

**RECFA-CERN  
NOVEMBER 25th 2010**

**LNf UPDATES**

**Mario Calvetti  
Frozen (sorry) LNf Director**

# DAΦNE present achievements & perspectives

	DAΦNE upgrade SIDDHARTA	DAΦNE KLOE	DAΦNE FINUDA
$L_{\text{peak}}$ [cm <sup>-2</sup> s <sup>-1</sup> ]	<b>4.53·10<sup>32</sup></b> (5.0·10 <sup>32</sup> )	1.5·10 <sup>32</sup>	1.6·10 <sup>32</sup>
$L_{\text{day}}$ [pb <sup>-1</sup> ]	<b>14.98</b>	9.8	9.4
$L_{\text{1 hour}}$ [pb <sup>-1</sup> ]	<b>1.033</b>	0.44	0.5
$I_{\text{MAX}}^-$ in collision [A]	<b>1.52</b>	1.4	1.5
$I_{\text{MAX}}^+$ in collision [A]	<b>1.0</b>	1.2	1.1
$N_{\text{bunches}}$	<b>105</b>	111	106
$\xi_y$	<b>0.0443</b> (0.074)	0.025	0.029

Scaling the present data from the luminosity monitor:

**$L_{\text{day}} \geq 20. \text{ pb}^{-1}$  seems possible!**

Assuming 80% collider uptime  $\Rightarrow L_{\text{month}} \sim .5 \text{ fb}^{-1}$

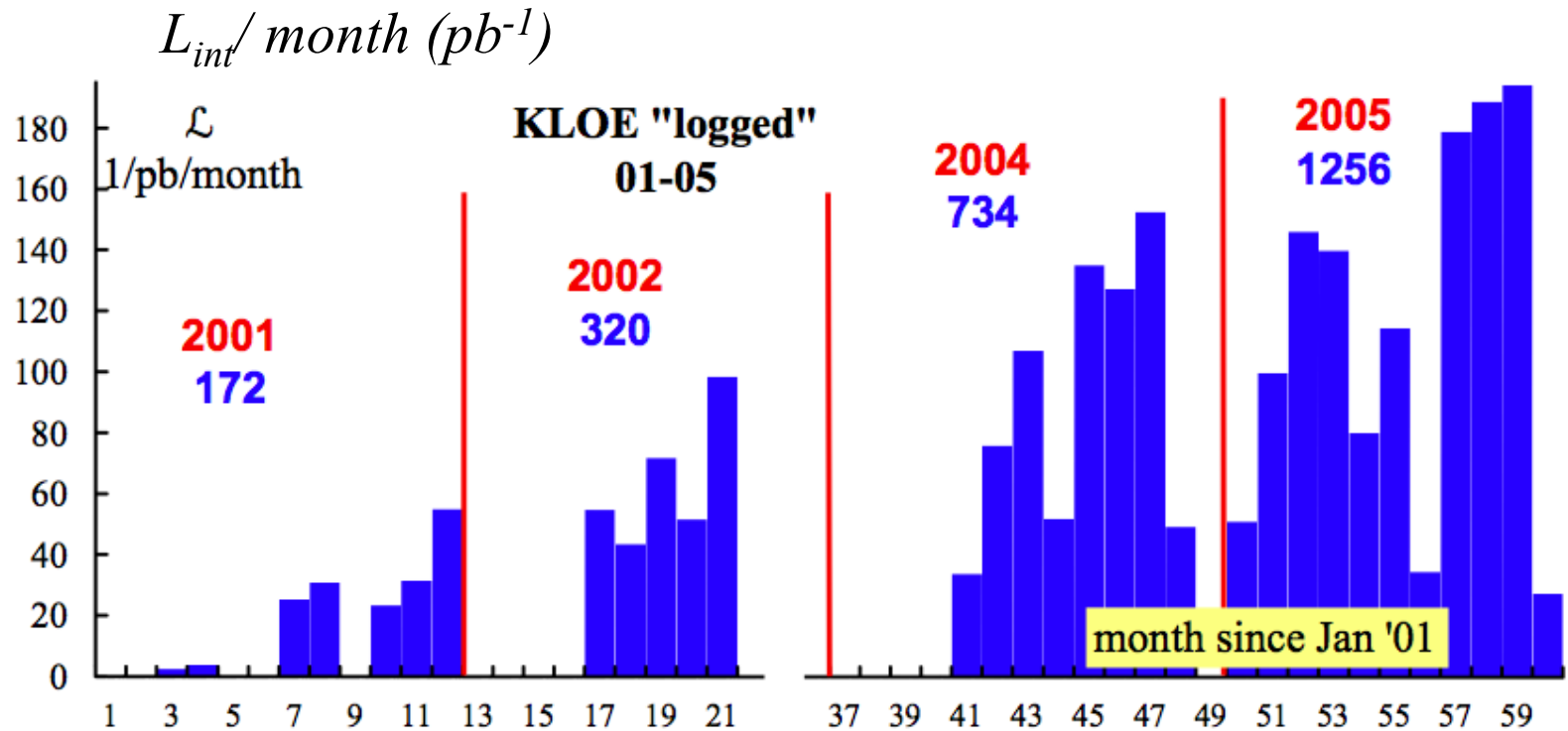
*The Crab-Waist collision scheme has been widely recognized as a major advance in the field of the beam-beam interaction in lepton colliders.*

