LINAC3 UPGRADE ECR

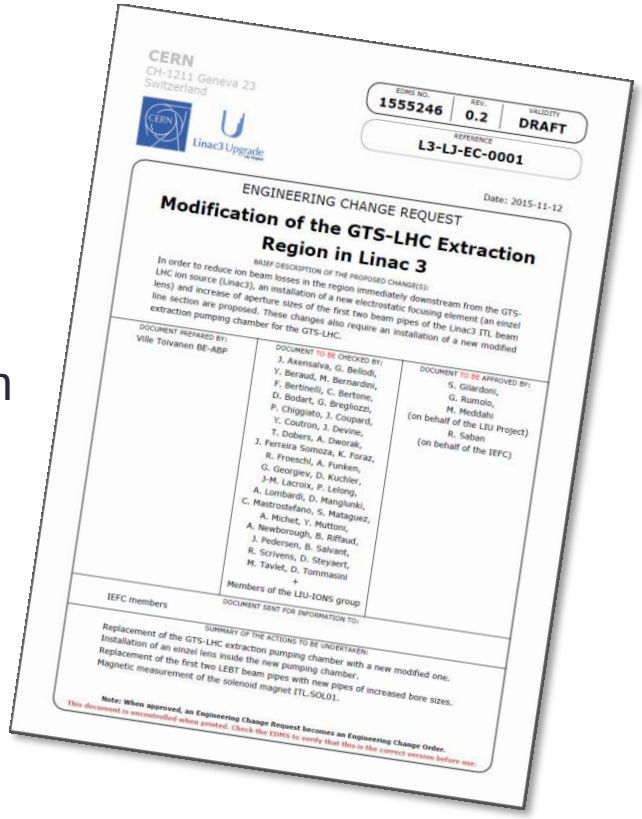
Modification of the GTS-LHC ion source extraction region in Linac3

3/12/2015

Ville Toivanen

Introduction

- Linac3 upgrade motivation and goals
  - Mitigate the beam losses taking place immediately downstream from the ion source
  - Improve ion source tuning flexibility by decoupling ion production and beam transport in the extraction region
- Implementation
  - Relax aperture restrictions in the beginning of the Linac3 ITL beam line (low energy beam transport)
  - Install a new focusing element, an einzel lens, downstream from the existing GTS-LHC extraction electrodes
- Linac3 upgrade ECR references
  - **LIU-IONS ECR L3-LJ-EC-0001**
  - **EDMS 1555246**



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EDMS NO. 1555246 | REV. 0.2 | VALIDITY DRAFT
REFERENCE L3-LJ-EC-0001

ENGINEERING CHANGE REQUEST

Date: 2015-11-12

Modification of the GTS-LHC Extraction Region in Linac 3

BRIEF DESCRIPTION OF THE PROPOSED CHANGE(S):

In order to reduce ion beam losses in the region immediately downstream from the GTS-LHC ion source (Linac3), an installation of a new electrostatic focusing element (an einzel lens) and increase of aperture sizes of the first two beam pipes of the Linac3 ITL beam line section are proposed. These changes also require an installation of a new modified extraction pumping chamber for the GTS-LHC.

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R. Saban (on behalf of the IEFC)

IEFC members

DOCUMENT SENT FOR INFORMATION TO:

SUMMARY OF THE ACTIONS TO BE UNDERTAKEN:

Replacement of the GTS-LHC extraction pumping chamber with a new modified one.
Installation of an einzel lens inside the new pumping chamber.
Replacement of the first two LEBT beam pipes with new pipes of increased bore sizes.
Magnetic measurement of the solenoid magnet ITL.SOL01.

