

Status of ATLAS activities and plans in Japan

Katsuo Tokushuku (KEK)

December 7, 2007

CERN-KEK Committee, 2nd meeting

ATLAS Collaboration

(Status October 2007)

37 Countries
167 Institutions
2000 Scientific Authors total
(1600 with a PhD, for M&O share)

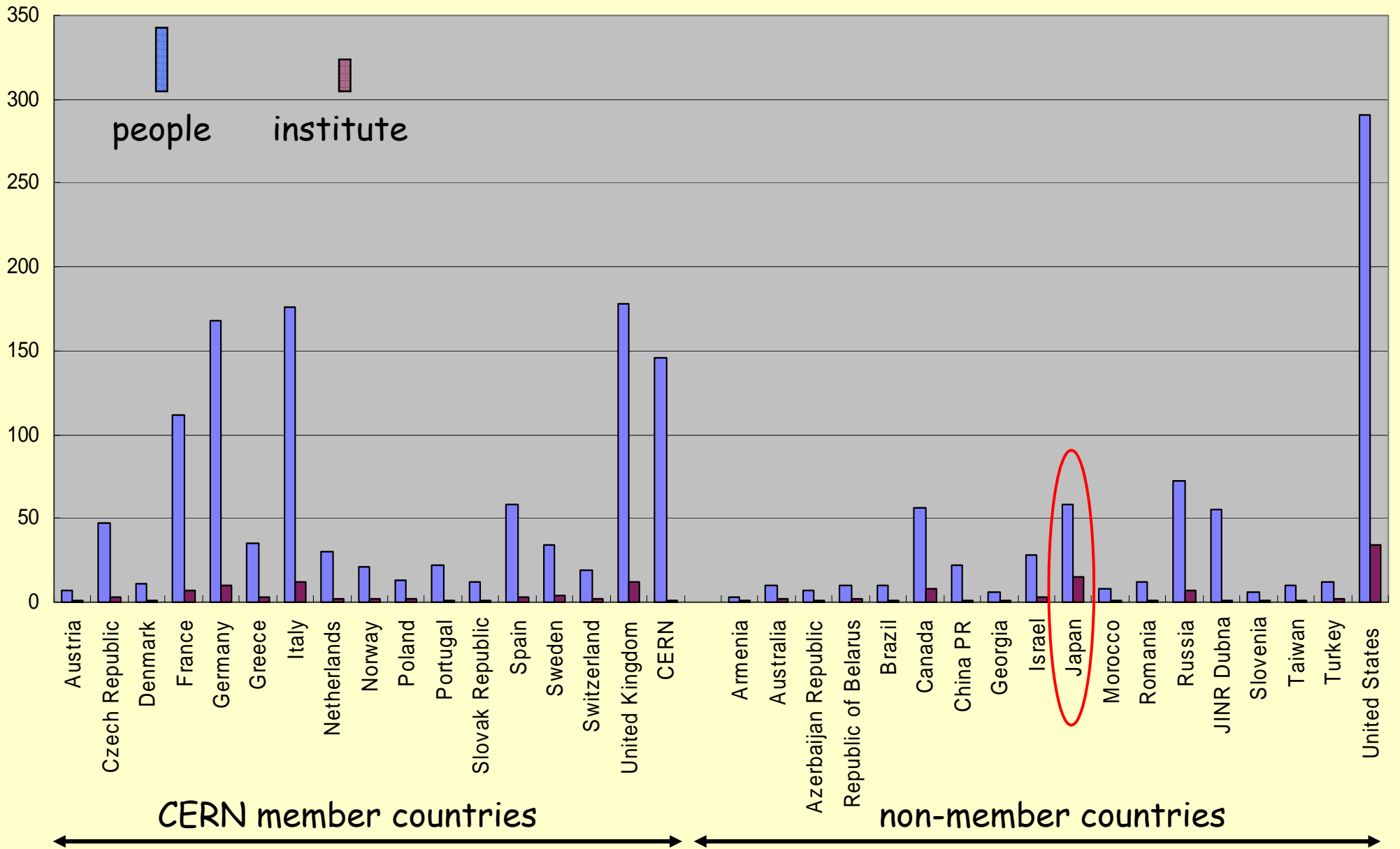
ATLAS-Japan

15 Institutes

~ 60 Scientific authors



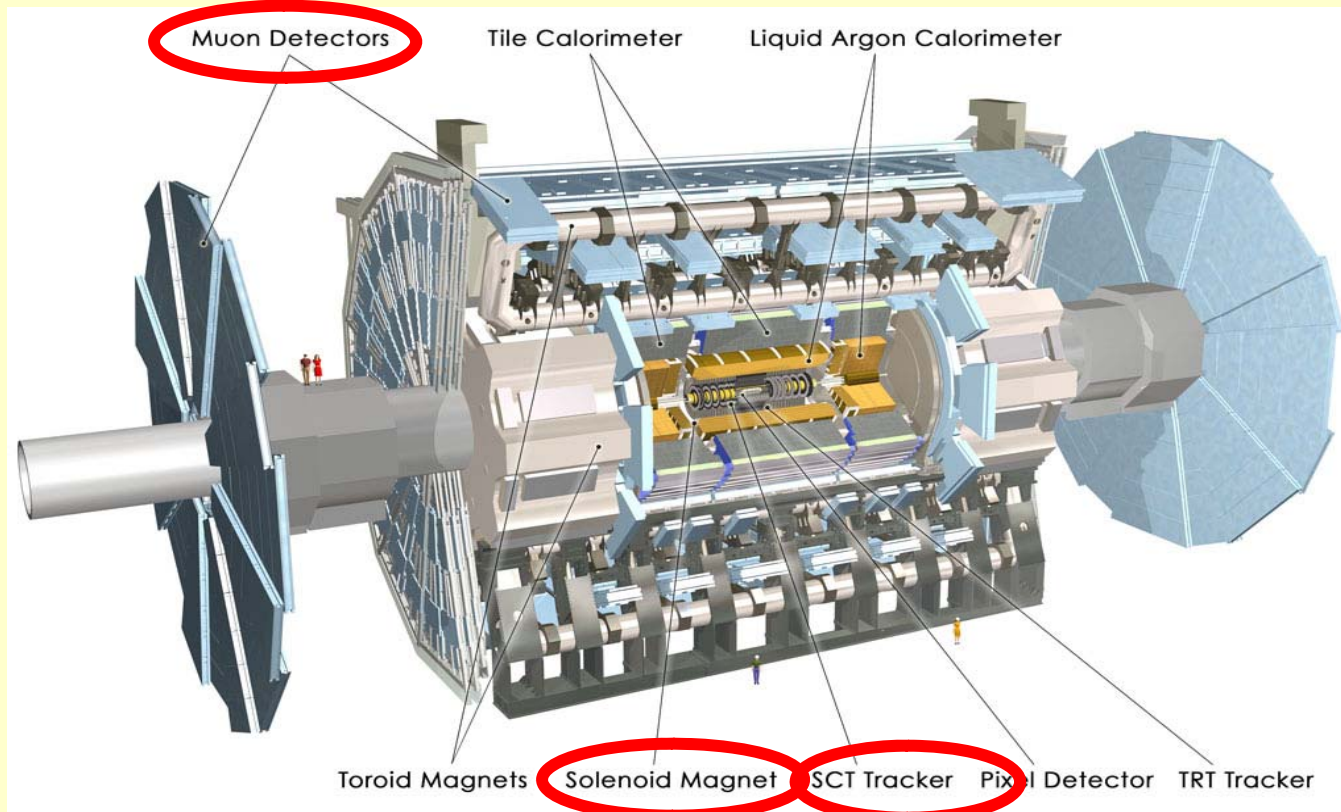
Albany, Alberta, NIKHEF Amsterdam, Ankara, LAPP Annecy, Argonne NL, Arizona, UT Arlington, Athens, NTU Athens, Baku, IFAE Barcelona, Belgrade, Bergen, Berkeley LBL and UC, HU Berlin, Bern, Birmingham, Bogota, Bologna, Bonn, Boston, Brandeis, Bratislava/SAS Kosice, Brookhaven NL, Buenos Aires, Bucharest, Cambridge, Carleton, Casablanca/Rabat, CERN, Chinese Cluster, Chicago, Chile, Clermont-Ferrand, Columbia, NBI Copenhagen, Cosenza, AGH UST Cracow, IFJ PAN Cracow, DESY, Dortmund, TU Dresden, JINR Dubna, Duke, Frascati, Freiburg, Geneva, Genoa, Giessen, Glasgow, Göttingen, LPSC Grenoble, Technion Haifa, Hampton, Harvard, Heidelberg, **Hiroshima**, **Hiroshima IT**, Indiana, Innsbruck, Iowa SU, Irvine UC, Istanbul Bogazici, **KEK**, **Kobe**, **Kyoto**, **Kyoto UE**, Lancaster, UN La Plata, Lecce, Lisbon LIP, Liverpool, Ljubljana, QMW London, RHBNC London, UC London, Lund, UA Madrid, Mainz, Manchester, Mannheim, CPPM Marseille, Massachusetts, MIT, Melbourne, Michigan, Michigan SU, Milano, Minsk NAS, Minsk NCPHEP, Montreal, McGill Montreal, FIAN Moscow, ITEP Moscow, MEPHI Moscow, MSU Moscow, Munich LMU, MPI Munich, **Nagasaki IAS**, **Nagoya**, Naples, New Mexico, New York, Nijmegen, BINP Novosibirsk, Ohio SU, **Okayama**, Oklahoma, Oklahoma SU, Oregon, LAL Orsay, **Osaka**, Oslo, Oxford, Paris VI and VII, Pavia, Pennsylvania, Pisa, Pittsburgh, CAS Prague, CU Prague, TU Prague, IHEP Protvino, Regina, **Ritsumeikan**, UFRJ Rio de Janeiro, Rome I, Rome II, Rome III, Rutherford Appleton Laboratory, DAPNIA Saclay, Santa Cruz UC, Sheffield, **Shinshu**, Siegen, Simon Fraser Burnaby, SLAC, Southern Methodist Dallas, NPI Petersburg, Stockholm, KTH Stockholm, Stony Brook, Sydney, AS Taipei, Tbilisi, Tel Aviv, Thessaloniki, **Tokyo ICEPP**, **Tokyo MU**, Toronto, TRIUMF, **Tsukuba**, Tufts, Udine/ICTP, Uppsala, Urbana UI, Valencia, UBC Vancouver, Victoria, Washington, Weizmann Rehovot, FH Wiener Neustadt, Wisconsin, Wuppertal, Yale, Yerevan



