DT Group Meeting

Engineering Contributions to Atlas and Neutrino Platform

June 22, 2017

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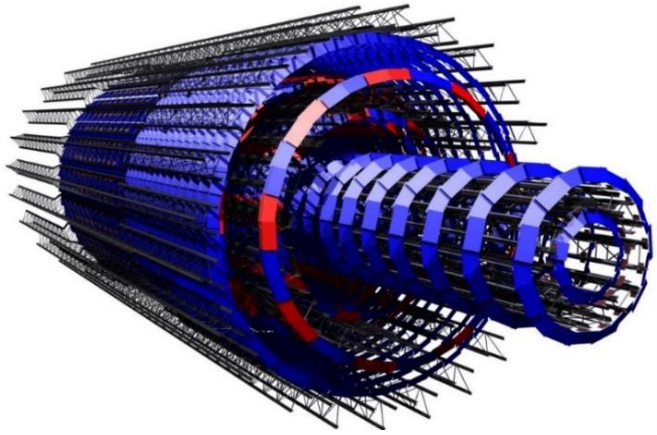
CERN
EP-DT
Detector Technologies

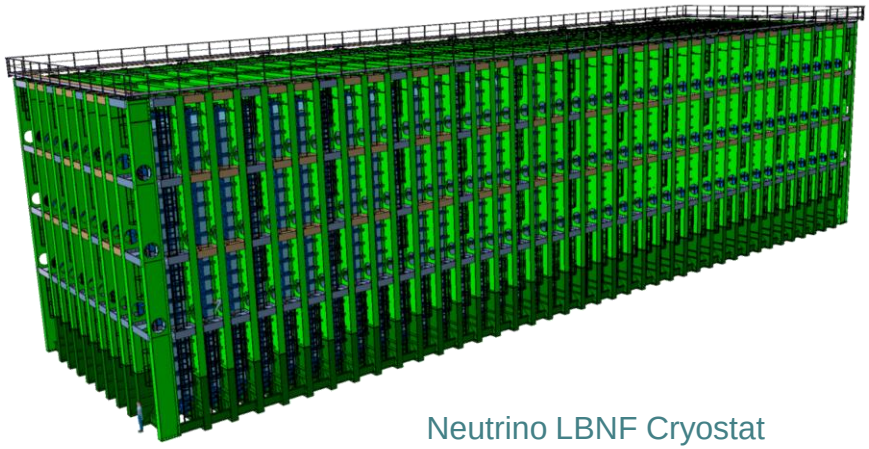
Outline

- Two engineering projects:
  - **Atlas ITk Pixel Upgrade**
  - **Neutrino Dune LBNF**
- Involving a number of DT resources today and in the future
- Supported by WP agreements



Atlas Pixel Upgrade

- Many other activities in EO are summarised in annex



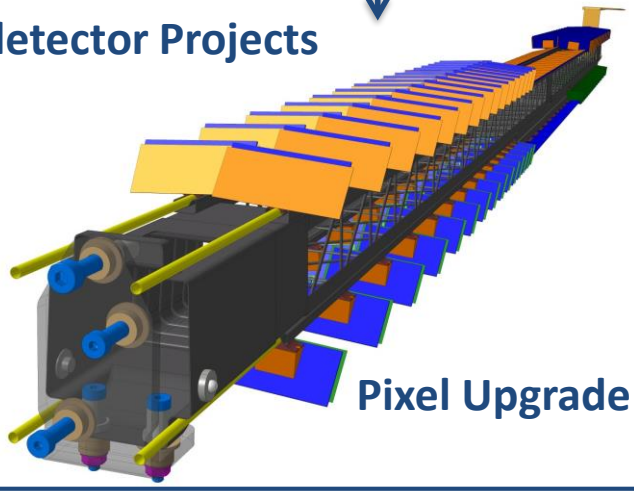
Neutrino LBNF Cryostat

WP between the ATLAS and EP-DT: 2017-2021

https://edms5.cern.ch/document/1735463/1 updated on 16/5/17

Areas of **collaboration for engineering activities** (as well as M&O, Services)

New detector Projects



Pixel Upgrade

Consolidation

TRT, **ID**, IBL, nSQP, Muon Big Wheels, Atlas Alfa, Atlas AFP Roman Pots, **Small wheels (Micromegas, Module 0 completed !)**

- CERN groups will contribute at **10% of the ITK Core**
- DT collaborates in the **Development and Construction of the Pixel**, plus common items and integration (EDMS 1569301)

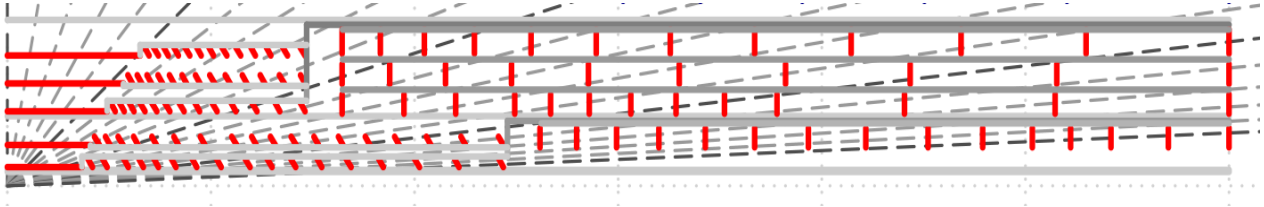
Two phases:

