日本におけるTGC生産

田中秀治 (高エ研)

高エ研　岩崎博行

神戸大自然　石井恒次, 宇田純郎, 越智敦彦, 緒方岳, 喜家村裕宣, 蔵重久弥, 杉本拓也, 武田廣, 本間康浩, 野崎光昭

東大素セ　石野雅也, 川本辰男, 小林富雄, 南條創,

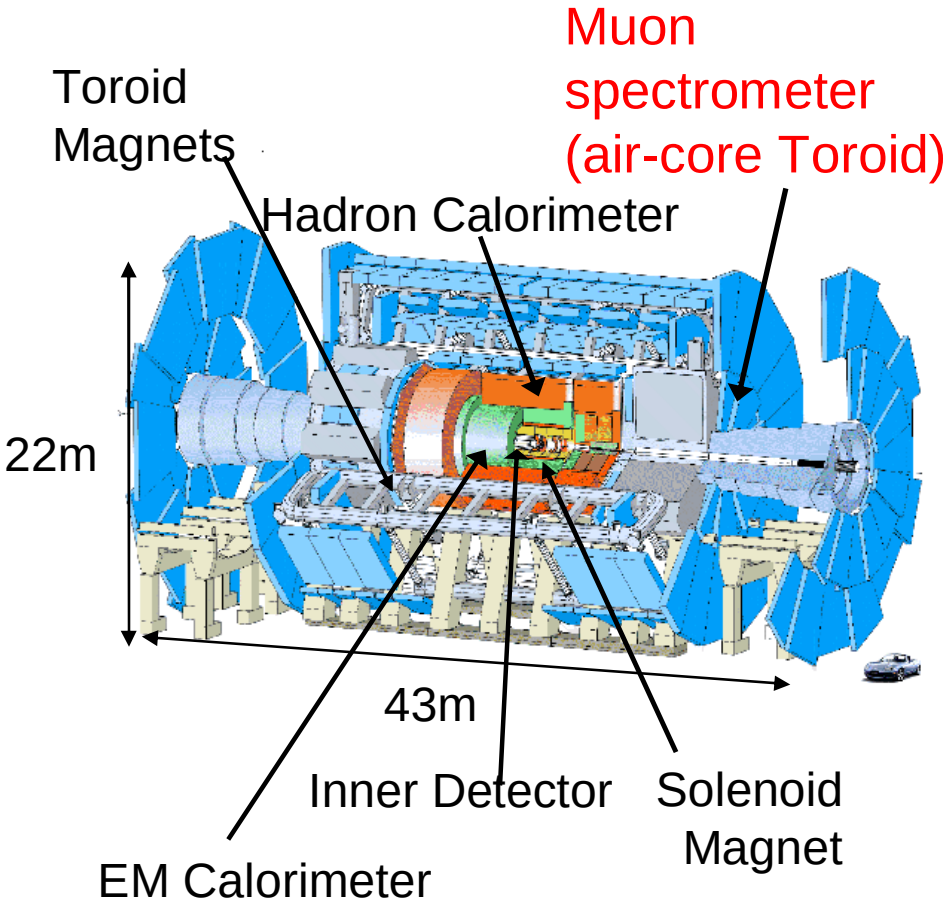
信州大理　竹下徹, 大下英敏

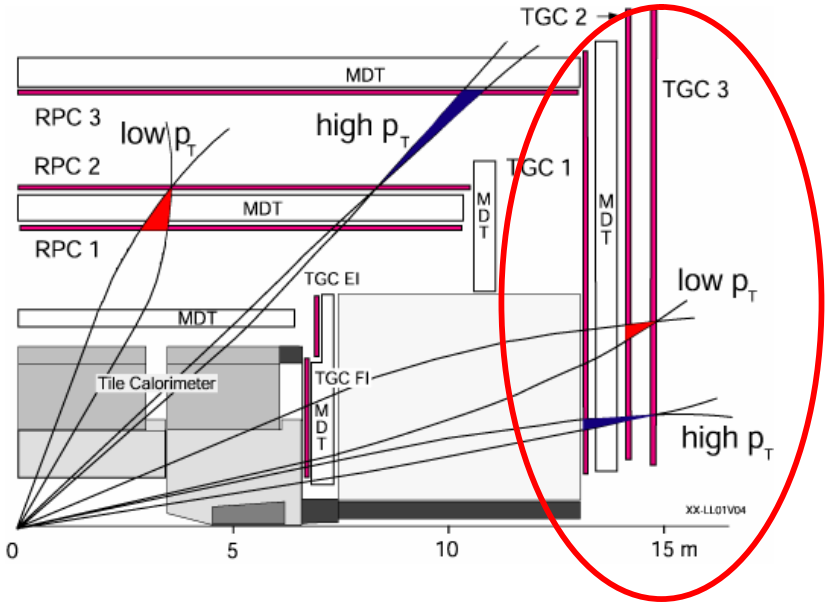
東大宇宙線研　横山千秋

2005/3/26

Introduction

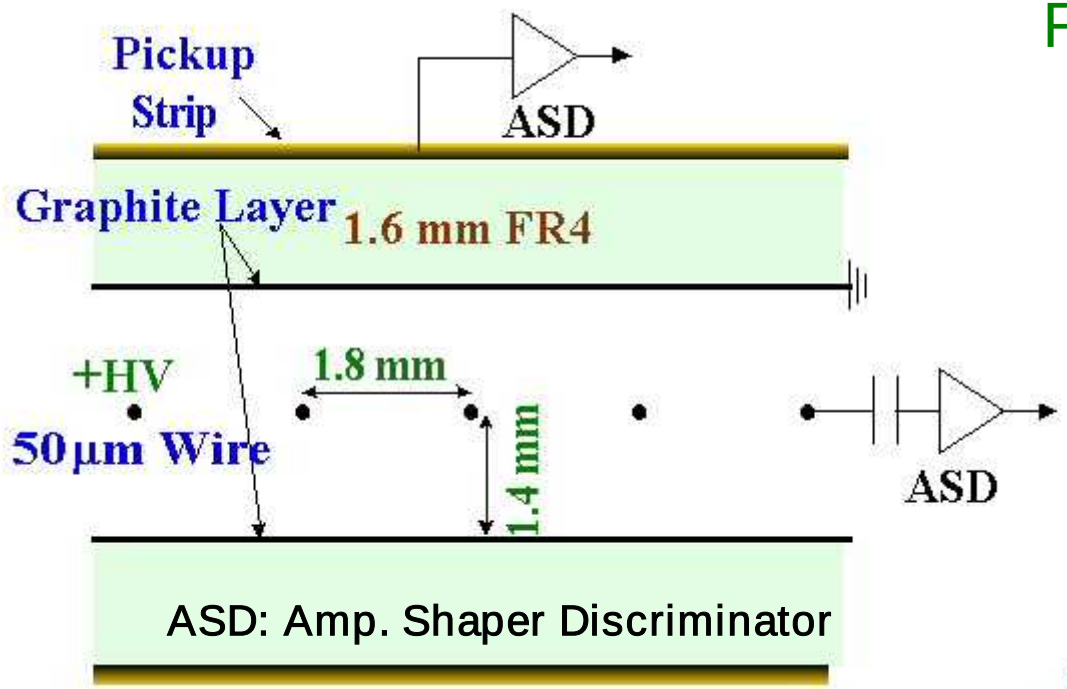
- Thin Gap Chambers (TGCs) are used for the muon trigger system in the end-cap regions of the ATLAS detector at Large Hadron Collider(LHC).