# DAFNE is UP and running again



## KLOE

Between years 2000 and 2006 DAΦNE has delivered to KLOE 2.5 fb<sup>-1</sup> of data at the  $\Phi(1020)$  peak plus additional 250 pb<sup>-1</sup> off-peak



Best day: 10 pb<sup>-1</sup>

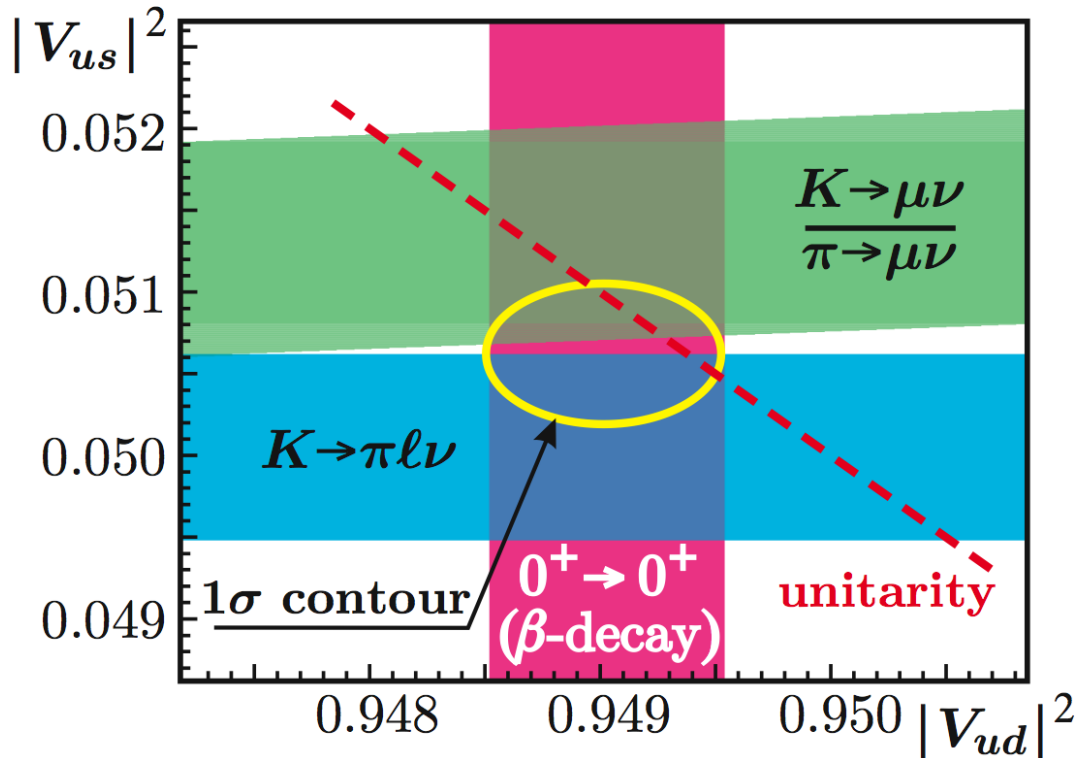
Best month: 194 pb<sup>-1</sup>

Using these data, KLOE has published about 50 physics papers, addressing several fundamental topics in the fields of flavour and hadronic physics. Among our results one can list:

- The complete set of measurement of neutral and charged kaon decay parameters to allow **the precision measurement of  $V_{us}$**  setting the best unitarity limit on the CKM matrix
  - A precise determination of the **hadronic contribution to the  $g-2$  of the muon**
  - The best limit published so far on **LFV in  $K_{e2}$  decays**
  - The most detailed studies on the **nature of scalar mesons**
  - The measurement of some of the **rarest branching ratios** of the  $K_s$  and  $\eta$  mesons
- 
-



