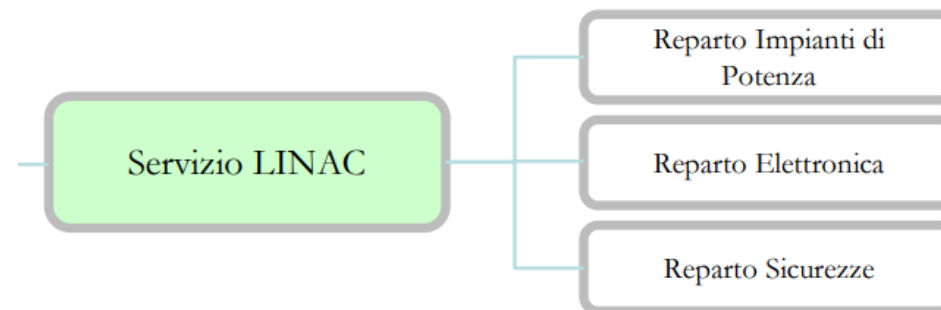


# SERVIZIO LINAC LNF

Sommario delle attività e progetti in corso

## Servizio LINAC:

- cura la progettazione, la realizzazione, la messa a punto, la manutenzione e lo sviluppo degli impianti e dei controlli degli acceleratori lineari (LINAC e SPARC\_LAB) e dei sistemi a radiofrequenza;
- progetta, realizza e installa sistemi di interlock degli acceleratori e ne cura la relativa operazione e manutenzione;
- collabora alla conduzione degli acceleratori



### ***Tecnologi (5):***

#### ***B. Buonomo,***

*F. Cardelli,  
C. Di Giulio,  
D. Di Giovenale,  
L. G. Foggetta*

*I tecnologi sono coinvolti anche nel funzionamento della Beam Test Facility di Frascati*

### ***Tecnici (7):***

*R. Ceccarelli,  
M.Ceccarelli (art15), A. Cecchinelli,  
G. Piermarini, A.L. Rossi,  
S. Strabioli, R. Zarlenga*  
***Pensionamenti:*** *M. Belli, R. Clementi*

*I Tecnici partecipano ai turni di conduzione del collider DAFNE nel Gruppo degli operatori di macchina*



# LINAC SCHEDULED ACTIVITIES

- **LINAC-DAFNE-BTF**

- LINAC**

- RUN DAFNE (DAFNE Run coordinators)
- Ordinary Maintenance (Modulators, LINAC)
- Extraordinary Maintenance and consolidation
- Modulator Consolidation:
  - Solid State Power supplies in Mod A
- Upgrade
  - Building and install of new modulator
  - Test Solid CERN state Switch on new Modulator

- BTF**

- **SPARC**

- Modulators Maintenance

- **SABINA**

- New C band Modulator at SPARC

- **TEX (LATINO)**

- Safety installation and Check
- Klystron commissioning and TEST
- Modulator SAT

