Platform for Research and Applications with Electrons

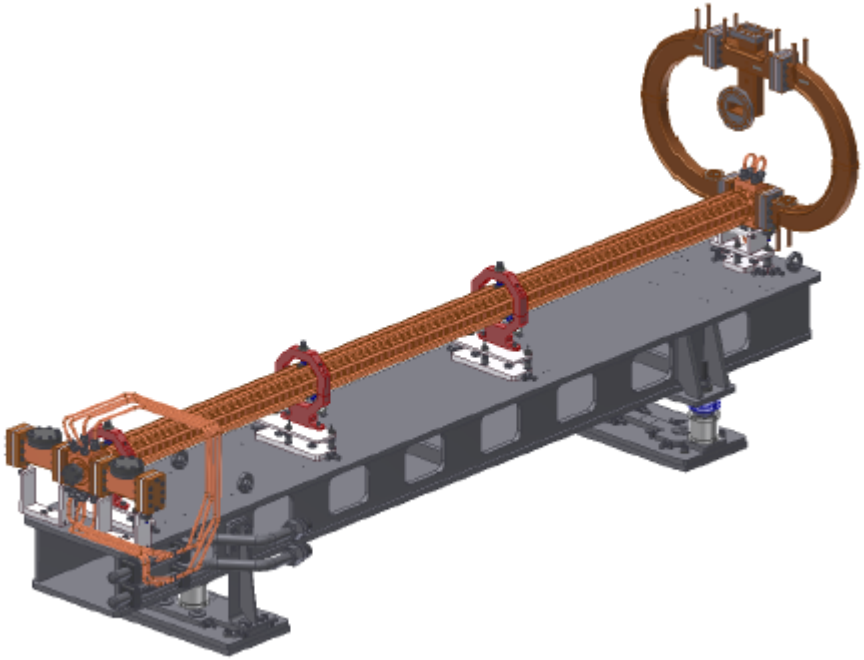
PRAE

Projet Emblématique

Programme SESAME

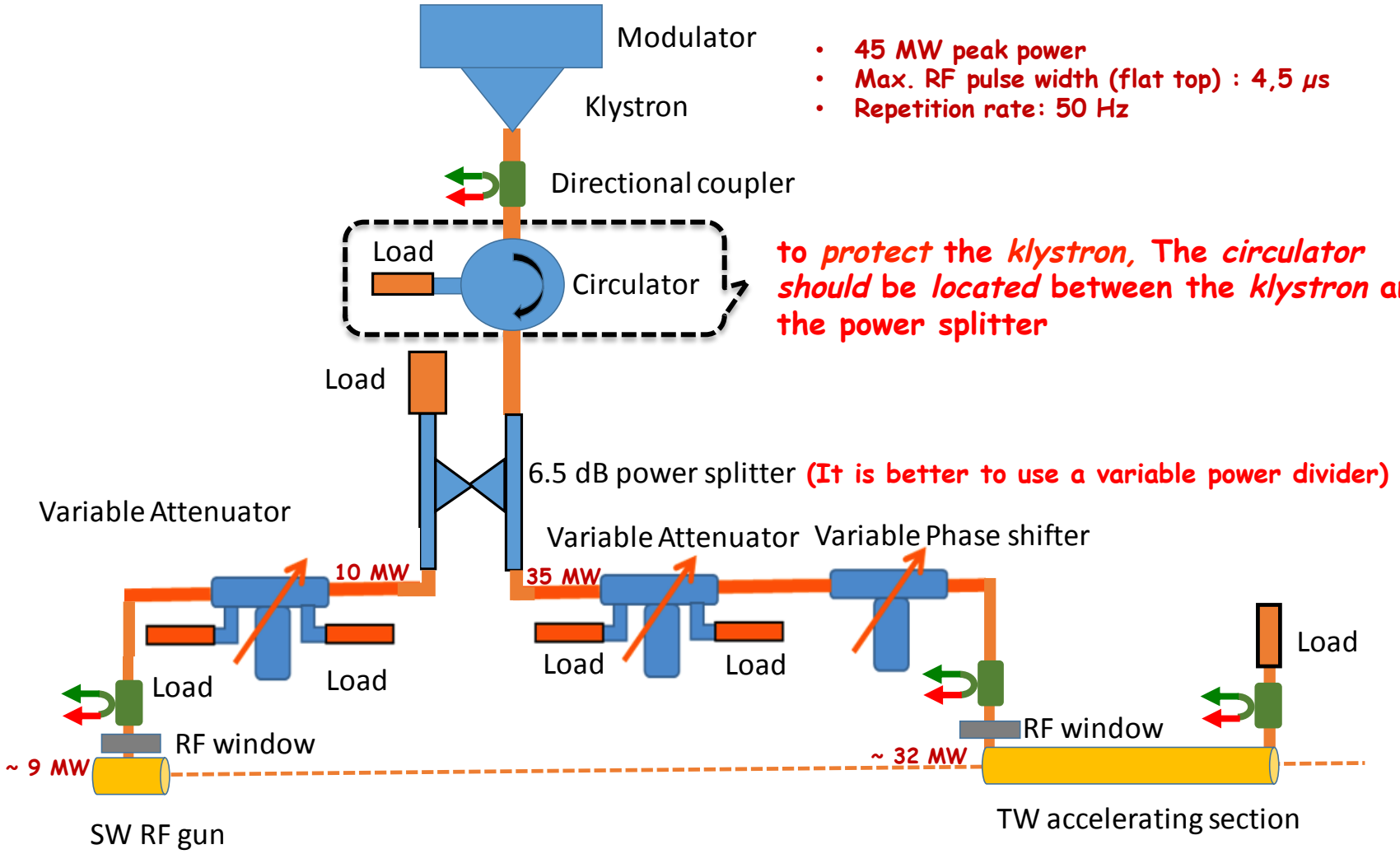
With the support of

3.5 m long TW accelerating structure



Mohamed - El Khaldi

Linac RF network proposal



- 45 MW peak power
- Max. RF pulse width (flat top) : 4,5 μs
- Repetition rate: 50 Hz

to *protect* the *klystron*, The *circulator should* be *located* between the *klystron* and the power splitter