Note: When approved, an Engineering Change Request becomes an Engineering Change Order.
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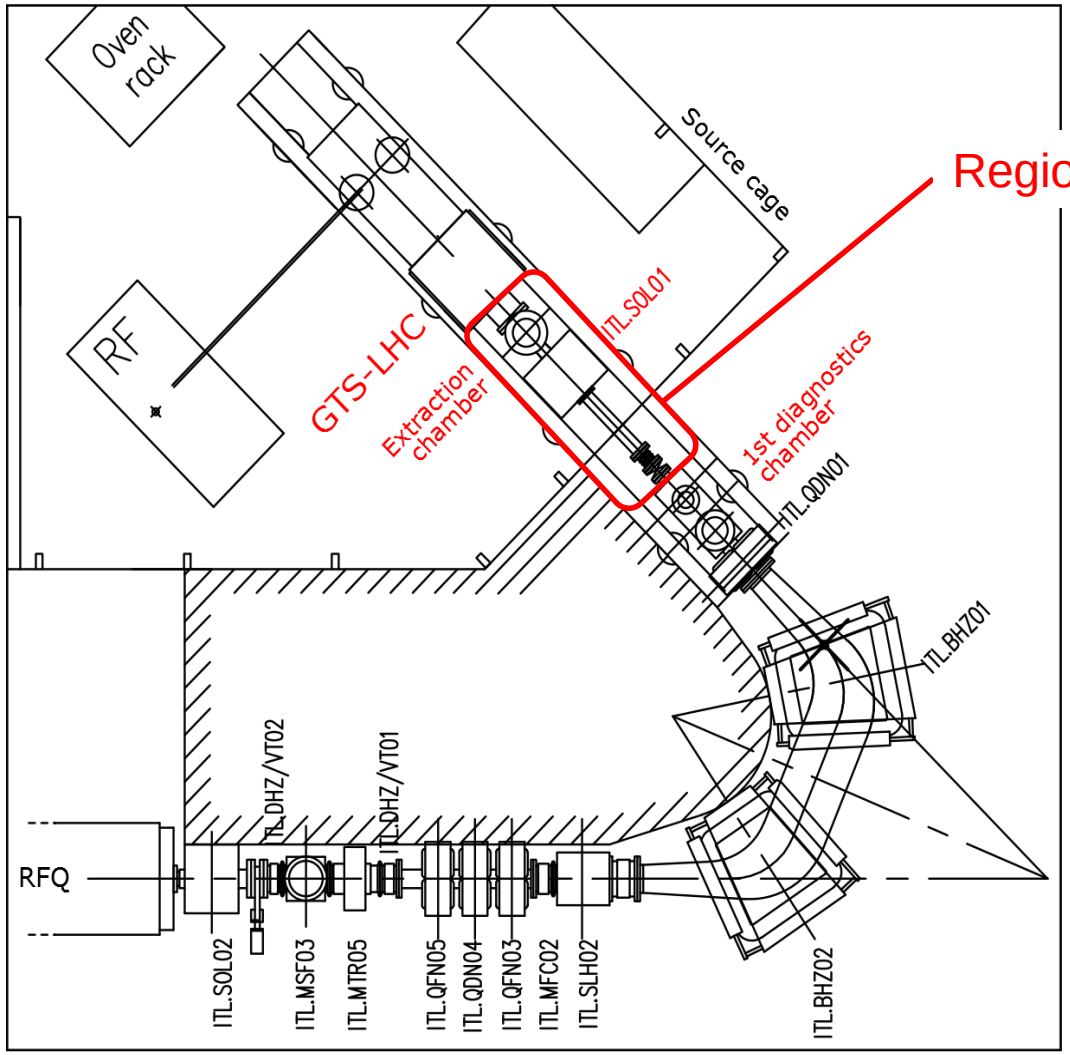
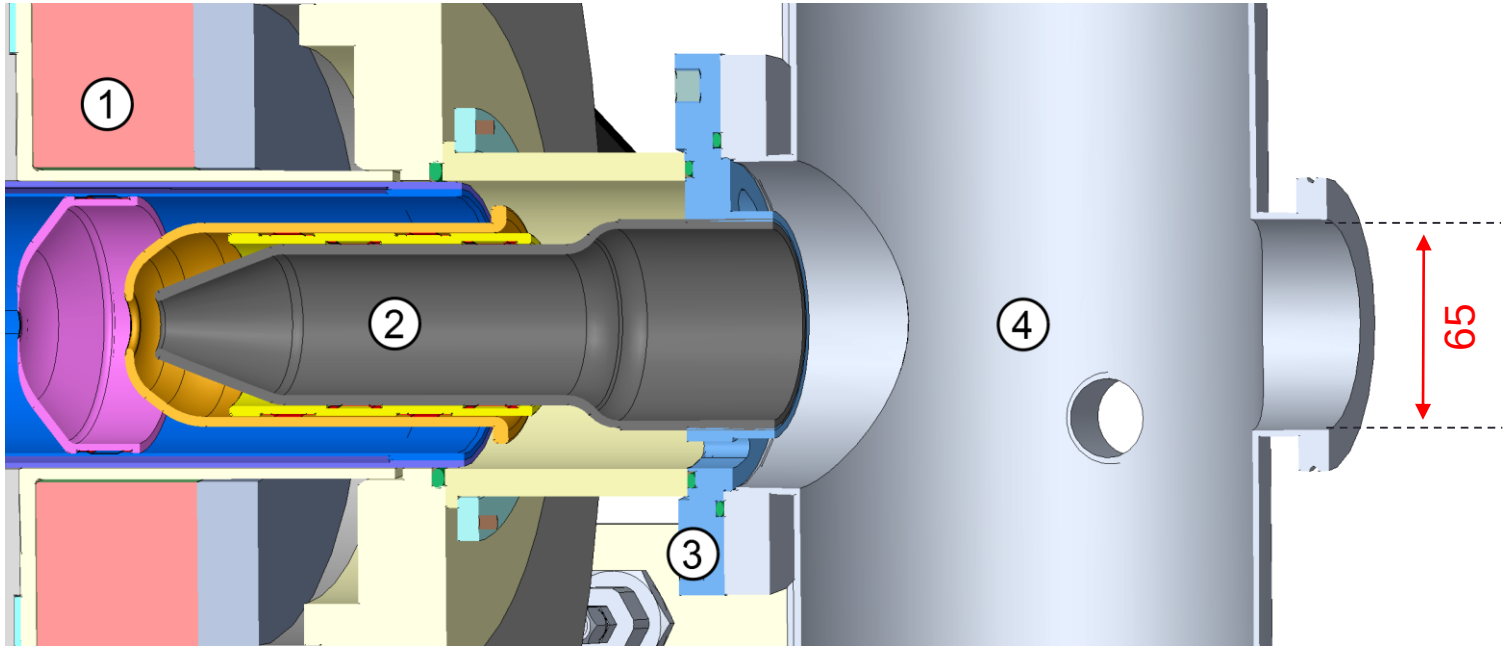
Linac3 ion source and ITL beam line



Region of interest

- GTS-LHC beam extraction system
- Extraction chamber + einzel lens
- 1st ITL beam pipe through ITL.SOL01
- 2nd ITL beam pipe with bellows
- Gate valve ITL.VVS10

