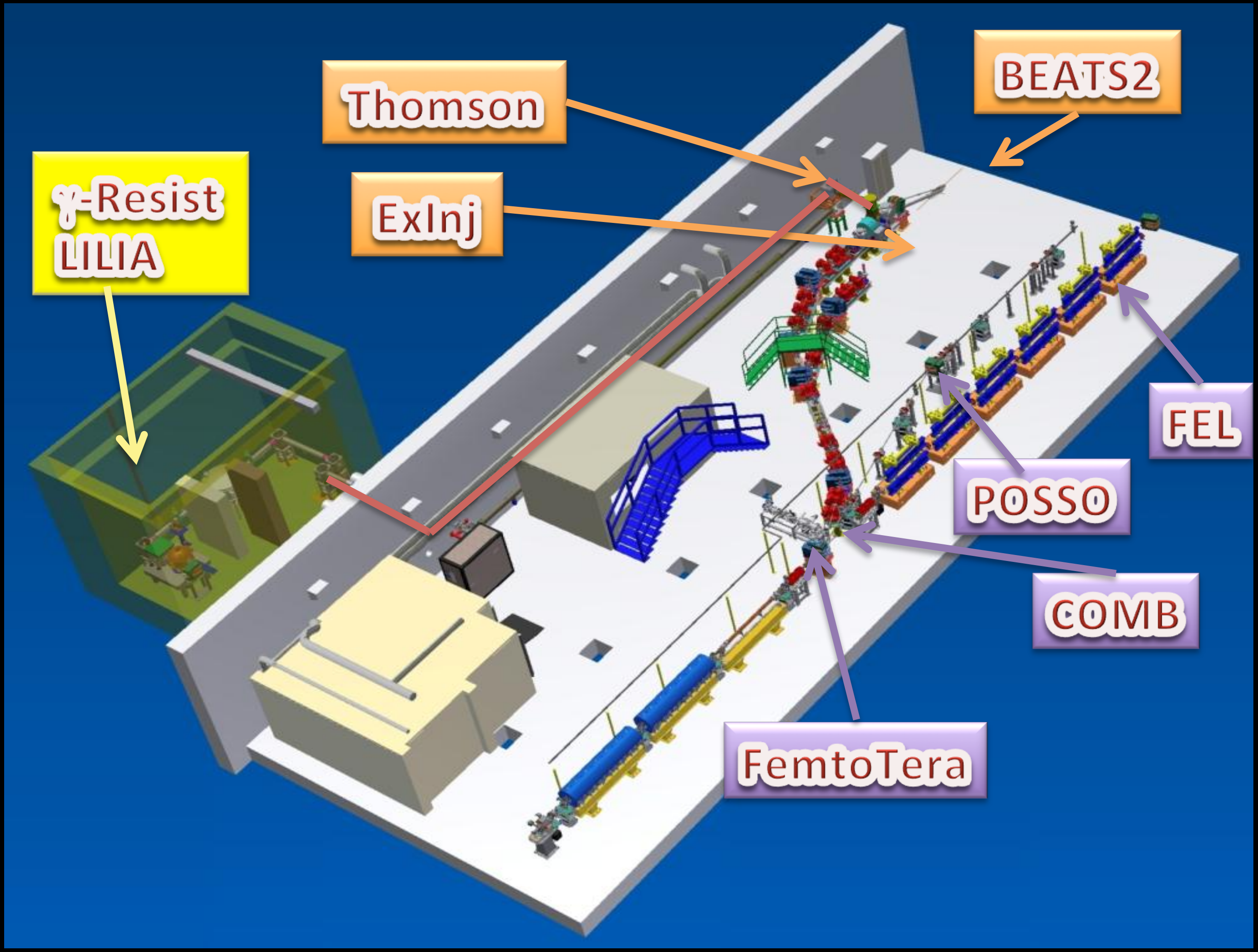
4th SPARC_LAB PAC Meeting



LNF- November 14, 2013

4th SPARC_LAB PAC Meeting

15:00 Welcome – U. Dosselli
15:07 Introduction – P. Muggli
15:15 SPARC_LAB status and plans – M. Ferrario
15:45 Thomson source status– C. Vaccarezza

16:00 Coffee Break

16:15 FLAME activities – G. Gatti
16:30 Experiments with THz radiation– S. Lupi
16:45 Collaboration with Stratclyde University – M. P. Anania
17:00 STAR/SPARC_LAB collaboration – D. T. Palmer
17:15 Measuring Propagation Speed of Coulomb Fields - G. Pizzella

17:30 Final Discussion – P. Muggli

https://agenda.infn.it/conferenceDisplay.py?confId=6941

What has been done since PAC_3

EXPECTED	May	June	July	Aug/Sept	Oct	Nov	Dec
Thomson	Electron Transp.	Photon Transp.	Synch. & First Collisions		Collisions	Collisions /Users	Users
FEL	Seeded 2 Colors Exp.			Inst. New Und.			Exp. With New Und.
THZ		Exp.	Exp.				
C-band	HP Test	HP Test	HP Test	Inst. on line			
Protons	Exp.						
Plasma/ Compton		Exp.					
ExInj./ Comb	Simulatio ns	EoS	Int. Chamber		Int. Chamber	Int. Chamber	Int. Chamber

Actual	May	June	July	Aug	Sept.	Oct/Nov
Thomson	Electron Transp./ Laser C. room pb	Electron Transp/ Kly problem	Electron Transp/ Kly problem		Kly problem fixing	Electron Transp
FEL			Seeded 2 Colors Tentative			
THZ		COMB EOS/THz	Stratc. Univ	Short pulse test		TH Exp.
C-band	RF Test	RF Test	RF Test		Inst. Off line	Conditioning>15 MW
Protons		Test				
Plasma/ Compton		Exp.				
ExInj./ Comb	Simulations	Int. Chamber	EOS/ emitt.			

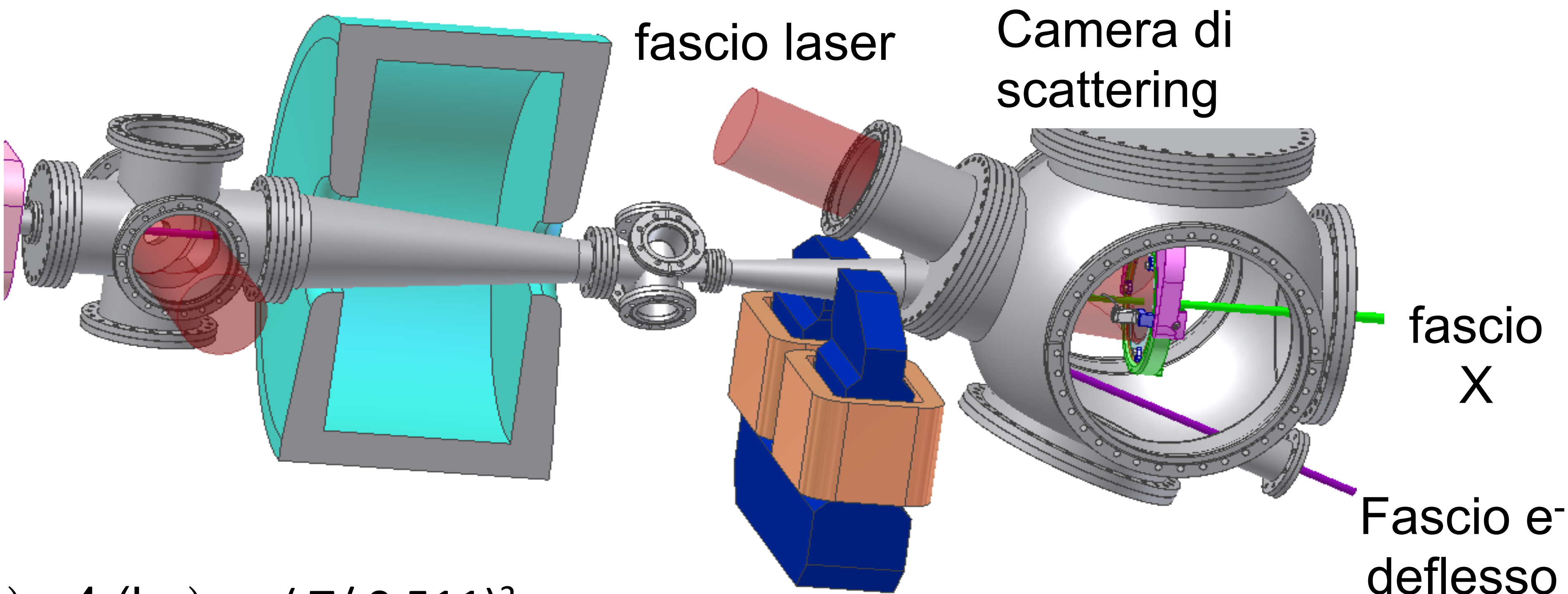
X-ray THOMSON Source

C. Vaccarezza / M. P. Anania / G. Gatti talks

STAR Colaboration

D. T. Palmer talk

Thomson Interaction region (20-550 keV)



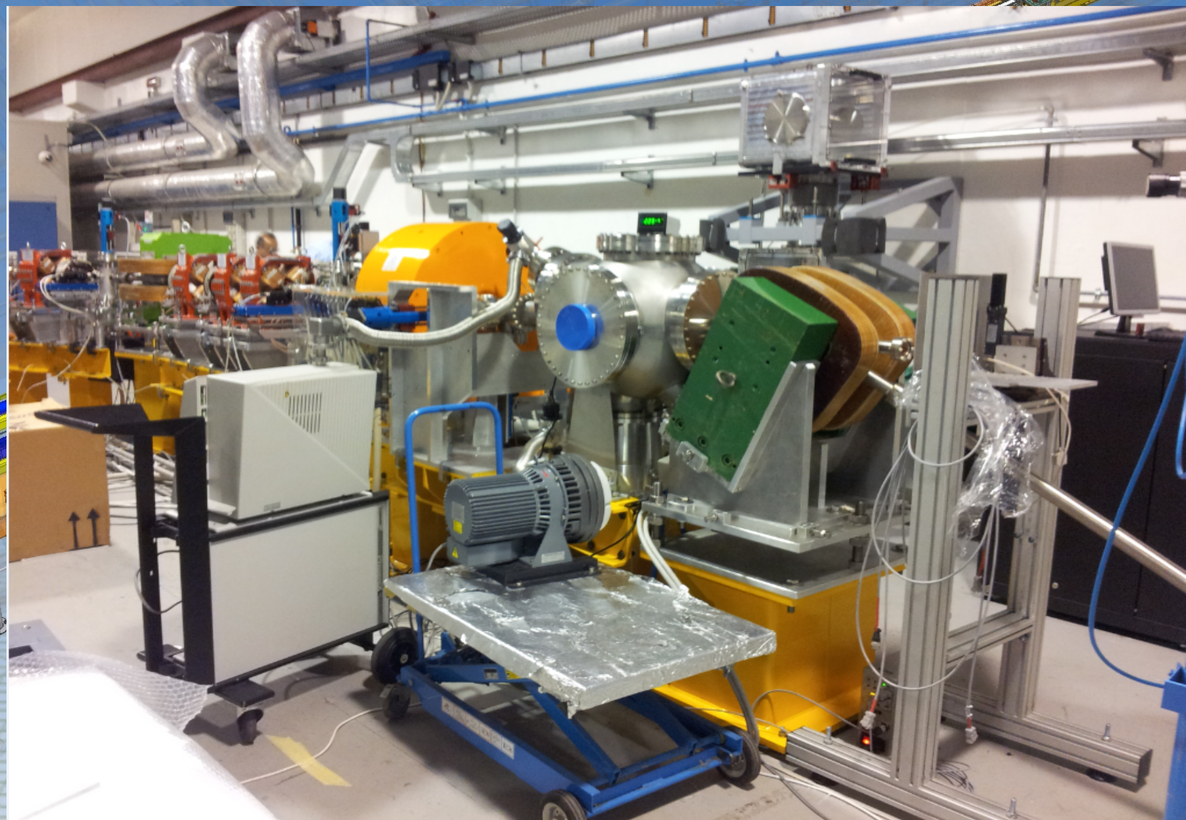
$(h\nu)_X = 4\ (h\nu)_{laser}\ (T/\ 0.511)^2$

$(h\nu)_{laser} = 1.2$ eV
T =30.28 MeV
$(h\nu)_X$ = 20 keV mammografia

Impulso laser: 6 ps, 5 J
pacchetto e^- : 1 nC , l: 2 mm (rms)
Impulso X: 10 ps, 10^9 fotoni
α emissione: 12 mrad

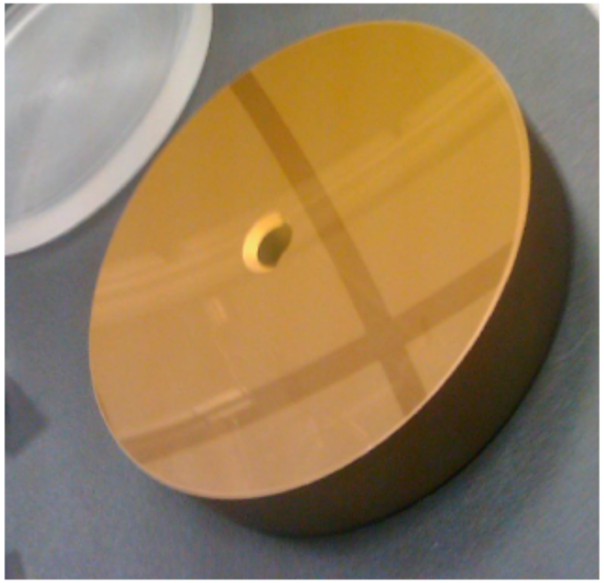
Thomson back-scattering source

carica (pC)	energia (MeV)	enx (mm mrad)	eny (mm mrad)	IP sigmax mm	IP sigmay (mm)
230	157	2.7	4.5	.50	.55
220 230	75 50	2.9 1.2	5 2.3	.28 .17	.36 .18



Thomson Beamline

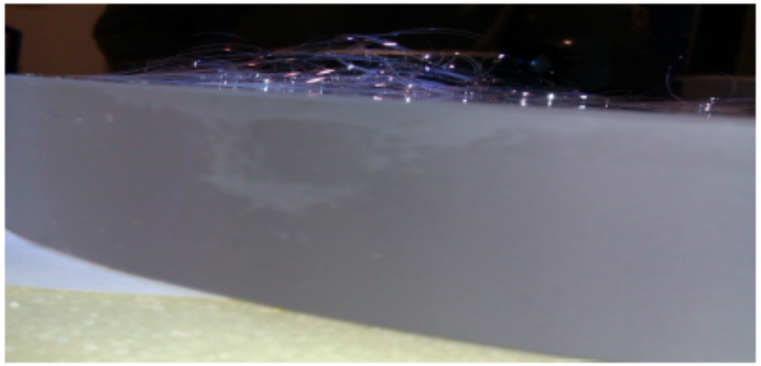
FINAL FOCUS



“Defective” OAP Ready to be mounted

F.F. Installation and line alignment under way during the present weeks

Some Issues..



But work in progress

Synchronization

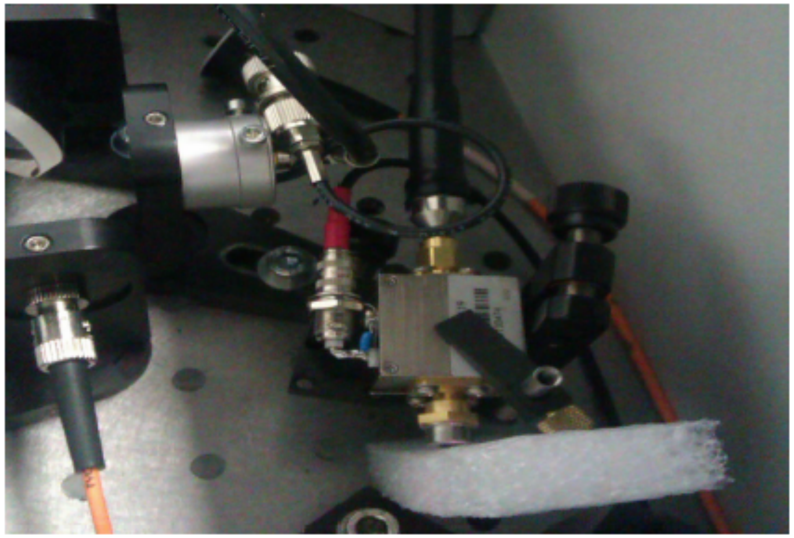
Slow EXT. Synchronization almost complete (Interaction with linac now possible)

NEW MODULE

Fast Synchronization (step 1) was already installed and checked (Electronic distribution)

Some work under way in order to
improve performance of
the system (bandwith of the loop)

Preparation work in progress
For optical synchroniz.



