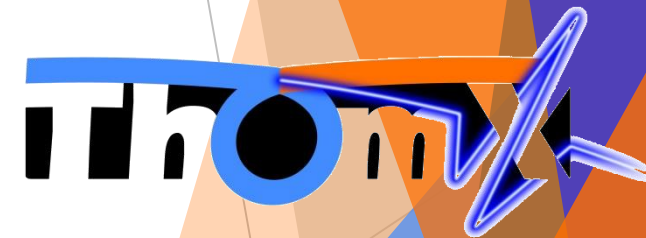


ThomX MAC 2018



H. Monard, 20 june 2018



MAC 2018

▶ Machine Advisory Committee of THOMX

- ▶ S. Schreiber (DESY)
- ▶ P. Raimondi (ESRF)
- ▶ D. Angal-Kalinin (Daresbury)
- ▶ A. Gallo (INFN)
- ▶ A. Variola (INFN)
- ▶ L. Nadolsky (SOLEIL)

What is expected :

- Comments on the first answer to MAC 2017
- Review of progresses, point out the bad/good of 2018
- International contacts with other labs for helping out the commissioning

Thanks to all collaborators for putting together the answers to MAC 2017

Critical issues identified 2017 - Program

A few critical issues have been identified and should be addressed with high priority:

- The proposed solution for synchronization is not typical and the need for the heterodyne techniques neither well motivated nor convincing the MAC members.
- Apart from the device server applications all the other aspects of the control system need to be aggressively developed. This may become a showstopper for the whole project.
- Full tracking simulations implemented with errors (alignment, field errors, etc.) should be worked out.
- A full table providing the tolerances of the stability and the sensitivity for different parameters should be provided.
- The emittance budget should be better defined and together with plans in order to optimize or upgrade the injector design in order to fit the design requirements.
- Process of the beam permit to be delivered by l'Autorité de Sureté Nucléaire (ASN— Nuclear Safety Authority) authorization for the machine operation seems critical and may induce delay in the project.
- A better integration of the X-ray beam line diagnostics as collision diagnostics for the Compton ring should be envisaged.
- A permanent magnet in the X-ray beam line would provide a complete safe operation mode against beam losses.
- We missed the presentations on the vacuum system, pulsed magnets, and of the machine protection system (MPS) that we think are critical items for the project.

Date	Time		Talk	Speaker	Duration
21/6	10:00	1	ThomX status	H. Monard	40
	10:40	2	Pulsed Elements	P. Alexandre	30
	11:10	3	Installation planning	D. Douillet	30
	11:40	4	Linac and Transfer Lines beam dynamics	H. Purwar	20
	12:00	5	Ring beam dynamics	A. Gamelin	20
	12:20		Lunch		60
	13:20	6	Control system status	P. Gauron	20
	13:20	7	High Level applications	H. Guler	20
	13:40	8	Commissioning Strategy and Planning	N. Delerue	30
	14:10	9	Vacuum status	F. Letellier-Coher	20
	14:30	10	High gradient cavity (PMB) status	M. El Khaldi	30
	15:00	11	Protection status (personnel, machine)	H. Bzyl + N. El Ka	40
22/6	15:40	12	Radioprotection	P. Robert	20
	16:00		Coffee break		30
	16:30		Closed session : MAC members		45
	17:15		Closed session : with sub-system responsible		40
	17:55		Visit to IGLEX		60
	18:55		Dinner		
	9:30	13	FP cavity status	F. Zomer	30
	10:00	14	X ray line	M. Jacquet	20
	10:20		Coffee break		10
	10:30		Closed session : MAC members		120
12:30		Lunch		60	
13:30		Closed session : with ThomX management		60	
14:30		Open session & discussion		60	

Program

Salle 101

Lunch : salle 101

Diner : Gramophone ~ 19h

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	14:30		Open session & discussion		60



Main events last MAC 2017

- ▶ COPIL, oct 2017, mai 2018
- ▶ Valorisation : oct 2017, mai 2018, SATT market study
- ▶ Annual meeting (with ANR) dec 2017, reporting to ANR march 2017
- ▶ RF source : operational
- ▶ Photocathode laser : operatinal (excpet CC)
- ▶ RF cavity prototype : 400 kW ! 10 s ...
- ▶ RF source ring cavity : 500 kW pdt 8h
- ▶ Integration of linac + TL + EL : except RF gun, vac. Chbers, valves
- ▶ Integration of ring : except vac. chbers, pulsed magnets
- ▶ Equipment X ray line for X hutch
- ▶ PSS+RP call for tender
- ▶
- ▶ Project Around Iglex : D3, D4, PRAE, (water building leaks)

Critical Issues

- ▶ Security engineer at LAL : new engineer since march 2018 (contractual)
- ▶ Pulsed Magnets : SigmaPhi
- ▶ Vacuum chambers : S Real Vacuum
- ▶ Acceleration section for 70 MeV : PMB collaboration : not working

- ▶ Global Delay of two years to handle

- ▶ futur of ThomX

Pulsed Magnets : $\sigma\phi$

- ▶ Soleil/LAL resp. : design, follow up
- ▶ Sigmaphi $\sigma\phi$: find subcontractor, fabrication, tests, training, documentation,...
- ▶ Call for tender without competition : 2 kickers + 1 septum (with pulsers)
- ▶ 565 k€ = 2 x [138 + 30] + 183 + 183
kick + vac chber septum + studies
- ▶ Start 24/03/2015 : delivery + 16 months : 24/07/2016
- ▶ Followed by DR4 of Gif/Yvette (rules of french public market)
- ▶ End of 2016 start 2017 : Soleil/LAL : urge $\sigma\phi$ to furnish fab drawing
- ▶ In sept 2017 : fabrication drawings still not ready !
- ▶ End of 2017 : harsh discussions with $\sigma\phi$: negotiation of contract
- ▶ 2018 : new planning