Existing GTS-LHC extraction region

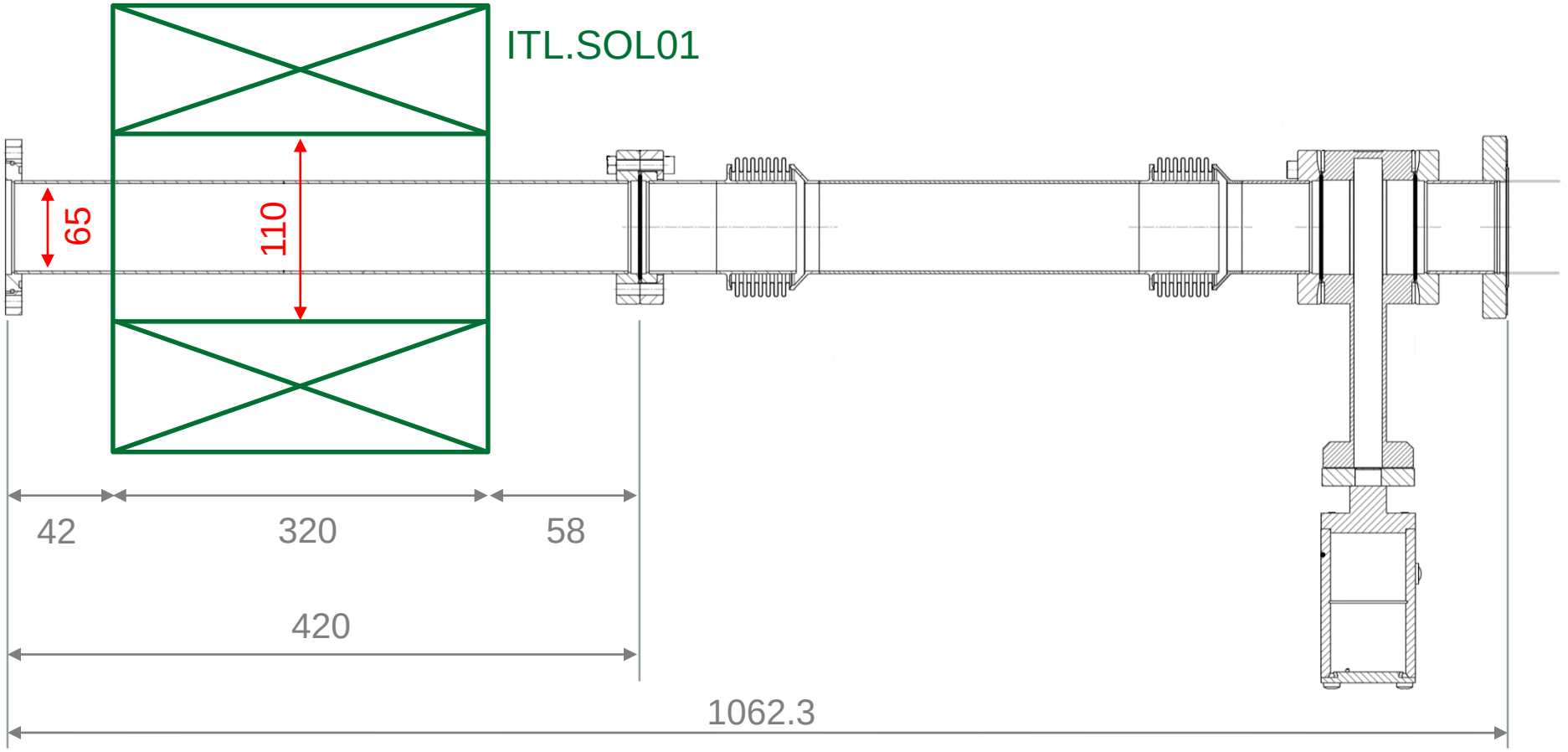


(1) Ion source body
(2) Extraction electrodes
(3) Fixing point (flange) for extraction electrodes
(4) Extraction chamber

Existing ITL section through ITL.SOL01

Ion source
extraction chamber

1st diagnostics chamber
and spectrometer



Ref.: LICLM___0231 (First pipe incorrect, should be LICLM___0245)