Top 10 countries in ATLAS construction sharing

	country	Cost sharing (MCHF)	Institutes	Sci. Authors
1	USA	80.74 (17 %)	33	232 (18 %)
2	CERN	60.50 (13 %)	1	137 (10 %)
3	France	52.76 (11 %)	7	90 (6.9 %)
4	Italy	45.09 (9.6 %)	12	141 (11 %)
5	Germany	40.00 (8.5 %)	10	109 (8.3 %)
6	UK	34.11 (7.3 %)	12	105 (8.0 %)
7	Japan	32.18 (7.0 %)	15	61 (4.7 %)
8	Russia	26.12 (5.6 %)	8	102 (7.8 %)
9	Switzerland	18.51 (4.0 %)	2	14 (1.1 %)
10	Canada	15.08 (3.2 %)	7	40 (3.1 %)
:	:	:	:	:
	TOTAL	468.41 (100%)	149	1,306 (100%)

ATLAS Detector: construction and commissioning



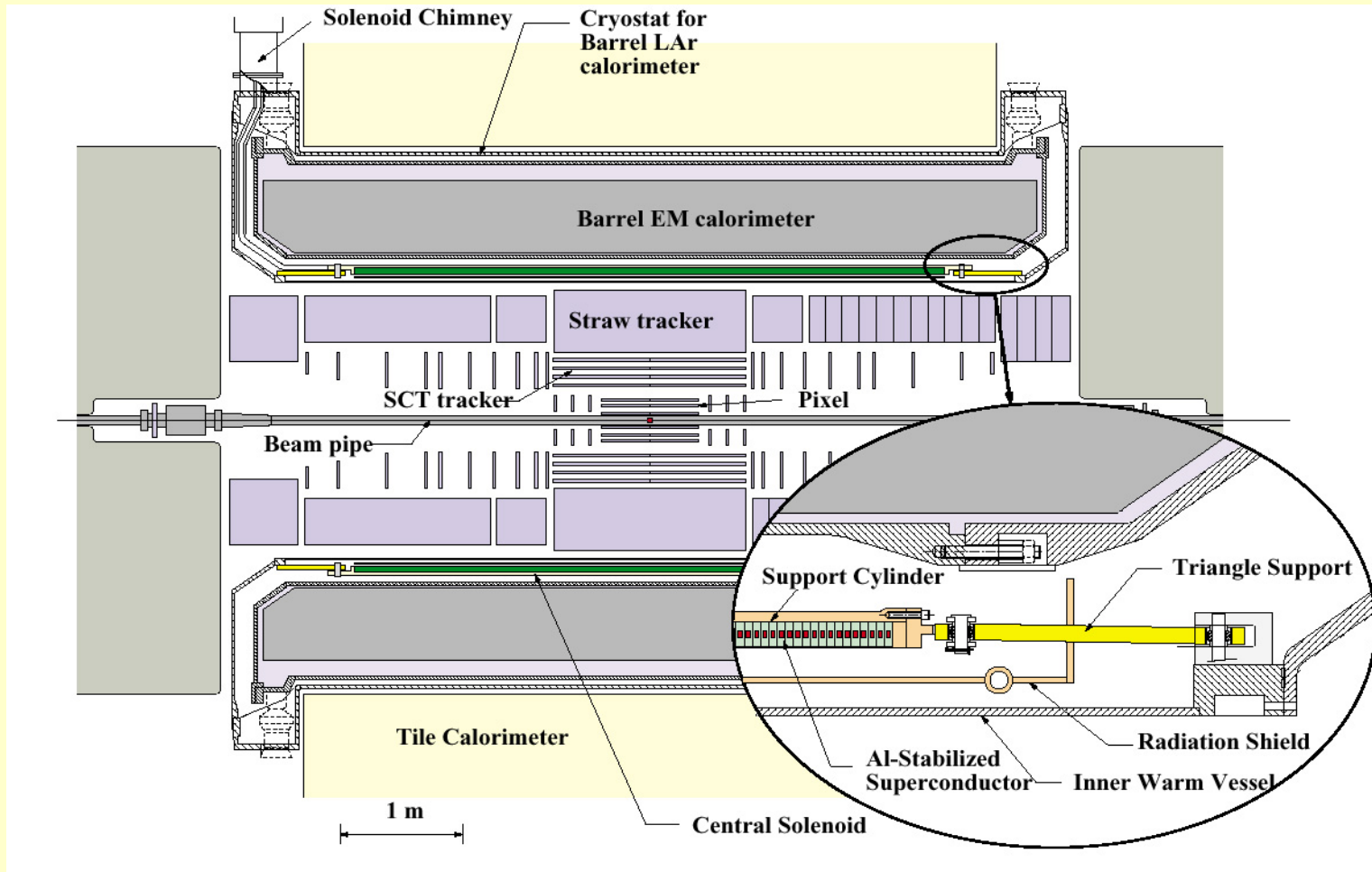
- **Tracking ($|\eta| < 2.5$, $B(\text{solenoid}) = 2\text{T}$) :**
 - Si pixels and strips
 - Transition Radiation Detector (e/π separation)
- **Calorimetry ($|\eta| < 5$) :**
 - EM : Pb-LAr
 - HAD: Fe/scintillator (central), Cu/W-LAr (fwd)
- **Muon Spectrometer ($|\eta| < 2.7$) :**
 - air-core toroids with muon chambers

Length : ~ 46 m
Radius : ~ 12 m
Weight : ~ 7000 tons
~ 10^8 electronic channels
~ 3000 km of cables

Construction to detector components:

- **Superconducting Central Solenoid (100%)**
- **Time-to-digital conversion chips for muon drift tubes (100%)**
- **End-cap muon triggering system (TGC) (~50%)**
- **Silicon microstrip tracking system (SCT) (~20%)**

ATLAS Central Solenoid (2T) : 100% responsibility by KEK (1)

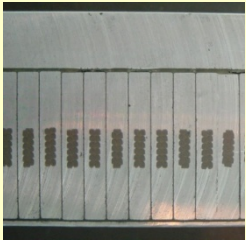


Specific features to minimize material thickness

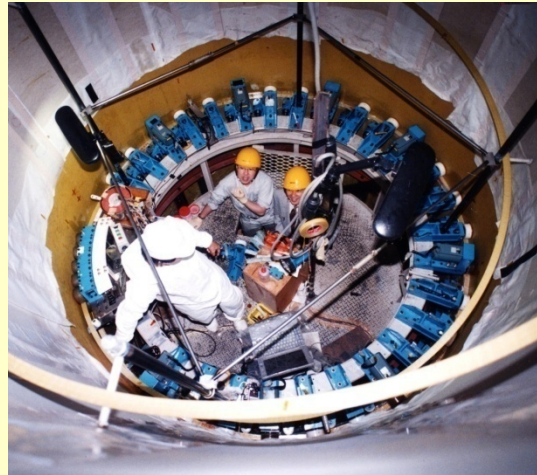
- Use of high strength Aluminum stabilizer for SC cables
- Common cryostat with LAr barrel EM calorimeter

ATLAS Central Solenoid : 100% responsibility by KEK (2)

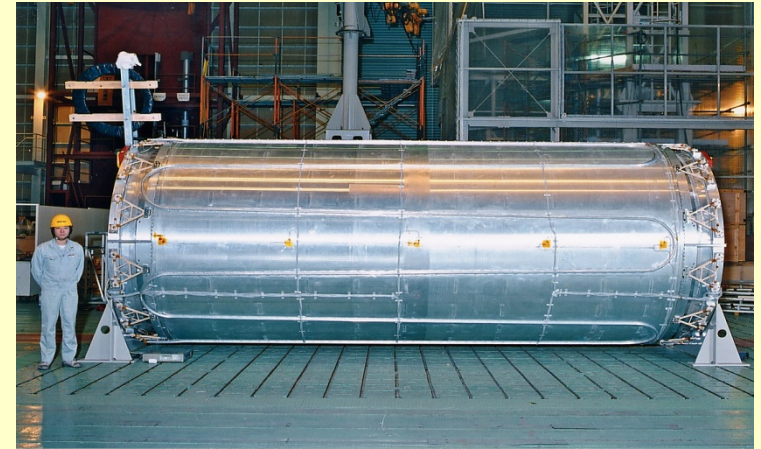
Superconductor
production



test coil winding
(1997-8)



Coil winding (1999)



Coil assembly at Toshiba (1999)



Tested in Japan (2000.12)