Pulsed Magnets : σφ

- La prolongation de la durée d'exécution du présent marché (article 4 du CCAP et article B5 de l'AE). La date de livraison du marché initialement prévu le 24/07/2016 est décalée jusqu'au 25/10/2018 pour la livraison des kickers et de leurs alimentations et au 06/11/2018 pour la livraison du Septum et son alimentation.
- De contractualiser la prise en compte des modifications des kickers d'injection et d'extraction : la division en deux parties de 100 mm, selon le plan 3D simplifié reçu le 2/1/18
- De contractualiser l'épaisseur de dépôt de titane ou de nitrure de titane pour la fourniture des chambres à vide selon votre FDR et nos remarques du 6/12/2017 : une épaisseur de 50 nm au centre et de 500 nm aux extrémités
- La prise en compte de votre devis B709/2564-2 du 24/01/2018 relative à la modification de 2 Kickers pour 54 000.00 € HT

Pulsed Magnets status

SEPTUM

- fabrication going on : SDMS chber october 2018, assembly nov. Delivery in DEC 2018
- Vacuum parts to send for mounting at SigmaPhi ,help needed for UHV tests
- UHV tests @SOLEIL : will participate to time saving
- electric & magnétic tests : done at SOLEIL : time saving
- Pulser : SigmaPhi has final spécifications. Pulser tested on charge **before** magnet ready

KICKERS

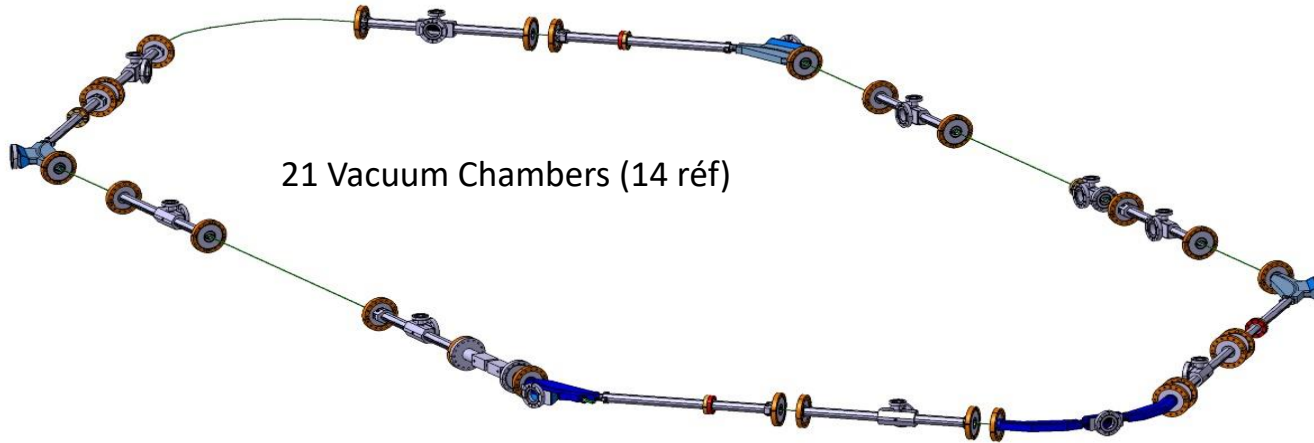
- validation of fabrication drawings for ferrites (Ceramic Magnetics) ; delivery sept. 2018
- SigmaPhi drawing **validation**
- Assembly at SOLEIL : time saving with LAL help
- Kicker magnets : nov 2018 (tests with proto pulsors)
- Vacuum chbers : KYOCERA still discussing : risk for delivery planning
- In // NTG discussion: plan B for Kyocera
- Switch board : fabrication going on , delivery in october 2018

- Note : cabling on site Iglex (july)

Still risk for date delivery. Actions to be taken to keep pressure.

SigmaPhi difficulties to handle the project : manpower, technically

Vacuum chambers : Rial Vacuum



21 chambers in 3 batches
Batch 1 : ok : at LAL

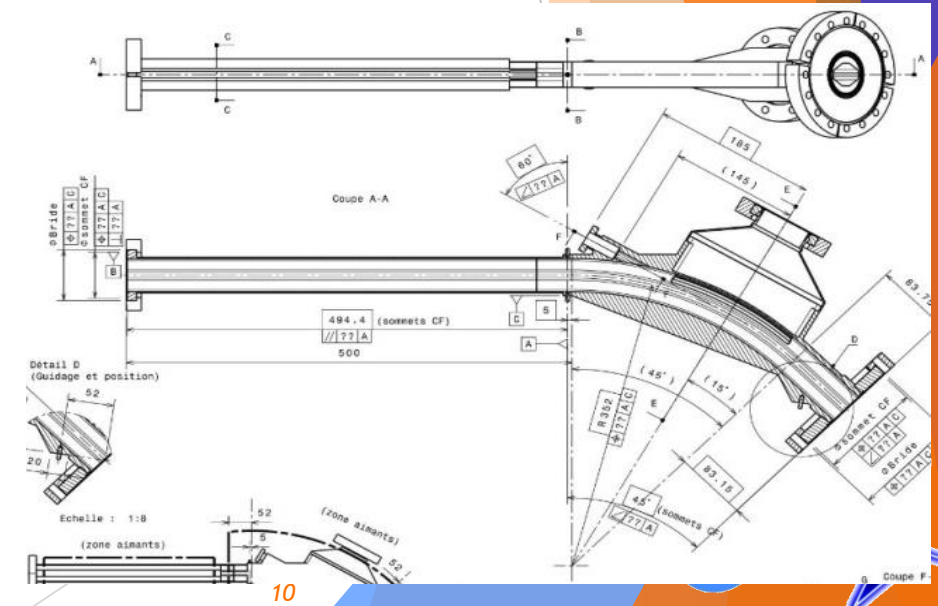
Batch 2 : 1 leak to repair
> baking to start