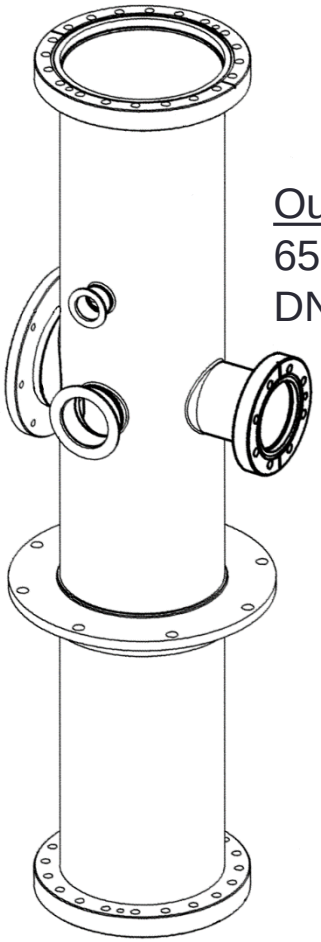
LINAC3 MODIFICATIONS

New extraction chamber

Existing chamber

Input port:
100 mm ID
ISO-F DN100

Output port:
65 mm ID
DN63CF

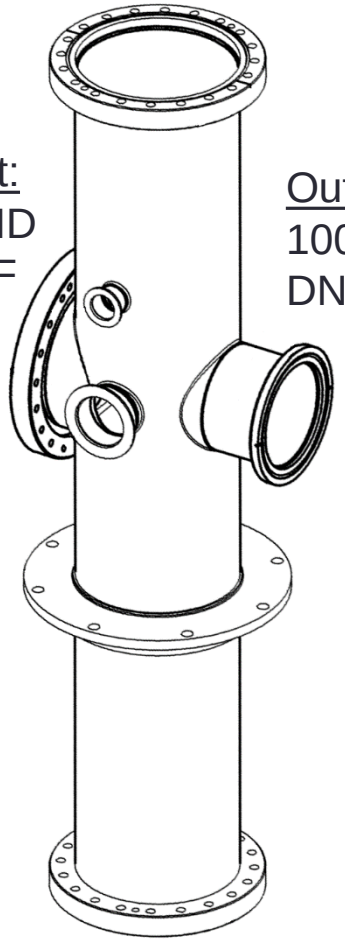


MASS: ~17 kg

New modified design

Input port:
138 mm ID
DN150CF

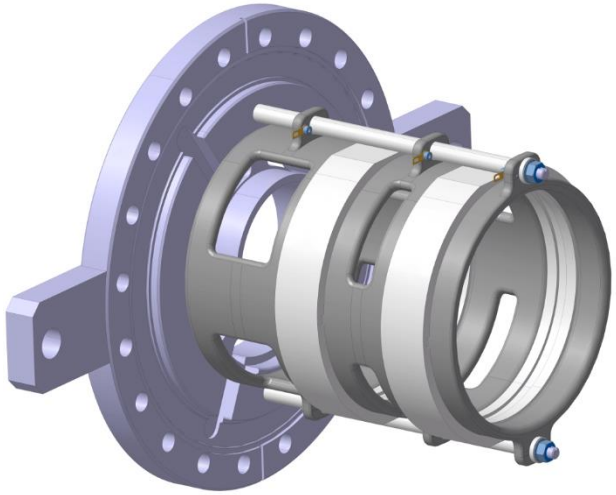
Output port:
100 mm ID
DN100 Quick CF

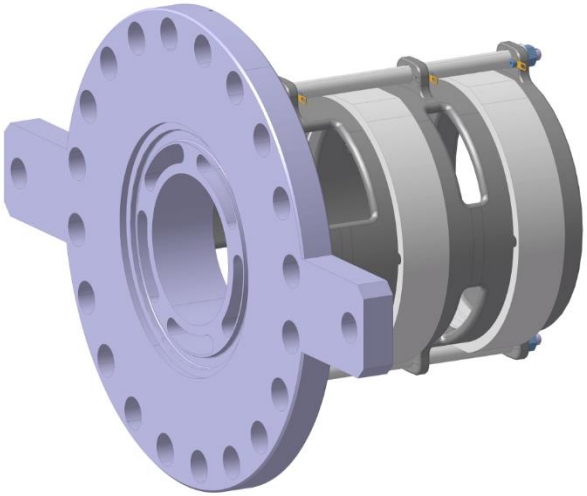


