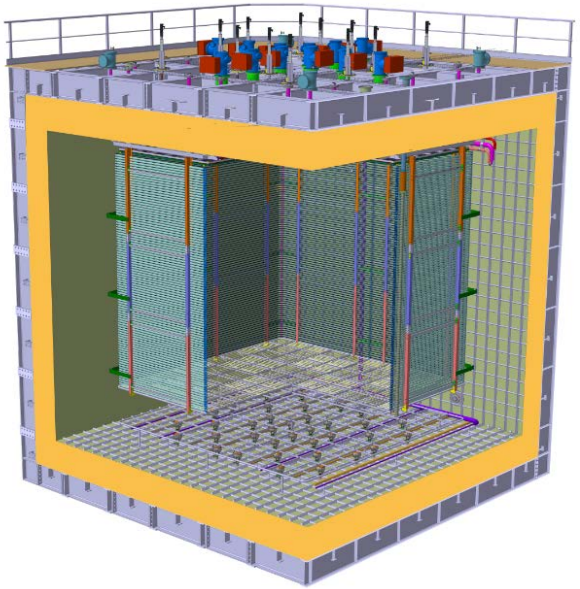
Plan for detector integration

D. Duchesneau / S. Murphy

- Integration organisation and activities
- Definition of infrastructure areas
- Updated construction and installation schedule



Collaboration meeting 23/03/2017

Integration group organisation and activities

The construction, installation, cabling, etc.. of the ProtoDUNE-DP detector are covered and supervised by the Integration Working Group (IG):

The activities already started include:

- The definition of the infrastructure areas. (e.g cryostat-roof, cryostat-inside, CR-185, CRB-EHN1, rack platform)
- The definition of the work, HR requirements, material, safety issues related to each of those areas
- The organisation the sequencing of the various activities
- The review and update of the planning for the detector preparation and construction

Organisational matters:

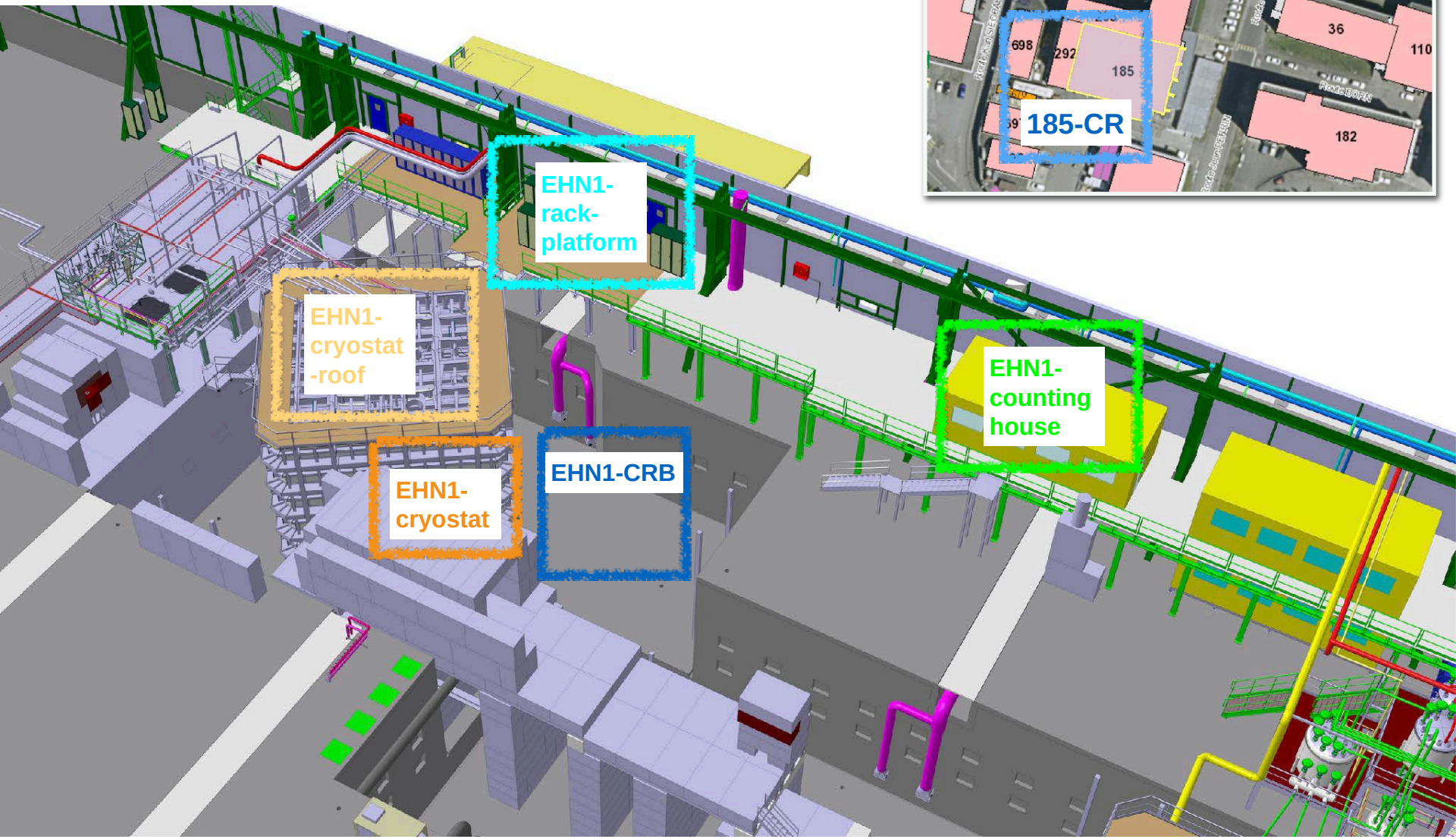
• Foresee regular IG meetings within WA105 => specific mailing lists have been created CENF-WA105-INTEGRATION@cern.ch

• We have setup weekly CERN technical integration meetings with CERN NP on Wednesday at 11:00

• Continuous communication with HSE (CERN safety dept), write required documents.

Definition of infrastructure areas

6 geographical zones.



