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E-JADE

Transport and Assembly Procedures

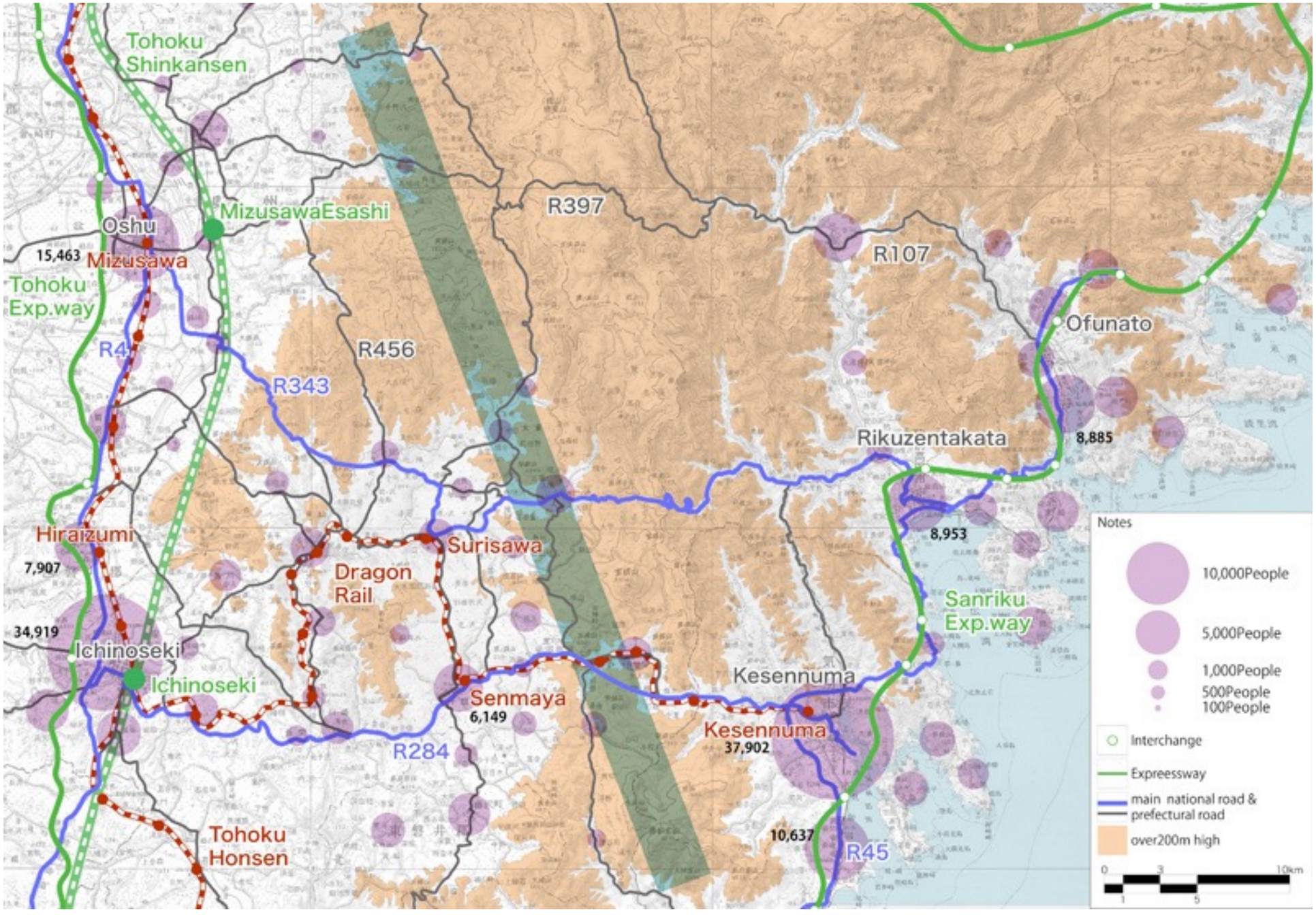
Karsten Buesser

ILD Task Force Meetings

LAL
87.11.2016

KITAKAMI Site: Transportation

Slide from Tokiko Onuki



General rule

total weight	trailer/ track	our package	daytime	night	Xpwy	paper work
25 ton	~10 ton	~15 ton	YES	YES	YES	0
44 ton	~20 ton	~24 ton	YES† / NO	YES	NO	1
80 ton	~30 ton	~50 ton	NO	YES	NO	10

† Probably "YES", if our package fits into a standard container (W=2,438mm).

Slide from Tomo Sanuki

TESLA Structure

AHCAL Assembly

Kitakami Side

or anywhere in any detector

HELMHOLTZ ASSOCIATION

Slide from Karsten Gadow

DESY

AHCAL Assembly

solution: all needed AHCAL parts fit into here

AUSSENMASSE		
Länge	mm	6058
	ft	19' 10 ½"
Breite	mm	2438
	ft	8'
Höhe	mm	2591
	ft	8' 6"

GEWICHT		
Tara	kg	2700
	pd	5950
Max. Zuladung	kg	27780
	pd	61250
Max. Bruttogewicht	kg	30480
	pd	67200

