The Implication of DaΦne-2 on Synchrotron Radiation Research

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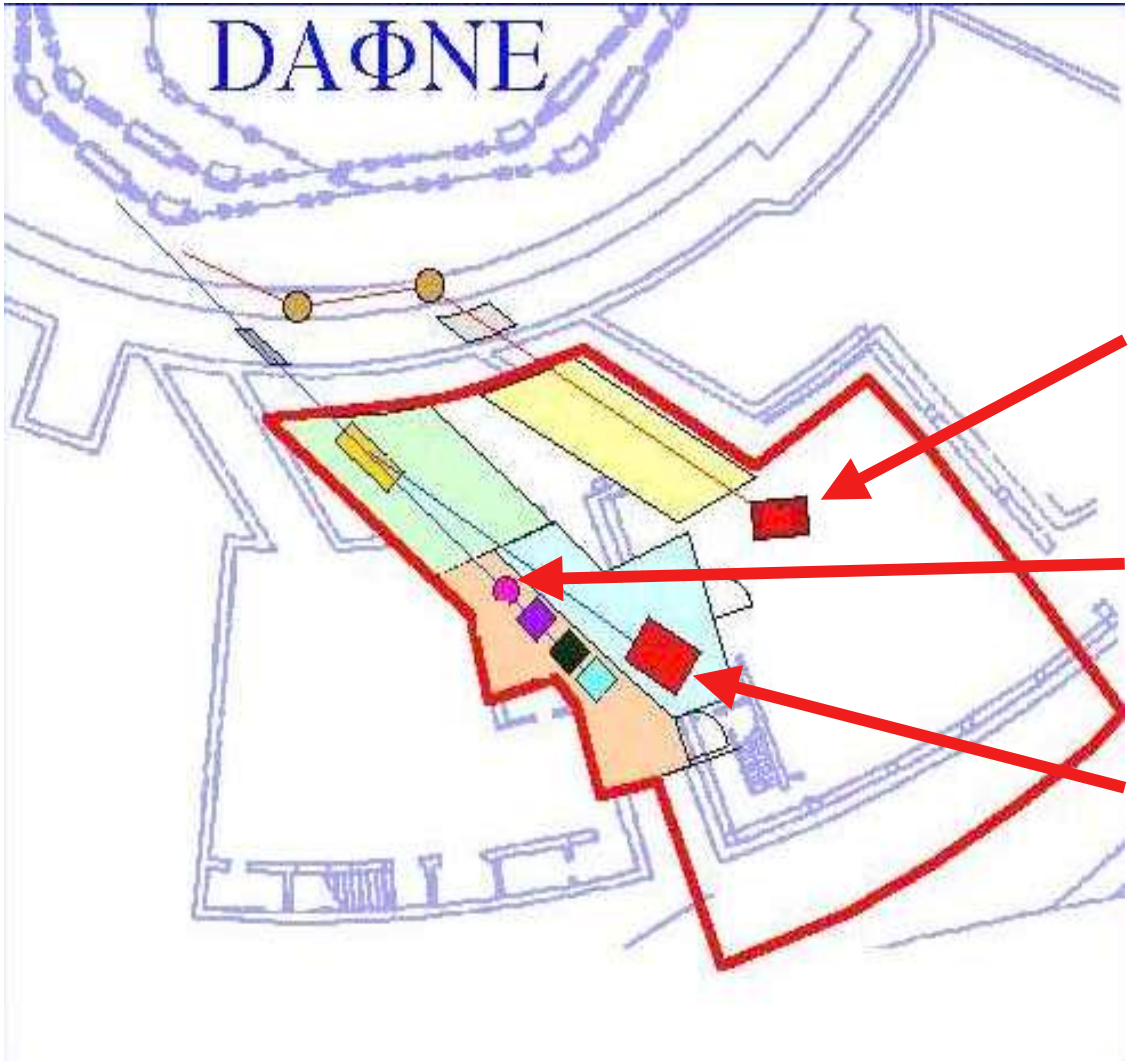
on behalf of the LDS Scientific committee

LNF-INFN Frascati (Roma) Italy.

- The DAΦNE-Light project: the existing and the expanding Laboratory.
- Future perspectives at **DaΦne-2**
- Scientific activities

DAΦNE-LIGHT

LNF - Synchrotron Radiation Facility



3 Beamlines:

1 from a B.M.:

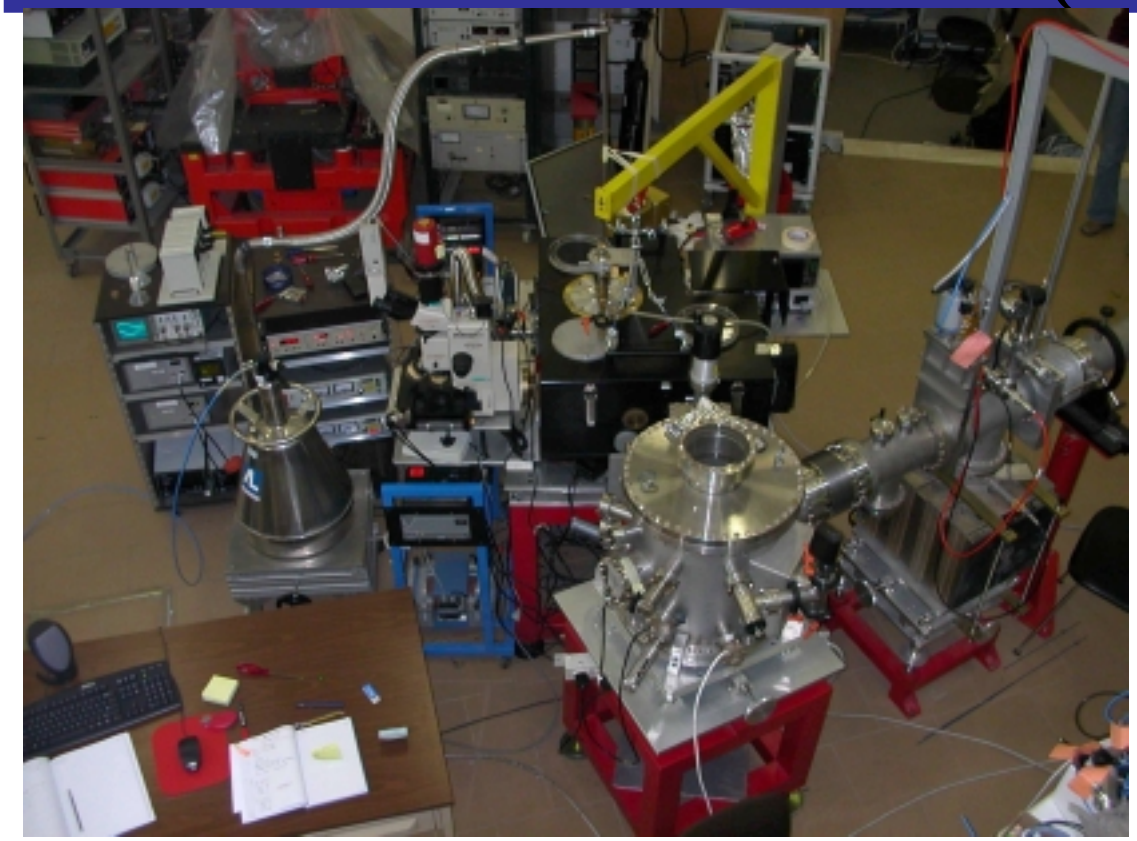
- SINBAD (infrared)

2 from aWiggler:

- DRX1- (1-5 KeV)
- DRX2- (near UV)

DAΦNE-LIGHT (B.M.)

SINBAD (infrared)