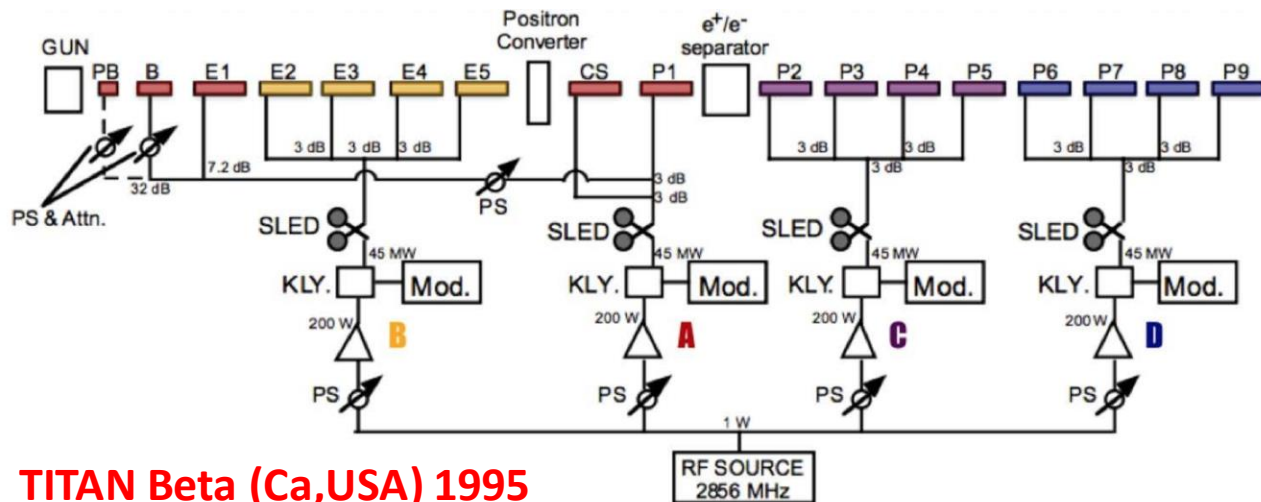
- **SINGULARITY**

- LINAC CONTROL Memcached DATA and AI feedback test

- **EUPRAXIA**

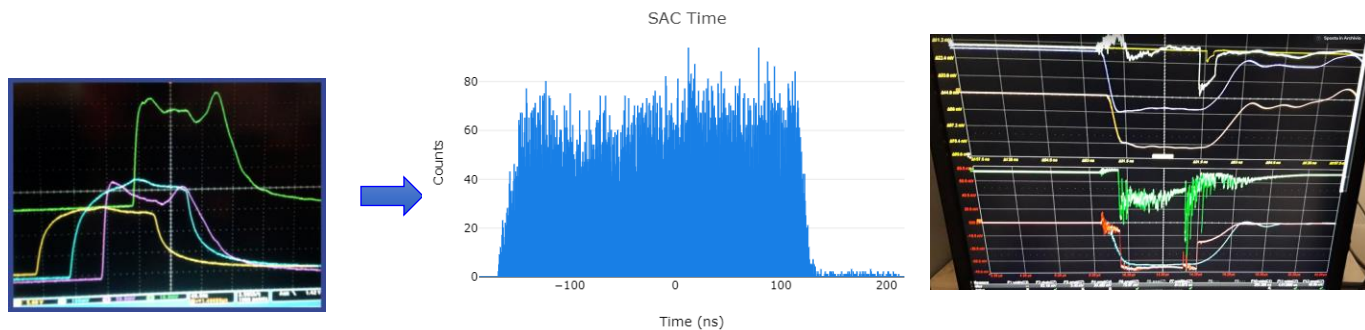
- WP12 RF Power and distribution

# DAFNE LINAC



## TITAN Beta (Ca,USA) 1995

- S-band Linear Accelerator ~60 m long
- Termoionic gun, 4x45 MW klystrons + SLED + 15x waveguide  $2/3\pi$  SLAC type section 3m long.



Upgrade pulse width: ~ 300 ns

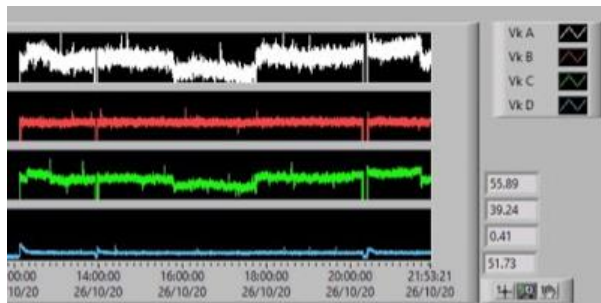
	Design	Operational
Electron beam final energy	800 MeV	510 MeV
Positron beam final energy	550 MeV	510 MeV
RF frequency	2856 MHz	
Positron conversion energy	250 MeV	220 MeV
Beam pulse rep. rate	1 to 50 Hz	1 to 50 Hz
Beam macropulse length	10 nsec	1.4 to 300 nsec
Gun current	8 A	8 A
Beam spot on positron converter	1 mm	1 mm
norm. Emittance (mm. mrad)	1 (electron) 10 (positron)	< 1.5
rms Energy spread	0.5% (electron) 1.0% (positron)	0.5% (electron) 1.0% (positron)
electron current on positron converter	5 A	5.2 A
Max output electron current	>150 mA	500 mA
Max output positron current	36 mA	85 mA
Transport efficiency from capture section to linac end	90%	90%
Accelerating structure	SLAC-type, CG, $2\pi/3$	
RF source	4 x 45 MWp sledged klystrons TH2128C	