(It is better to use a variable power divider)

Interactions at LAL

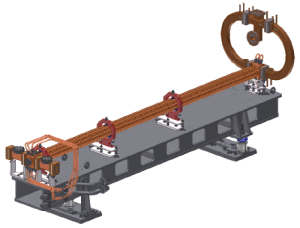
RF

- Coordination and manufacturing follow-up
- Participation in tuning and low power RF tests at RI
- RF conditioning (High power tests) at LAL

BE

- Mechanical installation
- Alignment

RI Accelerating section



Vacuum

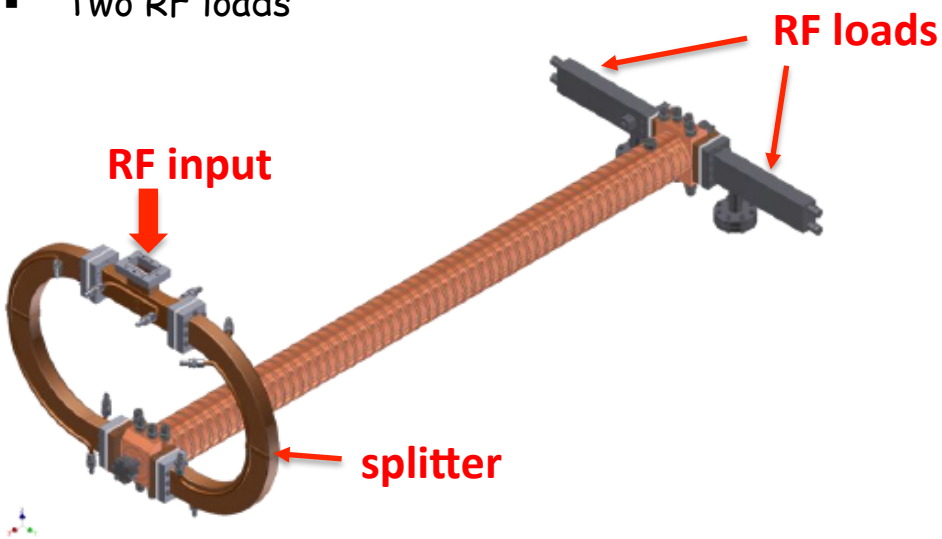
- Pressure test
- He leak-test
- Bake out
- RGA