- TGC at ATLAS detector
  - Total 3600 chambers
  - 320,000 read-out channels
  - Total area ~2,000m^2

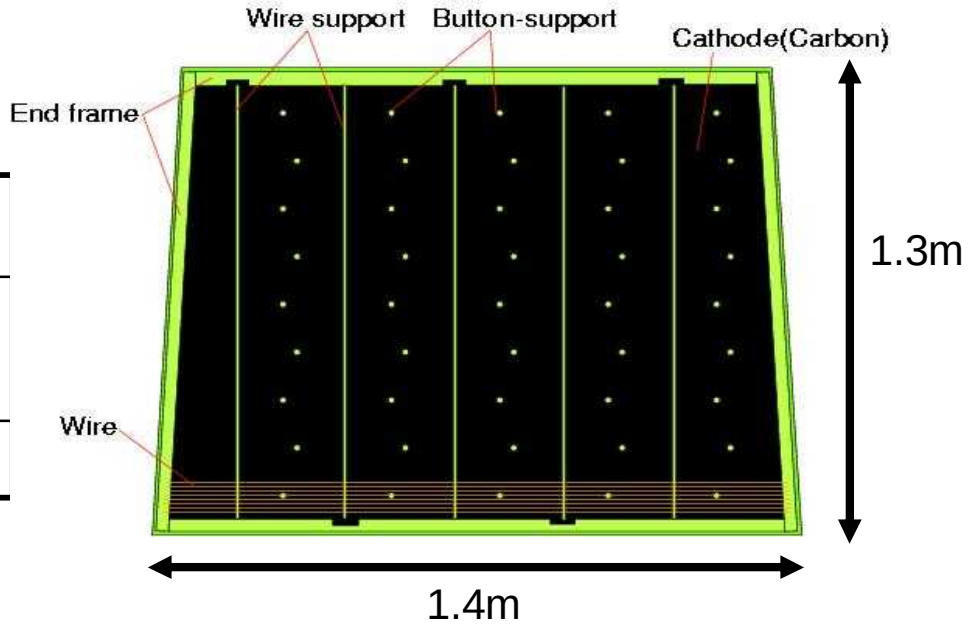
Thin Gap Chamber



Requirements on ATLAS:

- Fast signal response (<25ns)
- High efficiency (>98 %)
- Radiation-proof (~0.6C/cm)
- Rate capability (~kHz/cm^2)

Wire potential	3.0 kV
Gas mixture	CO2 + n-pentane (55%) (45%)
Wire diameter	50 μm