Batch 3 : delivery postponed to sept 2018

done at LAL :

- Dimensional control (before/after baking)
- baking

R.V. able to handle technically but delays not mastered
Initialy : oct 2017, then june 2018 (last contract)



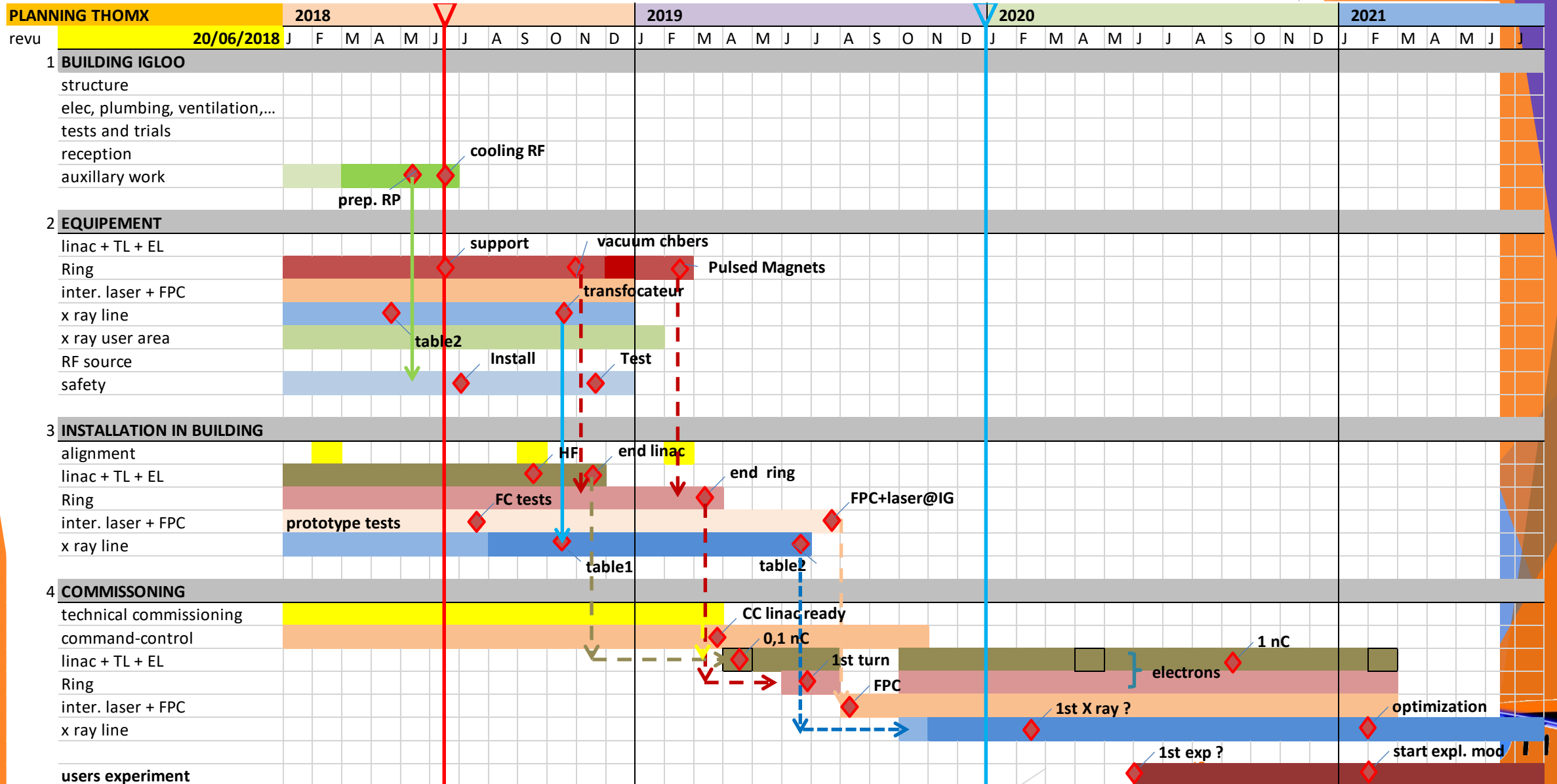
Acceleration section for 70 MeV

- Recall : commissioning will start with LIL section lended by SOLEIL for 50 MeV
- PMB : fabrication of acceleration section for 70 MeV (>30MV/m, PhD ended in 2017)
- STOP collaboration avec PMB
We estimate that PMB will not be able to furnish the section

Plan B :

- Buy « on shelf » acceleration section to R.I. to ensure 50 MeV ~ 100 k€ (benefit call for tender [PRAE](#)). Mid term ~ 2 ans (2020)
- Cu Prototype (LAL) + collaboration PSI+Elettra for 70 MeV long term ~ 4 ans (2022) ~ 200 k€ ?
- Ask SOLEIL a longer period for using LIL section : + 2 ans
- More details by M. EL Khaldi

Planning : delay ~ 2 years



Ask for delay to ANR : +2 years

- ▶ +2 y : T1 & T2 : 2019 → 2021
- ▶ T1 = 10 M €, 5% of flexibility without demand
- ▶ Flexibility to 10% : demand sended in may

besoins en plus								
	destination		coût tot (k€)	coût (/mois)	durée (mois)	niveau		resp
CDD	caracterisation RX		91,2	4,8	19	post doc	ch	M Jacquet, JL Hazeman
	caracterisation linac		48	4	12	post doc	ch	C Bruni
	câblage interne baies		13,5	2,7	5	tech	T	P Cornebise
	adjoint chef projet/suivi		104,5	5,5	19	ing	IR	H Monard
	cavite FP - laser		40	4	10	post doc	ch	F Zomer
	technicien plateforme ThomX		54	3	18	tech	T	M Omeich
	post doc manip X		57,6	4,8	12	post doc	ch	P Walter, C Dejoie
	autre	mission		40				
	transports		50			SMI		
	total		498,8 k€					
	passer de 5 % à		10,0%					

