



LNF : a multidisciplinary laboratory

- 1) **DAΦNE**
- 2) **Synchrotron Light**
- 3) **Electron Beams**
- 4) **Free Electron Lasers**
- 5) **Detector R&D**
- 6) **CNAO-Hadrontherapy**
- 7) **Particle acceleration**
- 8) **Future programs**

**INFN-LNF
Road Map**

Research Division

.....many other experiments.....that I will not mention today...

Panorama LNF

Acceleratori

- ATLAS
- LHC-b
- CMS
- BABAR
- CDF

Astroparticelle

- NAUTILUS
- OPERA
- PVLAS
- RAP
- ROG
- VIRGO
- WIZARD
- LARES

Fisica Nucleare

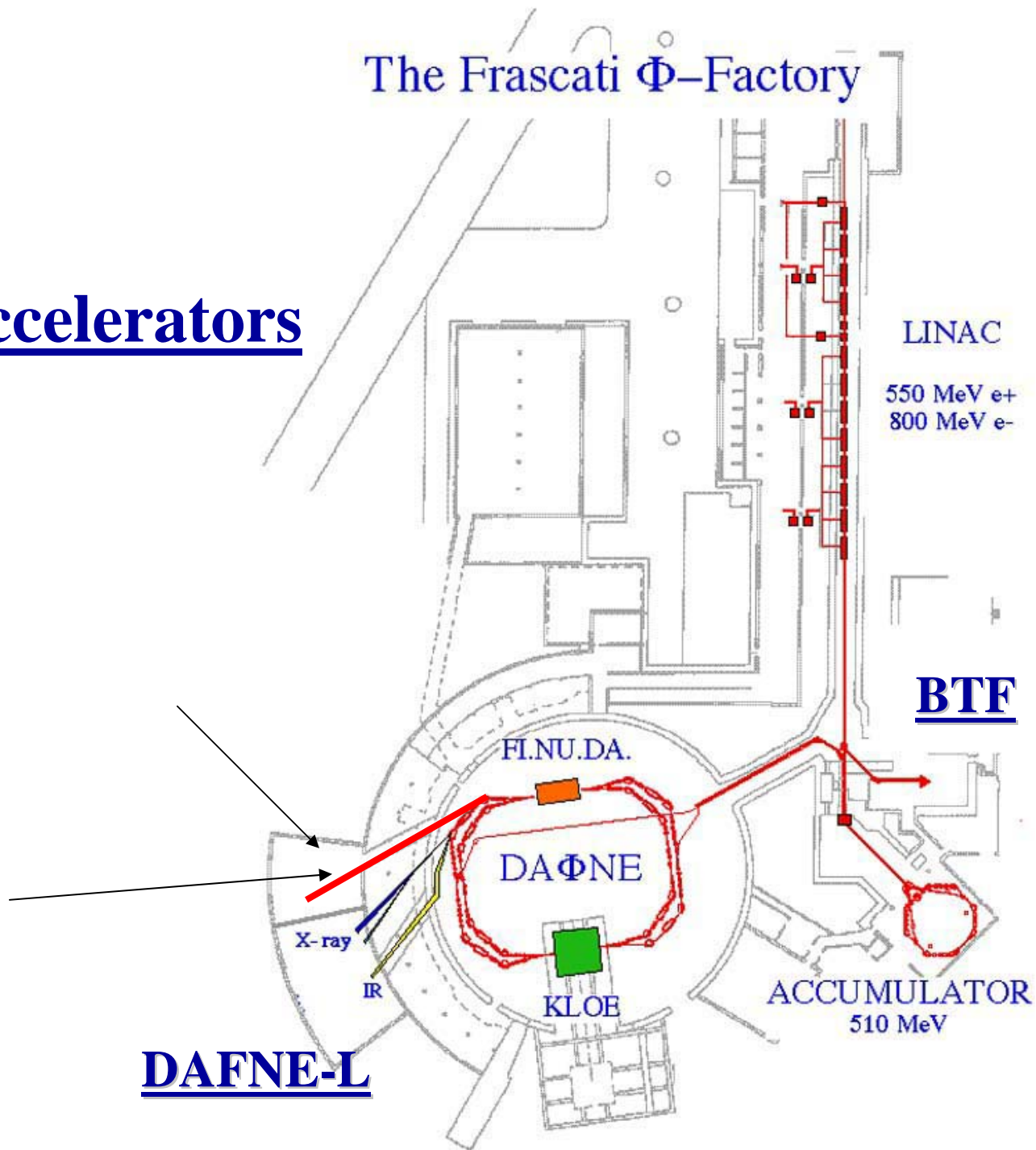
1. AIACE
2. HERMES
3. GRAAL
4. SIDDHARTA
5. VIP
6. GRAAL