2001.7 Shipped from
Yokohama Bay

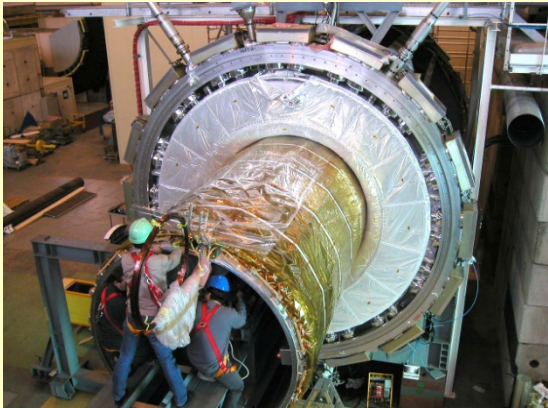


Arrived at CERN (2001.9)

7/12/2007



ATLAS Central Solenoid : 100% responsibility by KEK (3)



coil insertion to LAr cryostat (2004.2)



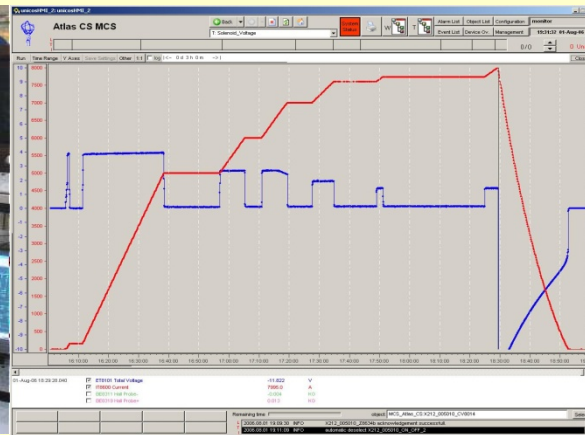
Connection works, cooldown and test (2004.2-9)



Transportation to ATLAS pit (2004.10)



2006.8.1 Solenoid was successfully commissioned up to 8.0 kA, exceeding 7.73 kA for B=2 Tesla operation.



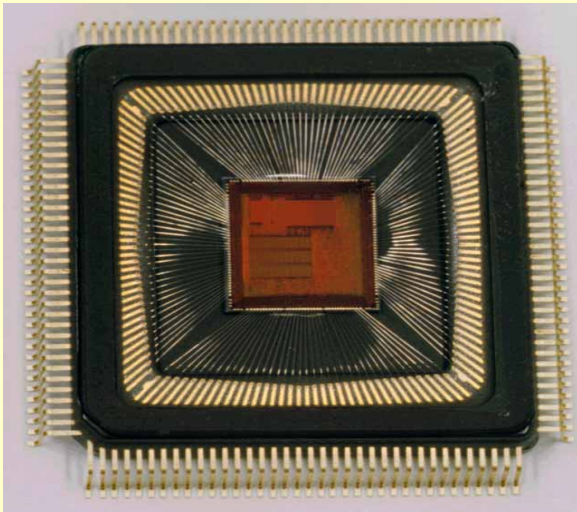
7/12/2007



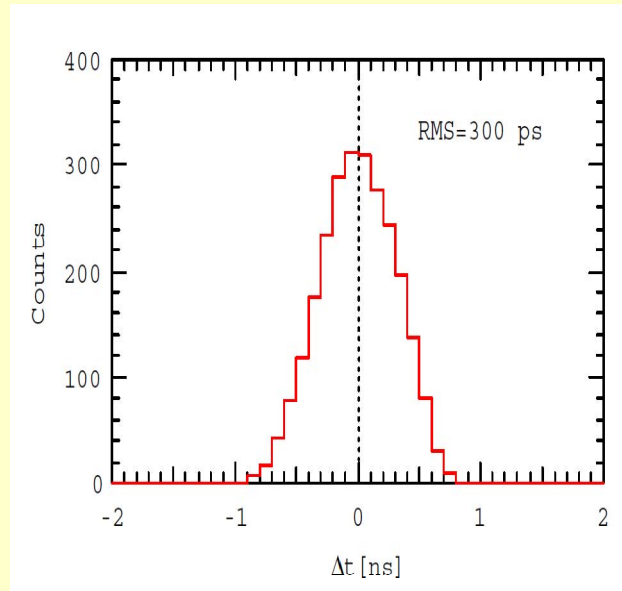
Installation into the ATLAS Detector center (2005.11)

TDC chips for ATLAS muon drift tubes (MDT)

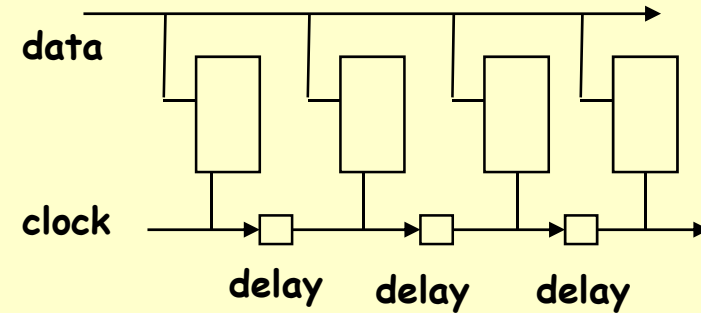
KEK responsible 100%. The design is based on KEK's patented idea, directly digitizing time difference using CMOS memory.



24ch TDC chips for ATLAS MDT, 20,000 chips made.



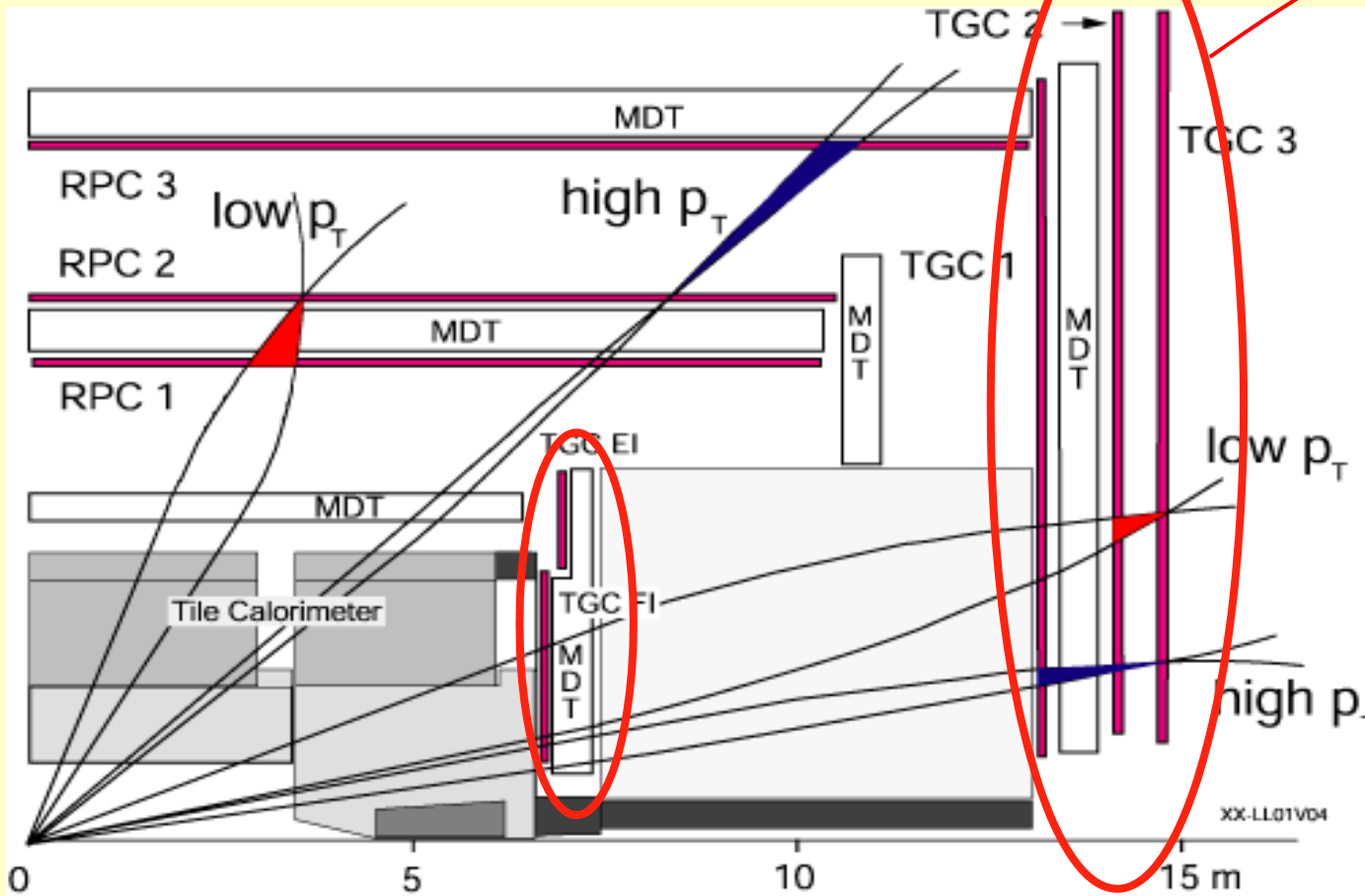
$\sigma \sim 300$ ps,
non-linearity $< \pm 80$ ps



Mounted on ATLAS MDT 10

* Similar chips used in H1 at HERA, Phenix, D0, K2K.....