- ▶ No answer form ANR yet

Coordination Mission OPC

- ▶ integration help : planning, co-activity, external compagny ..
DAHER : rehabilitation of building
- ▶ Phase 1 :
expected : planning, inventory, reception cond. of sub-systems
- ▶ Phase 2 : integration follow up, co-activity handling, security,...
- ▶ Phase 3 : sub-system reception, reservations withdraw, documentation
- ▶ Duration ~ 1 y → start of commissioning
- ▶ Note : ANDROMEDE integration

Example : LIL section

- Inside bunker
- Aligned
- Undervacuum
- RF connection
- Cooling system connection
- ...

Budget

	EQUIPEMENT	AUTRES DEPENSES	FACTURES INTERNES	PERSONNEL	TOTAL
	9 328 870,00	399 030,00	0,00	272 100,00	10 000 000,00

Facturé et engagé à ce jour T1 :

au 6-6-2018

	EQUIPEMENT	AUTRES DEPENSES	FACTURES INTERNES	PERSONNEL	TOTAL	
2011	0,00	0,00	0,00	0,00	0,00	
2012	132 919,60	70 950,25	16 496,17	0,00	220 366,02	* montants payés pris sur justif 2012
2013	135 155,56	127 503,54	16 690,11	60 608,28	339 957,49	* montants payés pris sur justif 2013
2014	404 627,70	116 873,98	32 191,49	77 942,24	631 635,41	* montants payés pris sur justif 2014
2015	961 641,67	129 569,46	23 994,90	40 935,72	1 156 141,75	* montants payés pris sur justif 2015
2016	1 102 276,77	242 984,05	38 459,51	50 081,58	1 433 801,91	* montants payés pris sur justif 2016
2017	2 010 952,98	216 440,87	60 767,59	32 044,62	2 320 206,06	* montants payés pris sur justif 2017
2018	337 712,99	11 747,32	2 144,12	2 567,97	354 172,40	facturé actuel
engagé non soldé	2 085 331,54	2 460,25	46 315,81		2 134 107,60	engagé sur origine
TOTAL	7 170 618,81	918 529,72	237 059,70	264 180,41	8 590 388,64	