TGC production facility in Japan

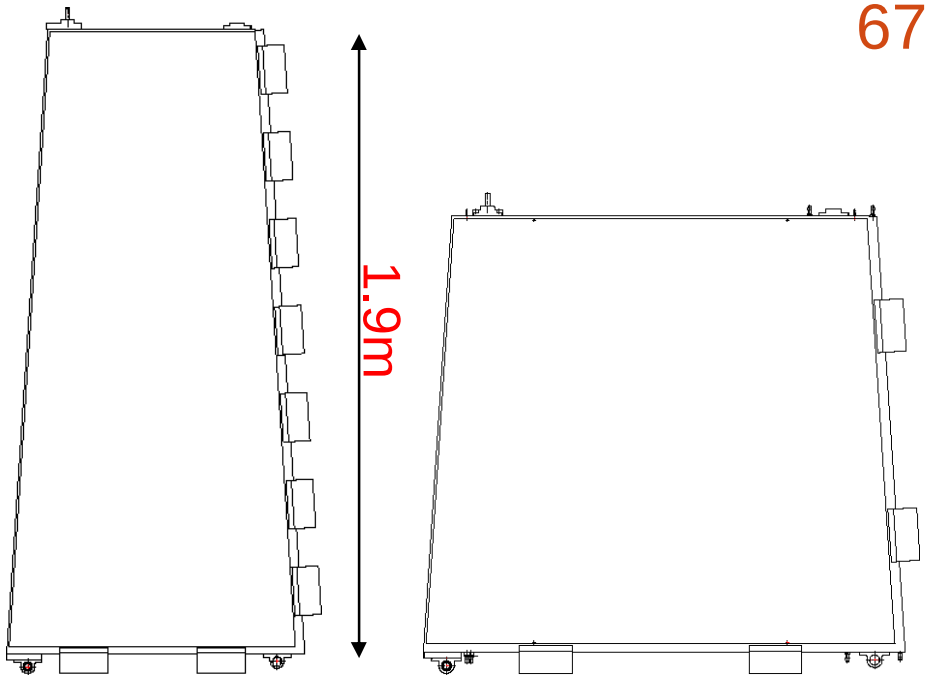
1998 1999 2000 2001 2002 2003 2004

Test production

T7 type production
672 chambers

T4
192

T5
192



T4/T5

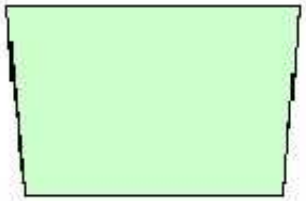
T7

- TGC modules in JAPAN
- Doublets: 384
- Triplets: 96
- Total 1056 TGCs

2 TGCs /day should be produced !

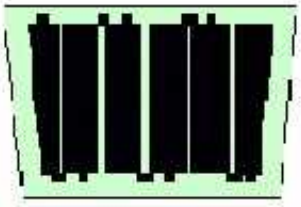
Production Procedure

Checking quality



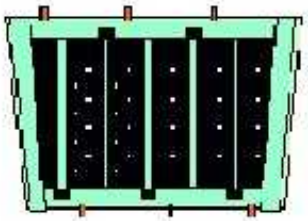
4 boards /day

Graphite spraying



80 boards/month

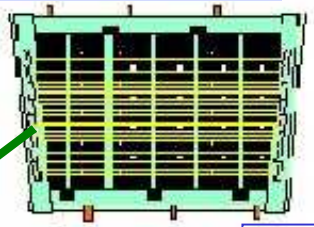
FR4 Frame Gluing



4 boards/day

3 persons

Wire winding



2 boards /day

1 person

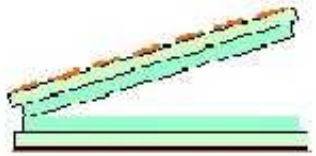
Mounting

Read-out boards

1 Unit/day

3 persons

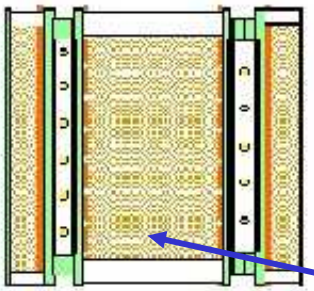
Singlet closing



2 TGCs /day

3 persons

Making doublet (triplet)