Definition of infrastructure areas and activities

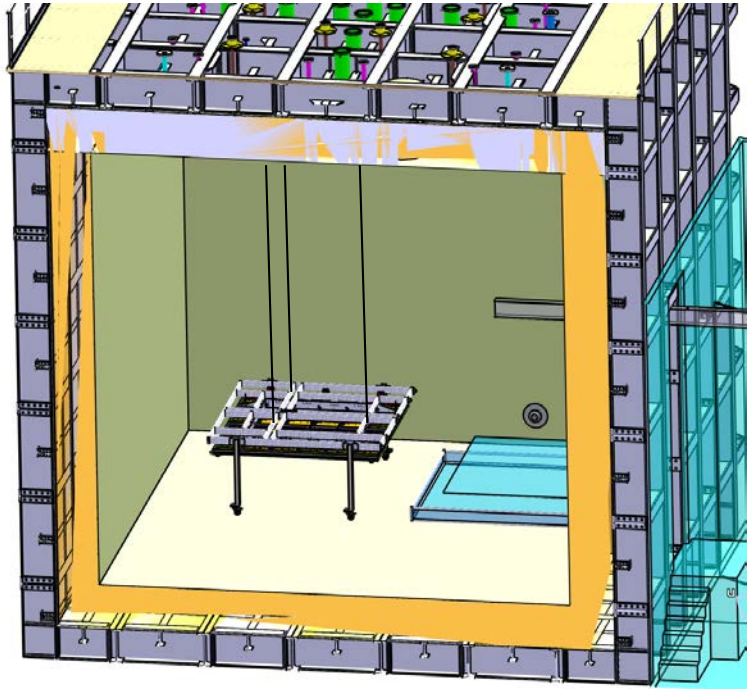
6 geographical zones.

EHN1-cryostat-roof:

- Chimneys and feedthroughs installati
- Element survey
- Charge readout crates
- Interface with cryo piping
- VHV system
- External cabling and cable trays

EHN1-cryostat:

- CRP mounting, cabling and survey and QA
- Field cage assembly, electrical connection and QA
- Cathode and ground grid installation and QA
- PMT installation and cablingand QA
- Slow control sensors installation and connections and QA

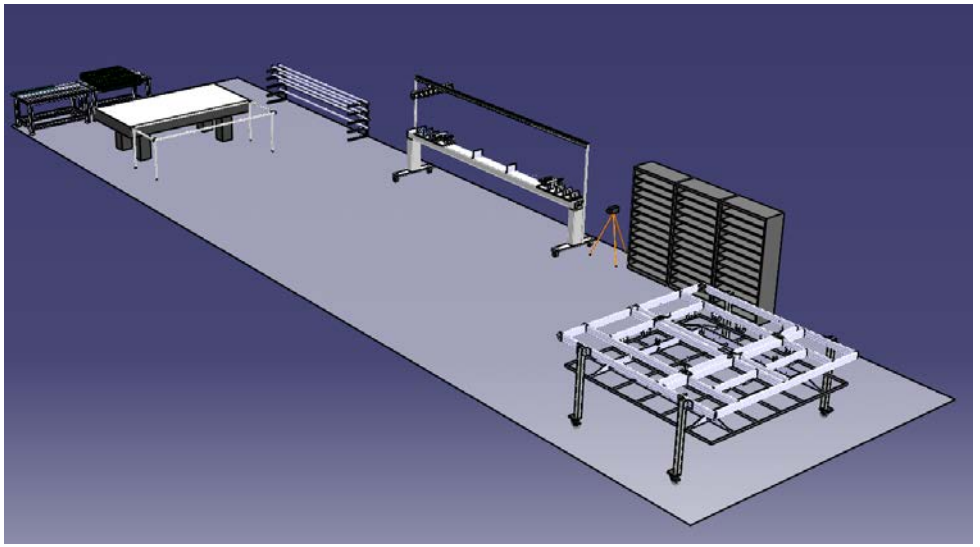


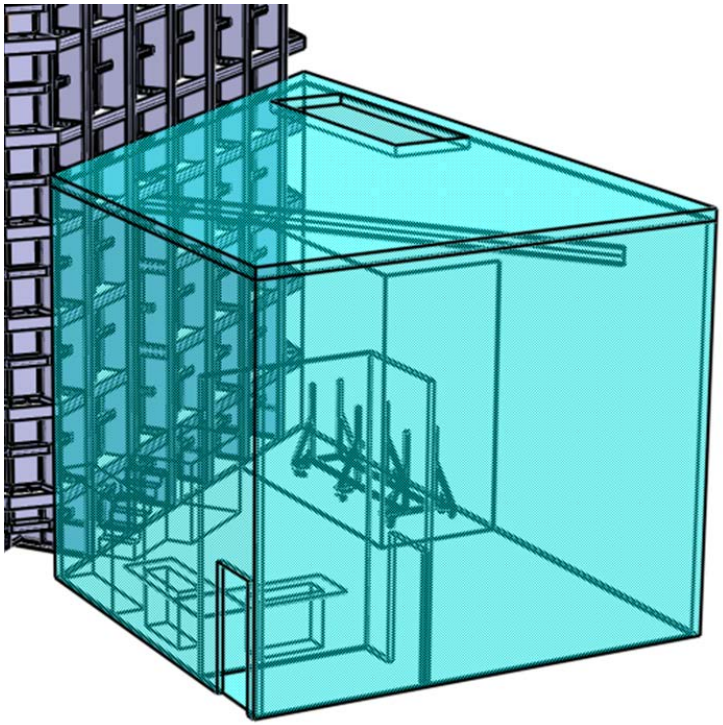
Definition of infrastructure areas and activities

6 geographical zones.

CR-185:

- LAS assembly and QA
- CRP assembly and QA
- Packing in transport boxes





EHN1-CRB:

- Reception and insertion of CRP in cryostat
- Assembly field cage submodules + QA and insertion in cryostat
- Reception and Insertion of cathode and ground grid elements

Definition of infrastructure areas and activities

6 geographical zones.

EHN1-rack-platform:

- Supervise uncabling and transport racks from 182 to EHN1
- Define power needs and electrical layout
- Manage the detector/building grounds (safety, insulating mats, ….)
- Rack design and layout
- Rack installation and cabling

EHN1 counting rooms

- Rack design and layout
- Define cooling power requirements
- Computing resources and network

CERN infrastructure for ProtoDUNE-DP:

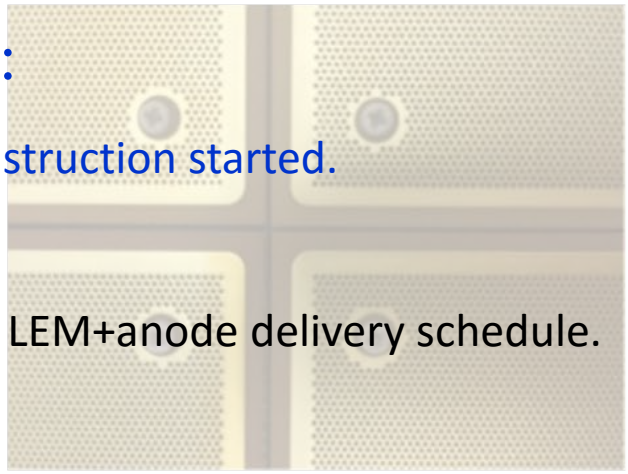
- Cryostat finished with CRB installed beginning of June (Cryostat finished = with the internal piping and temporary floor)
- Building 185 Clean Room availability April 10th.
- Rack migration from 182 to EHN1

Specific construction tooling

Main goals for the first semester 2017:

For now the most important is to get the CRP construction started.
This includes:

- finalising the details of the design,
- getting 185 organised and understanding LEM+anode delivery schedule.