RESTE SUR T1

1 409 611,36 au 06/06/2018



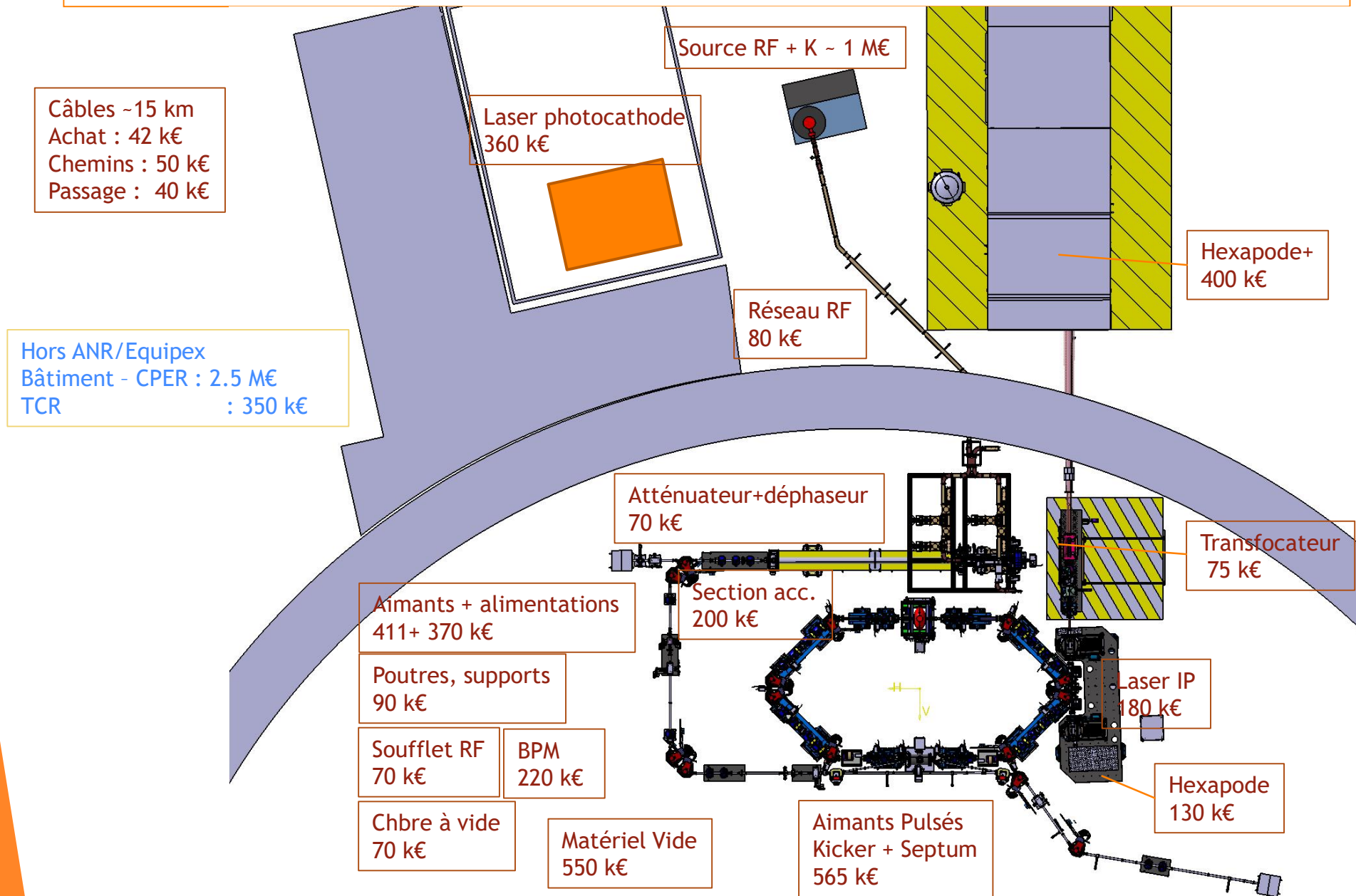
Budget

POINT THOMX SUR T2					
Date de fin de la T2 : 31/12/2019					
	EQUIPEMENT	AUTRES DEPENSES	PRESTAT° DE SERVICE EXTERNE	PERSONNEL	TOTAL
Prévu au contrat par Alessandro	586 040,00	902 037,00	435 000,00	0,00	1 923 077,00
Montant DR4 frais gestion déduits	568 966,38	902 037,00	435 000,00	0,00	1 906 003,38
montant pris en compte					
VU DR4 LE 24/3/15 NOUVEAUX MONTANTS ! Réajustement fait selon montants ci-dessous :					
1 994 243,52 - frais de gestion 4% soit 88 240,14 = 1 906 003,38 (voir fichier DR4 sur le 3ème onglet)					
La différence entre les prévisions d'Alessandro et le montant DR4 est de : 17 073,62					
En accord avec Agnès le 1/04/2015, j'ai déduit la totalité de ce montant du poste "équipement" pour notre suivi.					
Facturé et engagé à ce jour T2:					
au 6-6-2018					
	EQUIPEMENT	AUTRES DEPENSES	PRESTAT° DE SERVICE EXTERNE	MISSION	TOTAL
2014	0,00	60 216,29	0,00	0,00	60 216,29
* montants payés pris sur justificatif 2014					
2015	0,00	12 961,57	0,00	0,00	12 961,57
* montants payés pris sur justificatif 2015					
2016	0,00	11 520,00	12 000,00	0,00	23 520,00
* montants payés pris sur justificatif 2016					
2017	102 003,34	46 145,75	17 808,41	0,00	165 957,50
* montants payés pris sur justificatif 2017					
2018	235 705,34	25 251,20	14 310,34		275 266,88
* montants payés à ce jour					
engagé non soldé	110 567,83	56 216,11	33 620,50	5 263,20	205 667,64
TOTAL	448 276,51	212 310,92	77 739,25	5 263,20	743 589,88

RESTE SUR T2

1 162 413,50

Achats/Approvisionnement : localisation des équipements des marchés



Handing over : Soleil → LAL

Sous-système	SOLEIL	LAL	Status	Commentaires
Linac	JP. Pollina	M. Omeich	90%	M. Omeich est responsable du linac depuis 23/4/18 JP. Pollina reste en appui pour le commissioning
Alignement	A. Lestrade	D. Douillet	100%	équipe alignement LAL opérationnelle après pré-alignement et alignement final de l'ANS prévu en commun SOLEIL-LAL
Aimants	F. Marteau	C. vallérand	90%	Tests sur site IGLEX à faire
Alimentations	Y. Dietrich	T. Chabaud	50%	Explication à M. Omeich (T Chabaud?) du fonctionnement des alims de correcteurs, de quadrupôles, de sextupôles : A SOLEIL en 2016 Explication du fonctionnement des devices alims à P. Gauron : A SOLEIL en 2016 Reste formation sur les alims de dipôles + alims des bobines du canon
Aimants pulsés	P. Alexandre	M. Omeich	10%	Aimants en cours de fabrication, documents techniques (specs) fournis à Maher en installation & commissioning dans ThomX (avec le concours de Maher) prévu actuel décembre 2018 / janvier 2019 puis passage de témoin en février 2019
RF anneau				
Ampli RF	P. Marchand	M. El Khaldi	90%	montage et Tests sur site IGLEX à faire
Cavite anneau	P. Marchand	M. El Khaldi	90%	montage et Tests sur site IGLEX à faire
Cooling rack	P. Marchand	M. El Khaldi	90%	montage et Tests sur site IGLEX à faire
Diagnostics				
Stations diags	N Hubert	N. Delerue	100%	
cerenkov et RS vers Streak	M. Labat	V. Soskov	30%	Utilisation de la streak OK, reste le transfert de connaissance sur la ligne de transpo
BPM	N Hubert	N. Delerue	30%	
ICT	N Hubert	V. Chaumat	20%	
Faraday cups	N Hubert	?	0%	
FBT	R. Sreedharan	M. El Khaldi, F. Wicek	0%	
Dynamique faisceau	A. Loulergue	C Bruni	100%	
		I. Chaikovska, N. Delerue	90%	AL reste en appuis pour le commissioning

X ray line : Institut NEEL → LAL

Future : Action Plan ask by ANR

Compte tenu des recommandations émises par le sous-jury, et à la demande du Comité de pilotage de l'action Equipex, il vous est demandé un plan d'action explicitant les points suivants :

- les modalités pratiques de préparation de la pérennisation financière de l'Equipex (notamment l'estimation du budget nécessaire, les ressources disponibles connues à ce jour, les actions concrètes menées/prévues pour lever d'autres fonds),
- l'ouverture à la communauté scientifique, et plus particulièrement, le développement de collaborations avec l'industrie.