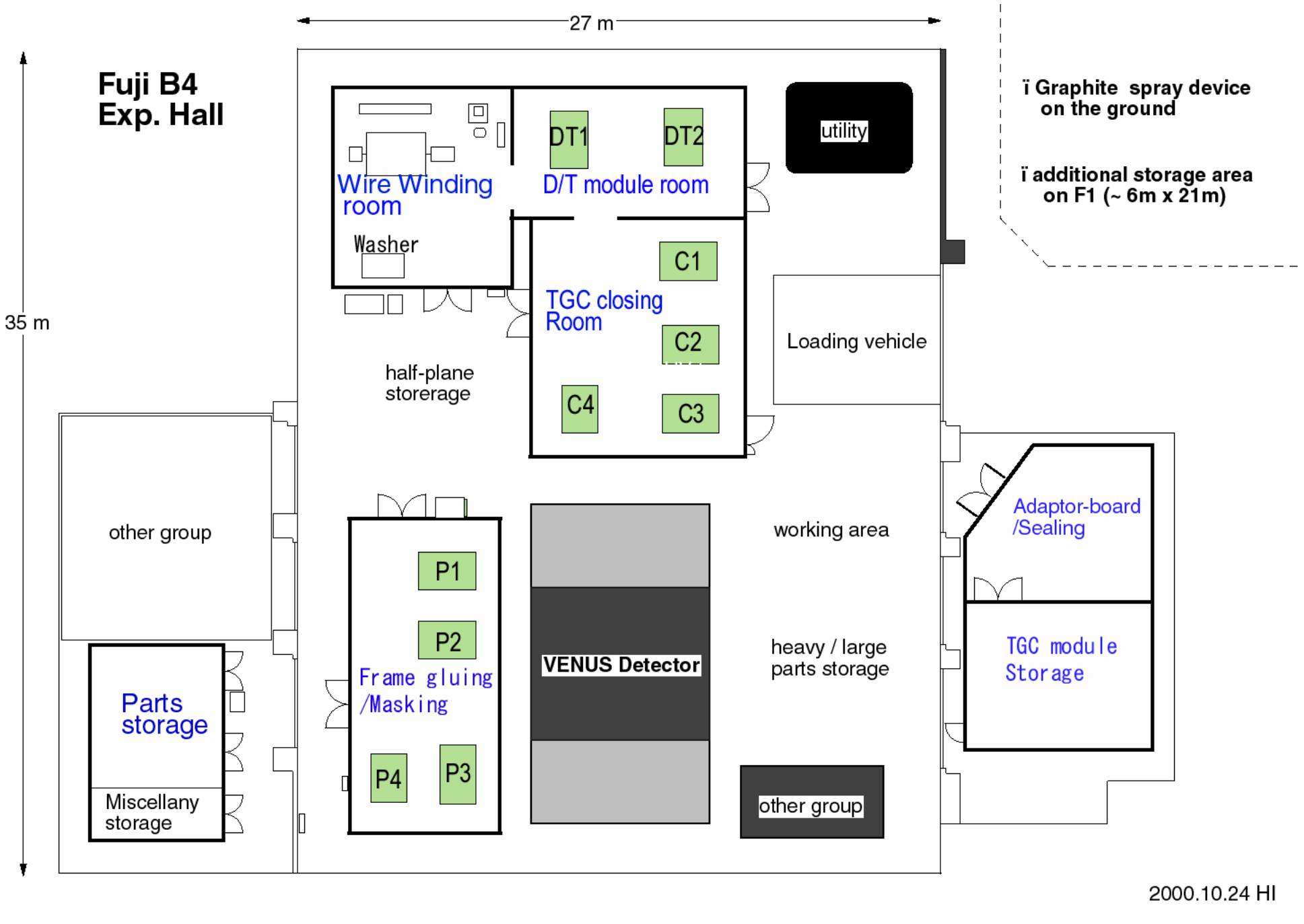


1 Unit/day

2 persons

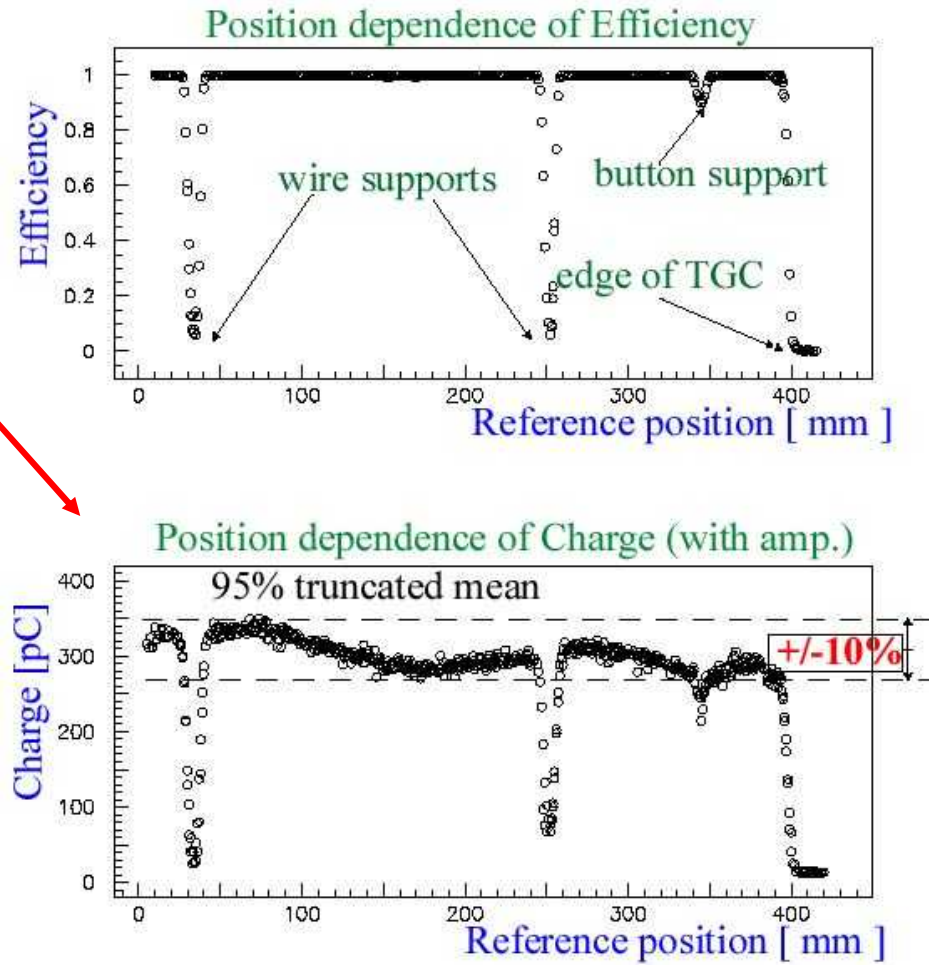
Paper honeycomb

Total : 12 persons


Fuji B4
Exp. Hall
27 m
35 m
DT1
DT2
utility
Wire Winding room
D/T module room
Washer
C1
TGC closing Room
C2
C4
C3
half-plane storerage
Loading vehicle
other group
P1
P2
Frame gluing /Masking
P4
P3
VENUS Detector
working area
heavy / large parts storage
Adaptor-board /Sealing
TGC module Storage
Parts storage
Miscellany storage
other group
ï Graphite spray device on the ground
ï additional storage area on F1 (~ 6m x 21m)
2000.10.24 HI

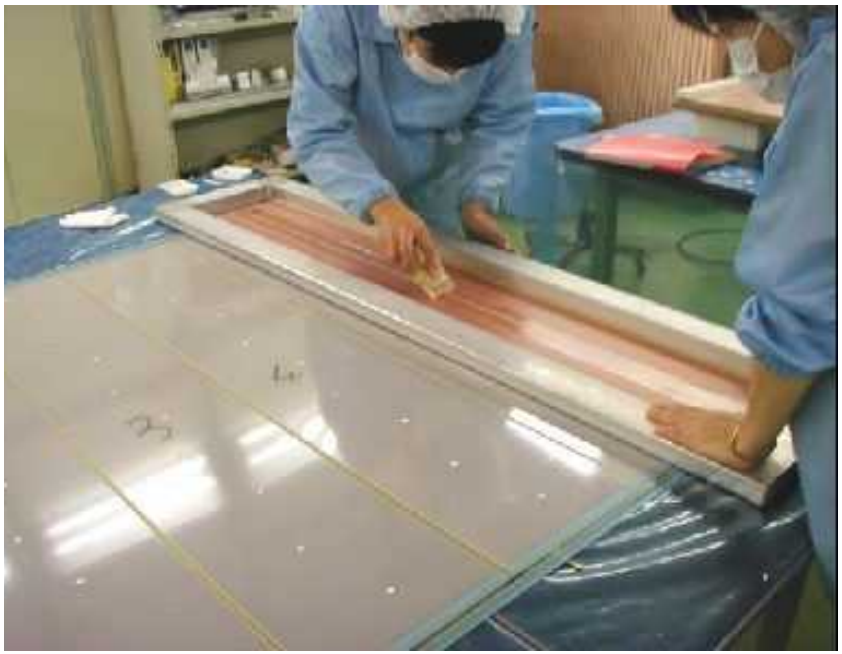
Quality Control

- TGC is fabricated by the gluing processes
  (we can no longer reopen it after closing TGC).
- We have to control the surface distortion less than 200 μm
- We apply following tests:
  - ✓ Measurement of the surface resistance of cathode after the graphite spraying,
  - ✓ High voltage test before and after closing singlet TGC,
  - ✓ Pulse test after mounting adapter board and
  - ✓ High voltage test after mounting adapter board.
  - ✓ Pulse response check by β-ray radioactive source
  - ✓ Cosmic ray test at KOBE Univ.



Graphite spraying and FR4 frame Gluing

- Graphite spraying by automatic sprayer
  - two-dimensional linear actuator
  - spray gun by the pneumatic control



AT FR4 Frame gluing :

To control the quality of epoxy adhesive.

Screen painting method for parts and Auto dispenser for button supports are adopted.