ARCHIMEDE

CORA
DEUTER
E-CLOUD
FLUKA
FREETHAI
LAZIO-SIRad
MINCE
MA-BO
MIVEDE2
POLYX
SUE
SAFTA2
SI-RAD
GILDA

www.lnf.infn.it

The running accelerators



Dove siamo

KLOE @ Φ PEAK
@ 1000 MeV

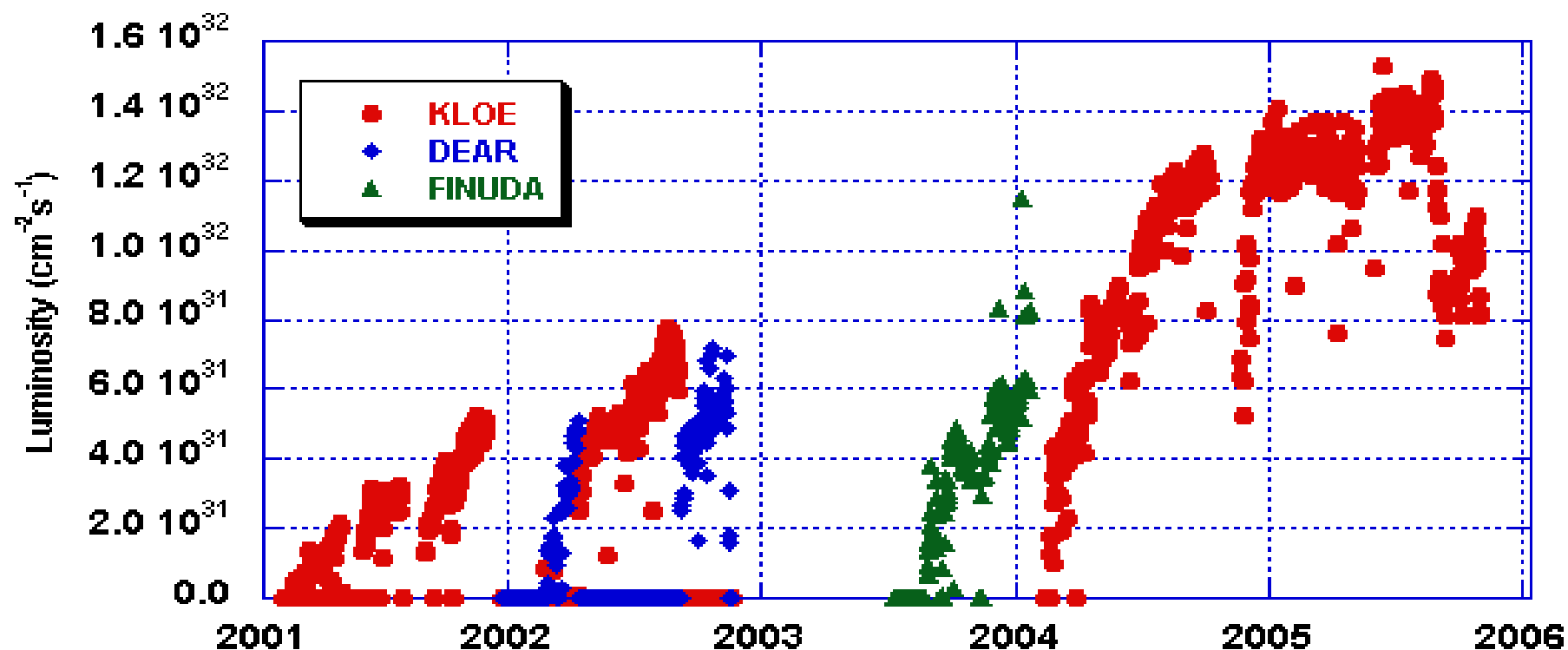
$$\int \mathcal{L} = 2.5 \text{ fb}^{-1}$$

$$\mathcal{L}_{\text{peak}} = 1.5 \times 10^{32} \text{ cm}^{-2} \text{ s}^{-1}$$

$$\int \mathcal{L} = 250 \text{ pb}^{-1}$$

$$\mathcal{L}_{\text{peak}} = 1.0 \times 10^{32} \text{ cm}^{-2} \text{ s}^{-1}$$

