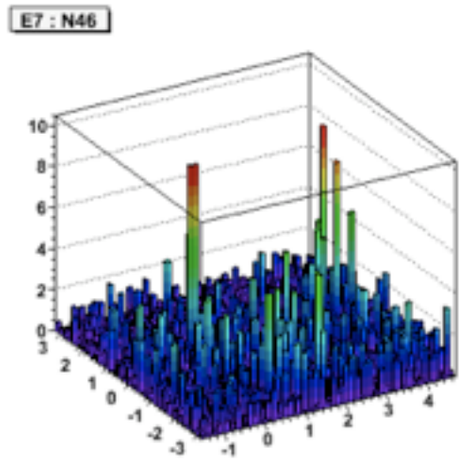
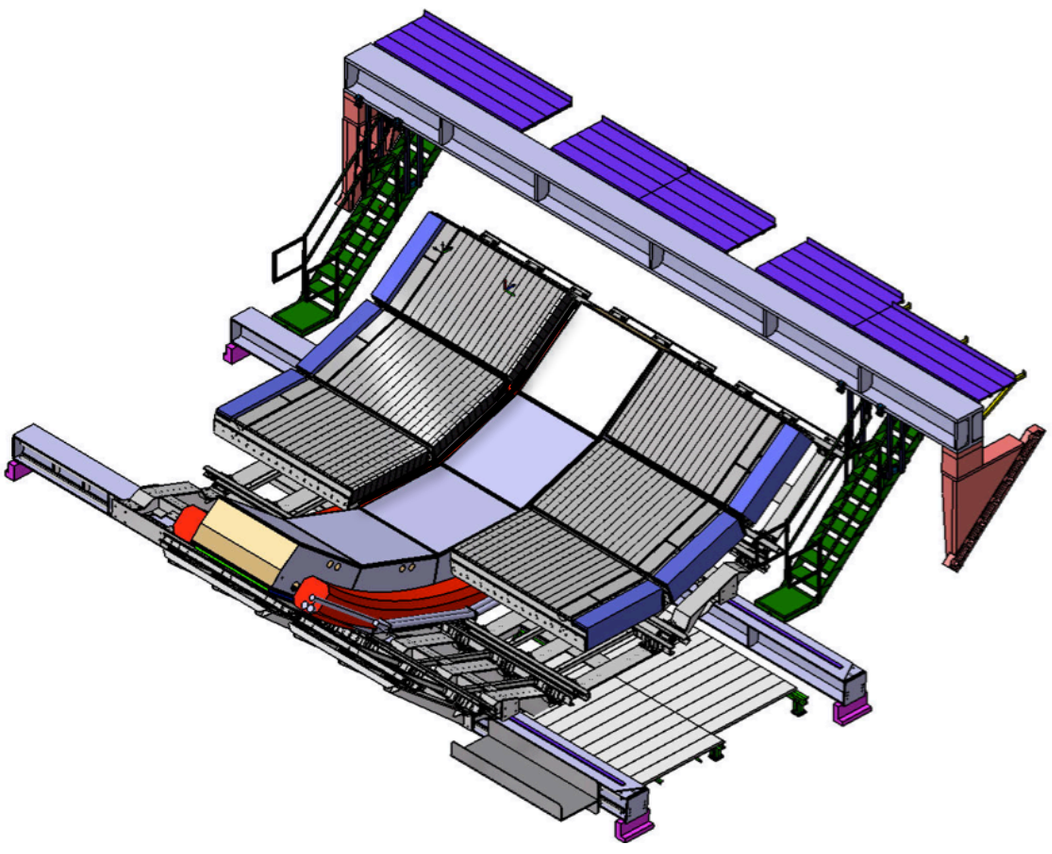
ALICE Activities at Tsukuba

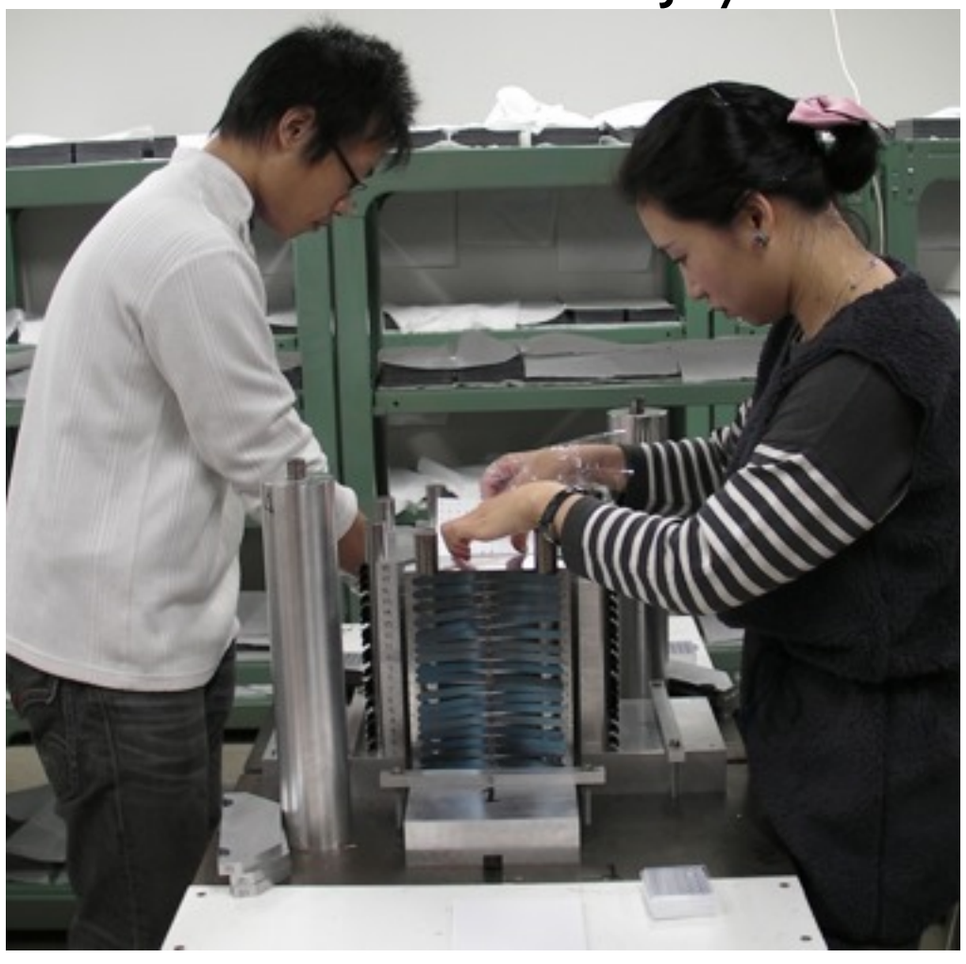




Yasuo MIAKE
Univ. of Tsukuba

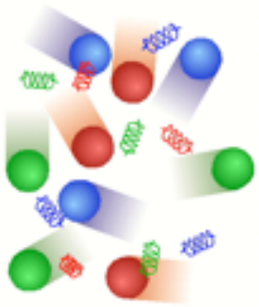
Thanks

Jihyun Bhom

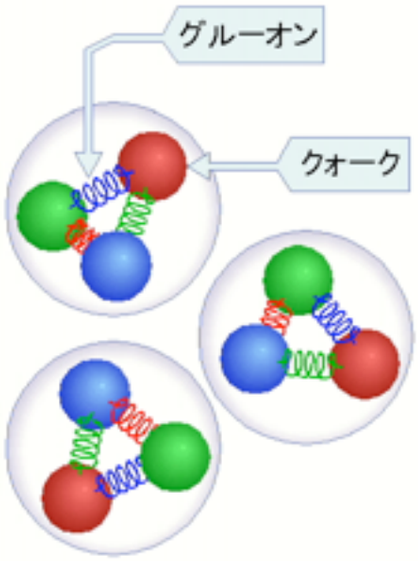


- ✓ Jihyun Bhom (Yonsei) joins Doctoral program, Univ. of Tsukuba in April, 2011.
- ✓ She has been working on DCal production since last fall at tsukuba.

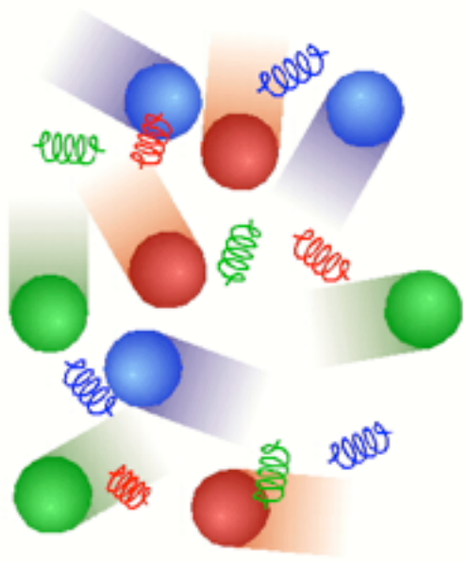
Outline



- ✓Introduction
  - 3 highlights @ RHIC with my biased view
    - ➡1) jet quenching
    - ➡2) v_2
    - ➡3) shock wave?
- ✓Activities related to ALICE at Tsukuba
  - v_2 analysis → Maya Shimomura
  - v_2 and higher harmonics → Shin'Ichi Esumi
  - Jet analysis
  - Test beam
- ✓Status of Dcal production at Tsukuba



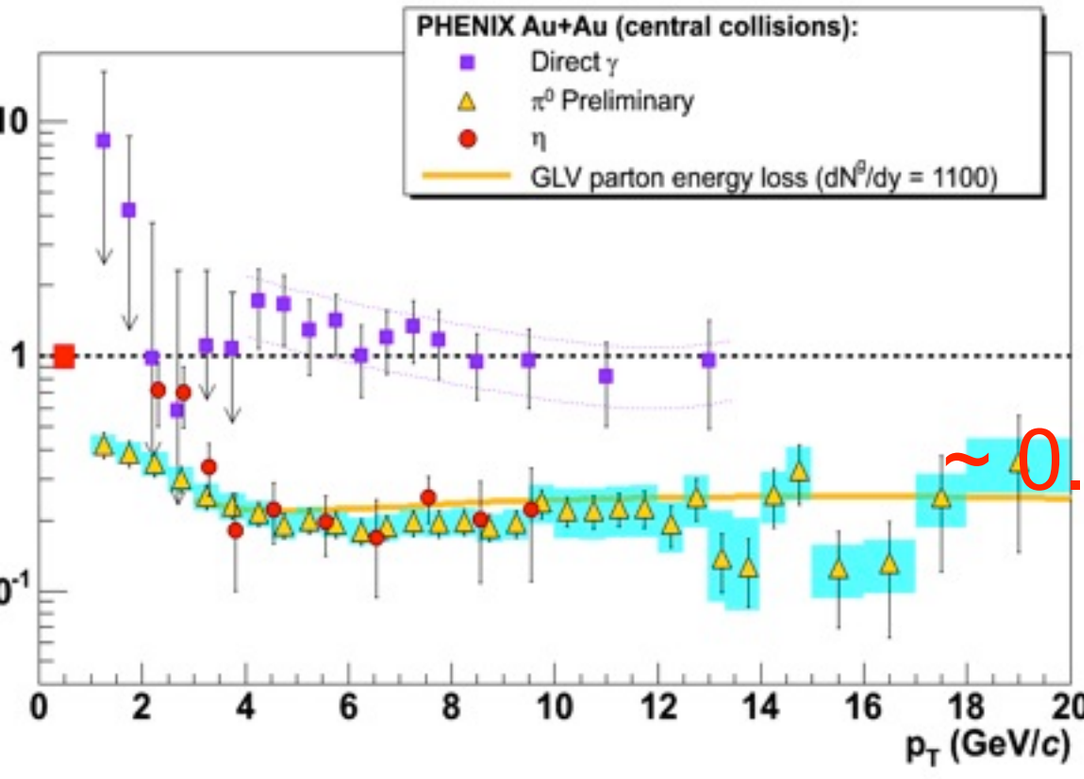
Introduction

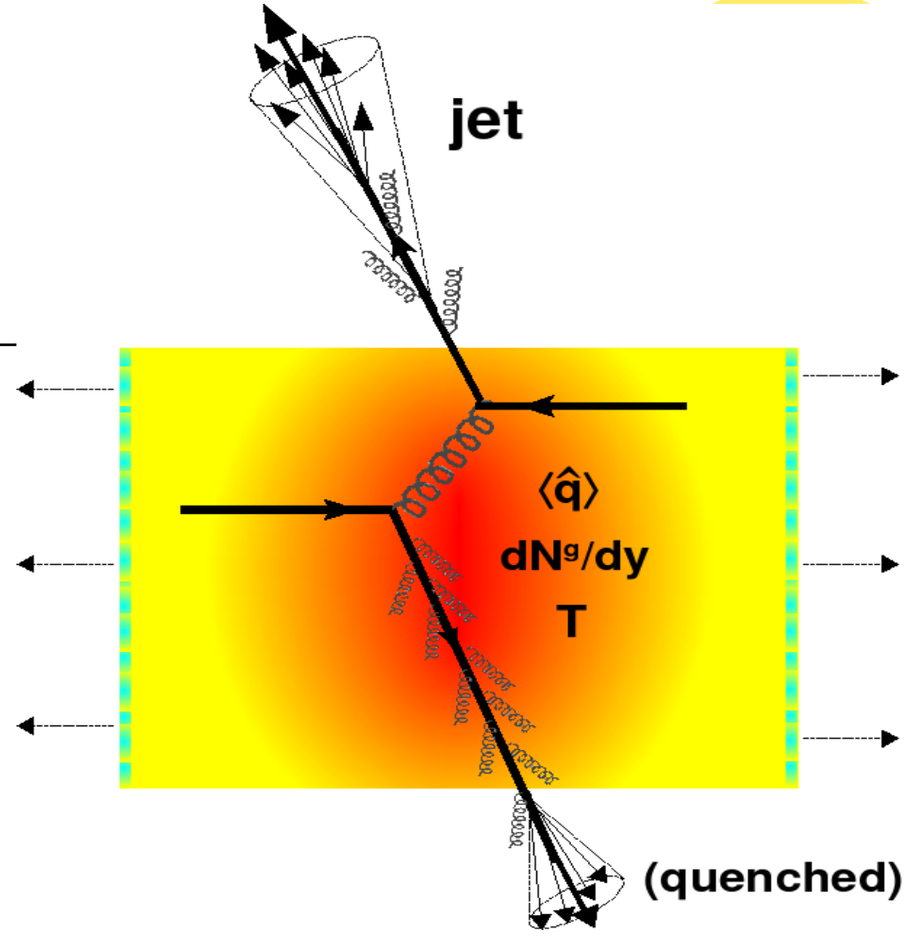


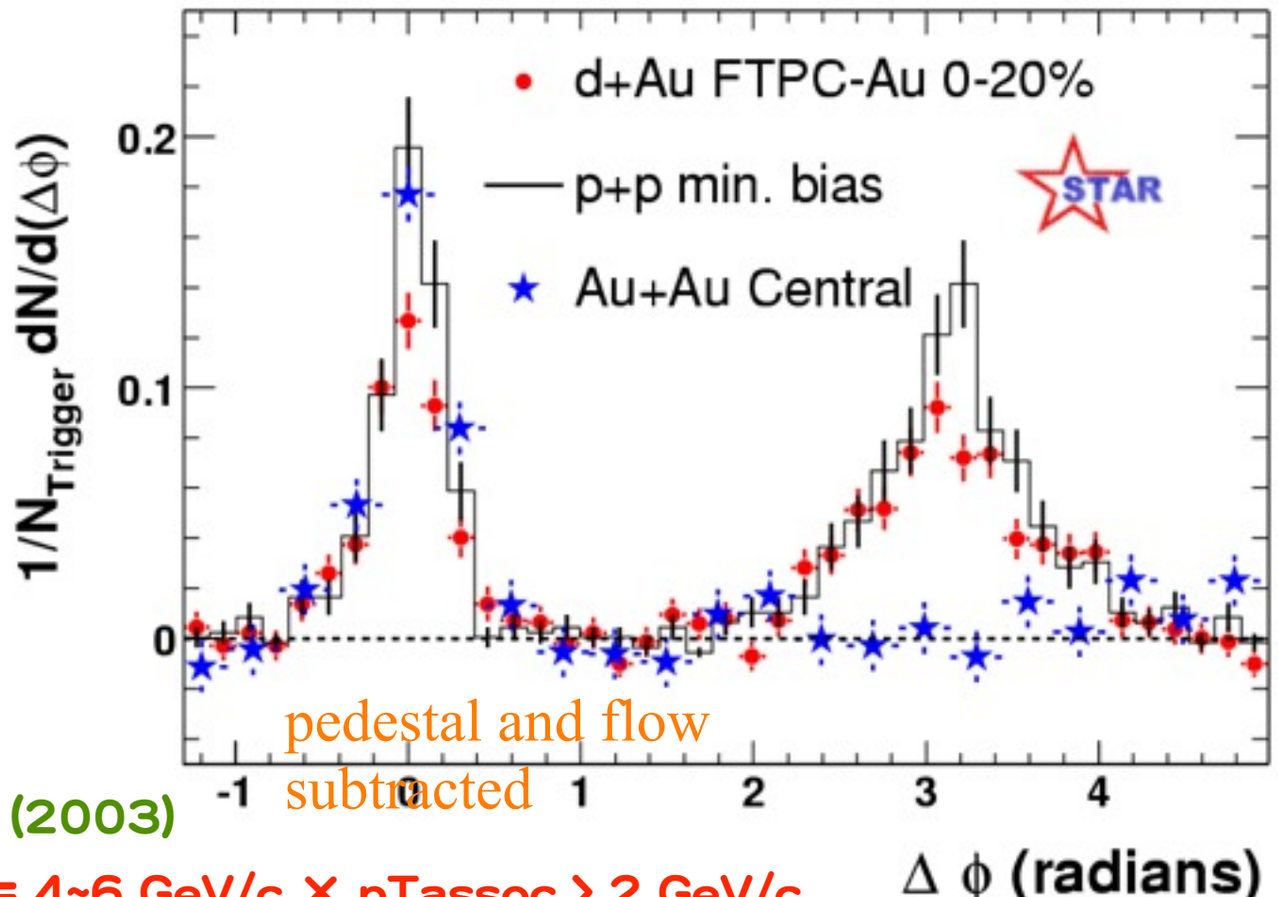
3 highlights@RHIC

1) Jet quenching

$$R_{\mathrm{AA}} = \frac{\text{"hot/dense QCDmedium"}}{\text{"QCD vacuum"}} = \frac{dn_{\mathrm{AA}}/dp_{\mathrm{T}}dy}{\langle N_{\mathrm{binary}}\rangle \cdot dn_{\mathrm{pp}}/dp_{\mathrm{T}}dy}$$



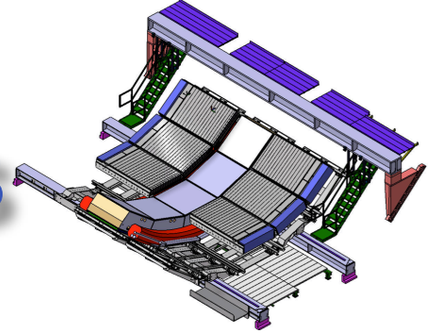




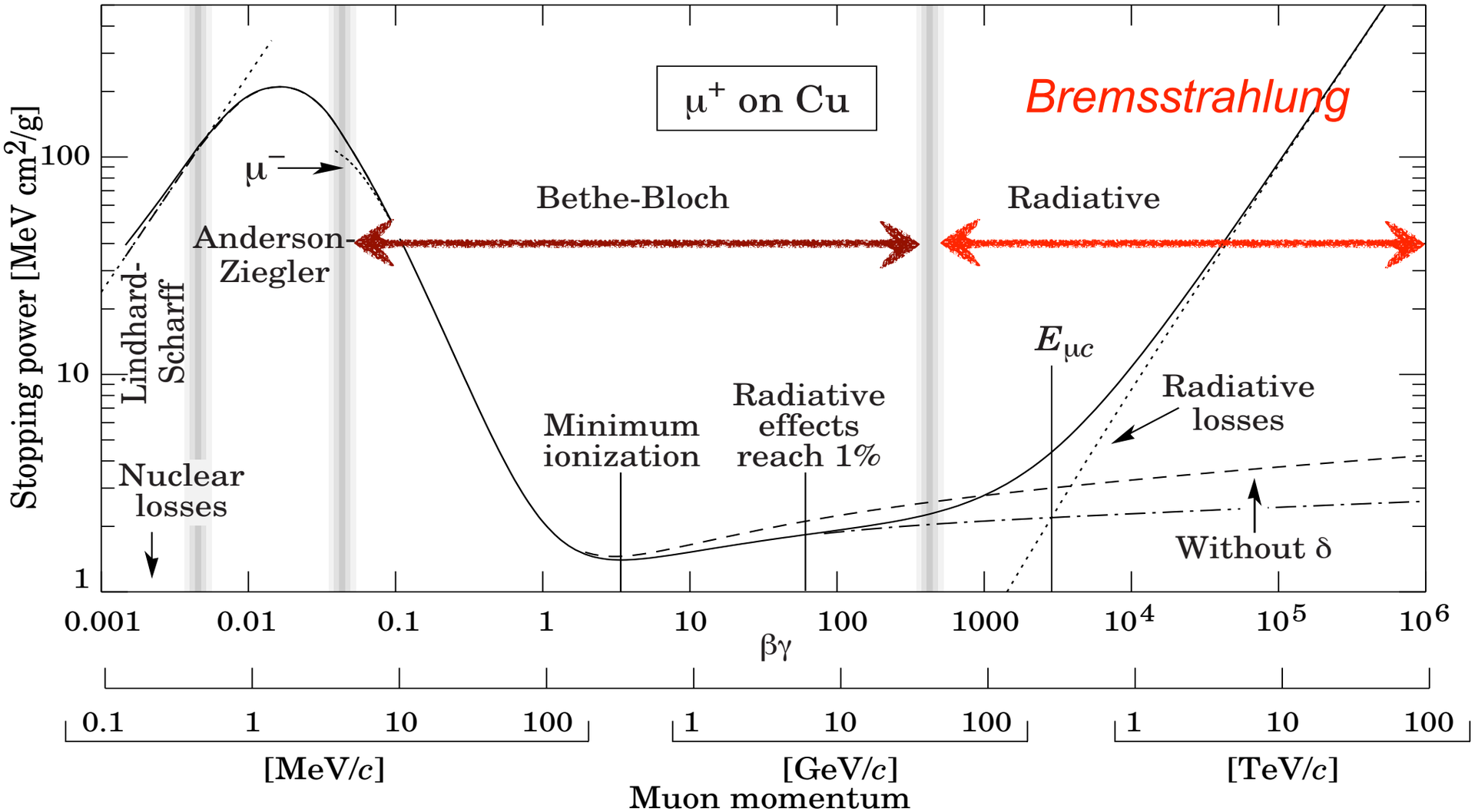
Star; P.R.L. 91, 72304 (2003)

pTtrig = 4~6 GeV/c × pTassoc > 2 GeV/c

Energy loss contains rich physics



Energy loss of charged particle in a matter



Collisional

✓Bethe-Bloch

Radiative

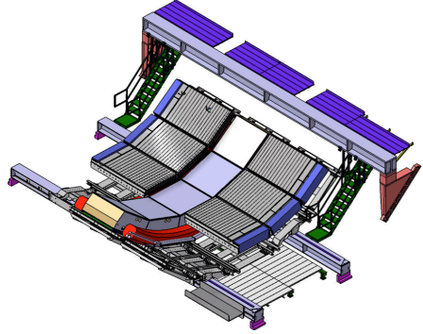
✓Bethe-Heitler (thin; $L \ll \lambda$)