# $V_{us}$ determination and CKM unitarity



Fit on

$V_{us}$  from  $K_{l3}$

$V_{us}/V_{ud}$  from  $K_{\mu 2}/\pi_{\mu 2}$

$V_{ud}$  from  $0^+ \rightarrow 0^+$   $\beta$  decays

$$|V_{us}| = 0.2249 \pm 0.0010$$

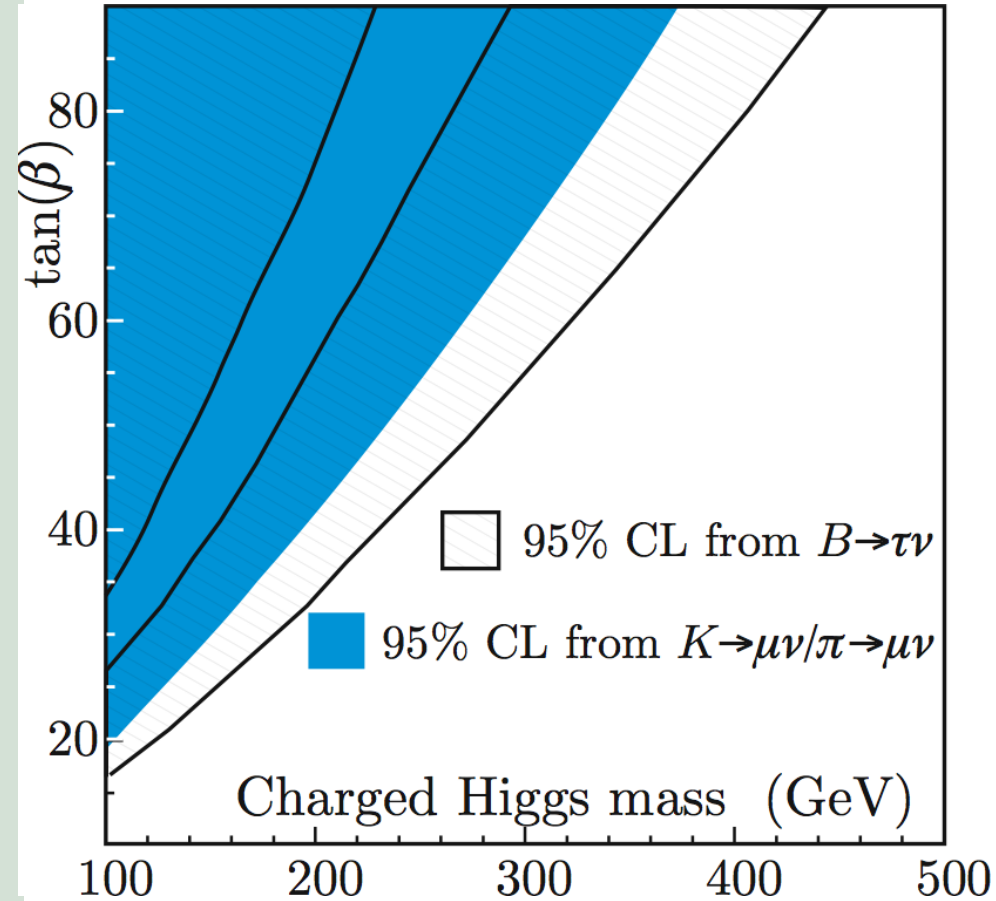
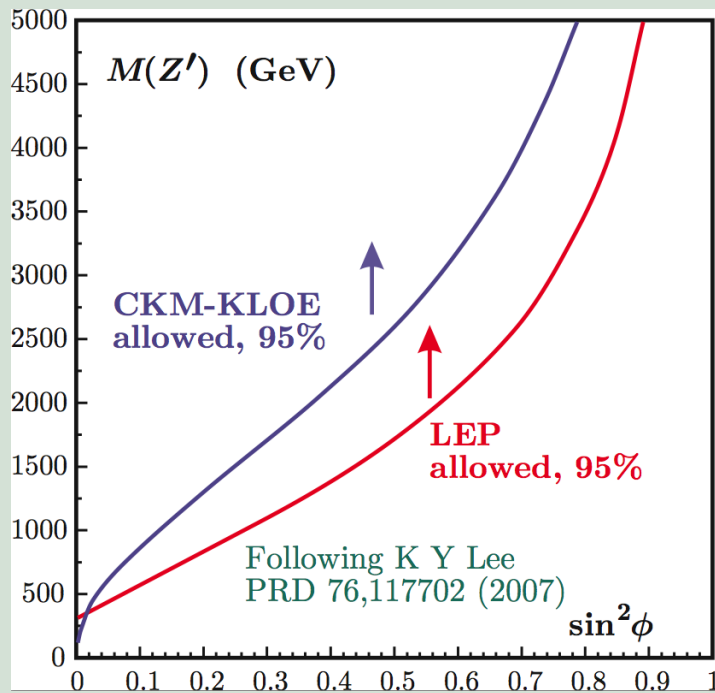
$$|V_{ud}| = 0.97418 \pm 0.00026$$