DAΦNE



Messaggio: LA DIVISIONE ACCELERATORI FUNZIONA BENE

Particle physics with KLOE :

Vus from KL, KS and charged K

Kaon form factors

Pion form factors/g-2

Ks rare decays

Charged kaon decays

KS semileptonic decays

KL branching ratios

KL life time

KS to $\gamma\gamma$

Φ radiative decays

eta and eta' decays

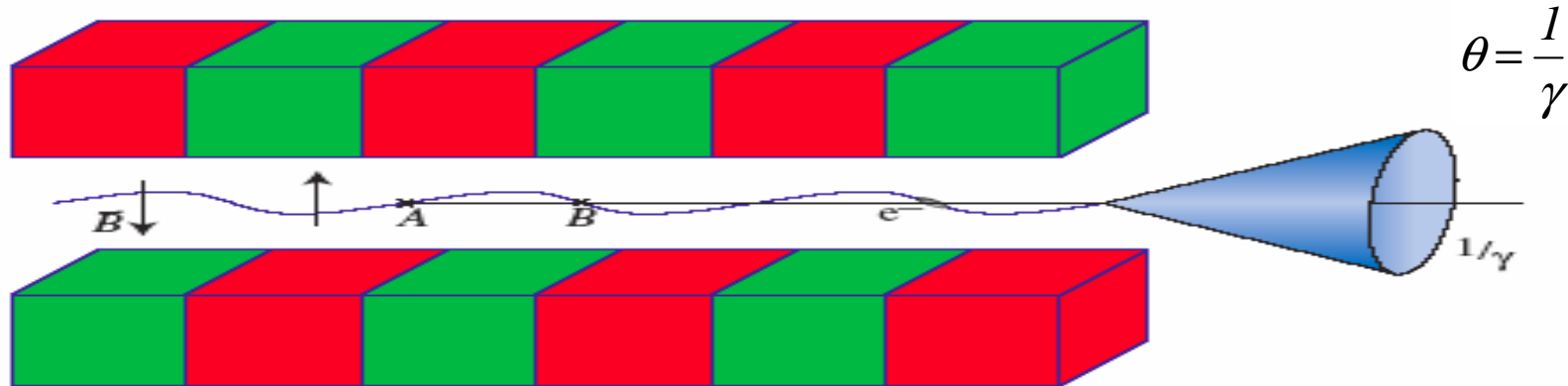
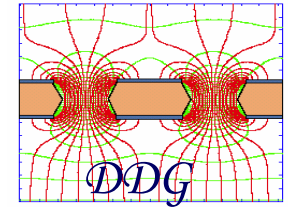
KO-KObar interference

2.2 fb^{-1} collected by KLOE

240 pb^{-1} a 1000 MeV (below the Φ)

Undulator Radiation

..need the use of high brilliance photo-injectors....



The electron trajectory is determined by the undulator field and the electron energy

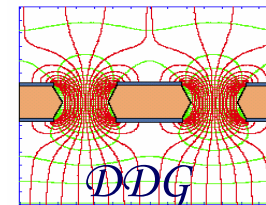
$$\langle \beta_{\perp} \rangle \approx \frac{K}{\gamma} = \frac{e\tilde{B}_u \lambda_u}{2\pi\gamma mc^2}$$

The electron trajectory is inside the radiation cone if $K \leq 1$

$$\lambda_{\text{rad}} \approx \frac{\lambda_u}{2\gamma^2} (1 + K^2)$$

TUNABILITY

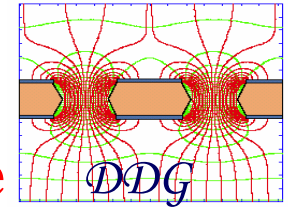
$$P_T = \frac{N_e^2 e^2}{6\pi\epsilon_0 c^3} \gamma^4 \dot{v}_{\perp}^2$$