TGC(1): Thin Gap Chambers (TGC) for μ triggering



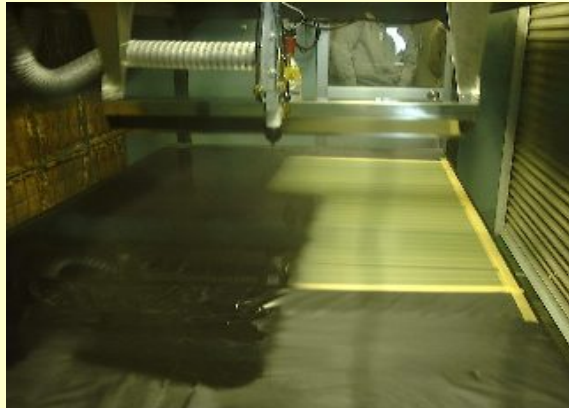
3600 TGC chambers
320,000 channels
Total area $\sim 2,000 \text{ m}^2$

Joint Construction
by
Israel,
Japan
China

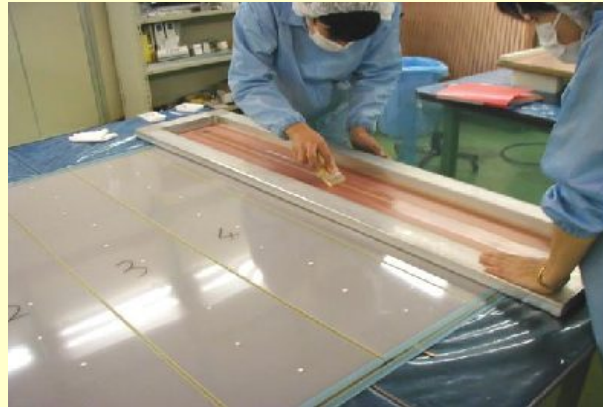
High energy muons penetrate calorimeters and be bent by magnetic field of toroid. TGC system measures the bend angle for Level-1 triggering.

TGC(2): 1200 TGC chambers were produced at KEK

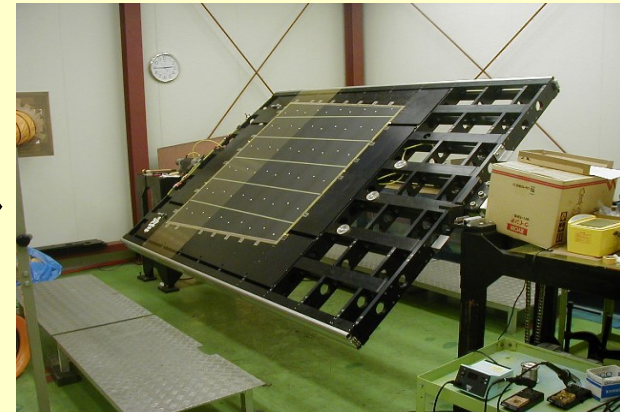
We accomplished 2 chambers/day and finished 1200 TGC chambers in 4 years



carbon spray



epoxy gluing



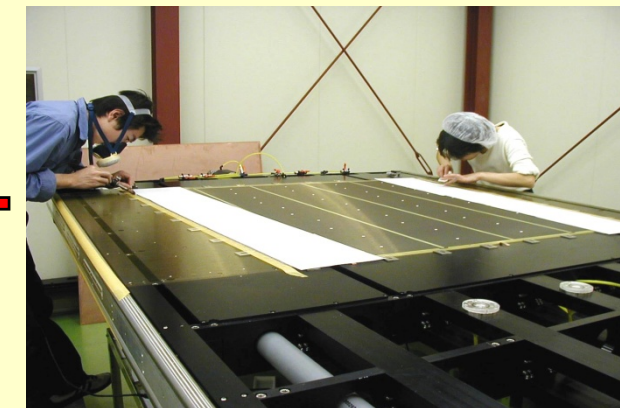
Automatic wire winding



Chamber assembly and ATLAS inspection team

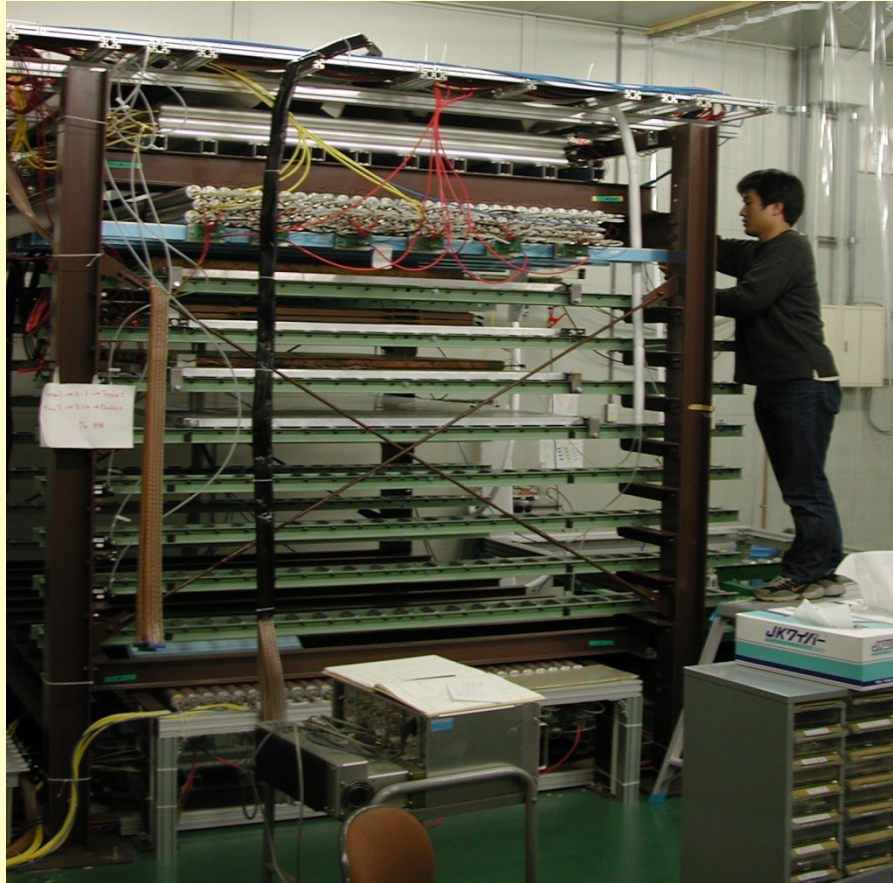


Checking & HV test

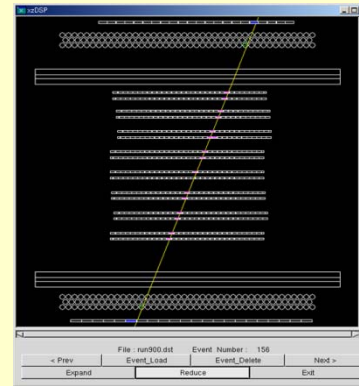


Soldering tungsten wires

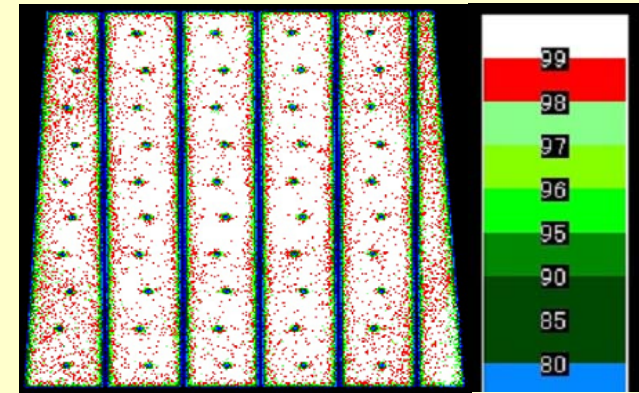
TGC(3): Inspection of all chambers using cosmic-rays



All TGC chambers were inspected using the cosmic-ray station built at Kobe Univ.



Event display with cosmic-rays



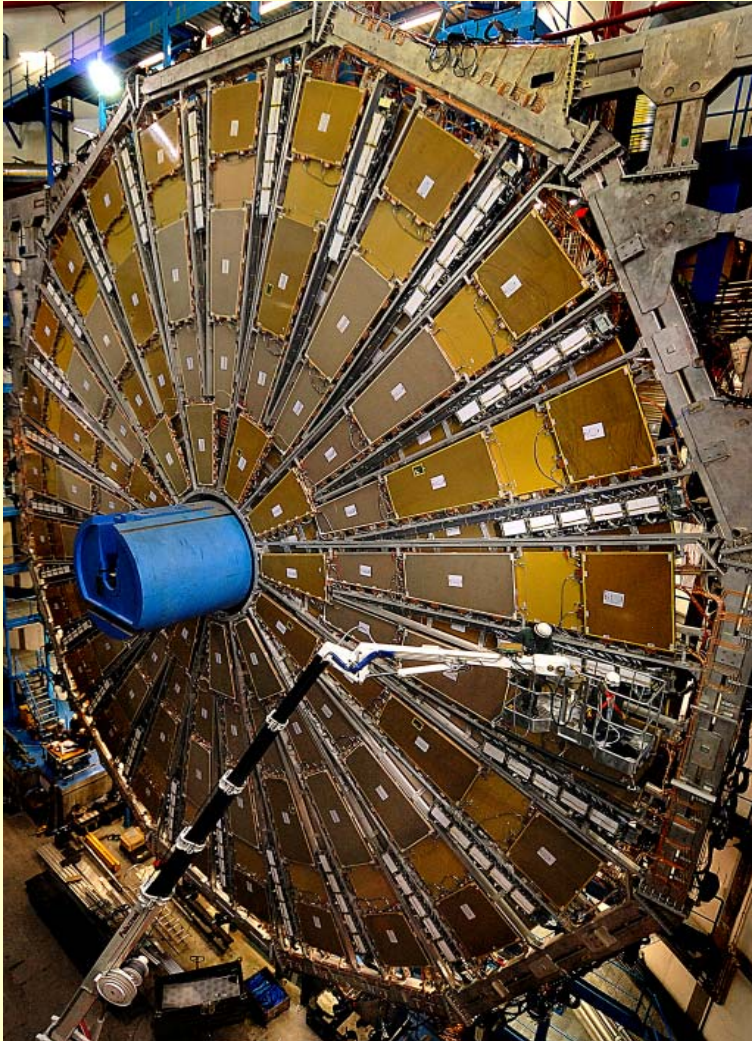
Efficiency map of a TGC chamber



THC chambers passed the cosmic-ray inspection were packed in air-conditioned containers by transportation to CERN.

