

SPARX@LNF

L. Palumbo

LNF Scientific Committee - June, 6, 2011

SPARC & SPARX

2003 - MIUR Funding of SPARC-Test Facility (7ME)

2005 - MIUR Funding of R&D for a soft X-ray FEL (10 ME)

2007 - Accordo Quadro with MIUR & Regione Lazio for
the development of SPAR soft X-ray FEL
(10+15 ME 06/08)

MIUR: SPARX - 10 ME (end February 2012)

Latest developments in the agenda:

New Gun

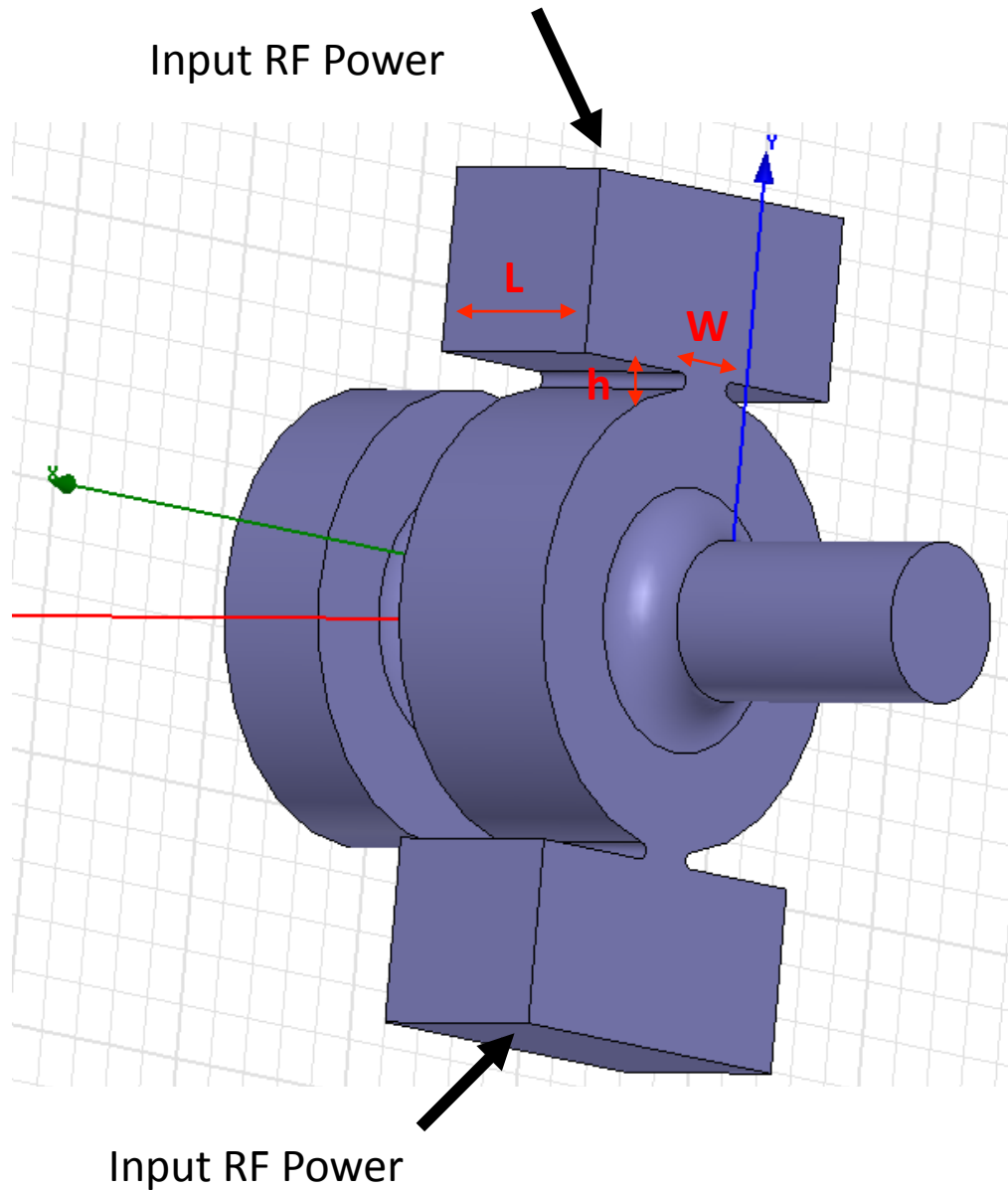
SPARC Energy up-grade C Band System

Synchronization system upgrade

Averall system rialibility

High Gradient High Repetition Rate S-band Gun

RF Gun



- Dual feed
- 100 Hz repetition rate
- 1.6 cell gun