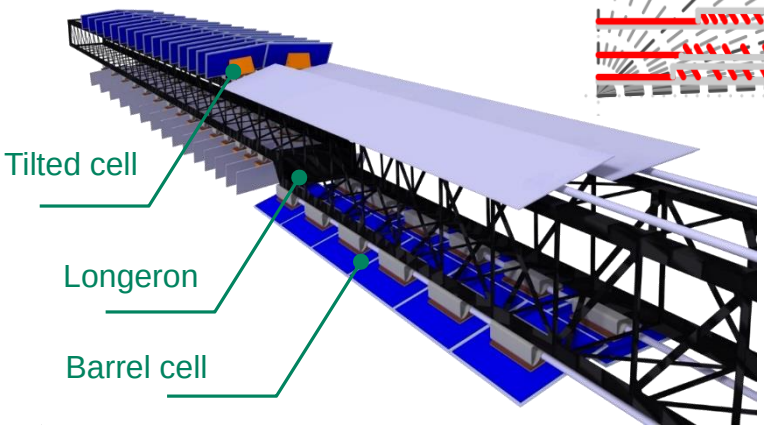
(1) Development towards TDR completion (2017 – 2018)

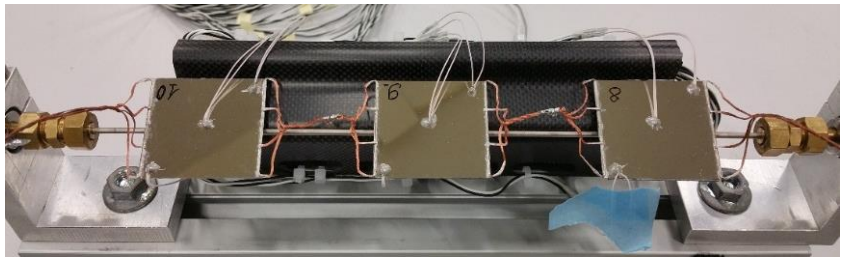
(2) Detector construction phase (2019 – LS3)

(1) R&D work towards TDR completion (2017 – 2018)

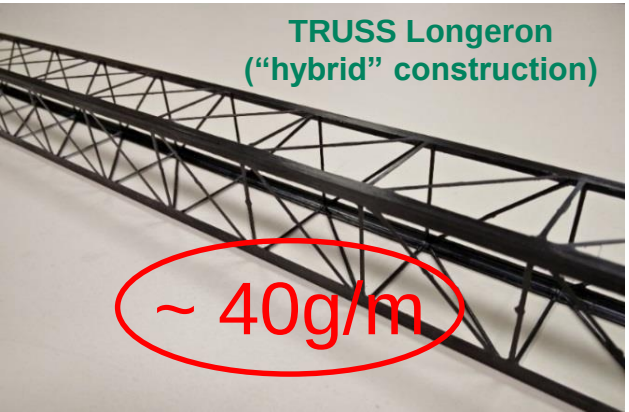
1. Development work:
   - Mechanical **design** of a **Pixel Barrel - inclined** layout proposal
   - **C-composite structures, advanced materials, thermo-mechanical solutions, and global structures.**

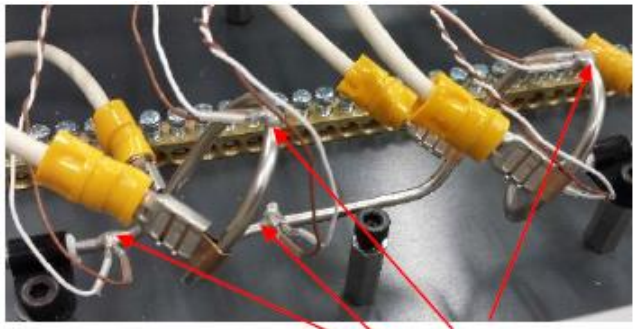




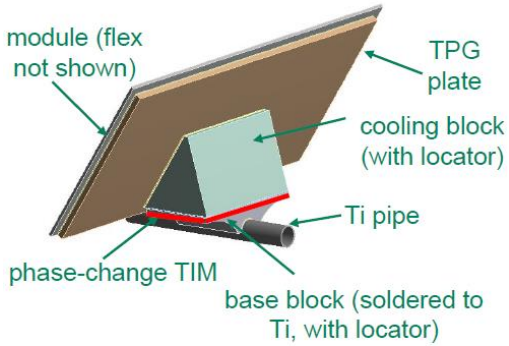


Single cells and "triplets" have been manufactured and tested (TFM validation)





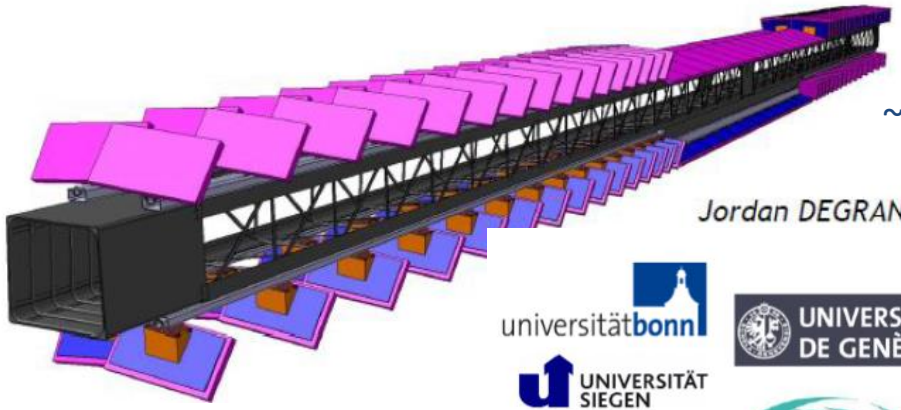
"**Looping" pipe concept**



Glued NTCs

(1) R&D work towards TDR completion (2017 – 2018)