Pérennisation financière

- Demande report des 2 tranches T1 et T2 : + 2 ans (2021)
- demande financement fonctionnement : 400 k€/an à faire pour 2020 (ou 2022 si demande acceptée)
- **Local** : UPS , P2i, **national** : Plateforme in2p3 ? ALCOV ? ...
International : action R&D source compton ? Autres ...
- Question du mode de fonctionnement : Depacc = étape démonstration, mode exploitation ? Modèle de gestion ? Autres instituts ?

Action Plan

- ***Scientifique community***

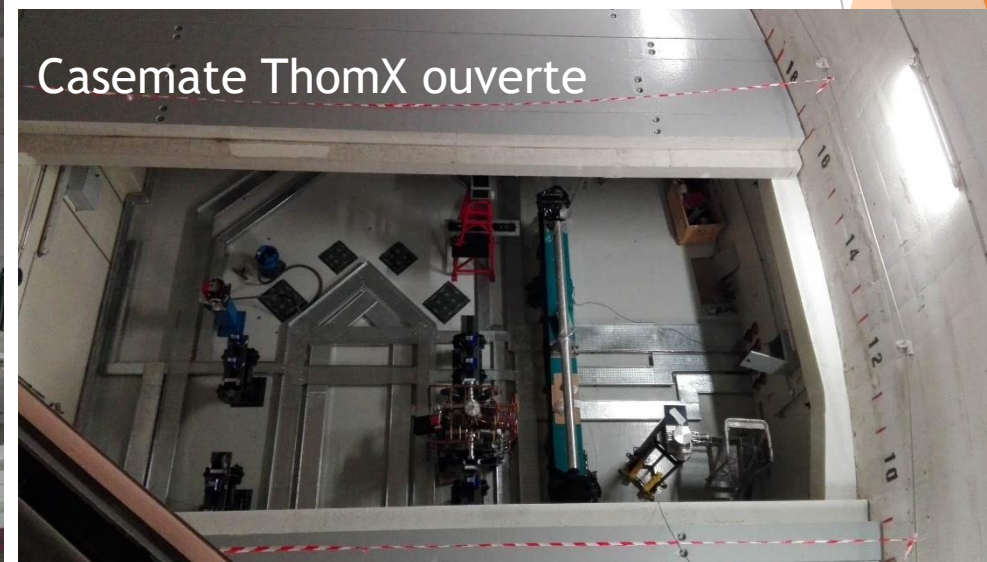
- 1st exp. Within ThomX consortium (LAMS, ESRF): demonstration
- Increase ThomX visibility : 1ere exp., conferences, workshop
- Contact users : AFURS ; French organization of Synchrotron and XFEL Radiation Users).
- Local Contact : UPS
- Other institutes : Institut Curie, ...
- PhD on both ESRF (ou Soleil) & ThomX
- Users comity will gather in january 2019 (A. Bravin)

- Note : visit of X ray Lyncean machine in Munich (10/07)

Action Plan

- **Industry**
 - ThomX industrialisation : ThXi → SATT, Thalès
 - > SATT market study
 - > SATT contacts with radiotherapy market actors
 - > ThXi estimation cost with Thalès

Integration Today



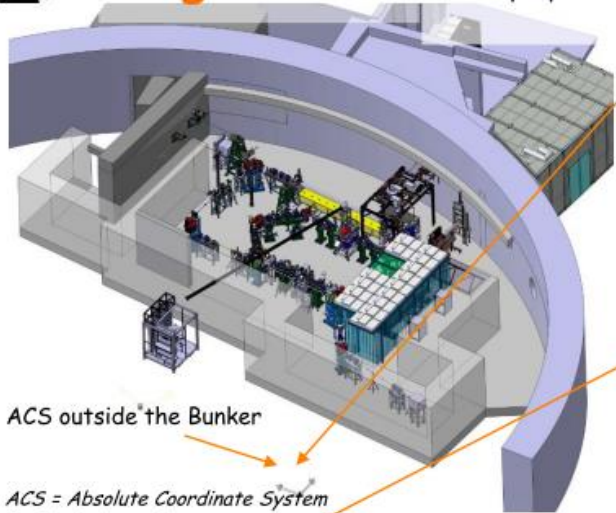


Fixation « semelles »



Alignment

Very 1st step : 11/2016, purchase of the AT930 Laser Tracker from HEXAGON METROLOGY
 6 LAL people from DO & Workshop trained by HM and SOLEIL Alignment Group
 (Thanks to A.Lestrades and M.Ros)



- Step 1 : before construction of the walls, several targets sealed to the ground in the area of the machine, targets fully described in the ACS
- Step 2 : Once the bunker built, 8 targets glued on the bunker walls to establish a network. These 8 targets are connected to the 1st ground targets and to the ACS (not visible anymore)
 => The 8 final targets are fully described X,Y,Z in the ACS
- Step 3 : survey of the 8 targets in the bunker and localization of the tracker in the ACS.
 4 targets were bonded in the X hutch
- Step 4 : permanent marks on the principals axis of the machine and adjustment frames in order to adjust plates (bonded) with the tracker for components of the storage ring, transfer and extraction line and Optical cavity



SOLEIL's targets (gift from Ros & Lestrades)



LAL Alignment Group : A.Thiebault, A.Gallas, R.Marie, B.Leluan, O.Vitez,D.Douillet