# DAFNE LINAC CONSOLIDATION

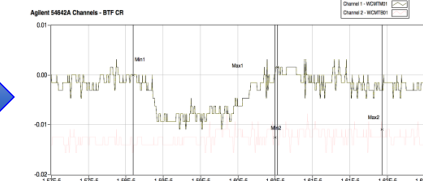
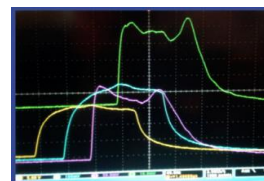
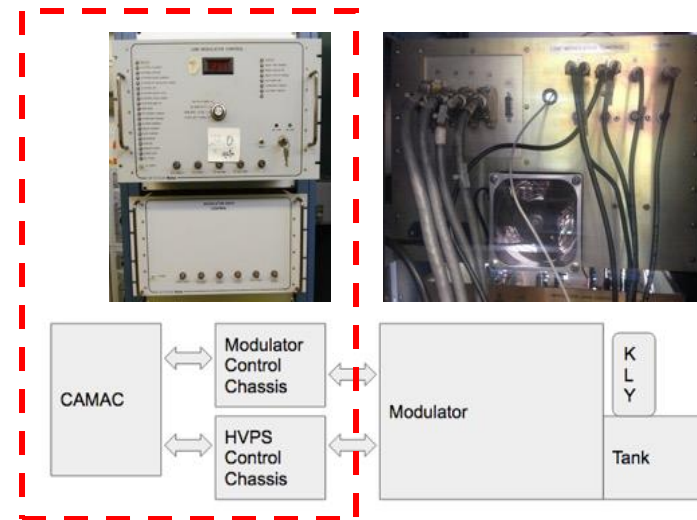
- Consolidate the LINAC during run time: extend lifetime of 10 years

- Implementing HVPS on 4 mod's
  - 75% full operative since months (B,D,C pulse transformer)

- A) SRC
- B) HVPS
- C) SRC
- D) HVPS



- Substituting mod's and subsystem old electronics with a new embedded one
  - Prototyping on Mod. B. (necessary time for test)



Upgrade pulse width up to 300ns for PADME Experiment

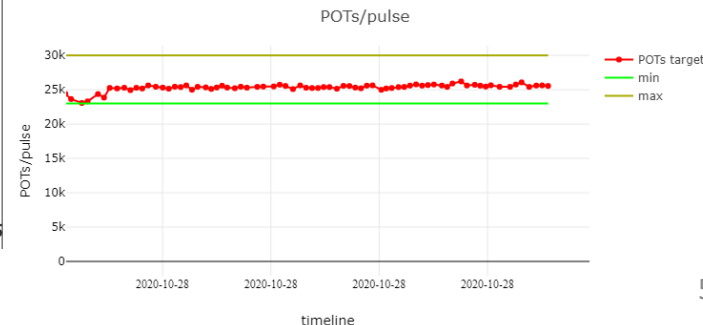
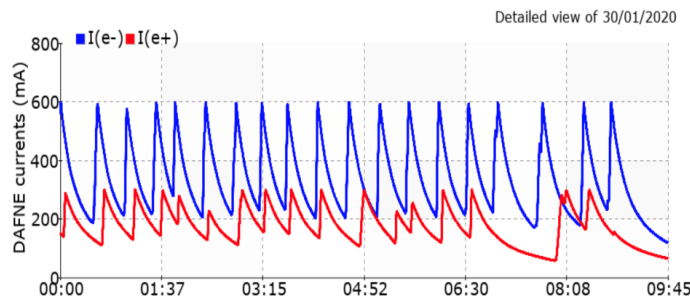
- Critical implementation for just one reason

LINAC has to be ready for all of the scheduled activities (and we got it):