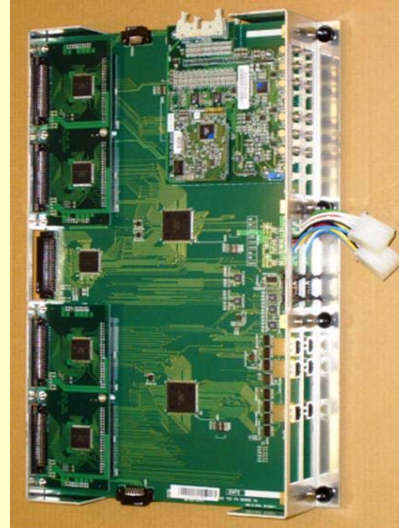


TGC(4): Assembly and Installation at CERN



1 st Big-wheel construction in ATLAS pit (2006.11)

7/12/2007



Mass production of readout boards (KEK) all designed by Japan



Chamber repair at CERN



Assembly of chambers and electronics at CERN bldg. 180.

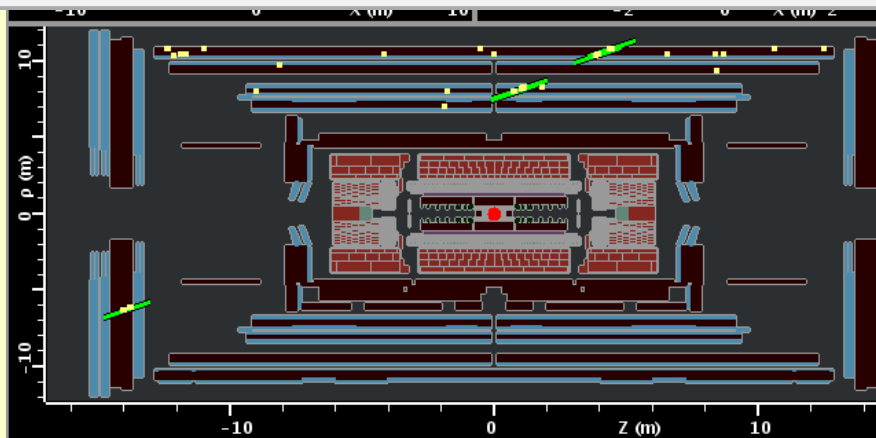
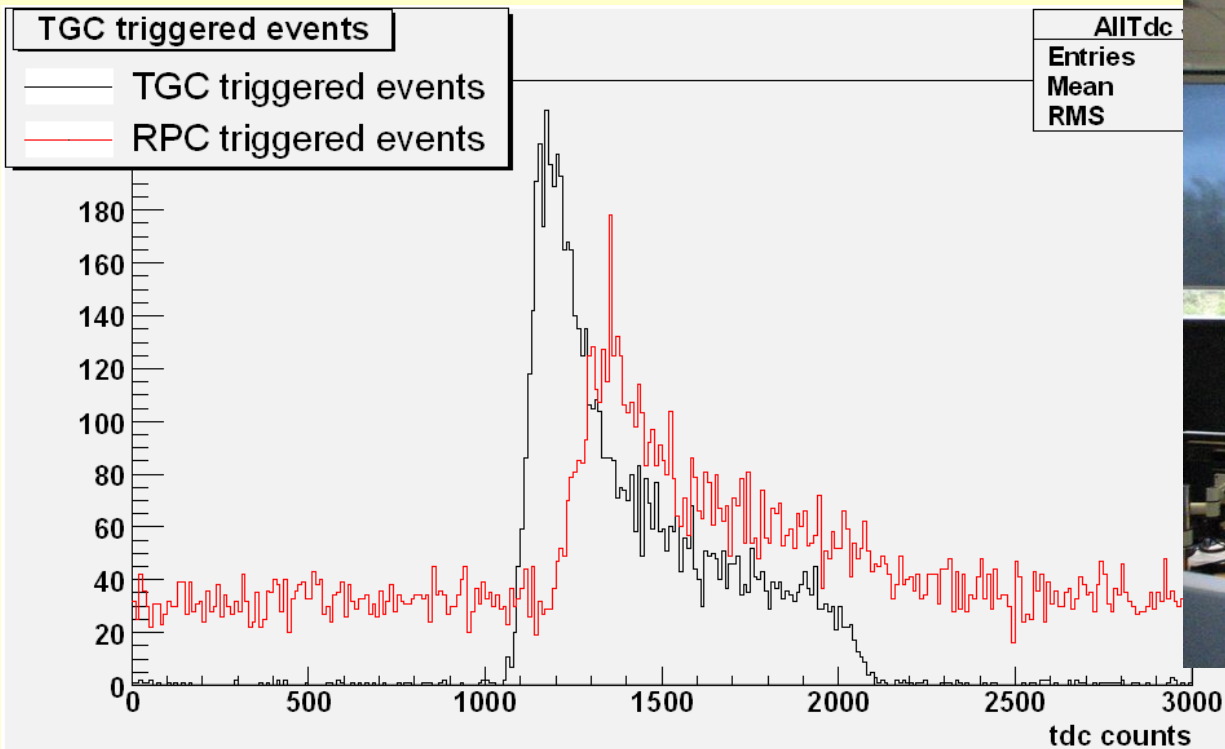


Transportation to ATLAS pit



All Big-wheels were installed in ATLAS pit (2007.9)

Commissioning



7/12/2007



Muon Higher Level Trigger

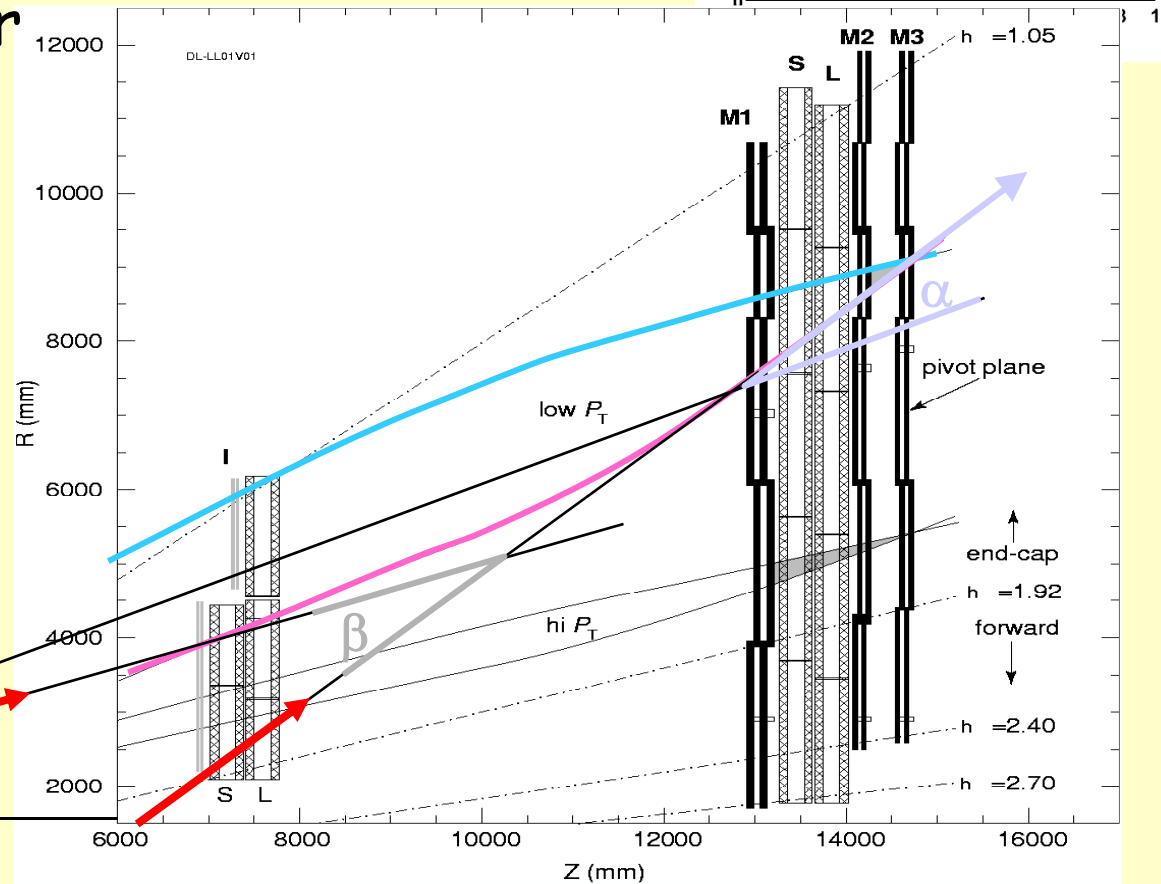
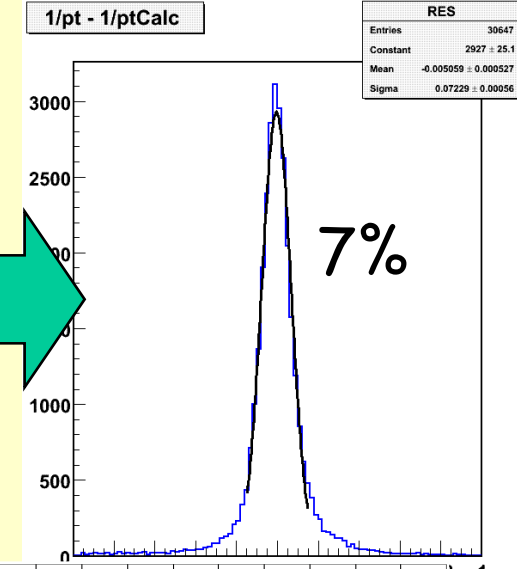
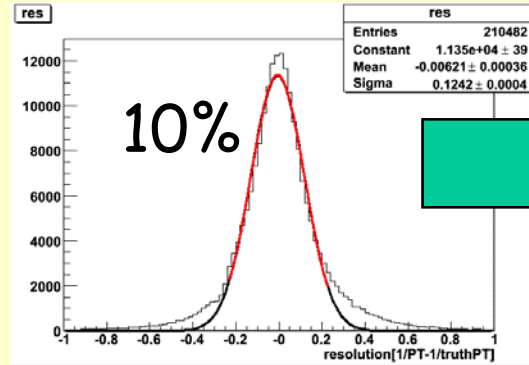
Muon rate reduction from the improved Pt resolution at LVL2 trigger.

