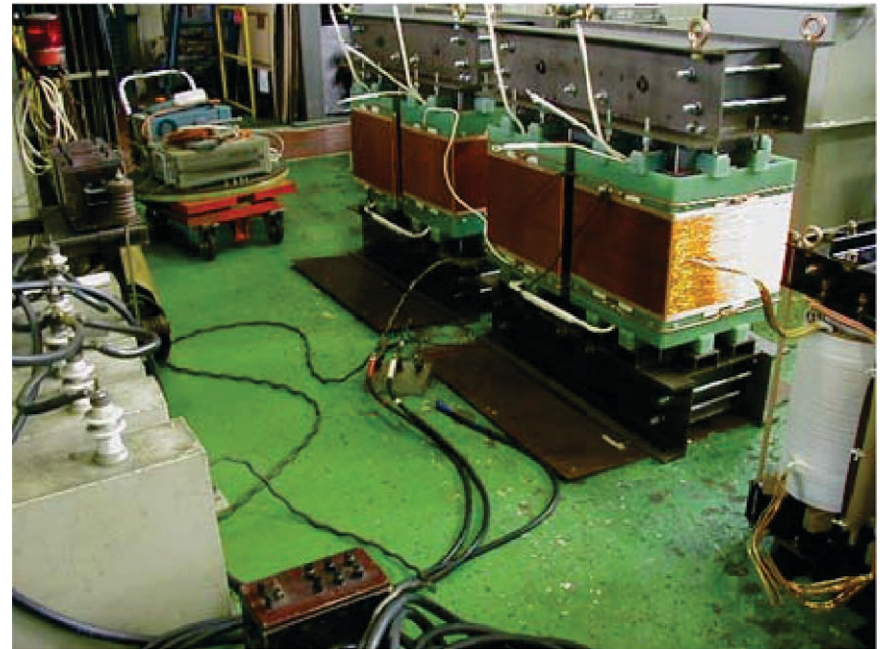
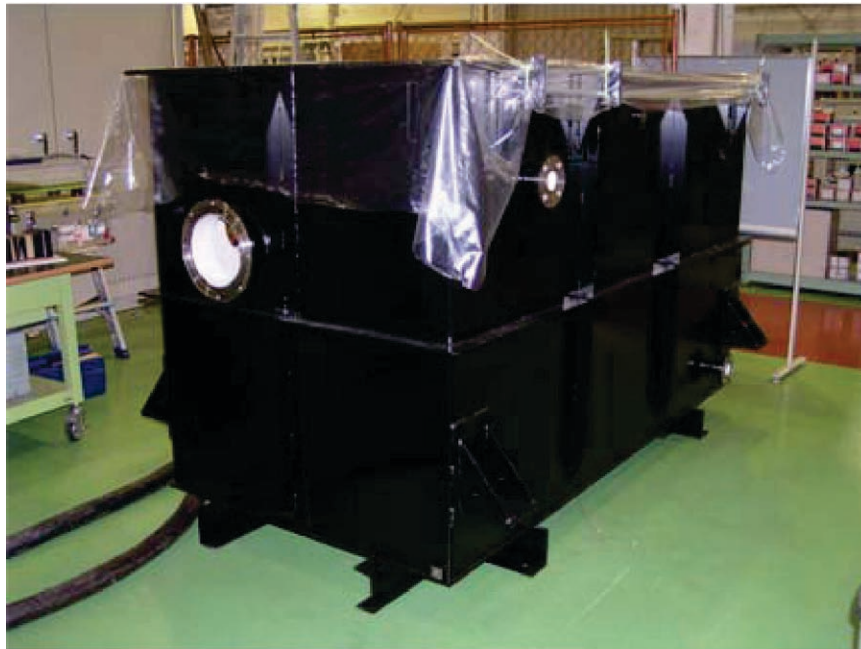
Laminated core suitable to mass-production



# Photos - Long Pulse Transformer

Tank

Impedance Measuring



# Status & Plan

- Factory Test & Site Installation Completed
- Starting Up at KEK STF
- Multi-beam Klystron Aging & Power Test Planned
- Further Improvement for System Reliability and Optimum Engineering Design