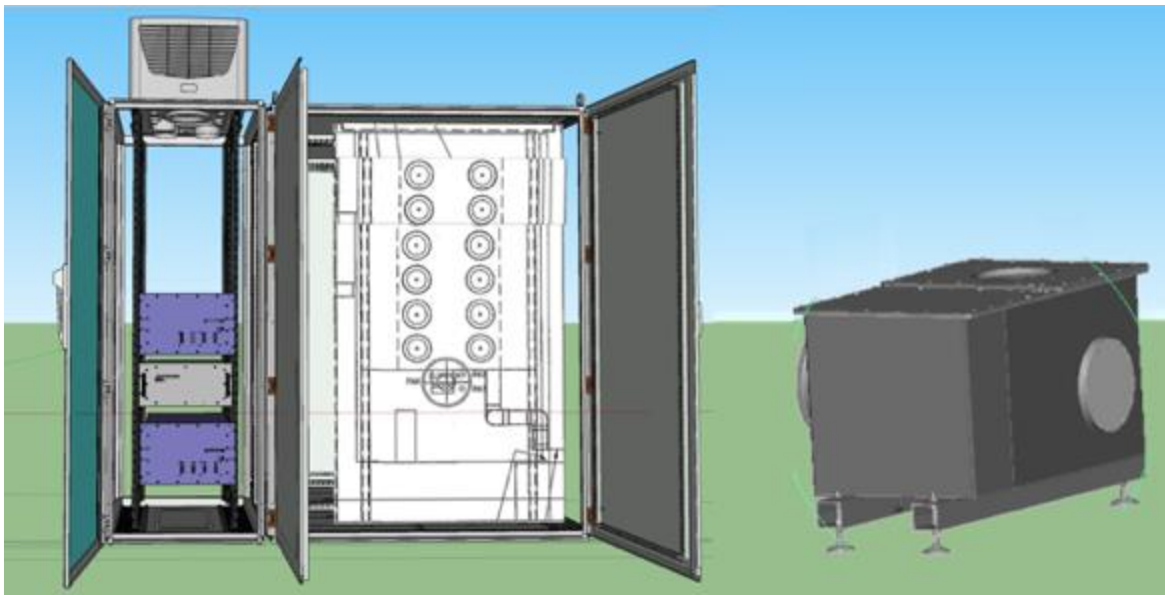
- BTF user run
- DAFNE in SIDDARTHA run
- PADME run

- LINAC 4618,4 thyatron hours of HV/year (37week/52 h24) (04/2016-12/2019)

Upgrade on going from 2018 to extend lifetime up to 6500h/y



# LINAC-UPGRADE: NEW MODULATOR



New power  
supplies rack



New tank



Tank elements in preparation for installation.



Progress slow but ongoing.

The operators are the same that operate DAFNE linac and SPARC modulator.