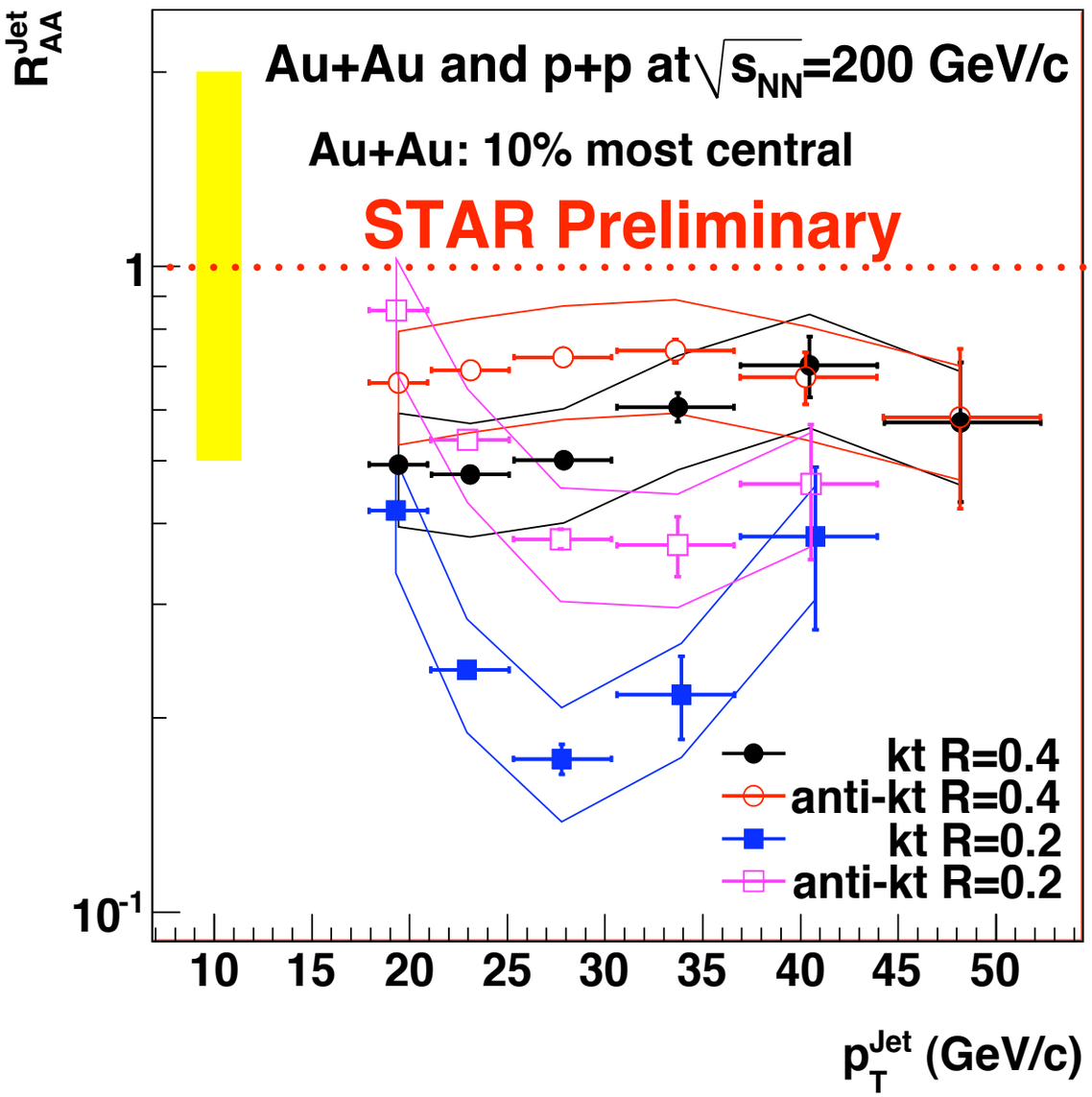
✓Landau-Pomeranchuk-Migdal (thick; $L \gg \lambda$)

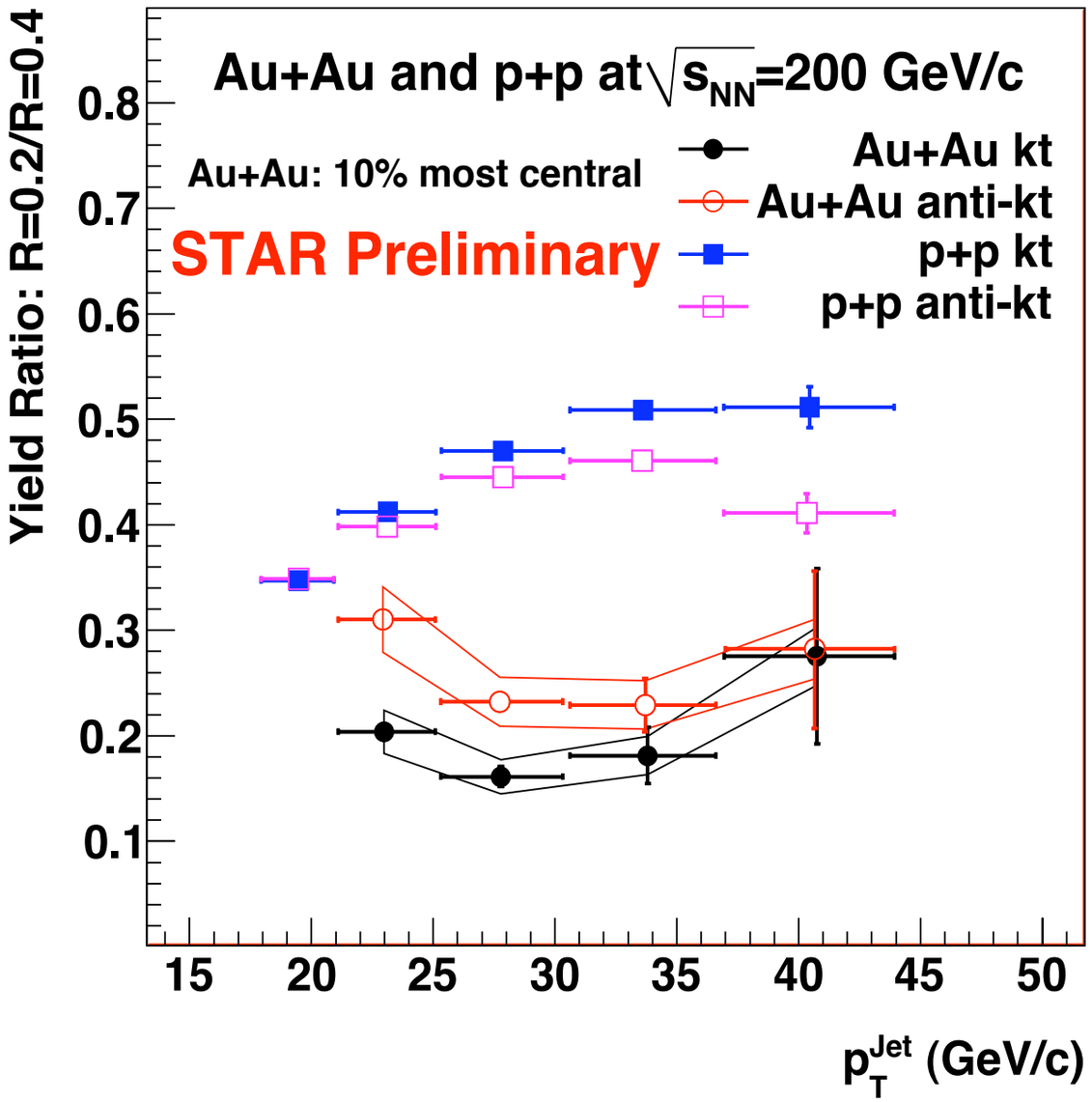
✓Measurements of dE/dx gives prop. of matter

- Energy loss in QED plasma gives T & m_D info.

Jet quenching in Jets?



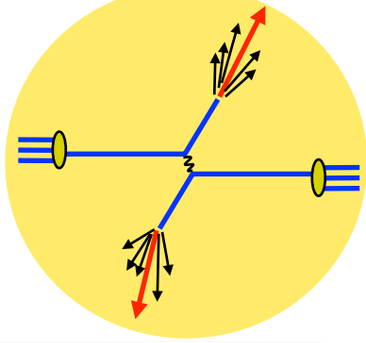


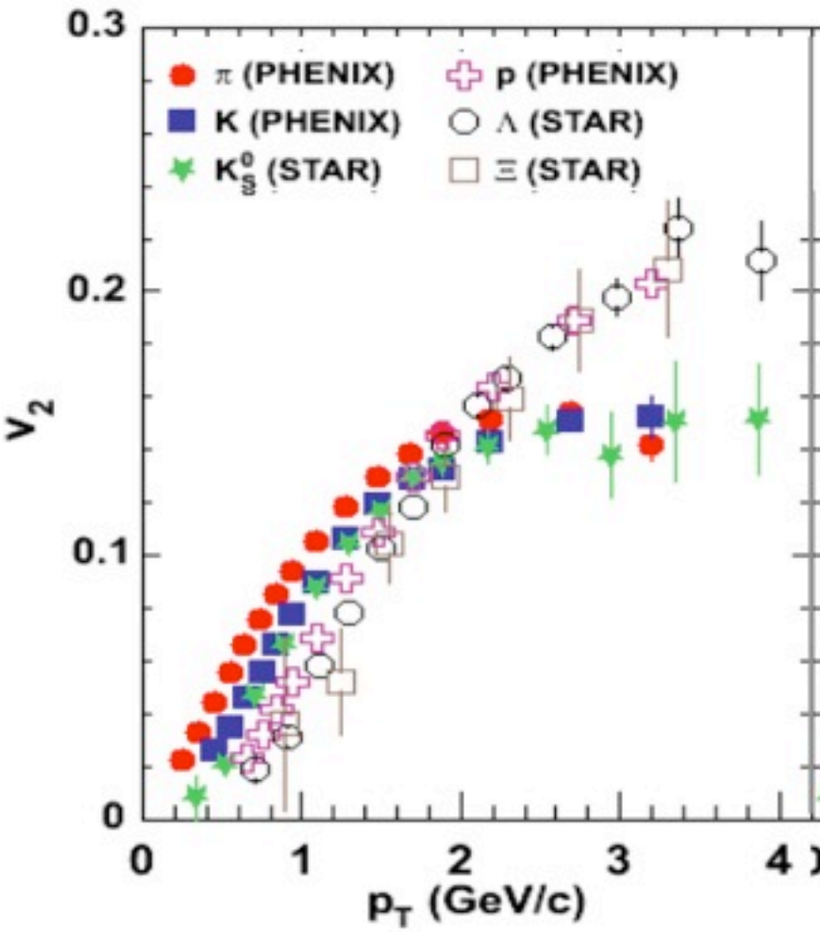


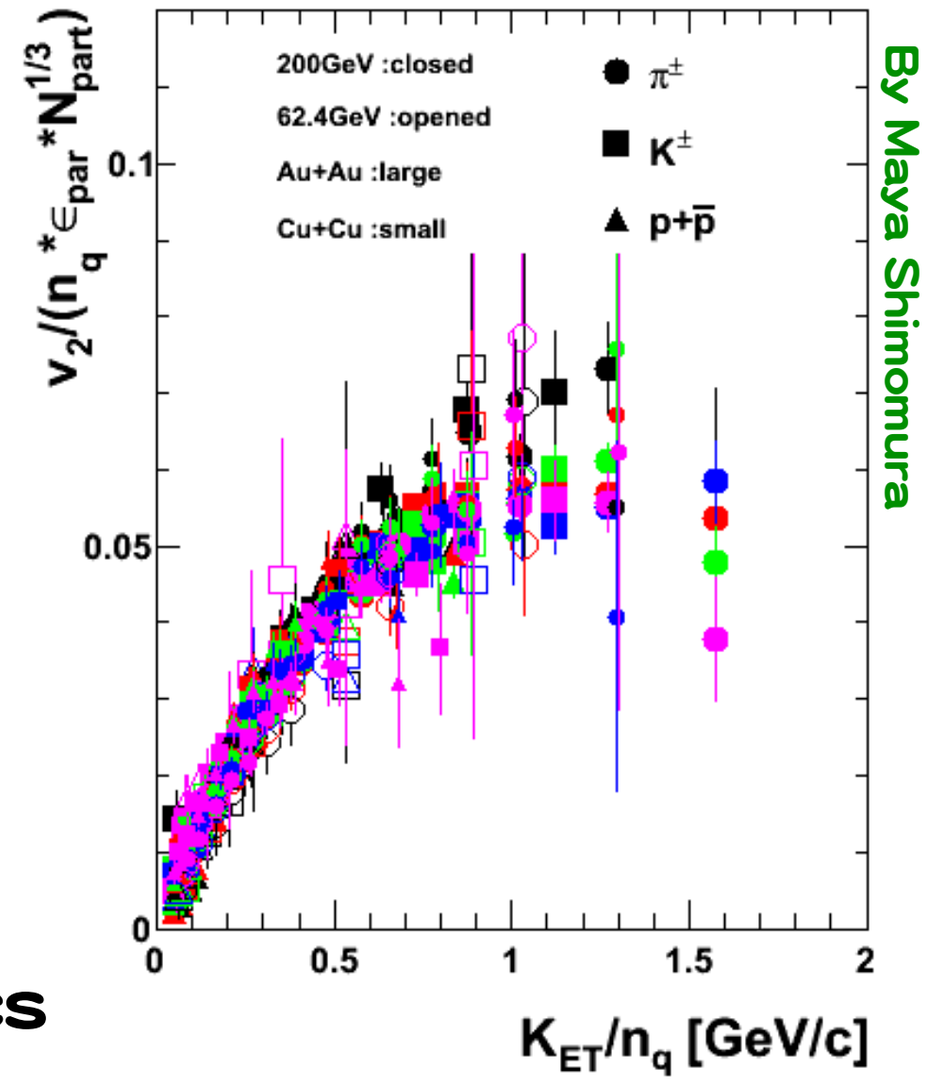
✓Broader distribution of Jets in AA

✓We look for higher jet energy

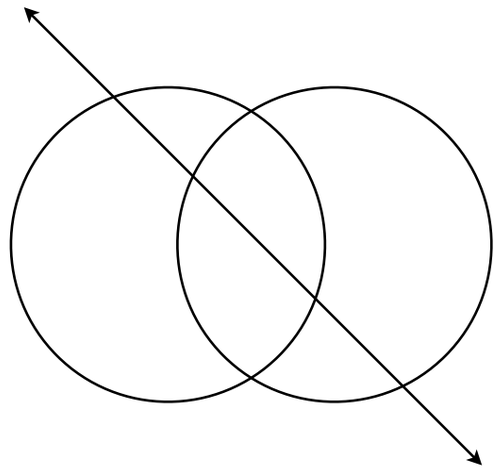
2) v2







By Maya Shimomura



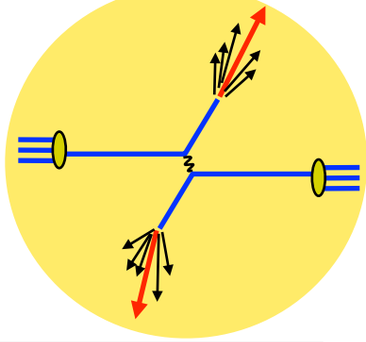
✓**Beautiful systematics**

- **Holds up to very high pt, where hard components and jet might be important**

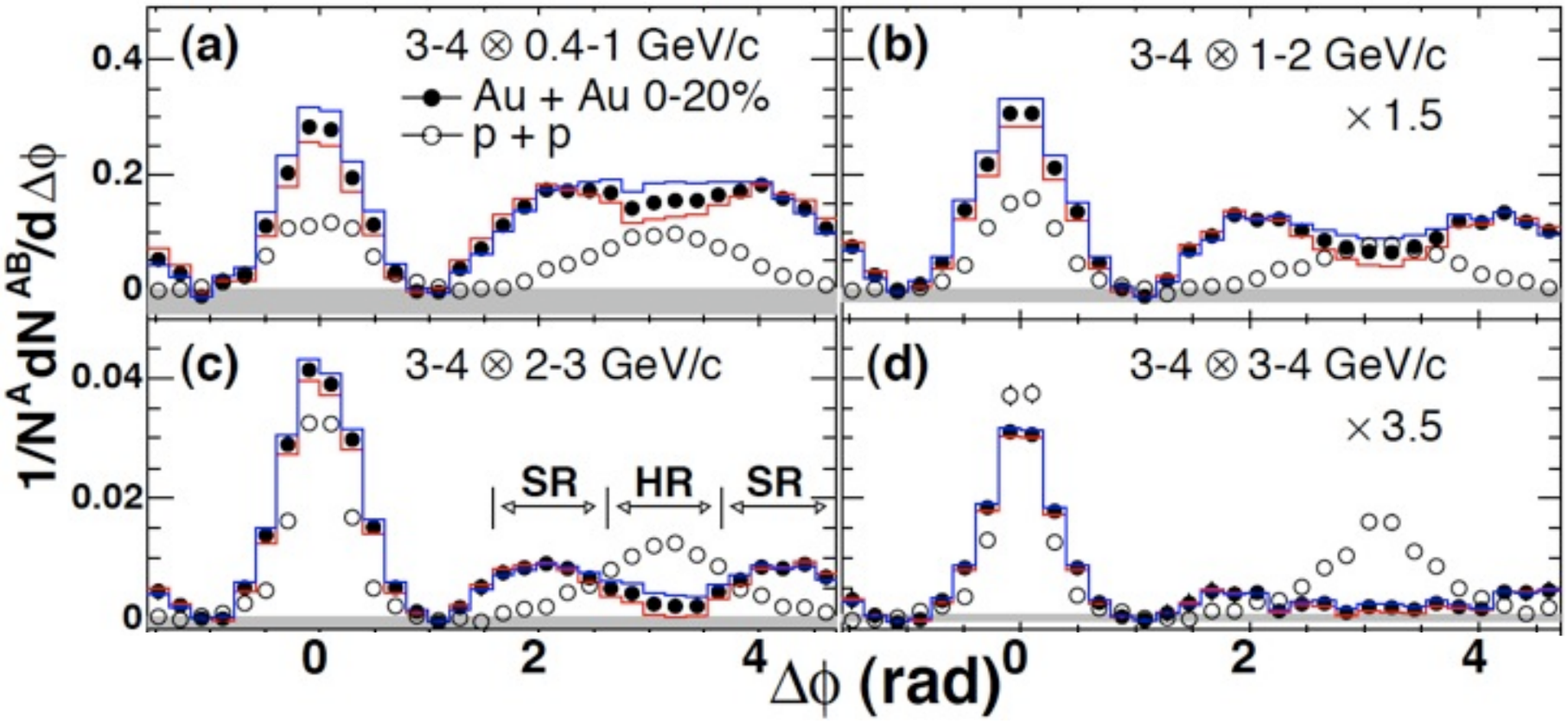
  ➡M. Shimomura, "ALICE v2 and RHIC v2 results"

- **Interplay of soft and hard ?** ➜ **Shinlchi Esumi**

3) Shock wave ?

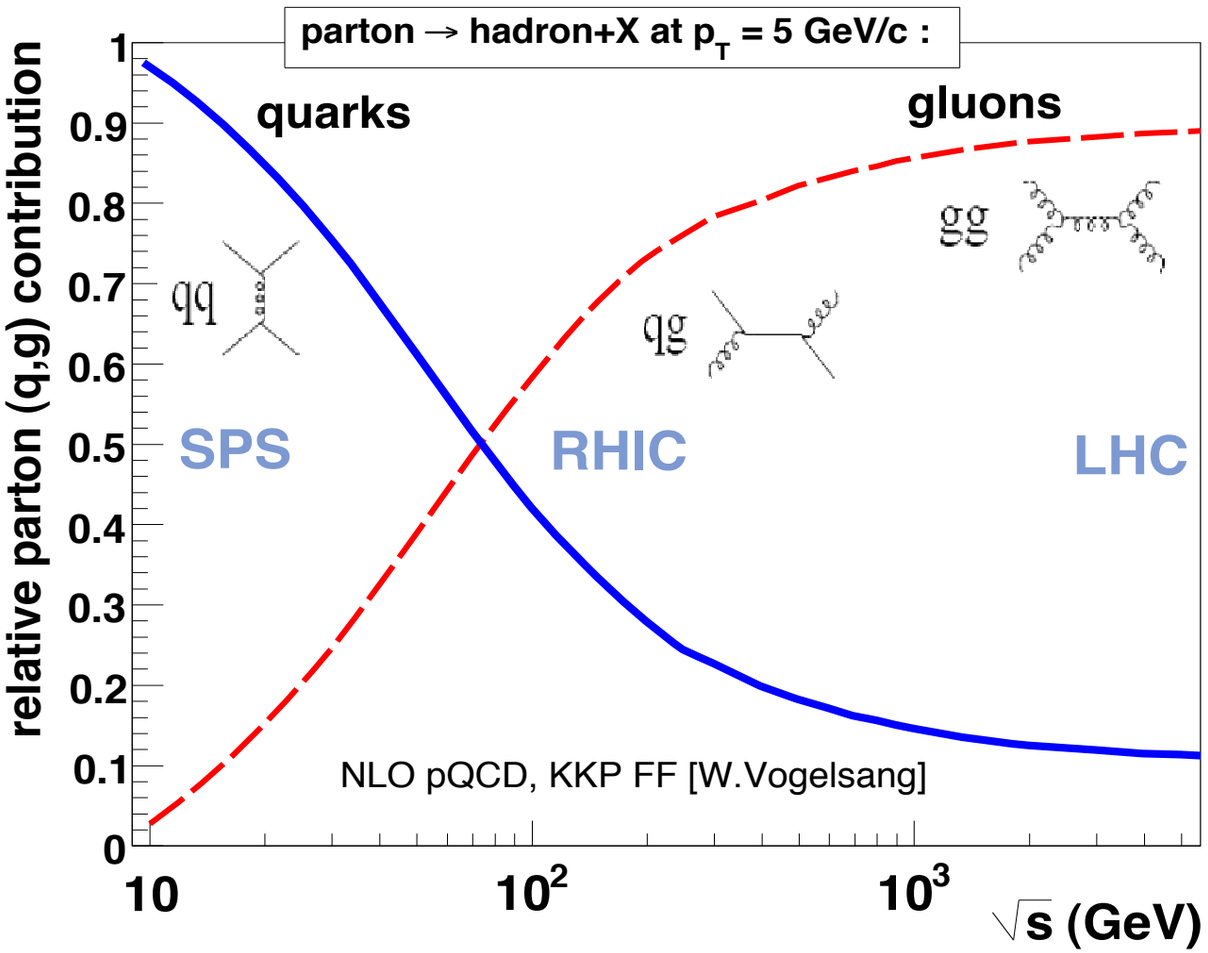


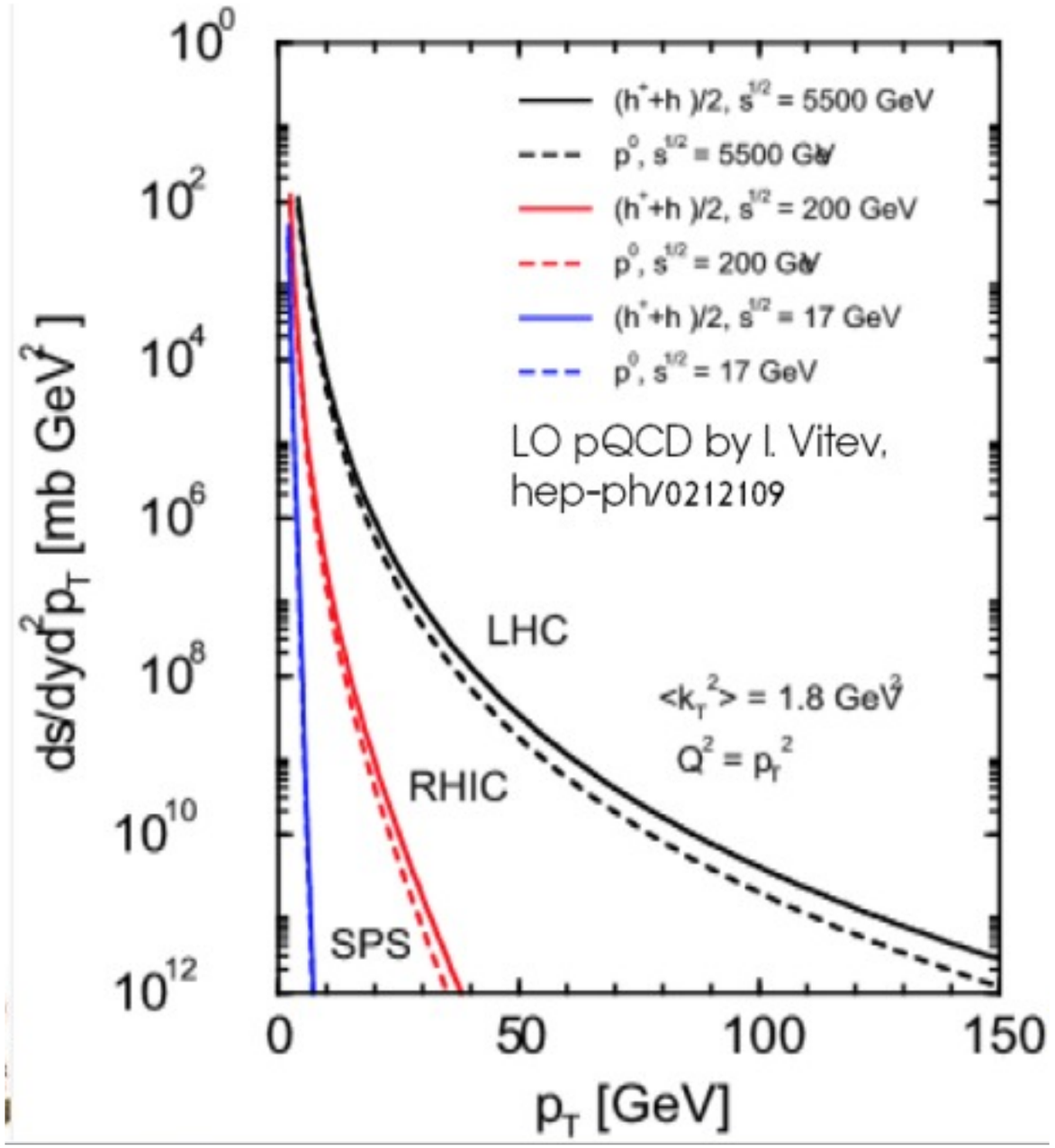
PHENIX, arXiv:0705.3238 [nucl-ex]