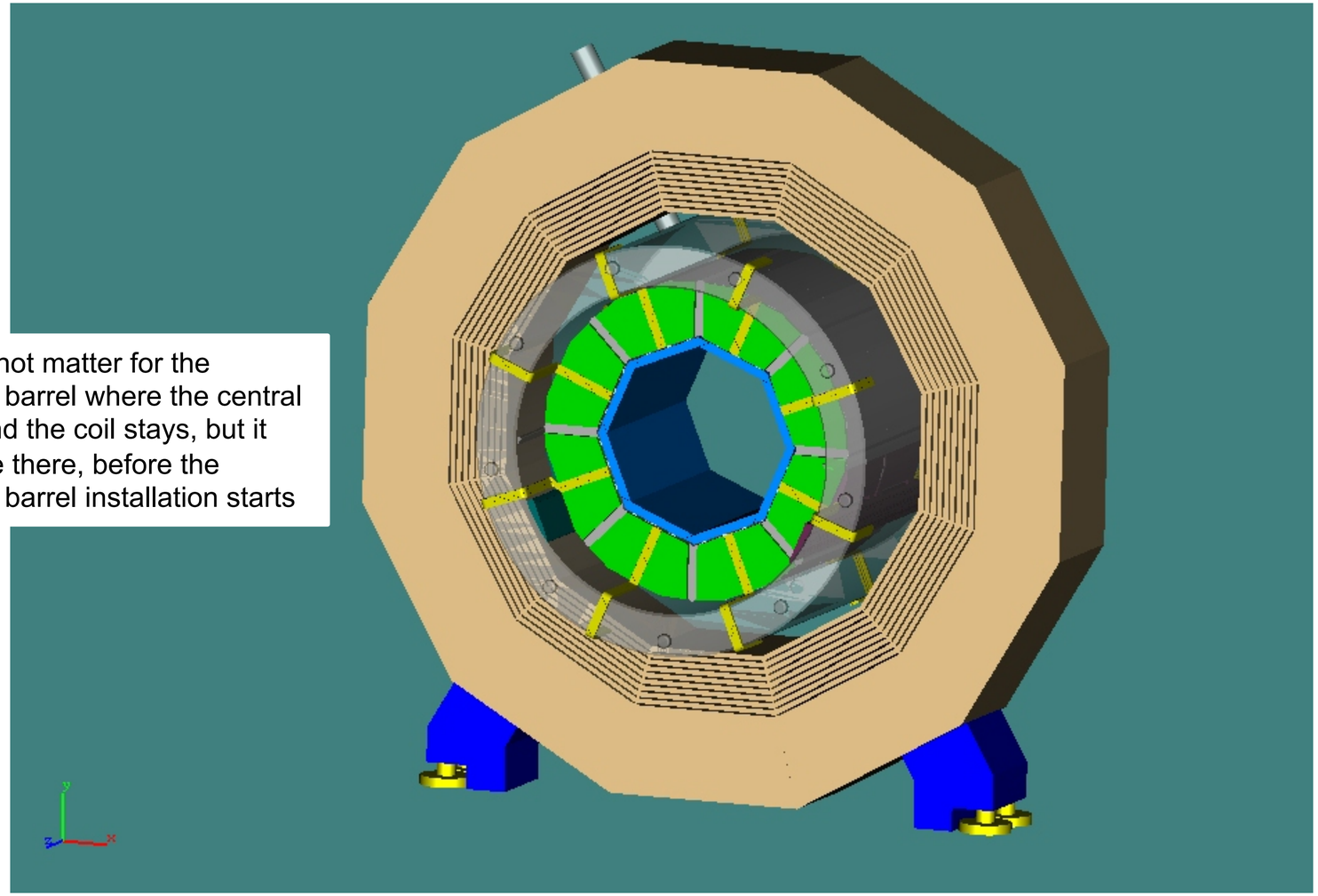
the container fits to standard transport systems

as ships, railways, trucks and through tunnels…..

Slide from Karsten Gadow

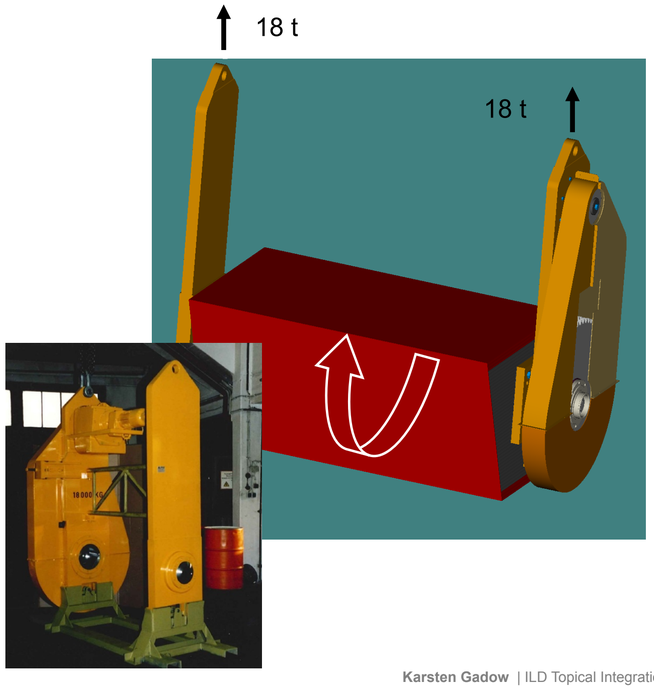
AHCAL barrel in ILD

it does not matter for the AHCAL barrel where the central yoke and the coil stays, but it must be there, before the AHCAL barrel installation starts