2. Construction of so-called **“Pixel Demonstrator Programme” .**
   - A **full-length active stave** – thermo-mechanical and electrical validation at CERN
   - DT with ADE: contribute and coordinate the collaboration work with several ATLAS institutes on the Pixel inclined solution

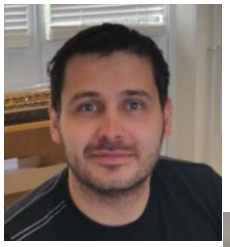


~ 200 modules on 4 lines

Jordan DEGRANGE

- **Two year programme** launched at the end of 2016
  - Engineering Prototypes (several)
  - Loading, integration, re-workability and survey
  - System test

(1) R&D work Resources: a wide range of skills



	Resources (FTE/y) 2017-2018	Name where applicable
Engineers	0.4 0.3 0.2	D.Alvarez A.Catinaccio X.Pons
Technicians	0.3 0.5 0.5 0.5	F.Perez J.Bendotti M.Vergain N. Dixon
Designers	0.7	J. Degrange
Physicists	1	N.Pacifico
	4.4	


DT Resources Estimated **4.4 FTE (but > 15 p. involved)**

Active members are also : **F. Boyer** (composites), PA (**Valery A.),** ass tech. **(Jan Mladek),** FTEC (**Ruben Gomez**) and a Tech Student (**Kari L. Ness**), co-funded by ATLAS and DT

Important contributions from **DT-EF** and rapidly increasing from **DT-DI** on DAQ











(2) Detector construction phase (2019 – LS3)

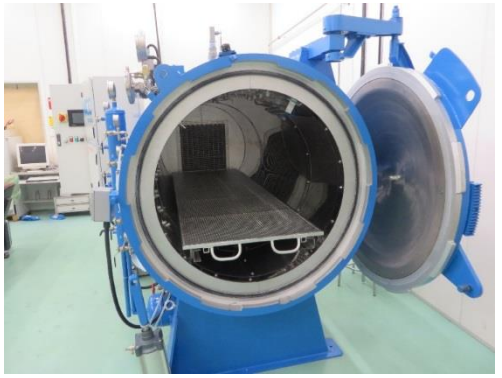
Focus on : one third of the pixel outer barrels construction

module, staves, loading, integration, testing, common items integration Tooling, CO_2 cooling system, Chip designs.

DT allocates resources to contribute to the following tasks:

- Carbon fiber final **Staves** and **Support** structures construction
- Services **integration**
- **Loading** with modules and QA
- **System tests & integration** (mechanical integration of staves with support structures).

The composite lab is now prototyping and producing final CFRP components for most of CERN Experiments



Autoclave 2.5m x 1 m

	Resources (FTE/y) 2019 – LS3	Name where applicable
Engineers	0.7 0.4 0.3	D.Alvarez A.Catinaccio X.Pons
Designers	0.5	J. Degrange
Technicians	0.4 0.5 0.5	F.Perez J.Bendotti N.Dixon
Physicists	1	N.Pacifico
	4.3	
Estimate of additional resources needed:		
Technicians **Physicist** **Fellow**	1.6 0.5 1	N.A. N.A. N.A.

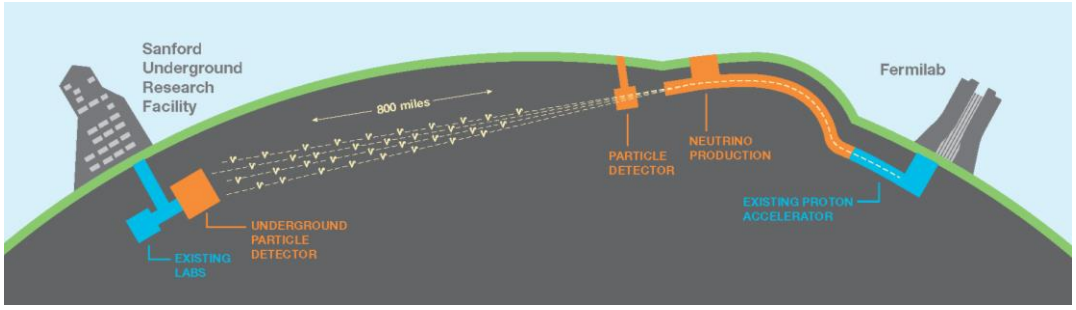
- **Additional manpower needed**
- **Key role of DT composite lab**
- Assembly space in 154 from demonstrator programme on.