Key dates:

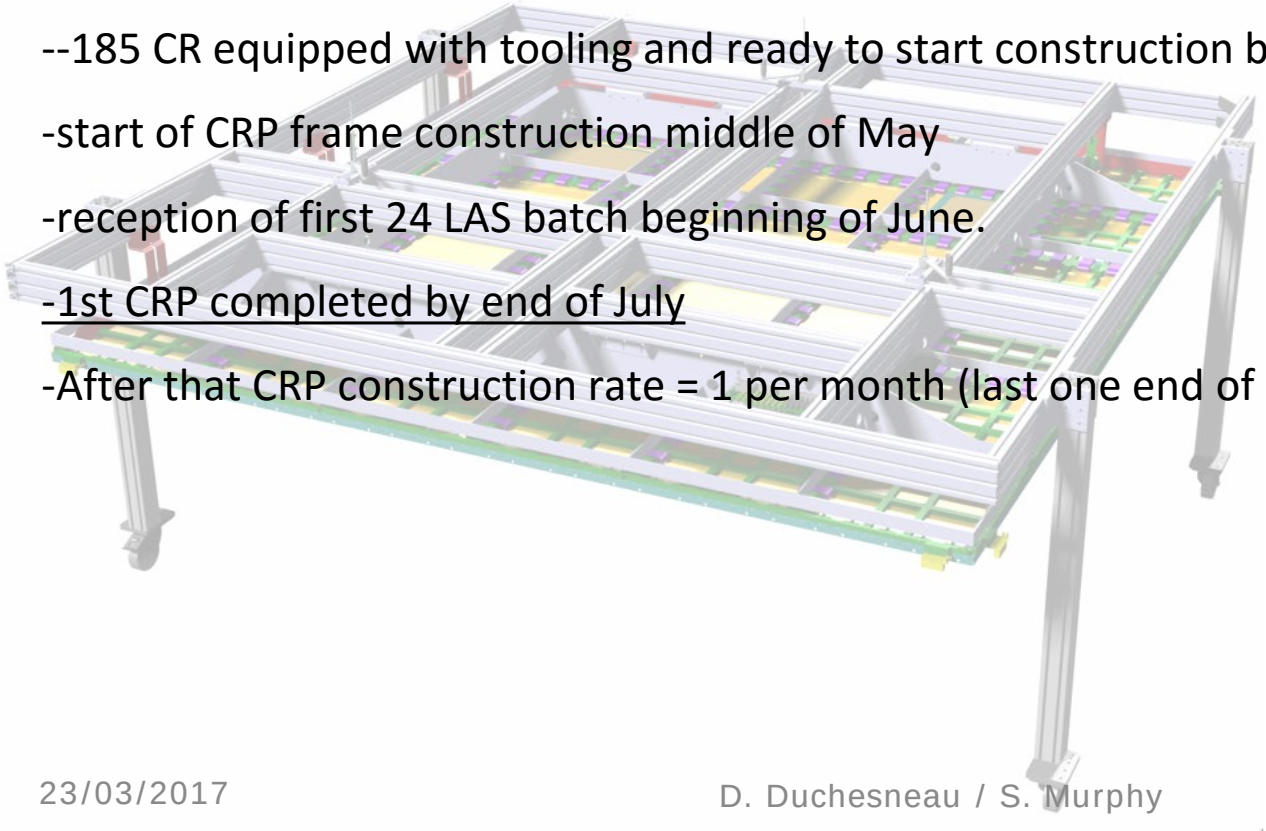
--185 CR equipped with tooling and ready to start construction beginning of May

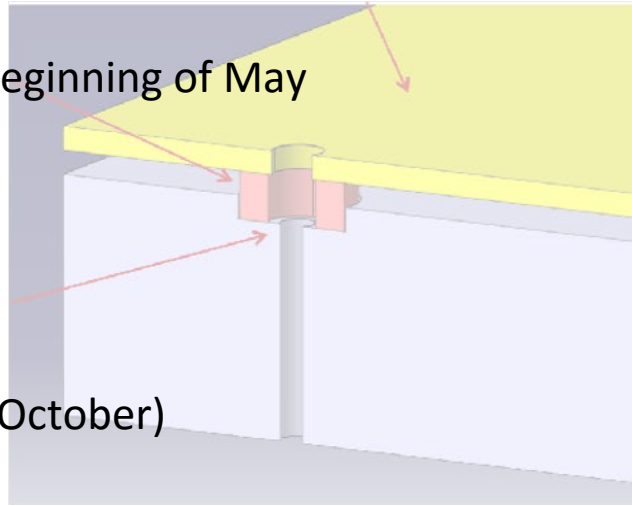
-start of CRP frame construction middle of May

-reception of first 24 LAS batch beginning of June.

-1st CRP completed by end of July

-After that CRP construction rate = 1 per month (last one end of October)





Immediate milestones for detector:

critical items to get started to comply with schedule:

- design of CRP-INS flange (who? when?)
- finalise design “CRP instrumentation and cabling” (types of cable, patch-panel, jumpers, pulsing system, .. see slide at last EC also in backup)
- design of LAS assembly tooling. (who? when?)
- finalise design of CRP transport boxes

Proceed with purchasing:

- purchase of building 185 tooling + furniture.
- purchase of CRP frame (G10+INVAR)
- purchase of “ CRP instrumentation and cabling”.
- purchase of all LEMs + anode
- purchase of LAS assembly components + tooling
- purchase of CRP transport boxes

Items presented today:

EHN1-rack-platform

EHN1-cryostat-roof

EHN1-counting house

EHN1-CRB

EHN1-cryostat

- Cryogenic installation plans
- CRB and detector assembly in cryostat
- LEM and anode production and QA/QC
- CRP assembly and installation
- Light readout system installation and cabling
- Racks, monitoring, power distribution and cabling

Construction and installation schedule

The updated schedule is based on the following changes and assumptions:

- Delays on various infrastructures have been taken into account
  - Bldg 185 clean room in April 2017
  - end of the cryostat construction in EHN1 in May 2017
- More detailed construction and installation procedures are known for the different parts
- Material orders timescale and delays
- Documents provided for LEM production and t0 estimated at the time of February
- Etc…

This updated schedule focuses mostly on the integration and construction phase

Main lines on the schedule

Version 15/03/2017

Tasks	start date	end date
ProtoDUNE-DP	**09/01/2017**	**20/02/2018**
CRP Production & Installation	**10/03/2017**	**08/11/2017**
Drift Cage Production and Installation	**01/05/2017**	**15/01/2018**
HV system	**27/11/2017**	**11/12/2017**
PMT and Light Read Out System	**09/01/2017**	**05/02/2018**
Chimneys and feedthroughs	**24/04/2017**	**04/08/2017**
Front End electonics	**11/09/2017**	**01/12/2017**
Slow control	**04/12/2017**	**26/01/2018**
Ground grid installation	05/02/2018	07/02/2018
Purity monitor	**08/01/2018**	**19/02/2018**
Beam plug installation	07/02/2018	14/02/2018
Ready to seal TCO & cryostat	19/02/2018	20/02/2018
Large Area Trigger Counters	**13/11/2017**	**22/12/2017**