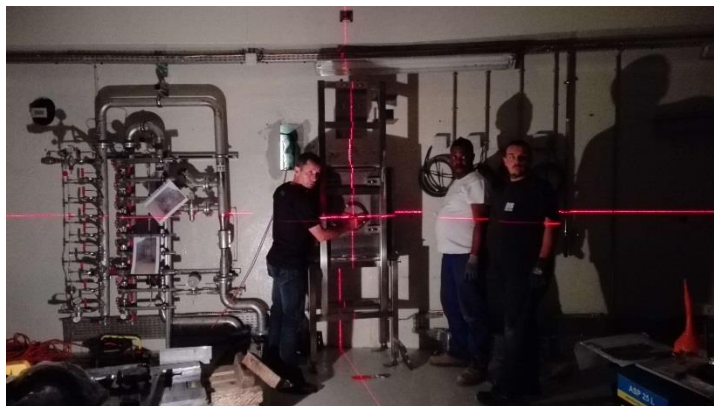


Bonding of the Steel plates on the bunker ground

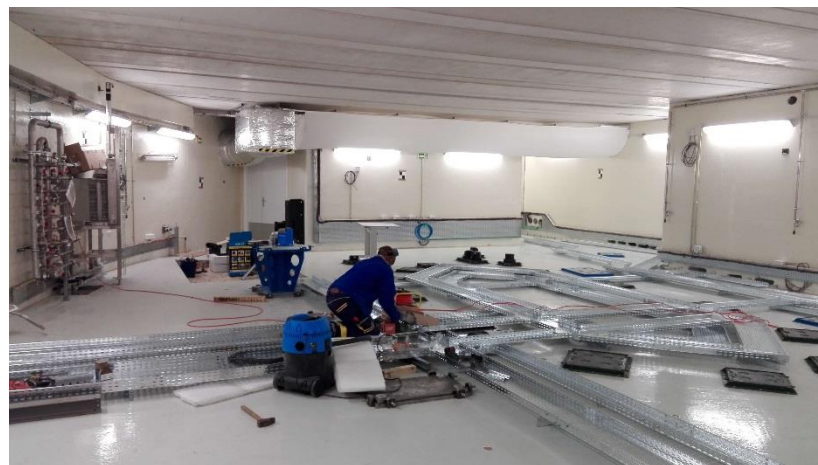




RX Beam shutter

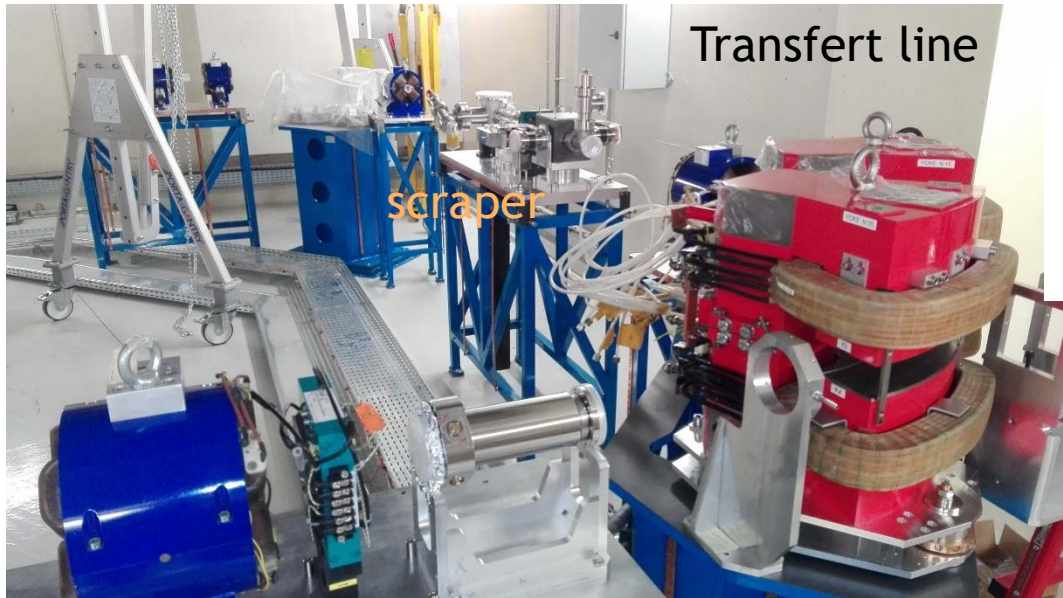


Chemins de câble

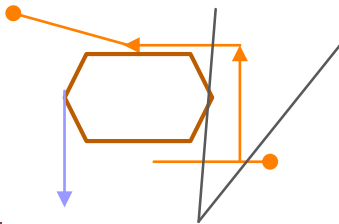


June 2018

Transfert line



scraper

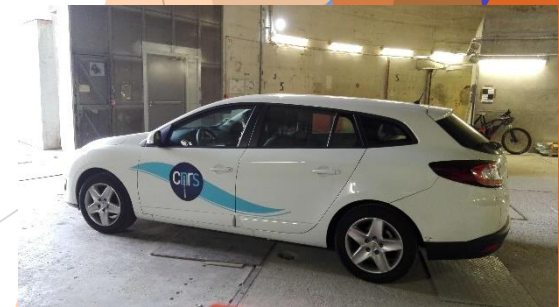


Ring

LIL section

RF cavity





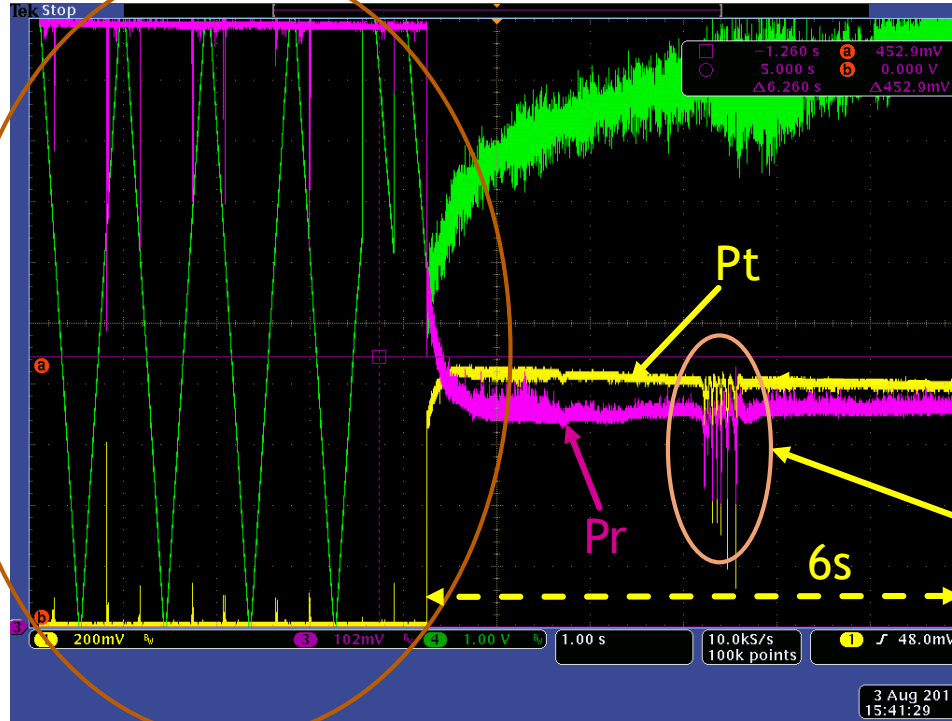
Cavité FP : (proto)
Record à 390 kW juillet 2017



$P_o = P_a \cdot \text{gain} \cdot \text{couplage}$
Gain ~ 15380
Finesse ~ 25000
Cpl ~ 65%
 $P_a \sim 40 \text{ W}$

 $P_o \sim 390 \text{ kW}$

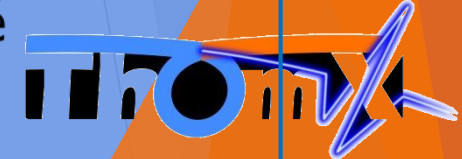
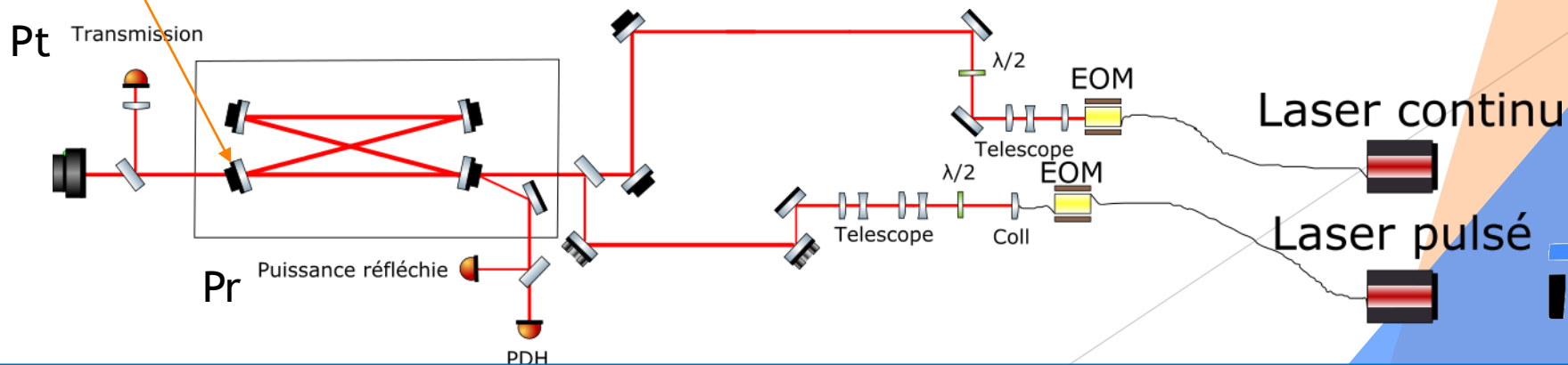