- use of MDT information
- use of inner muon chamber
- better algorithm

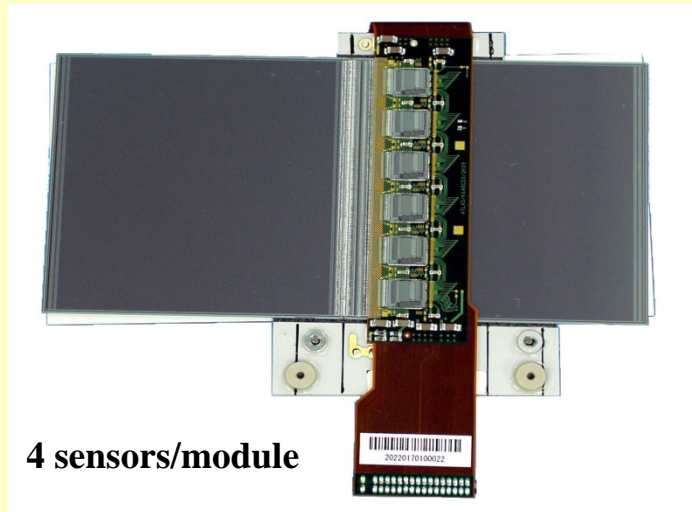
KEK/Kobe group has joined to the effort on improving the LVL2 muon performance, in collaboration with Rome and Technion groups.

7/12/2007

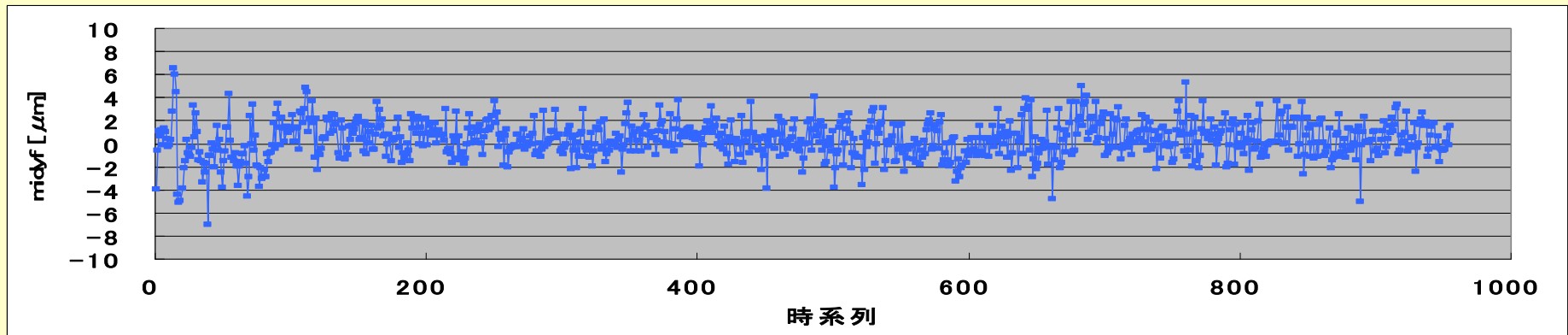
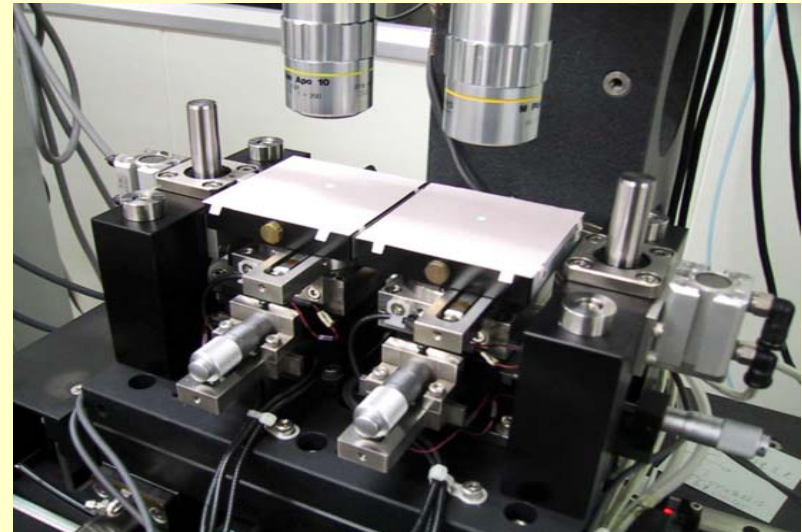
Pt resolution



ATLAS Silicon Micro-strip Detector (SCT)

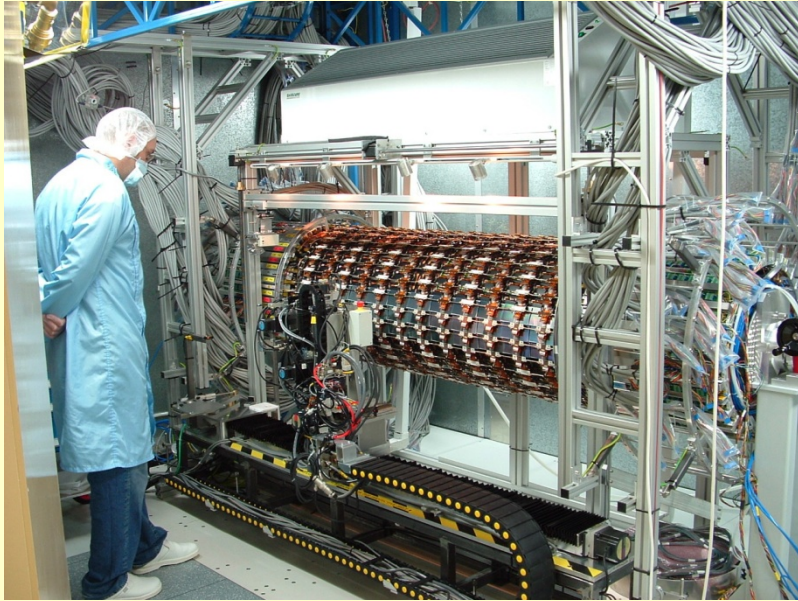


The module is based on Japan's idea.
KEK assembled 980 modules (40%).

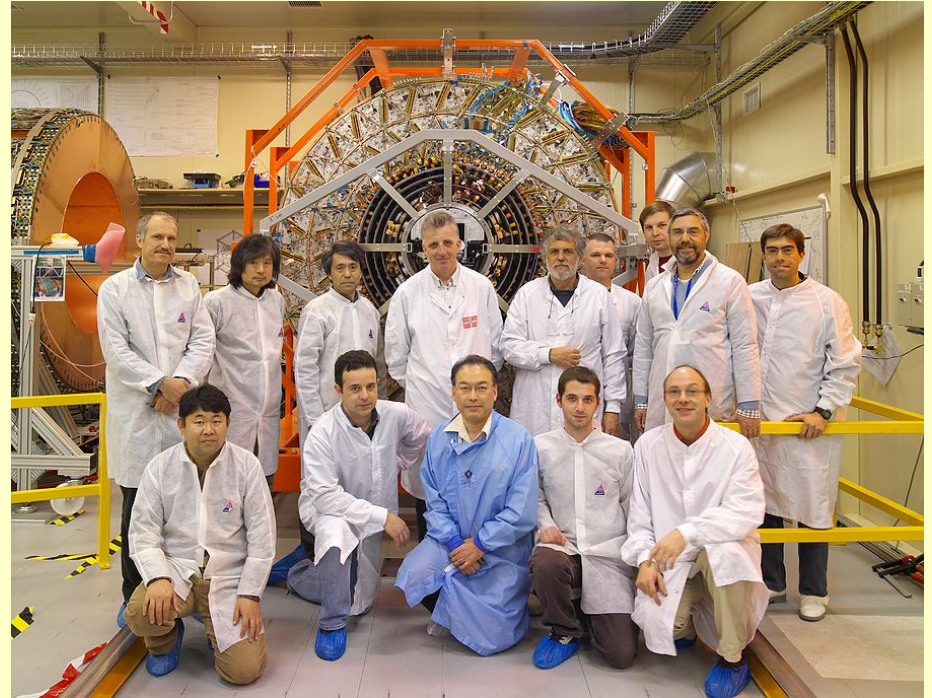


The accuracy of module assembly is mostly within $\pm 2 \mu\text{m}$, the best performance among four assembly sites.