STAR: **S**outhern Europe **T**homson back-scattering source for **A**pplied **R**esearch

SPARC Program Advisory Committee
22 Oct 2013

Dennis T. Palmer, INFN-Milano

Electron Machine Parameters

Beam Parameter	Phase 1	Phase 2
Bunch Charge (nC)	0.5	0.5
Energy (MeV)	20 - 60	20 - 85
RMS Bunch Length (ps)	1 - 5	1 - 5
$\varepsilon_{n\_x,y}$ (mm-mrad)	1 - 3	< 1.5
Energy Spread (%)	0.1 - 2	0.05 - 0.5
RMS Focal Spot Size (μm)	15 - 40	10 - 40

Photon Machine Parameters

Parameter	IP Laser	PC Laser
Repetition rate (Hz)	100	100
Oscillator Repetition rate	39 2/3 MHz	39 2/3 MHz
Output Energy (mJ)	> 130 mJ (IR)	> 300 μJ (UV)
Short Term Energy Stability (rms)	3 %	1 %
Long Term Energy Stability (P2P)	< 5 %	< 2 %
Wavelength	1029 nm	258 nm
Jitter (rms) 10 – 10 KHz	<1 ps	< 1 ps
Bandwidth	< 0.5 nm	< 1 nm
Technology	Yb:YAG	Yb:KGW
Amplifier Pump Technology	QCW Diode Pumps	CW Diode Pump
Pulse duration (ps FWHM)	5	5
Beam diameter (FW $1/e^2$ mm)	10 mm < X < 15 mm	1 mm < X < 2 mm
Strehl Ratio	0.8	NA
M^2	NA	1.3

Managment Board

Coordinator (Ezio Puppin)
CNISM Representative (Raffaele Agostino)
Unical Representative (Mauro Ghedini)
INFN Representative (Andrea Ghigo)
ST Representative (Edoardo Busetto)

Advisory Committee

Claudia Dallera
Massimo Ferrario
Federico Boscherini
Giorgio Rossi

Project Director

Leader: Luca Serafini
Deputy: Dennis Palmer

Management Team

segreteria, consulenti amministrativi e legali

Alberto Bacci
Paolo Tomassini
Gianluca Diraddo

Roberto Boni
Dennis Palmer

Tadzio Levato
Fabio Villa
Giancarlo Gatti

WP1a	BEAM DYNAMICS SIMULATIONS
WP1b	THOMSON BACK-SCATTERING
WP1c	BEAMLINE LAY-OUT
WP2a	RF POWER SOURCE: ST
WP2b	RF WAVEGUIDE SYSTEM
WP2c	RF STRUCTURES
WP3a	LASER SYSTEMS IP AND PC
WP3b	LASER SYSTEM AND DIAGNOSTICS

WP4A	MAGNETS AND POWER SUPPLIES
WP4B	VACUUM SYSTEM
WP4C	BEAM DIAGNOSTICS
WP5A	CONTROL SYSTEM: ST
WP6A	CONVENTIONAL FACILITY
WP6B	CABLE PLANT
WP7A	RADIATION SAFETY SYSTEMS
WP7B	LASER SAFETY SYSTEMS

Cristina Vaccarezza
Valerio Lollo
Alessandro Cianchi

Verardo Torri

Adolfo Esposito
Fiorello Martire

Campus di Arcavacata UNIVERSITÀ DELLA CALABRIA

cnism

MaTeRiA materiali, tecnologie e ricerca avanzata

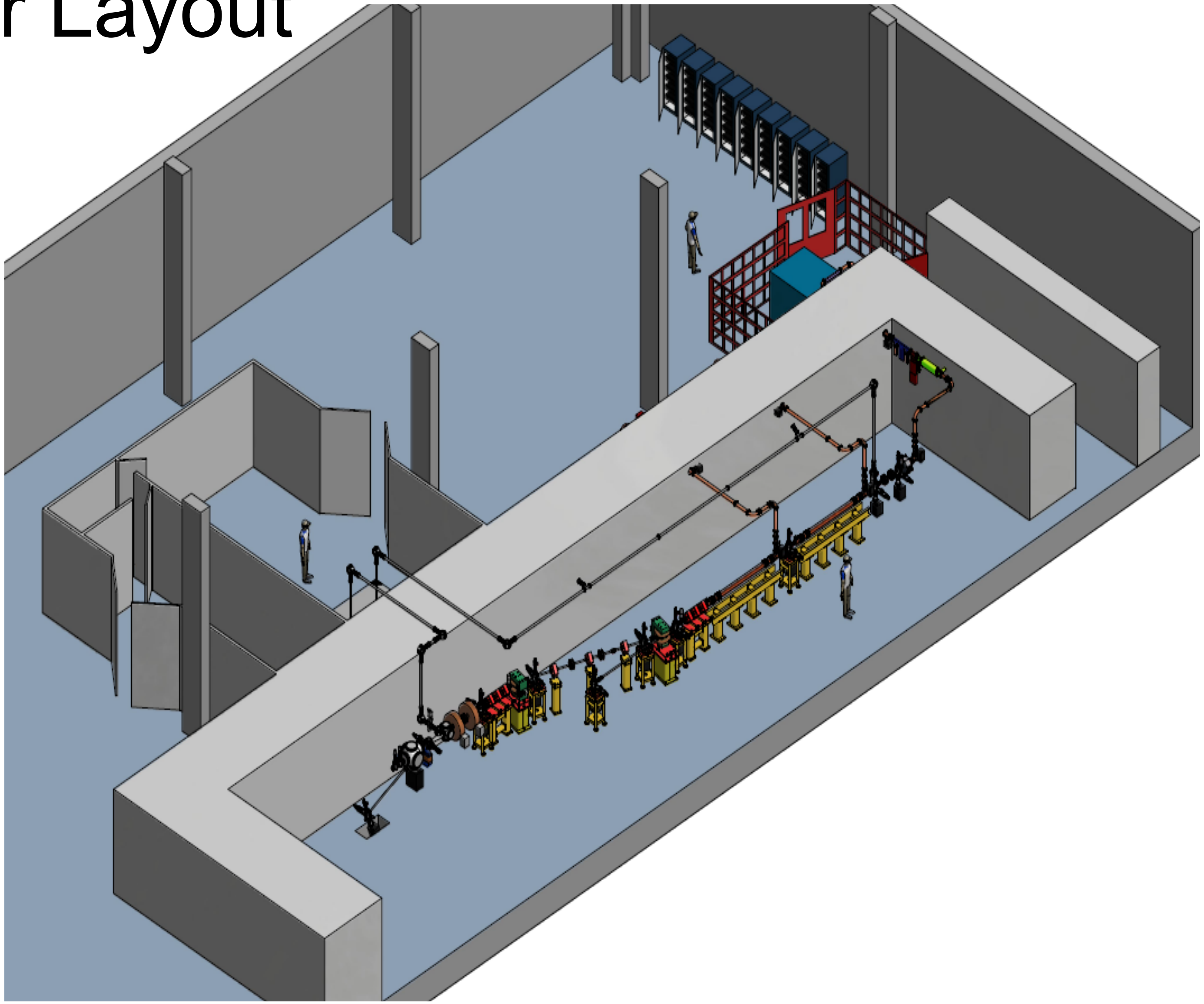
INFN Istituto Nazionale di Fisica Nucleare

elettra Sincrotrone Trieste Elettra and FERMI lightsources

Hangar and Bunker Construction at University of Calabria

UNIVERSITÀ DELLA CALABRIA · cnism · MaTeRiA · INFN · Sincrotrone Trieste — Elettra and FERMI lightsources

STAR Bunker Layout



JOURNAL OF APPLIED PHYSICS **113**, 194508 (2013)

Electron Linac design to drive bright Compton back-scattering gamma-ray sources

A. Bacci,[1] D. Alesini,[2] P. Antici,[3] M. Bellaveglia,[2] R. Boni,[2] E. Chiadroni,[2] A. Cianchi,[4] C. Curatolo,[1,5] G. Di Pirro,[2] A. Esposito,[2] M. Ferrario,[2] A. Gallo,[2] G. Gatti,[2] A. Ghigo,[2] M. Migliorati,[3] A. Mostacci,[3] L. Palumbo,[3] V. Petrillo,[1,5] R. Pompili,[2,4] C. Ronsivalle,[6] A. R. Rossi,[1] L. Serafini,[1] B. Spataro,[2] P. Tomassini,[5] and C. Vaccarezza[2]

Physics and Applications of High Brightness Beams Workshop, HBEB 2013

Inverse Compton cross section revisited

C. Curatolo[a,b,*], L. Lanz[a], V. Petrillo[a,b]

[a] *University of Milan, via Celoria 16, 20133 Milan, Italy*
[b] *INFN - Milan, via Celoria 16, 20133 Milan, Italy*

Dual color X-rays from Thomson/ Compton sources

V. Petrillo[1,2], A.Bacci[1], C. Curatolo[1,2], M. Ferrario[3], C. Maroli[2], J.V. Rau, C. Ronsivalle[4], L. Serafini[1], C. Vaccarezza[3], and M. Venturelli[2*]

[1] *INFN Milano ,Via Celoria, 16 20133 Milano, Italy*
[2] *Università degli Studi di Milano, Via Celoria, 16 20133 Milano, Italy*
[3] *LNF, INFN Via E.Fermi, 40 Frascati (Roma), Italy and*
[4] *ENEA Via E.Fermi, 45 Frascati (Roma),Italy*

PAC Findings and Recommendations

15:45 Thomson source – C. Vaccarezza

The commissioning of the Thomson source made giant steps forward in relatively few days of operation. The electron beam was transported first at high energy to the interaction point and then the transport was scaled successfully down to close to the desired energy (50 instead of 30MeV). The next step is to focus the effort on the photon beam line transport. This is one of the key SPARC_LAB program, interesting by itself, but also strongly linked to the possible participation in the ELI-NP Compton source program, as well as in the STAR program. The committee is impressed by the progress over the last six months.

17:00 Star/Sparc_lab collaboration – D. T. Palmer

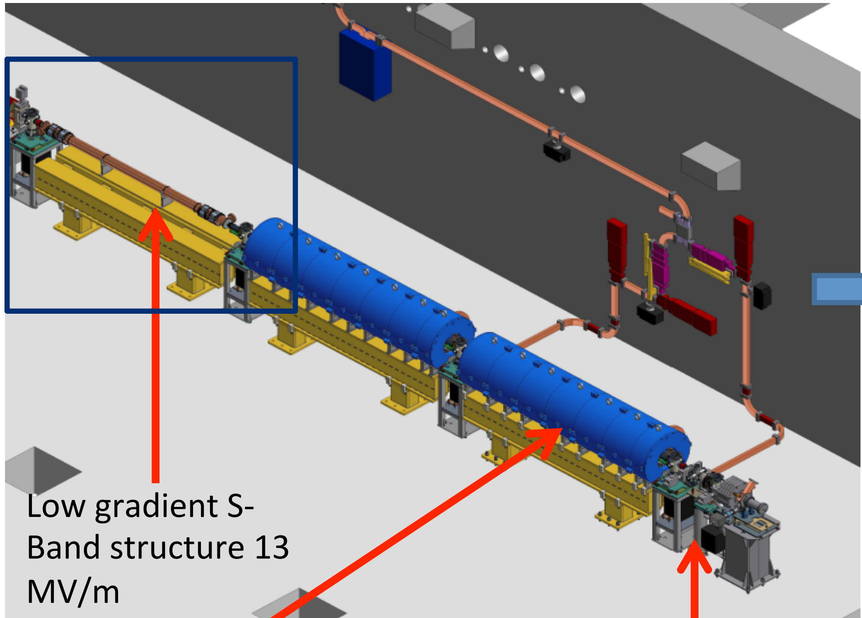
This is a collaboration in which SPARC_LAB acts as consultant assisting in the conception and commissioning of a Thompson x-ray facility in the framework of economic development help to a specific region of Italy. Besides the very positive societal impact of the project, the expertise needed and the interaction with the scientists and students of the University of Calabria brings extra know-how and staff to the laboratory. The project also serves as a training ground for the possible participation (at much larger scale) of the laboratory in the ELI-NP project. The committee strongly supports this project, which has a definitive ending date of Dec. 31, 2014 and has no strong commitment attached to the successful commissioning. It is also a source for potential synergies with other projects and activities of the SPARC_LAB.

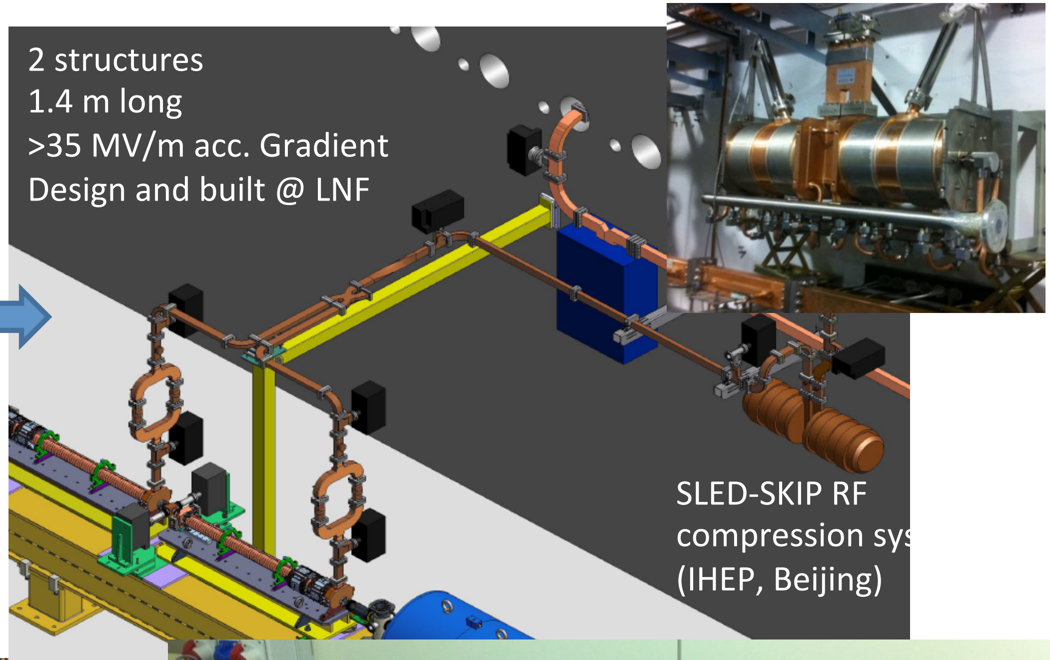
C-BAND for SPARC_LAB and ELI_NP

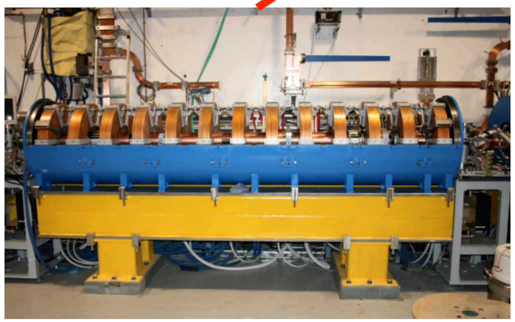
Courtesy D. Alesini

C-BAND ACCELERATING SYSTEM @ SPARC

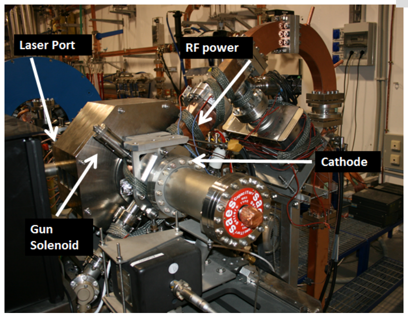
The **energy upgrade of the SPARC** photo-injector at LNF-INFN from 150 to more than 240 MeV will be done by replacing a low gradient S-Band accelerating structure with two C-band structures. The structures are **TW and CI**, have symmetric axial input couplers and have been optimized to work with a SLED RF input pulse. In the SPARC photoinjector the choice of the C-band for the energy upgrade was dictated by the opportunity to **achieve a higher accelerating gradient**, enabled by the higher frequency, and to **explore a C-band acceleration combined with an S-band injector** that, at least from beam dynamics simulations was very promising in terms of achievable beam quality.



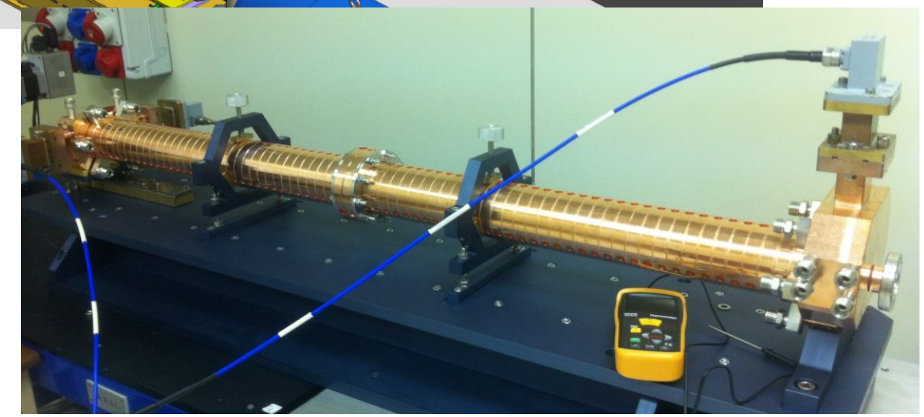




S-Band SLAC-type structure
22 MV/m



S-Band gun 120 MV/m

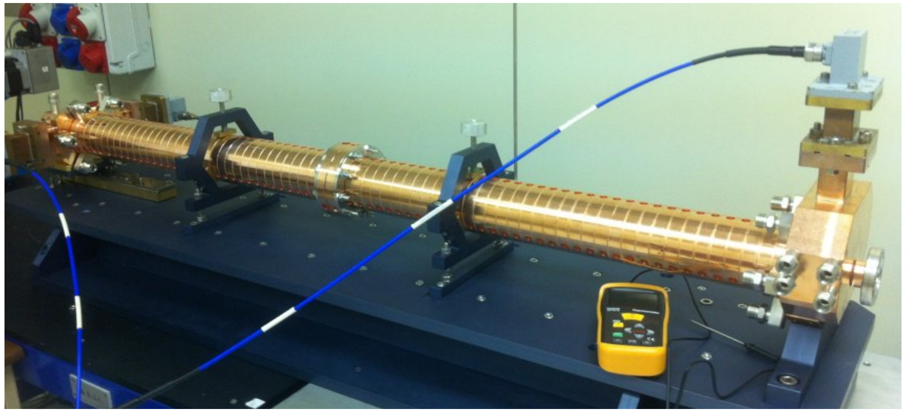


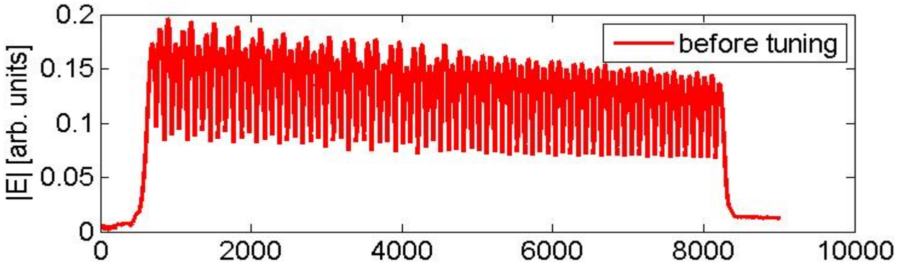
FINAL C-BAND STRUCTURES AND TEST AT SPARC