Electron Beam Energy (MeV)	155
Bunch charge (nC)	1.1
Repetition rate (Hz)	1-10
Cathode peak field (MV/m)	120
Peak solenoid field @ 0.19 m (T)	0.273
Photocathode spot size (mm, hard edge radius)	1.13
Central RF launch phase (RF deg)	33
Laser pulse duration, flat top (ps)	10
Laser pulse rise time (ps) 10%→90%	1
Bunch energy @ gun exit (MeV)	5.6
Bunch peak current @ linac exit (A) (50% beam fraction)	100
Rms normalized transverse emittance @ linac exit (mm-mrad); includes thermal comp. (0.3)	< 2
Rms slice norm. emittance (300 μm slice)	< 1
Rms longitudinal emittance (deg.keV)	1000
Rms total correlated energy spread (%)	0.2
Rms incorrelated energy spread (%)	0.06
Rms beam spot size @ linac exit (mm)	0.4
Rms bunch length @ linac exit (mm)	1

ELECTRON BEAM PARAMETER LIST

The Linac of SPARC is in the commissioning phase

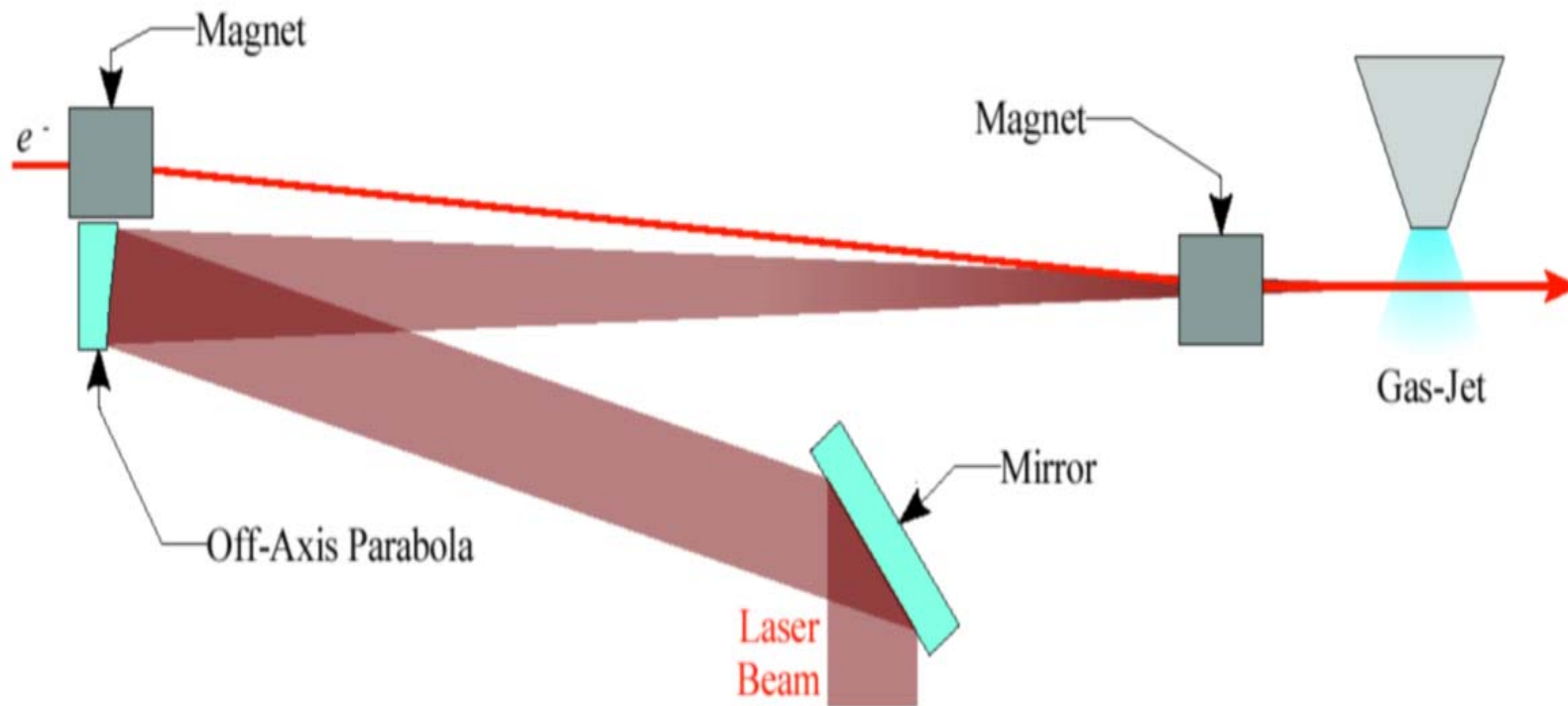


The SPARC test facility will start operating in 2006

- Ultra-brilliant 150 MEV electron beam
- RF and magnetic electron bunch compression
- Diagnostics of ultra-short, low emittance electrons beam
- SASE FEL experiment
- Seeding experiment
- Synchronization
- Diagnostics for ultra-short radiation pulses

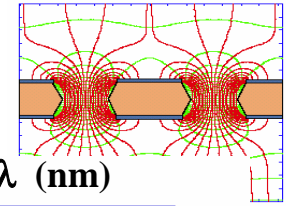
- Thomson X-source
- Plasma acceleration
- IFEL acceleration
- Channeling
- Quantum SASE FEL

Experimental setup for LWFA acceleration of externally injected electrons in a gas-jet plasma