- Multibunch operation

L	33.436mm
W	12.308mm
h	3mm

R&D on X-BAND ACCELERATING CAVITY

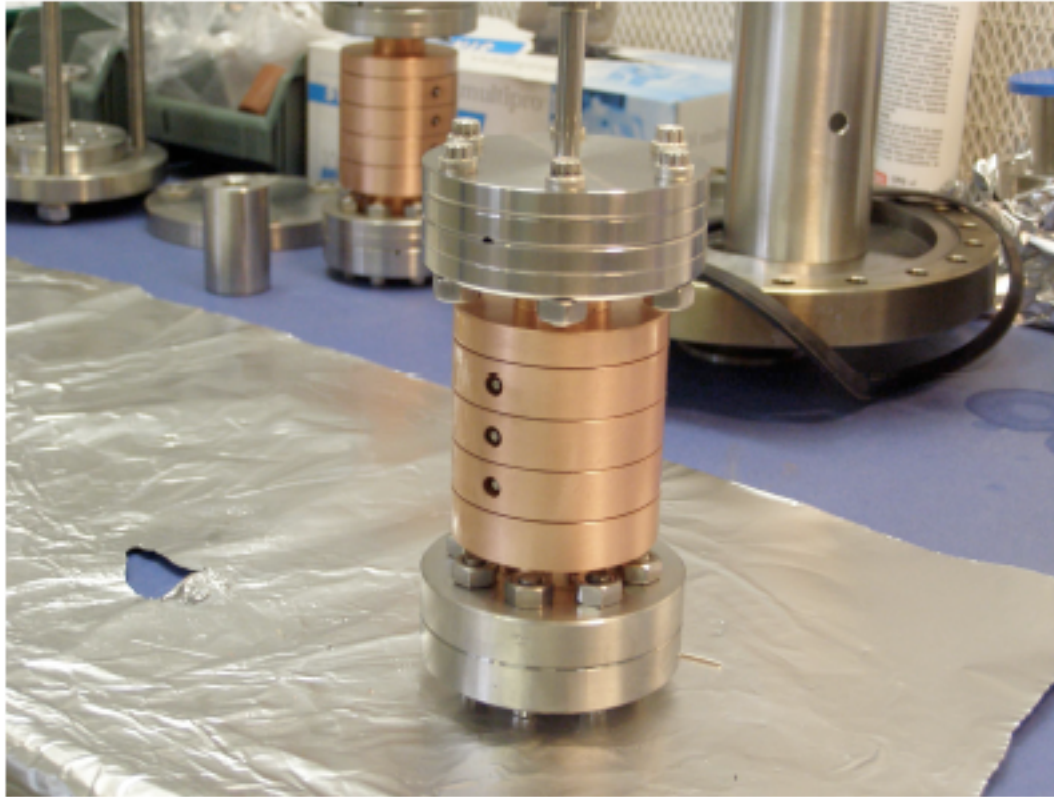
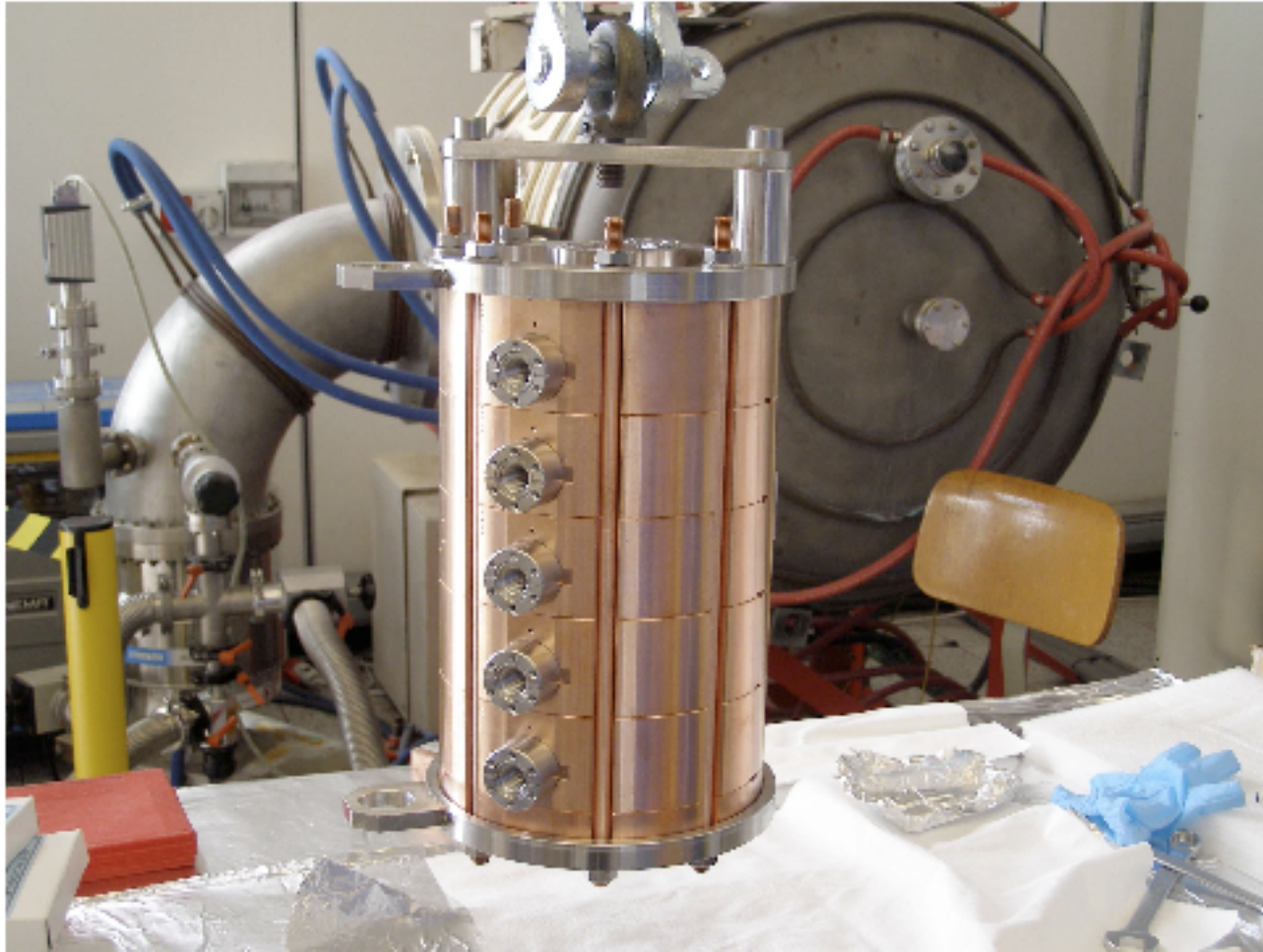


FIG. 4: picture of the copper structure under test.

RF DEFLECTOR

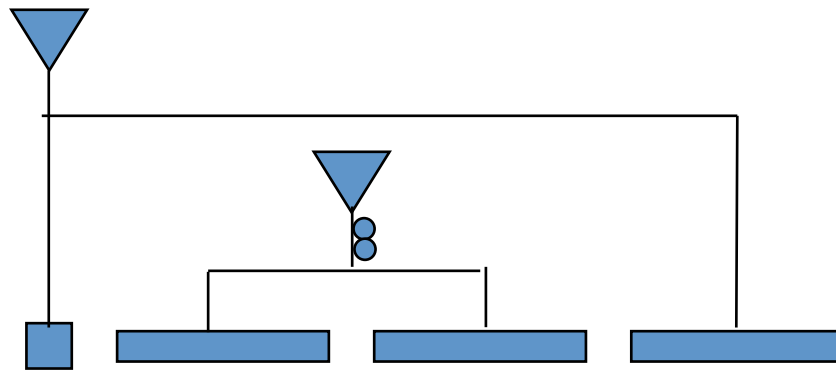


C-BAND LINAC

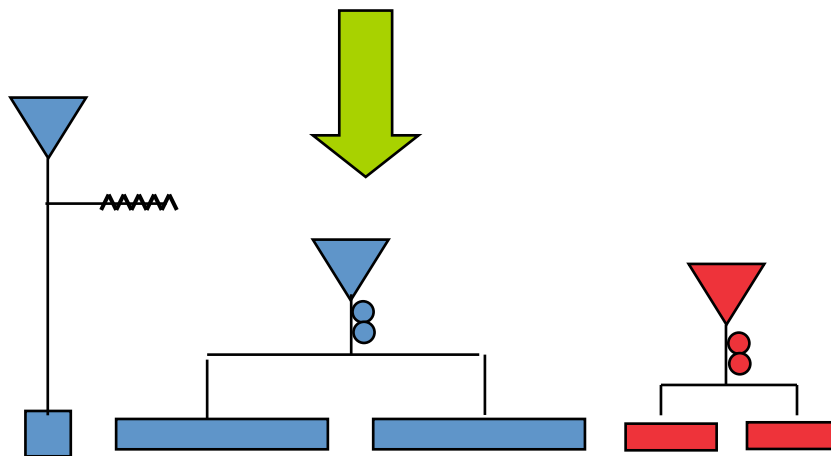
Energy Up-grade - C-band

main Motivation: to increase the SPARC beam energy *from* ≈ 180 MeV *to* ≈ 250 MeV to lase closer to the UV and improve the seeding experiment

2nd Motivation: to gain experience with a rather new RF technology. in the light of possible future developments