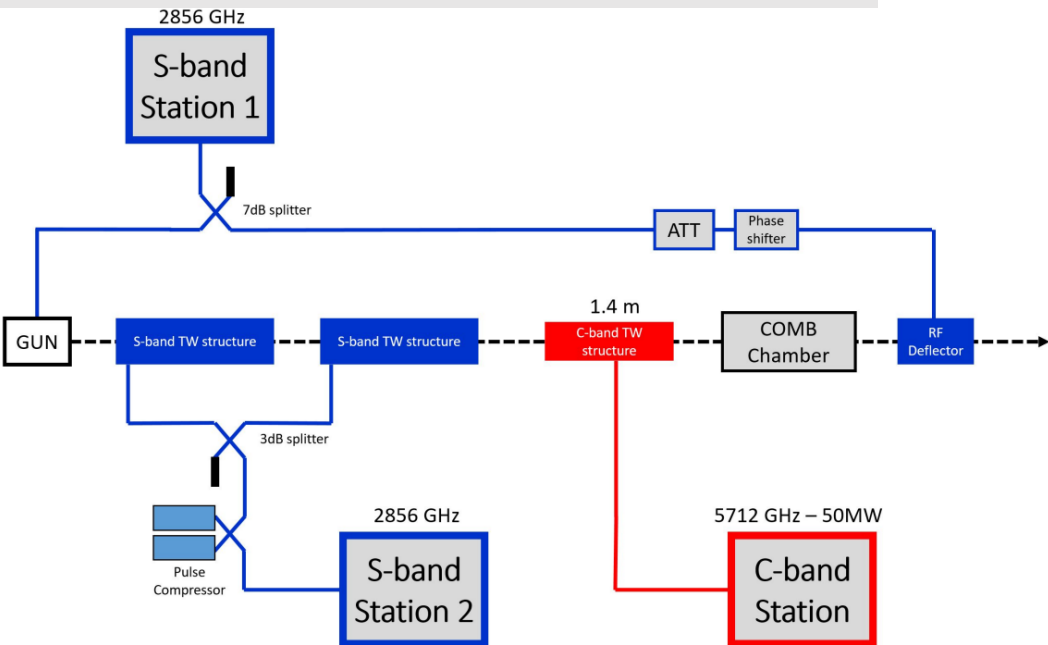
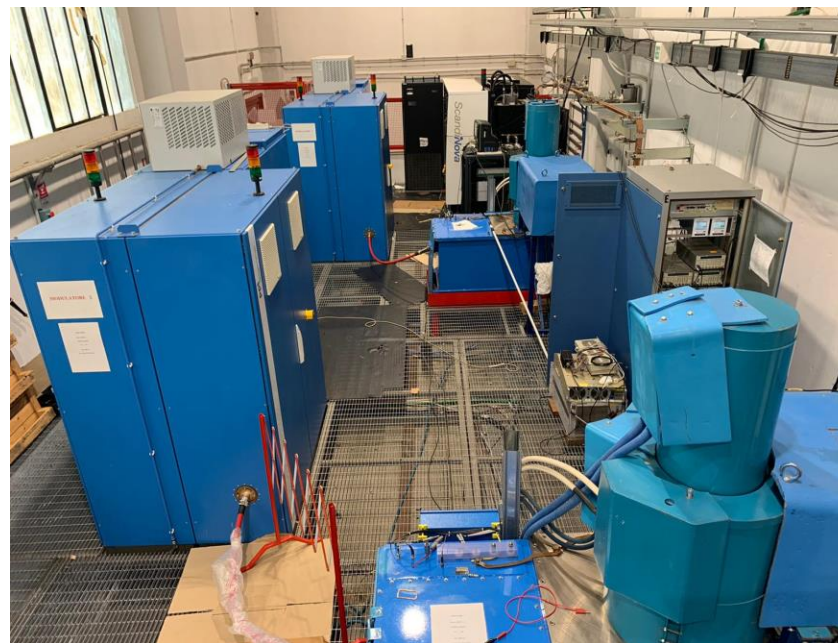


Figure 1: SPARC\_LAB Linac RF System layout

### Three power stations:

- 2x PPT PFN Modulator with S-band klystron Thales TH2128C (45 MW, 4.5 $\mu$ s, 10Hz)
- 1x Scandinova k2 Solid State Modulator with C-band Toshiba E37202 Klystron (50MW, 2.5 $\mu$ s, 10Hz), Klystron voltage 370 kV Klystron current 344 A