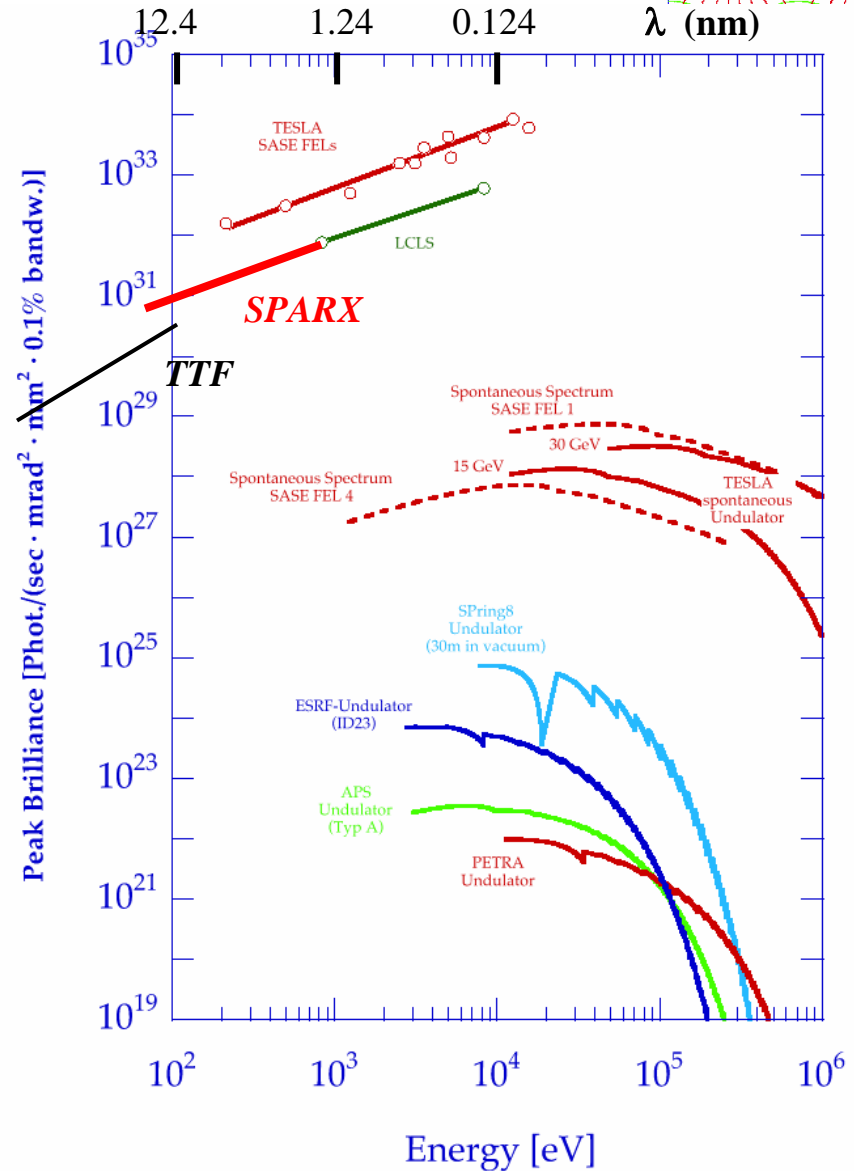


A NEW PROJECT an X-FEL

Brilliance of X-ray radiation sources