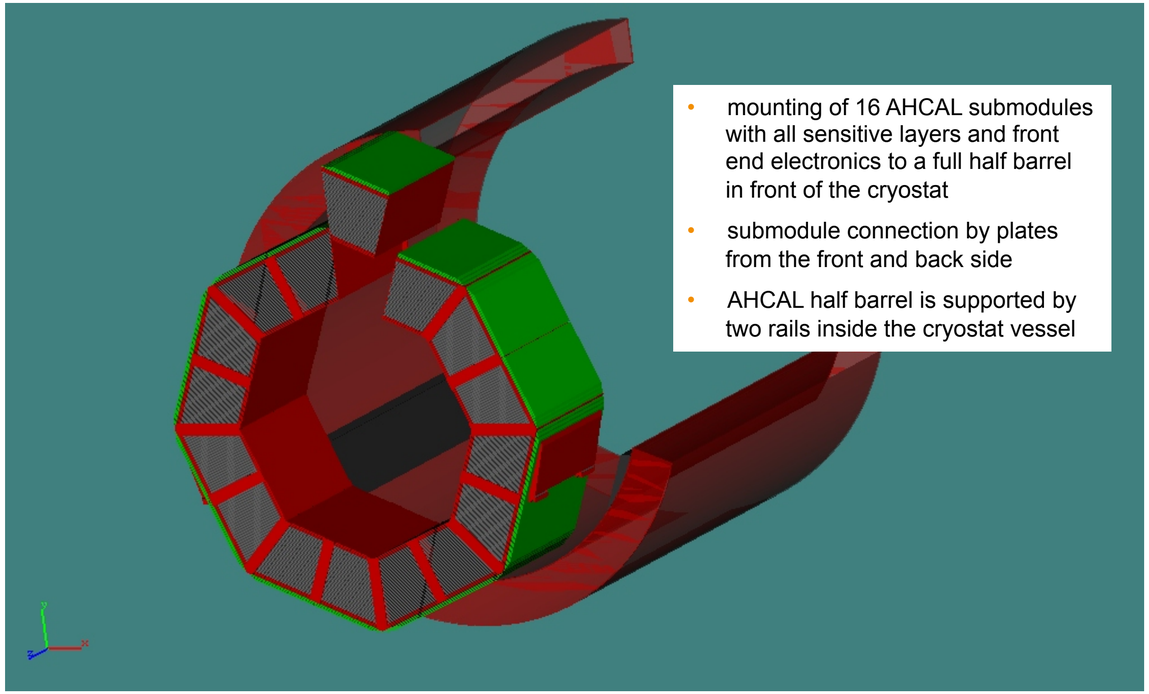
Slide from Karsten Gadow

AHCAL barrel integration tools



- lifting and turning tool for AHCAL barrel absorber submodules available
  - 2 x 18 t capacity
  - operation with 2 hooks (z angle adjustment)
  - precise motor controlled turning
  - design for adaptation for sub-modules with and without sensitive layers started
- mounting, support and insertion frame
  - insertion frame design ready
  - insertion frame support design depends on final yoke size and useable space
- push and pull tool available
  - must be modified to the rail distance and rail shape/size

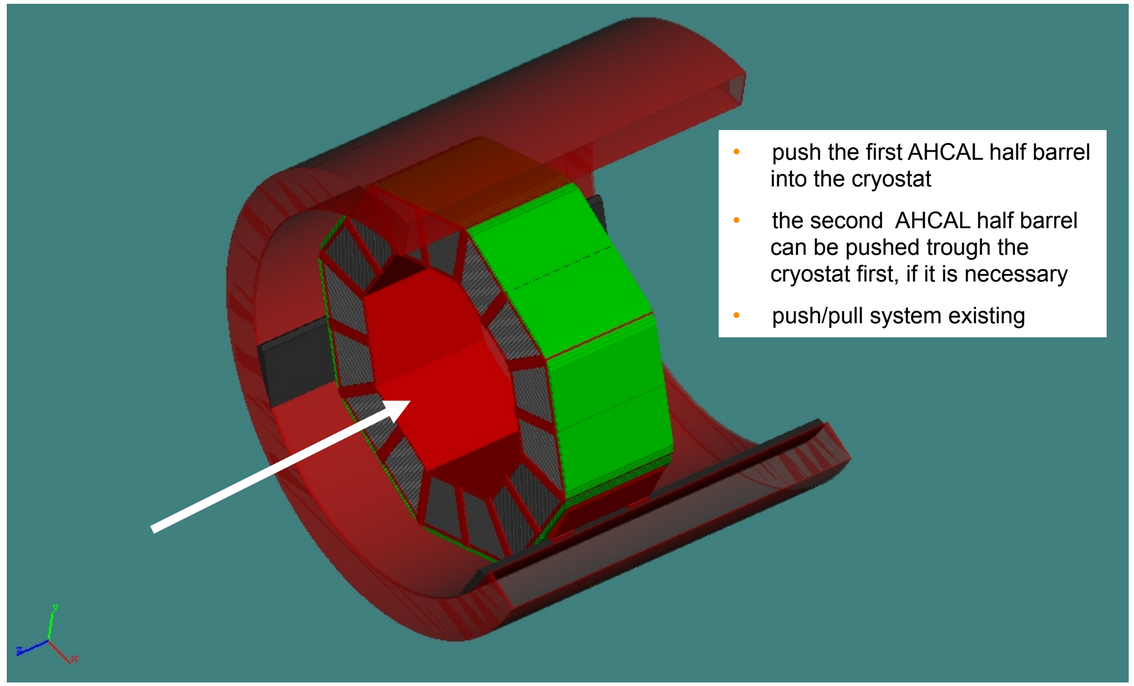
AHCAL half barrel absorber installation
step 1



- mounting of 16 AHCAL submodules with all sensitive layers and front end electronics to a full half barrel in front of the cryostat
- submodule connection by plates from the front and back side
- AHCAL half barrel is supported by two rails inside the cryostat vessel

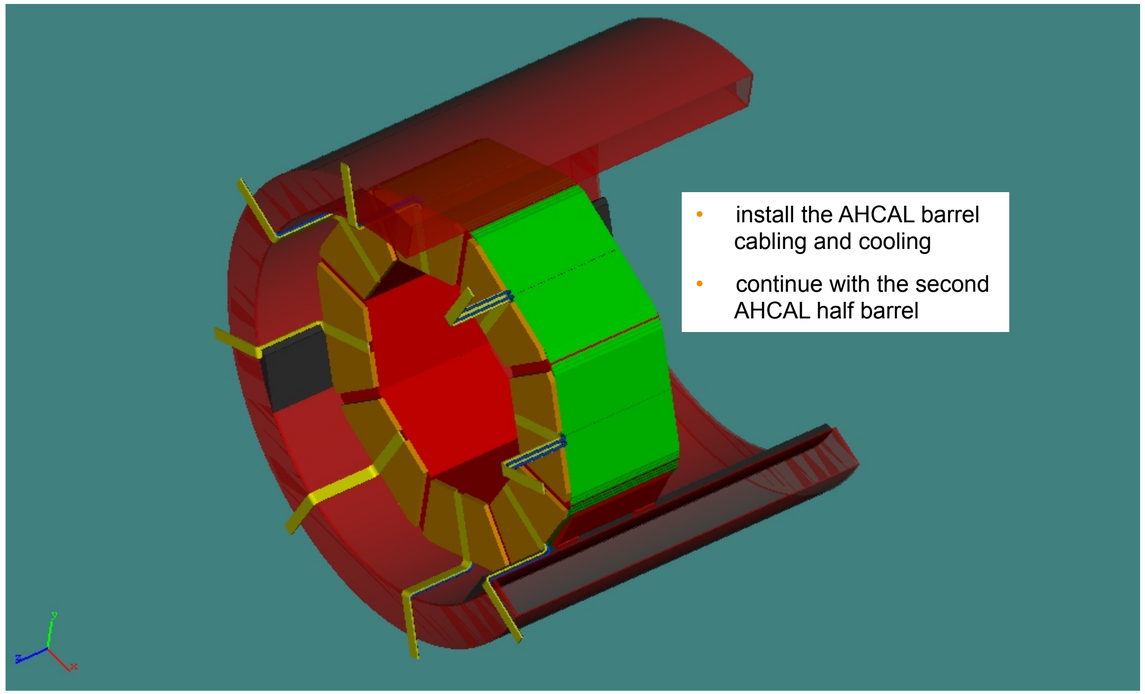
Slides from Karsten Gadow

AHCAL barrel integration
step 2



- push the first AHCAL half barrel into the cryostat
- the second AHCAL half barrel can be pushed trough the cryostat first, if it is necessary
- push/pull system existing