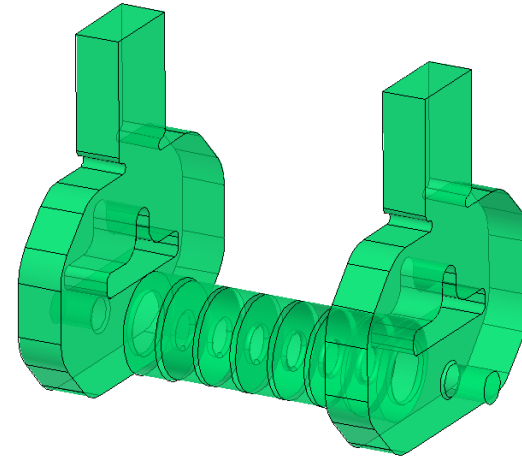


S-band



S-band

C-band

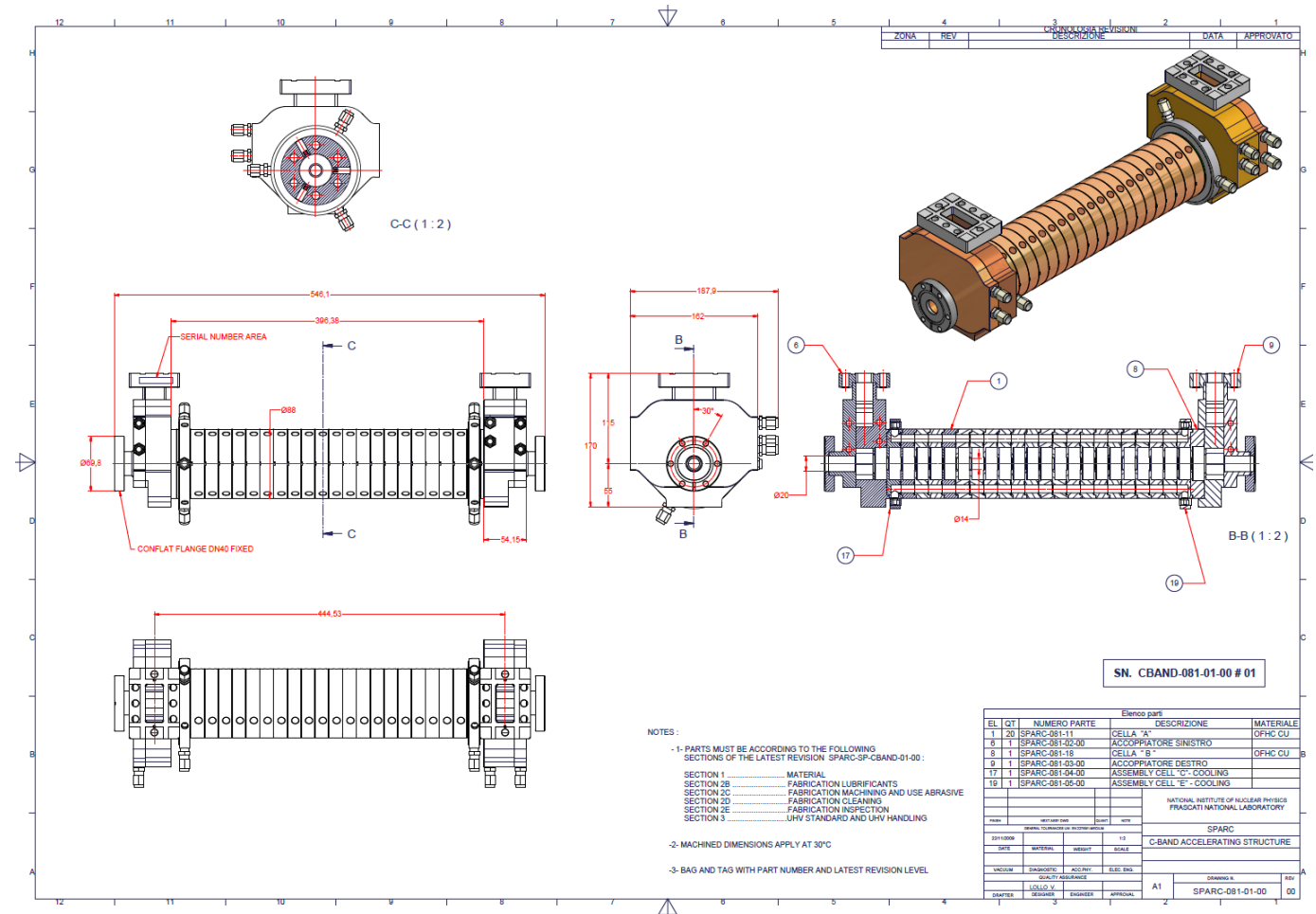


PARAMETERS	
Frequency (f_{RF})	5.712 [GHz]
Phase advance per cell ($\Delta\phi$)	$2\pi/3$
Number of accelerating cells (N)	86
group velocity (v_g):	$0.0278 \cdot c$
Field attenuation (α)	0.22 [1/m]
Filling time (τ)	180 [ns]
Average accelerating field @ $t=\tau$	35 [MV/m]
Average diss. Power @ 10 Hz	46 [W]

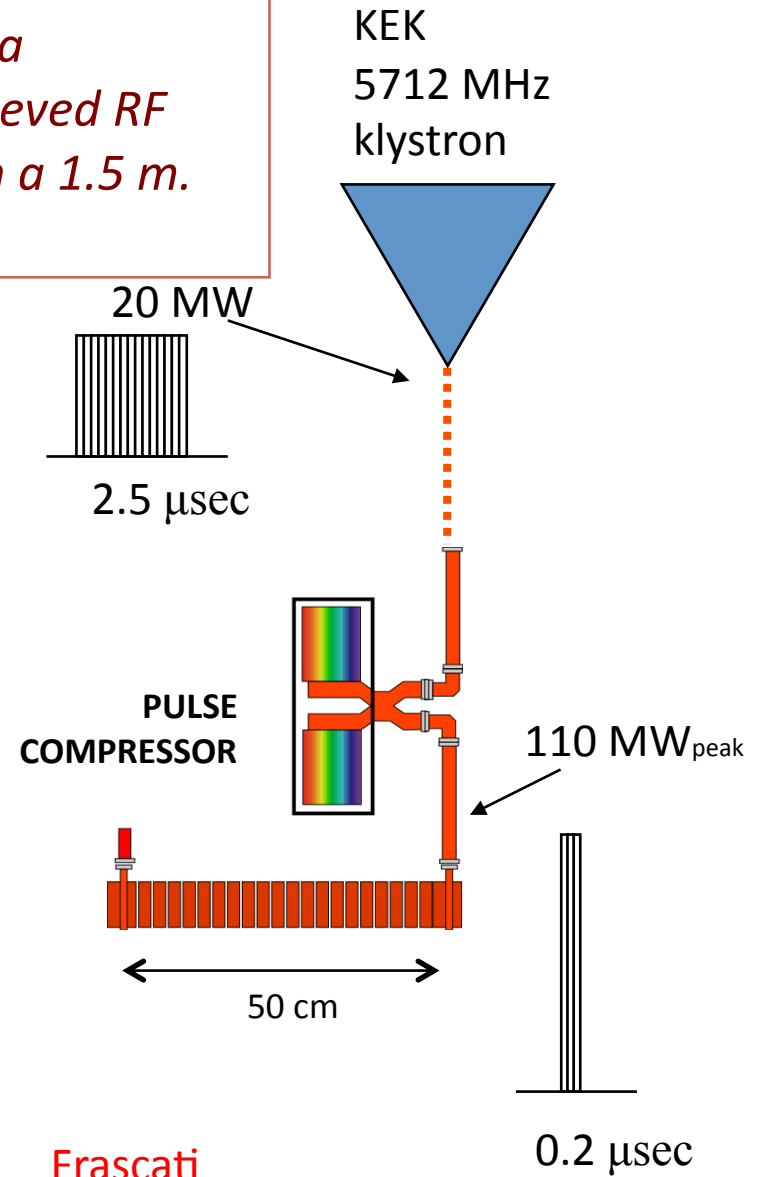
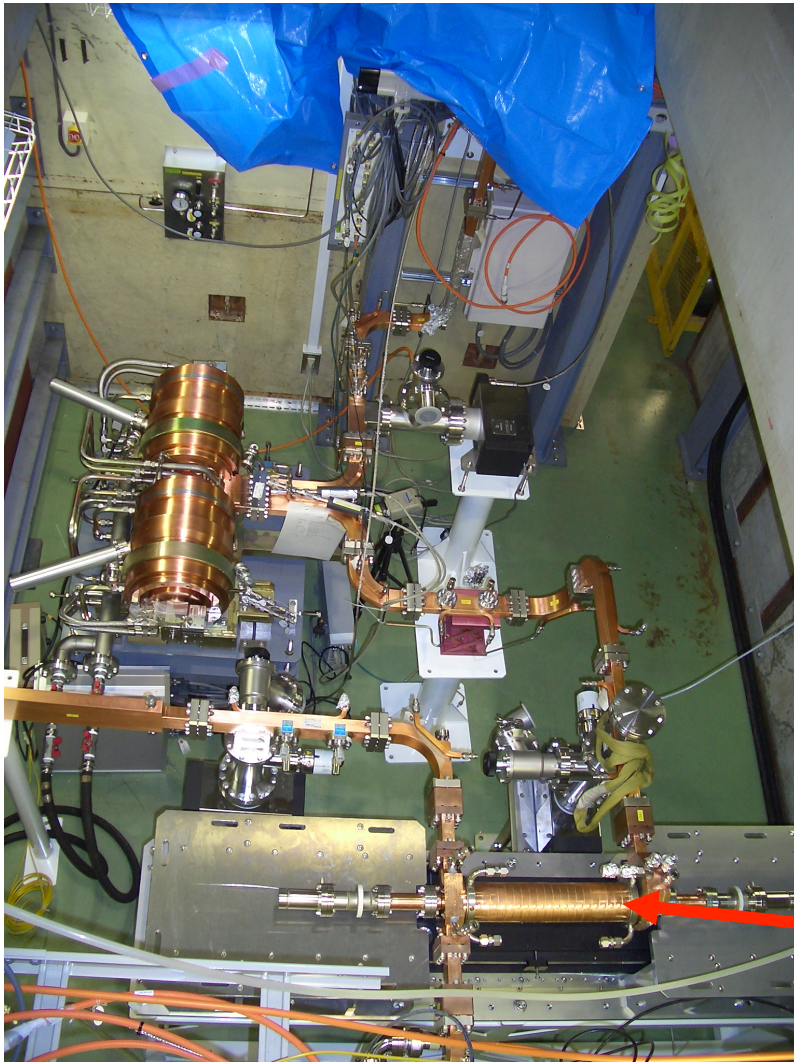
Design activity