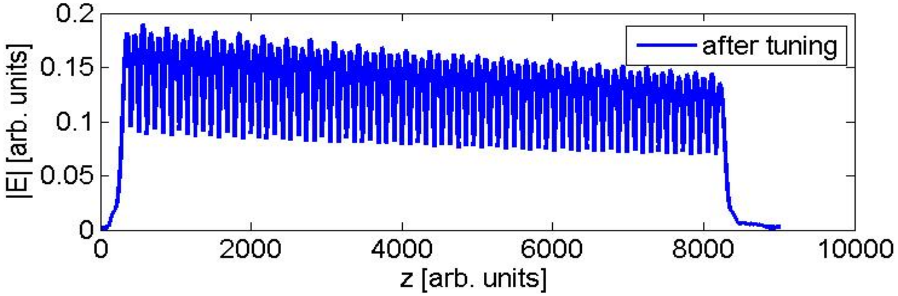
Toshiba klystron and solid state modulator by Scandinova

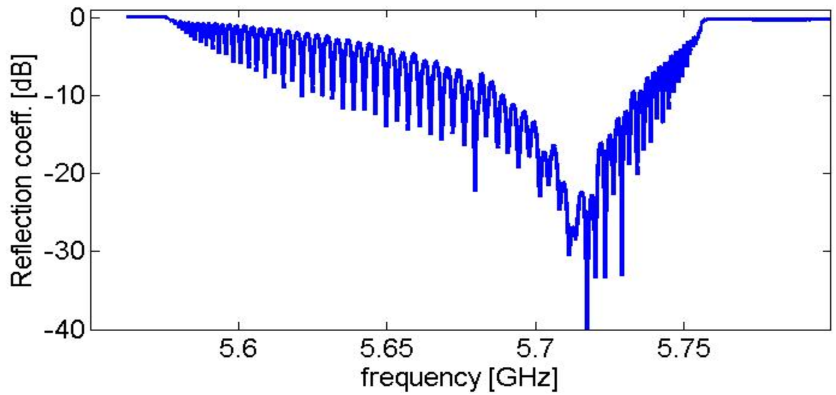
Test stand for high power test

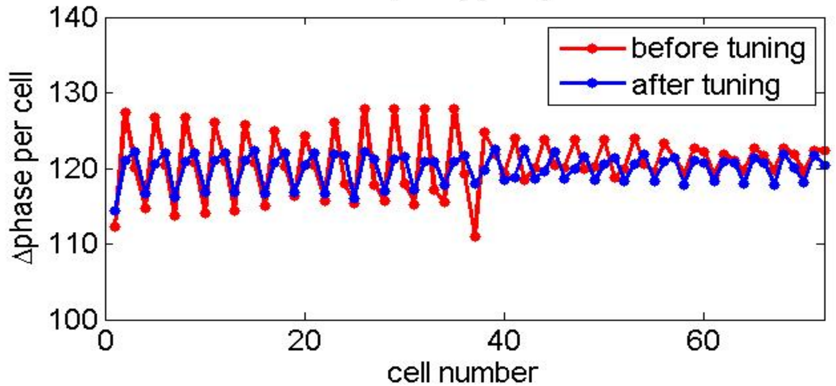
First fabricated C-band structure









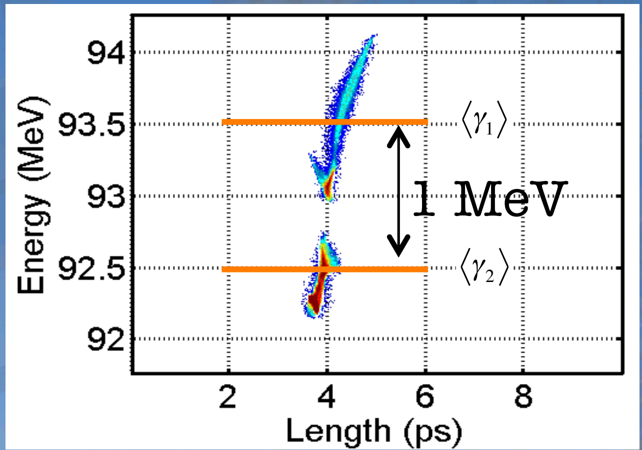


PAC Findings and Recommendations

The committee praises the decision to set up the C-Band RF structure testing and conditioning in a parallel beamline, allowing this activity to proceed in parallel with the experiments using the electron beam. Thanks to this setup they managed good progress in C-Band work.

TWO COLORS FEL

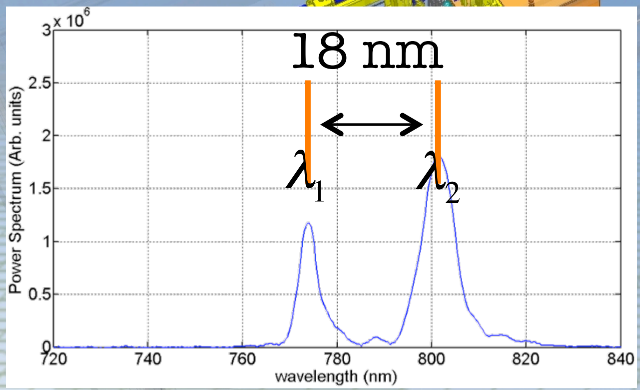
TWO COLORS SASE FEL



two bunches with
a two-level energy distribution
and time overlap (Laser COMB tech.)

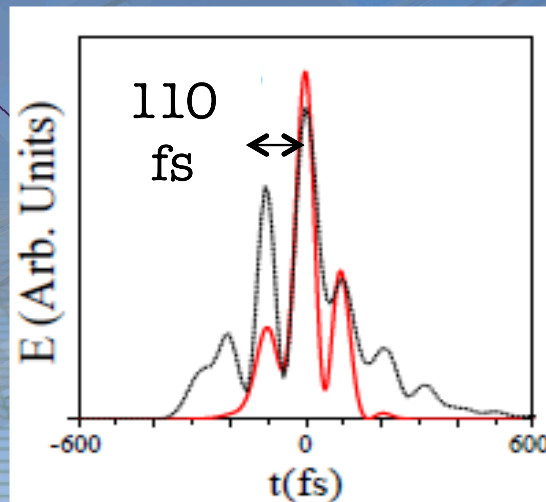
$$\lambda_r = \frac{\lambda_u}{2\gamma^2}\left(1+K_{rms}^2\right)$$

$$\frac{\Delta\lambda_r}{\langle\lambda_r\rangle} = 2\frac{\langle\gamma_1\rangle-\langle\gamma_2\rangle}{\langle\gamma\rangle}$$

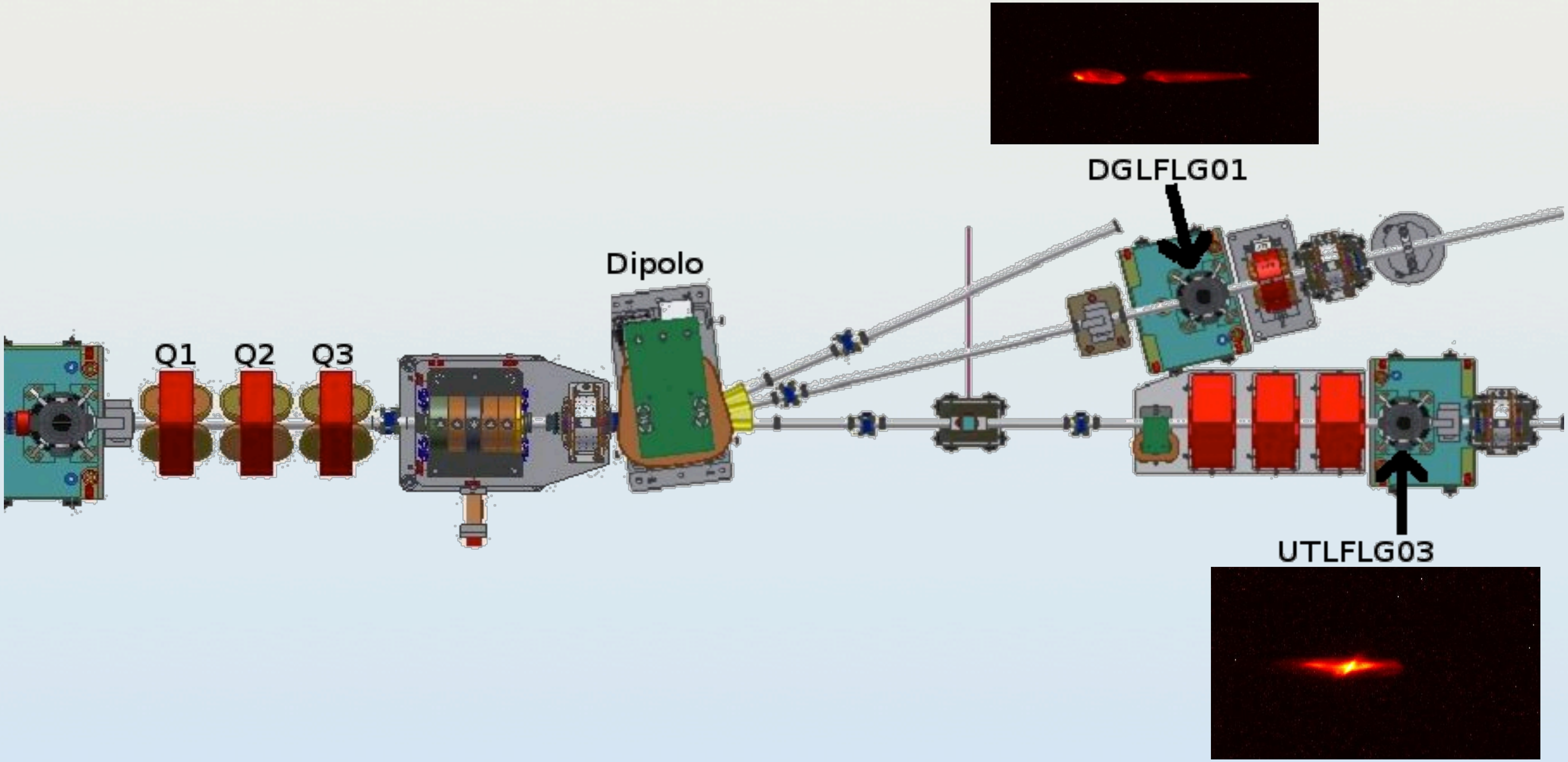


produce two wavelength
SASE –FEL radiation
with time modulation

$$\Delta t = \frac{\lambda_u\left(1+K_{rms}^2\right)}{4c\langle\gamma\rangle\langle\gamma_1\rangle-\langle\gamma_2\rangle}$$



Measuring single beam properties



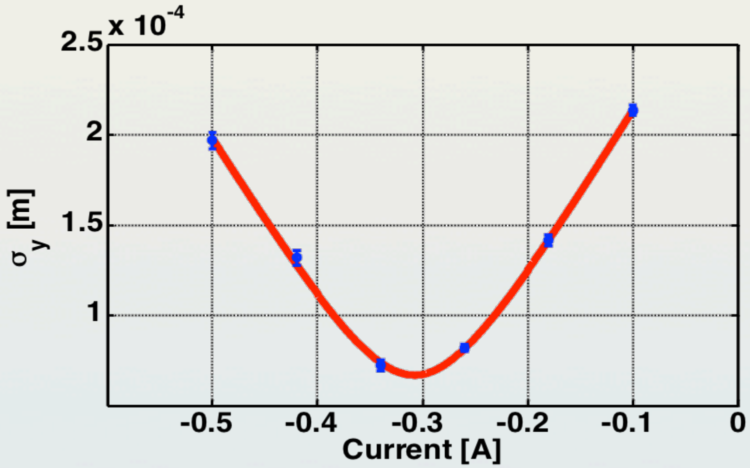
Emittance measurements comb beams

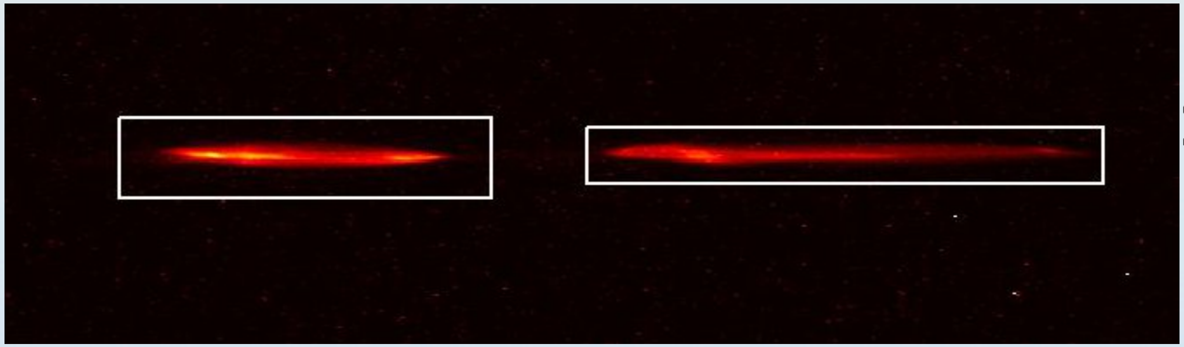
First bunch

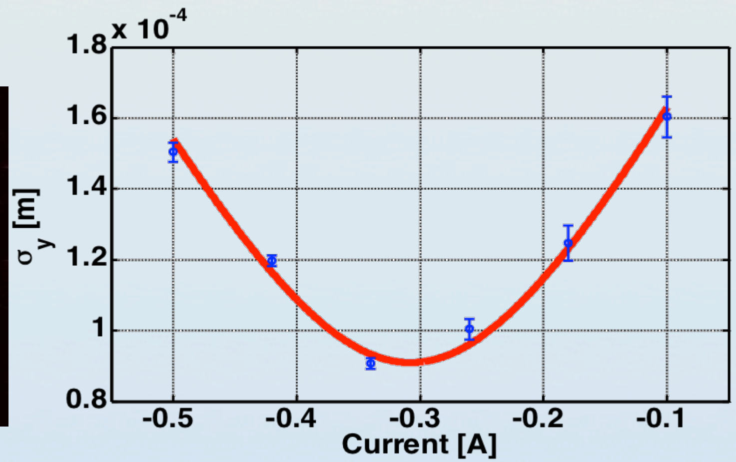
$$\varepsilon = (1.77 \pm 0.05)\ \mathrm{mm\ mrad}$$
$$\alpha = -2.1 \pm 0.1$$
$$\beta = (27 \pm 1)\ \mathrm{m}$$

Second bunch

$$\varepsilon = (1.62 \pm 0.04)\ \mathrm{mm\ mrad}$$
$$\alpha = -0.94 \pm 0.05$$
$$\beta = (13.4 \pm 0.5)\ \mathrm{m}$$







L. Innocenti

PRL 111, 114802 (2013) PHYSICAL REVIEW LETTERS week ending 13 SEPTEMBER 2013

Observation of Time-Domain Modulation of Free-Electron-Laser Pulses by Multipeaked Electron-Energy Spectrum

V. Petrillo,[1] M. P. Anania,[2] M. Artioli,[3] A. Bacci,[1] M. Bellaveglia,[2] E. Chiadroni,[2] A. Cianchi,[4] F. Ciocci,[3] G. Dattoli,[3] D. Di Giovenale,[2] G. Di Pirro,[2] M. Ferrario,[2] G. Gatti,[2] L. Giannessi,[3] A. Mostacci,[5] P. Musumeci,[6] A. Petralia,[3] R. Pompili,[4] M. Quattromini,[3] J. V. Rau,[7] C. Ronsivalle,[3] A. R. Rossi,[1] E. Sabia,[3] C. Vaccarezza,[2] and F. Villa[2]

Two Color Free-Electron Laser and Frequency Beating

F. Ciocci[1], G. Dattoli[1]*, S. Pagnutti[2], A. Petralia[1], E. Sabia[1], P. L. Ottaviani[3], M. Ferrario[4], V. Petrillo[5] and F. Villa[4]

Large-bandwidth two-color free-electron laser driven by a comb-like electron beam

C. Ronsivalle[1], M. P. Anania[2], A. Bacci[3], M. Bellaveglia[2], E. Chiadroni[2], A. Cianchi[4], F. Ciocci[1], G. Dattoli[1], D. Di Giovenale[2], G. Di Pirro[2], M. Ferrario[2], G. Gatti[2], L. Giannessi[1], A. Mostacci[5], P. Musumeci[6], L. Palumbo[5], A. Petralia[1], V. Petrillo[3], R. Pompili[4], J. V. Rau[7], A. R. Rossi[3], C. Vaccarezza[2], F. Villa[2]

Physics and Applications of High Brightness Beams Workshop, HBEB 2013

Two Color FEL driven by a Comb-like Electron Beam Distribution

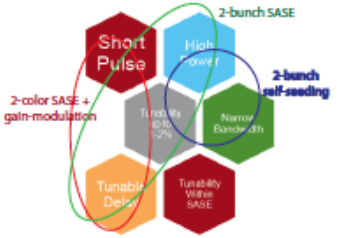
E. Chiadroni[a,*], M. P. Anania[a], M. Artioli[b], A. Bacci[c], M. Bellaveglia[a], A. Cianchi[d], F. Ciocci[b], G. Dattoli[b], D. Di Giovenale[a], G. Di Pirro[a], M. Ferrario[a], G. Gatti[a], L. Giannessi[b], A. Mostacci[e], P. Musumeci[f], L. Palumbo[e], A. Petralia[b], V. Petrillo[c], R. Pompili[a,d], C. Ronsivalle[b], A. R. Rossi[c], C. Vaccarezza[a], F. Villa[a]

Two-Color Schemes at LCLS

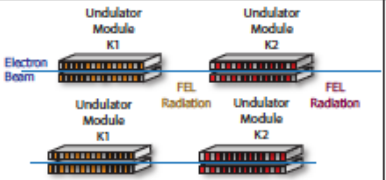
A. Marinelli, A.A. Lutman, J. Wu, D. Ratner, S. Gilevich, F. J. Decker, J. Turner, H. Loos, Y. Ding,
J. Krzywinski, Y. Feng,H. D. Nuhn, J. Welch, T. Maxwell, C. Behrens, R. Coffee, Z. Huang, C. Pellegrini

Introduction

Two color x-FELs have received considerable attention at fourth generation light sources [1-4], since they enable a wide range of applications from bio-imaging to time-resolved studies of atomic physics.
Many schemes have been developed to achieve two-color operation. While no individual scheme can meet all the requirements set by the large x-ray user community, each scheme can meet a set of requirements for some specific applications.