Technical Specification

TW S-Band accelerating structure from RI

Property	Value	Unit
Length (flange to flange)	3.5	m
Beam tube diameter	18	mm
Cell length @ T_{oper}	33.326	mm
Operation temperature T_{oper}	30	°C
Number of cells	1+ 96 + 1	
Coupling cells	In-/Outcoupler symmetric Racetrack	
Surface roughness of acc. cells rf surfaces	Ra <0.1	µm
Type	const. gradient	
Frequency at operating temperature	2998.55	MHz
Mode	2 π/ 3	
velocity β	1	
Filling time	<1.0	µs
Pulse length	3	µs
Repetition Rate	50	Hz
Max input power	40	MW
Max. average dissipated power	5	kW
Matching S11 @ f_{oper}	≤-30	dB
Matching S11 @ f_{oper} +/-1MHz	≤-20	dB
Acc. cells field amplitude variation	≤10	%
Maximum acc. cells phase advance deviation	$\left\lvert\lvert\sum_{i=1}^{n}(\Delta\phi)_i\rvert - n(\Delta\phi_{nom})\right\rvert \leq 5$	°
Max allowed leak rate	2e-10	mbarl/s
Straightness with respect to cavity axis |Dr|	≤150	µm
Guaranteed unloaded energy gain (at 35MW peak input power)	>63	MeV

- Constant gradient
- Racetrack dual feed coupler:
  - **Symmetric dual-feed** → no dipole magnetic field component
  - **Racetrack shape** → compensation of the quadrupolar component
  - Two RF loads



At Elettra this RI structure has been successfully high power conditioned during two weeks up to 19 MW with a pulse length of 4µs and repetition rate of 50 HZ (to get the desired gradient, just 16 MW are required at Elettra)

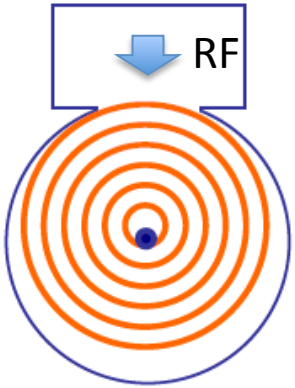
Coupler design

Compensation of the field distortions

Because of the relatively low energy of the electron beam (few MeV) the accelerating field has to have an excellent uniformity to preserve the beam quality.

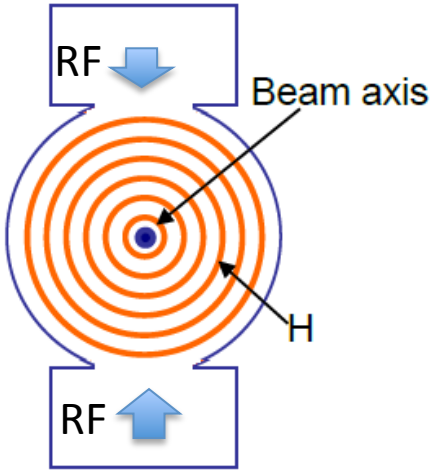
"Standard"coupling slots introduce a distortion in the field distribution and a **dipole and quadrupole component of the field** can apper strongly affecting the beamdynamics.

Single feed introduces a distortion in RF Fields



Solution

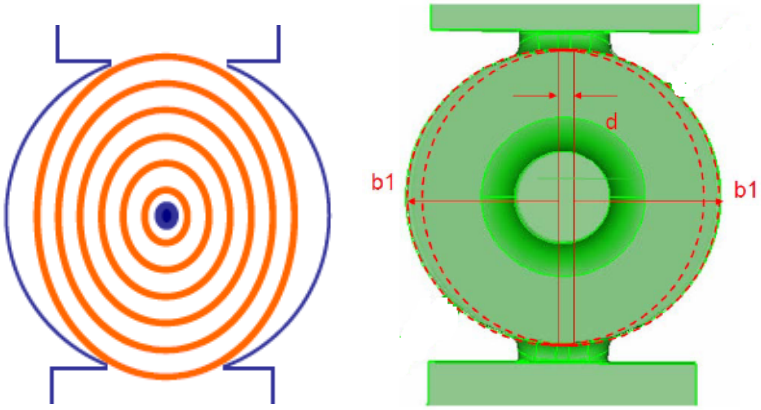
Symmetric dual feed eliminates Dipole component