Neutrino LBNF: Overview

- LBNF: Long Baseline Neutrino Facility
  - Far detector LAr TPC at SURF
  - Near detector at Fermilab

DUNE

(Deep Underground Neutrino Experiment)

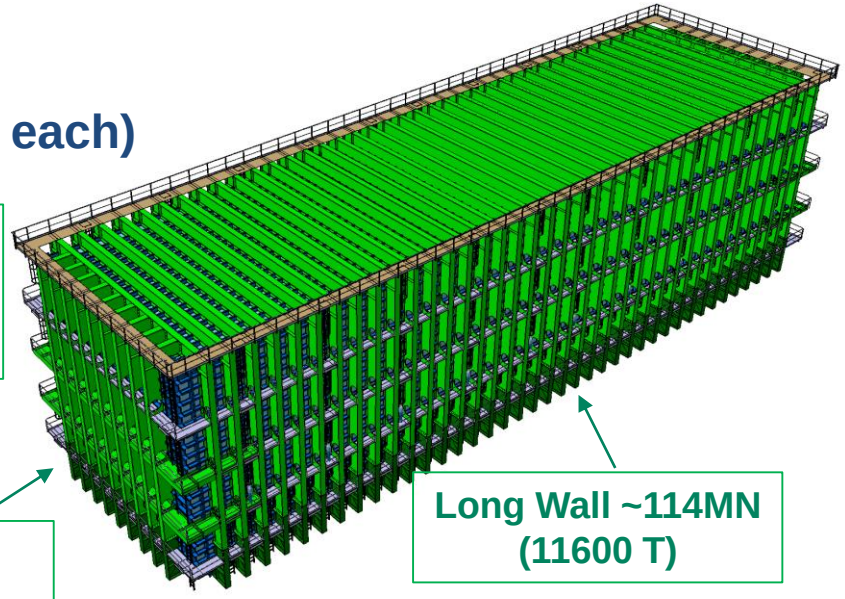


(http://www.dunescience.org)

- 1500m underground
- Four LAr Cryostats **(17kT LAr each)**

Size similar to building 156

Inner Dimensions:
- **L = 62m**
- **W = 15.1m**
- **H = 14m**

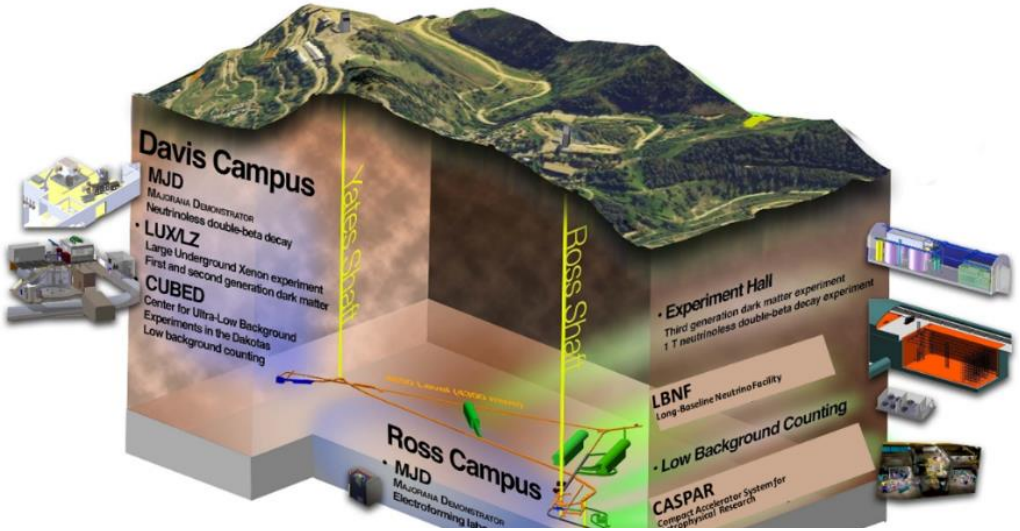


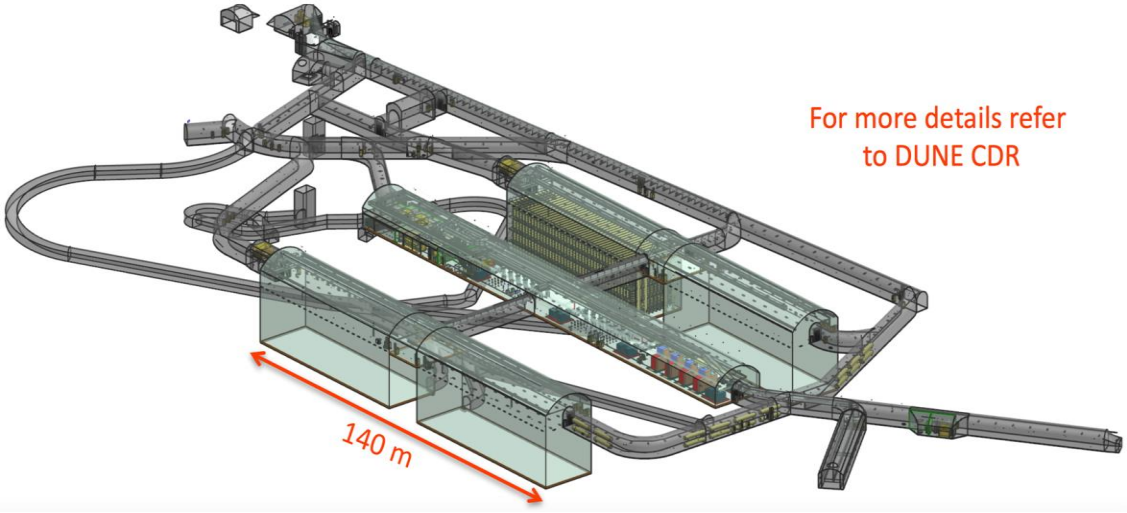
Short Wall ~27.7MN (2800 T)

Long Wall ~114MN (11600 T)

Some unusual constraints

- Severe constraints imposed by shaft size and crane capacity
  - Shaft dimensions (cage): 3.77 x 1.42 x 2.13 m (LxWxH)
  - Crane capacity: expected max 9.5 ton.