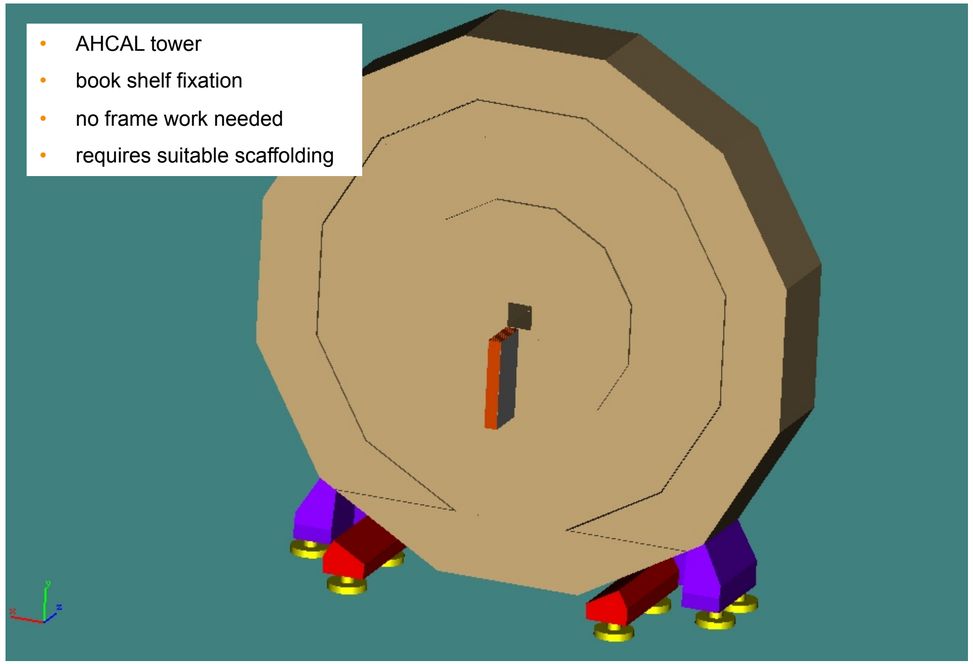
AHCAL barrel integration
step 4



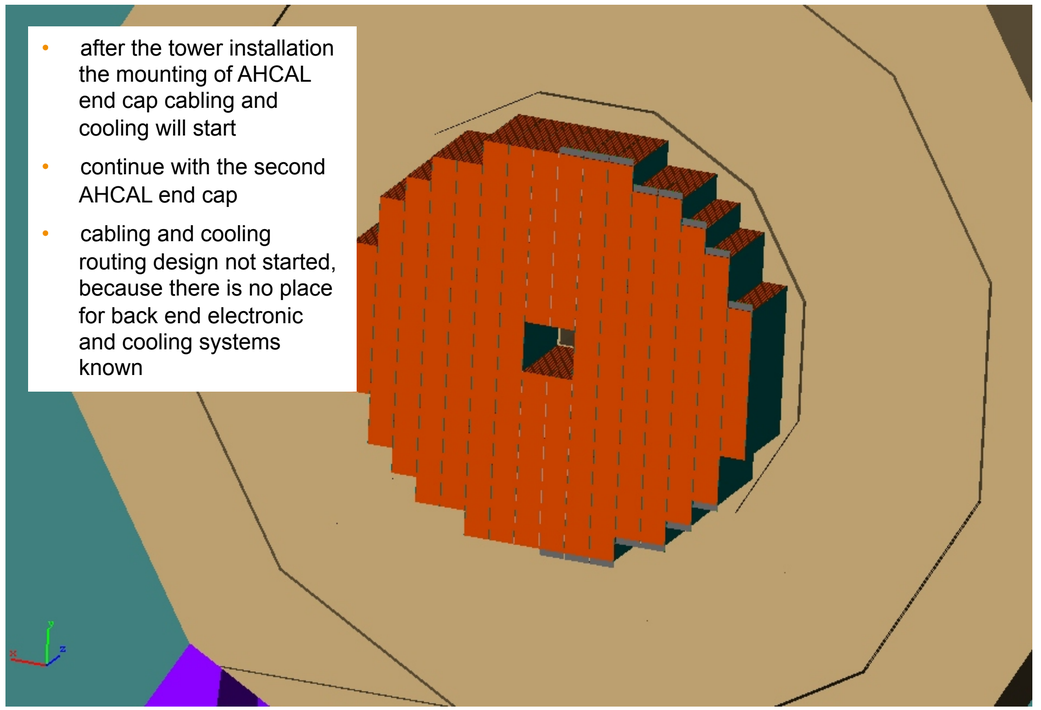
- install the AHCAL barrel cabling and cooling
- continue with the second AHCAL half barrel

Slide from Karsten Gadow

AHCAL end cap installation
step 1



AHCAL end cap installation
step 15-28



Slide from Karsten Gadow

AHCAL assembly in ILD
installation scenario

- AHCAL submodules and towers should be already equipped with sensitive layers and pretested anywhere in the world to reduce installation, transportation and storing charges at the installation area
- all AHCAL parts and tools can be transported in standard containers
- the AHCAL assembly can be done at the surface or in the experimental hall
- after transportation to the experimental site, the AHCAL submodules and towers must be tested before the AHCAL barrel and endcap installation, to reduce possible delays due to failures by transportation
- the testing of the sensitive layers and frontend electronics for the AHCAL submodules and AHCAL towers needs a testing and storing place
- laboratory space and infrastructure should be available close to the experimental hall