$$1 - |V_{us}|^2 - |V_{ud}|^2 = 0.0004 \pm 0.0007$$

was  $0.0031 \pm 0.0015$  in PDG04

# Tree level breaking of unitarity in models with non-universal gauge interaction

## Constraints on New Physics

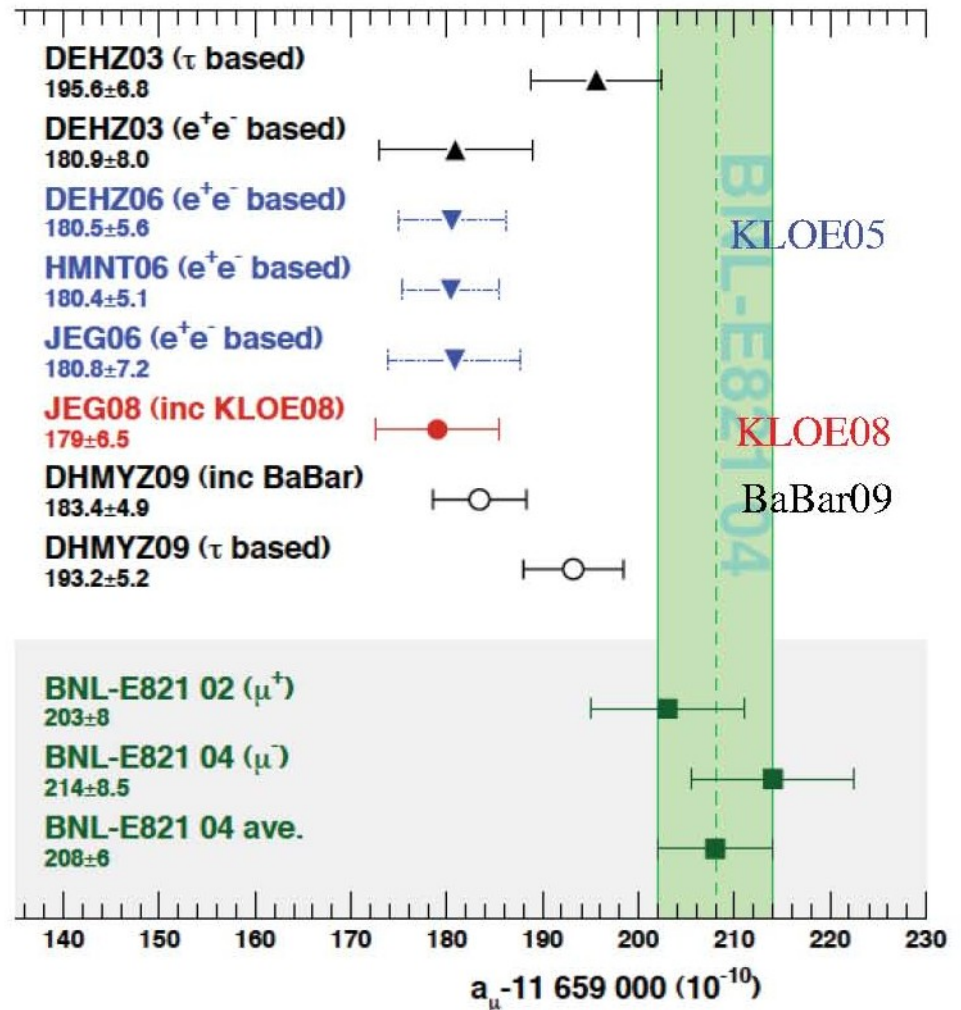
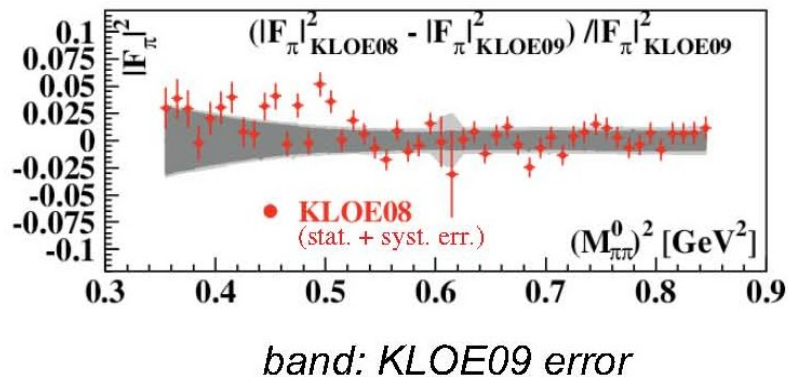


# Hadronic contribution to muon g-2

Discrepancy between  $a_\mu^{\text{SM}}$  and  $a_\mu^{\text{EXP}}$  at  $3.2\sigma$  level

New KLOE analysis, with different selection criteria confirms KLOE08

Fractional difference:





# ***SIDDHARTA short story:***

- ***run on upgraded DAΦNE 2008-2009 (first experiment !)***

- ***Measurements:***

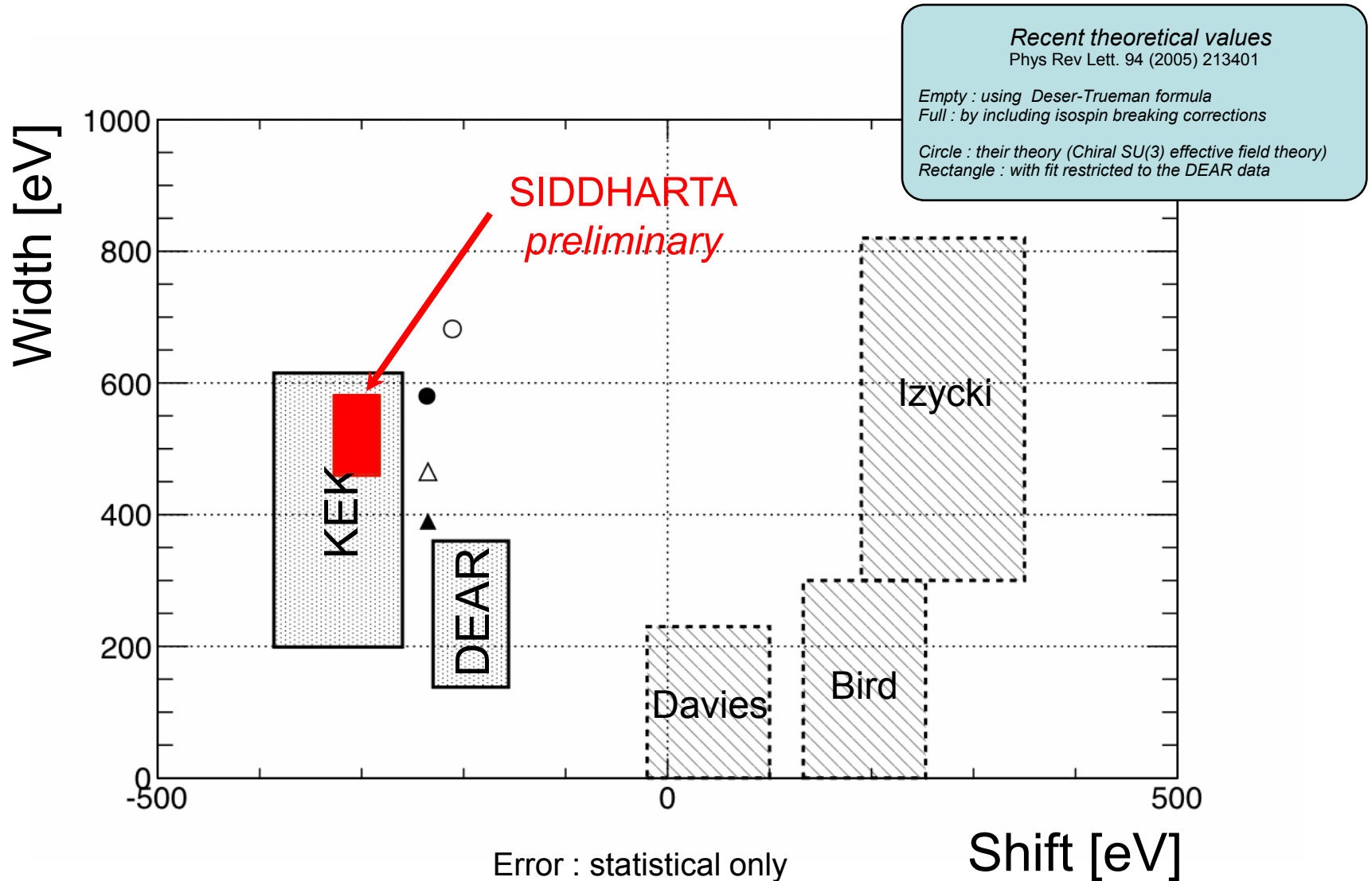
***Kaonic Hydrogen*** - best measurement in the world– paper in preparation