- ✓ Location & <pt> of the shoulder seem to be independent of centrality and pt.
- ✓ Shock wave or triangular flow due to initial fluctuation
  - ➡ S. Esumi, "Elliptic and triangular flow measurements"

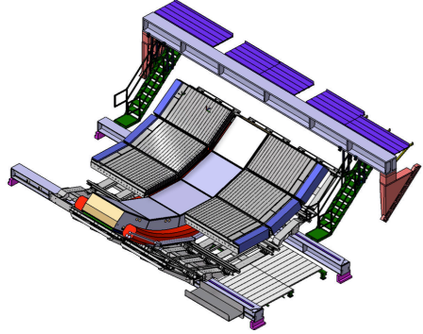
RHIC vs LHC

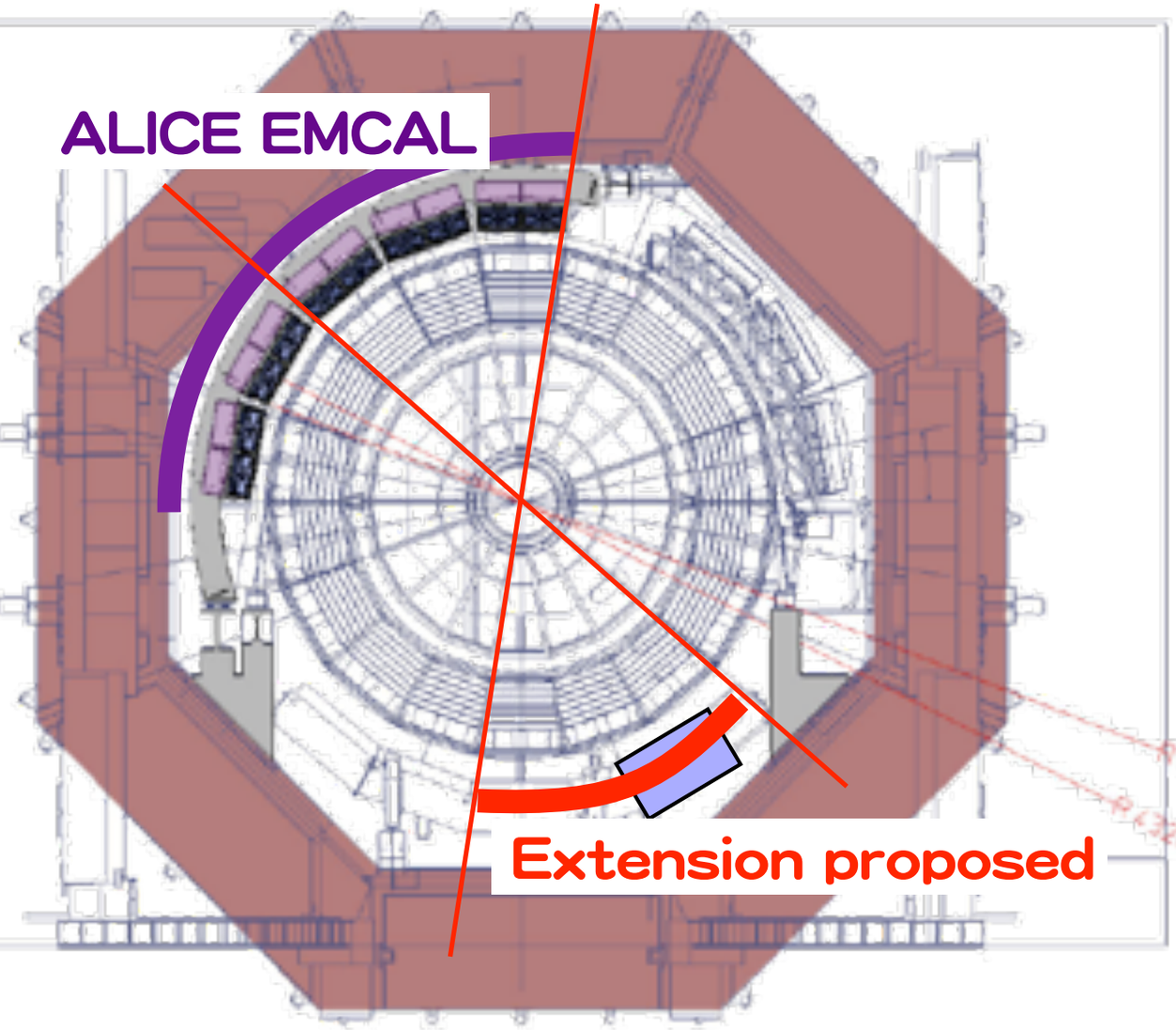




- No more goodies in soft components alone (prejudice)
- LHC has superior advantage in hard components

DCal as an extension of EM-Cal

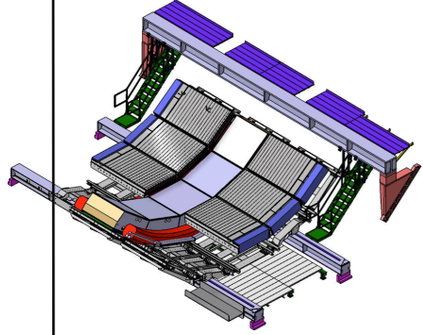




DiJet Calorimeter

- ✓For better performance of back-to back capability
  - ➡Define back-to back jets
  - ➡Trigger back-to back jets
- ✓Progress
  - Proposed in Feb.,09
  - Discussed w. IN2P3 in May, 09
  - Discussed in March,09
  - Proposal in May, 09
  - Partial approval in July, 09
  - Full approval by ALICE in Oct. 09
- ✓Construction started !

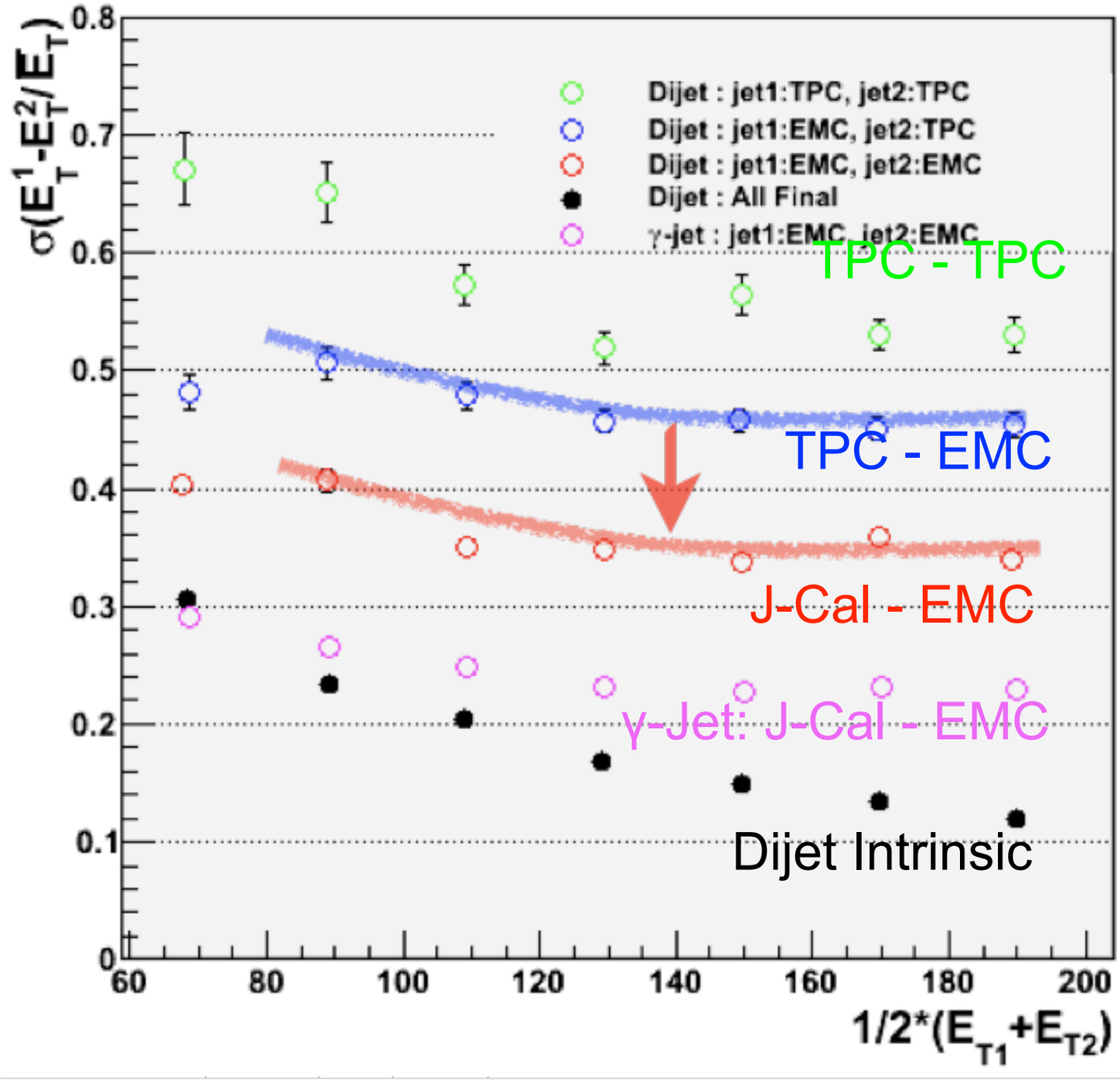
Energy resolution



PYTHIA8, detector resolution included

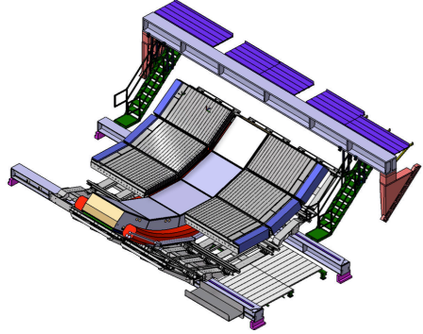
gfrac1

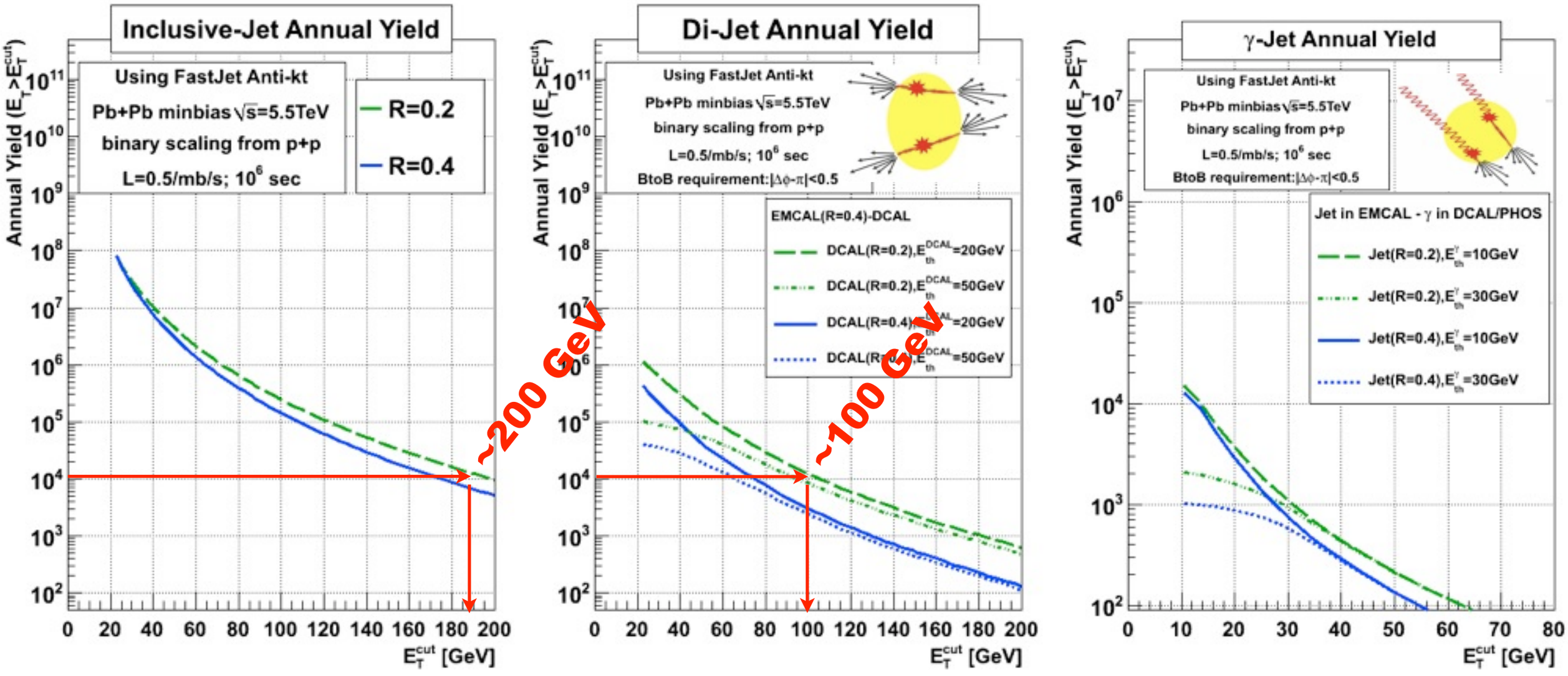
R_{cone} = 0.2



- ✓ Statistical fluctuation in neutrals determines the resolution.
- ✓ D-Cal improves the resolution from ~45% to ~35%
- ✓ Imbalance in energies provides information on the partonic energy loss.

What we expect; Reach of Jet Energy

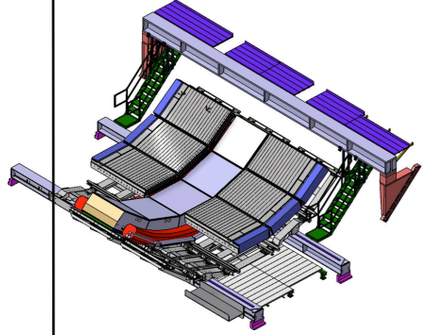




✓ For 10^4 events/year in Pb+Pb@5.5TeV,

- Inclusive jet up to 200 GeV
- Di-Jet to 100 GeV

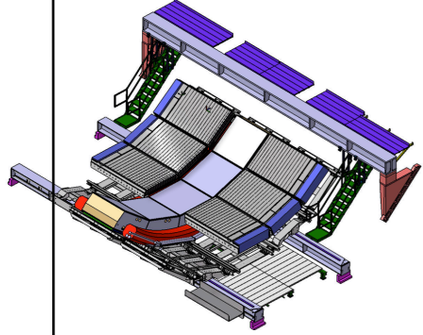
Control variables for AA



✓Since heavy ion collisions is so complicated, while there is no ‘standard model’, we need to measure heavy ion collisions w. many control variables.

- Centrality / impact parameter of collisions
- Reaction Plane Angle
- Yet, another control variable for the next generation experiments ;

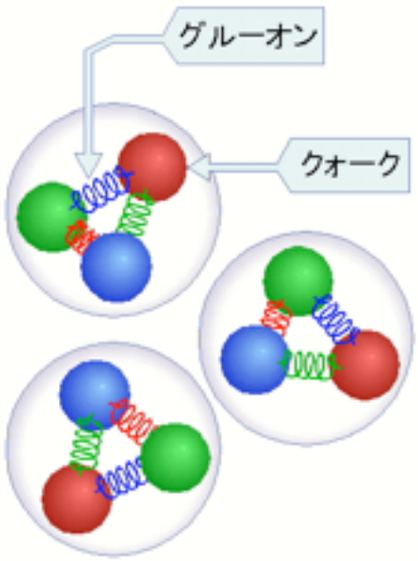
Control variables for AA



✓Since heavy ion collisions is so complicated, while there is no ‘standard model’, we need to measure heavy ion collisions w. many control variables.

- Centrality / impact parameter of collisions
- Reaction Plane Angle
- Yet, another control variable for the next generation experiments ;

→ Jet Axis



Activities related to ALICE at Tsukuba


Masato Sano

v2 analysis → Masato Sano

→ Maya Shimomura

v2 and higher harmonics → Shinlchi Esumi

Jet analysis → Tatsuya Chujo

→ Dousatsu Sakata

Test beam → Kaoru Gunji

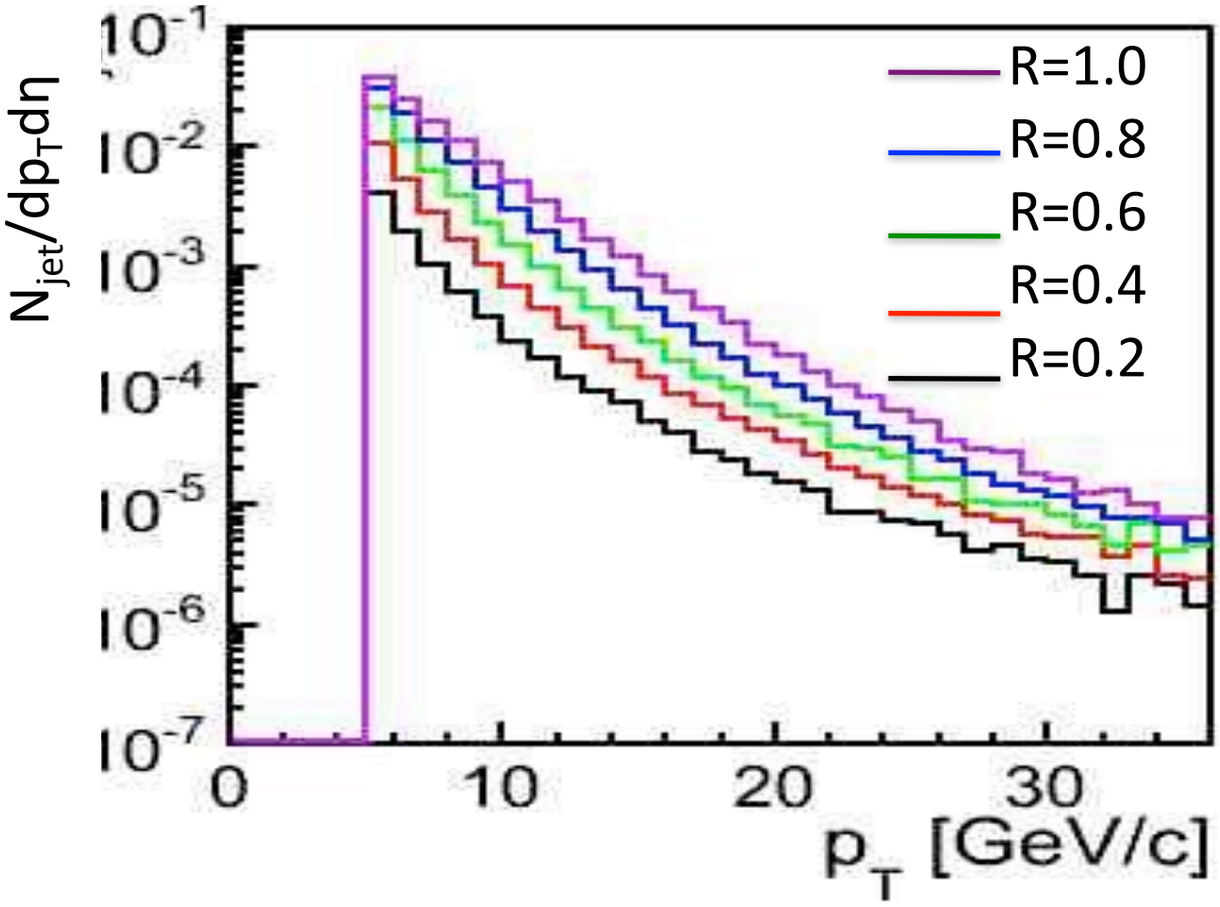

Dousatsu Sakata


Kaoru Gunji

Dousatsu Sakata

2nd grade student
of doctor course (Tsukuba)
Junior Research Associate (RIKEN)

Jet Yield using anti-kt (p+p √s = 7TeV)



(It's not adopted unfolding)