The new date for TCO ready to seal: Feb 20th 2018

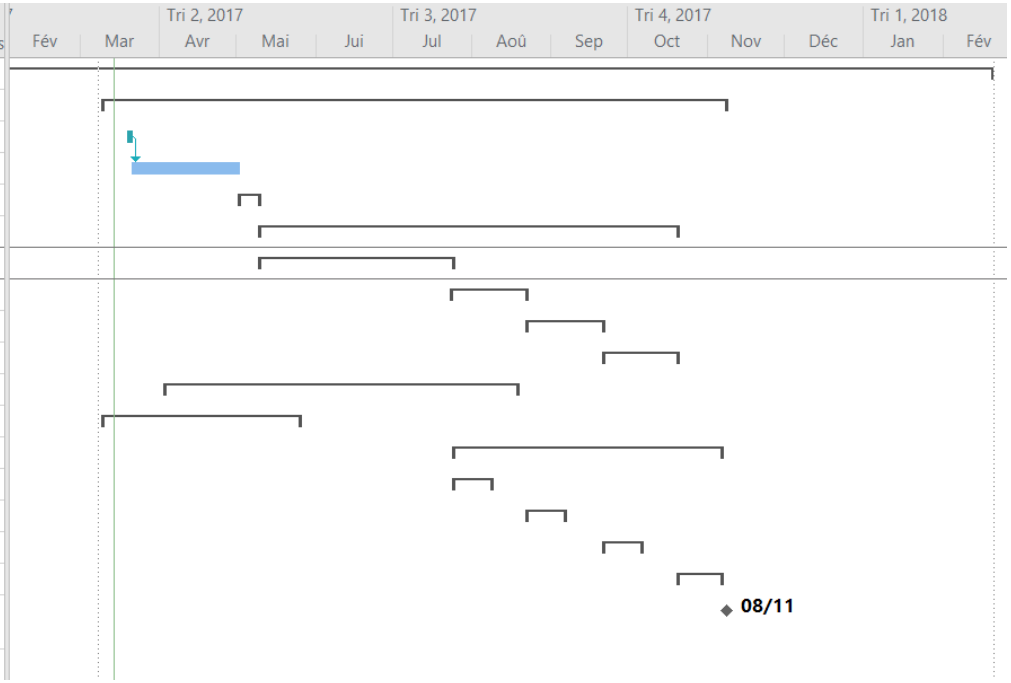
CRP Production and Installation

Detailed processes are included

Example:

Version 15/03/2017

Nom de la tâche	Durée	Début	Fin	Prédécesseurs
ProtoDUNE-DP	**281,71 jours?**	**09/01/2017**	**20/02/2018**	
CRP Production & Installation	**173,71 jours**	**10/03/2017**	**08/11/2017**	
CR185 material order	1 jour	20/03/2017	20/03/2017	
Clean Room Material reception	30 jours	21/03/2017	01/05/2017	3
CR185 preparation	**6 jours**	**02/05/2017**	**09/05/2017**	
CRP assembly in CR185	**117,71 jours**	**10/05/2017**	**20/10/2017**	
CRP #1	**54 jours**	**10/05/2017**	**24/07/2017**	
CRP #2	**21,57 jours**	**24/07/2017**	**22/08/2017**	
CRP #3	**21,57 jours**	**22/08/2017**	**21/09/2017**	
CRP #4	**21,57 jours**	**21/09/2017**	**20/10/2017**	
LAS Supply	**100 jours**	**03/04/2017**	**18/08/2017**	
Cryostat preparation	**55 jours**	**10/03/2017**	**25/05/2017**	
CRP installation in the cryostat	**74,71 jours**	**25/07/2017**	**06/11/2017**	
CRP #1 Installation in Cryostat	**11 jours**	**25/07/2017**	**08/08/2017**	
CRP #2 Installation in Cryostat	**11 jours**	**22/08/2017**	**06/09/2017**	
CRP #3 Installation in Cryostat	**11 jours**	**21/09/2017**	**06/10/2017**	
CRP #4 Installation in Cryostat	**11 jours**	**20/10/2017**	**06/11/2017**	
CRP lateral position adjustment (warm conditions)	2 jours	06/11/2017	07/11/2017	172



If one selects this line

CRP #1	**54 jours**	**10/05/2017**	**24/07/2017**	
Parts reception in CR185	1 jour	10/05/2017	10/05/2017	8
Supporting structure assembly	1 jour	11/05/2017	11/05/2017	11
Invar frame on supporting stucture	4 hr	12/05/2017	12/05/2017	12
G10 assembly on optical table	1 jour	11/05/2017	11/05/2017	11
G10 and Invar connection	1 jour	12/05/2017	15/05/2017	13;14
LAS assembly on CRP	4 jours	26/06/2017	29/06/2017	15;78
Instrumentation assembly	2 jours	30/06/2017	03/07/2017	16
Grid weaving	5 jours	04/07/2017	10/07/2017	17
Grid Installation	5 jours	04/07/2017	10/07/2017	17
Planarity tuning	4 jours	11/07/2017	14/07/2017	19
Electrical Tests	5 jours	17/07/2017	21/07/2017	20
Packing in transport box	1 jour	24/07/2017	24/07/2017	21