Multicolor FEL via Gain-Modulation

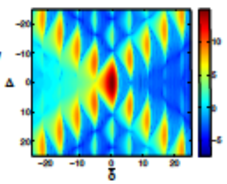


Alternately amplify 2 resonant wavelengths in a long undulator -> 2 color spectrum

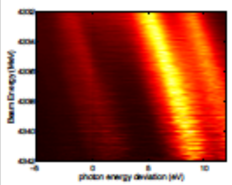
Linear FEL dynamics in each undulator.
Detuning changes by a fixed amount Δ

$$\begin{pmatrix} B \\ P \\ A \end{pmatrix} = \prod_{n=1}^{N_u} M_{T_n}(\bar{\delta} + (-1)^n \Delta) \begin{pmatrix} B_0 \\ P_0 \\ A_0 \end{pmatrix}$$

Discrete lines separated by the undulator modulation period...



Experimental Demonstration



Beam parameters:

I = 2 kA ε = 0.3 μm

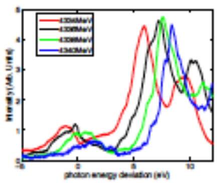
Eph = 830 eV Eb = 4.8 GeV

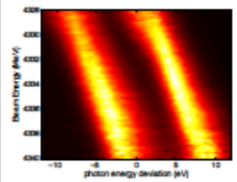
Alternating every other undulator section.

Line separation given by the undulator periodicity:

$\delta\lambda/\lambda = 0.43\%$

ddK = 0.5

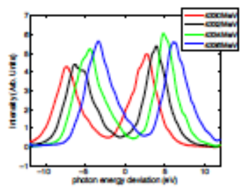




With increased periodicity sidebands merge into two dominant lines.

Alternating every 3 undulators: two-colors

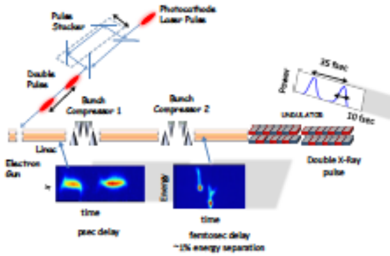
Spectrum peaks at resonant wavelengths



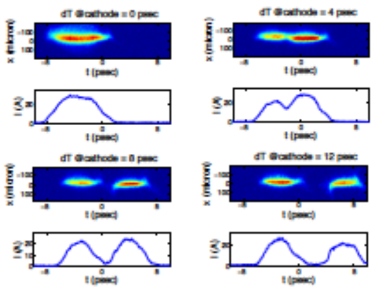
ACCEPTED

Double-Bunch Operation at LCLS

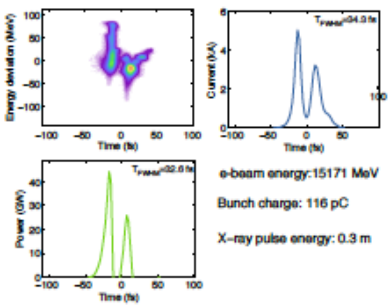
Generate double pulse at cathode and compress.
Similar concept demonstrated at SPARC in the infrared [4]



BEFORE COMPRESSION



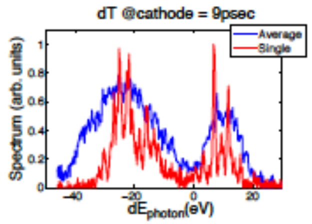
AFTER COMPRESSION (2 STAGE)



e-beam energy:15171 MeV

Bunch charge: 116 pC

X-ray pulse energy: 0.3 m



Spectrum around 9.1 keV
Spectrum clearly shows apperance of two separate spectral lines.
Tunability up to several tens of eV is a key feature for bio-imaging experiments based on MAD techniques.

Conclusions

The generation of multicolor X-FEL pulses with gain-modulation has been demonstrated experimentally. This technique has already been used in user experiments and has proved to be a valid alternative to 2-color SASE in cases in which full time overlap of the two colors is a crucial feature.

Two-bunch operation is currently under developement. Preliminary experimental results at hard x-rays show the key advantages of this method: full saturation power and possibility to diagnose the x-ray time structure with the x-tcav ona single shot base.

Bibliography

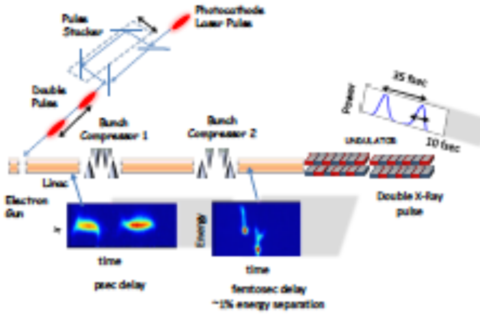
1) A. Lutman et al. *Experimental demonstration of femtosecond two-color x-ray free-electron lasers* Phys. Rev. Lett. 110, 134801 (2013).
2) G. De Ninno et al. *Chirped Seeded Free-Electron Lasers: Self-Standing Light Sources for Two-Color Pump-Probe Experiments* Phys. Rev. Lett. 110, 064801 (2013)
3) A. Marinelli et al. *Multicolor Operation and Spectral Control in a Gain-Modulated X-Ray Free-Electron Laser.* Phys. Rev. Lett. (in production)
4) V. Petrillo et al. *Observation of time-domain modulation of free-electron-laser pulses by multi-peaked electron-energy spectrum* Phys. Rev. Lett. (in production)

Double-Bunch Operation at LCLS

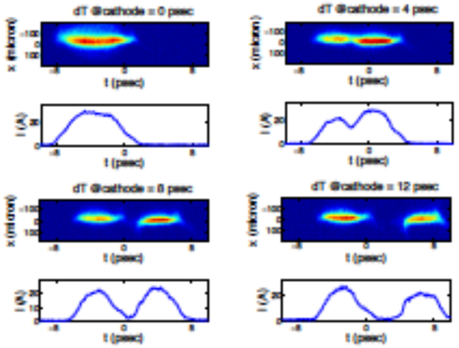
Generate double pulse at cathode and compress.
Similar concept demonstrated at SPARC in the infrared [4]

Double-Bunch Operation at LCLS

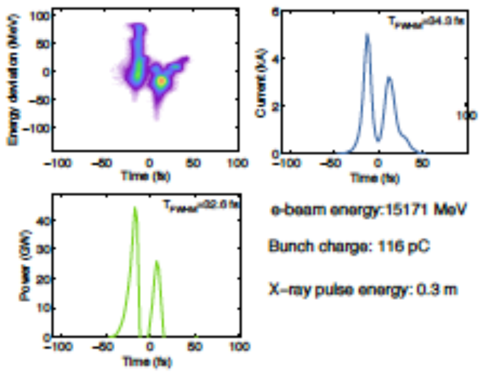
Generate double pulse at cathode and compress.
Similar concept demonstrated at SPARC in the infrared [4]



BEFORE COMPRESSION



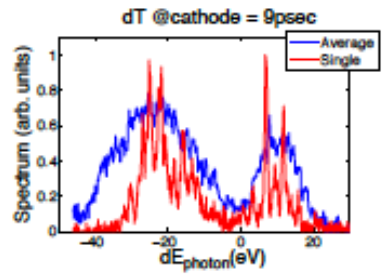
AFTER COMPRESSION (2 STAGE)



e-beam energy:15171 MeV

Bunch charge: 116 pC

X-ray pulse energy: 0.3 m



Spectrum around 9.1 keV
Spectrum clearly shows apperance of two separate spectral lines.
Tunability up to several tens of eV is a key feature for bio-imaging experiments based on MAD techniques.

Conclusions

The generation of multicolor X-FEL pulses with gain-modulation has been demonstrated experimentally. This technique has already been used in user experiments and has proved to be a valid alternative to 2-color SASE in cases in which full time overlap of the two colors is a crucial feature.

Two-bunch operation is currently under developement. Preliminary experimental results at hard x-rays show the key advantages of this method: full saturation power and possibility to diagnose the x-ray time structure with the x-tcav ona single shot base.

Bibliography

1) A. Lutman et al. *Experimental demonstration of femtosecond two-color x-ray free-electron lasers* Phys. Rev. Lett. 110, 134801 (2013).
2) G. De Ninno et al. *Chirped Seeded Free-Electron Lasers: Self-Standing Light Sources for Two-Color Pump-Probe Experiments* Phys. Rev. Lett. 110, 064801 (2013)
3) A. Marinelli et al. *Multicolor Operation and Spectral Control in a Gain-Modulated X-Ray Free-Electron Laser.* Phys. Rev. Lett. (in production)
4) V. Petrillo et al. *Observation of time-domain modulation of free-electron-laser pulses by multi-peaked electron-energy spectrum* Phys. Rev. Lett. (in production)

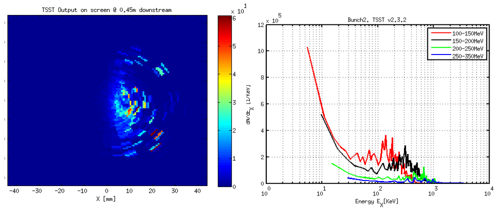
FLAME activities

More details in G. Gatti talk

γ-RESIST

Inverse Compton scattering of of self-injected, LWFA sub-GeV electrons[1,2]

Exp'ed: 2E8 photons/shot



Montecarlo TSST: expected angular and spectral distribution

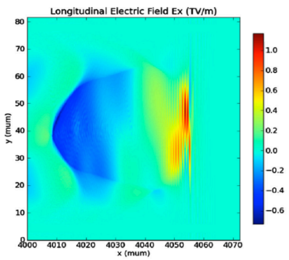
Photons at screen: image and spectrum

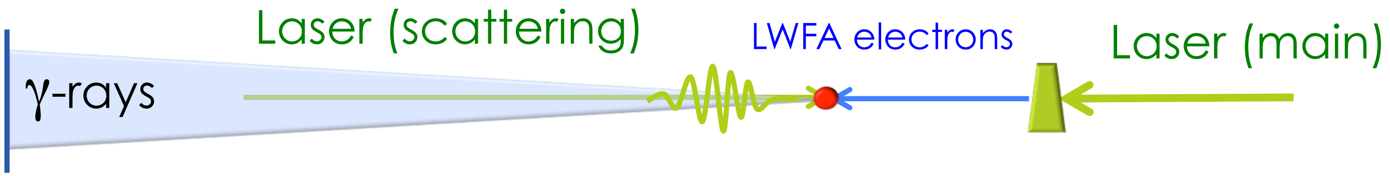
SIMULATIONS

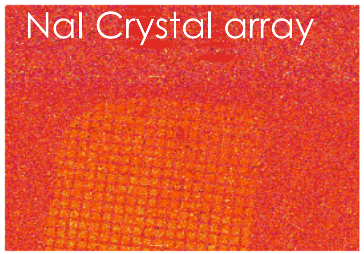
e^- bunch

γ-photons

PIC (Jasmine) self-injection on a 4 mm gas–jet







First measured (July 2013) γ-ray signal: low S/N ratio.

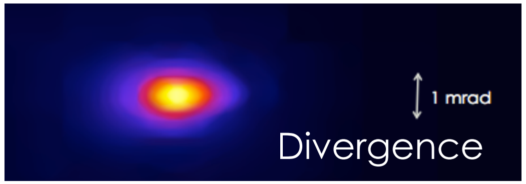
Higher shielding, collision stability and laser beam energy needed

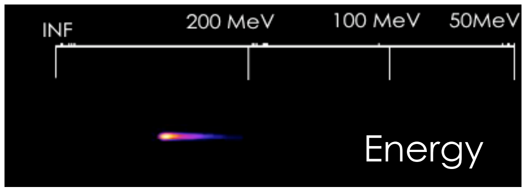
EXPERIMENT

e^- bunch

γ-photons

Measured bunch fully established July 2013 run: monoenergetic+ **low emittance**





[1]L.A. Gizzi et al., NIM B 309, 202-209 (2013);[2]T. Levato et al., NIMA A720, 95-99 (2013) [3]P. Tomassini et al., Appl. Phys. B **80**, 419-436 (2005)

DESY Proposal

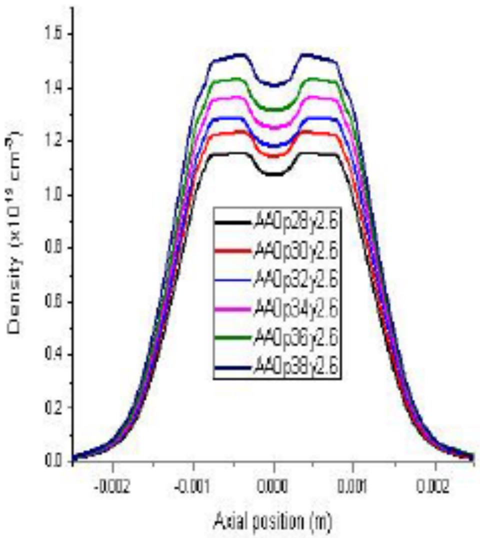
DESY, INO-CNR, Strathclyde University, LNF

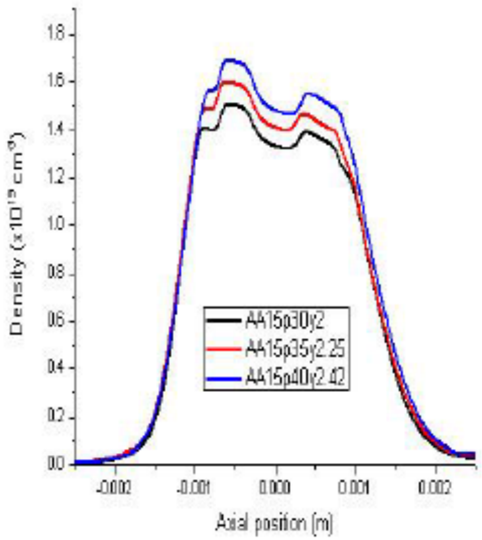
Density Profile Modulation:

Goal → Dephasing Length
Goal → Pump Depletion

Also study of pointing, divergence dependence on the density profile parameters (ramp, plateau)

Expected asimmetries in the 2 planes



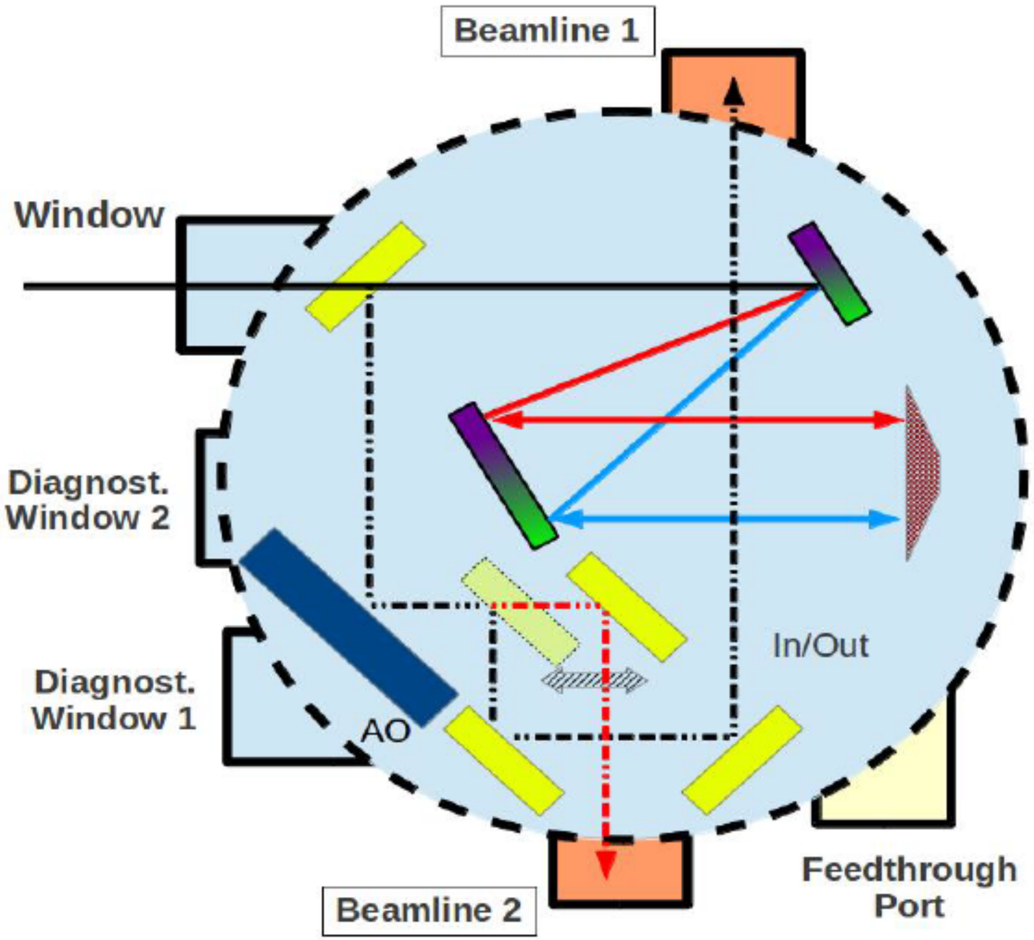


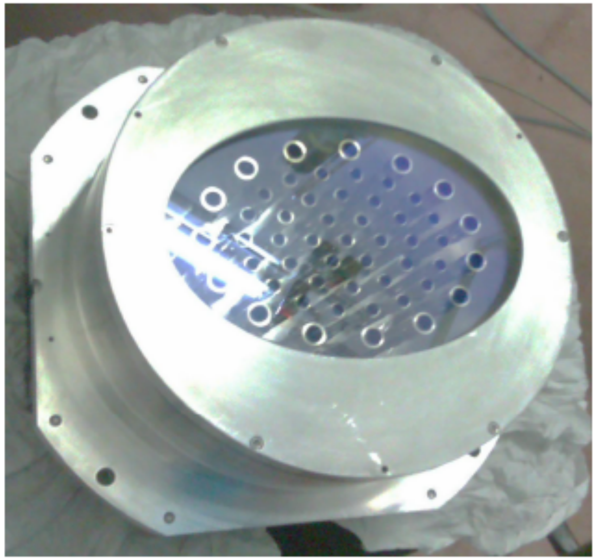
FURTHER ON...