Slide from Karsten Gadow

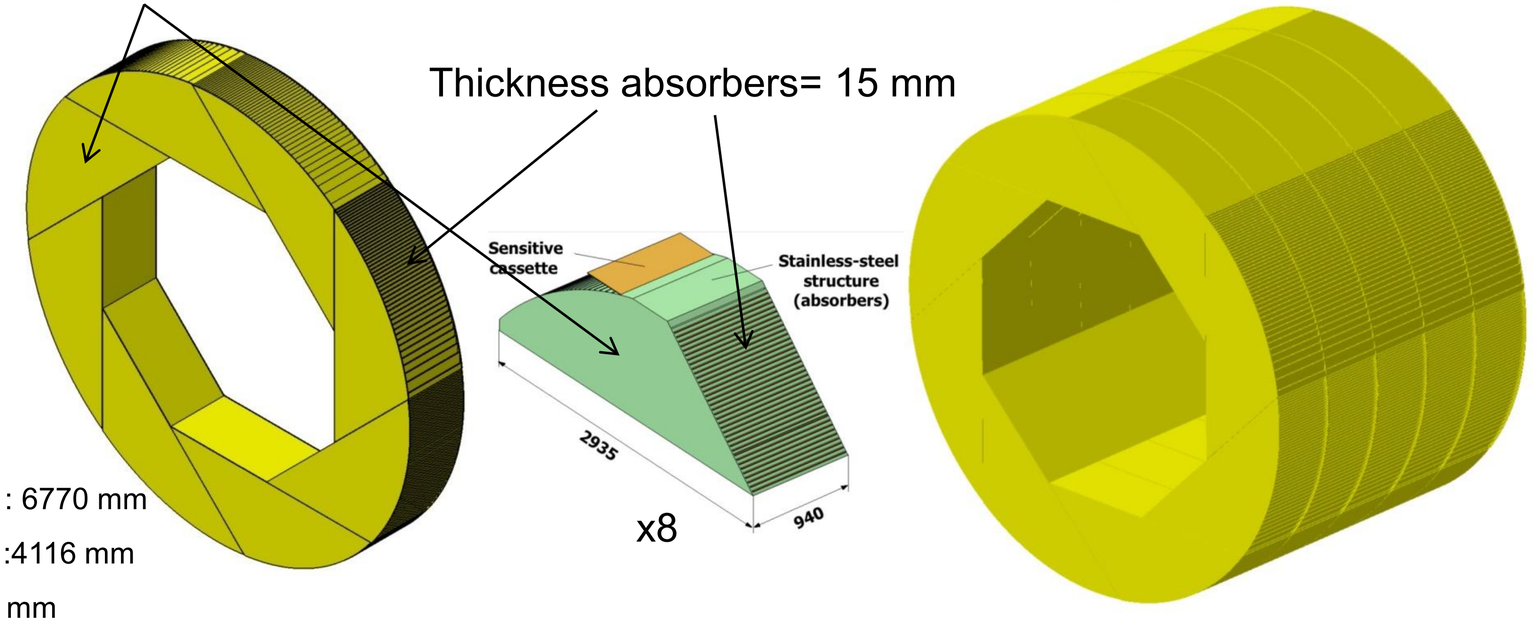
Videau Structure

Barrel integration : « Videau's Design » remind

Ext. Diameter	6770 mm
Int. Diameter	4116 mm
Lenght	4700 mm

Thickness disk face = 10 mm

Thickness absorbers= 15 mm



Ext. Diameter : 6770 mm

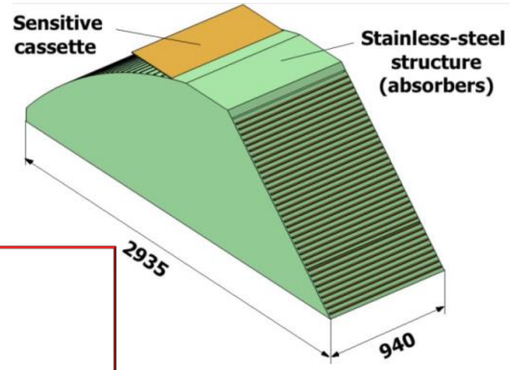
Int. Diameter :4116 mm

Lenght : 940 mm

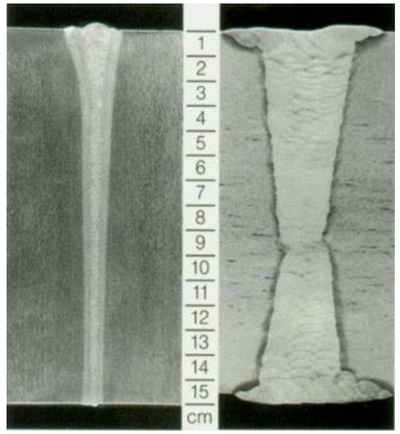
Stainless steel	1 wheel (8 mod.)	5 wheels (Barrel)
Weight (t):	**88 t**	440 t
Detectors W. (t):	36.8 t	184 t
Total Weight (t) :	124.8 t	**624 t**

Slide from J.C. Ianigro

Barrel integration : Module building



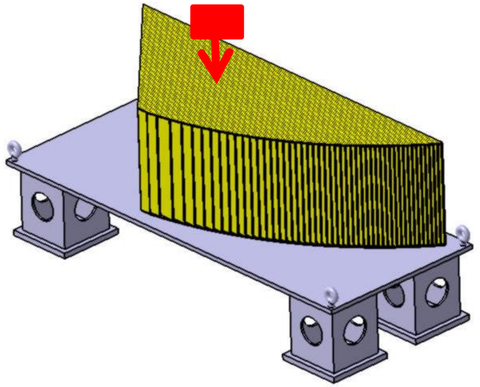
- Building in Industry: 40 parts



Welding method : Electron Beam Welding
- Tight continuous weld
- Accuracy and repeatability
- Low distortion
- Narrow weld and narrow heat affected zone
- Filler metal is not required

Technology adapted to larged skin & repeatable structure

Tested with success at CIEMAT (Madrid)