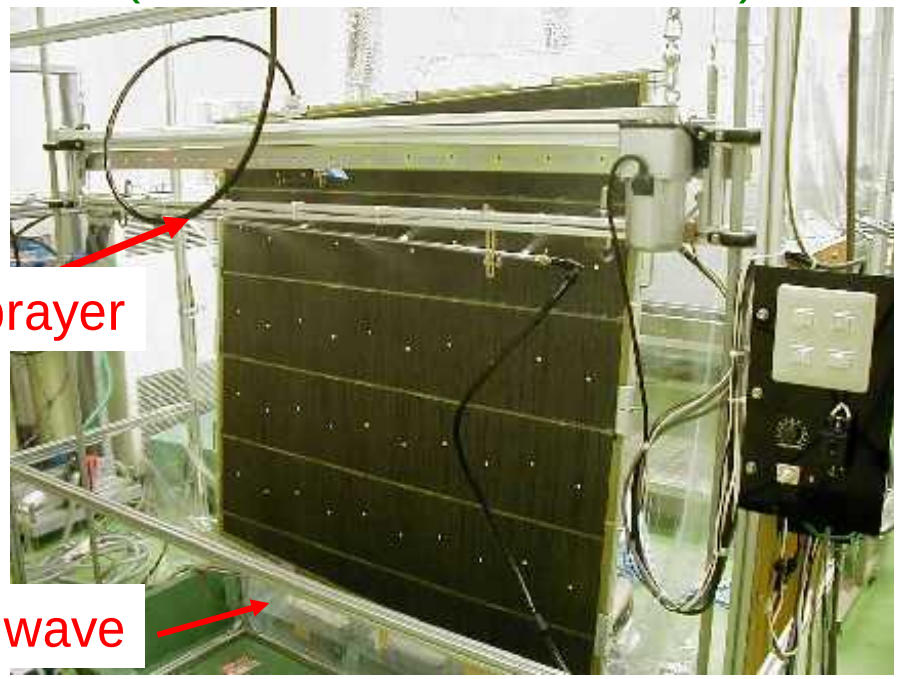
Wire winding

Wire winding machine

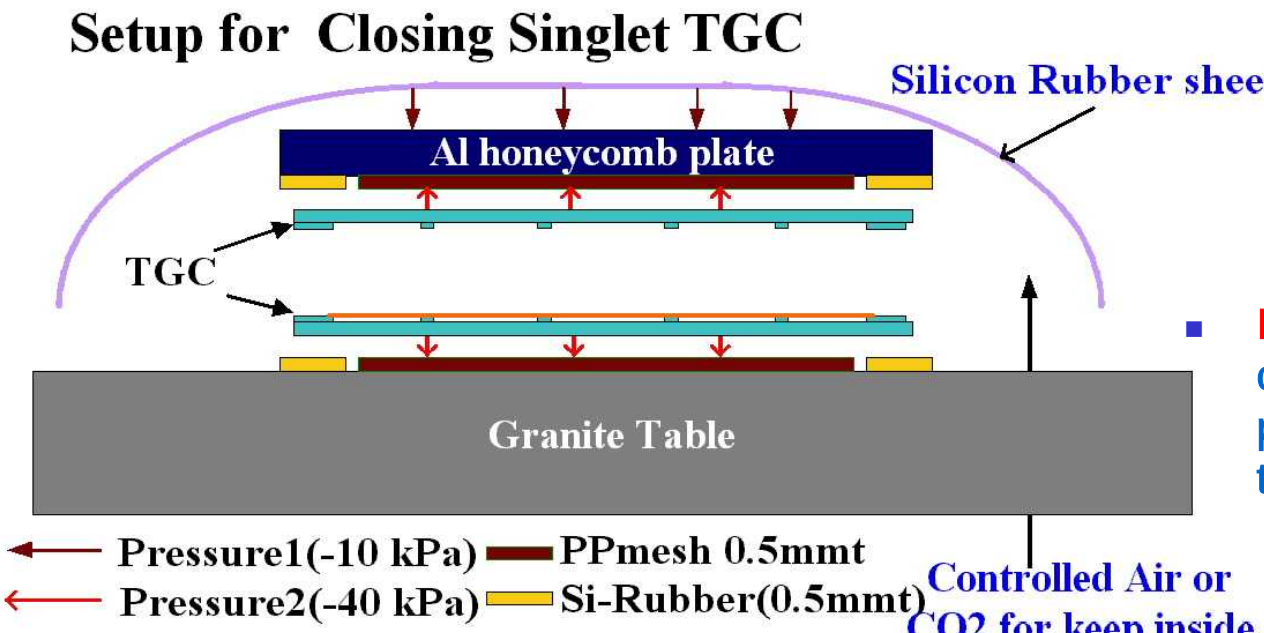
- ✓ Consists of a linear actuator and a rotating table.
- ✓ Total ~ 800,000 wires
  - Anode Wire: Gold plated Tungsten (A.L.M.T. co. Ltd.)
  - Solder: Sn(80)+Zn(20)
- ■ Flux: Water soluble flux

Washing machine:

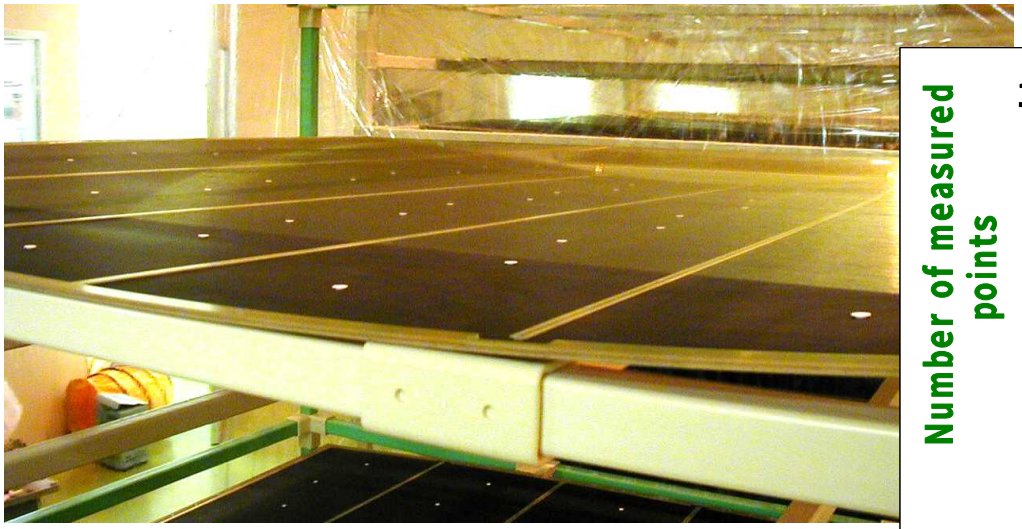
- ➢ to remove some dusts on the cathode plane by mist.
- ➢ Washing away the solder flux with ultrasonic cleaning
- ➢ (water-soluble flux is used)