2 Gas-Jet → Plasma lensing effect, dependence on the gas ionization (different gases)

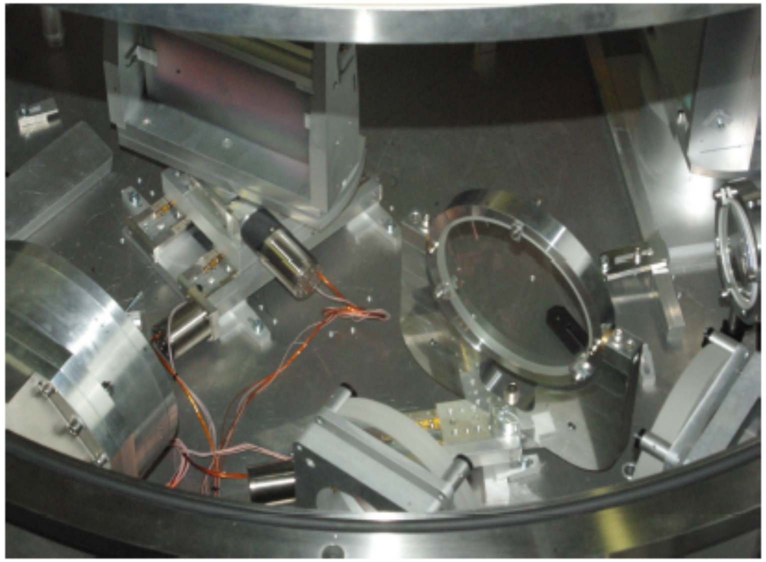
AO Installation

NEW SETUP: SWITCH
AND WFE MEASUREMENT
FOR BOTH BEAMLINES





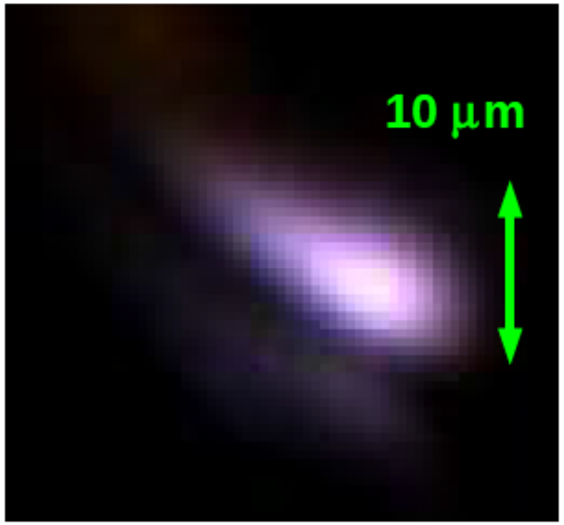
AO AND DIAGNOSTICS LEAK



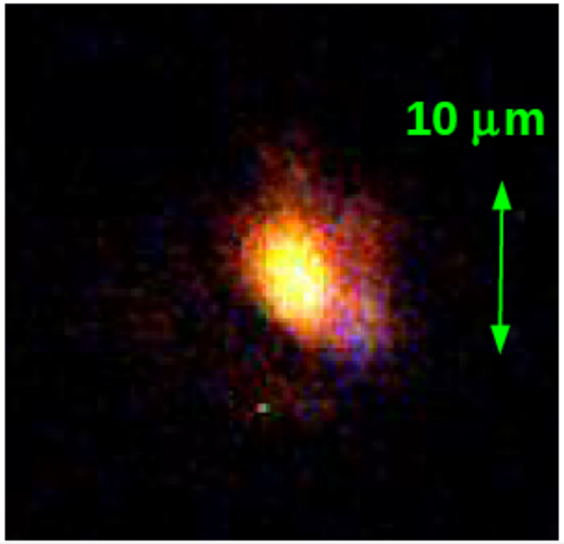
AO Testing

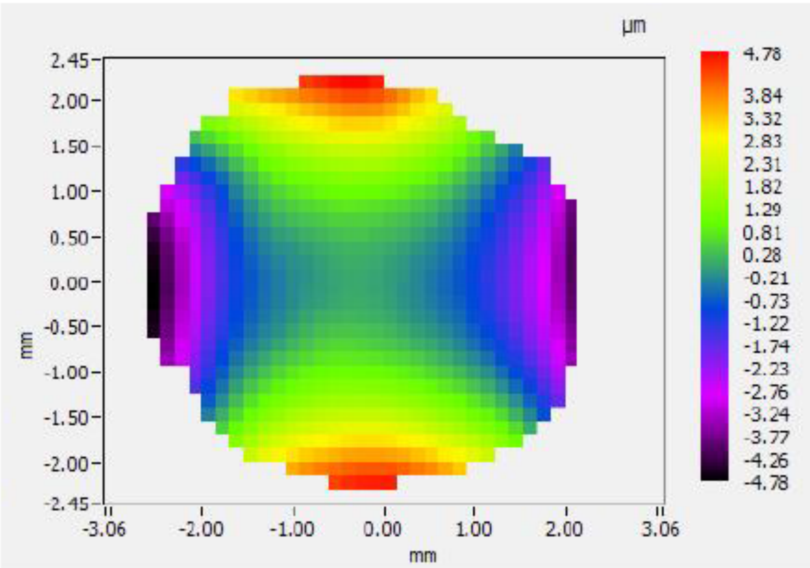
NO CORRECTION

AO CORRECTION



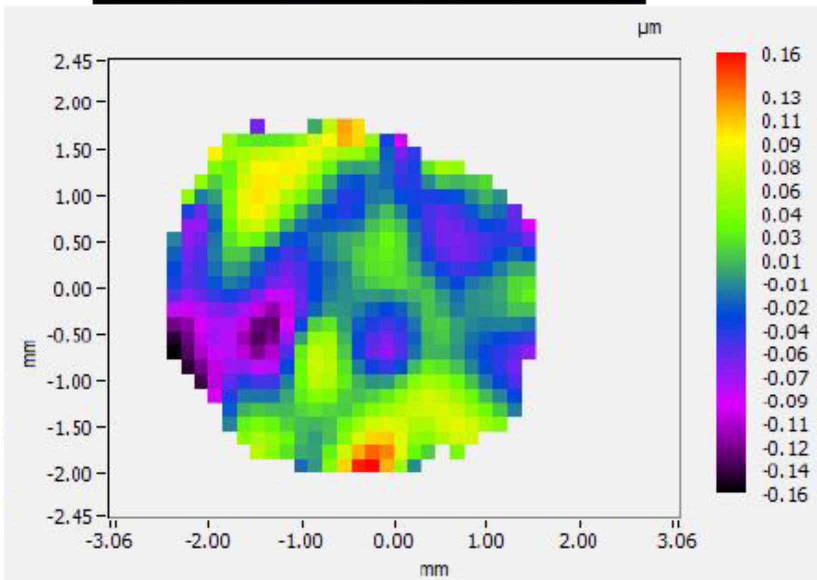
FOCUS





1.98 um RMS WFE

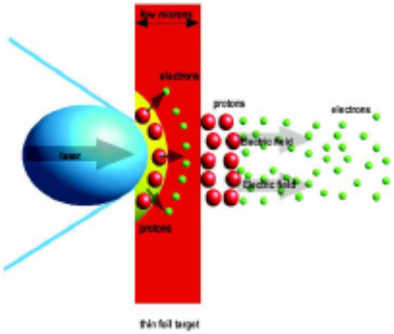
WFE



0.054 um RMS WFE

LILIA: Solid target

Collaboration:Milano, Milano Bicocca, Bologna, Pisa, Lecce, LNS, LNF.



Goal: Production of a proton beam suitable for injection into (conventional) accelerating structures

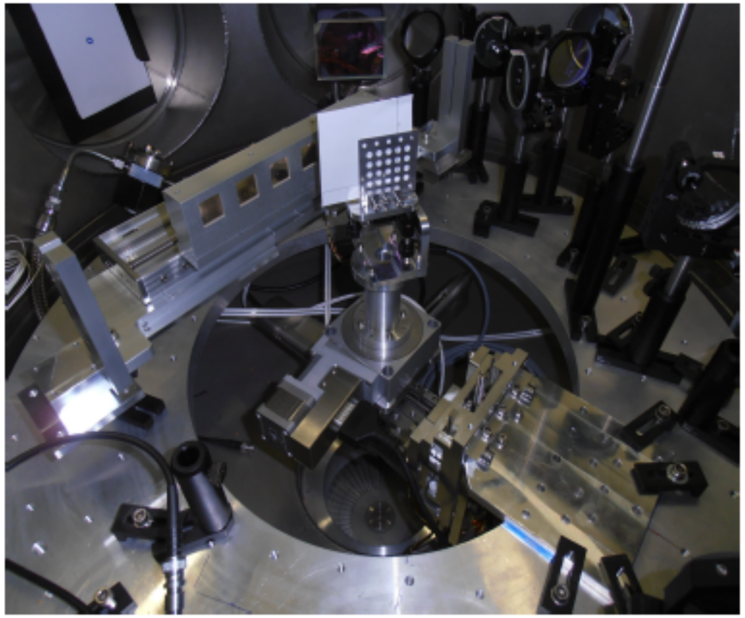
TNSA in the regime $1E18 < I < 1E20 \ W/cm^2$

-Metallic target of 1-10 microns

-GAFchromic and CR39 films have been used
Solid state detectors (PIN) in order to investigate
Noise baseline.

-Last run: Thomson parabola (ELIMED LNS)

-Detected protons < 4 MeV



Possible higher intensity
For the next run

OAP F=1 mt → OAP F= 0.5 mt

PAC Findings and Recommendations

16:15 FLAME activities – G. Gatti (presented by M. Anania)

Various activities using the FLAME laser were reported. Previously, most experiments were hampered by the low quality focal spot the laser was producing. This issue has been almost solved by including a deformable mirror immediately before the last focusing optic. Operation of the mirror software seems difficult. The also possibility exists to use a new diagnostic method that would look directly at the focal spot quality rather than at the beam quality on the deformable mirror. This seems very promising and would greatly improve the performance of the laser and the outcome of the experiments that use it (including of course the Thompson

scattering experiment. Collaboration with DESY further strengthens the UserLab aspect and the international significance of SPARC-Lab infrastructure.

The committee further recommends full support to maintain, improve and operate the FLAME laser, which is a key component of a number of important experiments.

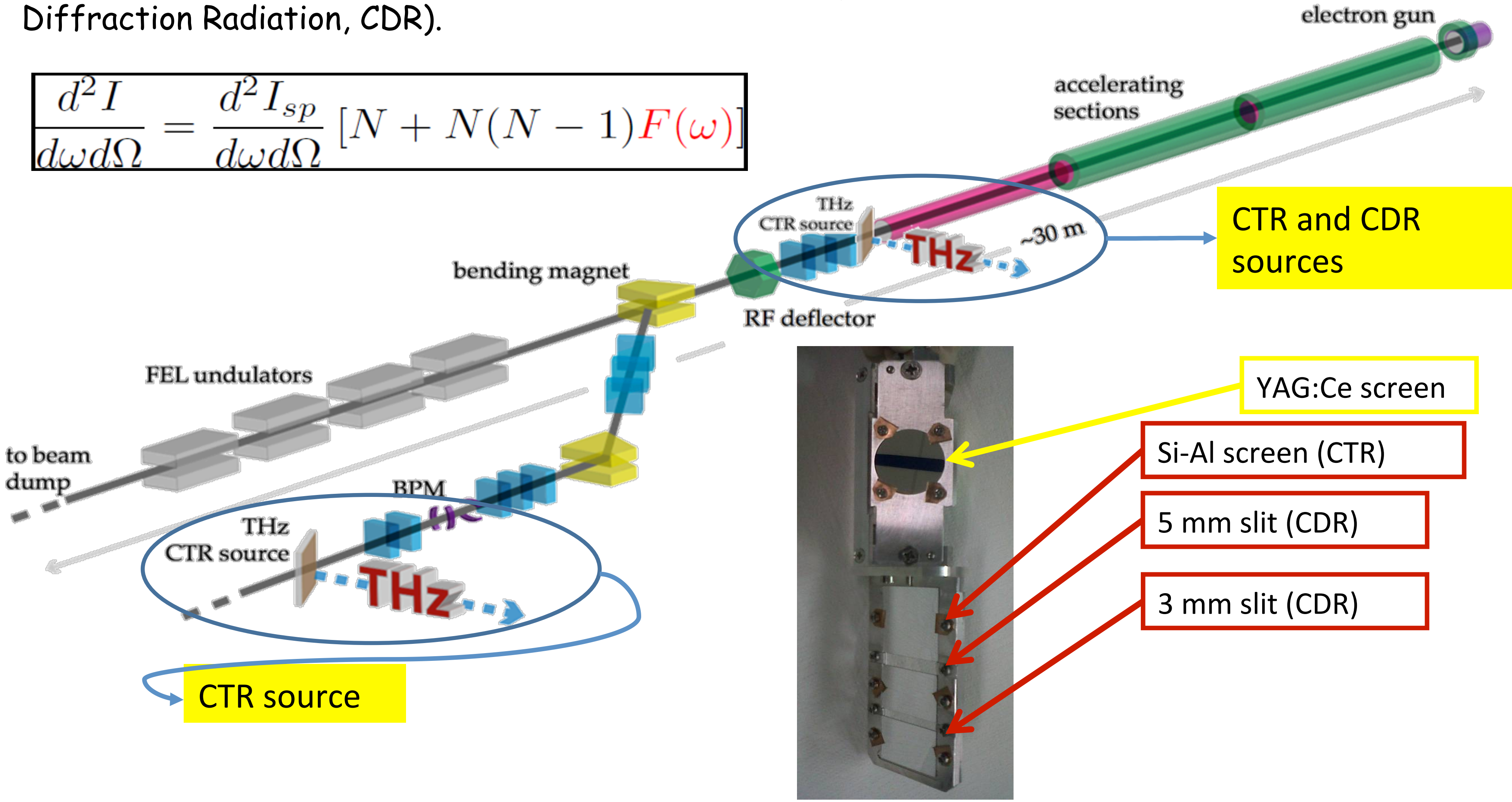
THz Source

Courtesy E. Chiadroni, S. Lupi

The SPARC_LAB THz beam lines

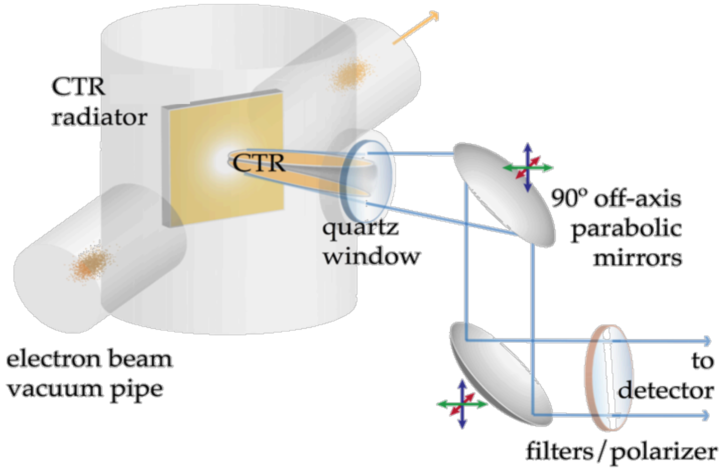
Linac-based source: Coherent Radiation from an aluminum-coated silicon screen (Coherent Transition Radiation, CTR) and from a rectangular aperture in the metallic screen (Coherent Diffraction Radiation, CDR).