Need a RF splitter (increase of the cost)

Racetrack shape eliminates Quadrupole component

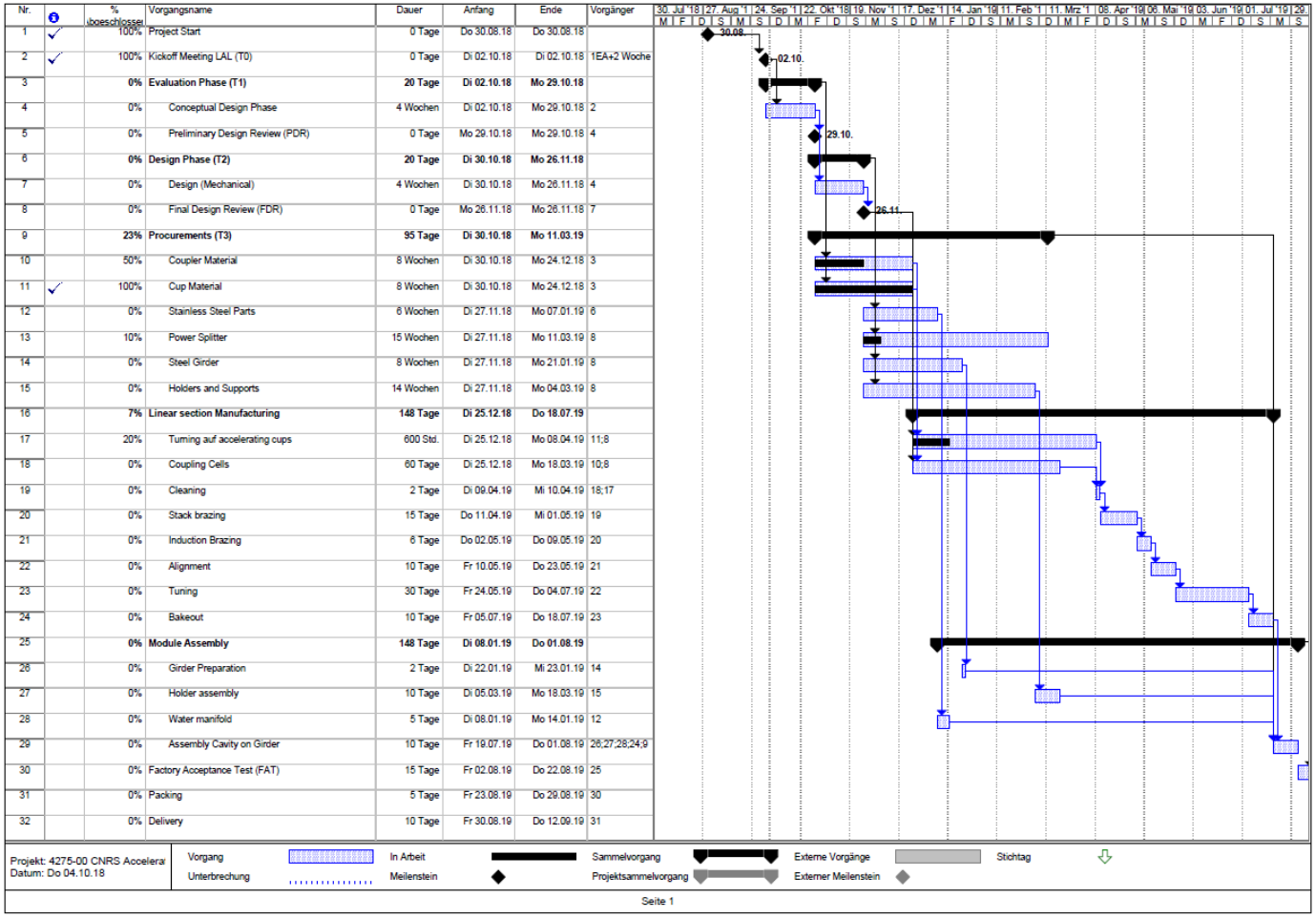
Racetrack profile



This cell deformation needs a computer controlled milling machine

RI Time schedule

- Estimated date of delivery : september 2019
- to minimize potential risks we need the extension of guarantee