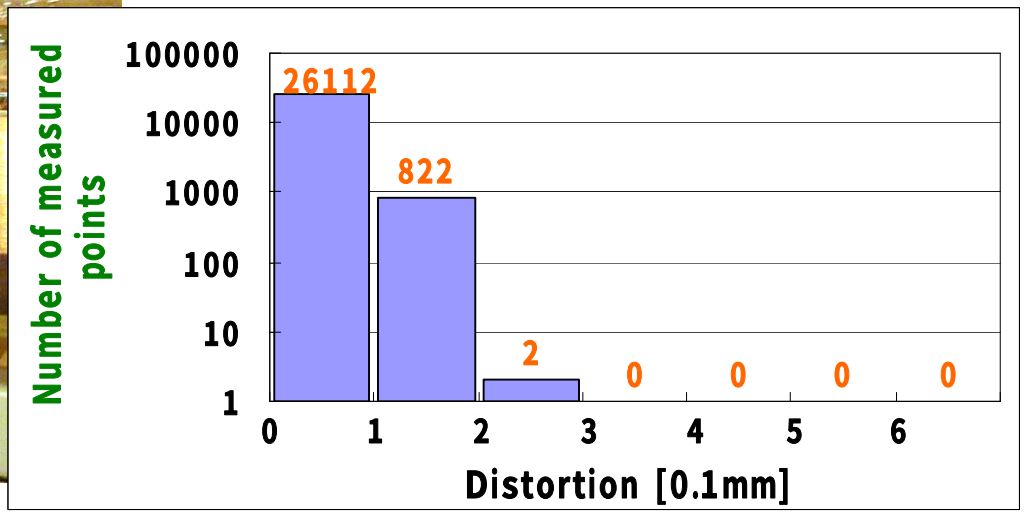


TGC closing



- In order to make flat plane, the combination of the vacuum-press and the suction plate technique have been adapted.





HV test

- Before closing TGC, HV test is performed to verify following performance
  - ✓ Discharge by some dust or impurities.
  - ✓ Electrical instability at operation point