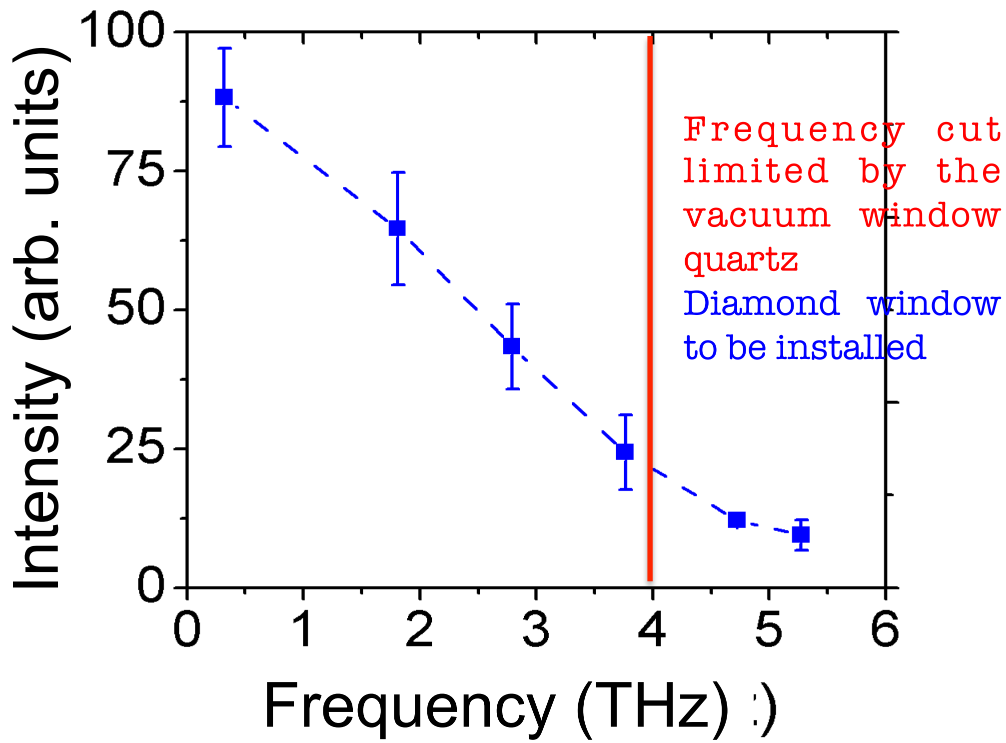
$$\frac{d^2 I}{d\omega d\Omega} = \frac{d^2 I_{sp}}{d\omega d\Omega}\left[N + N(N-1)F(\omega)\right]$$



enrica.chiadroni@lnf.infn.it

Broad-band THz radiation: Measurements





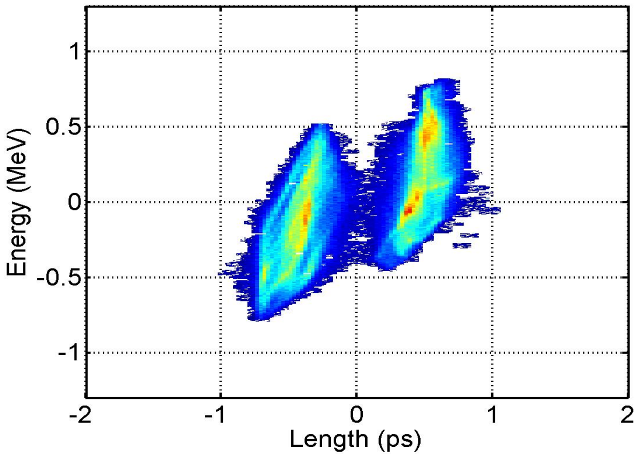
Electron beam parameters	
Energy (MeV)	100
Charge (pC)	260
RMS bunch length (fs)	260

E. Chiadroni et al., Appl. Phys. Lett. 102, 094101 (2013)

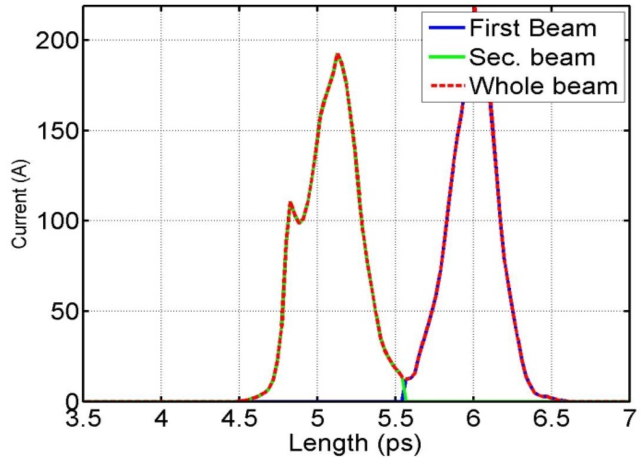
Narrow-band THz radiation:
2-bunches train measurements

Electron beam parameters	
Energy (MeV)	122
Charge/bunch (pC)	80
RMS bunch 1 length (fs)	150
RMS bunch 2 length (fs)	165
Time distance (ps)	0.91 (0.019)

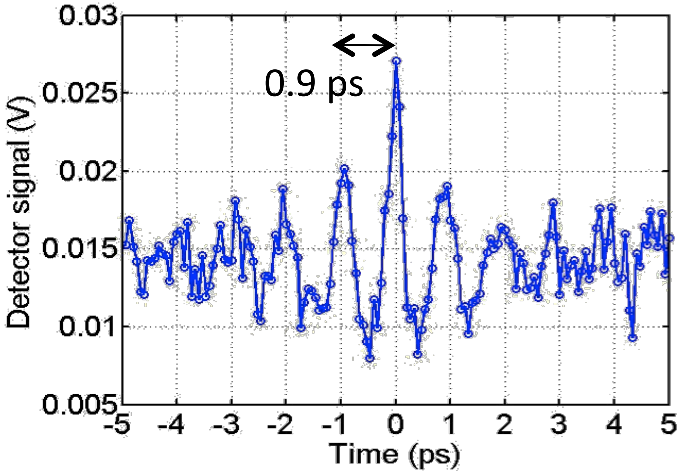
Measured Longitudinal Phase Space (LPS)

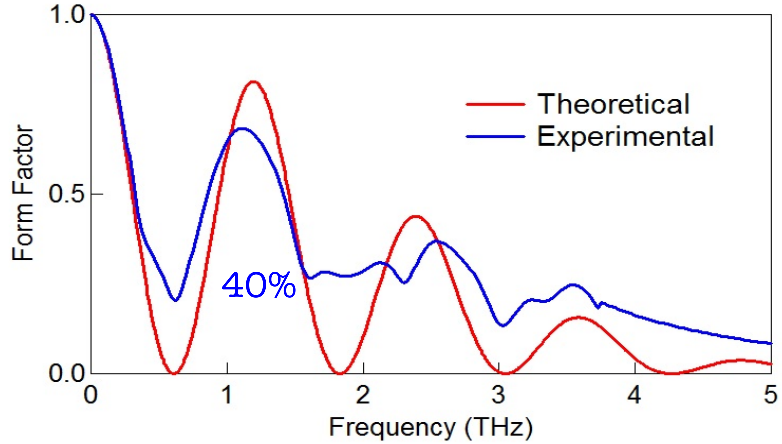


Current profile as measured at the end of the linac



Autocorrelation measurement of CTR with a Michelson interferometer





Achieved THz Performances

Electron beam parameters	Single bunch (VB mode: max compression)	4-bunches per train (VB mode + laser comb)
Charge/bunch (pC)	300	50
Energy (MeV)	130	100
Bunch length (fs)	160	200
Rep. Rate (Hz)	10	

Radiation parameters	SPARC (single bunch)	SPARC (4-bunches/train)
Energy per pulse (J)	$40\ 10^{-6}$	$0.6\ 10^{-6}$ (@ 1 THz)
Peak power (MW)	> 100	3 (@ 1 THz)
Average power (W)	$1.8\ 10^{-4}$	$6\ 10^{-6}$
Electric field (kV/cm)	500	> 10
Pulse duration (fs)	160	< 100
Bandwidth (%)	broadband	< 25

REVIEW OF SCIENTIFIC INSTRUMENTS **84**, 022703 (2013)

Characterization of the THz radiation source at the Frascati linear accelerator

E. Chiadroni,[1] M. Bellaveglia,[1] P. Calvani,[2] M. Castellano,[1] L. Catani,[3,4] A. Cianchi,[3,4] G. Di Pirro,[1] M. Ferrario,[1] G. Gatti,[1] O. Limaj,[2] S. Lupi,[2,5] B. Marchetti,[3] A. Mostacci,[5,6] E. Pace,[1] L. Palumbo,[5,6] C. Ronsivalle,[7] R. Pompili,[1,3] and C. Vaccarezza[1]

APPLIED PHYSICS LETTERS **102**, 094101 (2013)

The SPARC linear accelerator based terahertz source

E. Chiadroni,[1] A. Bacci,[1] M. Bellaveglia,[1] M. Boscolo,[1] M. Castellano,[1] L. Cultrera,[1] G. Di Pirro,[1] M. Ferrario,[1] L. Ficcadenti,[1] D. Filippetto,[1] G. Gatti,[1] E. Pace,[1] A. R. Rossi,[1] C. Vaccarezza,[1] L. Catani,[2] A. Cianchi,[2] B. Marchetti,[2] A. Mostacci,[3] L. Palumbo,[3] C. Ronsivalle,[4] A. Di Gaspare,[5] M. Ortolani,[5] A. Perucchi,[6] P. Calvani,[7] O. Limaj,[7] D. Nicoletti,[7] and S. Lupi[7]

PHYSICAL REVIEW SPECIAL TOPICS - ACCELERATORS AND BEAMS **16**, 100701 (2013)

Controlling nonlinear longitudinal space charge oscillations for high peak current bunch train generation

P. Musumeci, R. K. Li, and K. G. Roberts
Department of Physics and Astronomy, UCLA, Los Angeles, California 90095, USA

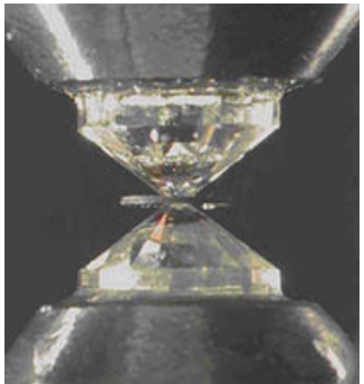
E. Chiadroni
INFN-LNF, Via E. Fermi, 40 00044 Frascati, Roma, Italy
(Received 19 May 2013; published 8 October 2013)

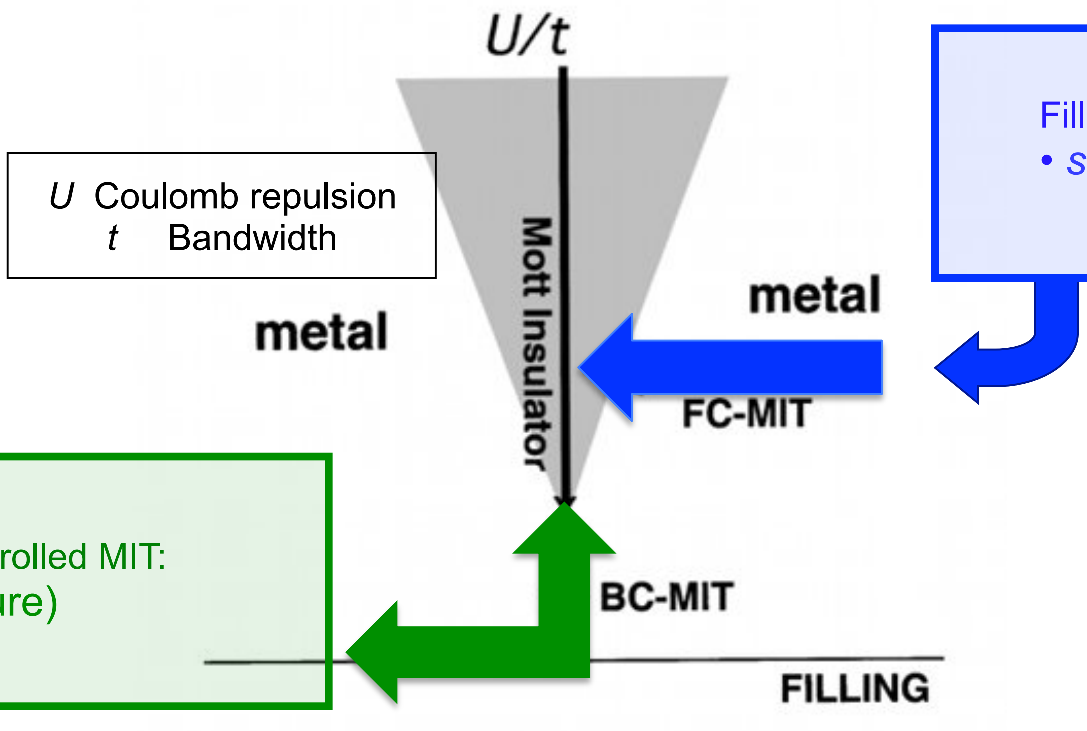
Insulator to Metal Transitions

Many materials are insulating although band theory suggests a metallic ground state: V_2O_3, VO_2, NiO, $NiSe_2$, La_2CuO_4, Cs_3C_{60}

→Strong Electronic Correlations

(Basic Ingredient for High-Tc Superconductivity)





Filling-Controlled MIT:
- *static* (doping)

Bandwidth-Controlled MIT:
- *static* (pressure)

PAC Findings and Recommendations

16:30 Experiments with THz radiation – S. Lupi

SPACR_LAB has now two coherent transition radiation (CTR) THz stations that can operate with a single electron bunch, producing a broad (~100%) THz spectrum or with two to four COMB bunches producing a narrower spectrum (~25%). Bunch separation measurements using CTR interferometry also agree with transverse deflecting cavity and electro-optical sampling results. The THz radiation produced at SPARC_LAB is interesting for material science study because of the relatively high power of the radiation and its correspondingly large electric and magnetic fields. The first external users will use the radiation for metal to insulator transition studies and well as for normal to semi conductor studies by dissociating Cooper pairs by reaching critical current and/or magnetic fields.

Establishing a reliable and reproducible source of THz radiation and to build up the external users community, this would further strengthen the UserLab aspect of SPARC_LAB. The committee strongly supports these activities.

Collaboration with Stratclyde

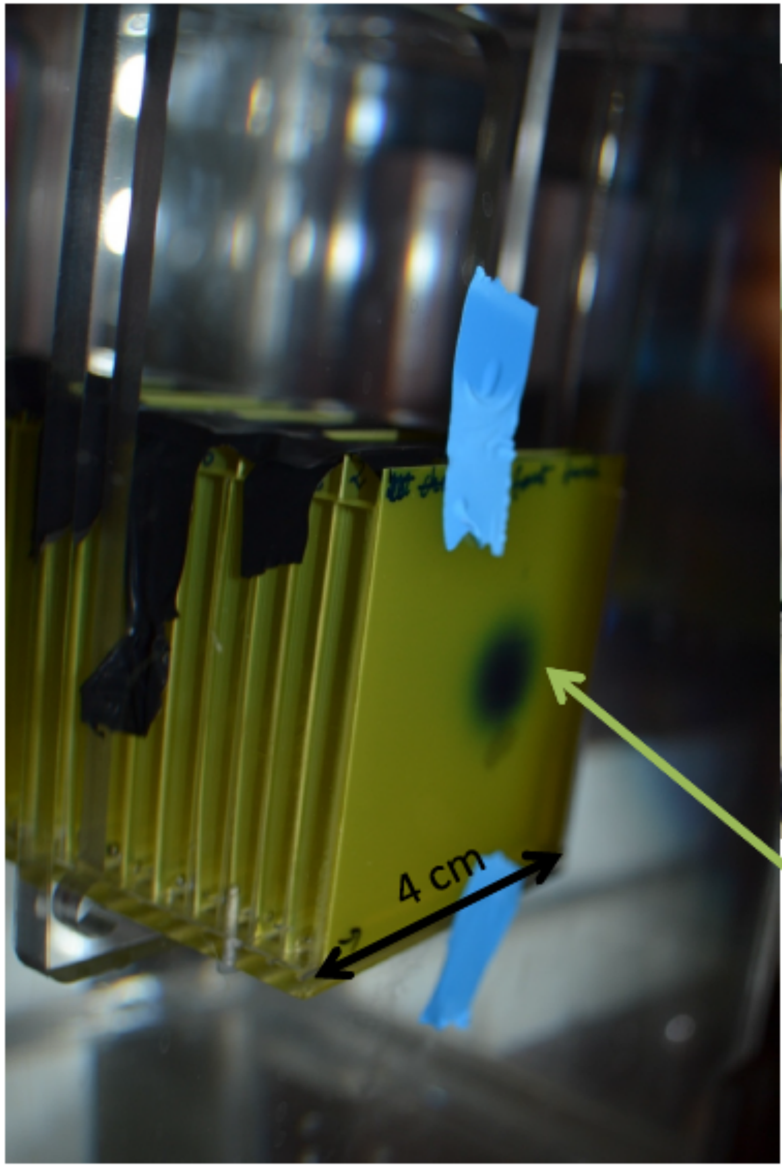
M. P. Anania talks

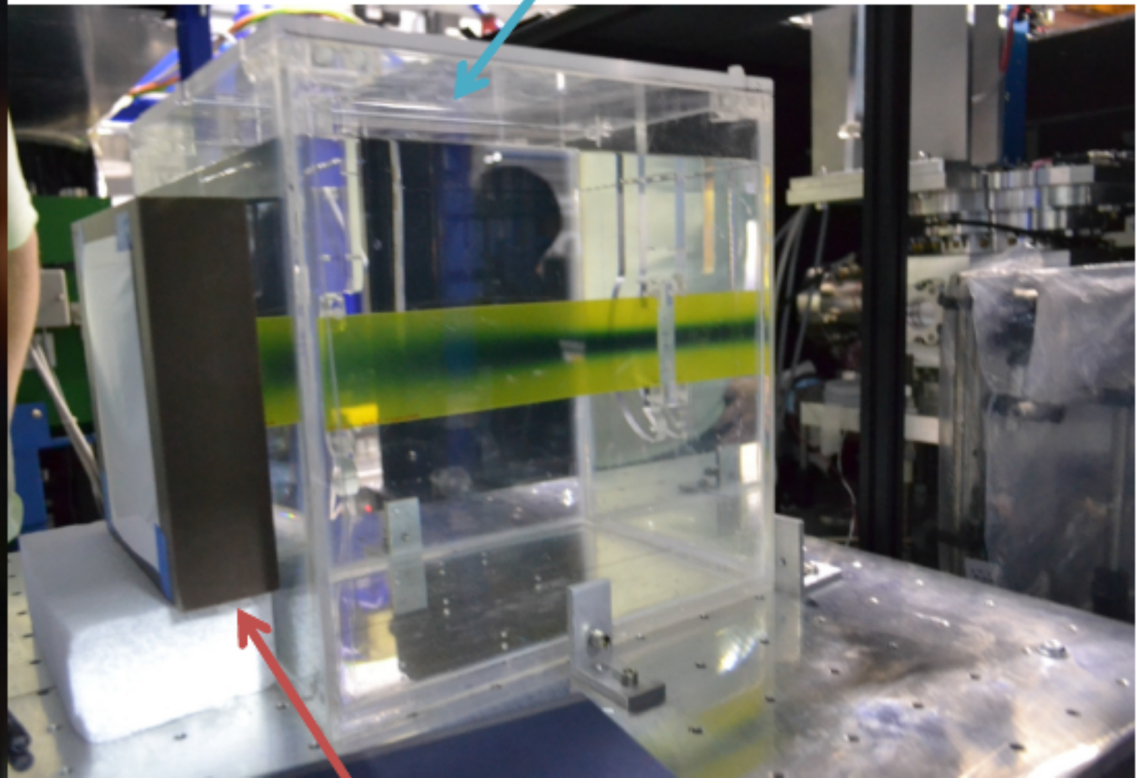
Goal of the experiment

The goal of the experiment was to obtain detectors calibration (Gafchromic EBT2 type film and ionization chamber) commonly used for conventional clinical radiotherapy LINACs with a source of well known properties (electron beam at SPARC).