### Modulator Hall



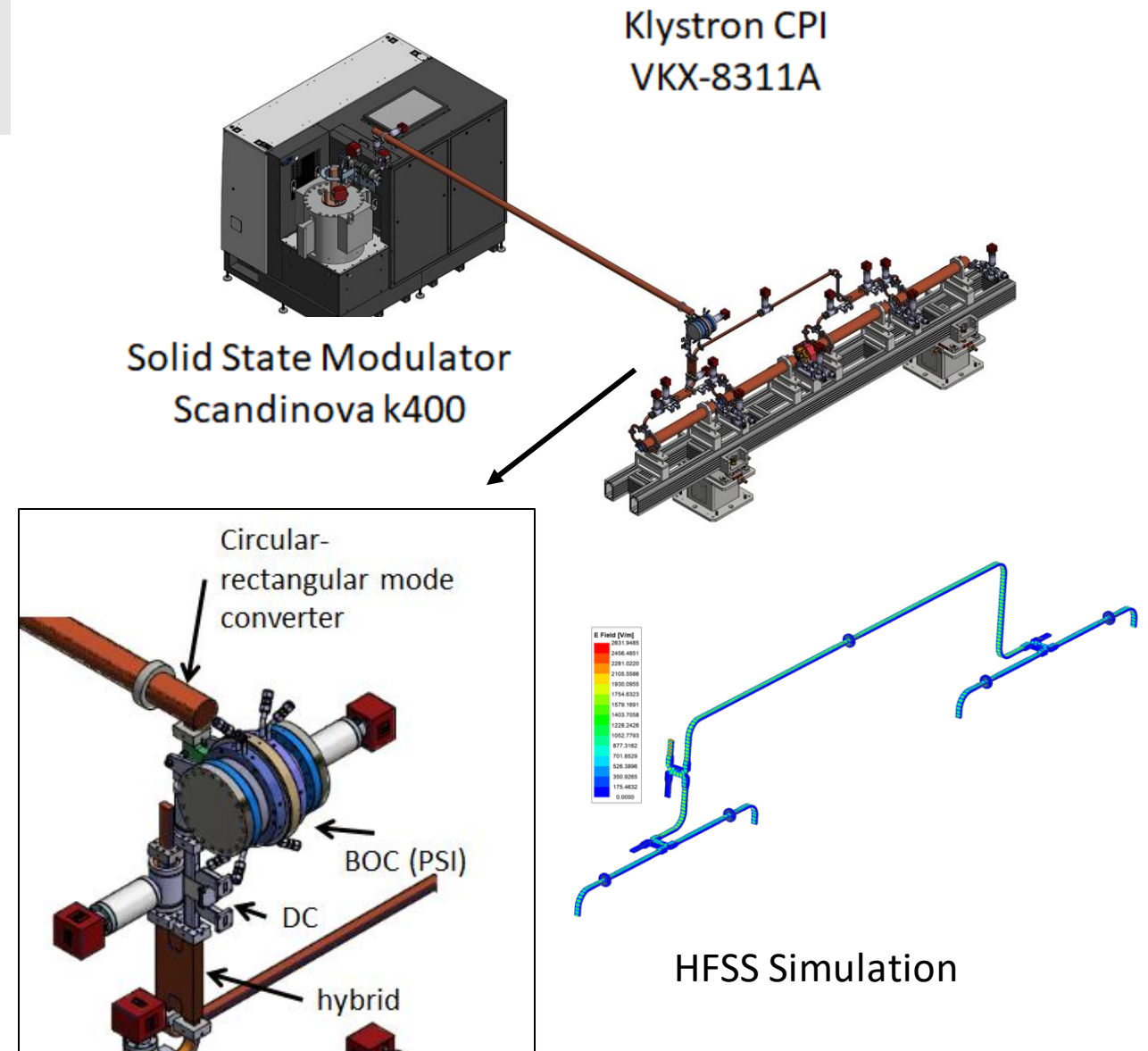
New k400 Scandinova Modulator for C Band in the framework of the SABINA Project for SPARC\_LAB upgrade.