For this line see next slide

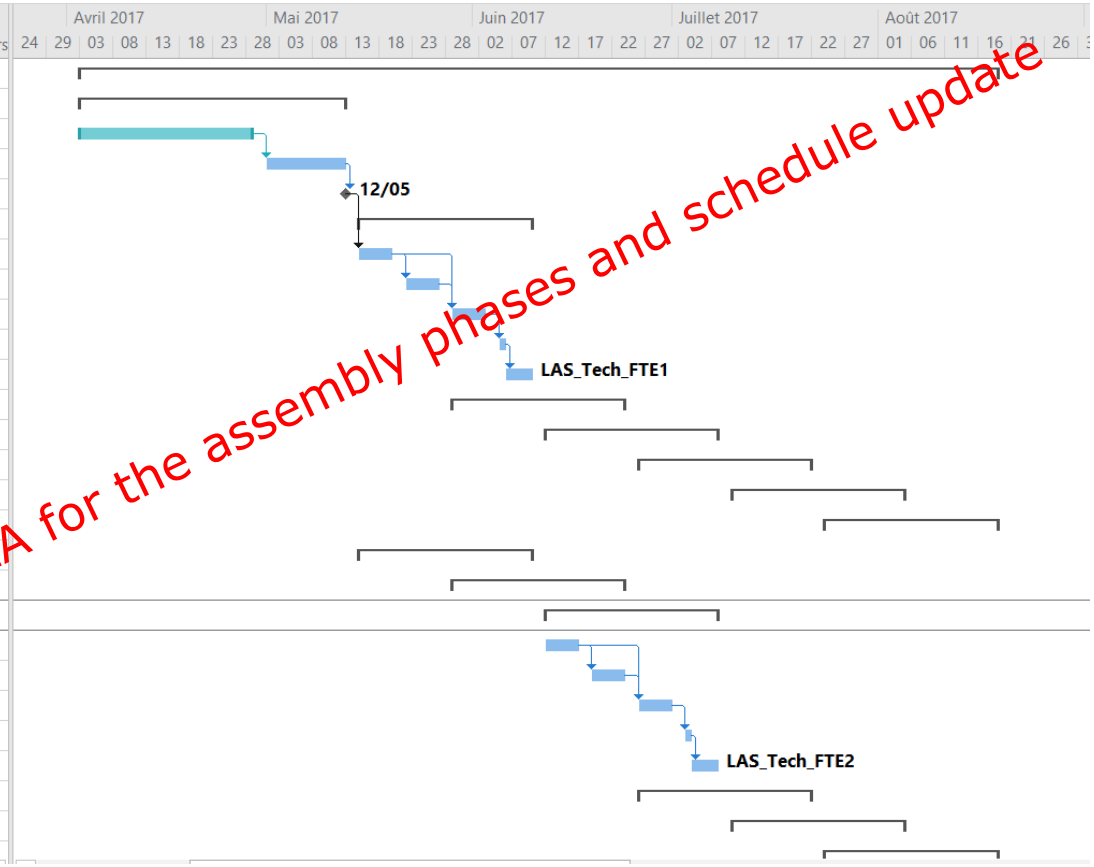
LEM and Anode Sandwich Production

Version 15/03/2017

Dependence on LEM and Anode production

All the timing is based on the LEM tender document provided by CEA

Nom de la tâche	Durée	Début	Fin	Prédécesseurs
LAS Supply	**100 jours**	**03/04/2017**	**18/08/2017**	
LAS Production Validation	**30 jours**	**03/04/2017**	**12/05/2017**	
LEM production (Preserie 6 LEMs)	20 jours	03/04/2017	28/04/2017	
LEM Preserie Tests	10 jours	01/05/2017	12/05/2017	64
LEM Production Validated	0 jour	12/05/2017	12/05/2017	65
12 LAS production	**20 jours**	**15/05/2017**	**09/06/2017**	
6 LEM Batch production	5 jours	15/05/2017	19/05/2017	66
6 LEM Batch production	5 jours	22/05/2017	26/05/2017	68
12 LAS Processing at Saclay	5 jours	29/05/2017	02/06/2017	68;69
12 LAS send to CERN	1 jour	05/06/2017	05/06/2017	70
12 LAS Assembly at CERN	4 jours	06/06/2017	09/06/2017	71
12 LAS production	**20 jours**	**29/05/2017**	**23/06/2017**	
12 LAS production	**20 jours**	**12/06/2017**	**07/07/2017**	
12 LAS production	**20 jours**	**26/06/2017**	**21/07/2017**	
12 LAS production	**20 jours**	**10/07/2017**	**04/08/2017**	
12 LAS production	**20 jours**	**24/07/2017**	**18/08/2017**	
12 LAS production	**20 jours**	**15/05/2017**	**09/06/2017**	
12 LAS production	**20 jours**	**29/05/2017**	**23/06/2017**	
12 LAS production	**20 jours**	**12/06/2017**	**07/07/2017**	
6 LEM Batch production	5 jours	12/06/2017	16/06/2017	111
6 LEM Batch production	5 jours	19/06/2017	23/06/2017	116
12 LAS Processing at Saclay	5 jours	26/06/2017	30/06/2017	116;117
12 LAS send to CERN	1 jour	03/07/2017	03/07/2017	118
12 LAS Assembly at CERN	4 jours	04/07/2017	07/07/2017	119
12 LAS production	**20 jours**	**26/06/2017**	**21/07/2017**	
12 LAS production	**20 jours**	**10/07/2017**	**04/08/2017**	
12 LAS production	**20 jours**	**24/07/2017**	**18/08/2017**	



Crucial items to be interleaved with the CRP mounting sequence in Bldg 185

The update may end up with more than 4 weeks delay (see Alain's talk)

Drift Cage Production and Installation

Version 15/03/2017

ETH **Drift cage assembly** WA10

test assembly in UTA:
mechanics:
24 modules, 6 per month, 2FTE 4 months may to September
Shipping dismounted modules mid-september
electronics:
PCB production + testing in cold, 1 FTE 4 months
->Shipping October

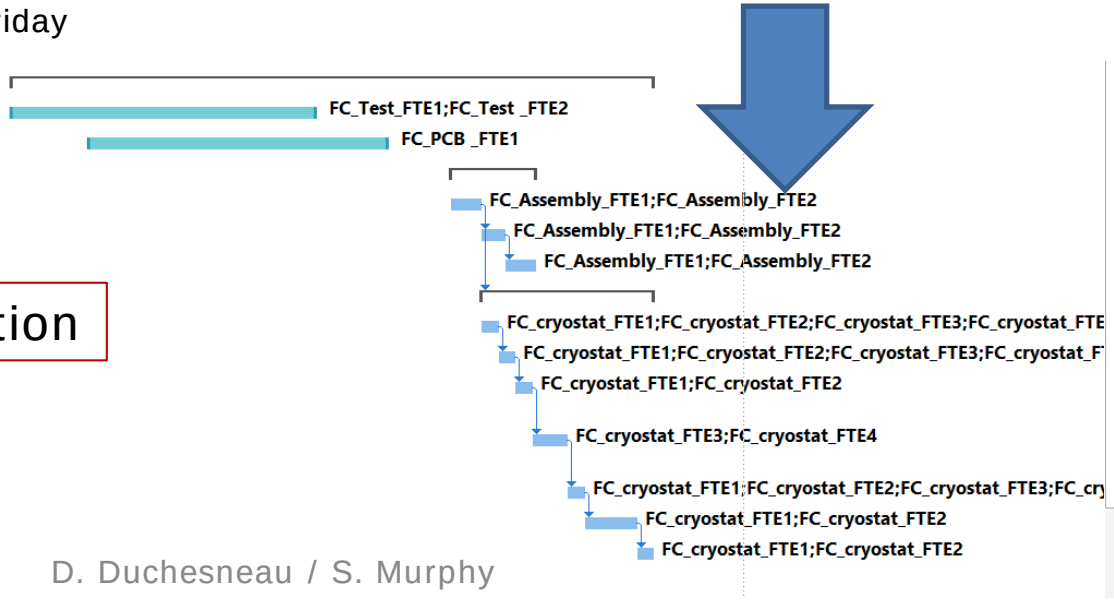
Assembly in CRB 2 FTE
1 module per day 2 FTE. 24 modules->**24 days with 2 FTE**