Detector Contribution

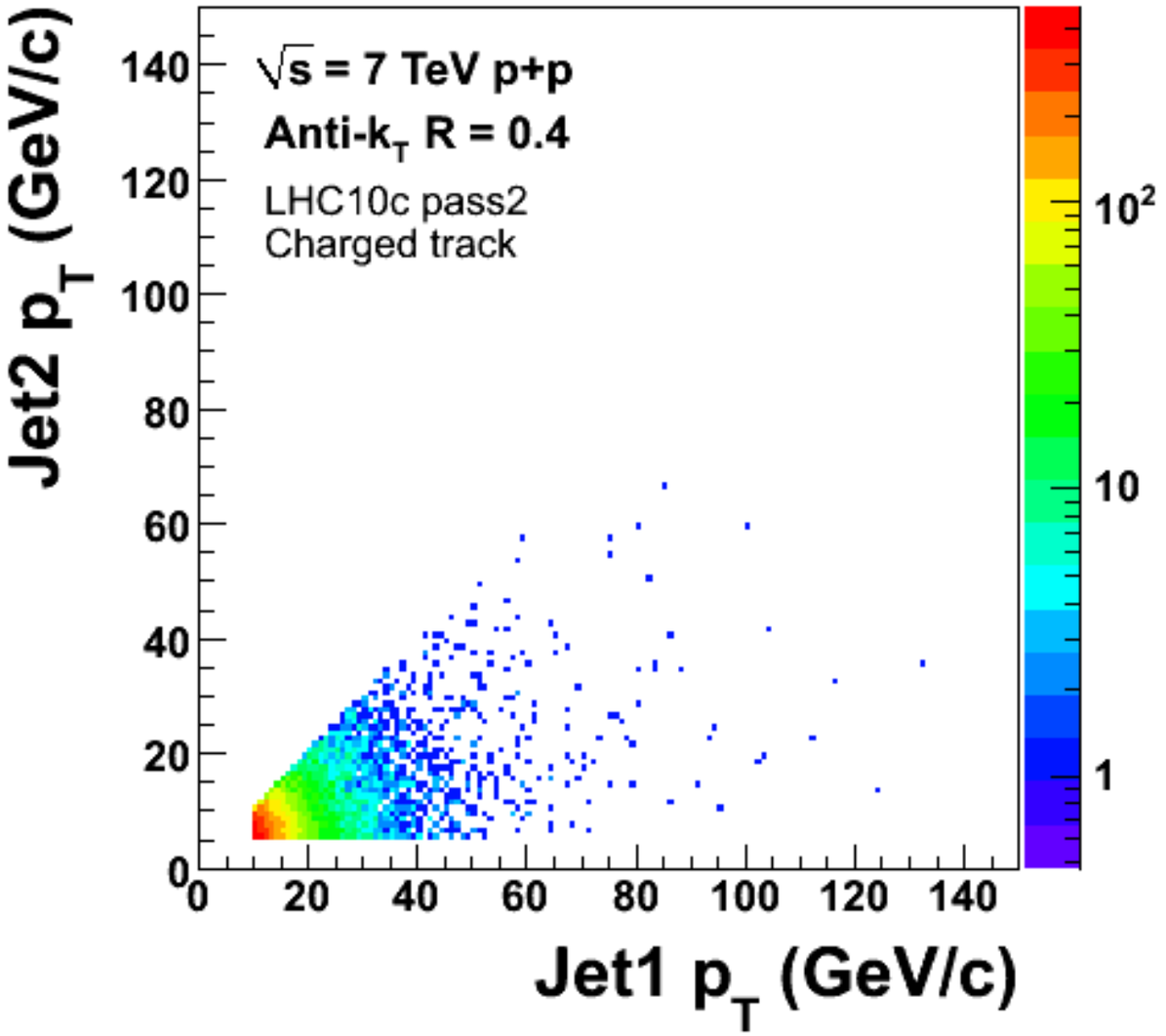
* DCS development of TRD

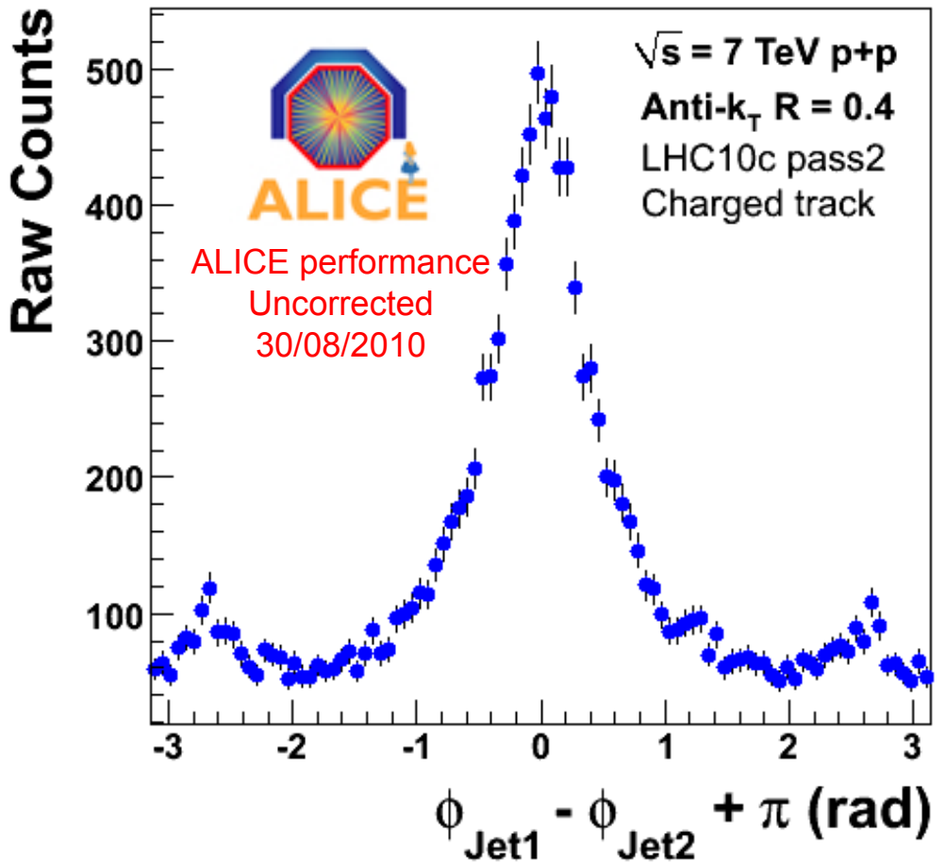
Analysis Subjects

* Jet Algorithm Study
* Jet Spectrum & Jet R_{AA}
* Jet modification
  - Jet Energy
  - Jet Broadness

Start looking at Dijet in pp@7TeV

Tatsuya Chujo





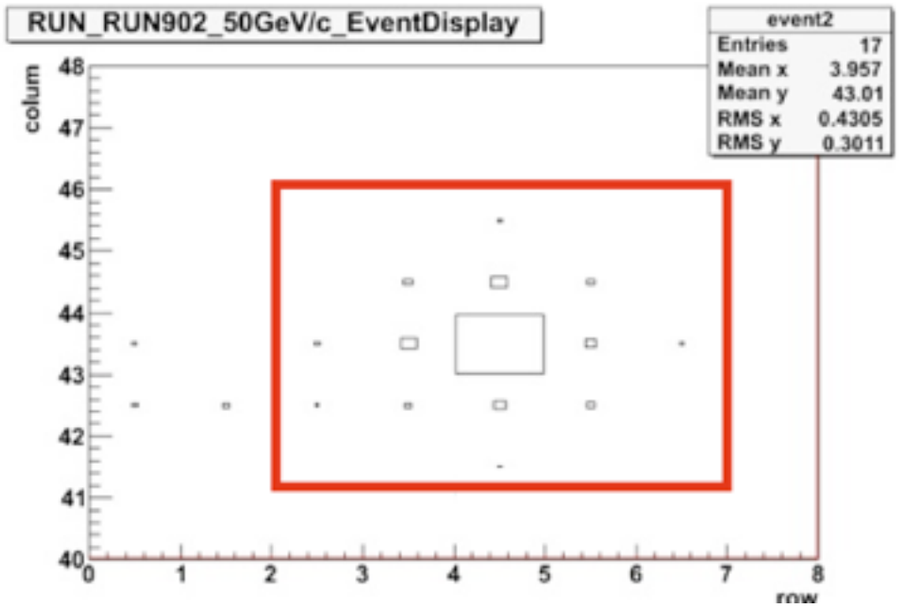
- ✓First look at Dijet in pp 7 TeV
- ✓In 128 M M.B., single jet up to pT ~ 70 GeV/c, dijet mass < 50 GeV/c^2 observed

Test beam experiment of EMCal

Kaoru Gunji

・participated in test beam experiment with CERN-PS/SPS in Aug, 2010.

・analyze Energy and timing resolution.

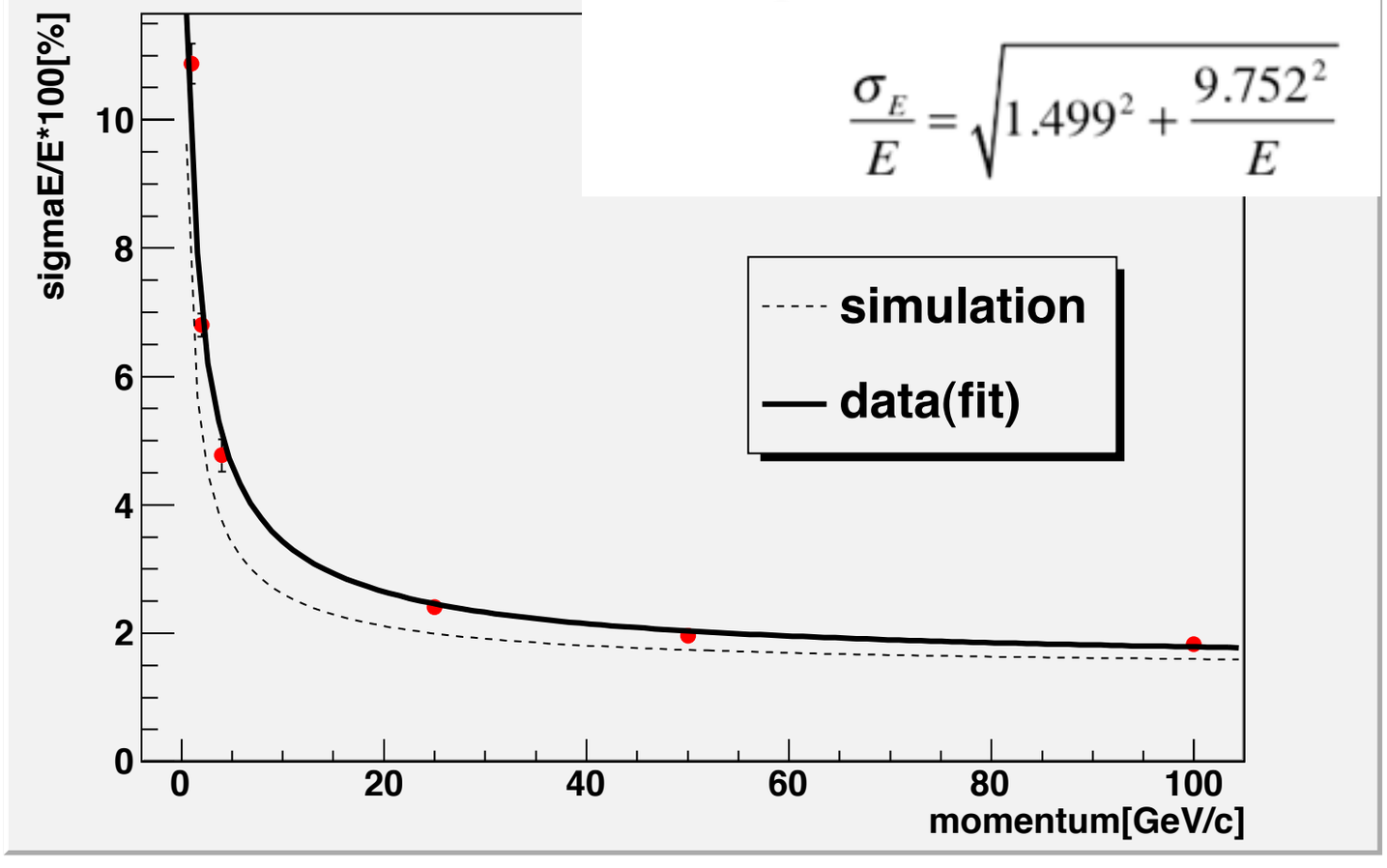


Clustering

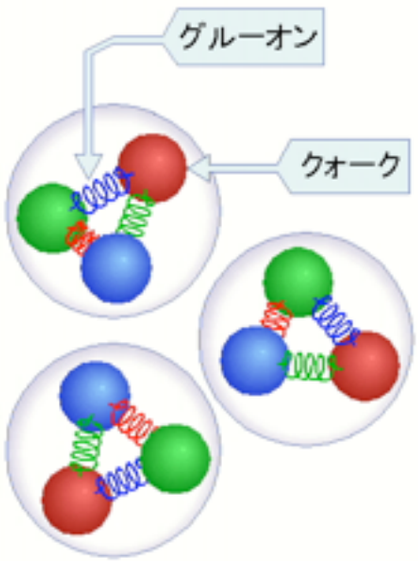
Energy Resolution

・Fitting function:

$$\frac{\sigma_E}{E} = \sqrt{1.499^2 + \frac{9.752^2}{E}}$$



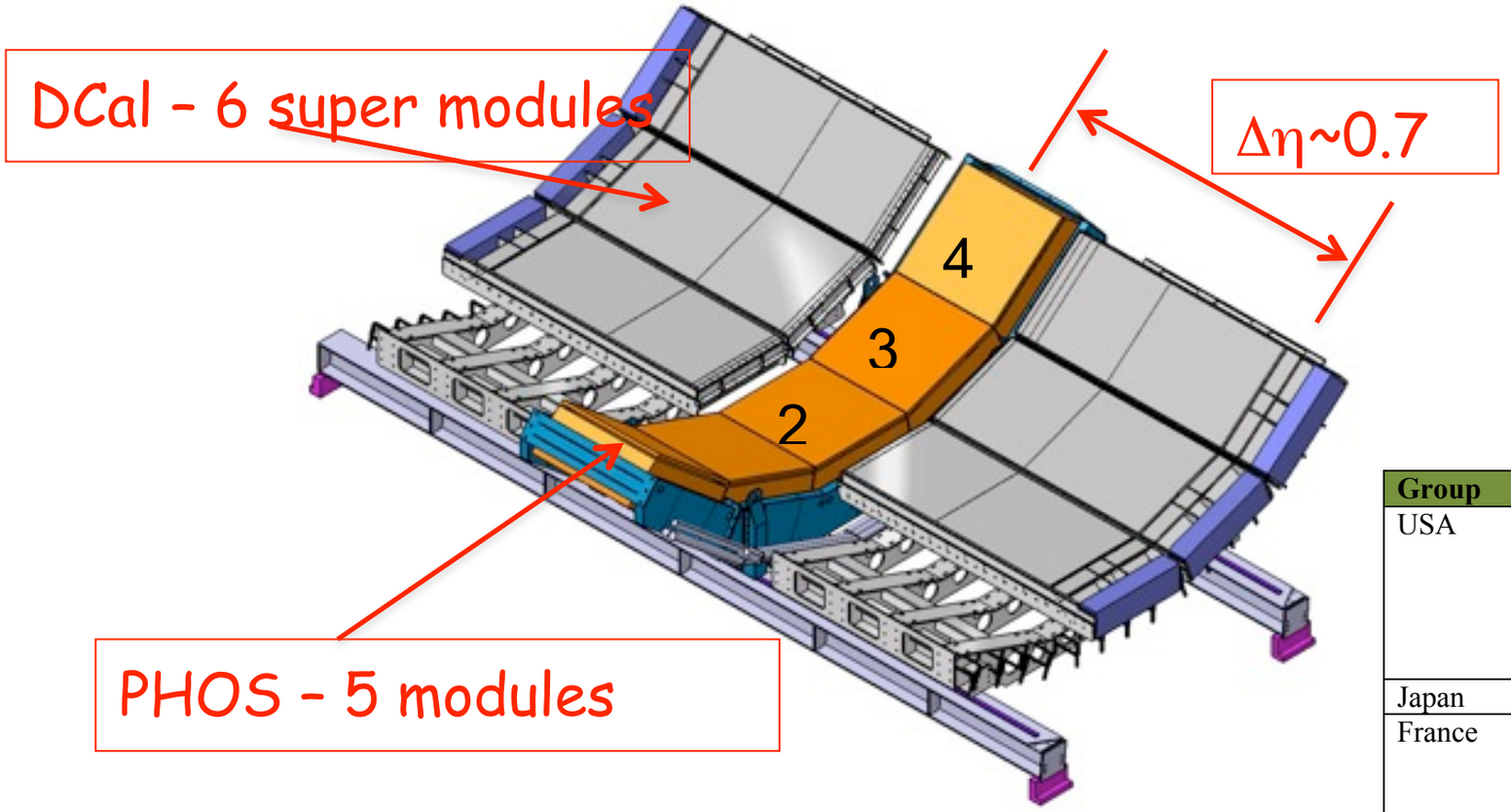
50GeV/c	EMCal
timing resolution	358.8±8.4[ps]



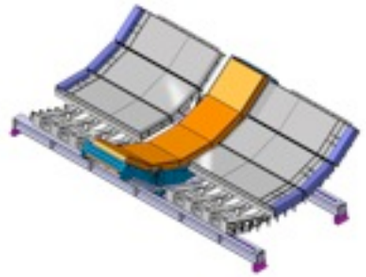
Status of DCal production at Tsukuba

Tatsuya Chujo

Why not here?



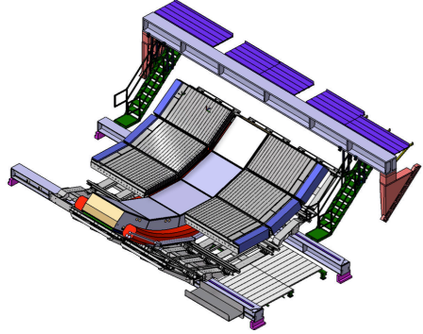
Group	Group Leader	Proposed Responsibilities
USA	T.J. Symons, LBNL	3 super modules Detector design Overall project management Project technical coordination DCal LED system
Japan	Y. Miake, Tsukuba	1.5 super module
France	C. Roy, IPHC Strasbourg	0.5 super modules Support structure design, fabrication Oversight and payment of up to 2/3 the cost Installation tooling design Installation oversight Jet trigger Design, hardware and integration SM integration and cosmic calibration
China	D. Zhou	1 super module
Italy	N. Bianchi	Module assembly Fiber production facilities

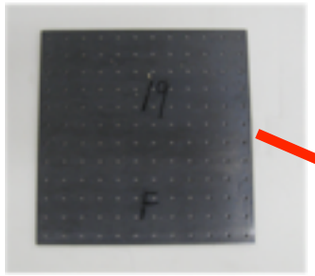


Box of Lead Tiles on the floor

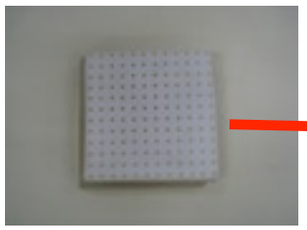
Due to the load capacity of the floor,,,,

DCal structure





Lead



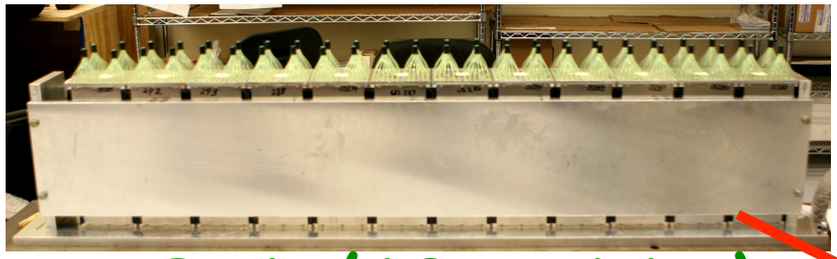
Paper

Scint.

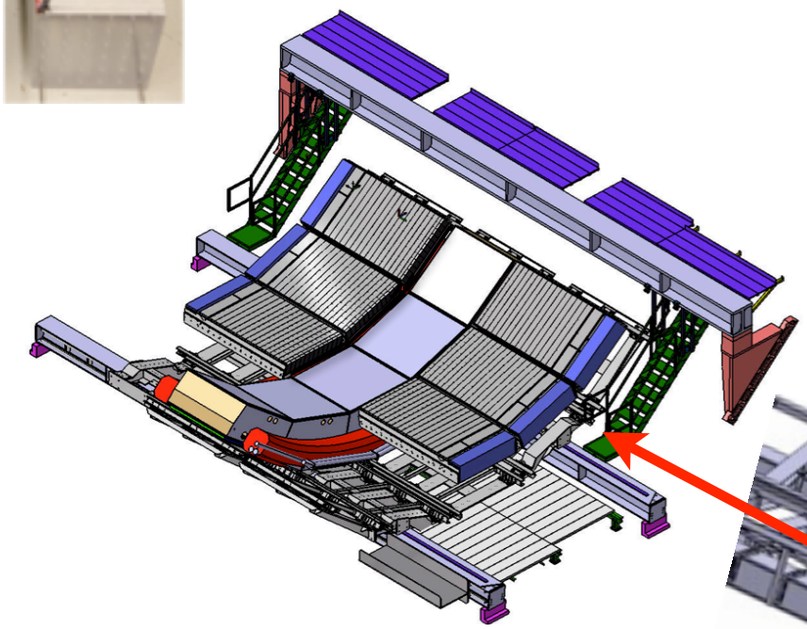
Module (77 layers)

4 APD/module

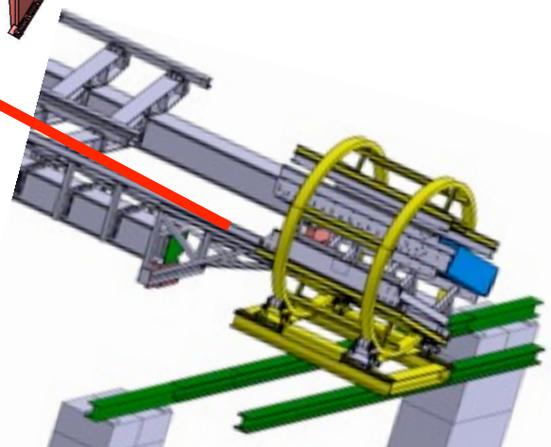
Quantity	Value
Tower Size (at η=0)	~6.0 × ~6.0 × 24.6 cm^3 (active)
Tower Size	$\Delta\phi$ x $\Delta\eta$ = 0.0143 x 0.0143
Sampling Ratio	1.44 mm Pb / 1.76 mm Scintillator
Number of Layers	77
Effective Radiation Length X_o	12.3 mm
Effective Moliere Radius R_M	3.20 cm
Effective Density	5.68 g/cm^3
Sampling Fraction	10.5
Number of Radiation Lengths	20.1

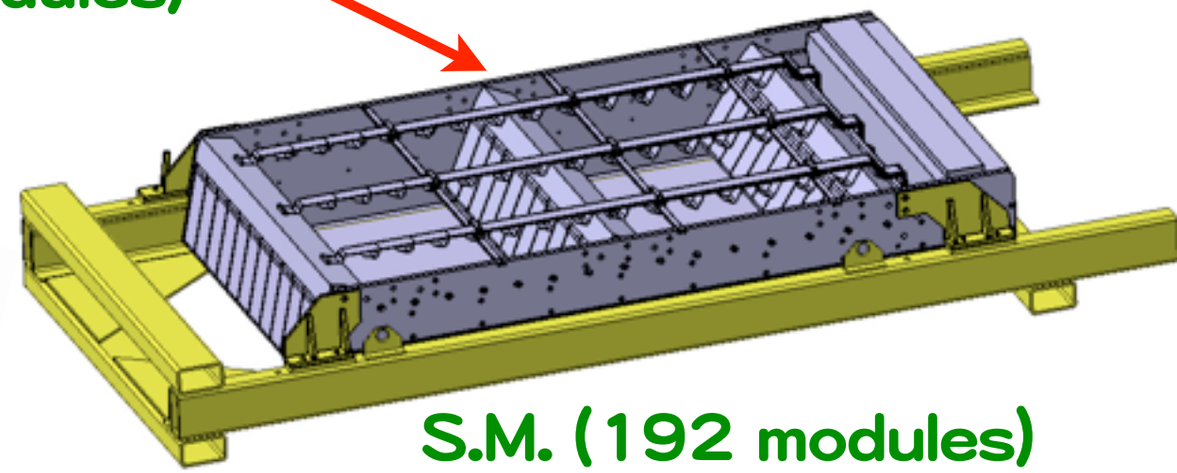


Strip (12 modules)



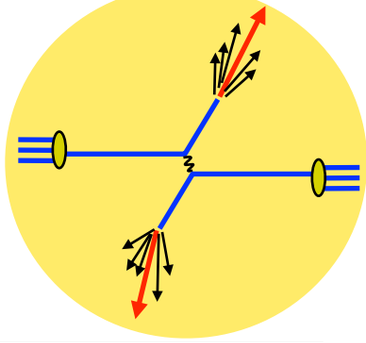
DCal (6 S.M.)