MASS : ~22 kg

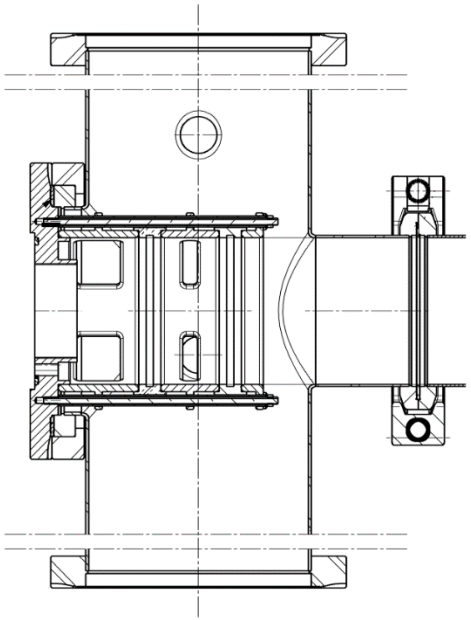
New einzel lens

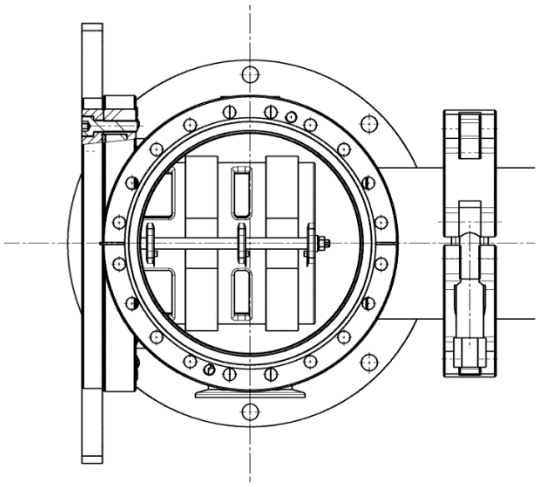
New stainless steel flange



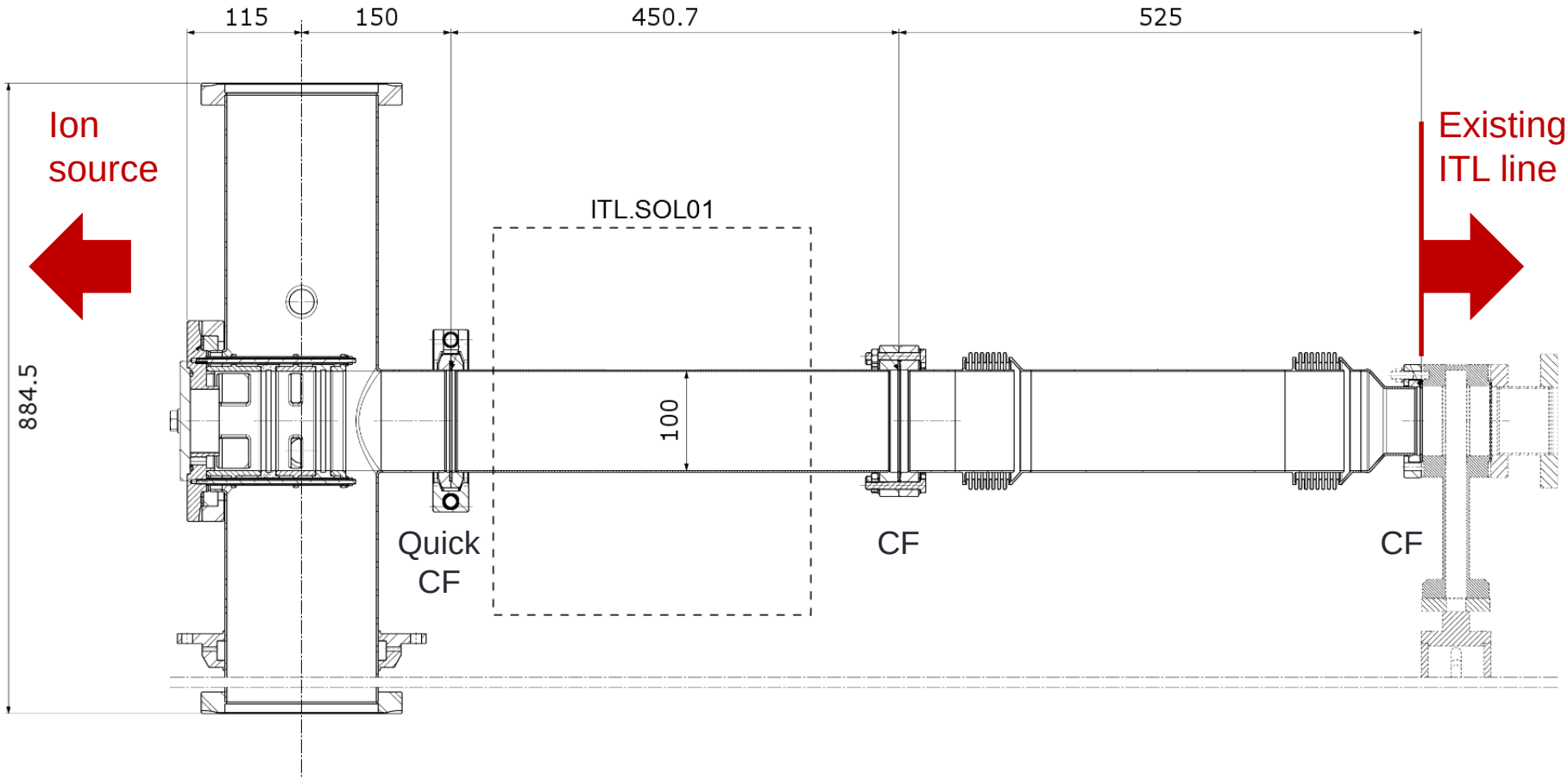


Titanium and MACOR lens assembly





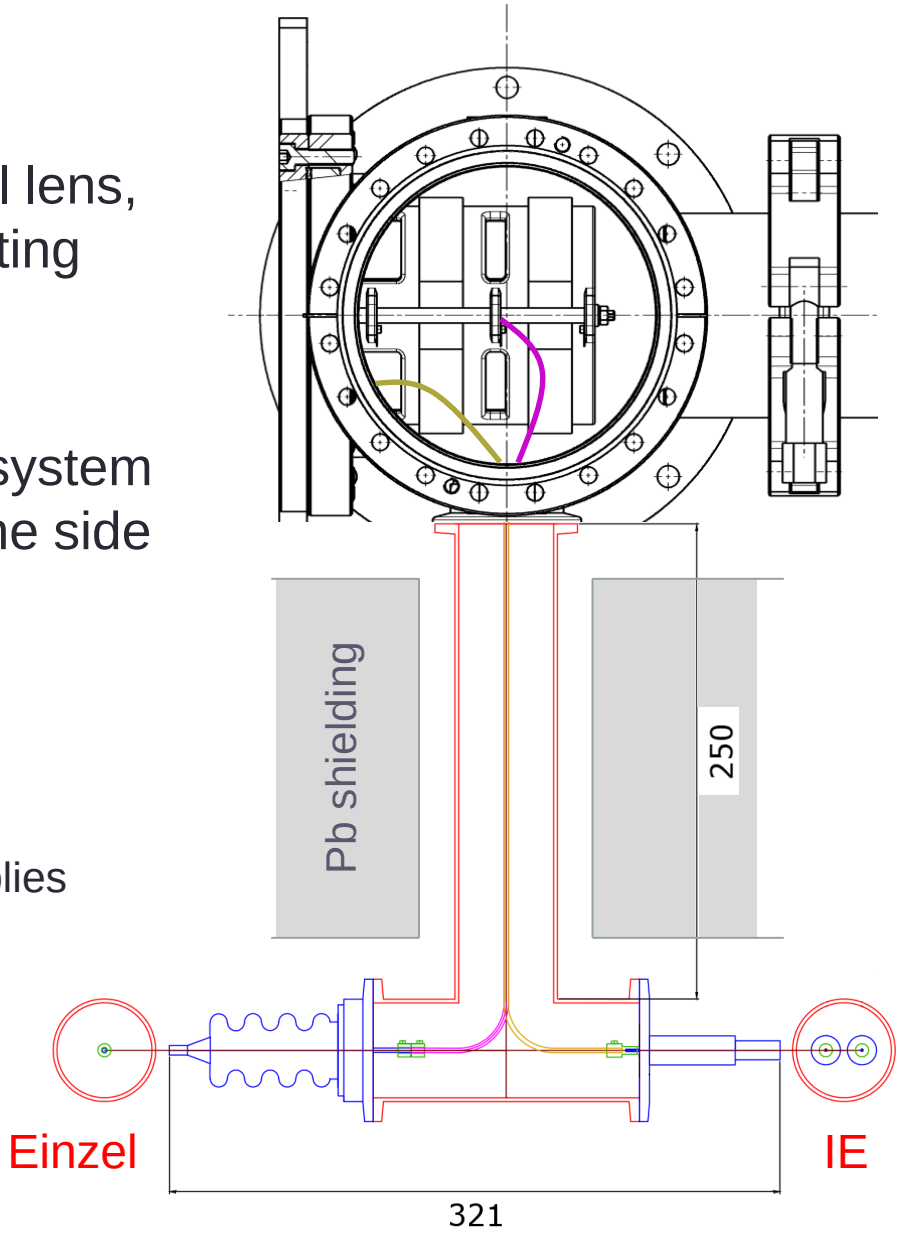
New ITL section beam pipes



From 65 mm to 100 mm bore pipes

Electrical issues

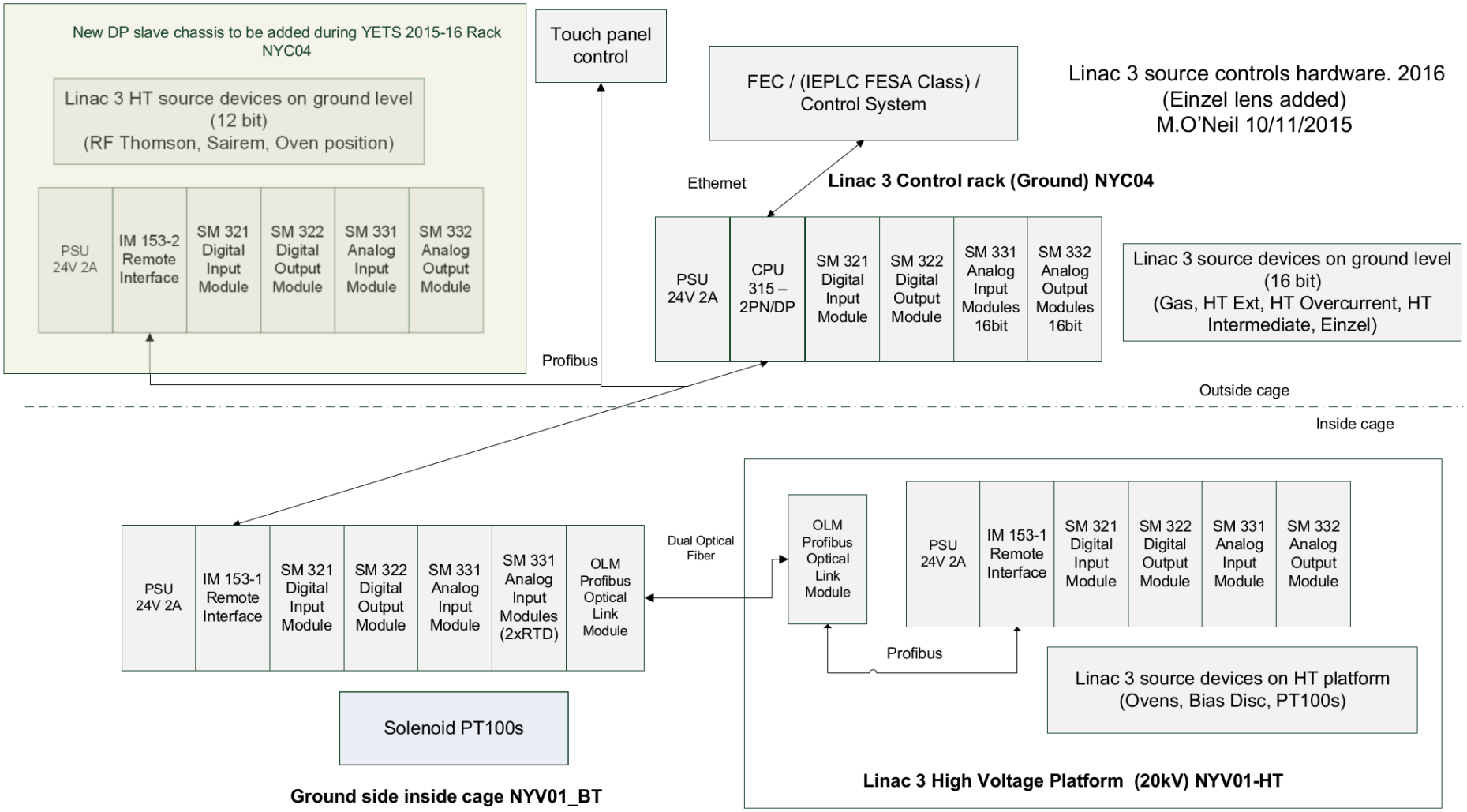
- New HV power supply for the einzel lens, installed in the rack next to the existing extraction power supplies
- Einzel lens and existing extraction system cabling through a new T-piece on the side of the extraction chamber
- Cabling:
  - HV cable for einzel lens
  - Control cables for einzel lens power supplies
  - Vacuum side with Kapton coated UHV compatible cable
  - All cabling will be done by BE-ABP