Installation in cryostat 4 FTE (can be parallelised with assembly in CRB)
bring inside, put in place hook and lift. 2 people bottom, 2 people top.
-1 week for lifting 8 submodules (1 row) 4 FTE
-1 week for lifting the next 8 submodules (2nd row) 4FTE
-1 week for fixing clips + contacting divider (2 scissor lifts with one person on each side drift cage) 2 FTE
-2 weeks to bring and install cathode + GND grid 4FTE?
-1 week for installing last row 4 FTE
-1 week for fixing clips + electronics on last row 4 FTE
-1 week HVFT + degraders 2 FTE?
-1 week beam plug 2 FTE?
=>Total installation in cryostat 9 weeks 4 FTE in average

Sebastien Murphy ETHZ 13

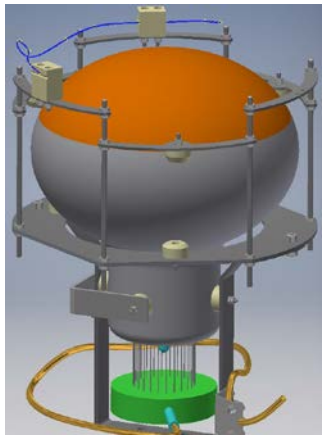
Drift Cage Production and Installation	**175,71 jours**	**01/05/2017**	**15/01/2018**
Mechanical Test assembly in UTA	89 jours	01/05/2017	31/08/2017
PCB production and testing in cold	87 jours	01/06/2017	29/09/2017
Assembly in CRB	**24 jours**	**25/10/2017**	**28/11/2017**
First 8 submodules	8 jours	25/10/2017	06/11/2017
Second 8 submodules	8 jours	06/11/2017	16/11/2017
Third 8 submodules	8 jours	16/11/2017	28/11/2017
Installation in cryostat	**40 jours**	**06/11/2017**	**15/01/2018**
Lifting First 8 submodules	5 jours	06/11/2017	13/11/2017
Lifting Second 8 submodules	5 jours	13/11/2017	20/11/2017
Fix clips and contacting dividers and reinforcements	5 jours	20/11/2017	27/11/2017
Bring and install cathode and GND grid	10 jours	27/11/2017	11/12/2017
Instal last 8 submodules	5 jours	11/12/2017	18/12/2017
Fix clips and electronics on last row	5 jours	18/12/2017	08/01/2018
HVFT and degraders	5 jours	08/01/2018	15/01/2018

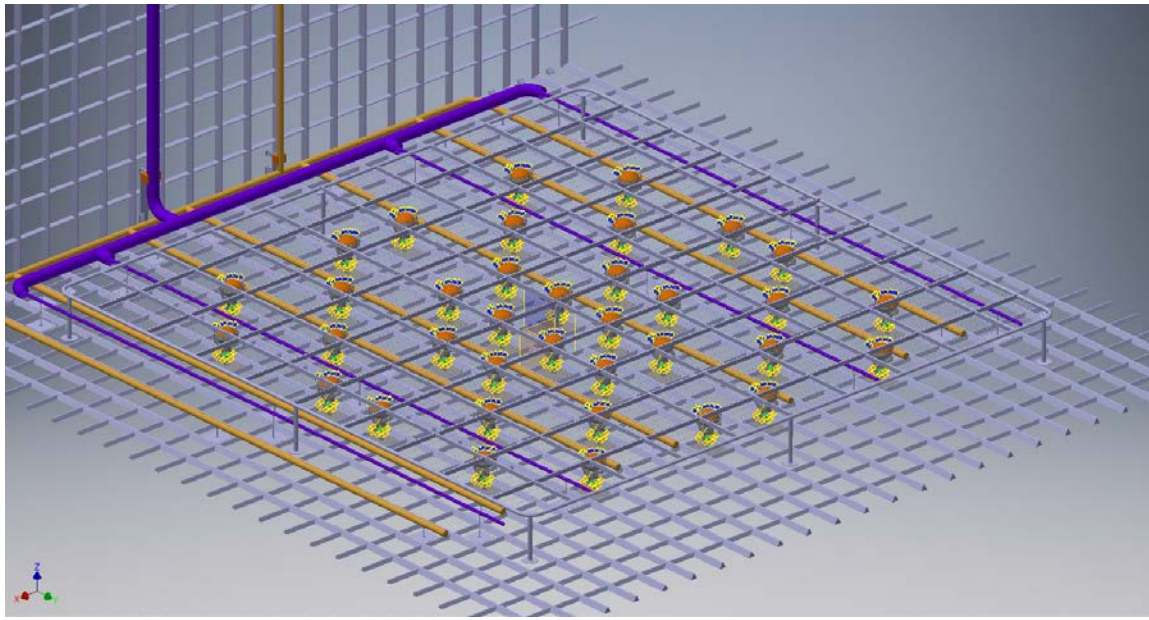
From Jae, Adamo and Sebastien last Friday



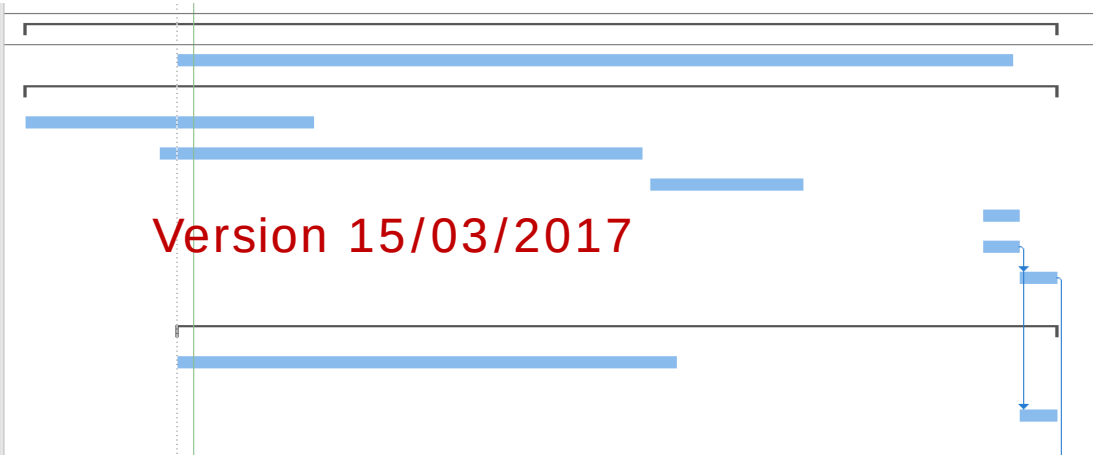
Example of work integration

Light Readout System





PMT and Light Read Out System	**270,71 jours?**	**09/01/2017**	**05/02/2018**	
LRO electronics	218 jours	08/03/2017	19/01/2018	
PMTs preparation and installation	**270,71 jours?**	**09/01/2017**	**05/02/2018**	
PMT base design and manufacturing	80 jours?	09/01/2017	28/04/2017	
PMTs characterization	132 jours?	01/03/2017	31/08/2017	
TPB coating	42 jours	04/09/2017	31/10/2017	
Splitter tests and installation	10 jours	08/01/2018	22/01/2018	188
PMT support structure	10 jours	08/01/2018	22/01/2018	188
PMT installation in cryostat and cabling	10 jours	22/01/2018	05/02/2018	201
Light calibration system	**228,71 jours**	**08/03/2017**	**05/02/2018**	
fibers, light source tests and procurement	136 jours	08/03/2017	13/09/2017	
Fiber calibration system installation	10 jours	22/01/2018	05/02/2018	201