Module done one by one

47 absorbers plates (thickness 15 mm) welded on 2 flanges

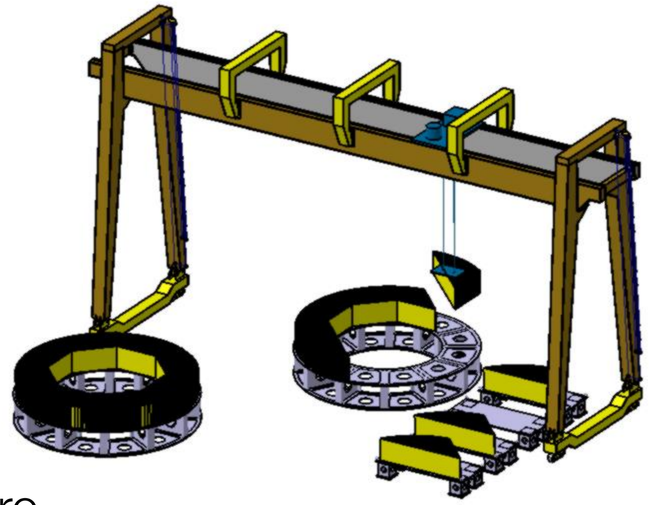
Weight = 11 t

Slide from J.C. Ianigro

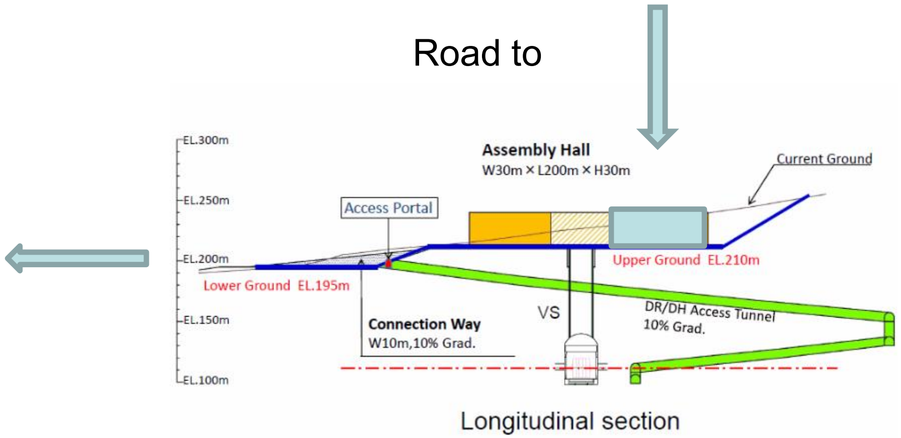
- Wheel Building in **Assembly Hall** : 8 modules x 5

Transport to Assembly Hall with normal truck - ILD area

- **Step 1** : Wheel structure transport (8 travels) & assembly
- **Step 2** : Modules transport 40 travels with 11 t
- **Step 3 :** Modules assembly on the wheel structure with 100 t crane
  - 8 modules in position on specific tool & screwing/welding



Road to



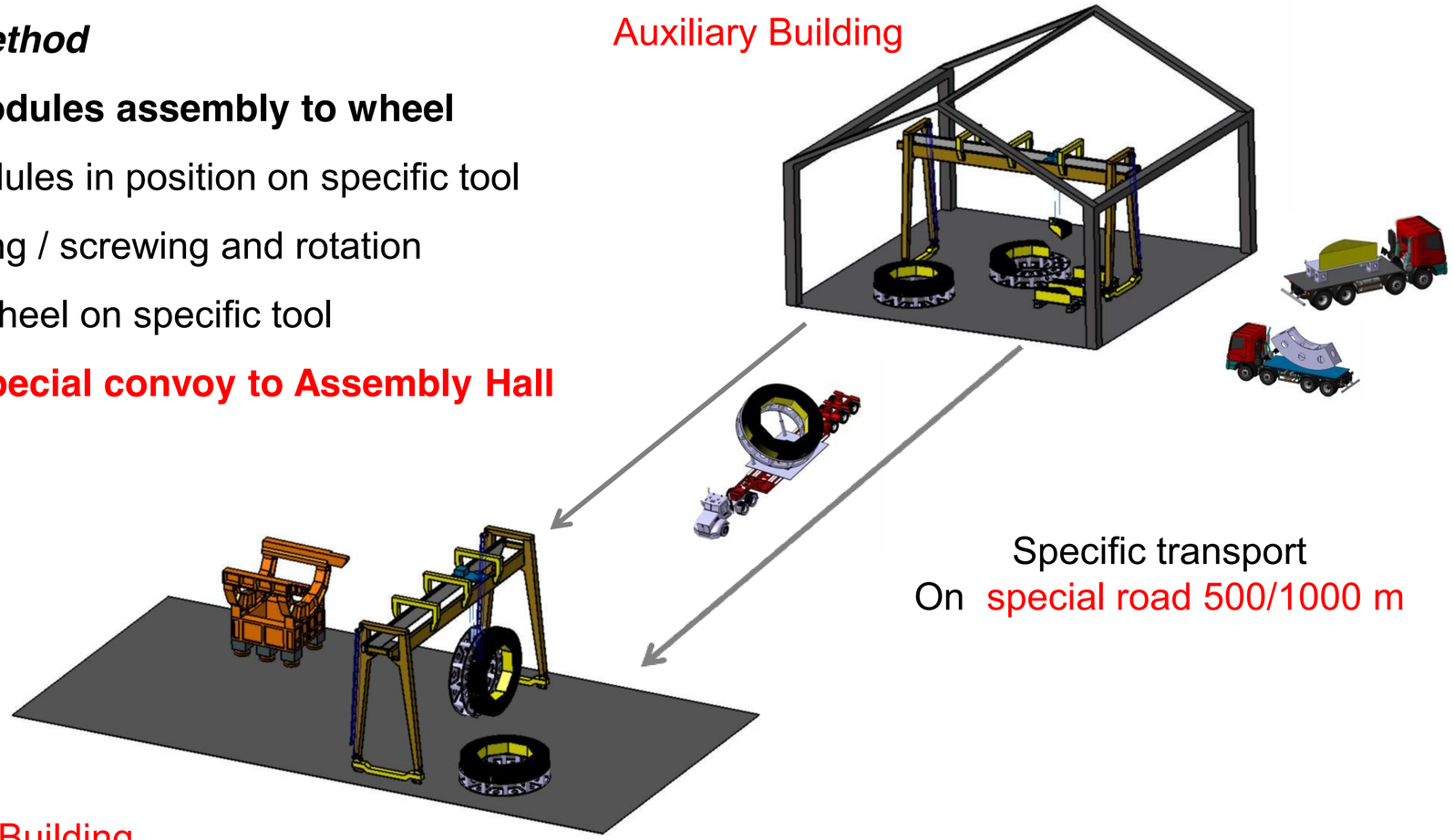
Longitudinal section

Slide from J.C. Ianigro

Wheel assembly in Auxiliary building : s

Building Method

- **Step 1 : Modules assembly to wheel**
  - 8 modules in position on specific tool
  - welding / screwing and rotation
- **Step 2 :** Wheel on specific tool
- **Step 3** : **Special convoy to Assembly Hall**