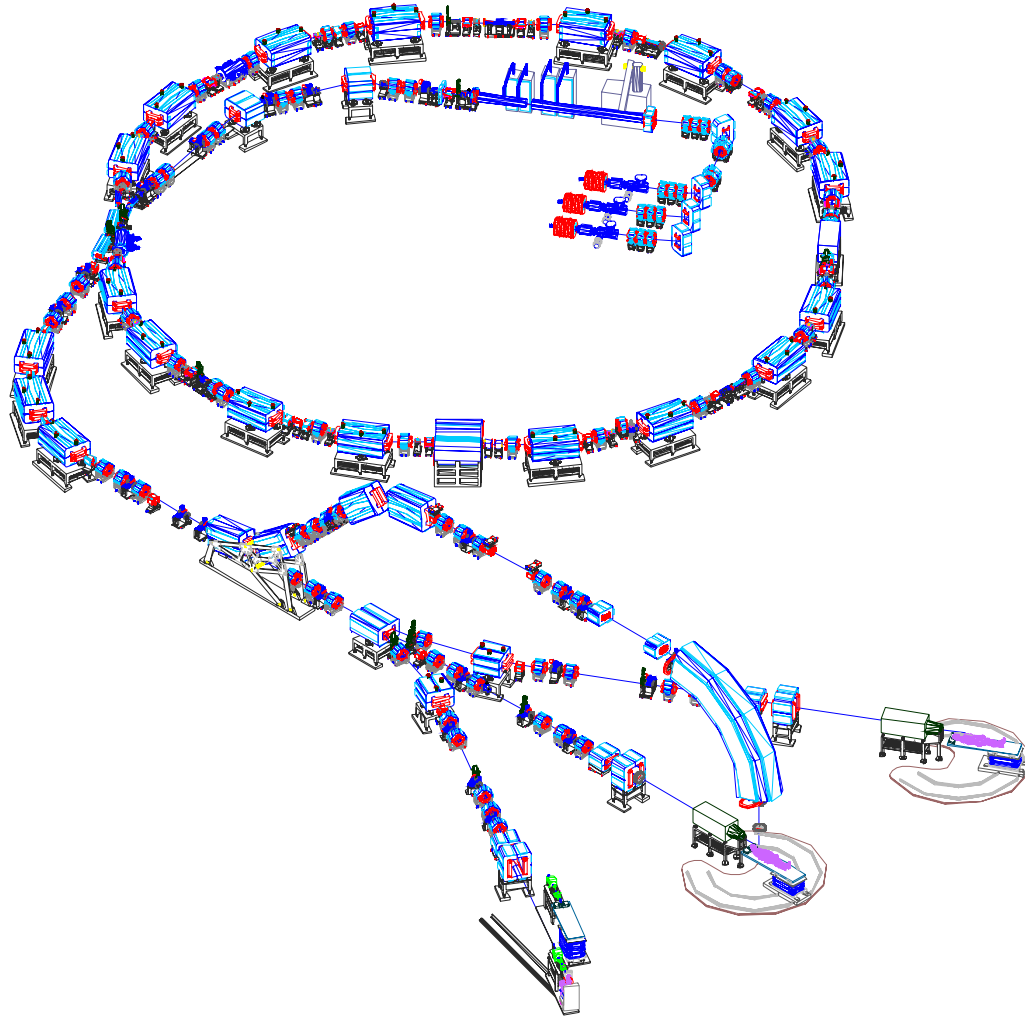
New FEL Covering from the VUV to the 1 Å X-ray spectral range:
new Research Frontiers