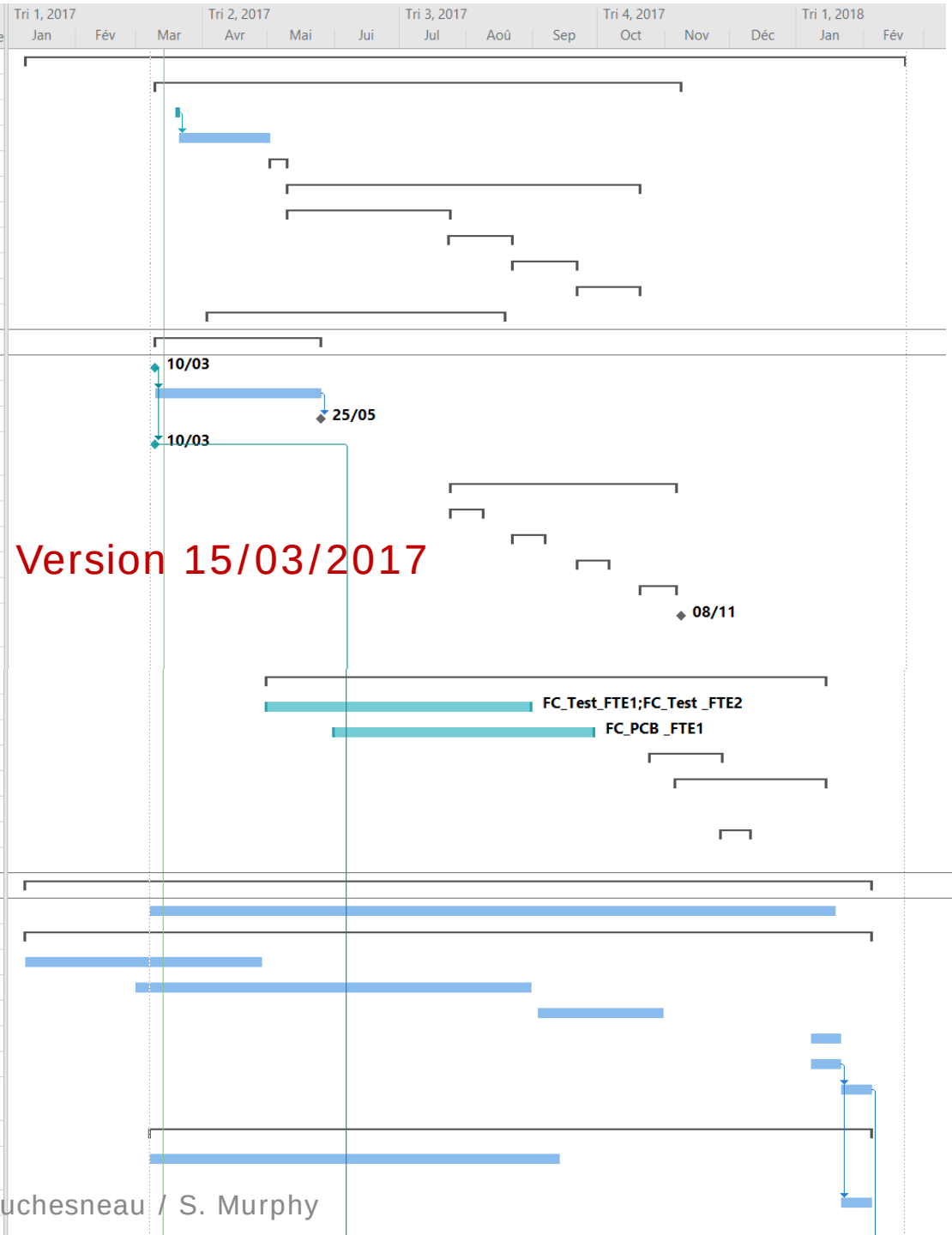


Meetings about LRO chaired by Inés during the last month: 23/2/17 and 6/03/17

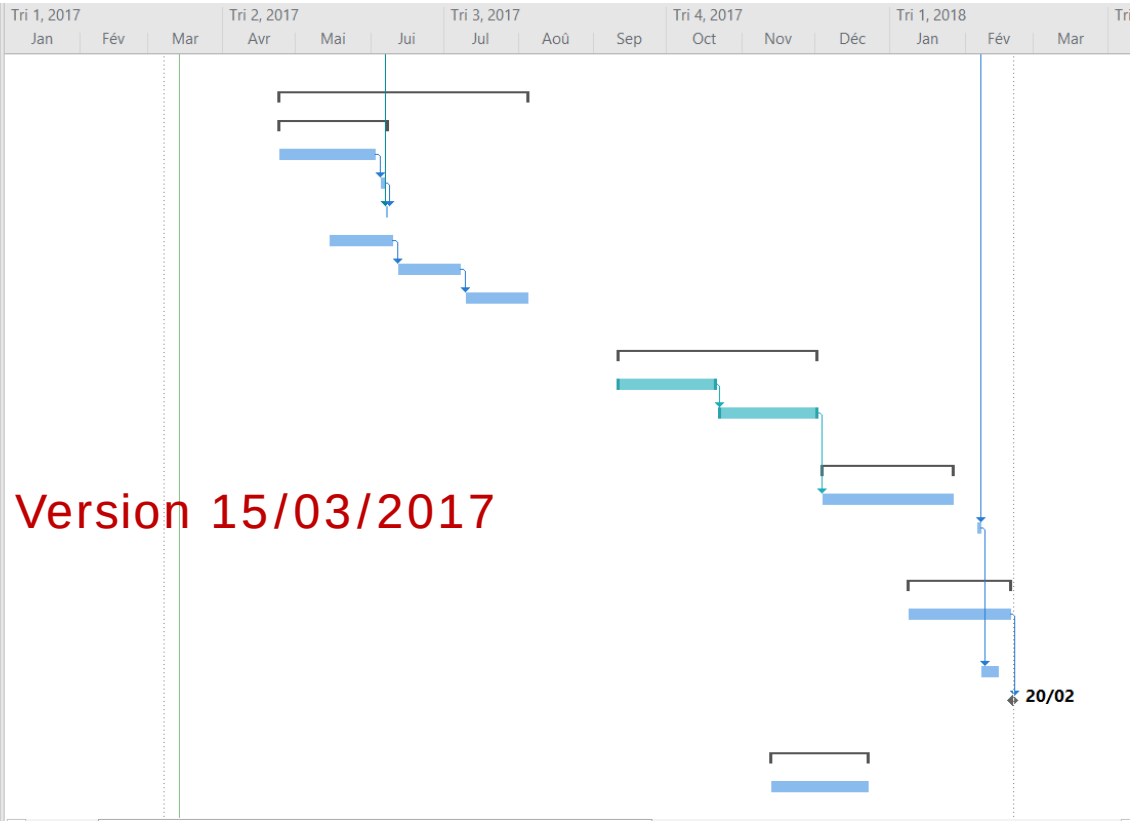
A mailing list has been set up: CENF-WA105-light-readout@cern.ch