Nr.	% abgeschlossen	Vorgangsname	Dauer	Anfang	Ende	Vorgänger
1	100%	Project Start	0 Tage	Do 30.08.18	Do 30.08.18	
2	100%	Kickoff Meeting LAL (T0)	0 Tage	Di 02.10.18	Di 02.10.18	1EA+2 Woche
3	0%	**Evaluation Phase (T1)**	**20 Tage**	**Di 02.10.18**	**Mo 29.10.18**	
4	0%	Conceptual Design Phase	4 Wochen	Di 02.10.18	Mo 29.10.18	2
5	0%	Preliminary Design Review (PDR)	0 Tage	Mo 29.10.18	Mo 29.10.18	4
6	0%	**Design Phase (T2)**	**20 Tage**	**Di 30.10.18**	**Mo 26.11.18**	
7	0%	Design (Mechanical)	4 Wochen	Di 30.10.18	Mo 26.11.18	4
8	0%	Final Design Review (FDR)	0 Tage	Mo 26.11.18	Mo 26.11.18	7
9	23%	**Procurements (T3)**	**95 Tage**	**Di 30.10.18**	**Mo 11.03.19**	
10	50%	Coupler Material	8 Wochen	Di 30.10.18	Mo 24.12.18	3
11	100%	Cup Material	8 Wochen	Di 30.10.18	Mo 24.12.18	3
12	0%	Stainless Steel Parts	6 Wochen	Di 27.11.18	Mo 07.01.19	6
13	10%	Power Splitter	15 Wochen	Di 27.11.18	Mo 11.03.19	8
14	0%	Steel Girder	8 Wochen	Di 27.11.18	Mo 21.01.19	8
15	0%	Holders and Supports	14 Wochen	Di 27.11.18	Mo 04.03.19	8
16	7%	**Linear section Manufacturing**	**148 Tage**	**Di 25.12.18**	**Do 18.07.19**	
17	20%	Turning auf accelerating cups	600 Std.	Di 25.12.18	Mo 08.04.19	11;8
18	0%	Coupling Cells	60 Tage	Di 25.12.18	Mo 18.03.19	10;8
19	0%	Cleaning	2 Tage	Di 09.04.19	Mi 10.04.19	18;17
20	0%	Stack brazing	15 Tage	Do 11.04.19	Mi 01.05.19	19
21	0%	Induction Brazing	6 Tage	Do 02.05.19	Do 09.05.19	20
22	0%	Alignment	10 Tage	Fr 10.05.19	Do 23.05.19	21
23	0%	Tuning	30 Tage	Fr 24.05.19	Do 04.07.19	22
24	0%	Bakeout	10 Tage	Fr 05.07.19	Do 18.07.19	23
25	0%	**Module Assembly**	**148 Tage**	**Di 08.01.19**	**Do 01.08.19**	
26	0%	Girder Preparation	2 Tage	Di 22.01.19	Mi 23.01.19	14
27	0%	Holder assembly	10 Tage	Di 05.03.19	Mo 18.03.19	15
28	0%	Water manifold	5 Tage	Di 08.01.19	Mo 14.01.19	12
29	0%	Assembly Cavity on Girder	10 Tage	Fr 19.07.19	Do 01.08.19	26;27;28;24;9
30	0%	Factory Acceptance Test (FAT)	15 Tage	Fr 02.08.19	Do 22.08.19	25
31	0%	Packing	5 Tage	Fr 23.08.19	Do 29.08.19	30
32	0%	Delivery	10 Tage	Fr 30.08.19	Do 12.09.19	31

Conclusion

Status

- CCTP: June 2018
- Call for tender: July 2018
- Order has been sent out to RI: 24 th August 2018

My involvement

- Writing a CCTP (technical specification part)
- Coordination and manufacturing follow-up
- Participation in tuning and low power RF tests at RI
- RF conditioning (High power tests) at LAL