The objective of the experiment was to calibrate detectors which could reliably being used for dosimetry measurements of very high energy laser-plasma accelerated electron beams (in particularly for ALPHA-X electron beams at the University of Strathclyde).

Experimental set-up





Water tank

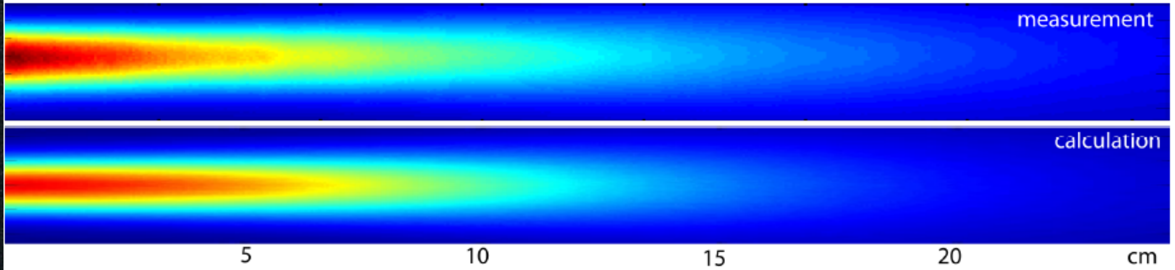
Solid water + lanex screen

Transver profile of the first electron bunch imaged on the Gafcromic film after 50 cm of propagation in air.

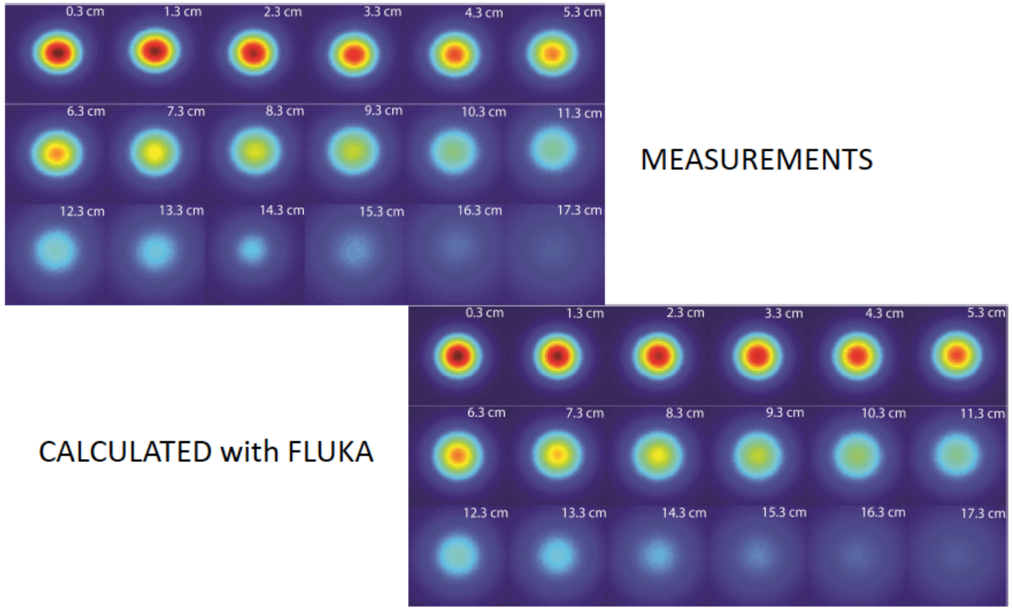
Results of the measurements:

LONGITUDINAL PROFILE

Calculation done with FLUKA (Monte Carlo code).



TRANSVERSE PROFILE



ALPHA-X experiment
di **mariapia.anania**
del 2013-07-27 20:42:47

Entry: 9058

Visite: 11

Dear the SPARC team,
We would like to say how grateful and thankful we are to each and every one of the team here, at Frascati. This extends from allowing us to perform our experiment on SPARC, to the planning of the experiment, setup of equipment and most importantly the aquisition of our data. Of course, with such a complex facility there were problems but luckily your team solved these in time.
I hope that we can use this experience to stimulate a frutiful collabotation in the future (and also continue the experiments we began this week).

Once again a big thank you from Gregor and Anna and the ALPHA-X team at the University of Strathclyde.

PAC Findings and Recommendations

16:45 Collaboration with Stratclyde University – M. Anania

The purpose of this collaboration was to accurately calibrate Gafchromic EBT2 types to be used for characterization of laser wakefield (LWFA) electron bunches containing very low charge but high peak current. These measurements have been successfully completed and are a good initial example of the SPAC_LAB ability to effectively function as a facility and to work with external users. Because of the systematic nature of the measurements spread over two weeks, this is an example where laboratory technical support would have been completely appropriate and beneficial.

Near future

	Oct 1-15	Oct 16-31	Nov 1-15	Nov 16-30	Dec	Jan	Feb
Thomson	Kly 2 Problem fixing	Electrons /Photons Transp		Photons/ Electrons Transp	Collisions Test		
FEL						Seeded 2 colors?	Shot Noise Red?
THZ			User				
C-band	Inst.	Inst.	HP-RF Test	HP-RF Test	HP-RF Test		
LILIA						Experim ent	
DESY							Experim ent

Istituto Nazionale di Fisica Nucleare

Ufficio di Presidenza

Istituto Nazionale di Fisica Nucleare

Piano Triennale INFN 2014 - 2016

Napoli, 17-18 ottobre 2013

GIORNATE DEL PIANO TRIENNALE 2014-2016

Fernando Ferroni

- Consolidamento e espansione di SPARC

- So che non tutti lo pensate. Ma e' la nostra grande ricchezza. E se vorremo fare ancora ricerche alla frontiera dell'energia dovremo trovare un modo per passare dai MV/m ai GV/m

- La macchina che abbiamo a LNF e' un gioiello ma deve essere messa in grado di competere con LBL, Stanford, KEK, DESY.

Considerations

- The ongoing SPARC_LAB activities are being studied in several other laboratories, including SLAC, DESY, CERN and KEK with equally or even more ambitious research programs.

- Therefore the time factor becomes very important to remain at the research frontier and to produce results with high-impact on the international scientific community.

- A redefinition of the priorities inside LNF and an increase in the number of dedicated researchers and technician shifts is an indispensable requirement to keep SPARC_LAB productive.

Minimal Requests

- Mirroring SPARC_LAB control room in DAFNE control room for routine operations: RF conditioning, machine warm up, etc. (in ~progress)
- At least 1 technician in shift at SPARC_LAB every running day (to be discussed)
- Always same priority in case of "first aid" (~promised)

PAC Findings and Recommendations

15:15 SPARC_LAB status and plans – M. Ferrario

The status and plan talk reported:

- Significant progress with commissioning
- Significant results recently obtained
- The team is now publishing in "real time". That had been noticed as a weakness of the group
- In general a more focused program
- A transition from a solely commissioning phase to a more operation-oriented phase

This last point lead to a strong request to the laboratory management, as well as to INFN to assign more (shift) time of more technical people (operators) to handle more routine operational issues. These include maintaining the machine warm 24/7 or at least overnight to avoid daily and mostly wasted warm-up time and to perform conditioning procedures (e.g., C-band structures). To work with external users to provide the facility service required for their experiment. This stronger technical staff support would significantly increase the output of the scientific staff that is currently tied in these activities. This stronger support could be delivered by transferring routine operation capabilities to the DAFNE control room. This would then also require that DAFNE operators become familiar with the SPACR_LAB operation. The committee very strongly supports this request and urges Frascati's management as well as INFN to fulfill this request. It is the committee's opinion that this support is necessary to insure the status of the SPARC_LAB as one of the flagship facilities at the INFN-Frascati laboratory.

The committee recommends that experiments stemming from the unique capabilities of the SPARC_LAB (such as external injection in a LWFA, PWFA-driven FEL, etc.) be pursued and moved forward, possibly with strong external (users) contributions.

Summary/recommendations

This meeting has been the best meeting in terms of progress in commissioning, experimental results obtained and published and in operation of SPARC_LAB as a user facility. The committee is particularly impressed by the number and range of achievements that demonstrate the potential of the SPARC_LAB. This potential will become even more evident once the facility will fully transition from a commissioning to an operation phase. This transition as well as the ensuing operation phase will require strong support of the laboratory in terms of time of laboratory technical staff used to perform routine maintenance and machine operation. This support is key for the future success of the SPARC_LAB. The program is more focused than before, more in line with other projects (STAR, ELI-NP). The committee strongly recommends that further progress with improvement of the FALME laser beam quality be made. This is a key element for many important experiments and as such deserves support comparable to that of the electron beam line. The committee vigorously recommends strong support of the SPARC_LAB by the laboratory management and by INFN. The science potential of SPARC_LAB is large, the team strong, the equipment unique and versatile.

Future ?

Il Ministro dell'Istruzione, dell'Università e della Ricerca

ATTO DEL GOVERNO
SOTTOPOSTO A PARERE PARLAMENTARE

Linea di intervento 3:

prog. n. 16: URANIA 2020: Tecniche di bassa radioattività al Servizio della Società	€	2.805.571
prog. n. 19: SPARC_LAB Upgrade: Sources for Plasma Accelerators and Radiation Compton with Lasers and Beams	€	5.611.143
prog. n. 21: IRPT: Innovation in Radio--- and Particle---Therapy	€	7.715.321

1) FLAME BEAM LINE UPGRADE

We propose to upgrade the FLAME laser system to the Petawatt power to access the region of high fields where particle dynamics enters the regime of non-linear quantum electrodynamics (QED), a first step towards the Schwinger limit of pair production from vacuum. Among the possible experimental breakthroughs, the Petawatt scale upgrade of FLAME will allow the first, unambiguous demonstration of radiation reaction, a process with fundamental open questions that concern the reliability of existing models, at the boundary between classical and quantum descriptions and involving the actual structure of electron charge, its nature and the role of quantum effects.

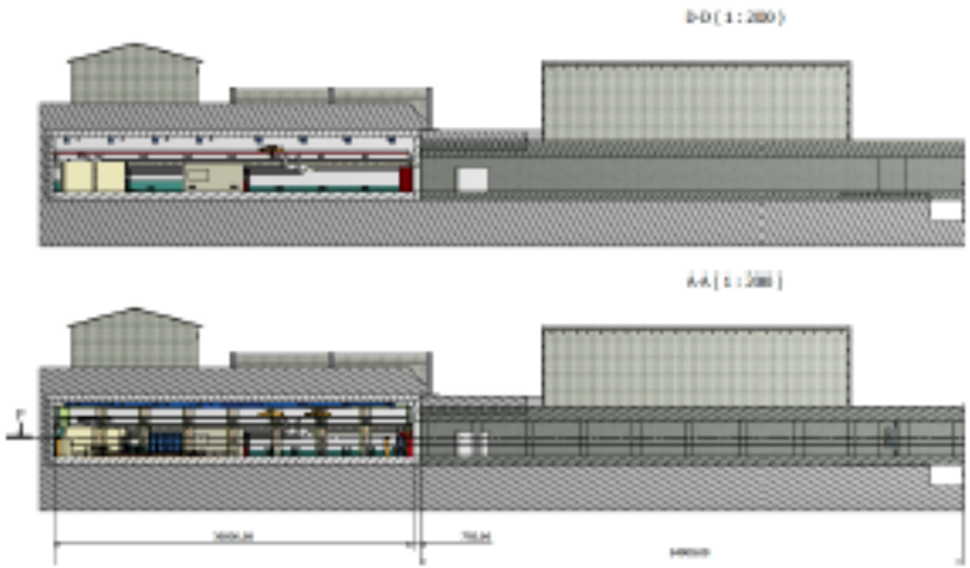
2) THz BEAM LINE UPGRADE

A linac-driven coherent THz radiation source has been developed at the SPARC-LAB test facility, based on coherent transition radiation (CTR) emitted by ultra-short (sub-ps) relativistic electron bunches hitting a metallic screen. The SPARC THz radiation source is able to deliver broadband (up to 5 THz) THz pulses with femtosecond shaping. In addition, high peak power, narrow (<30%) spectral bandwidth THz radiation has been also generated. This source takes advantage of advanced electron beam manipulation techniques, able to generate an adjustable train of electron bunches with sub-picosecond length and spacing, as obtained through the laser comb technique in the velocity bunching regimes. Based on the experience gained so far on the CTR-based THz radiation source for both electron bunch diagnostics and spectroscopic applications, we propose to enrich the scenario of THz sources available at SPARC_LAB. **In particular we propose to build up a tunable quasi-monochromatic radiation source, extending from THz to mid-infrared (MIR), with narrower spectral bandwidth than achieved so far.**

More Future with ~40 M€?

WP0

- Aumento dell'energia del fascio di elettroni fino ad 1 GeV, aggiungendo 4 moduli acceleranti in banda C [23,24], con adeguata ottica e diagnostica del fascio nell'esistente sala sperimentale di SPARC_LAB. Ogni modulo è composto da: 1 Klystron con Modulatore, Driver, guide d'onda e SLED, che alimenta 4 sezioni RF dampate da 1.8 m ciascuna. Assumendo un campo medio accelerante circa 30 MV/m si ottiene un guadagno di energia per modulo 216 MeV.
- Estensione della sala sperimentale di SPARC_LAB di circa 40 m con uno scavo di ~ 10 m al di sotto della strada ed estensione alla adiacente Sala Tecnologie (~30 m), come riportato nello schema seguente [22].



Possibile estensione dell'attuale sala sperimentale di SPARC_LAB (bunker a sinistra) al di sotto della strada con annessione della sala "tecnologie" (edificio a sinistra).

WP1

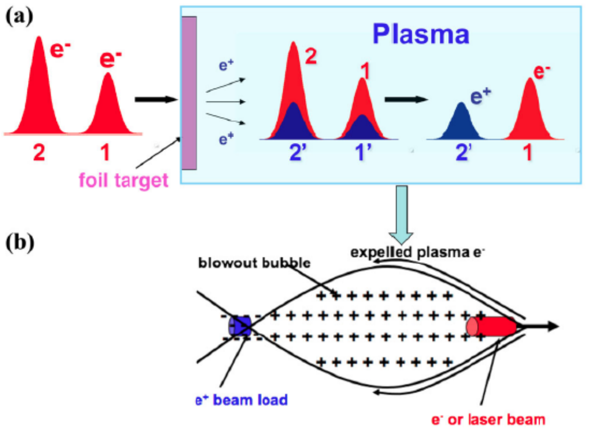
Sviluppo di un acceleratore a plasma (PWFA) in grado di produrre fasci di elettroni di alta qualità, tali da pilotare una sorgente FEL di V generazione.

WP2

Realizzazione di una sorgente di positroni polarizzati di bassa emittanza pilotata da fasci gamma ~40 MeV prodotti da Inverse Compton Scattering (ICR) [27].

WP3

Esperimento dimostrativo di accelerazione di positroni, generati da ICR o direttamente in un plasma da un treno di elettroni incidente su targhetta, secondo lo schema riportato nella figura sottostante [21] adattato al fascio COMB [7].