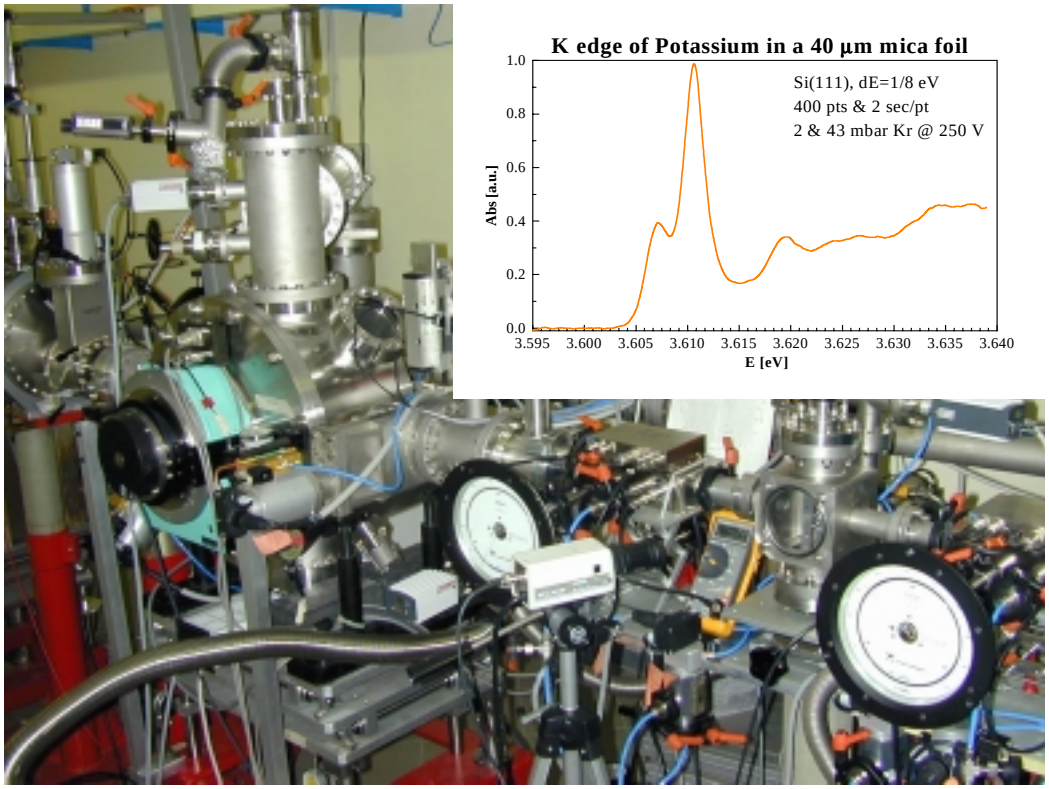


Applications:
Fourier Transform IR Spectroscopy in transmission and reflection
i) material studies at high pressure
ii) analysis by polarized IR light
iii) FTIR spectromicroscopy

Characteristics: Bruker Equinox interferometer:
i) wavenumber range 10-10000 cm^{-1} with max resolution 0,5 cm^{-1}
iii) under vacuum operation iv) diamond anvil cell or cryostat.
Bruker mid- IR microscope

Since the 2002 SINBAD is open to EU users within the TARI project (DAΦNE-Light SR Facility):
10 proposals (7 running, 3 closed)

DAΦNE-LIGHT (wiggler)
DRX1- (1.5-5 KeV)



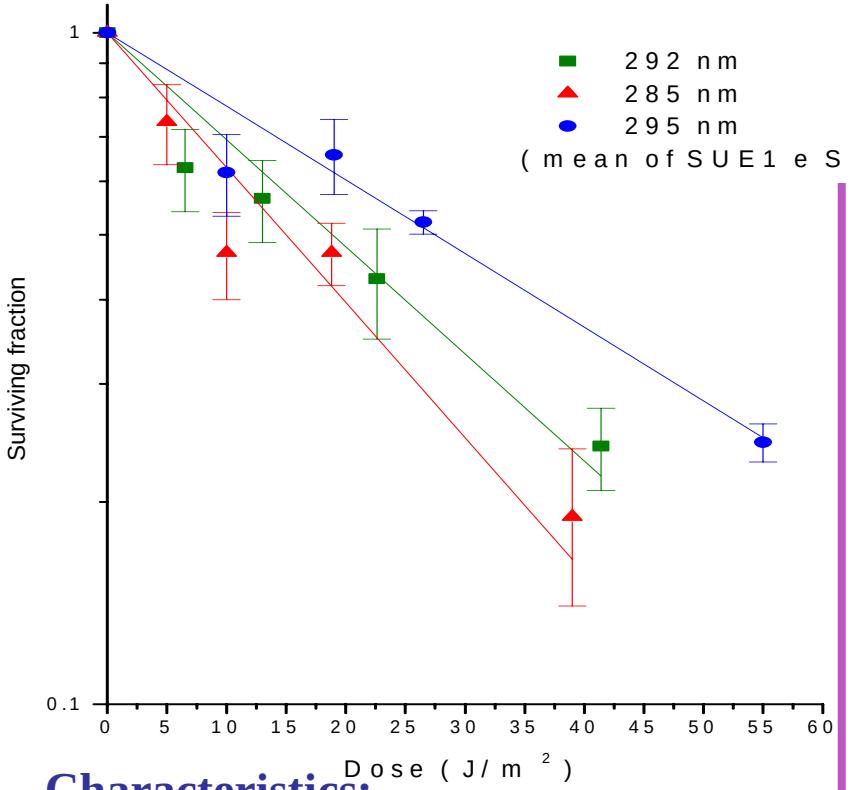
Applications:
X-ray Absorption Spectroscopy:
i)XANES on thin samples
ii)absorption and emission Spectroscopy on low Z elements or shallow edges of heavy elements.

Light elements X-ray Microscopy
X-Ray LIGA processes
Trace elemental analysis of light atoms.

Characteristics:
Double-crystal “boomerang” monochromator
Si(111), Quartz(10-10) and KTP(011) crystals

DAΦNE-LIGHT (Wiggler)

DRX2- (near UV)



Applications:

investigation of the biological effects on human cell cultures (HeLa-x human skin fibroblast) of irradiation by UV B band:

i) dose and wavelength dependence

ii) threshold effects

iii) death & neoplastic transformations

Characteristics:

Jobin Yvon grating monochromator:

i) Intensities from 20 to 40 J/m^2

ii) UVB band (280-320 nm); resolution better than 0,3%

The DAΦNE-Light proposed Bending Magnet beamlines

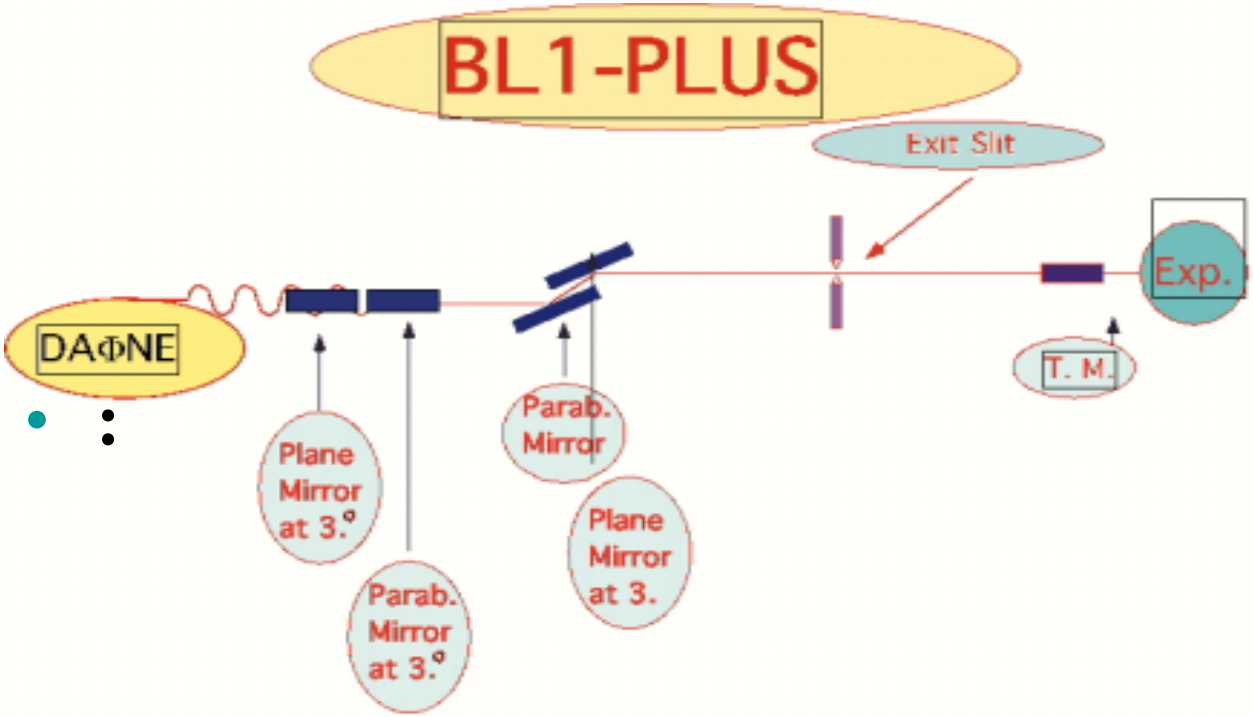
2 B.M. Beamlines:

- BL1 (60-1000 eV)
- BL2 (5-150 eV)

The detailed optical project is undergoing!

DAΦNE-LIGHT (B.M. proposed)

BL1 : 60 ÷ 1000 eV



- :

Application:

(Biology, Surface - Material Science)

i)XAS: NEXAFS and EXAFS

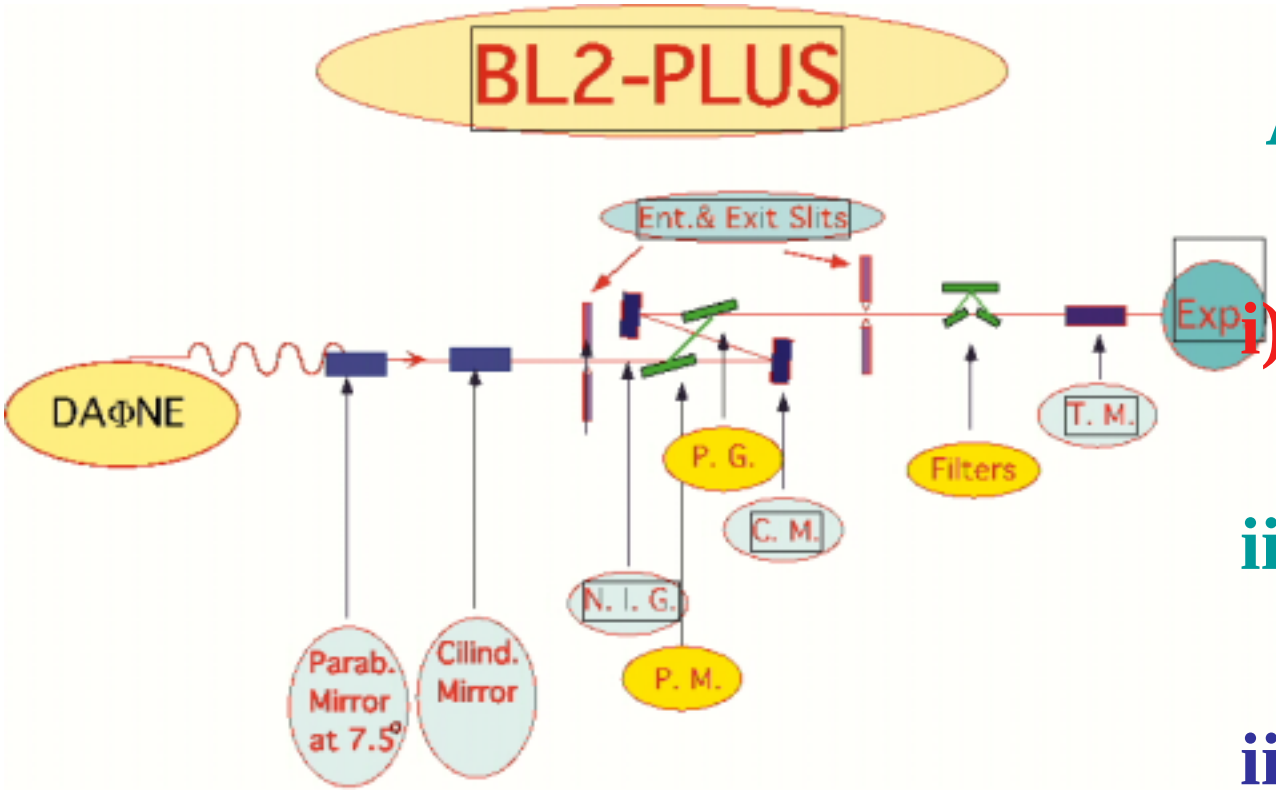
ii) Core Level and Resonant Photoem.