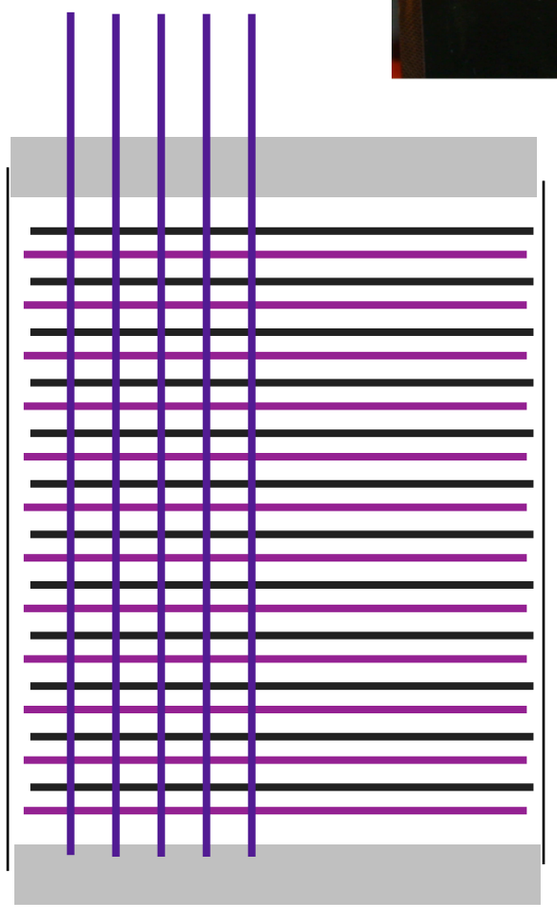




S.M. (192 modules)

Why it is time consuming

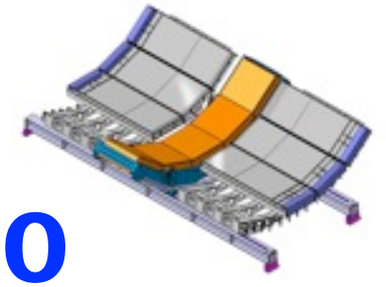




Holes of lead tiles and scintillators need to be aligned
  1.2mm holes for 1mm fibers

Enough tension among lead tiles and scintillators by stainless plate on the side to keep the alignment even at 45 degree position
  no glue in between for better optical transmission

Control of tension is very important
  Lead tile is soft.
  Height of the stacks shrinks in time



Cleaning of Lead Tiles in Jun. – Jul., 2010

- Every lead tile cleaned with ethanol in supersonic cleaner

Sanshiro Mizuno

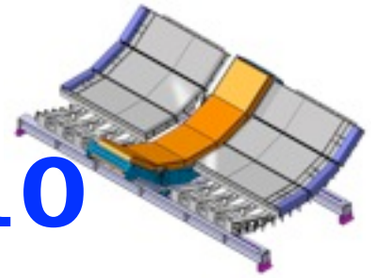
Cleaning Lead Tile (Jun. 21 - Jul. 22)

>20k tiles

>100 liter ethanol

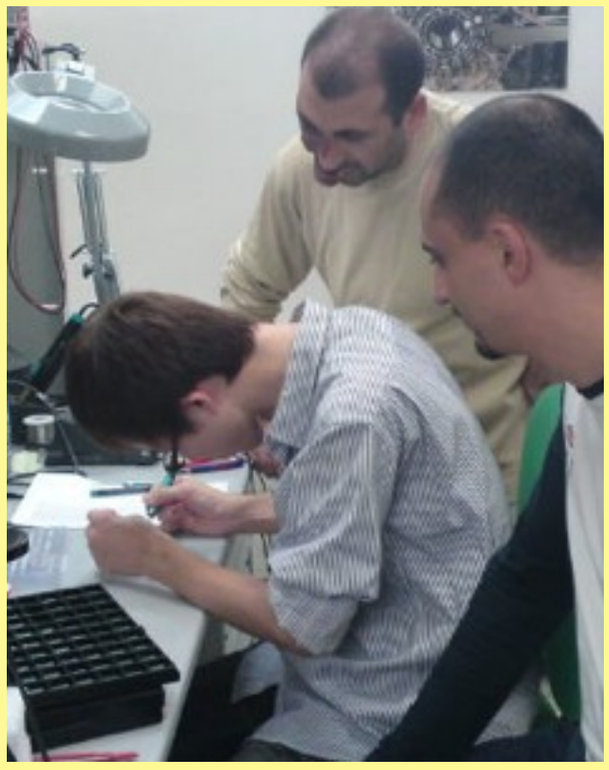
Tomo Nakajima

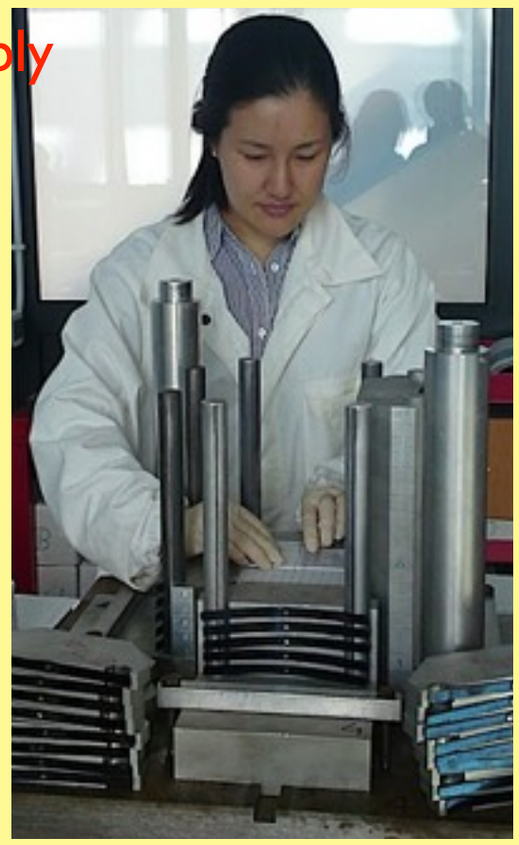
Tsukuba team at Catania in Oct.-Dec,2010



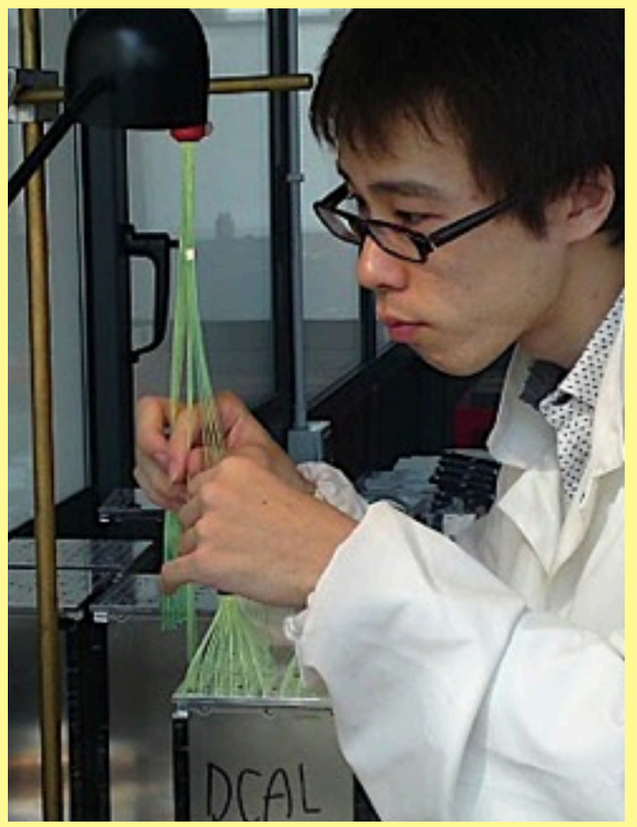
- Module Assembly & APD assembly/calibration at Catania
  - Assembly of modules (96 modules, 1/2 S.M.)
  - APD assembly & calibration (2400)

Hiroki & Maya at Catania fir APD & module assembly



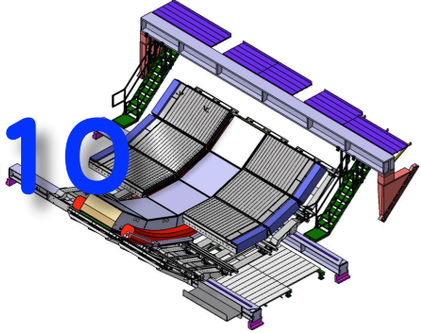


Maya Shimura



Hiroki Yokoyama

Tsukuba team at Catania in Oct.-Dec,2010

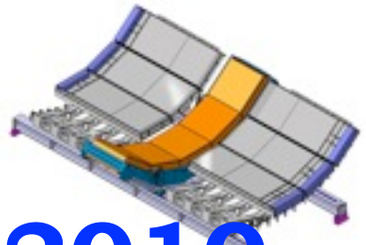


- ✓Completed 96 modules production with Catania's help.
- ✓APD assembly/calibration for 2,400 APDs with Angela B.'s team

Hiroki & Maya at Catania

Strip assembly also done at Catania, then ship to France.

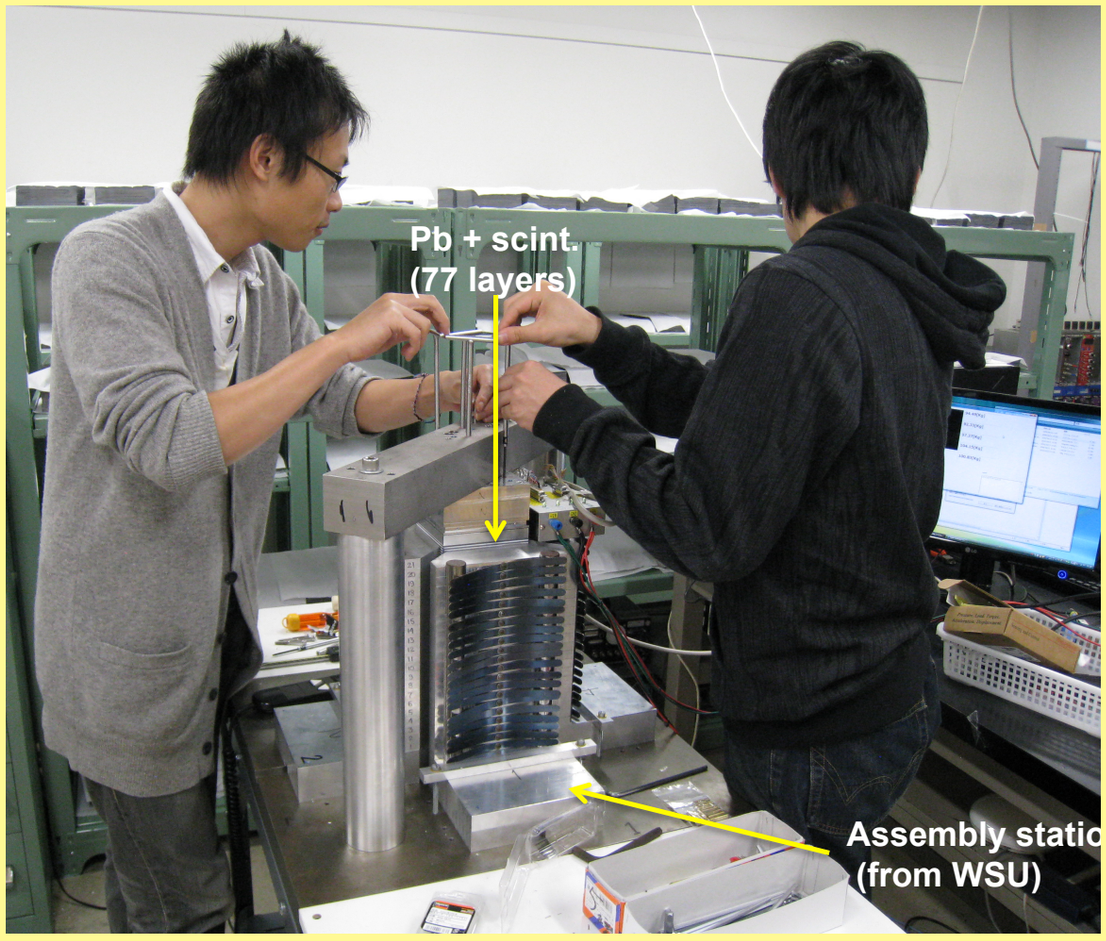
First Module assembled at Tsukuba



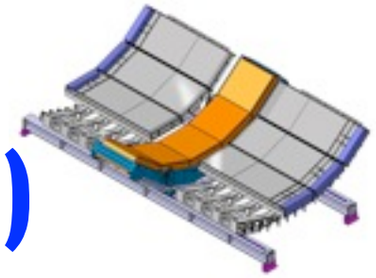
Oct 27,2010

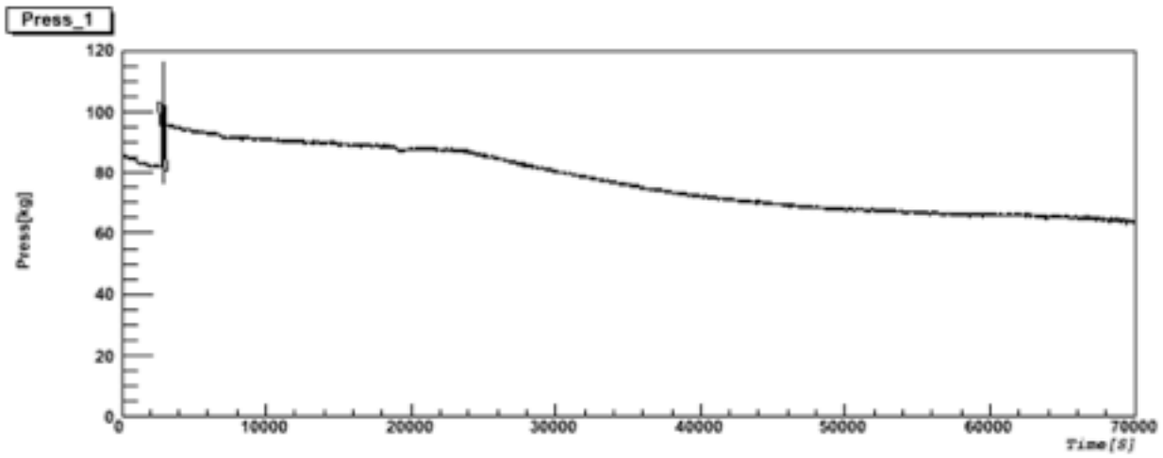
- November:
  - Load cell pressure control system (4+1 spare & calibration) is ready to use (Nov. 1).
  - Finished 3 modules assembly in Tsukuba by using the US assembly station only (as of Nov. 5).

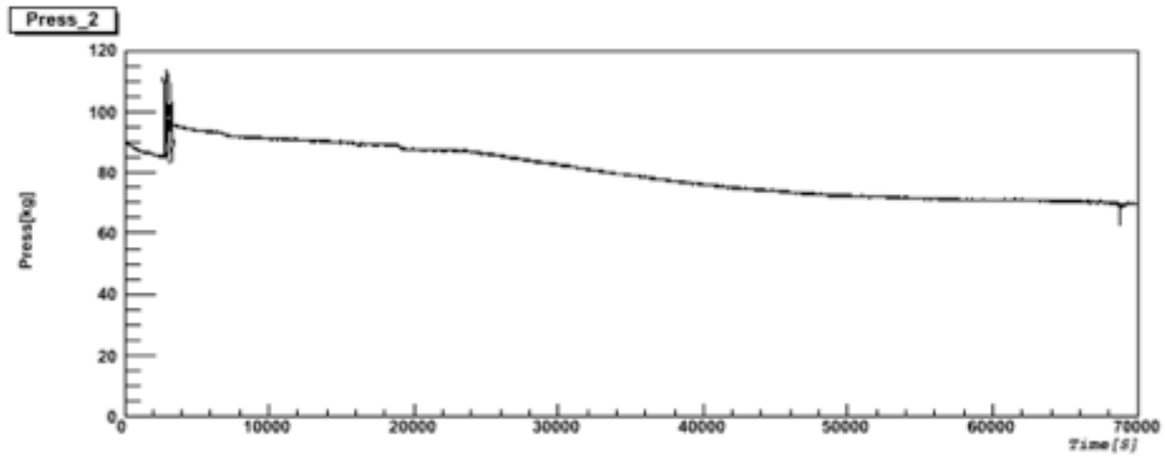
Shintaro Kubota

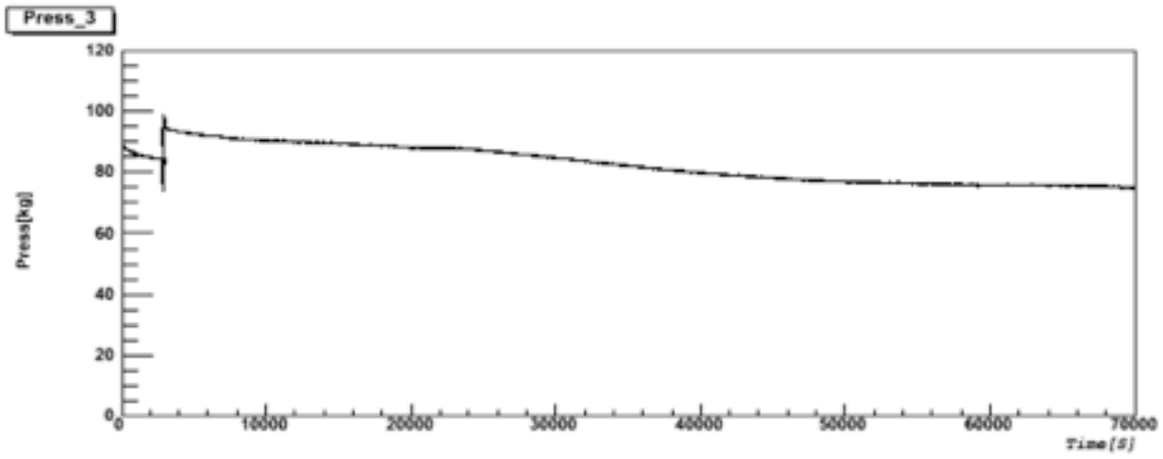


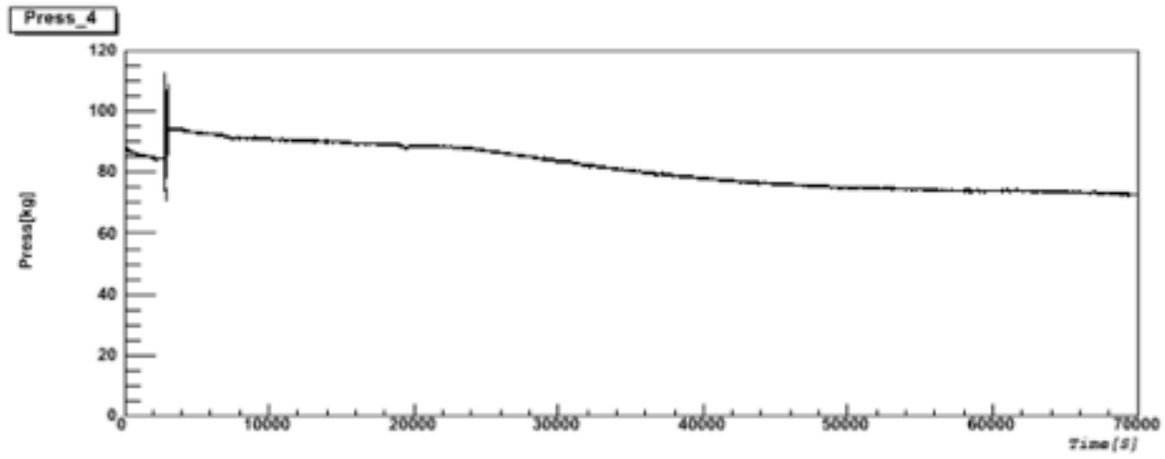
Pressure in the first 24 hours (on the station)

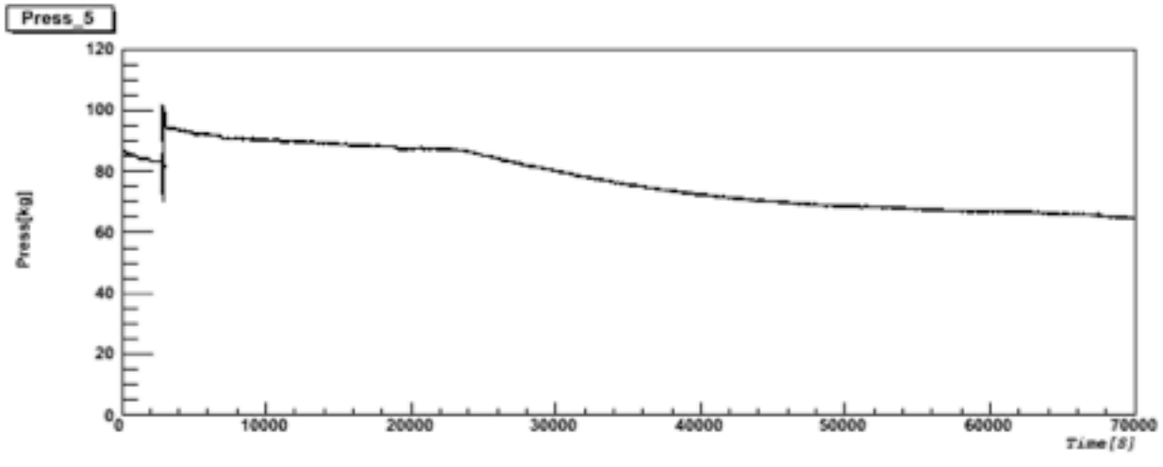




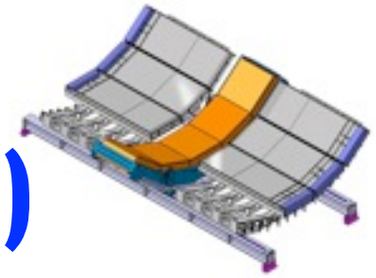


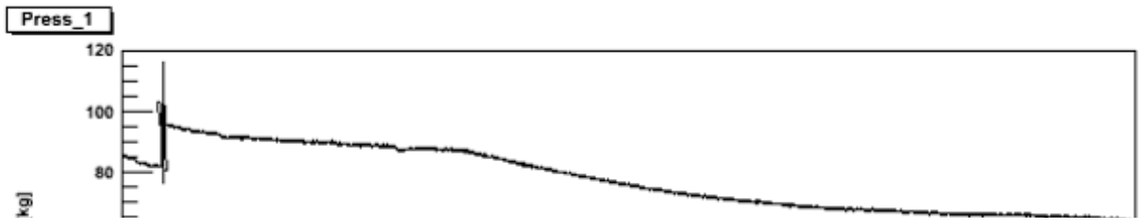


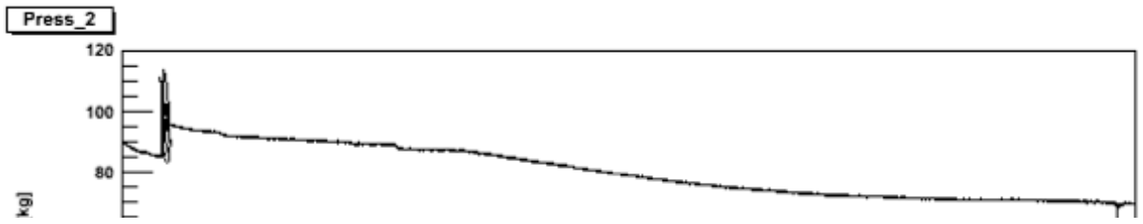


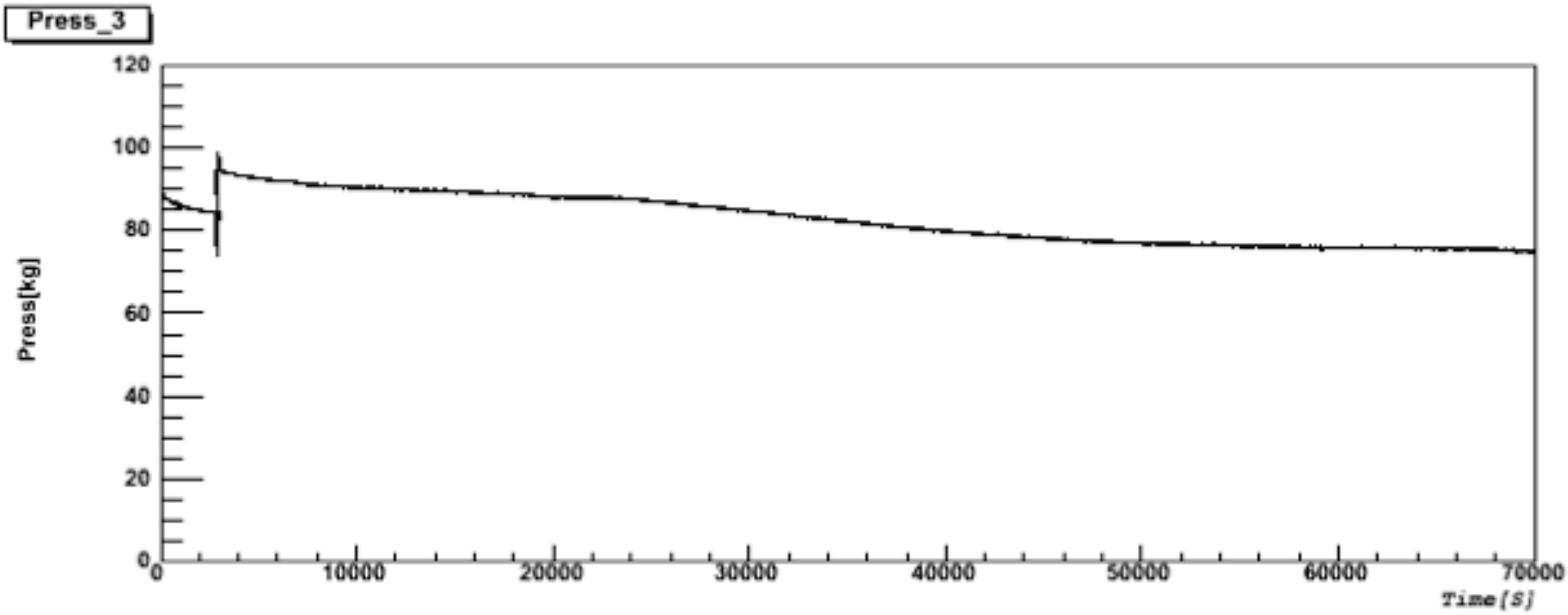


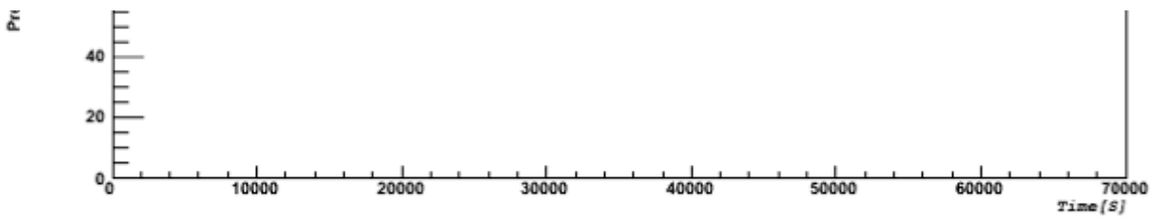
Pressure in the first 24 hours (on the station)