- 1) The **aim of the activity** is to design and realize two 1.5 m long TW structures to be installed in SPARC.
- 2) The activity is divided in **two parts**:
 - a) **realization of a 20 cell structure** (~50 cm long) to be tested at High power (in Japan, KEK) in fall 2010. The structure is a prototype of the full structure and differs from this one only by the number of TW cells. It will be completely realized @ LNF since it fits the LNF oven;
 - b) **realization of the complete 1.5 m long structures.**

The mechanical drawings are ready for structure construction.



*Frascati C-band 50 cm Accelerating structure under test at KEK. So far, the achieved peak RF power is **110 MW** with a 'breakdown rate' of a few discharges/hour. The achieved RF field of 54 MeV/m corresponds to about 43 MV/m in a 1.5 m. long structure*



Frascati
C-band
prototype



Ministero dell'Università
e della Ricerca

sparX  *fel*



(2003) SPARC TEST FACILITY

(2005) SPARX R&D

(2007) SPARX-FEL Facility



SPARX Goals

SPARX workshops

- *INFN-LNF*
- *INFN-LNF*

09.05.2005
19.06.2007

SIMPOSI SPARX

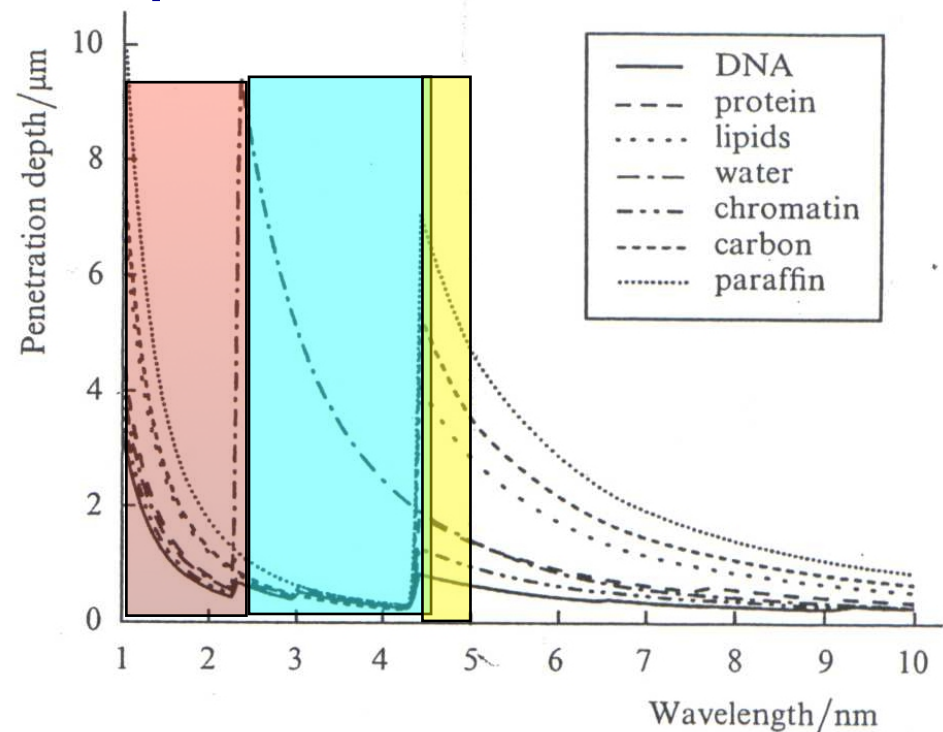
March, June and October 2008

Bio&Medical Sciences workshop - Rome
Bio&Medical Sciences workshop - London

March 2009
March 2010

Wavelength range :
0.6 - 40 nm

- water window
(~ 2.5 – 4.5 nm)
- carbon window
(~ 4.5 – 5.0 nm)



Boundary conditions for SPARX (2010)

- Accordo Quadro with Regione Lazio & MIUR (15+10 ME)
(necessary additional fundings of about 25 ME for Tor Vergata SPARX Project)
- It was included in the Italian Road Map of national infrastructures.
- It participated actively to the construction of a European Consortium of FELs and SPS through a PP of VII-UE-FP (EuroFEL)
- It was committed in the development of C/X band and PLWA technology in UE projects-

Giornata di Studio sul Piano Triennale 2011-2013

13-14 October 2010

LNGS

R. Petronzio:

- SparX moved to LNF
- Strong R&D and exploration of new ideas
- Allow for users
- Tor Vergata site only when economically affordable also thanks to technical progress

Roma, 02 DIC. 2010

OGGETTO: Progetto SPARX.

Dichiarazione d'intenti

Sulla scorta di quanto emerso nella riunione tenutasi il 10 settembre u.s. presso la sede dell'Istituto Nazionale di Fisica Nucleare (INFN) fra i sottoscritti: prof. Renato Lauro, Rettore dell'Università degli Studi di Roma "Tor Vergata", ing. Giovanni Lelli, Commissario dell'ENEA, prof. Luciano Maiani, Presidente del CNR, prof. Roberto Petronzio, Presidente dell'INFN, si ribadisce quanto segue.

Tenuto conto dello sforzo profuso dalla collaborazione nella realizzazione del progetto SPARX, in termini di studio, sperimentazione e sviluppo del citato progetto da parte dei ricercatori delle istituzioni coinvolte, nonché dei risultati già ottenuti ed altresì del mutato scenario internazionale che suggerisce lo studio di soluzioni innovative nello sviluppo dei sistemi di Free Electron Laser (FEL), riteniamo che quanto deciso nell'ambito della riunione suddetta sia la soluzione più appropriata per le fasi successive del progetto.


Preso, dunque, atto dell'interesse dell'Università di Roma "Tor Vergata" di ospitare SPARX nella sua versione finale, risulta opportuno, per ragioni tecniche ed economiche, avviare la realizzazione di una sorgente - che offra le prestazioni di una facility per l'utenza e di R & D per nuove soluzioni nell'ambito della Fisica dei laser ad elettroni liberi - presso i laboratori dell'INFN di Frascati per poi realizzare le successive azioni presso il Campus di "Tor Vergata" attraverso la stipula di una apposita convenzione, ferma restante la disponibilità delle risorse economiche.

Resta inteso che, per rendere concreta l'iniziativa, è necessario avviare immediatamente l'iter di costituzione del Consorzio LUCE con lo scopo di gestire le necessarie azioni e regolamentare i rapporti reciproci tra le Parti e tra esse e i Soggetti finanziatori.