$P_t = P_o \cdot T$ $P_t = 1,12 \text{ W}$
 $P_o = P_t / T$ $T = 2,85 \text{ ppm}$
(à travers miroir) } $P_o = 393 \text{ kW}$



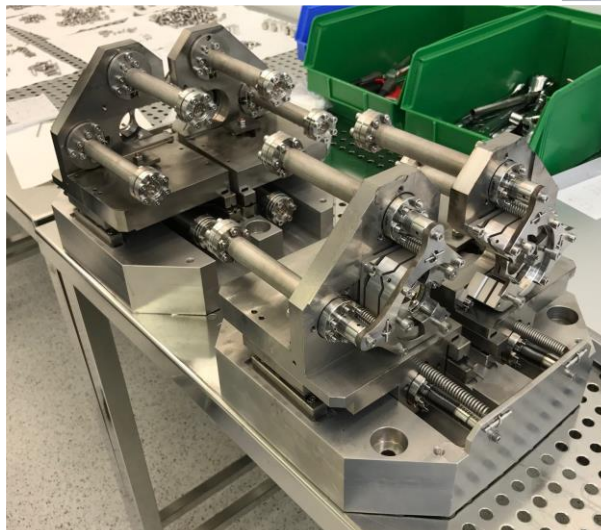
Cavité non lockée
Pr max, Pt nulle

Cavité lockée

Cavité prototype



ThomX final cavity ready for testing (july 2018)



19/12/2017

Conclusion

- ThomX project is progressing thanks to all collaborators

Critical issues

- Pulsed magnets still to be watched over closely
 - Spare acceleration section at least 50 MeV
(comissioning possible with LIL section up to 2020)
 - End on installation : april 2019
 - Comissioning start : april 2019 ?
-
- Future of THomX ?
 - DEPACC mission : demonstrator phase
 - Industrial version ?