## Working Package 12 – High Power RF and Distribution (F. Cardelli)

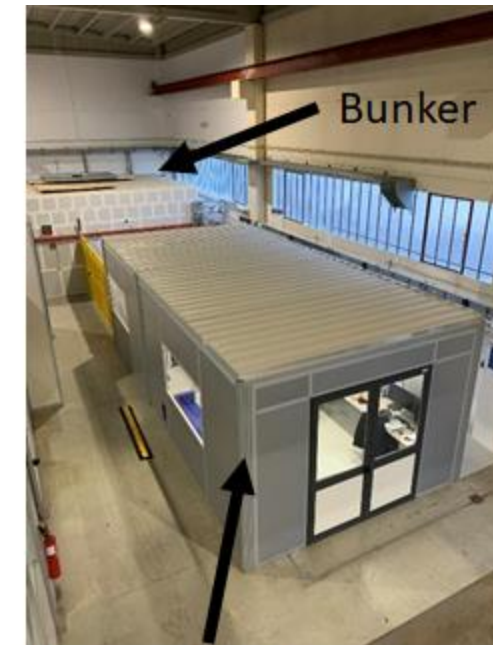
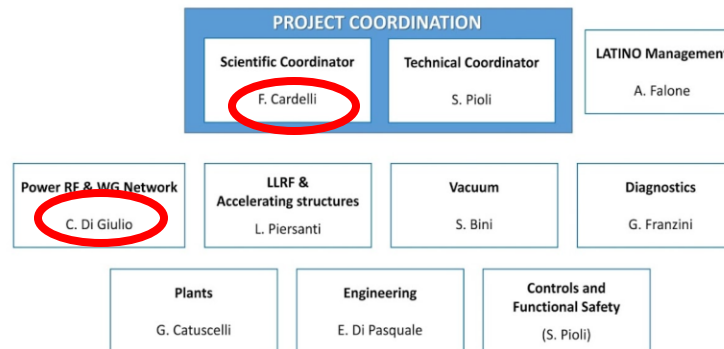
- Assessment of the X-band technology (Wg and Sources)
- Definition of the RF Sources of the Linac (Modulator and Klystron)
- Definition of the Waveguide distribution system of the Linac
- Design and test of X-band Waveguide component

**X-band technology requires strong R&D activity** in order to evaluate and define the acceptance and quality procedures of the different components (Phaseshifter, BOC, Power divider or attenuator, Windows, Power loads, etc). Most of the components have been developed by CERN but still need to be tested at the EuPRAXIA nominal RF parameters (SLED/BOC, Power divider, rf loads,...).

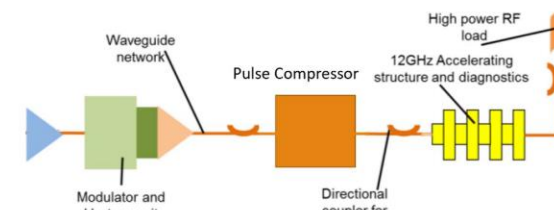
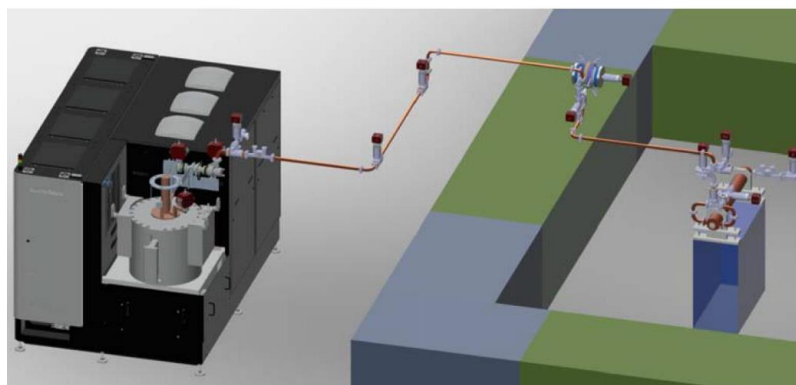
The **TEX test stand** (currently in commissioning at LNF) will be used for component testing and definition of acceptance and quality tests. Therefore, its **commissioning and operation are crucial** for the all R&D activity.







TEX Control Room



New **Test Facility** at LNF, in the framework of the **LATINO project**, for developing and conditioning of **X-band accelerating structures** (Eupraxia@SPARC\_LAB, CLIC, IFAST...) and of X-band RF waveguide components.

Test stand for the basic RF module for Eupraxia@SPARC\_LAB RF Linac.

For this reason, it represent a test and development bench for all the Linac systems and procedures:

- High Power RF source (Modulator and Klystron)
- LLRF System
- Diagnostics
- Vacuum System
- Control and Safety Systems
- Conditioning algorithms
- High gradient technology

It is based on a k400 Scandinova Solid state Modulator and a CPI 50MW VKX8311A Klystron. The commissioning of this source is scheduled for half October 2021 then will start the waveguide system installation in order to be ready for the test of the first Eupraxia accelerating structure prototype.