In fede,


Renato Lauro

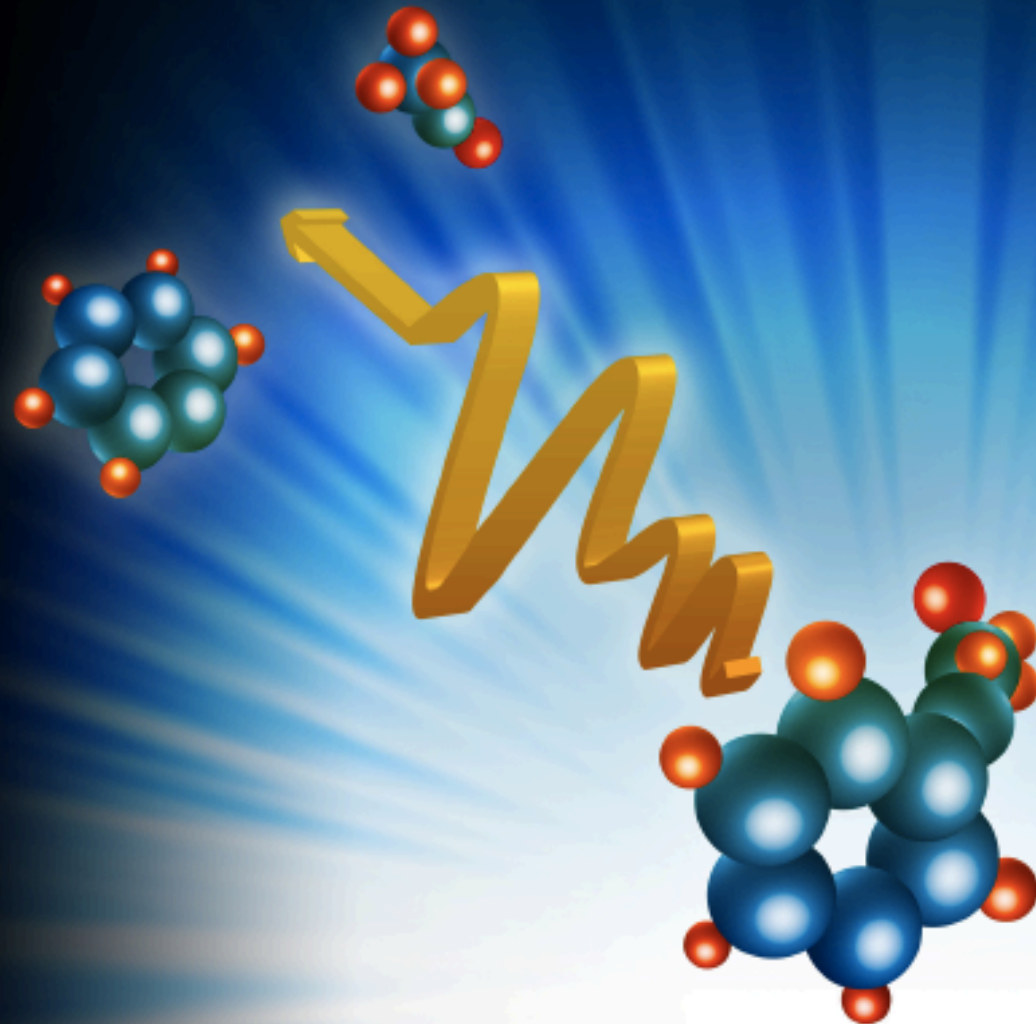

Giovanni Lelli


Luciano Maiani


Roberto Petronzio

Next Generation Photon Sources for Grand Challenges in Science and Energy

A REPORT OF A SUBCOMMITTEE TO THE BASIC ENERGY SCIENCES
ADVISORY COMMITTEE | MAY 2009



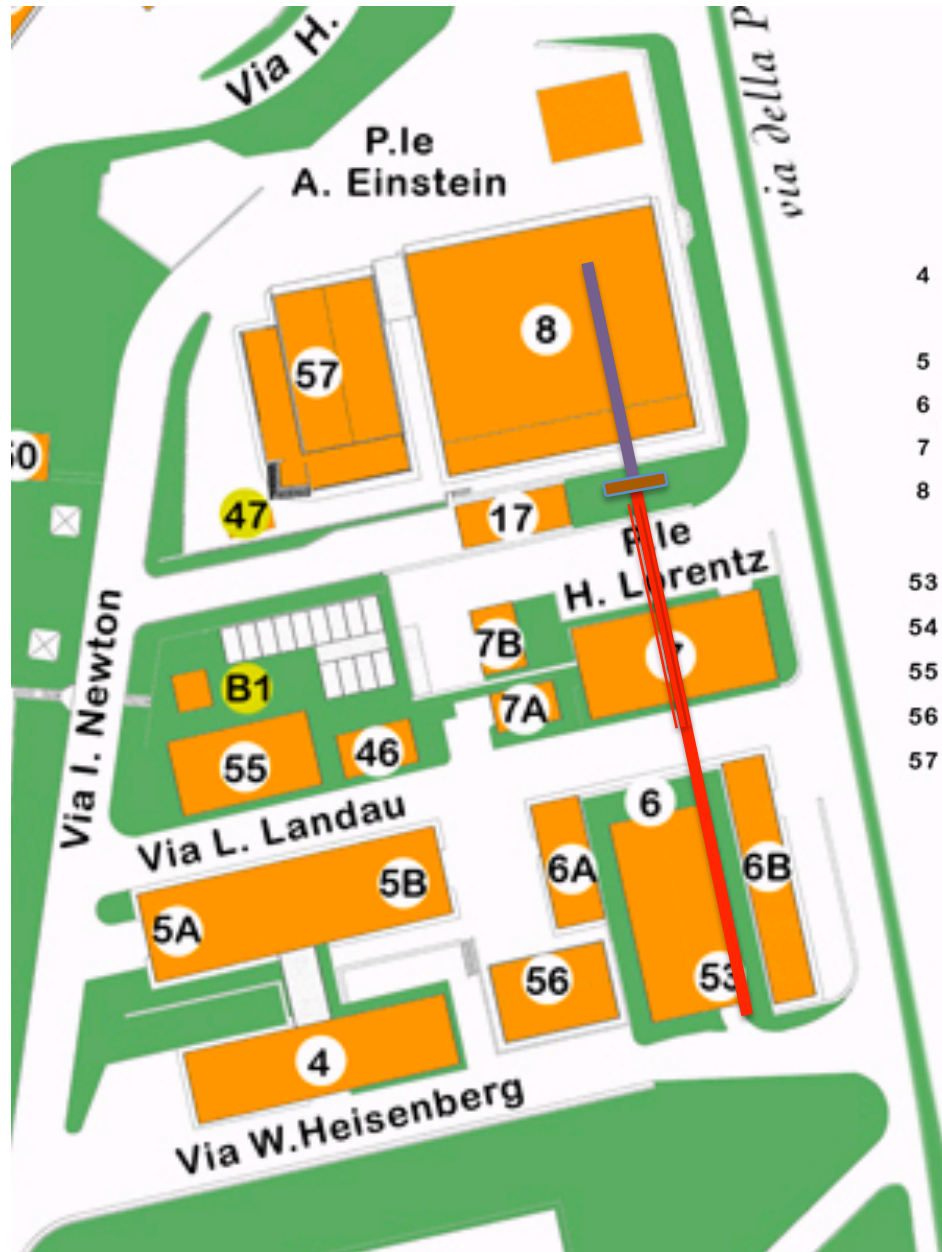


Proposta di realizzazione di
una sorgente FEL- UV presso i
laboratori di Frascati