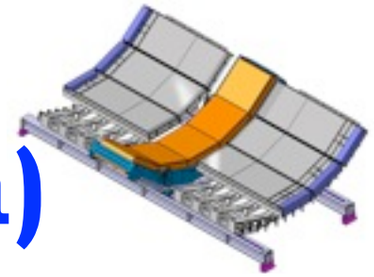


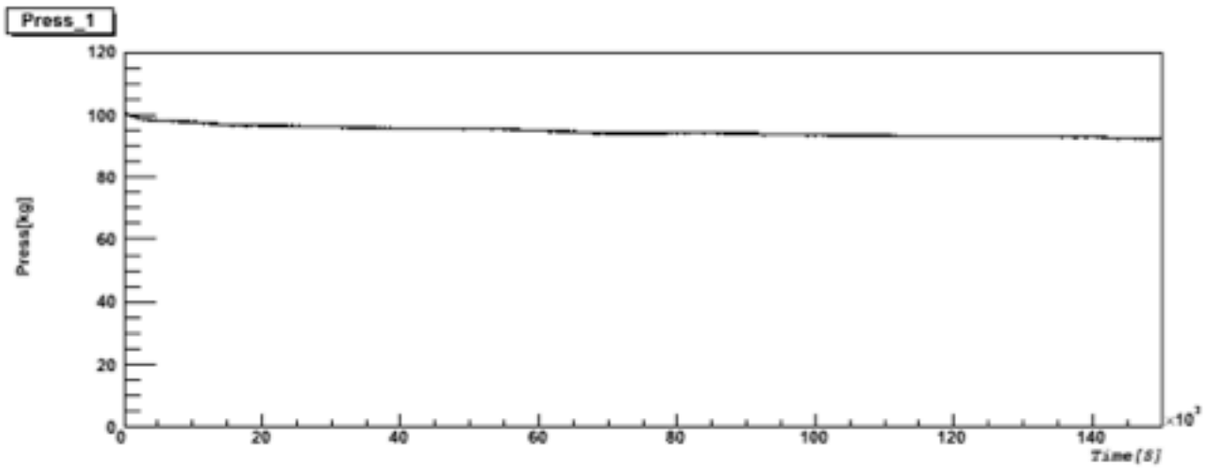


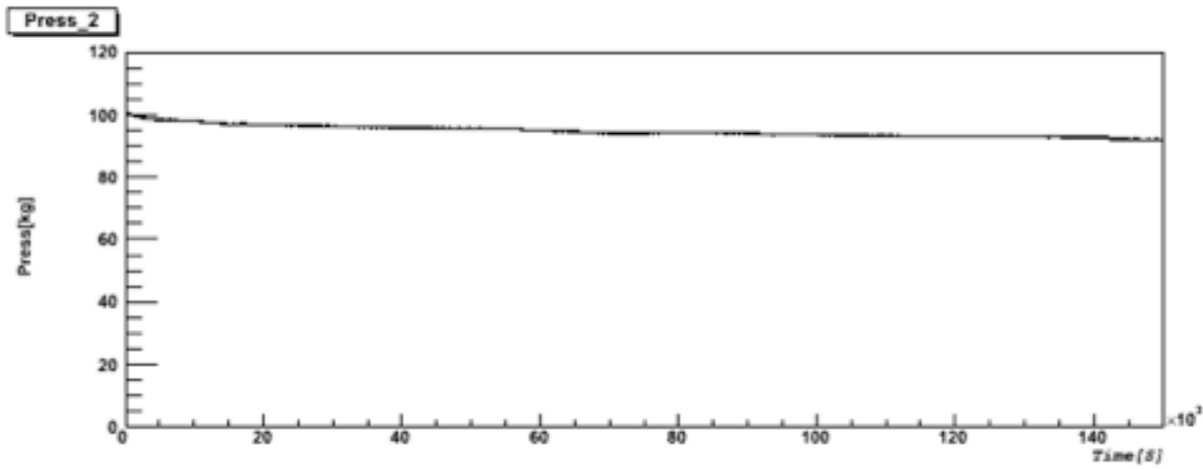


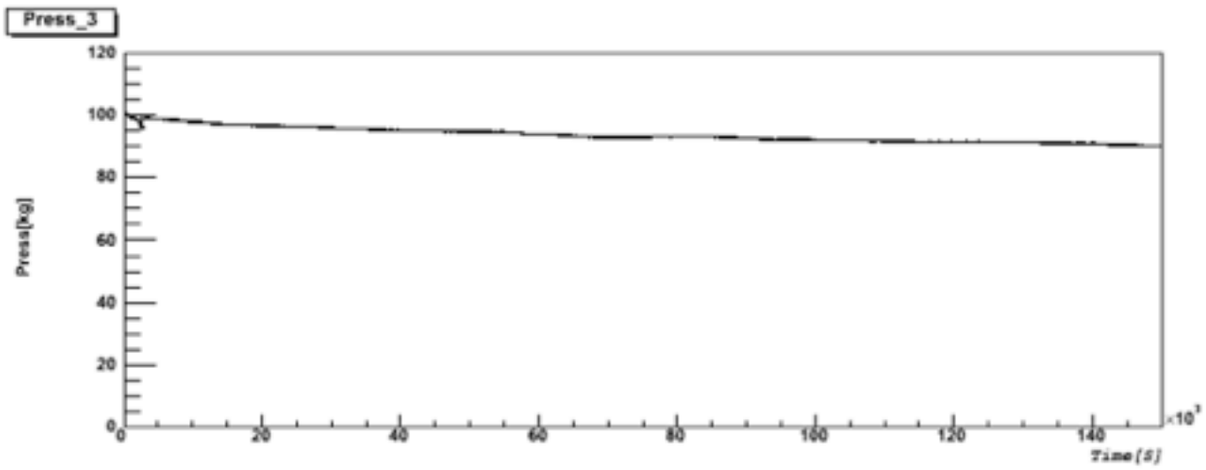


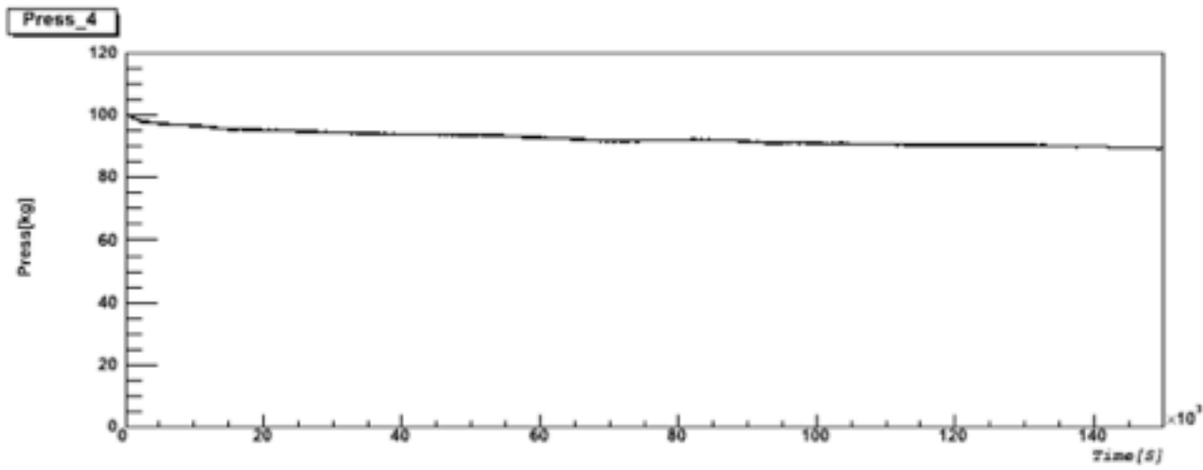
Pressure in the second 24 hours (off the station)

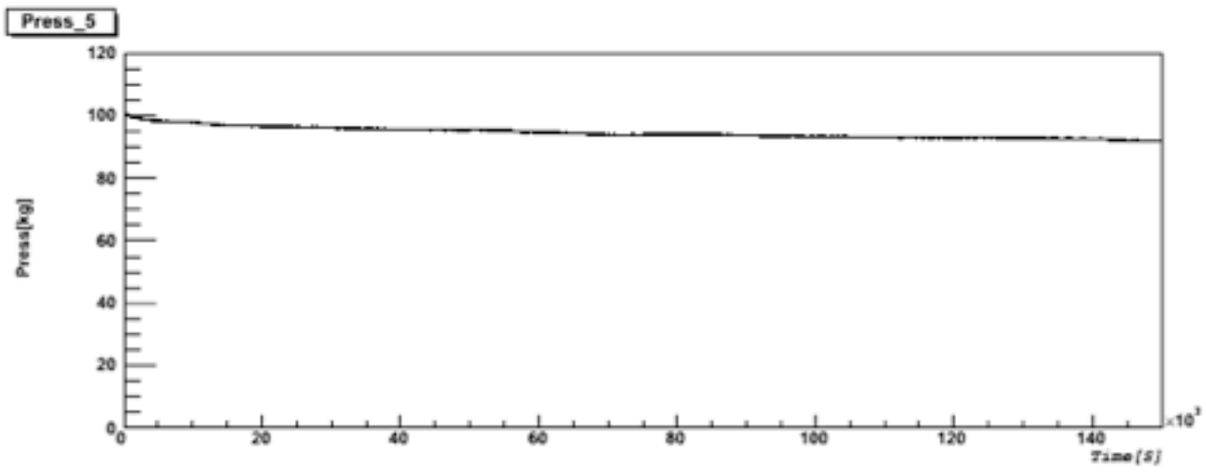




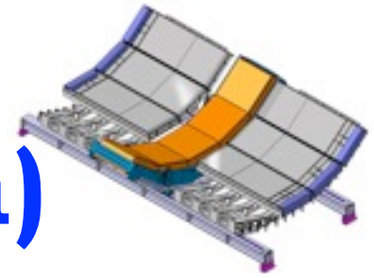


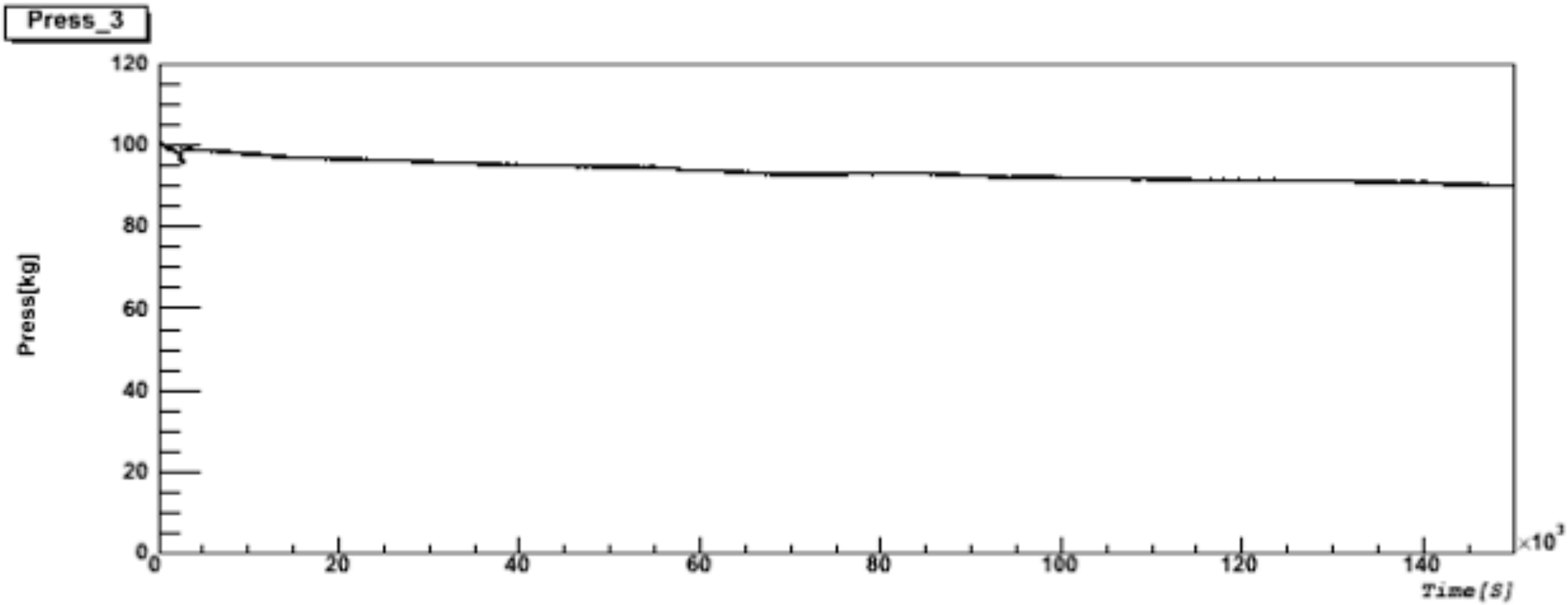


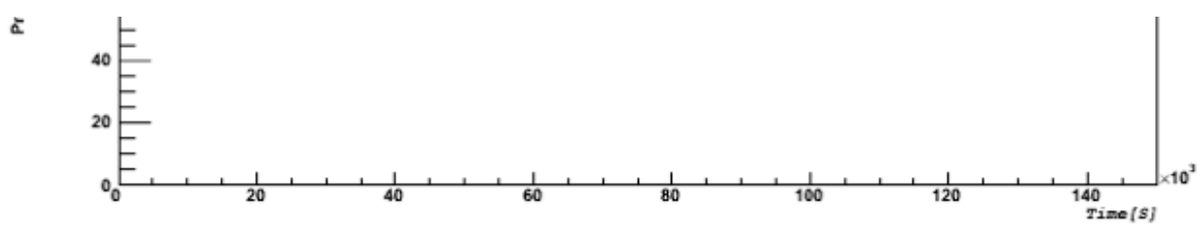




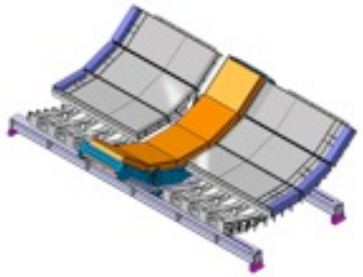
Pressure in the second 24 hours (off the station)



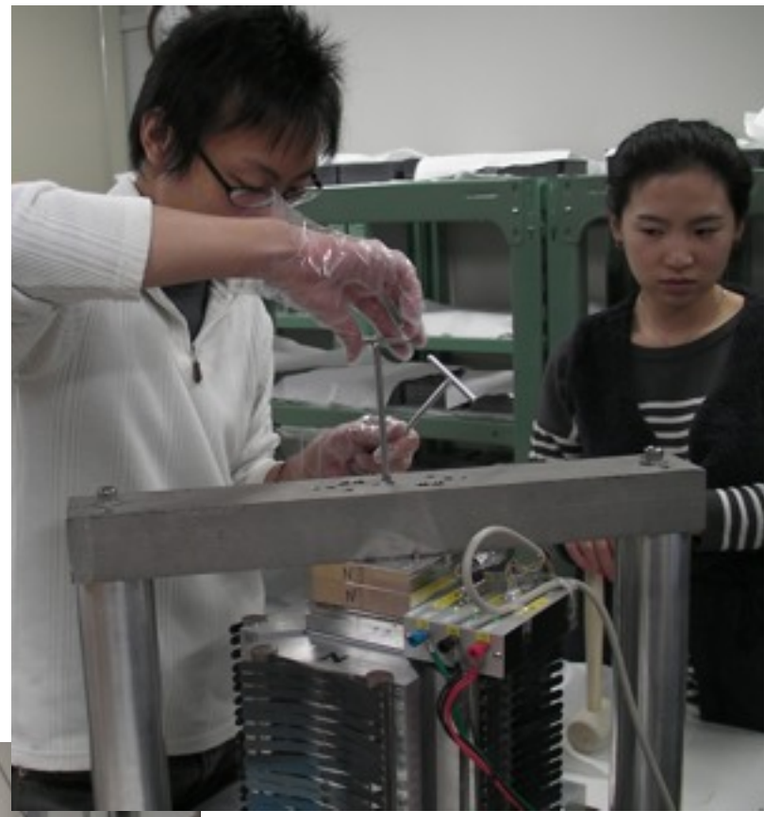




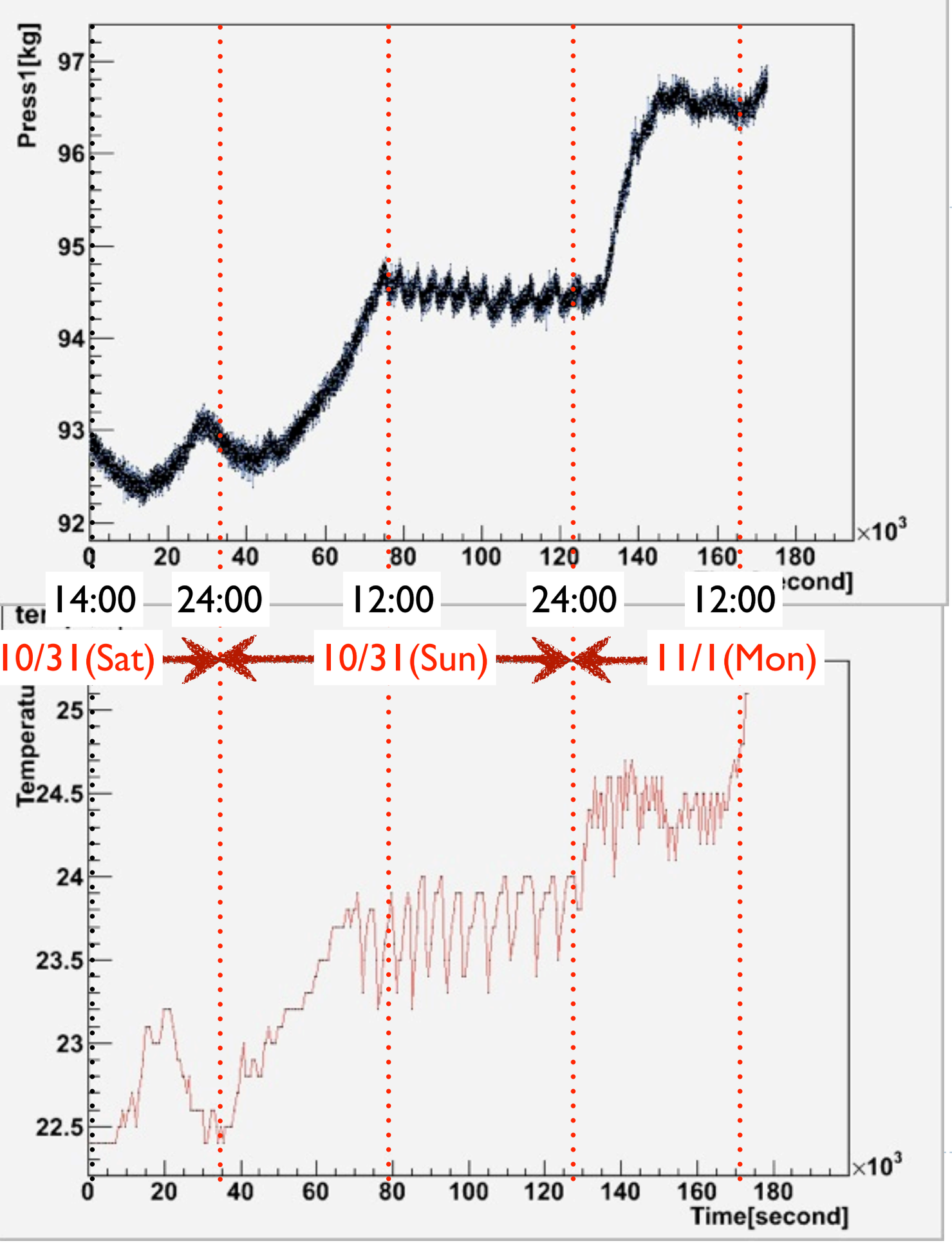
3rd assembly work in smooth and confident

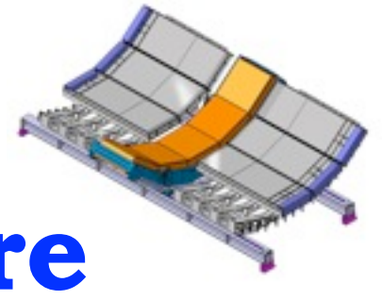


Shintaro Kubota



Jihyun Bhom

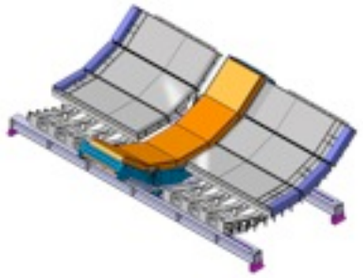


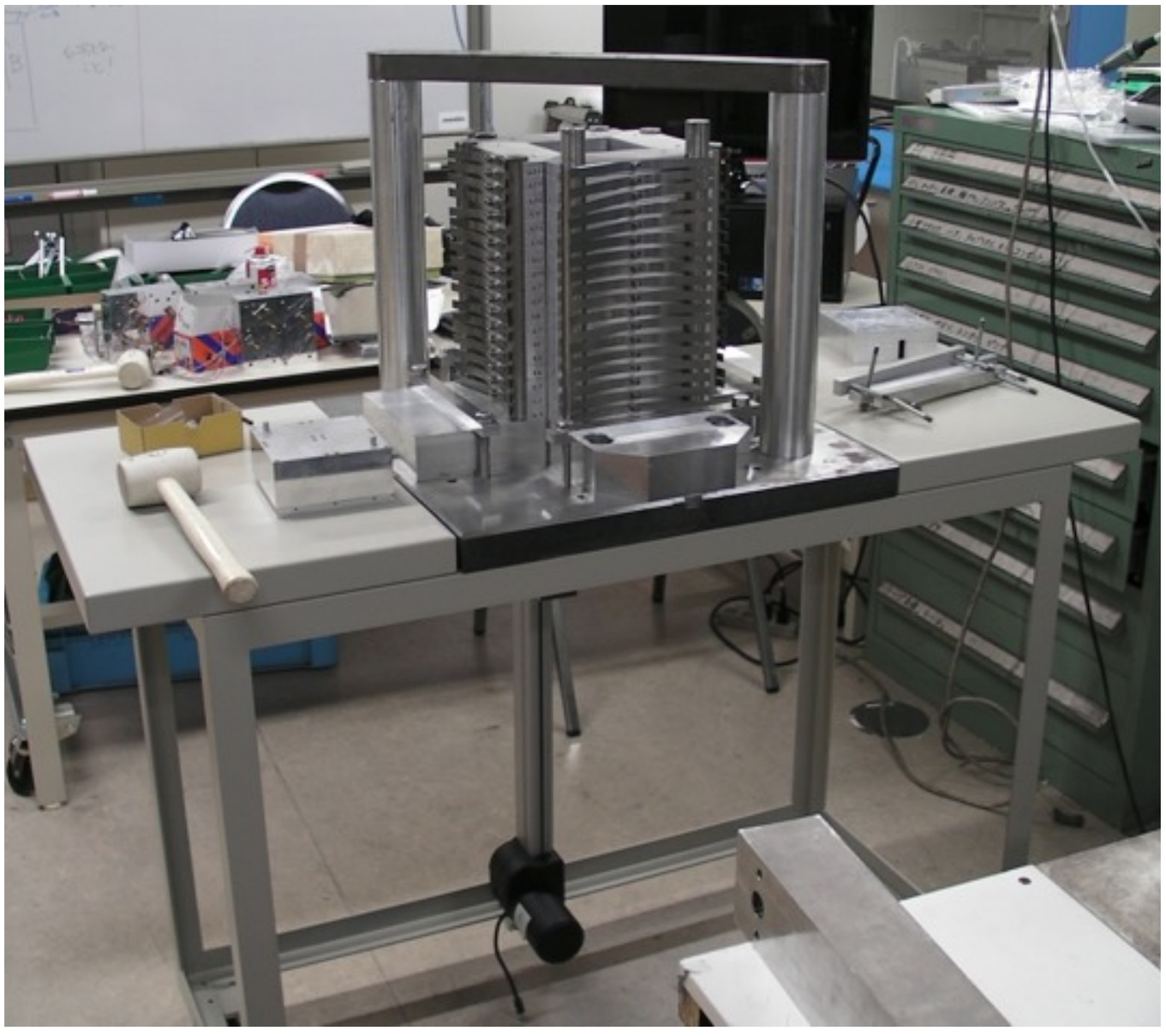


Temperature Problem ?