ATLAS Silicon Micro-strip Detector (SCT)



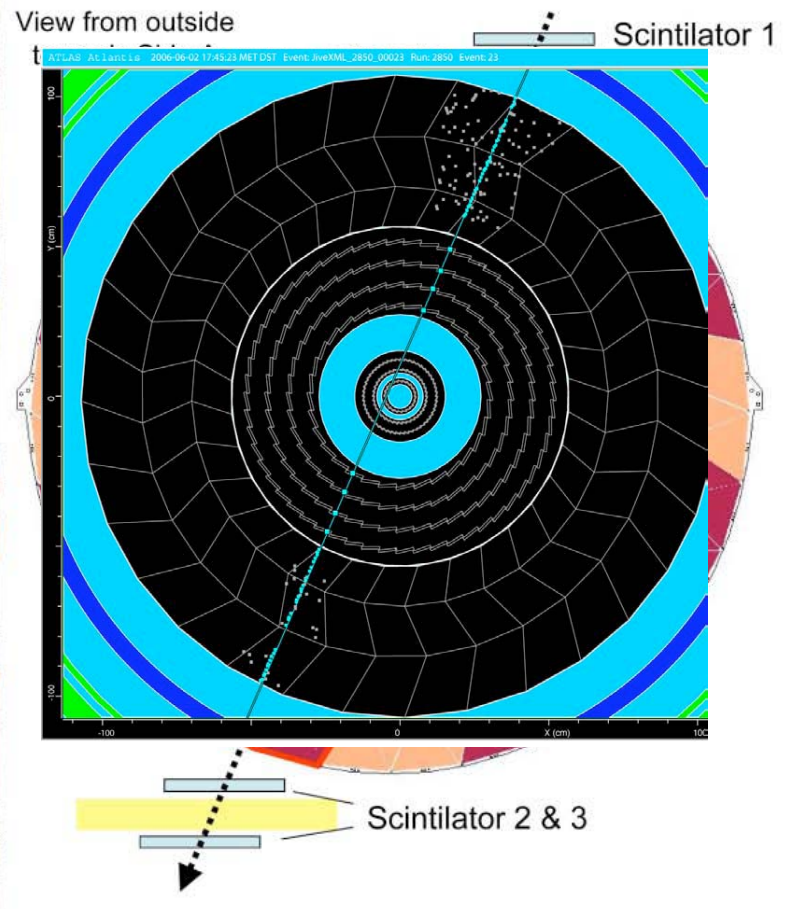
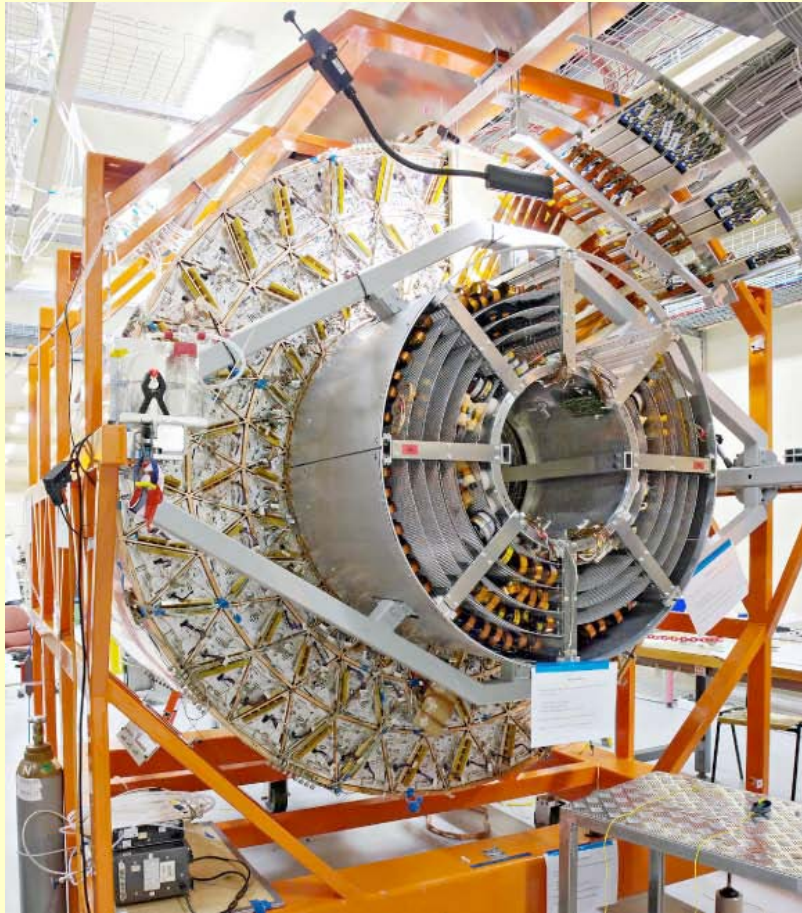
Module assembly at Oxford
with KEK mounting robot.
(2112 modules on 4 cylinders)



SCT-TRT integration in the surface building.(Feb. 2006)

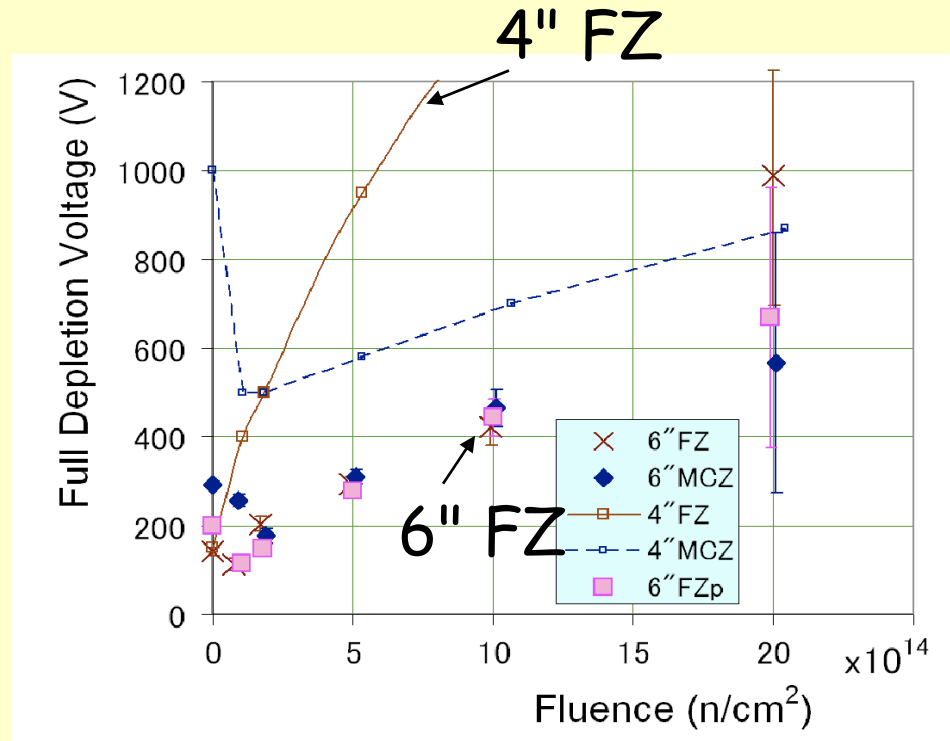
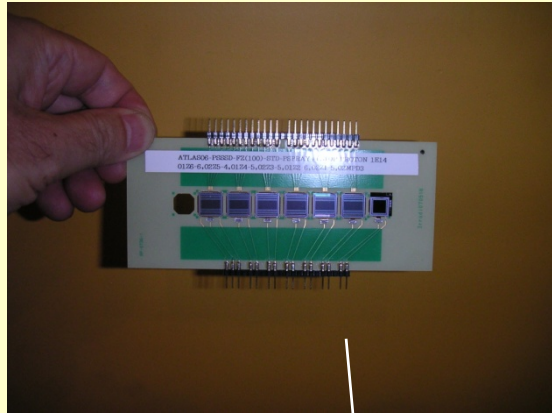


ATLAS Silicon Micro-strip Detector (SCT)