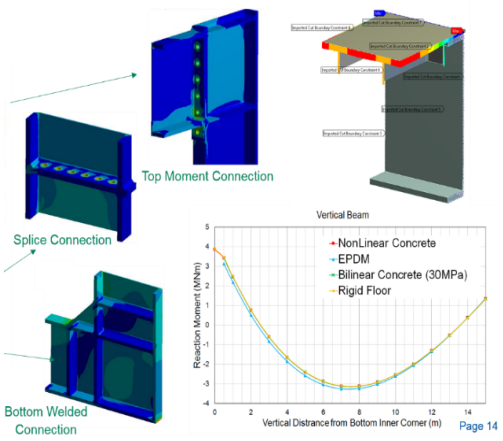


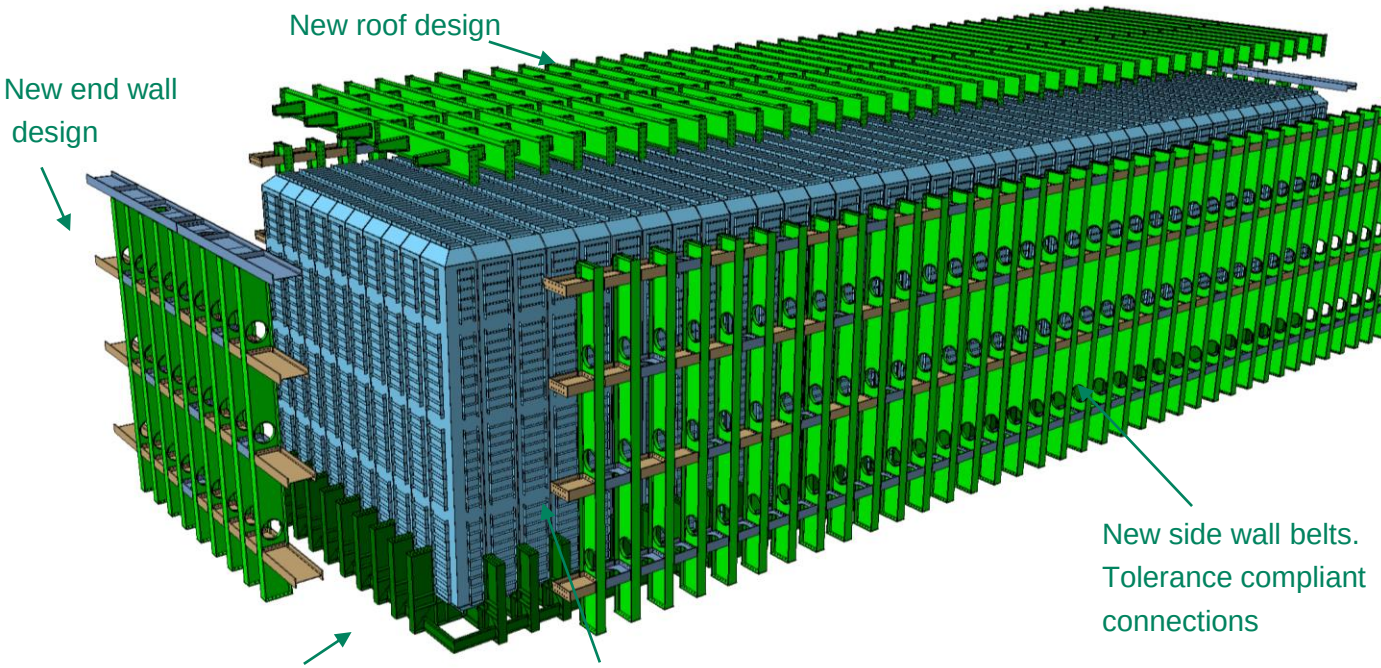


For more details refer to DUNE CDR

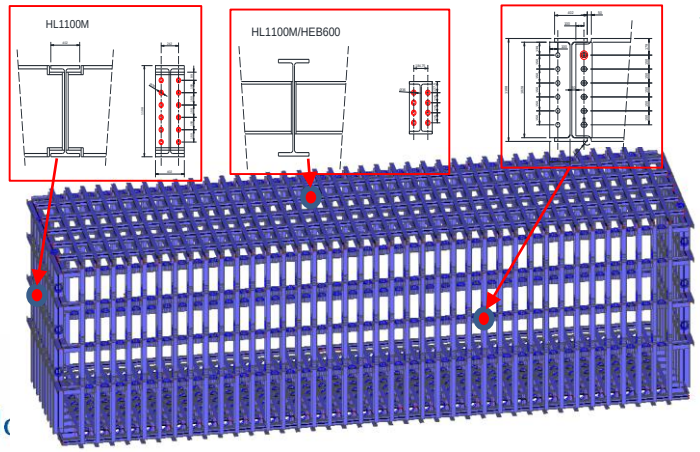
Re-design of the Cryostat Warm Structure