- To check stability, pressure monitored for 2 days, from 10/31(sat) 14:17 to 11/1(mon) 14:17.
- Is this due to pressure (load)sensor ? or thermal expansion?
- Need better temperature control?

Francesco N. & Maurizio S. from Catania, visited Tsukuba (Nov. 11-18, 2010)





- Francesco & Maurizio visited Tsukuba in Nov. 9-17, 2010
- Second assemble station becomes operational

Yasuo MIAKE, Nov.8,2010

Module assembly room in Tsukuba

Module for 2nd 24hr. compression

Module for 2nd 24hr. compression

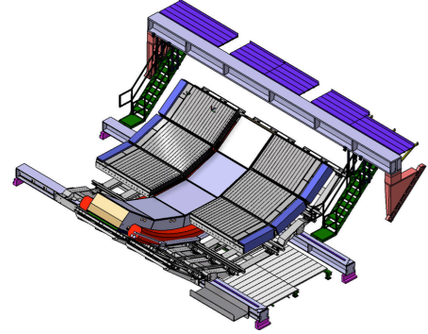
Modules for first 24hr. compression

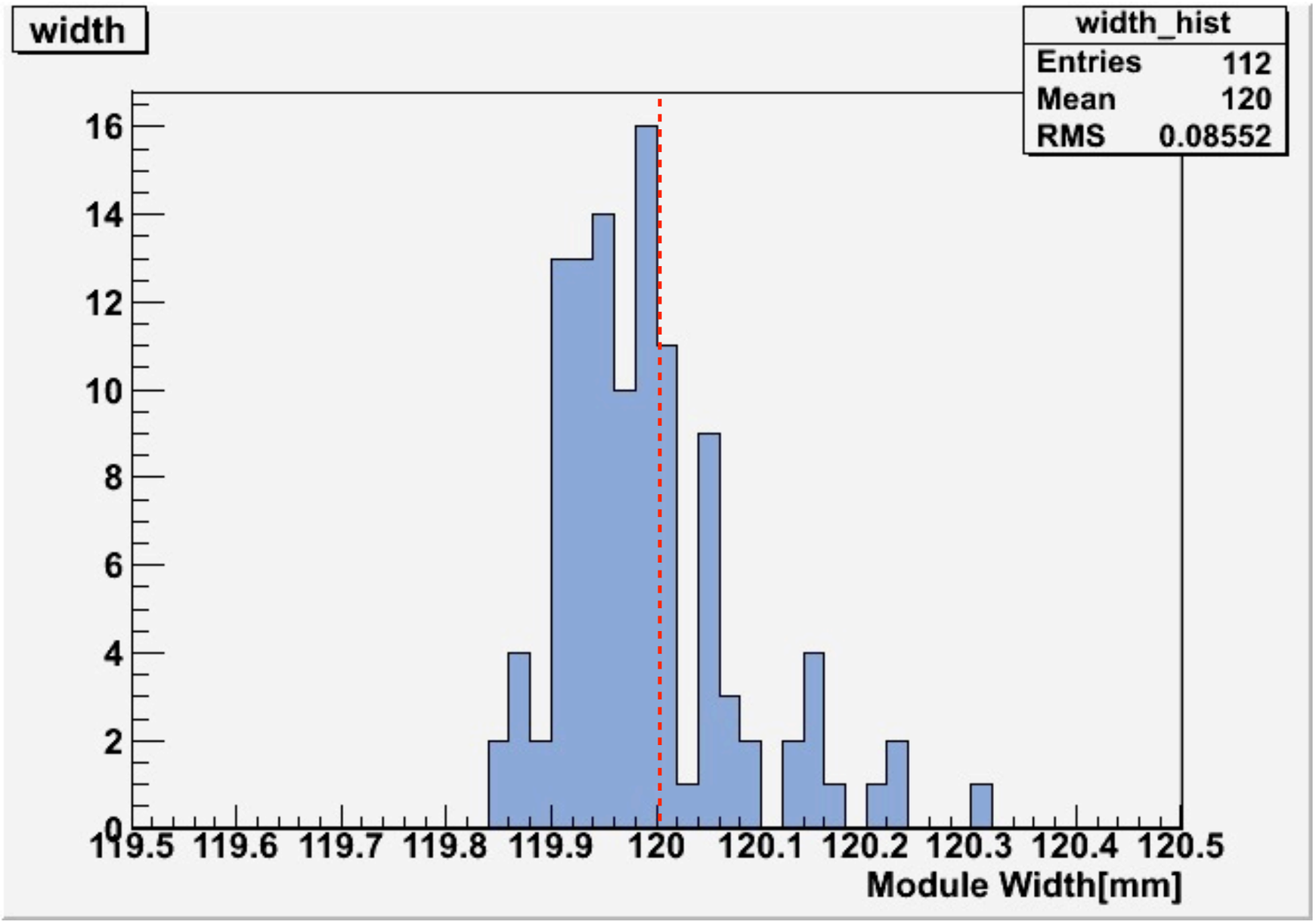
Assembly Station from Catania

Assembly Station from Wayne State

73 DCal modules in Tsukuba (as of Jan.13, 2011)

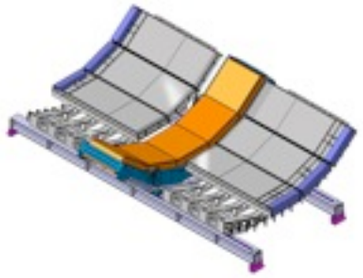
Q.A. of module production





- ✓ Width
  - < 120 mm
- ✓ Pressure
  - 13 modules need to be re-tuned

Manoel Dialinas from Subatech, visited Tsukuba (Feb. 8-12, 2011)



A few modules found to be bad out of 96 modules

- Manoel visited us for the final Q.A. check just before the first shipping
- Second assemble station becomes operational

Shipping Festival

Jihyun Bhom

Satoshi Horiuchi

Sanshiro Mizuno

Takahumi Niida


TOYOTA
25


~ 1 ton/Box

Bad news came in

WFS 0223 Worldwide Flight Services	CONSTAT de DOMMAGE / CARGO DAMAGE REPORT ☒ FH ☐ RH ☐ SFS	Codification	Révision	
		DOC-LIT-02	C	1 / 1

LTA *AWB*	217-9184 9505	mise à : *Issued*	NRT	Le: *On :*	19/02/2011	Par: *By :*	TG

Aéroport de départ *Airport of departure*	NRT	Vol / date *Flight /date*	TG932/20/02/2011	Aéroport de destination *Airport of destination*	CDG

Nom et adresse de l'expéditeur
Shipper's name and address

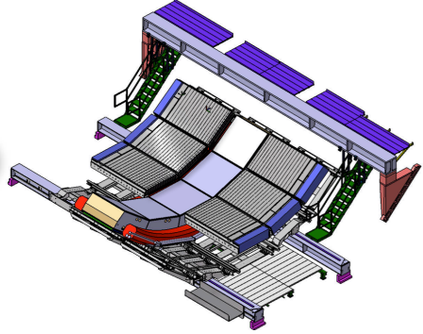
YAMATO GLOBAL LOGISTICS NRT

Damage during handling at airport

Arrived at Subatech, March 2, 2011

Damages are wooden box only. Modules are OK.

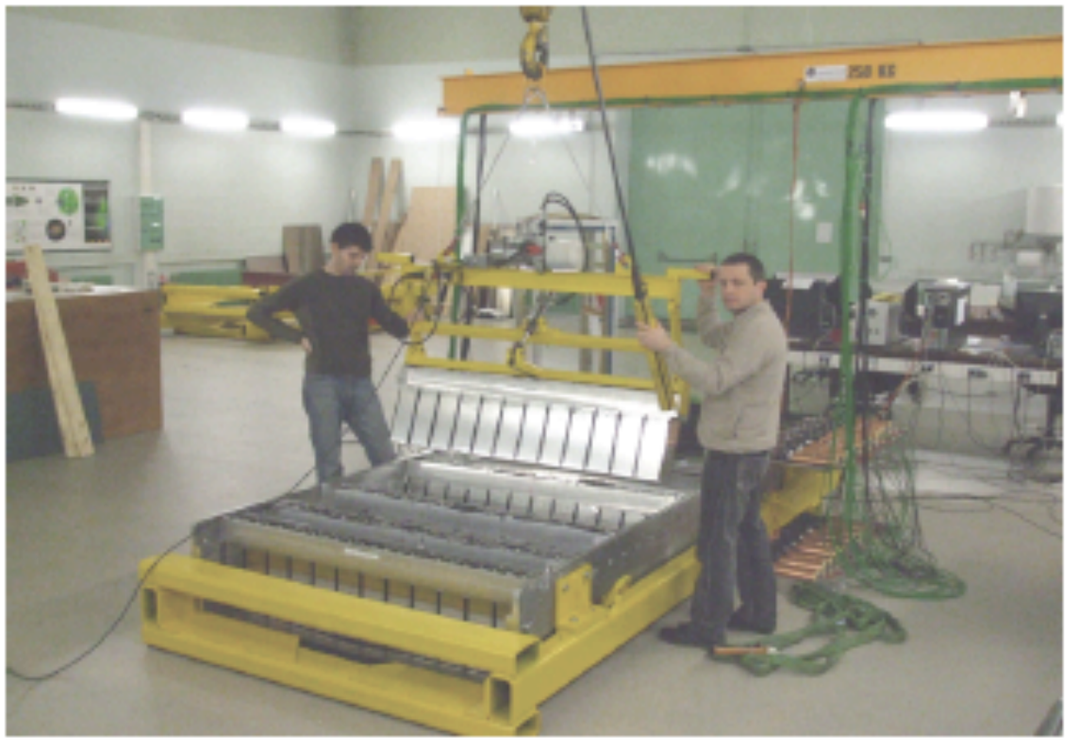
All the modules sitting safely, peacefully at Subatech



March 3, 2011

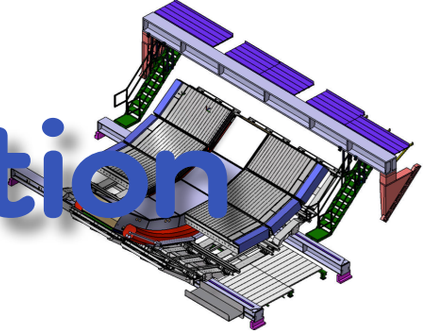
✓No “slipped disk” during the transportation

Assembly, cabling, calibration, storage and shipping of all DCal SModules.



Two students from Tsukuba will be sent to Subatech in May~June.

Yet, another type of collaboration



- ✓Education ! Education ! Education !
- ✓Everybody agrees that international collaboration is effective place for the education.
- ✓I just learned there is a plan/idea for international cooperative master degree program between Japan-Korea-Germany.
  『日独韓共同修士学位プログラム』
- ✓We may consider similar program for our future

KOREA UNIVERSITY

universitätbonn
Rheinische Friedrich-Wilhelms-Universität Bonn

筑波大学
University of Tsukuba

Thanks to Prof. Aizawa,
Literature and Linguistics
人文社会科学研究科・国際日本研究専攻
International and Japanese Studies

✓TEACH ;Transnational European and East Asian Culture and History

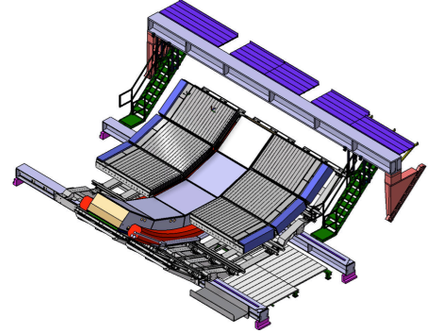
- Initiated by Germany, DAAD.
- Master degree program (3~6 students/univ./year)

➡3-18 students move together and attend lectures.
Lectures are given either in German, Korean or Japanese

- Dual degree program

➡One master thesis is evaluated at two universities;
i.e., master degree from Tsukuba and Bon.

Real dual degree program



- ✓Real Dual degree program in medical science
- ✓Tsukuba and National Taiwan Univ.
- ✓Officially start in this April 2011.
- ✓Master program and Doctoral program

- 3 years to graduate master degree but obtain two degrees.

➡2011.4 Enter master program at Tsukuba, study at Tsukuba for the first semester

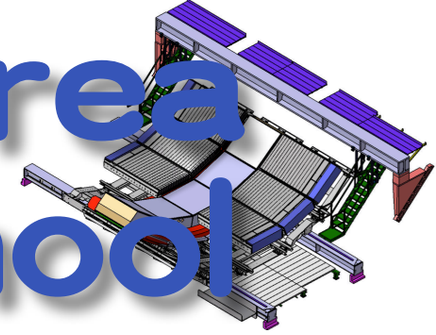
➡2011.9 Enter NTU

➡2013.8 Graduate NTU and obtain degree

➡2013.9 Resume at Tsukuba

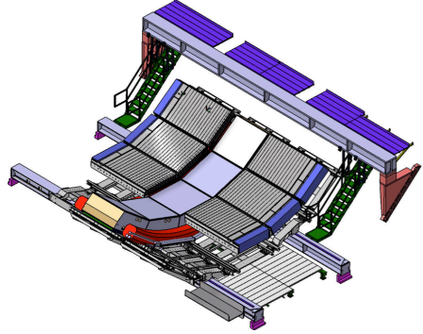
➡2014.3 Graduate Tsukuba and obtain degree

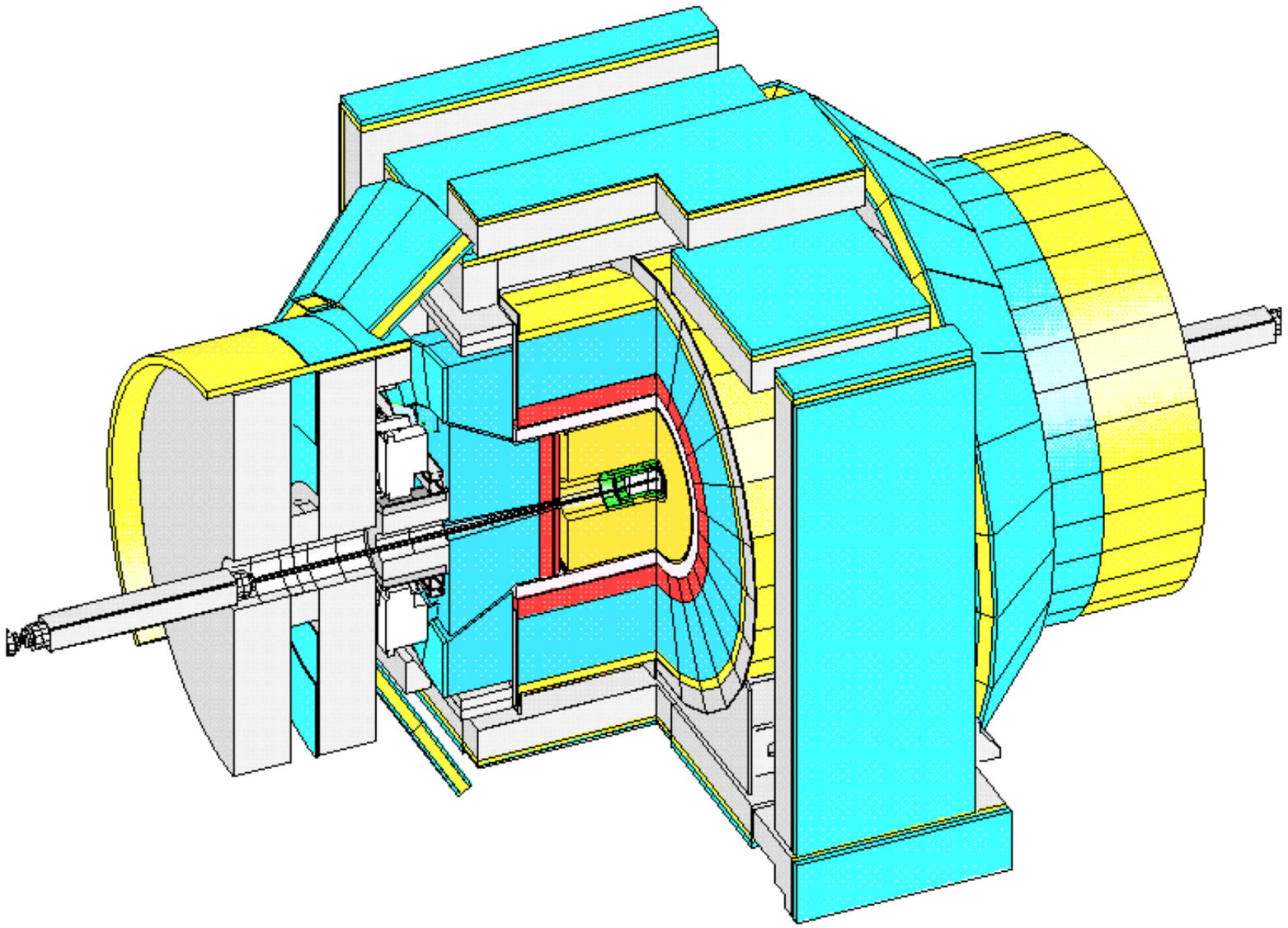
A dream ; Japan-China-Korea cooperative graduate school



- ✓Similar program, but our case might be easier than TEACH
  - existing international activity, common field, common place of activity, common language
  - exchange units of lectures
  - authorize ourselves as guest? professor each other
- ✓Dual degree
  - one master thesis certified from 2 universities

ALICE like CDF



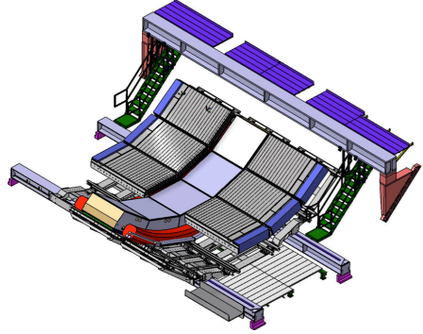


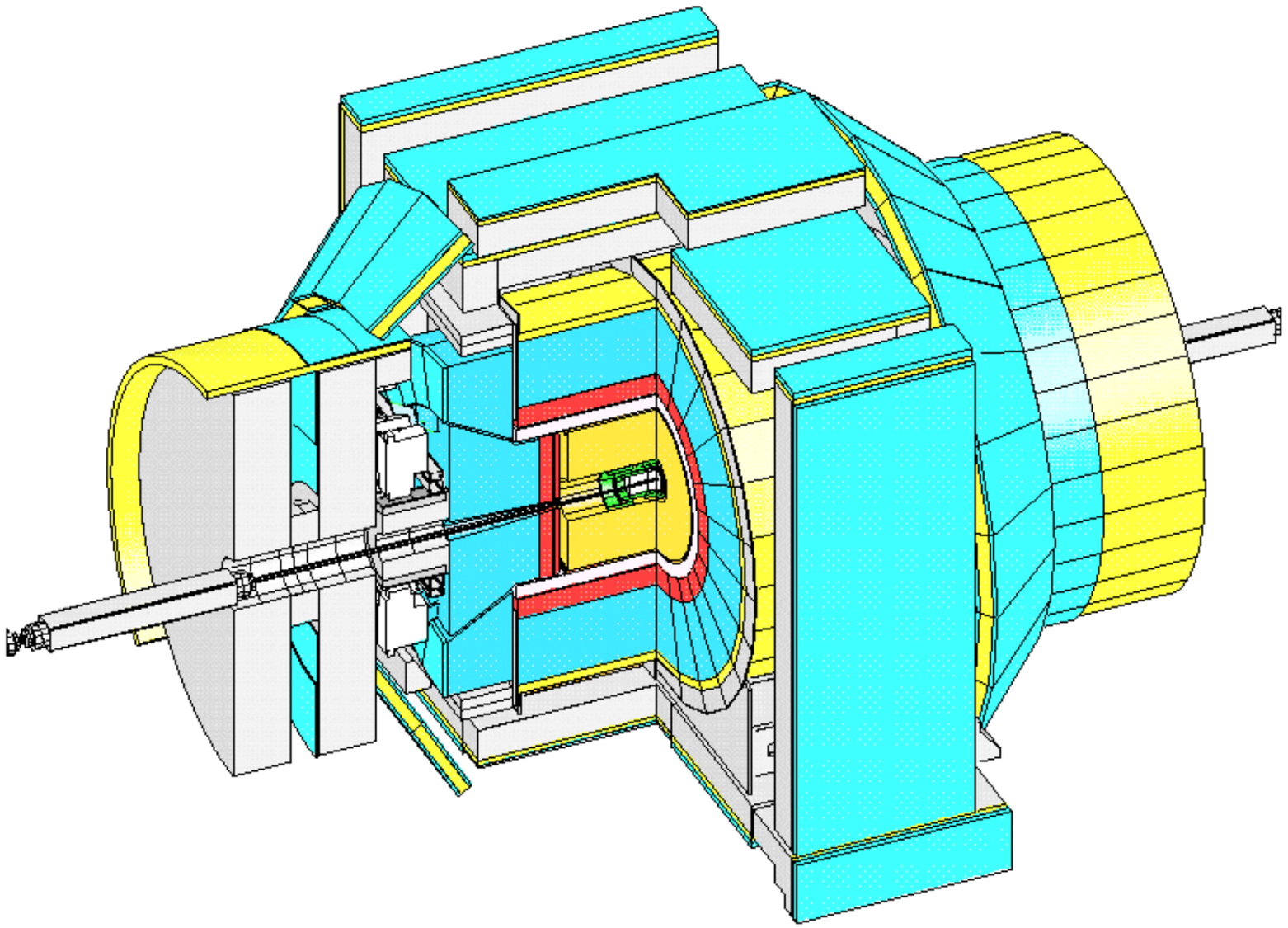
- ✓ Full coverage
  - Plug
  - Central
- ✓ Azimuthally symmetric.

http://www-cdf.fnal.gov/events/detintro.html

As an epilogue

ALICE like CDF

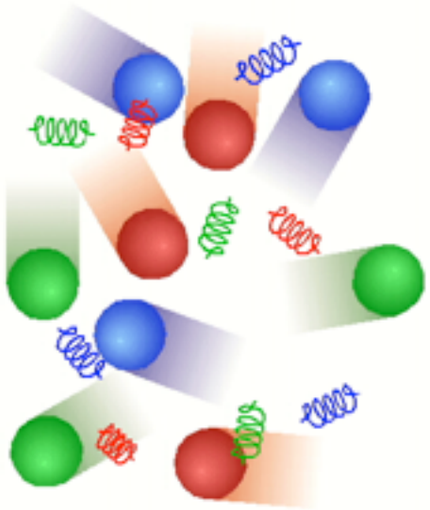


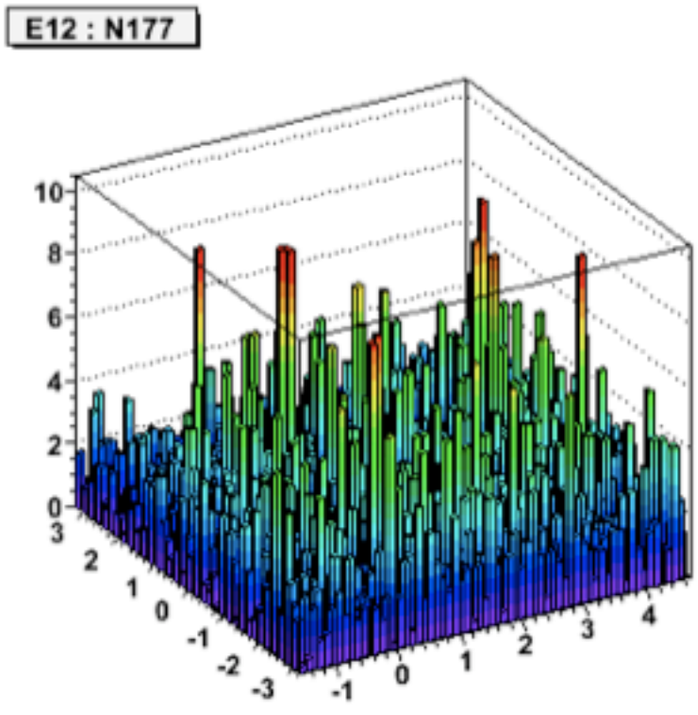


- ✓ Full coverage
  - Plug
  - Central
- ✓ Azimuthally symmetric.