Slide from J.C. Ianigro

Wheel assembly in Auxiliary building : 8 modules => 5 wheels

Building Method

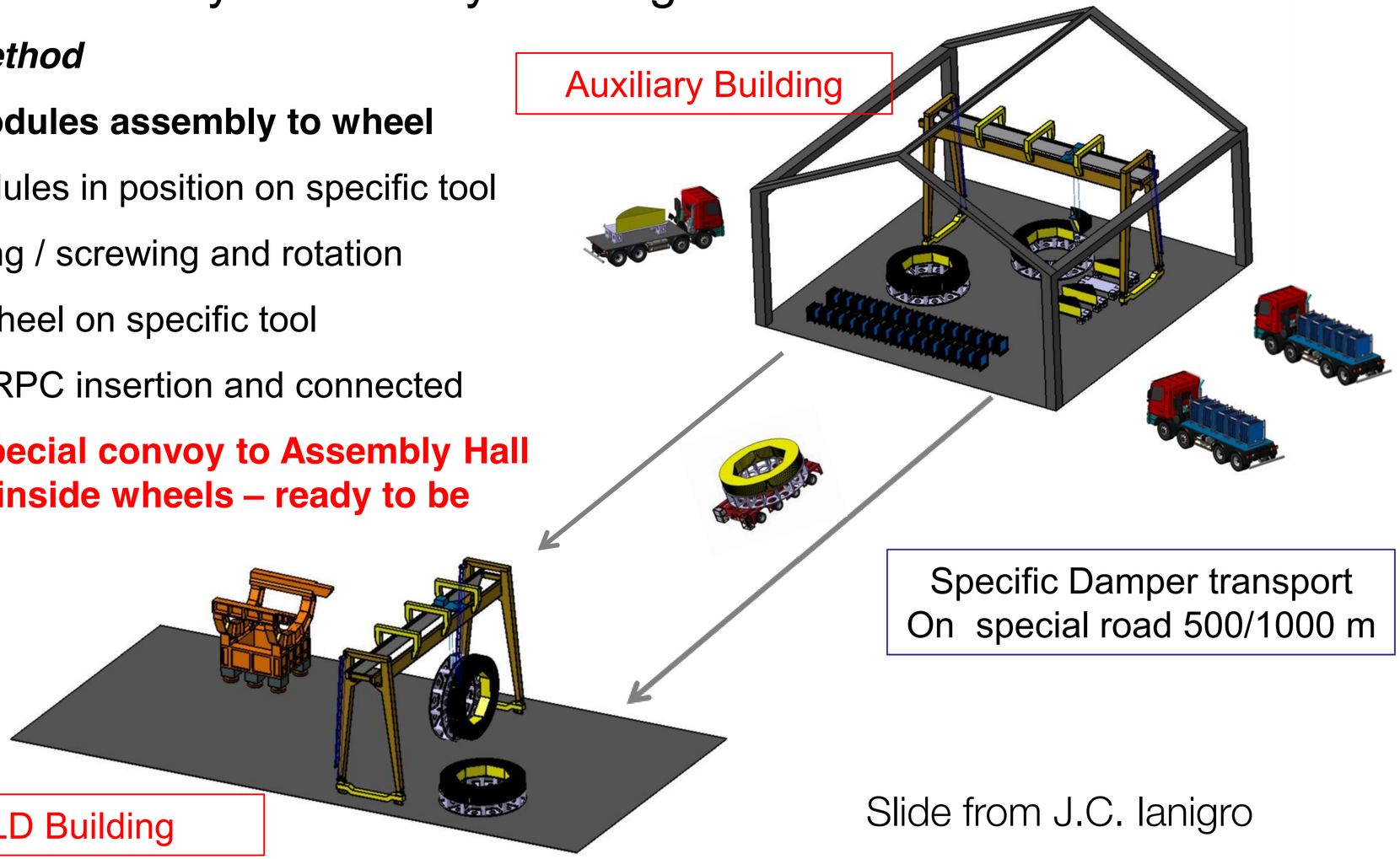
•**Step 1 : Modules assembly to wheel**

- 8 modules in position on specific tool
- welding / screwing and rotation

• **Step 2 :** Wheel on specific tool

• **Step 3** : GRPC insertion and connected

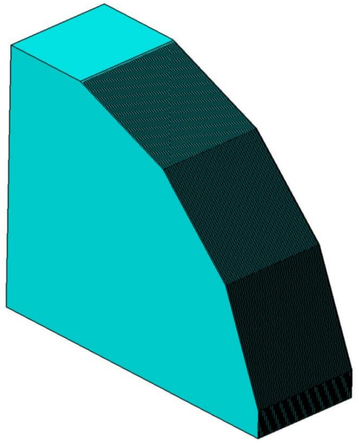
• **Step 4** : **Special convoy to Assembly Hall with GRPC inside wheels – ready to be connected**