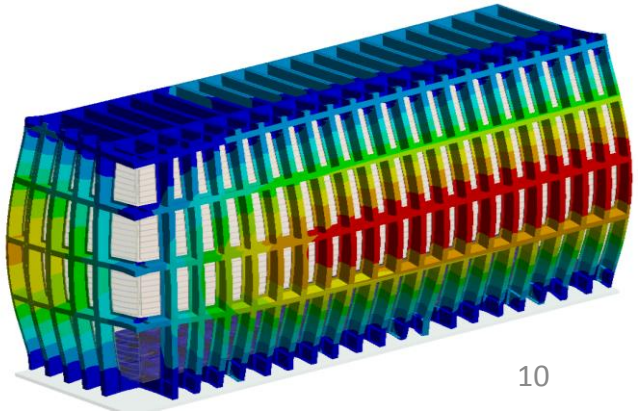
- Since **early 2015, 4 design revisions, 3 WP's, 2 Reviews, next Final Design Review** 22.08 with DOE





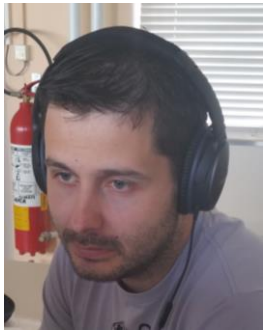
MN m connections (6T@100m)





Very busy people & next Deliverables

Activity FTE/year	2017	2018	2019	2020	2021
5.3, EP-DT-EO staff	**1.35**	**1.0**			
5.3, EP-DT-EO fellow	1.0	1.0			
5.4, EP-DI staff	0.2	0.2	0.2	0.2	0.2
total	**2.55**	**2.2**	**0.2**	**0.2**	**0.2**



- **Four design assessments** of load-carrying structure
- Analysis Models - Analytical & Numerical **(>150 models)**
- Code Interpretation (EUROCODE 3 & ASME BPVC) **(3000 pages)**
- 3D CAD, Assembly **(23 models)**
- Reports **(>3300 pages)**

Next EP-DT-EO deliverables

- **CATIA 3D models and installation sequence** (Ch. Bault)
- **Final design and structural analysis**, (J. Batista Lopes , D. Alvarez , L. D'Angelo)
- **Definition of test components (ie full size connections)** L. D'Angelo, plus structural calculations above).
- **Design and coordination (**A. Catinaccio)

- **Next: hand over design to construction company in 2018**

Thank You

List of agreed work packages

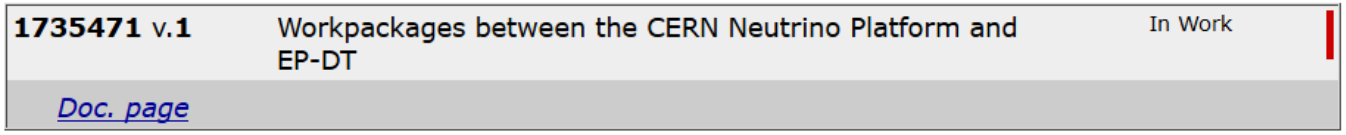
Available at: EP-DT EDMS:

- WP between the **ATLAS Experiment and EP-DT** for the period **2017-2021** https://edms5.cern.ch/document/1735463/1 updated on 16/5/17

- Workpage agreement **Engineering support for the LBNF** 10kT outer structure - 23-02-2015. Towards conceptual design review mid-June 2015 https://edms5.cern.ch/document/1505004/1 - **Version 1**

- Further work after June 2015 review, described within the framework of a WP between the NP and EP-DT : **Version2** https://edms.cern.ch/document/1579843/1

- WP's between the CERN Neutrino Platform and EP-DT 1735471 v.1: a link to WP's as the **LBNF cryostat engineering EP-WP-05 - Version3 and 4**



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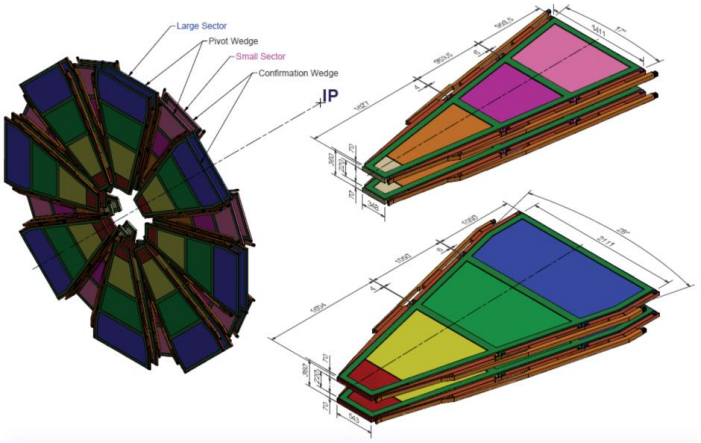
total	**2.55**	**2.2**	**0.2**	**0.2**	**0.2**

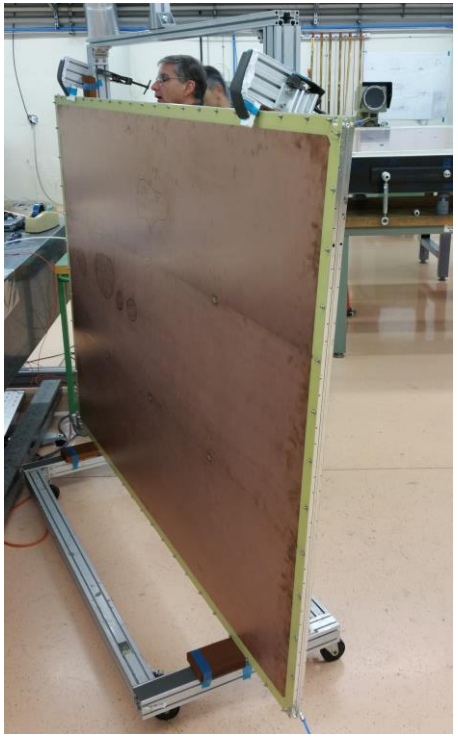
EP-DT-EO deliverables:

- **CATIA 3D models and installation sequence** (Ch. Bault 40% FTE in EP-DT-EO for 2017, 2018)
- **Final design and structural analysis**, (J. Batista Lopes at 50% and D. Alvarez at 25%, Luca)
- **Definition of test components (ie full size connections)** (100% L. D'Angelo, for 2017 and 2018 also contributing to the structural calculations of the paragraph above).
- **Design and coordination** of these activities in 2017-2018: (20% of A. Catinaccio, and 5% in 2019 to 2021 if proven necessary).

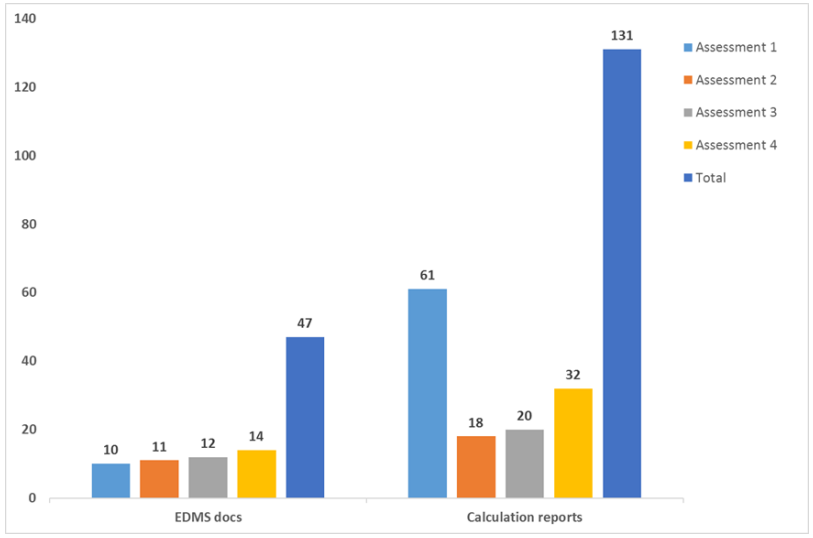
ATLAS New Small Wheel Micromegas Upgrade (LS2)

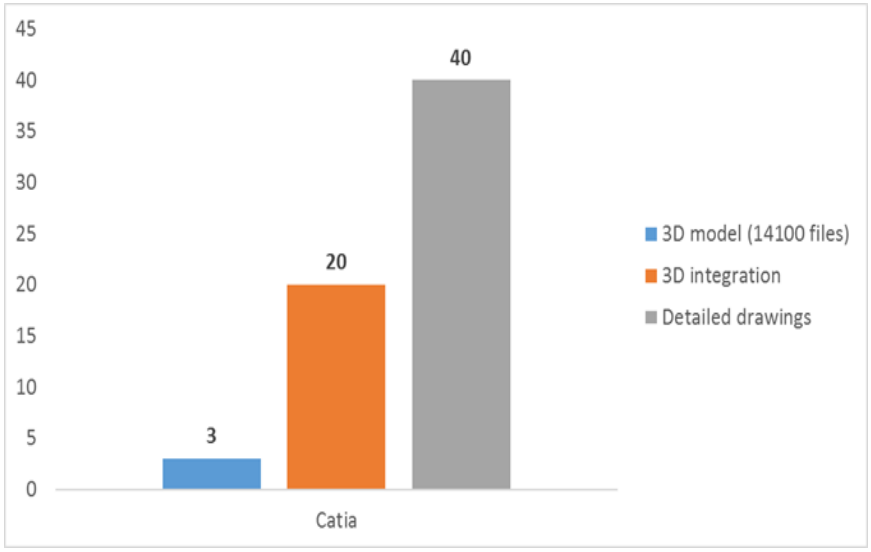
- **Motivation**
  - The only major detector upgrade in ATLAS for LS2
- **DT activities within the project**
  - **Design one out of four module** types (LM2) and construct module 0
  - **Develop tooling and assembly procedures** for the series production. Train the assembly teams
  - **Consult and assist** the collaboration on the **industrial production** of the PCBs (micromegas)
  - **Participate in the development of the resistive coating** which is crucial for the success of the project