Cosmic test on surface
with 468/2112 SCT modules, 1/8 TRT

SCT for SLHC



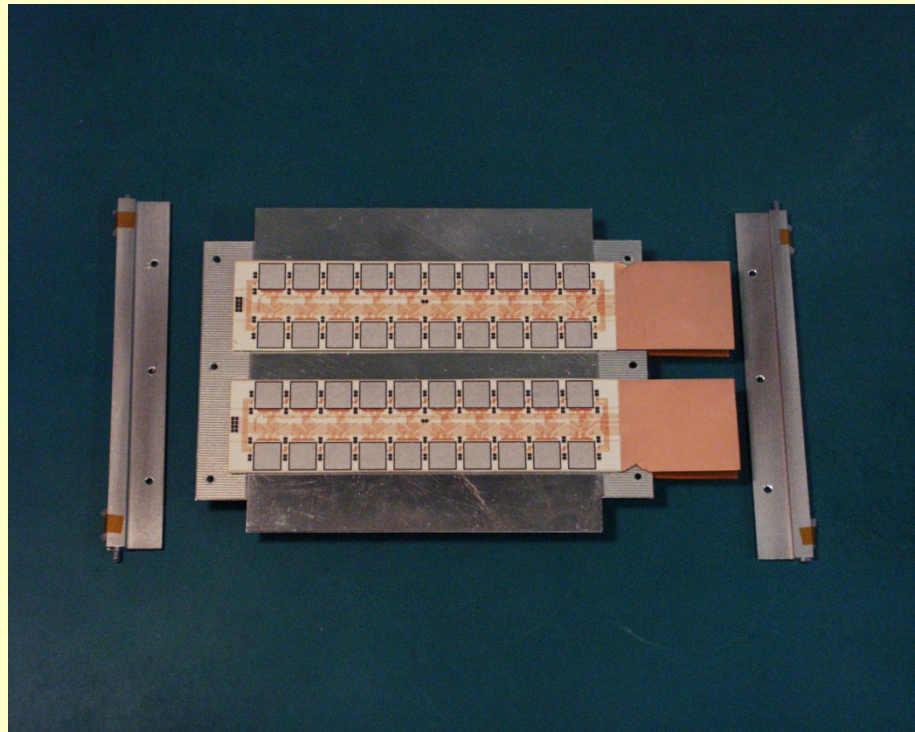
LHC(2×10^{14}) \rightarrow SLHC(1×10^{15})

4'' FZ \rightarrow 6'' FZ (or MCZ)

Irradiations have found
very different V_{dep}
evolution

Proton irradiations in Japan at CYRIC, Tohoku U.

SCT for SLHC : SLHC Module Development



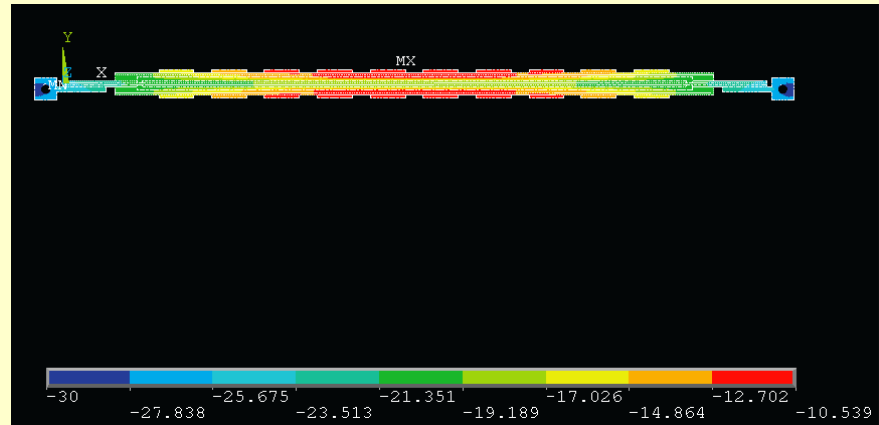
SLHC module mock-up: module (centre), cooling plates (2 sides)

Heat generation after radiation-damaged:

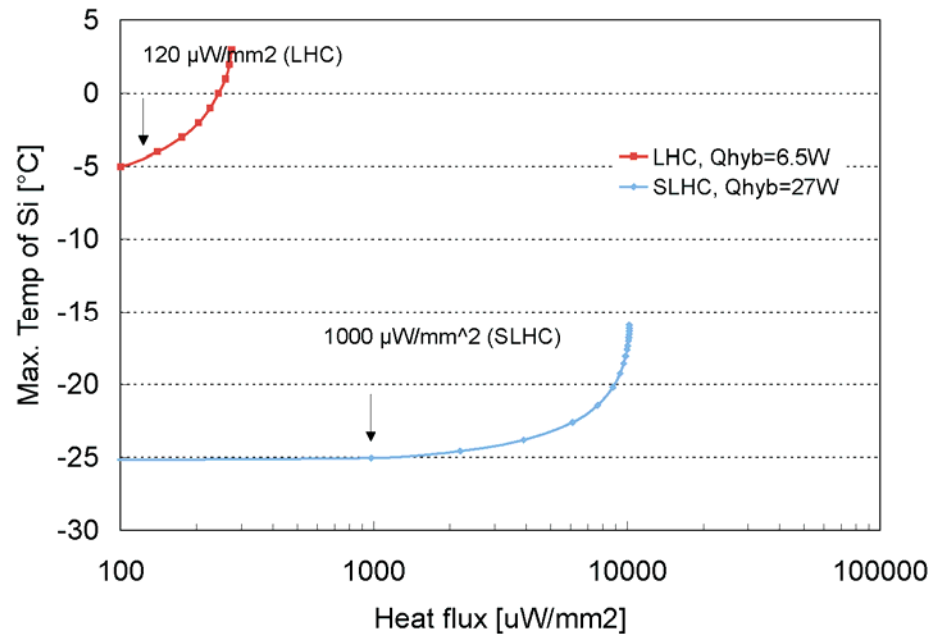
LHC ($120 \mu\text{W}/\text{mm}^2$)

→ SLHC ($1000 \mu\text{W}/\text{mm}^2$)

Thermal design and cooling are critical



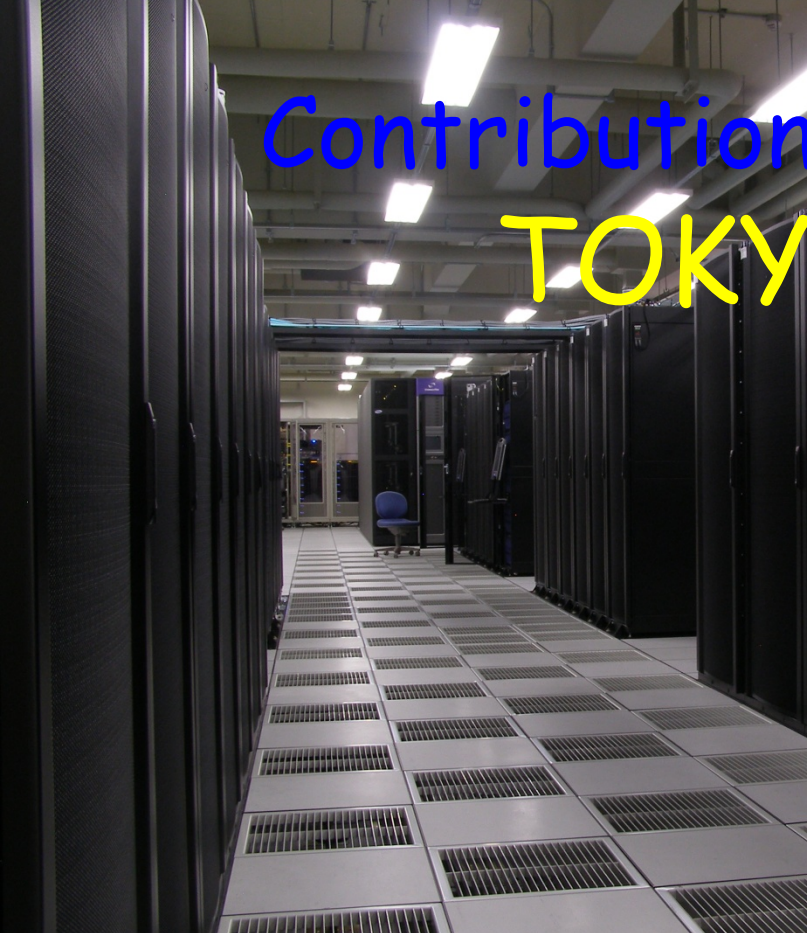
ANSYS FEA simulation example



Contribution for Computing

TOKYO-LCG2

LCG Tier2 Center for ATLAS is operational since 2005 at International Center for Elementary Particle Physics (ICEPP), the University of Tokyo



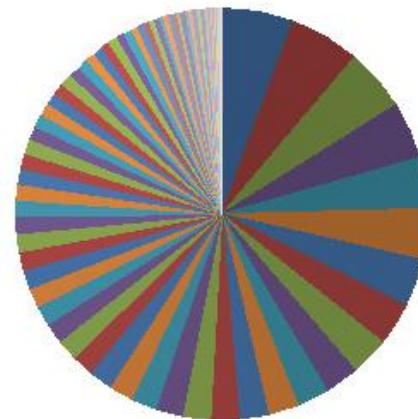
WLCG Resource Pledged in 2007:

CPU: 1000kSI2k

Disk: 200TB

7/12/2007

Tier-2 Sites
CPU Usage - October 2007



- IN2P3-LPC
- UKI-NORTHGRID-MAN-HEP
- GRIF
- TOKYO-LCG2
- JINR-LCG2
- PROD_SLAC
- GLOW
- IN2P3-SUBATECH
- AGLT2
- Nebraska
- CIT_CMS_T2
- MWT2_UC
- NIHAM
- UKI-LT2-IC-HEP
- BU_ATLAS_Tier2
- UKI-LT2-Brunel
- ITEP
- RU-PNPI-LCG2
- DESY-HH

Physics preparation

- Growing contributions in ATLAS physics groups

Shoji Asai (Tokyo) : SUSY convener (2005-2006)

Osamu Jinnouchi (KEK) : Monte Carlo Coordinator (2007-)

Soshi Tsuno (KEK) : Higgs VBF group coordinator

- Higher weights on Higgs and SUSY physics. But start contributing to the other physics, such as B-physics and SM.

(we need more man power)

Summary

- Japanese group has been taking major roles in the detector construction. (Solenoid, TGC, SCT, MDT frontend)
- Commissioning of the detectors are on going with cosmic rays.
- New contribution on HLT muon trigger
- Physics contributions are growing.
- R&D studies for LHC upgrade has already started.