Versione 1.0



31 Gennaio 2011

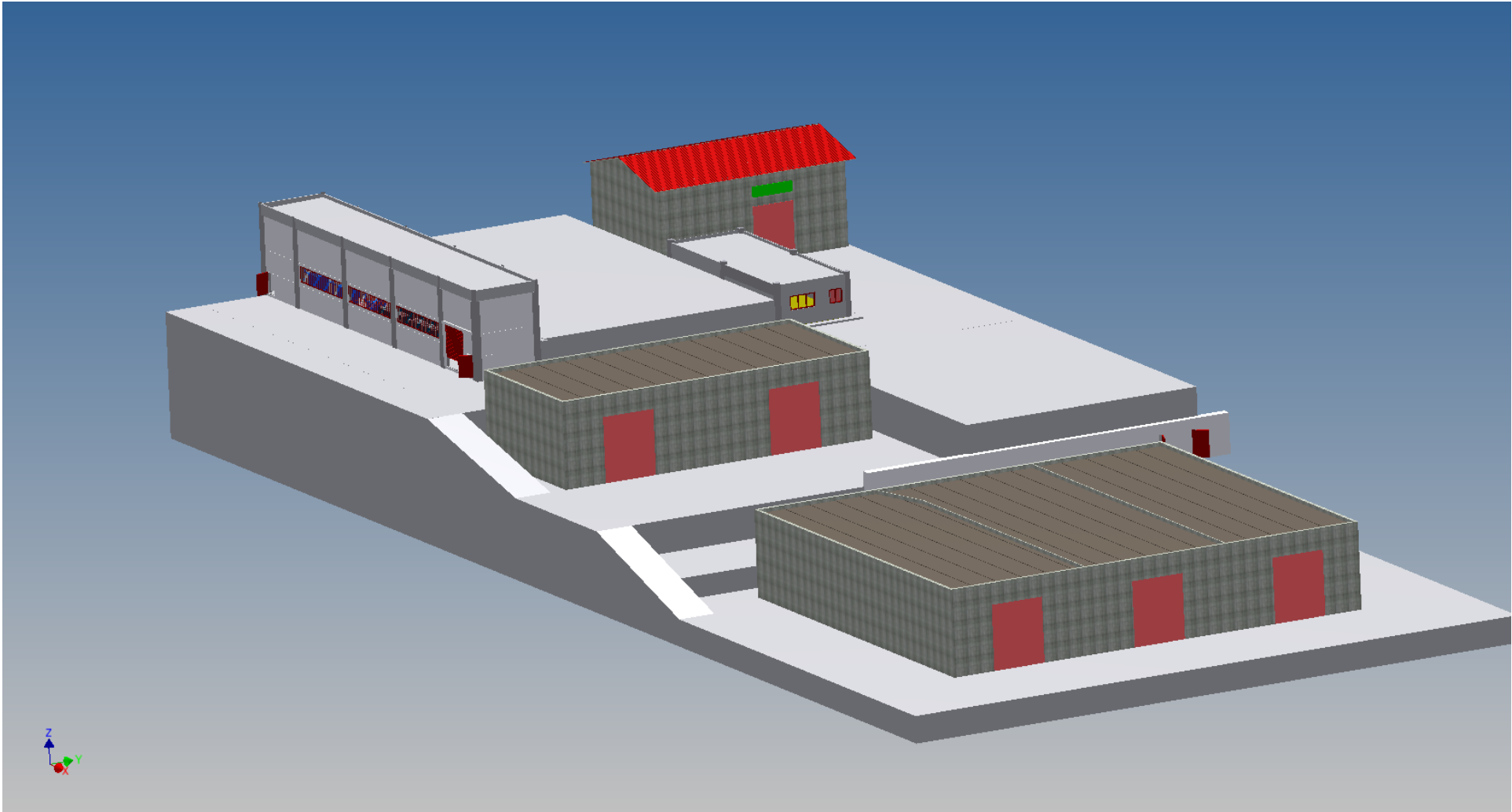
SPARX-750MeV@LNF



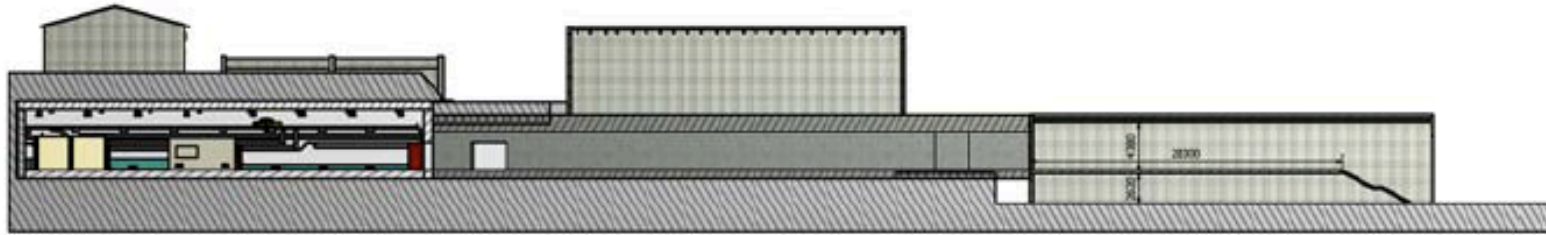
- 4 Puls - Servizio Meccanica ed Impianti
(Aula Master, Aula Puls)
- 5 Officine Servizi Ingegneria Meccanicas - 5a Laboratorio Servizi Vuoto
- 6 SPARC - 6a Sala Controllo - 6b Sala Macchine
- 7 Laboratorio Tecnologie - 7a & 7b Sala Compressori
- 8 Laboratori Gran Sasso ed Antenna Gravitazionale NAUTILUS

- 53 Capannone deposito materiale
- 54 Sala controllo BTF
- 55 Uffici SPARC
- 56 Laboratorio FLAME in assetto provvisorio
- 57 Ampliamento Laboratorio GRAN SASSO e annessi uffici

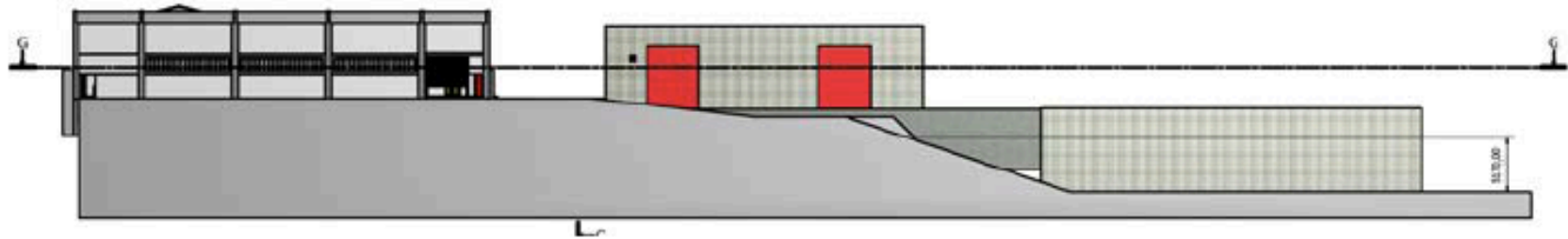
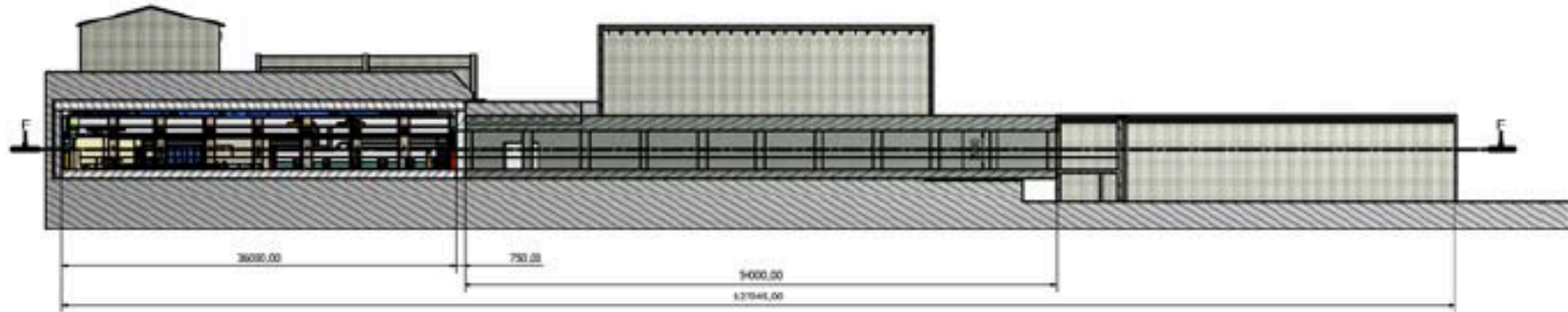
-  SPARX Linac+undulators
-  SPARX VUV optical line



D-D (1 : 200)