RISORSE UMANE NECESSARIE	I temi proposti sono oggetto di studio in numerosi laboratori, tra cui SLAC [30], DESY, CERN e KEK con programmi di ricerca altrettanto ambiziosi. Il fattore tempo diventa quindi importante per restare alla frontiera e produrre risultati ad alto impatto scientifico internazionale. Una ridefinizione delle priorita' interne ai LNF ed un incremento del personale dedicato a SPARC_LAB diventa quindi un requisito indisensabile, sia in

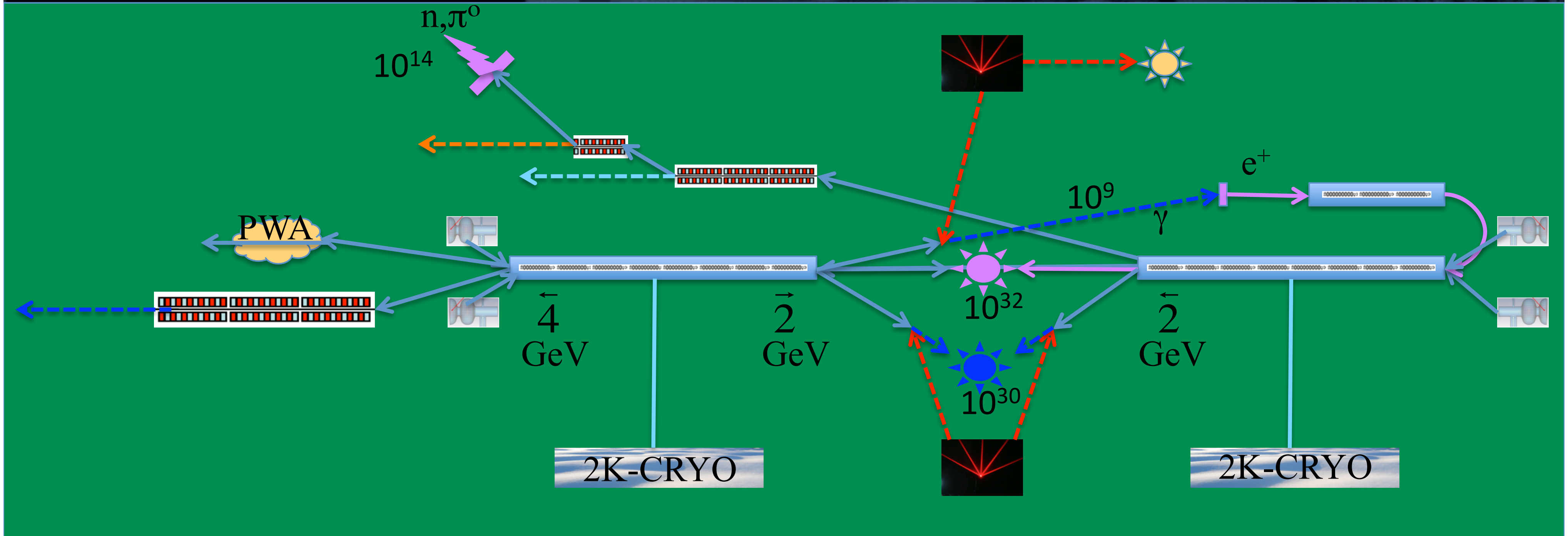
fase di progettazione che di installazione ed operazione.

Gran parte delle risorse necessarie sono reperibili all'interno dei LNF e del Cabibbo_Lab. In aggiunta all'attuale personale di SPARC_LAB saranno necessari in particolare:

3 Fisici degli acceleratori (Dinamica, Diagnostica, Plasmi)
1 Fisico esperto di Laser di potenza
1 Ingegnere Meccanico
1 Ingegnere del Vuoto
1 Ingegnere RF
1 Esperto Sistema di Controllo
1 Esperto progettazione magneti

IRIDE

I R I D E is a large infrastructure for fundamental and applied physics research. Conceived as an innovative and evolutionary tool for multi-disciplinary investigations in a wide field of scientific, technological and industrial applications, it will be a high intensity "particle beams factory".



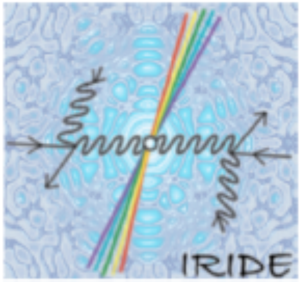
Based on a combination of a high duty cycle radio-frequency superconducting electron linac (SC RF LINAC) and of high energy lasers it will be able to produce a high flux of electrons, photons (from infrared to γ-rays), neutrons, protons and eventually positrons, that will be available for a wide national and international scientific community interested to take profit of the most advanced particle and radiation sources.

IRIDE _V4_17/07/2013

I R I D E

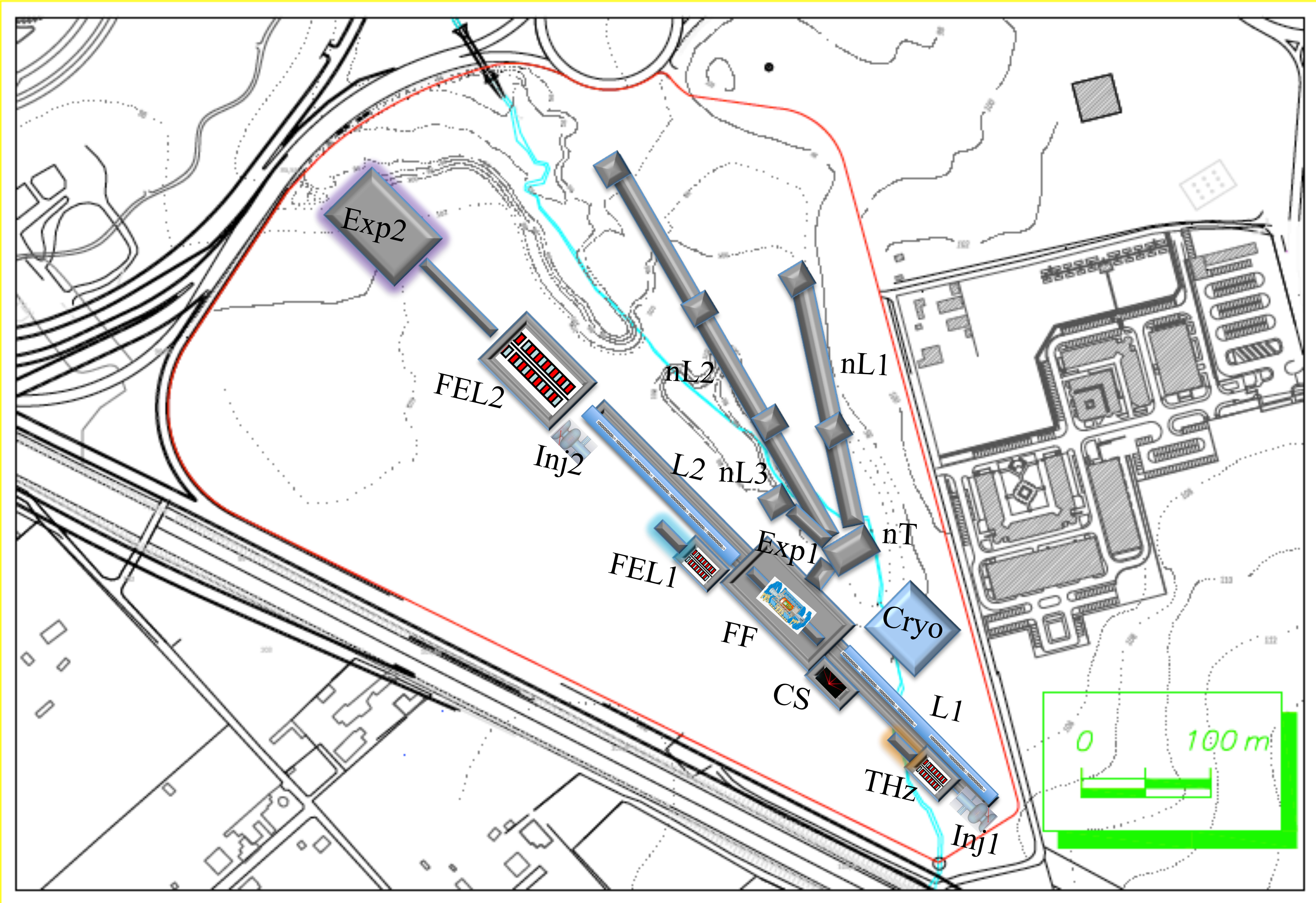
An **I**nterdisciplinary **R**esearch **I**nfrastructure based on **D**ual **E**lectron linacs&lasers

A WHITE BOOK



This report describes the scientific aims and potentials as well as the preliminary technical design of IRIDE, an innovative tool for multi-disciplinary investigations in a wide field of scientific, technological and industrial applications. IRIDE will be a high intensity "particle factory", based on a combination of a high duty cycle radio-frequency superconducting electron linac and of high energy lasers. Conceived to provide unique research possibilities for particle physics, for condensed matter physics, chemistry and material science, for structural biology and industrial applications, IRIDE will open completely new research possibilities and advance our knowledge in many branches of science and technology. IRIDE will contribute to open new avenues of discoveries and to address most important riddles: What does matter consist of? What is the structure of proteins that have a fundamental role in life processes? What can we learn from protein structure to improve the treatment of diseases and to design more efficient drugs? But also how does an electronic chip behave under the effect of radiations? How can the heat flow in a large heat exchanger be optimized?

The scientific potential of IRIDE is far reaching and justifies the construction of such a large facility in Italy in synergy with the national research institutes and companies and in the framework of the European and international research. It will impact also on R&D work for ILC, FEL, and will be complementarity to other large scale accelerator projects. IRIDE is also intended to be realized in subsequent stages of development depending on the assigned priorities.


Exp2
FEL2
Inj2
nL2
nL1
L2
nL3
nT
Exp1
FEL1
FF
Cryo
CS
L1
THz
Inj1
0
100 m

IRIDE: Interdisciplinary Research Infrastructure based on Dual Electron linacs and lasers

M. Ferrario[1], D. Alesini[1], M. Alessandroni[51], M. P. Anania[1], S. Andreas[56], M. Angelone[14], A. Arcovito[26], F. Arnesano[25], M. Artioli[14], L. Avaldi [40], D. Babusci[1], A. Bacci[3], A. Balerna[1], S. Bartalucci[1], R. Bedogni[1], M. Bellaveglia[1], F. Bencivenga[50], M. Benfatto[1], S. Biedron[66], V. Bocci[2], M. Bolognesi[27], P. Bolognesi[40], R. Boni[1], R. Bonifacio[7], M. Boscolo[1], F. Boscherini[43], F. Bossi[1], F. Broggi[3], B. Buonomo[1], V. Calo[25], D. Catone[41], M. Capogni[14], M. Capone[14], K. Cassou[70], M. Castellano[1], A. Castoldi[17], L. Catani[4], G. Cavoto[2], N. Cherubini[14], G. Chirico [28], M. Cestelli-Guidi[1], E. Chiadroni[1], V. Chiarella[1], A. Cianchi[4], M. Cianci[29], R. Cimino[1], F. Ciocci[14], A. Clozza[1], M. Collini[28], G. Colo[3], A. Compagno[14], G. Contini[41], M. Coreno[40], R. Cucini[50], C. Curceanu[1], F. Curciarello[54], S. Dabagov[1], E. Dainese[30], I. Davoli[4], G. Dattoli[14], L. De Caro[31], P. De Felice[5], V. De Leo[54], S. Dell Agnello[1], S. Della Longa[32], G. Delle Monache[1], M. De Spirito[26], A. Di Cicco[44], C. Di Donato[57], D. Di Gioacchino[1], D. Di Giovenale[1], E. Di Palma[14], G. Di Pirro[1], A. Dodaro[14], A. Doria[14], U. Dosselli[1], A. Drago[1], K. Dupraz[70], R. Escribano[23], A. Esposito[1], R. Faccini[2], A. Ferrari[52], A. Filabozzi[4], D. Filippetto[18], F. Fiori[53], O. Frasciello[1], L. Fulgentini[15], G. P. Gallerano[14], A. Gallo[1], M. Gambaccini[11], C. Gatti[1], G. Gatti[1], P. Gauzzi[2], A. Ghigo[1], G. Ghiringhelli[49], L. Giannessi[14], G. Giardina[54], C. Giannini[31], F. Giorgianni[2], E. Giovenale[14], L. Gizzi[15], C. Guaraldo[1], C. Guazzoni[17], R. Gunnella[44], K. Hatada[1,44], M. Iannone[69], S. Ivashyn[12], F. Jegerlehner[58], P.O. Keeffe[40], W. Kluge[58], A. Kupsc[60], L. Labate[15], P. Levi Sandri[1], V. Lombardi[34], P. Londrillo[20], S. Loreti[5], A. Lorusso[9], M. Losacco[25], A. Lukin[1], S. Lupi[2], A. Macchi[15], S. Magaz[54], G. Mandaglio[54], A. Marcelli[1,46], G. Margutti[67], C. Mariani[16], P. Mariani [35], G. Marzo[14], C. Masciovecchio[50], P. Masjuan[61], M. Mattioli[2], G. Mazzitelli[1], N.P. Merenkov[21], P. Michelato[3], F. Migliardo[54], M. Migliorati[2], C. Milardi[1], E. Milotti[13], S. Milton[66], V. Minicozzi [4], S. Mobilio[48], S. Morante[4], D. Moricciani[4], A. Mostacci[2], V. Muccifora[1], F. Murtas[1], P. Musumeci[10], F. Nguyen[62], A. Orecchini[55], G. Organtini[2], P. L. Ottaviani[14], E. Pace[1], M. Paci[35], C. Pagani[3], S. Pagnutti[14], V. Palmieri[6], L. Palumbo[2], G.C. Panaccione[45], C. F. Papadopoulos[18], M. Papi[26], M. Passera[63], L. Pasquini[43], M. Pedio[45], A. Perrone[9], A. Petralia[14], M. Petrarca[1], C. Petrillo[55], V. Petrillo[3], P. Pierini[3], A. Pietropaolo[14], M. Pillon[14], A. D. Polosa[2], R. Pompili[4], J. Portoles[22], T. Prosperi[41], C. Quaresima[41], L. Quintieri[5], J. V. Rau[15], M. Reconditi [34], A. Ricci[38], R. Ricci[1], G. Ricciardi[57], G. Ricco[71], M. Ripani[71], E. Ripiccini[2], S. Romeo[54], C. Ronsivalle[14], N. Rosato[37], J. B. Rosenzweig[10], G. Rossi[4], A. A. Rossi[6], A. R. Rossi[3], F. Rossi[20], D. Russo[15], A. Sabatucci[30], E. Sabia[14], F. Sacchetti[55], S. Salducco[68], F. Sannibale[18], G. Sarri[19], T. Scopigno[35], J. Sekutowicz[56], L. Serafini[3], D. Sertore[3], O. Shekhovtsova[64], I. Spassovsky[14], T. Spadaro[1], B. Spataro[1], F. Spinozzi[35], A. Stecchi[1], F. Stellato[4,38], V. Surrenti[14], A. Tenore[1], A. Torre[14], L. Trentadue[65], S. Turchini[41], C. Vaccarezza[1], A. Vacchi[13], P. Valente[2], G. Venanzoni[1], S. Vescovi[1], F. Villa[1], G. Zanotti[39], N. Zema[41], M. Zobov[1], F. Zomer[70].

[1]INFN-LNF, Italy. [2]INFN and Univ. di Roma 1, Italy. [3]INFN and Univ. di Milano, Italy. [4]INFN and Univ. di Roma 2, Italy. [5]ENEA C.R Casaccia, Italy. [6]INFN-LNL, Italy. [7]INFN and Univ. Federal da Paraiba, Brazil. [8]Univ. di Camerino, Italy. [9]INFN and Univ. del Salento, Italy. [10]UCLA, USA. [11]INFN and Univ. di Ferrara, Italy. [12]Kharkov Institute of Physics and Technology, Ukraine. [13]INFN and Univ. di Trieste, Italy. [14]ENEA, Frascati, Italy. [15]CNR, Italy. [16]CNISM and Univ. di Roma 1, Italy. [17]Politecnico di Milano and INFN-Milano, Italy. [18]LBNL, USA. [19]The Queen's University of Belfast, UK. [20]INFN-Bologna. [21]NSC KIPT, Kharkov, Ukraine. [22]Instituto De Fisica Corpuscular, Spain. [23]Universitat Autonoma de Barcelona. [25]Univ. di Bari, Italia. [26]Univ. Cattolica del Sacro Cuore - Roma, Italia. [27]Univ. di Milano, Italia. [28]Univ. di Milano Bicocca, Italia. [29]EMBL, Germany. [30]Università di Teramo, Italia. [31]CNR, Bari, Italia. [32]Univ. dell Aquila, Italia. [34]Univ. di Firenze, Italia. [35]Univ. Politecnica delle Marche, Ancona, Italia. [36]Univ. di Roma 2, Italia. [37]NAST, Roma, Italia, and Univ. di Roma 2, Italia. [38]CFEL - DESY, Germany. [39]Univ. di Padova, Italia. [40]CNR- Area della Ricerca di Roma 1, Italia. [41]CNR- Area della Ricerca di Roma 2, Italia. [42]Univ. Roma 1, Italia. [43]Univ. of Bologna, Italy. [44]CNISM and Univ. di Camerino, Italy. [45]CNR TASC area science park, Trieste, Italy. [46]Univ. of Science and Technology of China, Hefei, P.R. China. [48]Univ. of Roma 3, Italy. [49]CNR/SPIN and Politecnico di Milano, Italy. [50]Sincrotrone Trieste, Italia. [51]RMP Srl. [52]HZ Dresden-Rossendorf, Germany. [53]Univ. Politecnica delle Marche - DISCO. [54]Univ. di Messina. [55]Univ. di Perugia. [56]DESY, Hamburg, Germany. [57]Univ. di Napoli Federico II and INFN-Napoli, Italy. [58]Humboldt-Universitat zu Berlin and DESY, Zeuthen, Germany. [59]Universitat Karlsruhe, Germany. [60]Uppsala University, Sweden. [61]Gutenberg-Universitat, Mainz, Germany. [62]Laboratorio de Instrumentacao e Fisica Experimental de Particulas, Lisbon, Portugal. [63]INFN - Padova, Italy. [64]Institute of Nuclear Physics, Cracow, Poland. [65]Univ. di Parma and INFN - Milano Bicocca, Italy. [66]Colorado State University, USA. [67]LFoundry, Avezzano (AQ), Italy. [68]Menkini s.r.l. , Albairate (MI), Italy. [69]Alenia Aermacchi, Pomogliano d Arco (NA), Italy. [70]CNRS-IN2P3, France. [71]INFN-Genova, Italy.

Abstract

This paper describes the scientific aims and potentials as well as the preliminary technical design of IRIDE, an innovative tool for multi-disciplinary investigations in a wide field of scientific, technological and industrial applications. IRIDE will be a high "particles factory", based on a combination of high duty cycle radio-frequency superconducting electron linacs and of high energy lasers. Conceived to provide unique research possibilities for particle physics, for condensed matter physics, chemistry and material science, for structural biology and industrial applications, IRIDE will open completely new research possibilities and advance our knowledge in many branches of science and technology. IRIDE is also supposed to be realized in subsequent stages of development depending on the assigned priorities.

Keywords: SC Linac, FEL, Particle Physics, Neutron source, Compton source, Advanced Accelerators Concepts

---


To Be Continued