Controls

- Hardware: a new 12 bit PLC remote station (no CPU)
  - Einzel lens control and the existing ion source controls divided between the existing PLC unit and the new one
- Software:
  - Einzel lens voltage control to the ion source FESA class
  - Control available in the ion source knob in INCA
- Both will be done by BE-ABP

Source control hardware at Linac3



ITL.SOL01 measurement

- Verification of field and calibration of solenoid ITL.SOL01
- Linac3 upgrade work during YETS2015-16 provides a possibility to remove ITL.SOL01 from Linac3 for magnetic measurements
- To be measured before installation of the new welded beam pipe
- Magnet will be removed 4.1.2015 and will be returned 12.1.2015 (no flexibility in schedule)

Realization and group support

EN-MME	EN-MEF	EN-HE
Design and production of new parts	Alignment work (ITL.SOL01 and extraction chamber)	Transport of ITL.SOL01 from Linac3 to magnetic measurements, to flange welding and back to Linac3
Welding of beam pipe flange after installation through ITL.SOL01		
Main contacts		
Yannick Coutron Didier Steyaert Pierre Moyret	Tobias Dobers	

Realization and group support

TE-MSC	TE-VSC	BE-ABP
Magnetic measurements of ITL.SOL01	Disassembly of existing vacuum parts and installation of new ones at Linac3	
Disconnection and reconnection of ITL.SOL01 at Linac3	Off-site vacuum test of the new chamber and the einzel lens	Off-site HV test of the einzel lens (at the same time as the vacuum test)
		Removal, modification and installation of lead shielding around the area of modifications
		Installation of the einzel power supply and cabling
		Controls modifications (hardware and software)
Main contacts		
Dominique Bodart Thomas Zickler	Alice Michet Jose Ferreira Somoza	Michael O'Neil Sebastien Bertolo Detlef Küchler Ville Toivanen

Schedule

	DECEMBER 2015			JANUARY 2016
	Week 50	Week 51	Week 52/53	Week 1
Mon	7	14 End of run | Remove Pb (SB)	21|28	4 Break vacuum (AM) | SOL away
Tue	8	15 Remove shielding (SB)	22|29 CERN	5 Start disassembly at Linac3 (AM)
Wed	9	16 Remove shielding (SB)	23|30 holidays	6
Thu	10 Delivery of new parts	17 SOL alignment check (TD)	24|31 (2 weeks)	7
Fri	11	18 SOL disconnected (DM)	25|1	8

	JANUARY			FEBRUARY
	Week 2	Week 3	Week 4	Week 5
Mon	11	18	25 Vacuum closed | Leak test (AM)	1 GTS-LHC plasma on
Tue	12 Flange welding | SOL back	19	26 Leak test (AM) | Install shielding (SB)	2
Wed	13 Start installation work at Linac3 (AM)	20	27 Leak test (AM) | Install shielding (SB)	3
Thu	14	21	28 Install shielding (SB)	4
Fri	15	22 SOL reconnected (DM)	29 Install shielding (SB)	5

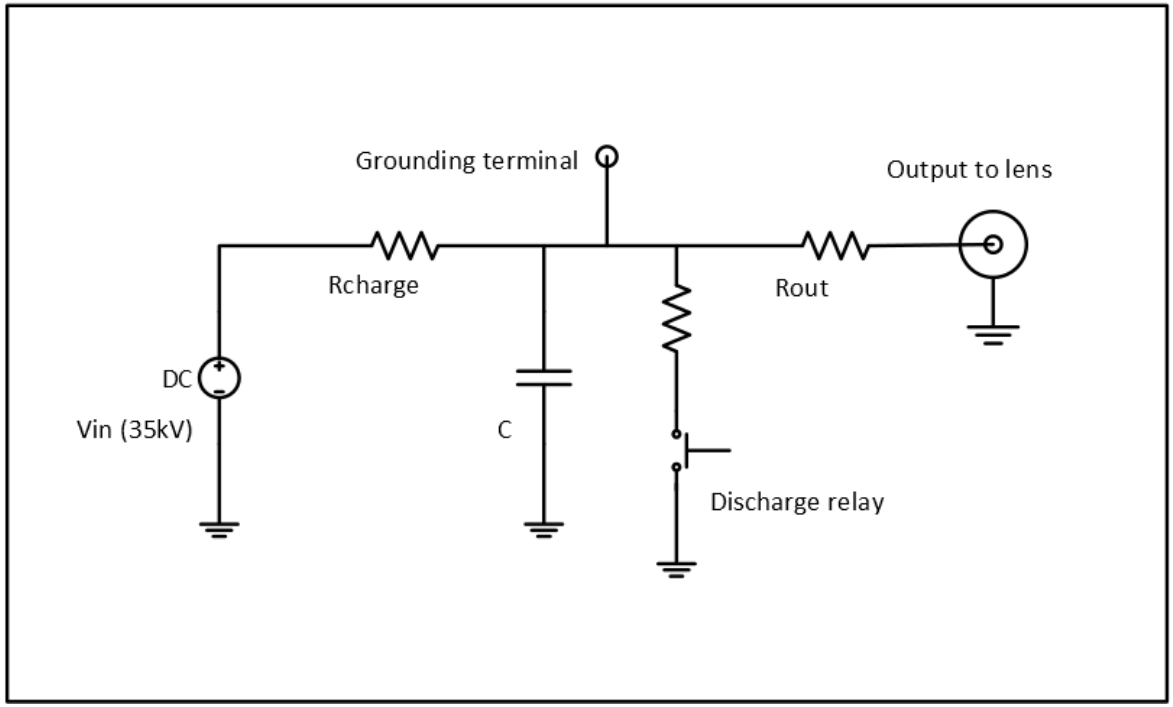
December	Delivery of parts, vacuum and HV tests
14-Dec ->	Physics run ends, Linac3 free to work
4-6 and 11-13-Jan	Controls maintenance
12-Jan - 22-Jan	Installation of new parts at Linac3
25-Jan	GTS vacuum closed, preparations for operation