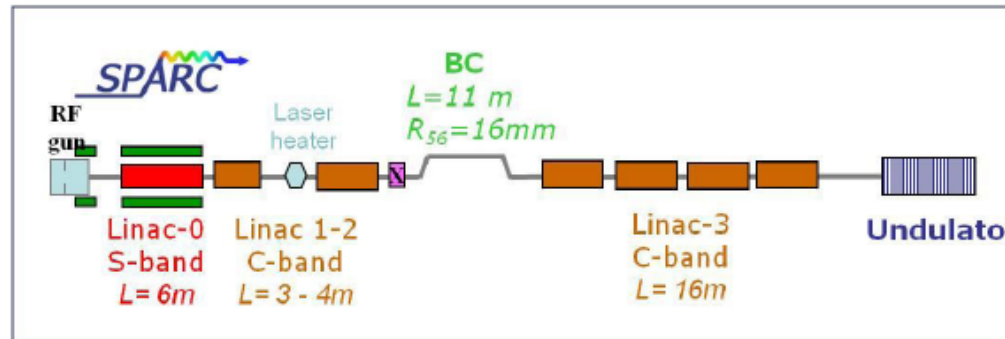


A-A (1 : 200)



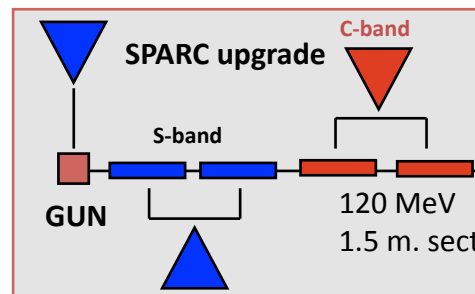
SPARC-X, Energy upgrade to 750 MeV

Following the successful result of the prototype power test, an average C-band RF gradient of 40 MV/m can be considered for the SPARC energy upgrade to 750 MeV.



General layout of SPARC-X-750

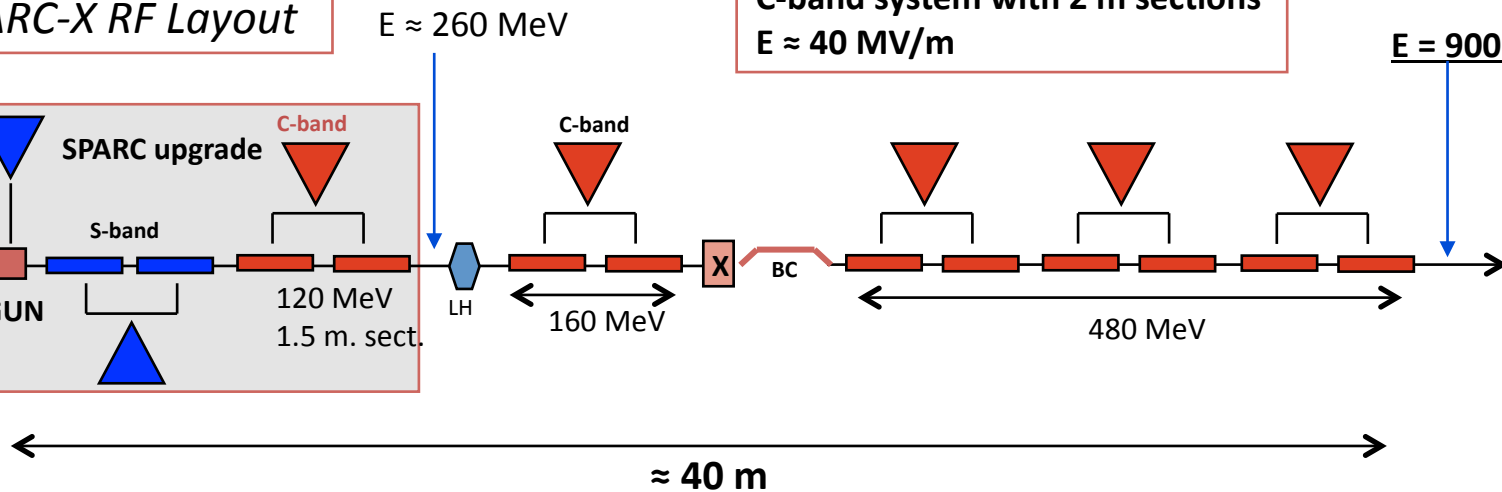
SPARC-X RF Layout

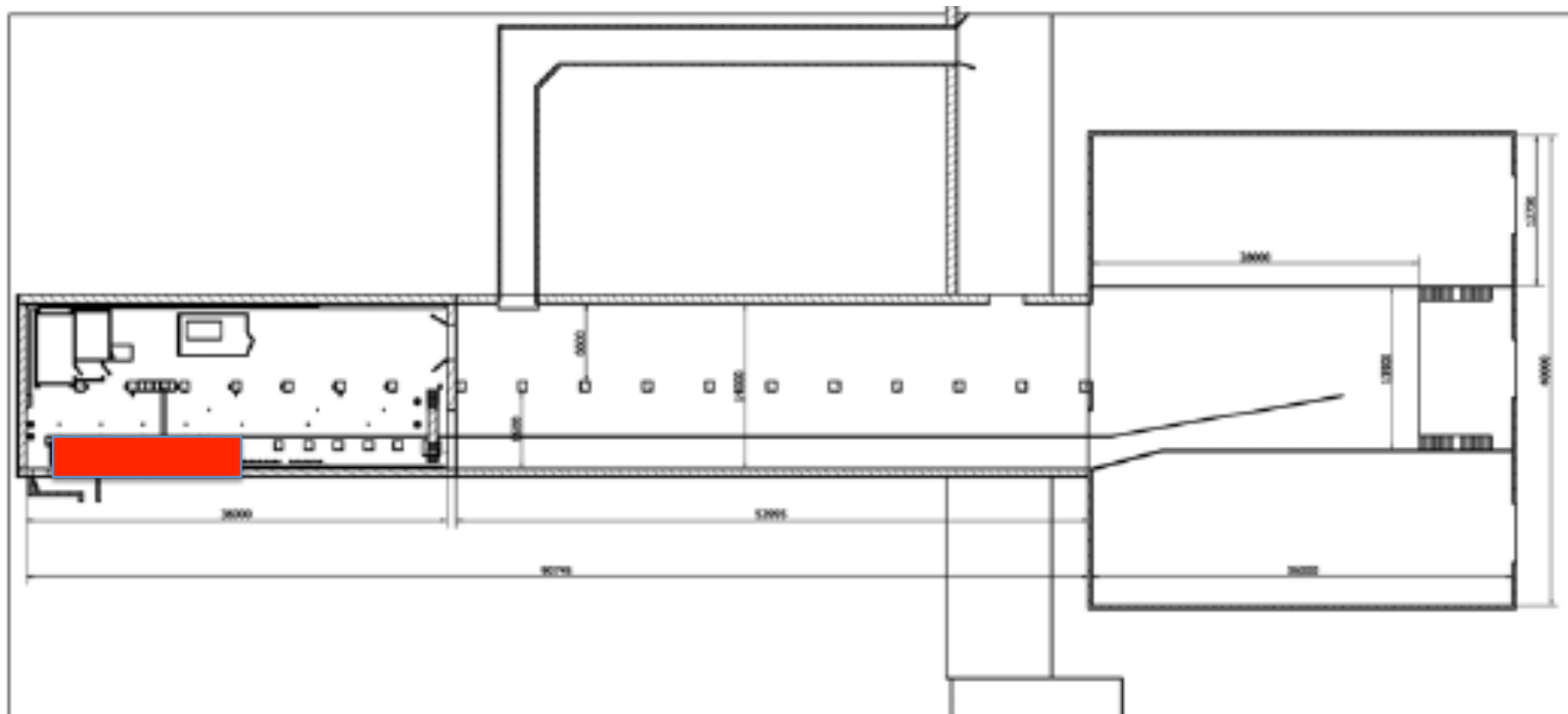


$E \approx 260$ MeV

C-band system with 2 m sections
 $E \approx 40$ MV/m

$E = 900$ MeV (on crest)