iii) Photoel. diffraction

With a PEEM Microscope: all experiment at sub-micrometer scale!

DAΦNE-LIGHT (B.M. proposed)

BL2: 5 ÷ 150 eV



Application (Surface - Material Science)

i) Angular resolved photoemission

ii) Angular resolved resonant photoem.

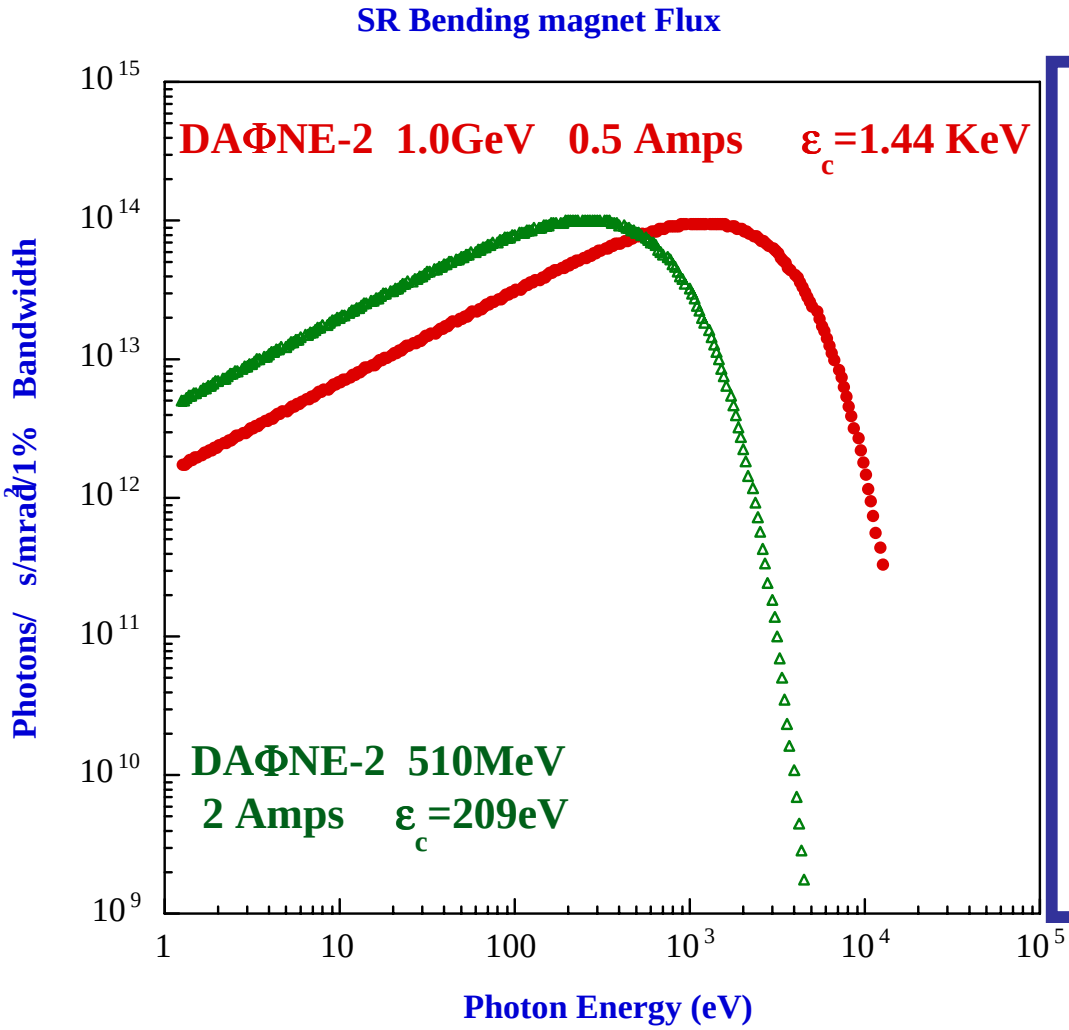
iii) Desorption

iv) Core level photoemission and photoelectron diffraction

What will happen to the DaΦne- light project with DaΦne-2?