L.Palumbo

CENTRO NAZIONALE ADROTERAPIA ONCOLOGICA

1.2 GeV proton synchrotron, C-ions



**Setting up a system to cure
Cancer in a systematic way
for several thousands people
per year**

It is an experiment

**The accelerator is under
construction-Commissioning
in 2007.**

Big contribution from LNF-INFN

C.Sanelli

CTF3 at CERN

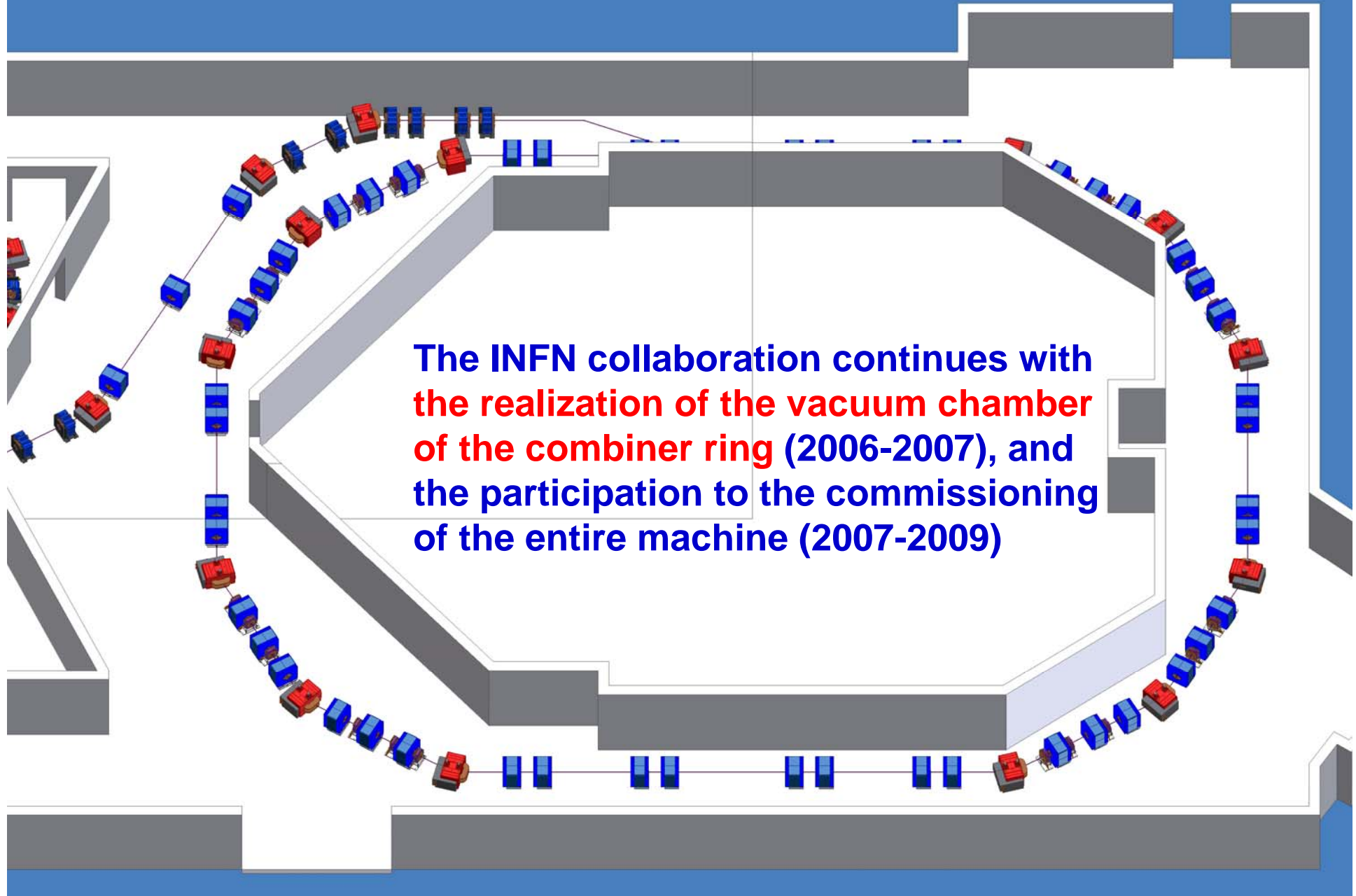
Delay Loop and transfer line
final lay-out