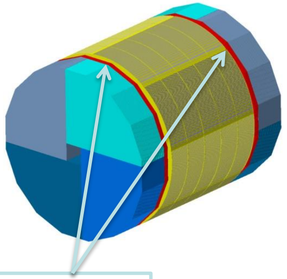


Slide from J.C. Ianigro

End caps integration : 2 endcaps

- Endcap



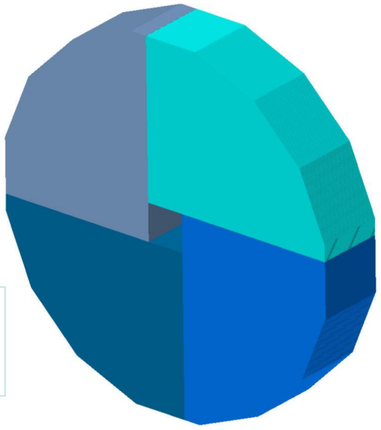


2 endcaps

Material : stainless steel

8 sides -> 16 sides

Encap : 48 detectors



EBW welded structure
Idem barrel
Modules built in Industry

One module

Module Weight : 50 t

Detectors weight : 22.5 t

Total weight : 72.5 t

One endcap made of 4 modules

Endcap Weight : 200 t

Detectors weight : 90 t

Total weight : 290 t

Barrel integration : scenarii

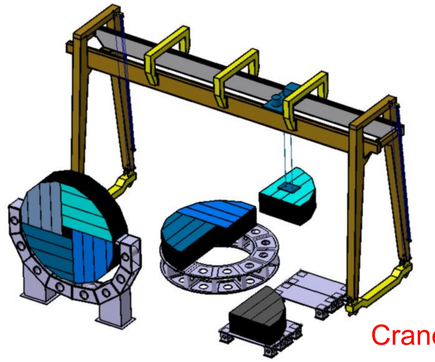
- Endcap Building : 4 modules x 2

Building Method similar to Barrel, done after the barrel

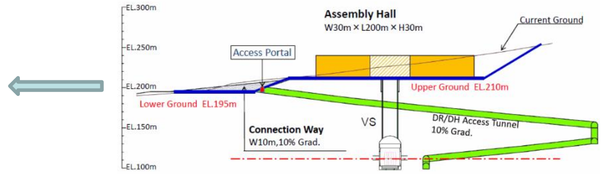
- **Scenario A** : Modules transport by normal truck to Assembly Hall, all operations made in the Assembly Hall
- **Scenario B :** Modules transport by normal truck to Auxiliary Hall, endcap built in the Auxiliary Hall and GRPC insertion in Assembly Hall
- **Scenario C :** Modules transport by normal truck to Auxiliary Hall, endcap built & GRPC insertion in the Auxiliary, damper convoy to Assembly Hall

Module weight = 50 t !!!

Road to



Crane capacity = 250 t



Longitudinal section

Slide from J.C. Ianigro

ILD Integration Resume.

- **Scenarii with idea that Barrel & Endcaps made separatly, one after the other one**
  - Modules of Barrel & Endcaps made in industry
  - Transport of modules to Assembly Hall or Auxiliary building
  - 5 Barrels wheels & 2 Endcap-Ring building
  - GRPC detectors insertion 1840 for barrel, 1872 for endcaps
  - Barrel & Endcaps-Ring insertion with specific tools
  - Services connections & efficiency test

- **Surface needed for operations**
  - 1200 m² for assembly of modules, specific structures, Services & GRPC detectors storage (3712 GRPC have to be brought)
  - Zone for barrel on structure storage before linked : 200 m²

- **Optimistic Time schedule**
  - Wheel transport & assembly : 1 week by wheel -> 5 weeks for barrel
  - GRPC insertion & test : 6 weeks by wheel -> 30 weeks for barrel
  - Connecting wheels, test & insertion in Yoke -> 5 weeks for barrel
  - **Total time for Barrel = 40 weeks**
  - **Approximately same time for both Endcaps-Ring**
  - **That means a SdHCAL integration time of :**
    - **Scenario A : 80 weeks in assembly Hall**
    - **Scenario B : 10 weeks in Auxiliary building & 70 weeks in Assembly Hall**
    - **Scenario C : 70 weeks in Auxiliary building & 10 weeks in Assembly Hall**

Slide from J.C. Ianigro

Assembly Study

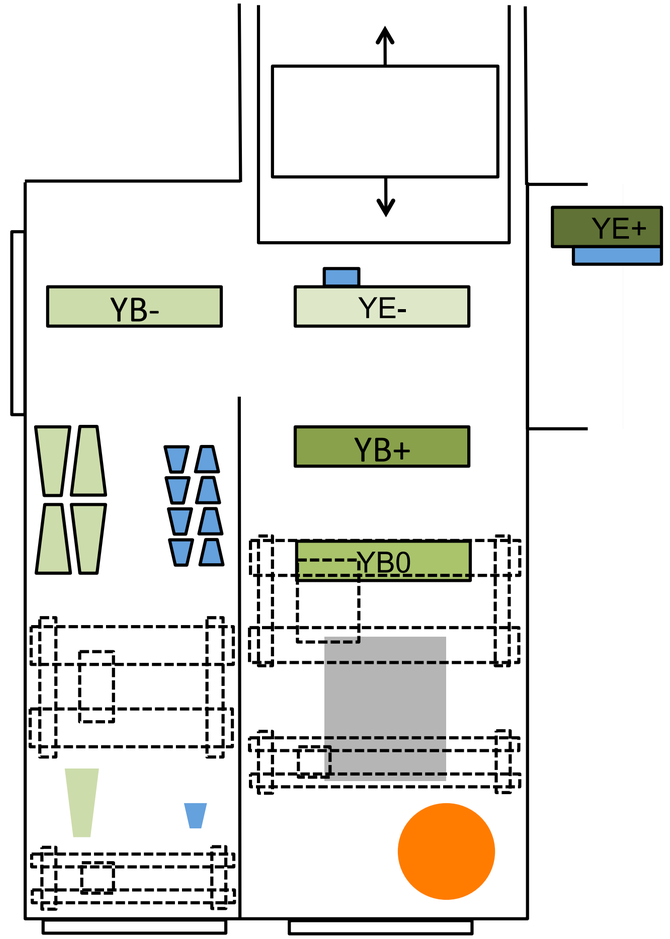
- Try to optimise the ILD assembly in a possible Kitakami scenario
- Biggest uncertainty:
  - where and how to build the coil

- A combined effort between sub-detectors, CFS group, ILD integration team is required to come up with a realistic assembly scenario for ILD
- Where can we do what?
  - at vendours/home institutes
  - at central lab campus
  - at IP campus
- This is cost relevant!

Integration Proposal

> YB-: production + assembly
  - One production lane for about 6 months (12 modules)
  - In parallel: solenoid assembly
  - In parallel: finalisation of muon installation in YE+ and begin muon installation in YB0 (120 days)

> HCAL production for endcaps
  - Mounting YE- HCAL
  - Start YB- yoke assembly once YE-HCAL is ready or assemble YB- wheel in garage



Slide from Thomas Schörner-Sadenius

Conclusion

- We have detailed assembly plans for both structure versions
- Steel modules in both options can be transported to Kitakami on existing roads
- Rings for both options need to be assembled in or close by the IP region
  - T-rings need to be assembled in front of the central barrel yoke ring
  - V-rings can be assembled close by, but require dedicated O(100t) transport possibility to the detector
- Details depend on the exact location and layout of the IP campus
- At this time it is probably safe to assume that either option could be made to work w.r.t. assembly and transportation boundary conditions in Kitakami (or elsewhere)