	DaΦne	DaΦne-2 @0.5GeV	DaΦne-2 @1.0GeV
Energy (GeV)	0.51	0.51	1.0
Current (A)	2-5	2	0.5
Emitt. hxv (rad·m)	$10\ 10^{-7}$x$18\ 10^{-9}$	2.10^{-7}x2.10^{-9}	5.10^{-7}x5.10^{-9}
σ_x xσ_y (mm) dip.	2.24x0.27	0.45x0.09	1.4x0.2
wiggler	yes	No **(or dedicated?)**	yes

The energy difference in the two solutions:



For daΦne -2 @ 1 GeV, the SR emission significantly expand in energy rendering exploitable the extremely interesting window between 1 to 10-15 KeV

The Current and presence of Wigglers:

Clearly, the reduction in current, especially in the case of daΦne -2 @ 1 GeV, decrease the intensity of the emitted SR by more than a factor 4.

The absence of wigglers in the daΦne -2 @ 0.51 GeV, reduces the flux and the available energy range, “blinding” the X ray beamline above 1 to 2 KeV.

In the case of DaΦne- upgrade:

If an “ad hoc” designed insertion device is inserted into the lattice, (to be operational ONLY during the dedicated time!!)

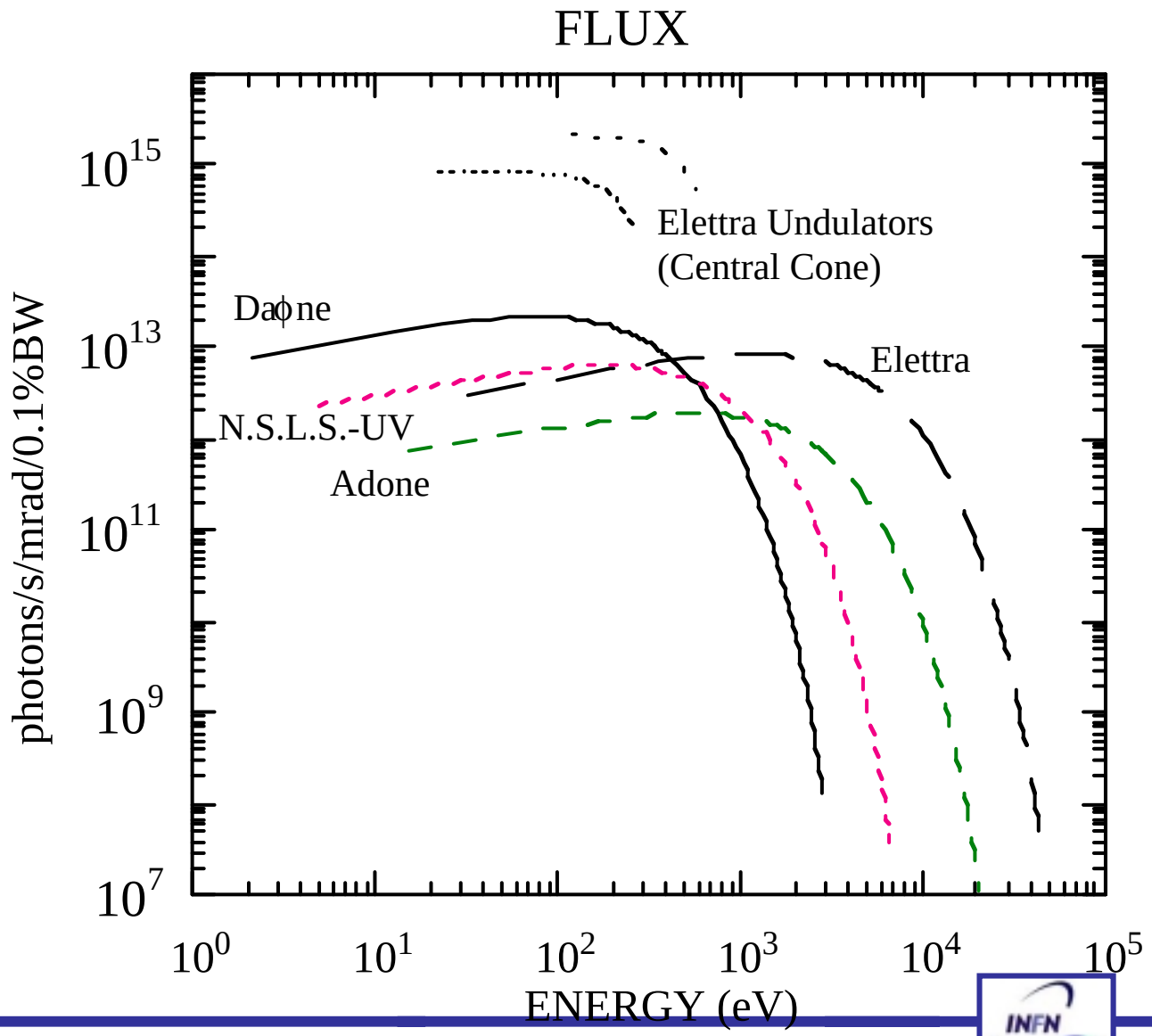
We can save and improve the x-ray region!!!