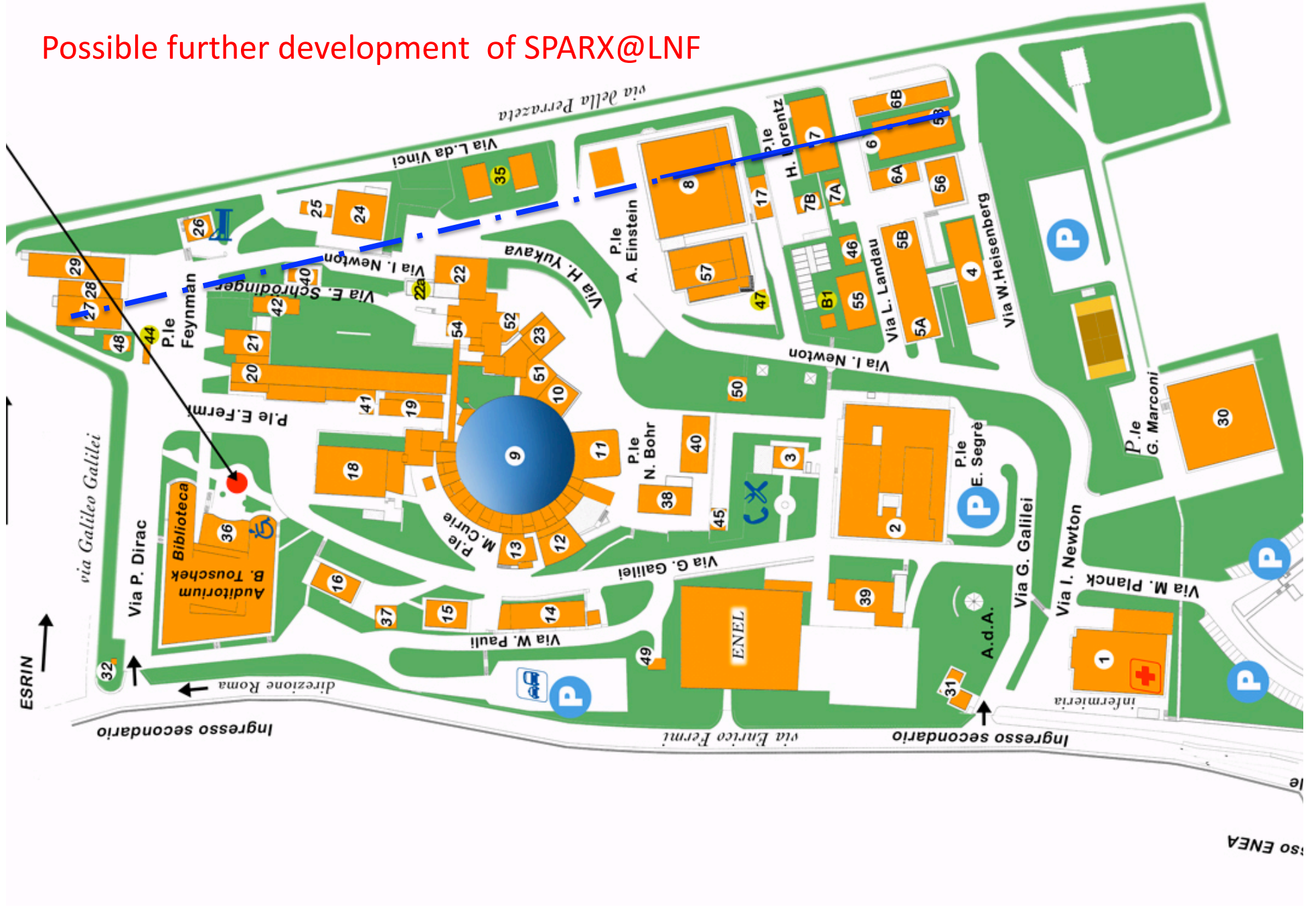
R&D-1. – (mature)

- 1. Hybrid S/C band Linac @750 MeV**
- 2. High gradient RF**
- 3. Ultrashort VUV pulses (sub-femto, attosecond)**
- 4. Multiple beams/RF pulse (COMB)**
- 5. Synchronization**
- 6. Seeding & harmonic cascade**
- 7. Fresh bunch technique**
- 8. Advanced undulator technology**
- 9. Photon beam optics**
- 10. Detectors and experimental techniques**

R&D-2. – (future ... linked to PlasmonX)

- 1. Plasma booster based on PWFA (up to 1.5-2 GeV)**
- 2. Compton Source (gamma photons 5-20 MeV)**
- 3. All Optical FEL (PWFA + HI Laser)**
- 4. Photon-electron Collider**
- 5.**

Possible further development of SPARX@LNF



EXTERNAL FUNDING (to INFN)

MIUR - FISR 2003 circa 2.5 ME (SPARC)

MIUR
MIUR



<i>Fondi nazionali</i>		Finanziamento INFN (in €)
FIRB Fase 1	RBAP04AXM5_001	3.290.173
FIRB Fase 2	RBAP006AHF8_002	2.807.112
Regione Lazio	Legge finanziaria regione n.4/2006, articolo 182, 5 annualità (2006-2008) di 5 M€ ciascuna	15.000.000
<i>Fondi internazionali UE</i>		
EUROFEL	FP6 Contract 011935, Design Study	960.389
CARE JPAPHIN	FP6 Contract 506395, I3	500.000
IA-SFS	FP6 Contract 506008, I3	310.800
IRUVX-FEL	FP7 Contract 211285, Preparatory Phase	181.144
ELISA JRA FELINS	FP7 Contract 226716, I3	101.610
EuCARD WP ANAC	FP7 Contract 227579, I3	80.000

MIUR : 10 MEuro (linked to “Accordo Quadro”)

2011 : too long delay with SPARX Consortium

MIUR - FISR 2003 circa 2.5 ME (SPARC)

MIUR
MIUR

<i>Fondi nazionali</i>		Finanziamento INFN (in €)
FIRB Fase 1	RBAP04AXM5 001	3.290.173
FIRB Fase 2	RBAP006AHF8 002	2.807.112
Regione Lazio	Legge finanziaria regione n.4/2006, articolo 182, 5 annualità (2006-2008) di 5 M€ ciascuna	15.000.000
<i>Fondi internazionali UE</i>		
EUROFEL	FP6 Contract 011935, Design Study	960.389
CARE JPAPHIN	FP6 Contract 506395, I3	500.000
IA-SFS	FP6 Contract 506008, I3	310.800
IRUVX-FEL	FP7 Contract 211285, Preparatory Phase	181.144
ELISA JRA FELINS	FP7 Contract 226716, I3	101.610
EuCARD WP ANAC	FP7 Contract 227579, I3	80.000

MIUR : 10 Meuro

NECESSARY TO RE-NEGOTIATE WITH REGIONE AND MIUR

INFN withdrew from UE-ESFRI projects

- EuroFEL

(INFN-ST)  ST

- X-FEL

(INFN)  ST

- ELI

(CNR-INFN)  (CNR- ST?)

Conclusions (1)

- 1.5 GeV - SPARX@Roma2 University is definitely dead.
- 750 MEV SPARX@LNF has been proposed by the partners institutions (CNR, ENEA, INFN, Univ Roma2).
- A preliminary project has been completed on Jan 2011.
- SPARX R&D program funded (10 ME) by MIUR will finish in February 2012.
- There is no information so far about further funding.
- Despite SPARX is in the 2010-12 plans of INFN at LNF, at the moment the project seems to have a very low priority.

Conclusions (2)

- There is a risk that this inter-disciplinary activity will lose funding opportunities, regional, national and international (UE). (Some already lost!!!!).
- LNF might see in few years an ineluctable decay of FEL activities, with disaggregation of the machine and user communities (INFN, CNR, ENEA, Universities).
- It's urgent to clarify which strategic priority has SPARX@LNF, and then make the necessary paces accordingly.