    HV=2.9 kV with CO_2 flow

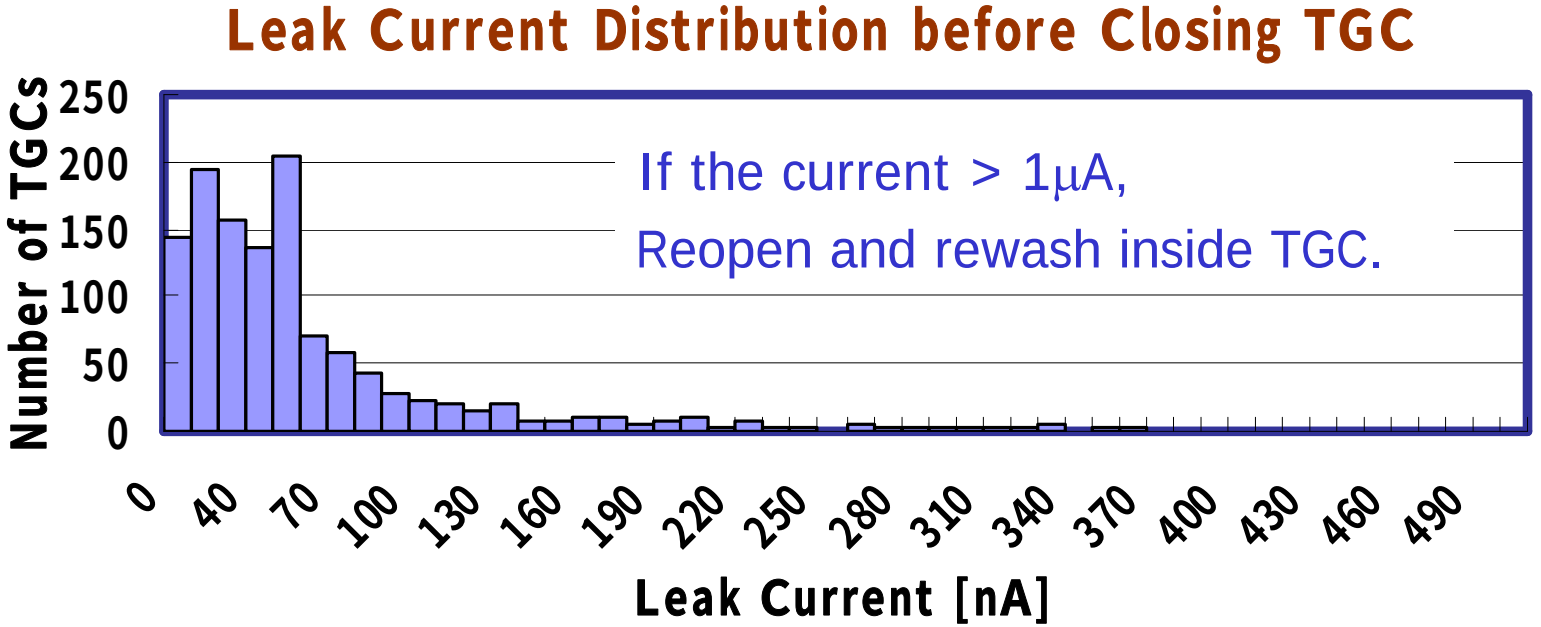
HV check is applied at

Before closing TGC

After closing TGC

After making modules

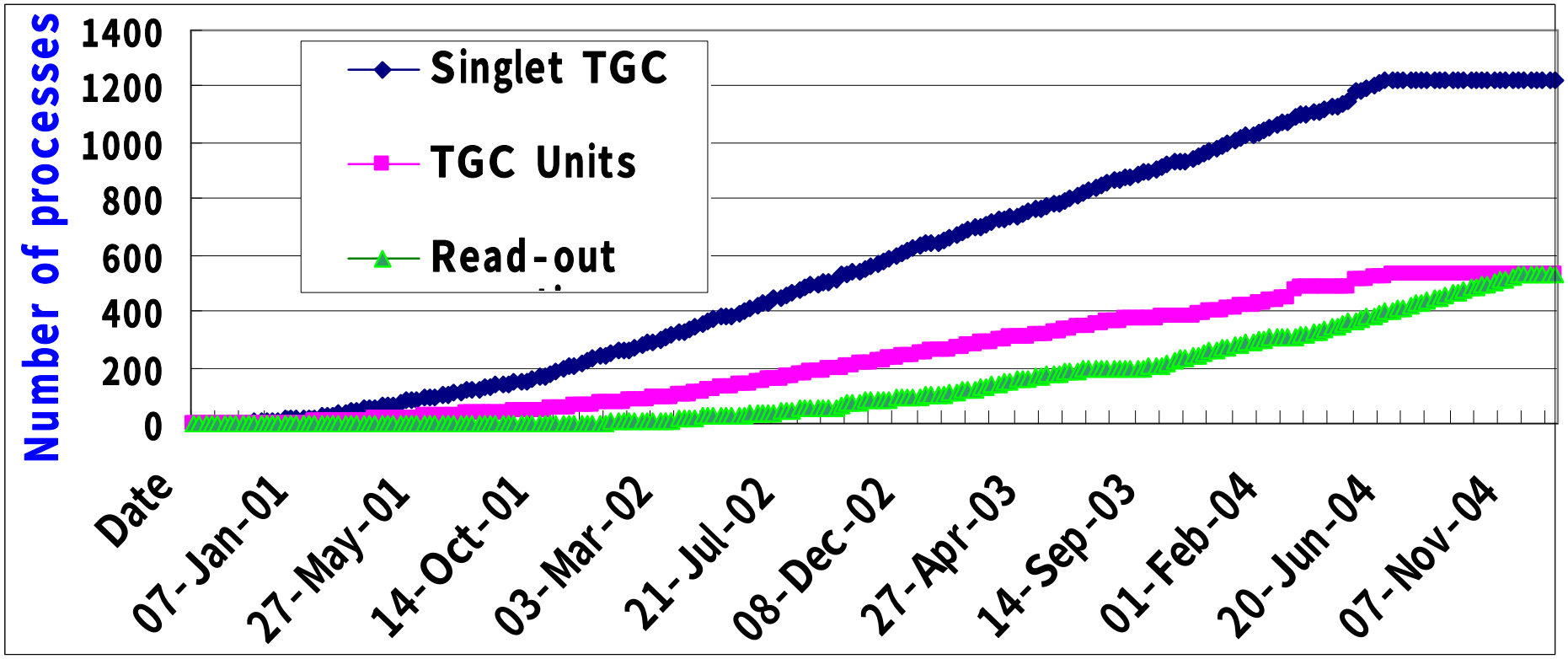
@ Kobe Univ. and @ CERN



Summary

- 1200 TGCs have been produced in Japan from 2001 to 2005 Feb.
  - We created the required environment to make 2 TGCs/day.
- We have to make uniform quality
  - Controlling the TGC's surface distortion < 200 μm
    - We have developed some tools (screen painting method or air control at gluing)

TGC type	TGC Wheel	Units Need for ATLAS	# of TGCs		# of Module		Total Yield rate
			Units	Process Yield	Units	Process Yield	
T7	M1	96	356	98.9%	113	95.2%	94.2%
	M2	96	218	98.9%	106	97.2%	96.1%
	M3	96	221	100.0%	108	97.7%	97.7%
T4	M2	96	215	99.5%	107	99.5%	99.1%
T5	M3	96	214	98.8%	107	100.0%	98.8%
SUM		480	1224		541		


Number of processes
1400
1200
1000
800
600
400
200
0
Singlet TGC
TGC Units
Read-out
Date
07-Jan-01
27-May-01
14-Oct-01
03-Mar-02
21-Jul-02
08-Dec-02
27-Apr-03
14-Sep-03
01-Feb-04
20-Jun-04
07-Nov-04