The emittance and spot size:

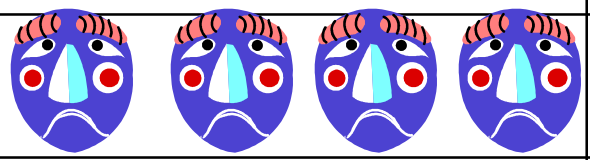
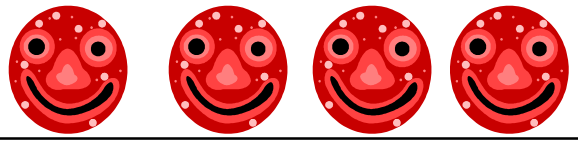
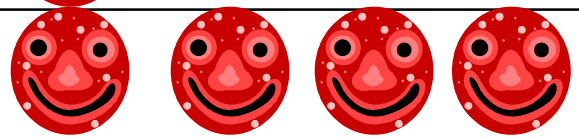
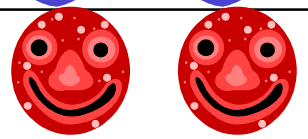
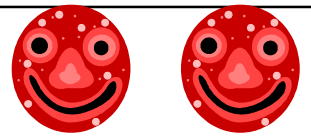
The reduction in the vertical emittance by a factor 10/ 4 and in spot size by 3 / 1.4 (in case of daΦne -2 @ 0.51 / 1 GeV respectivelly), improve the BM beam-line performances (flux and resolution) by a factor 10 to 4 (in the two upgrade scenarios) with the exception of the IR beamline.

Do not forget that daΦne-1 is already a super-SR source in the VUV and soft X ray energy range :

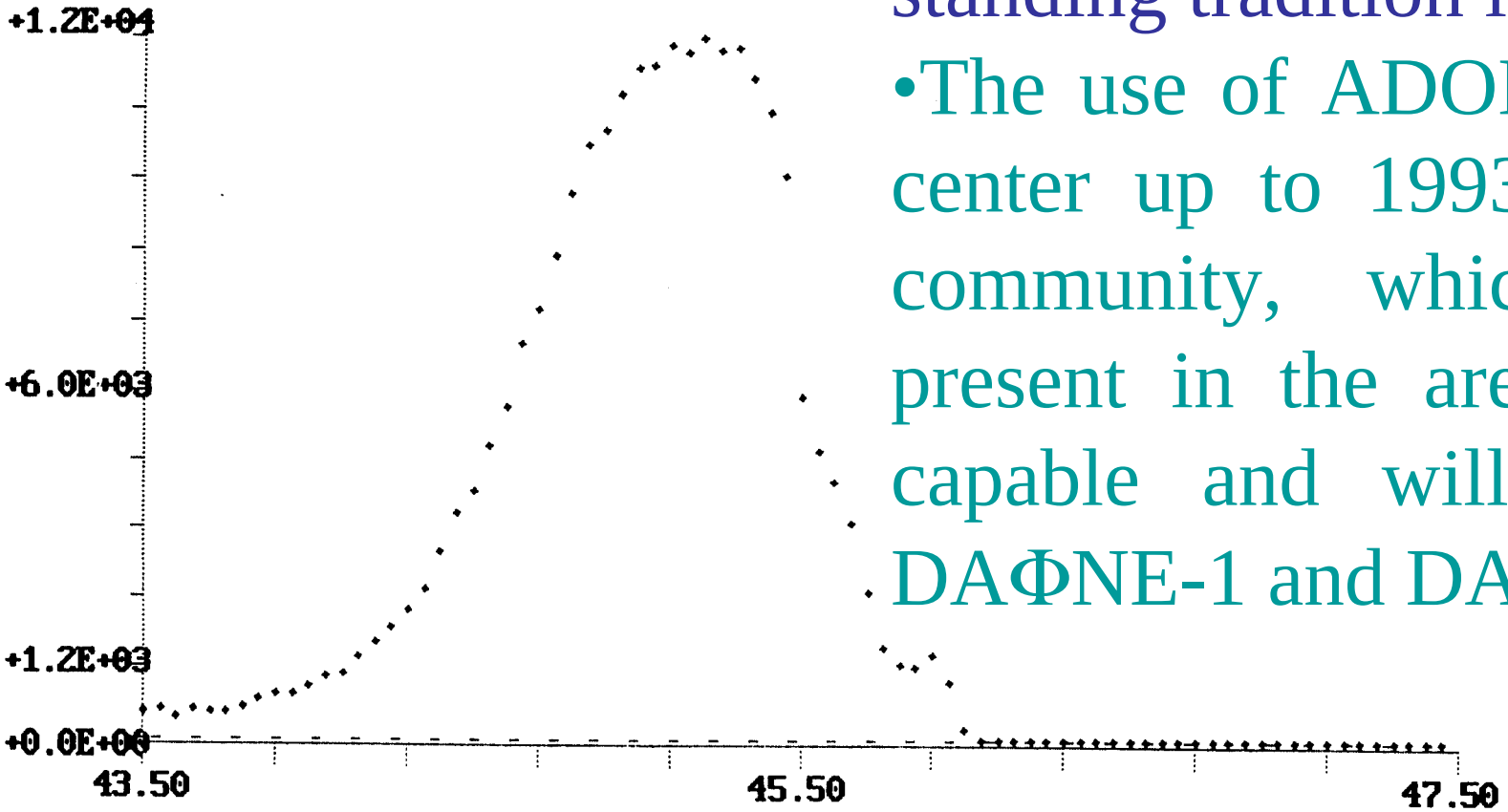
DAΦNE- 1 Flux:


FLUX
photons/s/mrad/0.1%BW
10^{15}
10^{13}
10^{11}
10^{9}
10^{7}
10^{0}
10^{1}
10^{2}
10^{3}
10^{4}
10^{5}
ENERGY (eV)
Elettra Undulators
(Central Cone)
Daϕne
Elettra
N.S.L.S.-UV
Adone

Beamlines vs. upgrades:

	daΦne-2 @ 0.51 GeV	daΦne-2 @ 1 GeV
DRX1 (Xray)		
DRX1 with ID		
DX2 (near UV)	-	-
SIMBAD (IR)		
BM1* (5-200 eV)		
BM2* (0.1 - 1KeV)		

Why?:

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c:\ULTIMO\EDC13              04-26-1993    09:02:17 # of scans = 1 T= 1
Y limits= 41780 0  Vmin= 43.5 Vmax= 47.5 # of points= 81
exp. EDC ADDIO ALLE ARMI... pass energy =15 ph. en. = 69.96795
   Enter Y to expand Y scale, X to choose new X limits, F to change file?
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- INFN-LNF has a long-standing tradition in SR.
- The use of ADONE as a SR center up to 1993, created a community, which is still present in the area, and still capable and willing to use DAΦNE-1 and DAΦNE-2 SR.

High external competition + Specific INFN scientific interest

- Daϕne and Daϕne-2 will continue delivering state of the art SR to user.
- Interdisciplinary research, R&D, and technologically oriented studies of interest to INFN, shows a growing attention to experiments where the use of a well equipped and available SR center is beneficial (X-ray as well as IR optics and detectors calibration; particles detector calibration and basic studies ; Accelerator vacuum issues and material science (see e-cloud) etc.....)
- Access to spectro-microscopy will open unprecedented capabilities to study nano-structures, nano-technology as well as biology with sub-μ spatial resolution.

Additional benefits:

- The prospective of building in the vicinity of Frascati an X-ray FEL, will require an unprecedented effort to develop and characterize optics and fast detectors, and a test facility like the proposed laboratory, could represent a key issue to a successful scientific exploitation of such new light source.
- The Spectroscopy program on DAΦNE is and will also greatly benefit from the theoretical expertise present at Frascati.

SR Committee requirements :

- Minimum but guaranteed access to the machine. (2-5%);
- Beam stability (better than 1/3 σ_v)
- Optimized injection scheme to operate and collect spectra during topping-up;
- Long beam life-time (τ >1-2 hours)
- Financial support.
- Manpower.

SR Committee requirements (**LAST BUT NOT LEAST**):

Guaranteed dedicated time (Minimum 15%) to assure international competitiveness and scientific excellence.

Conclusions:

- **The upgrade at 0.51 GeV will cause:**

- a Slight improvement in IR performances
- blinding of the X ray DRX1 ab[illegible]
- in case of a dedicat[illegible]
  Substa[illegible] the 1-5 KeV region!!!
- improver[illegible]tor 10 in intensity and resolution of the [illegible]posed BM beamline performances.

preferable solution!

- **The upgrade at 1 GeV will cause:**
  - a substantial reduction in IR performances
  - slight improvement in intensity and resolution of the proposed BM beamline performances.
  - enhancement of the x ray region.

the LDS Scientific Committee @ LNF

Antonella Balerna, Stefano Bellucci, Maurizio Benfatto, Enrico Bernieri, Sergio Bertolucci, Emilio Burattini, P. Calvani, Roberto Cimino, Gianfelice Cinque, Alberto Clozza, Claudio Marcelli, Settimio Mobilio, Miro Pregher, Rino Natoli, Lucia Votano.