Thank you

	Nom de la tâche	Durée	Début	Fin	Prédéce
1	**ProtoDUNE-DP**	**281,71 jours?**	**09/01/2017**	**20/02/2018**	
2	**CRP Production & Installation**	**173,71 jours**	**10/03/2017**	**08/11/2017**	
3	CR185 material order	1 jour	20/03/2017	20/03/2017	
4	Clean Room Material reception	30 jours	21/03/2017	01/05/2017	3
5	**CR185 preparation**	**6 jours**	**02/05/2017**	**09/05/2017**	
9	**CRP assembly in CR185**	**117,71 jours**	**10/05/2017**	**20/10/2017**	
10	**CRP #1**	**54 jours**	**10/05/2017**	**24/07/2017**	
23	**CRP #2**	**21,57 jours**	**24/07/2017**	**22/08/2017**	
36	**CRP #3**	**21,57 jours**	**22/08/2017**	**21/09/2017**	
49	**CRP #4**	**21,57 jours**	**21/09/2017**	**20/10/2017**	
62	**LAS Supply**	**100 jours**	**03/04/2017**	**18/08/2017**	
139	**Cryostat preparation**	**55 jours**	**10/03/2017**	**25/05/2017**	
140	Cryostat with penetrations is ready	0 jour	10/03/2017	10/03/2017	
141	CRB and insertion rail preparation	55 jours	10/03/2017	25/05/2017	140
142	CRB ready	0 jour	25/05/2017	25/05/2017	141
143	Cryostat is ready for CRP & SPFT installation	0 jour	10/03/2017	10/03/2017	140
144	**CRP installation in the cryostat**	**74,71 jours**	**25/07/2017**	**06/11/2017**	
145	**CRP #1 Installation in Cryostat**	**11 jours**	**25/07/2017**	**08/08/2017**	
152	**CRP #2 Installation in Cryostat**	**11 jours**	**22/08/2017**	**06/09/2017**	
159	**CRP #3 Installation in Cryostat**	**11 jours**	**21/09/2017**	**06/10/2017**	
166	**CRP #4 Installation in Cryostat**	**11 jours**	**20/10/2017**	**06/11/2017**	
173	CRP lateral position adjustment (warm conditions)	2 jours	06/11/2017	08/11/2017	172
174					
175	**Drift Cage Production and Installation**	**175,71 jours**	**01/05/2017**	**15/01/2018**	
176	Mechanical Test assembly in UTA	89 jours	01/05/2017	31/08/2017	
177	PCB production and testing in cold	87 jours	01/06/2017	29/09/2017	
178	**Assembly in CRB**	**24 jours**	**25/10/2017**	**28/11/2017**	**169**
182	**Installation in cryostat**	**40 jours**	**06/11/2017**	**15/01/2018**	**179**
190					
191	**HV system**	**10 jours**	**27/11/2017**	**11/12/2017**	
193					
194	**PMT and Light Read Out System**	**270,71 jours?**	**09/01/2017**	**05/02/2018**	
195	LRO electronics	218 jours	08/03/2017	19/01/2018	
196	**PMTs preparation and installation**	**270,71 jours?**	**09/01/2017**	**05/02/2018**	
197	PMT base design and manufacturing	80 jours?	09/01/2017	28/04/2017	
198	PMTs characterization	132 jours?	01/03/2017	31/08/2017	
199	TPB coating	42 jours	04/09/2017	31/10/2017	
200	Splitter tests and installation	10 jours	08/01/2018	22/01/2018	188
201	PMT support structure	10 jours	08/01/2018	22/01/2018	188
202	PMT installation in cryostat and cabling	10 jours	22/01/2018	05/02/2018	201
203	**Light calibration system**	**228,71 jours**	**08/03/2017**	**05/02/2018**	
204	fibers, light source tests and procurement	136 jours	08/03/2017	13/09/2017	
205	Fiber calibration system installation	10 jours	22/01/2018	05/02/2018	201
206					



	Nom de la tâche	Durée	Début	Fin	Prédéce
206					
207	**Chimneys and feedthroughs**	**75 jours**	**24/04/2017**	**04/08/2017**	
208	**SPFT Production & Installation**	**33 jours**	**24/04/2017**	**07/06/2017**	
209	SPFT production	30 jours	24/04/2017	02/06/2017	
210	SPFT Pre-Assembly	2 jours	05/06/2017	06/06/2017	209
211	SPFT Assembly on Cryostat Roof	1 jour	07/06/2017	07/06/2017	210;143
212	Signal Feedthrough SGFT	20 jours	15/05/2017	09/06/2017	
213	TANK_INST	20 jours	12/06/2017	07/07/2017	212
214	CRP_INST	20 jours	10/07/2017	04/08/2017	213
215					
216	**Front End electonics**	**60 jours**	**11/09/2017**	**01/12/2017**	
217	F/E electronics installation	30 jours	11/09/2017	20/10/2017	
218	microTCA installation	30 jours	23/10/2017	01/12/2017	217
219					
220	**Slow control**	**30 jours**	**04/12/2017**	**26/01/2018**	
221	cabling and testing	30 jours	04/12/2017	26/01/2018	218
222	Ground grid installation	2 jours	05/02/2018	07/02/2018	202
223					
224	**Purity monitor**	**30 jours**	**08/01/2018**	**19/02/2018**	
225	Installation	30 jours	08/01/2018	19/02/2018	188
226					
227	Beam plug installation	5 jours	07/02/2018	14/02/2018	222
228	Ready to seal TCO & cryostat	1 jour	19/02/2018	20/02/2018	225
229					
230	**Large Area Trigger Counters**	**30 jours**	**13/11/2017**	**22/12/2017**	
231	Installation	30 jours	13/11/2017	22/12/2017	



Update will be done regularly and ressources will be completed to follow the detector installation and construction