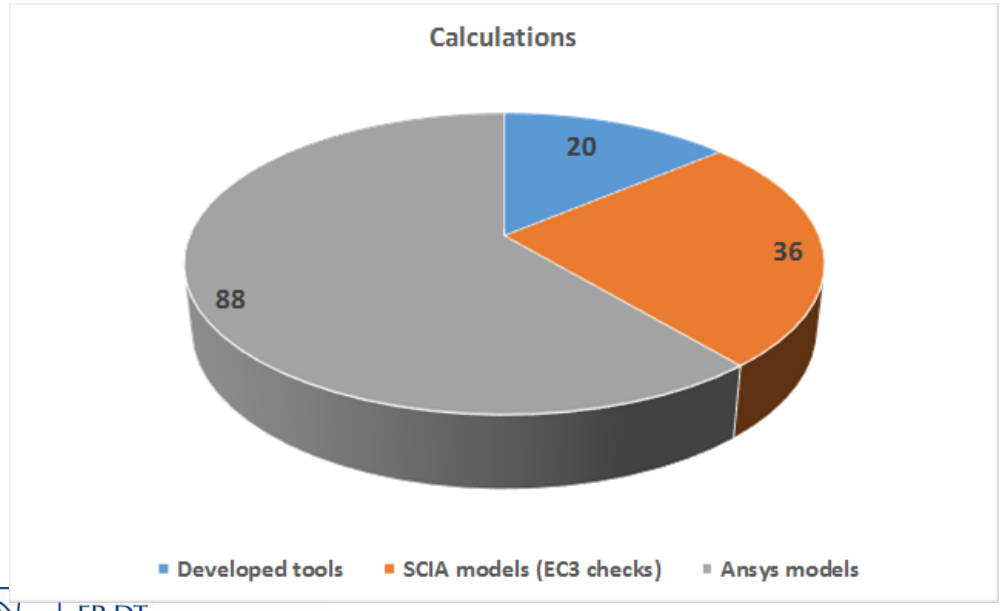


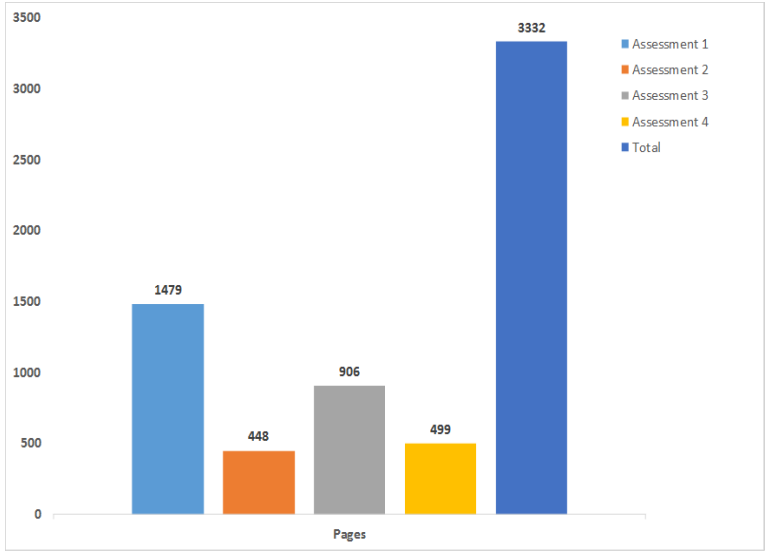


EP-DT-EO LBNF Contribution Summary









EO other Projects

Other examples of running projects/ activities (non exhaustive list):

CMS :
- Upgrade TOB, TIB
- Upgrade High granularity Si Calorimeter
- CMS HGCal wafer probe station setup

Alice
- ITS upgrade
- ITS, TPC, installation LS2
- TC integration

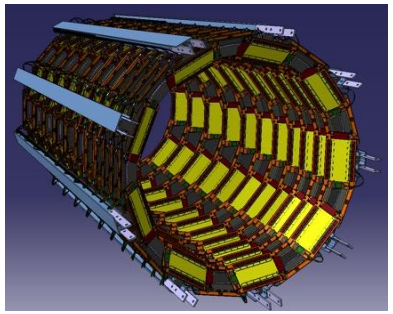
LHCb
- upgrade (SciFi tracker), UT detector
- TC integration, infrastructure design and calculations

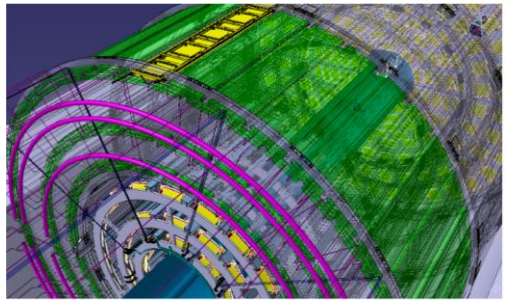
NA62 (post installation support)
- GTK integration and micro-cooling
- Straw detector

LCD:
- CLICdp Vertex, Integration studies HCAL, ILC collaboration
- Outer tracker support structure prototype
- Testbeam telescope

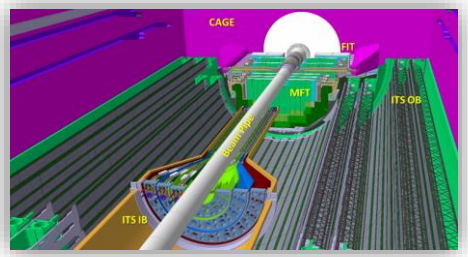
COMPOSITE LAB

Support to Gas Detector R&D lab
Support to the Cooling Project (EP-DT-FS)
Support to Micro-fabrication
Support Catia / Smarteam

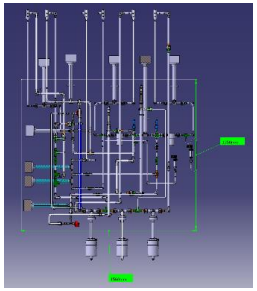




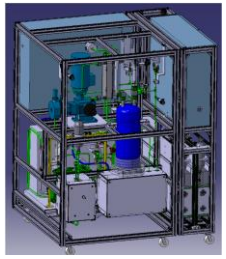
Integration: CMS OUTER TRACKER PHASE 2 UPGRADE



Alice ITS staves production, Beam pipe production, TC integration



Junction Box for LHCb detectors: UT & Velo



Operation Lucasz Plant modelling