01-Feb	GTS-LHC plasma on
04-Mar	RFQ online
28-Mar	Full Linac3 online (Easter Monday)
18-Apr	Linac3 delivers beam to LEIR (MDs)

ADDITIONAL SLIDES

Einzel lens voltage stabilization

- If beam loading on the lens, a capacitor may be required to stabilize the voltage during beam pulse
- Operation with beam will show if needed or not
- Preparations made to realize such a system



Comments from first ECR round

- “It should be added that increasing the acceptance of the first part of the LEBT has the effect of transporting more current of unwanted charge state for a longer distance with potential implication on beam qualities.” (Alessandra Lombardi)
- “Cabling request not yet received! Due to the huge cabling activity in PSR during YETS 2015/2016, no cabling activity in Linac3 before de 15th of February.” (Patrick Lelong)
- “I would just add to the list of works on page 9: (1) TE-VSC : removal/extraction of existing vacuum chambers, (2) BE-ABP : removal of lead shielding.” (Giulia Bellodi)
- “A local grounding system (perche de terre) installed in the immediate proximity of the Heinzel lens is not mentioned but should be added to secure interventions on the source.” (Jean-Marc Cravero)
- “Nice document, but the new vacuum chamber drawings referred to in this documents has not be created with the correct numbers according to the CERN naming convention and none of drawings has been send for approval to TE/VSC by the approval leader.” (Jan Hansen)
- “(1) Please clarify the comment from Jan Hansen and be sure that vacuum chamber are ready. (2) Cabling (if I am not wrong) is done internally by BE-ABP, no request for EN-EL.” (Julie Coupard)

Current situation

- Design work has been completed
- Production is going on at the workshop – all parts will be delivered in December 10th
- Off-the-shelf items have been ordered and received
- Control system hardware expansion is under way

Full schedule

	DECEMBER 2015				JANUARY 2016		
	Week 49	Week 50	Week 51	Week 52/53	Week 1	Week 2	Week 3
Mon	30	7	14 End of run | Remove Pb (SB)	21|28	4 Break vacuum (AM) | SOL away	11	18 -"-
Tue	1	8	15 Remove Pb (SB)	22|29 CERN	5 Remove old chambers (AM)	12 SOL back | Flange welding	19 -"-
Wed	2	9	16 Remove Pb (SB)	23|30 holidays	6 -"-	13 Install new chambers (AM)	20 -"-
Thu	3	10	17 SOL alignment check (TD)	24|31 (2 weeks)	7 -"-	14 -"-	21 -"-
Fri	4	11	18 SOL disconnected (DM)	25|1	8 -"-	15 -"-	22 SOL reconnected (DM)

	JANUARY	FEBRUARY				MARCH	
	Week 4	Week 5	Week 6	Week 7	Week 8	Week 9	Week 10
Mon	25 Vacuum closed | Install Pb (SB)	1 GTS-LHC plasma on	8	15	22	29	7
Tue	26 Install Pb (SB)	2	9	16	23	1	8
Wed	27 Install Pb (SB)	3	10	17	24	2	9
Thu	28 Install Pb (SB)	4	11	18	25	3	10
Fri	29 Install Pb (SB)	5	12	19	26	4 RFQ online	11

	MARCH			APRIL			
	Week 11	Week 12	Week 13	Week 14	Week 15	Week 16	Week 17
Mon	14	21	28 Easter Monday	4	11	18 Beam to LEIR	25
Tue	15	22	29 Full Linac3 online	5	12	19	26
Wed	16	23	30	6	13	20	27
Thu	17	24	31	7	14	21	28
Fri	18	25 Good Friday	1	8	15	22	29

December	Delivery of parts, vacuum and HV tests
14-Dec ->	Physics run ends, Linac3 free to work with
4-Jan - 6-Jan	Controls maintenance
12-Jan - 22-Jan	Installation of new parts at Linac3 (after SOL1 is back at Linac3)
25-Jan	GTS-LHC vacuum closed, preparations for operation start

01-Feb	GTS-LHC plasma on
04-Mar	RFQ online
28-Mar	Full Linac3 online (Easter Monday)
18-Apr	Linac3 delivers beam to LEIR (MDs)