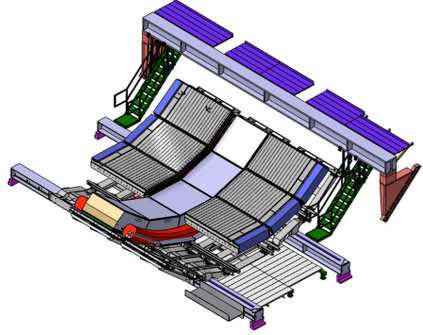
http://www-cdf.fnal.gov/events/detintro.html

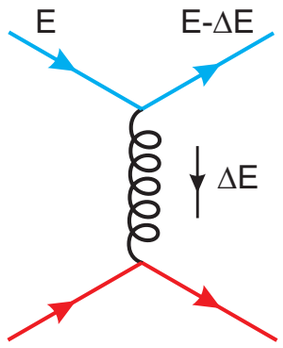
Backups



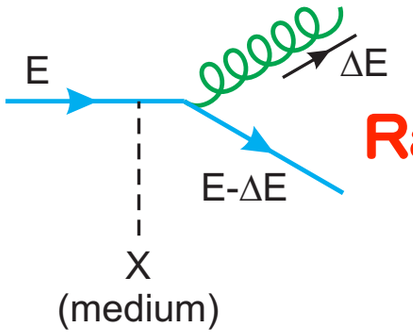


Energy Loss in QCD





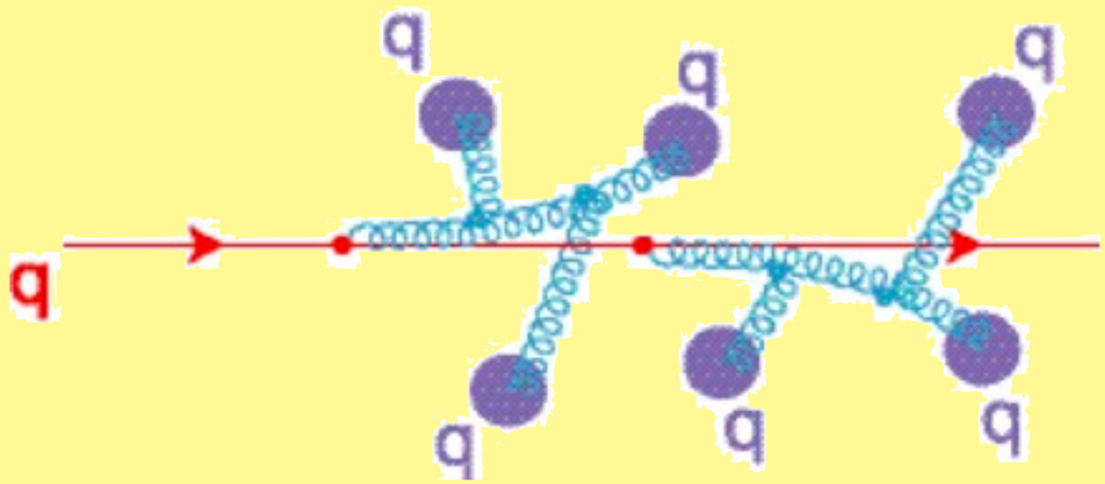
Collisional



Radiative

✓Many theories on

- **Collisional loss**
- **Radiative loss**
  - ➡**Bethe-Heitler regime**
  - ➡**LPM regime**
  - ➡ **“dead-cone” effect**



$$\Delta E \propto \alpha_S C_{\mathrm{R}} \langle \hat{q} \rangle L^2$$

(Executive) Summary

Radiative loss is dominant

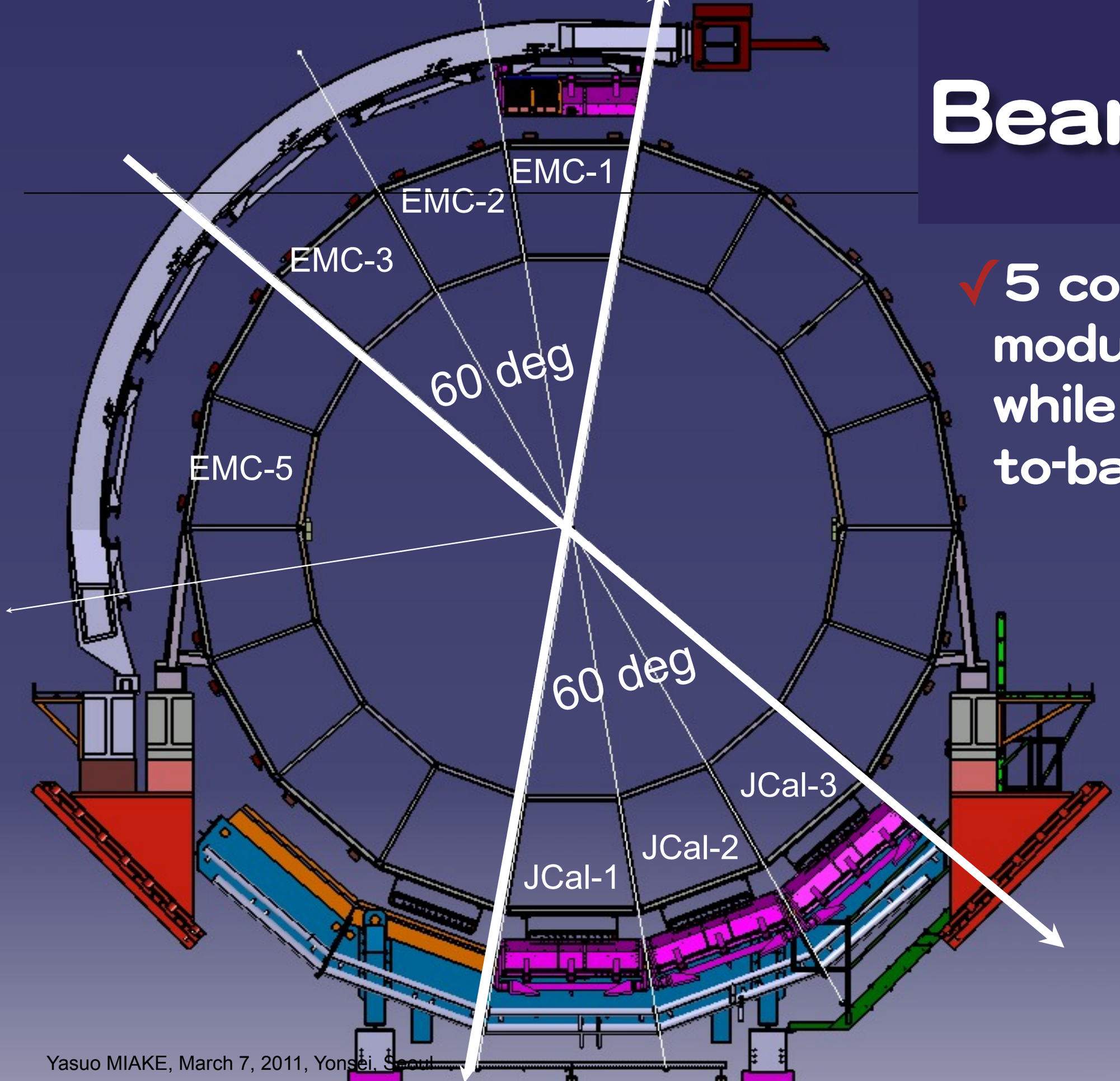
Effects are;

- suppression of high pt hadron
- unbalanced back-to back
- modification of jet fragmentation
  softer, larger multiplicity,
  angular broadening

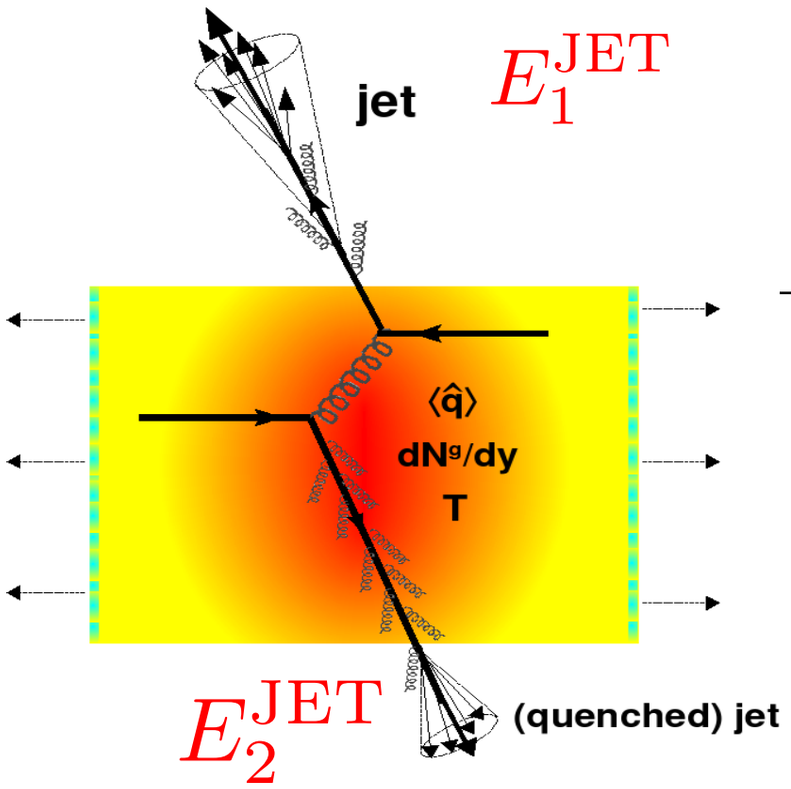
$$\Delta E_{\mathrm{gluon}} > \Delta E_{\mathrm{quark}} > \Delta E_{\mathrm{charm}} > \Delta E_{\mathrm{bottom}}$$

Beam View

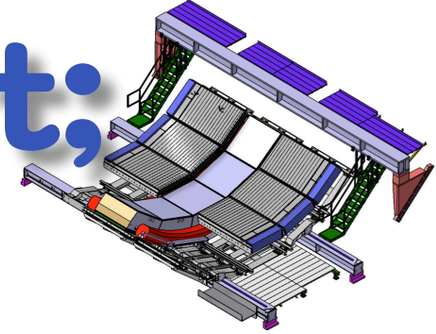
- ✓ 5 contiguous modules possible, while exact back-to-back is 3

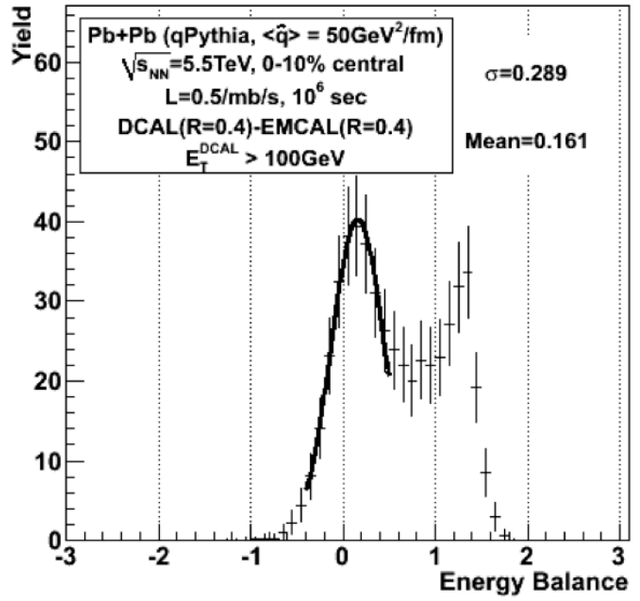


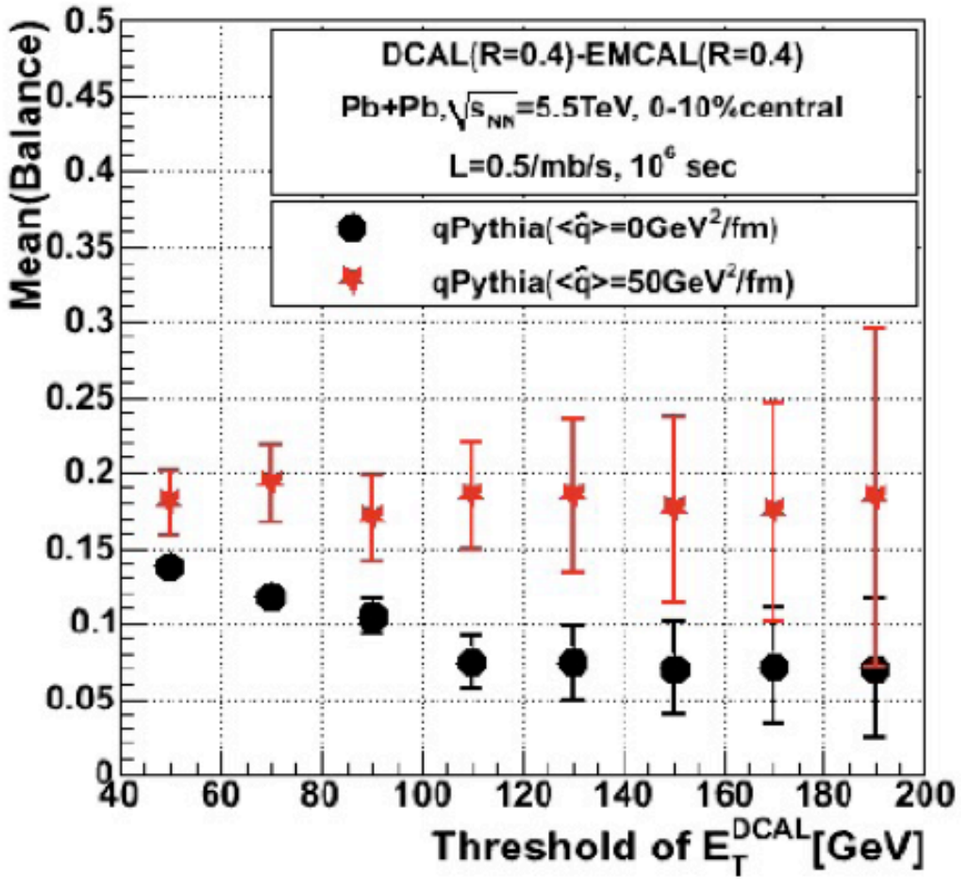
What we expect; sensitivity

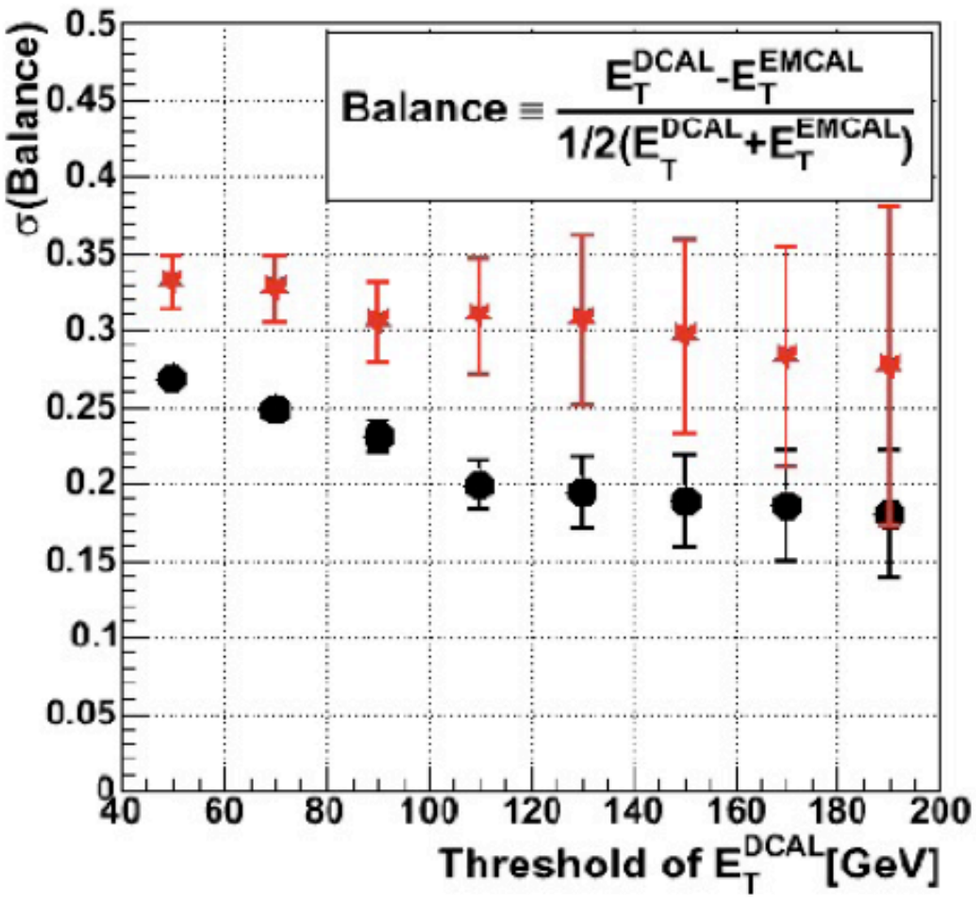


$$\text{Balance} \equiv \frac{E_1^{\text{JET}} - E_2^{\text{JET}}}{1/2(E_1^{\text{JET}} + E_2^{\text{JET}})}$$









✓Sensitivity in data of 1 year

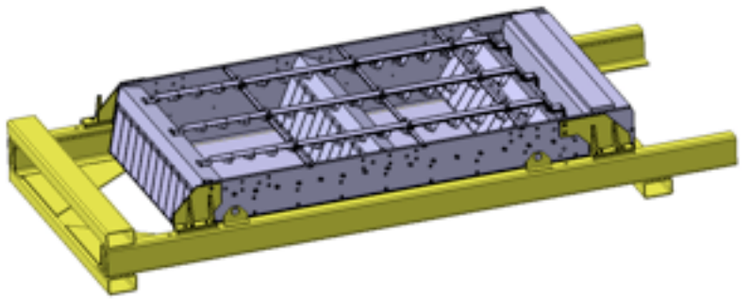
France-Japan collaboration for ALICE-DCal

Institute & People

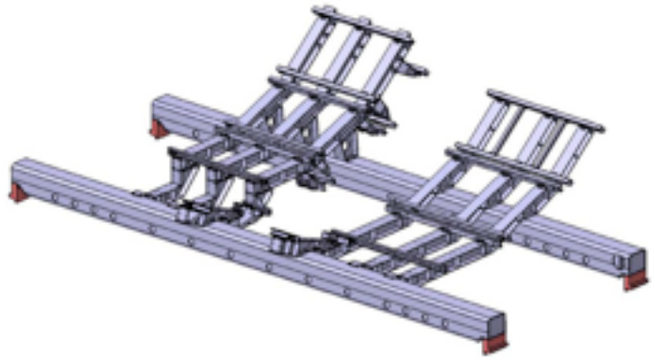
LPSC Grenoble
- Christophe Furget
- Jean-François Muraz

Subatech Nantes
- Manoel Dialinas

IPHC Strasbourg
- Christelle Roy

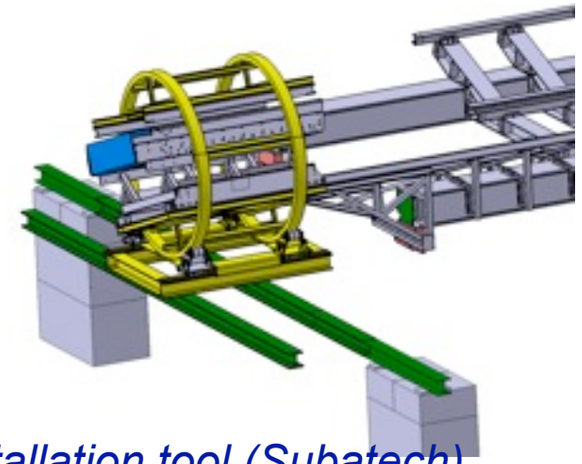


DCal SM platform (LPSC)



DCal support structure (Subatech)

DCal SM shipping crate (LPSC)

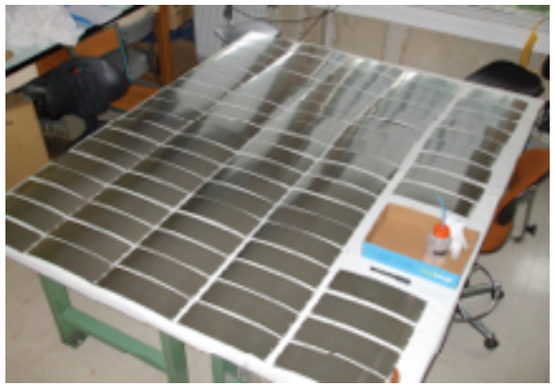


DCal installation tool (Subatech)

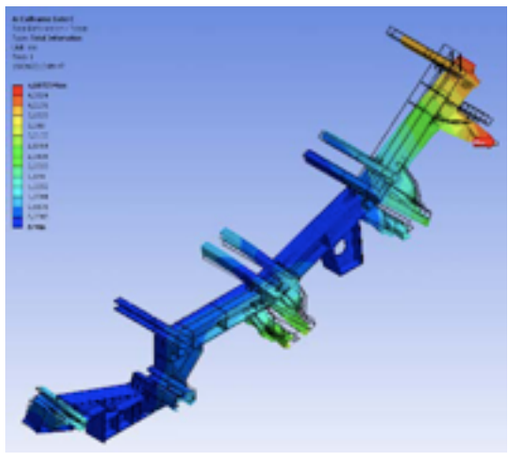
Contributions to DCal

LPCS Grenoble:

-DCal module straps
-DCal supper module (SM) cables
-DCal platform, shipping boxes
-DCal SM assembly



DCal straps (LPSC)



DCal weight cal. (Subatech)

Subatech Nantes:

•DCal SM installation tool, support structure, integration
•DCal strip module production, DCal strong back