Transfer line:
installed and commissioned.
Delay Loop: installed

D.Alesini, G.Benedetti,
C.Biscari, R.Boni, M.Castellano,
A.Clozza, A.Drago, D.Filippetto,
A.Gallo, A.Ghigo (resp), F.Marcellini,
C.Milardi, L.Pellegrino, B.Preger,
M.A.Preger, R.Ricci, C.Sanelli, M.Serio,
F.Sgamma, A.Stecchi, A.Stella, M.Zobov
+
Accelerator Division Technical Staff



Combiner Ring: INFN design



The INFN collaboration continues with the realization of the vacuum chamber of the combiner ring (2006-2007), and the participation to the commissioning of the entire machine (2007-2009)

FUTURE LINEAR COLLIDER

LNf at EUROTeV

- **Coordination of the Working Package on Damping Rings (S. Guiducci)**
 - **ECLOUD: study of the instabilities from e-cloud**
 - **Code benchmarking at DAFNE (C. Vaccarezza)**
 - **Misure di SEY (Secondary Emission Yield) (R.Cimino)**
 - **RFSEP : Application of **RF-deflectors** for injection and extraction in the damping rings. (D. Alesini, F. Marcellini)**
 - **WGLRDYN: Magnetic field simulation in the Wiggler and computation of the dynamical aperture (M. Biagini)**
- **Participation to the Working Package GANMVL (Global Accelerator Network Multipurpose Virtual Laboratory) (G. Di Pirro)**

We consider mandatory to have also R&D on accelerator physics at LNF

- 1) Analytic upgrade of DAFNE to the highest possible luminosity**
- 2) Important upgrade in 2010 to increase even further the luminosity, which is required by physics**

....we propose to upgrade DAFNE:

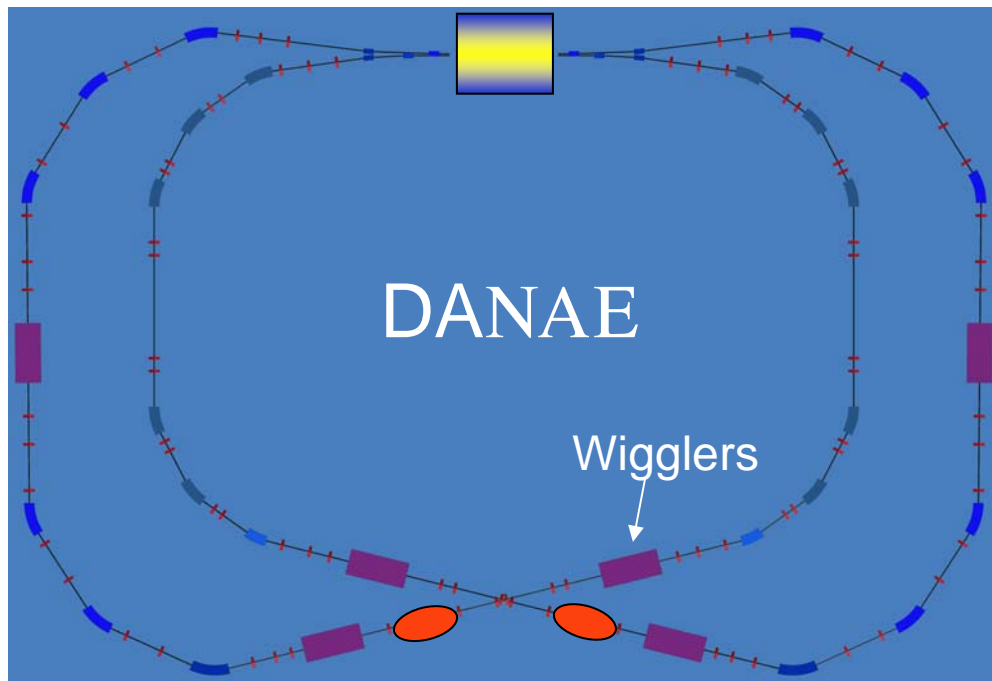
in Luminosity at the Φ resonance (times 7)

...and in Energy up to 2.4 GeV.

The energy should change continuously from 1GeV to the maximum energy

Road map: Conceptual Design Reports by the end of 2006

Construction 2007-2008-2009-2010



LoI's : KLOE2 exp
AMADEUS exp
DANTE exp
DANA E acc

They can be found at:

www.lnf.infn.it