***Kaonic deuterium*** – first ever exploratory measurement; paper in preparation

***Kaonic helium 4*** – first gaseous target measurement: Phys. Lett. B 681 (2009) 310; another paper in preparation;

***Kaonic helium 3*** – first measurement in the world; paper submitted PLB and ***Ph D***

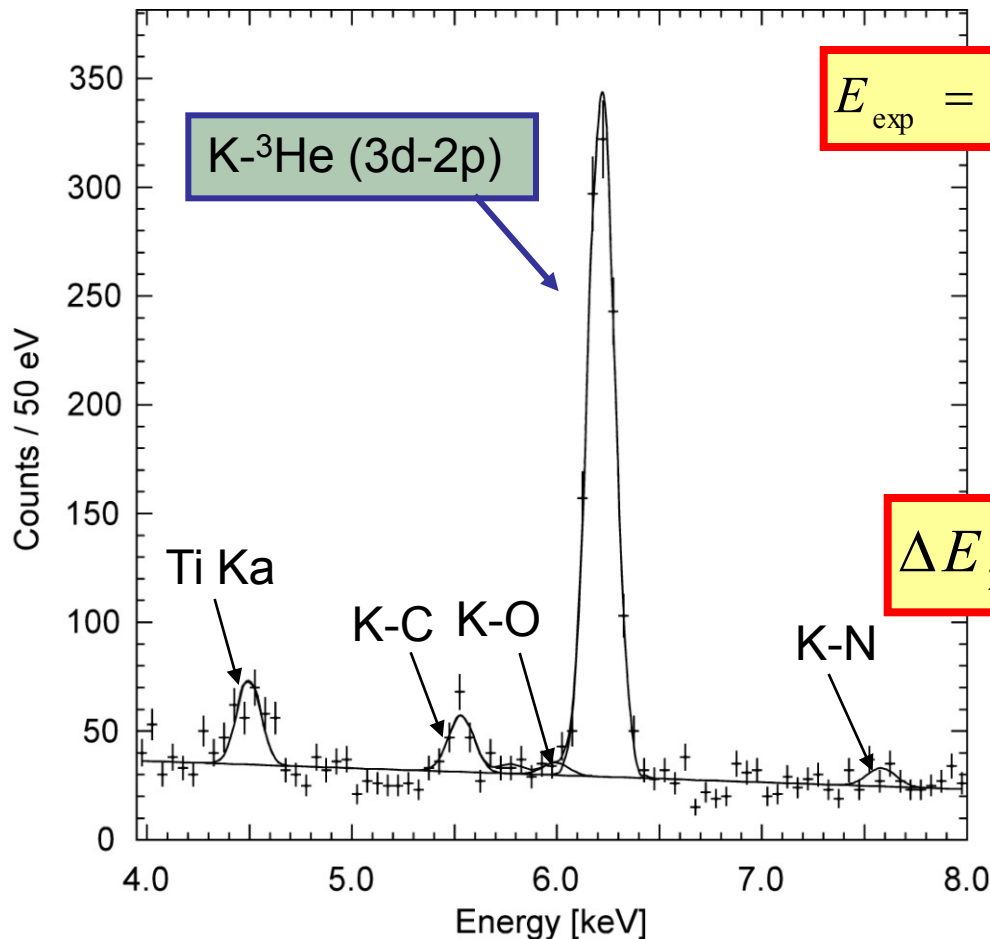
# Kaonic hydrogen result



# Kaonic Helium-3 spectrum

*First observation of kaonic He-3 X-rays*

X-ray energy of K-3He 3d-2p



$$E_{\text{exp}} = 6223.0 \pm 2.4(\text{sta}) \pm 3.5(\text{sys}) \text{ eV}$$

QED value:

$$E_{e.m.} = 6224.6 \text{ eV}$$

$$\Delta E_{2p} = E_{\text{exp}} - E_{e.m.}$$

$$\Delta E_{2p} = -2 \pm 2(\text{sta}) \pm 4(\text{sys}) \text{ eV}$$

arXiv:1010.4631  
Submitted to PLB

# The Frascati $\Phi$ -Factory

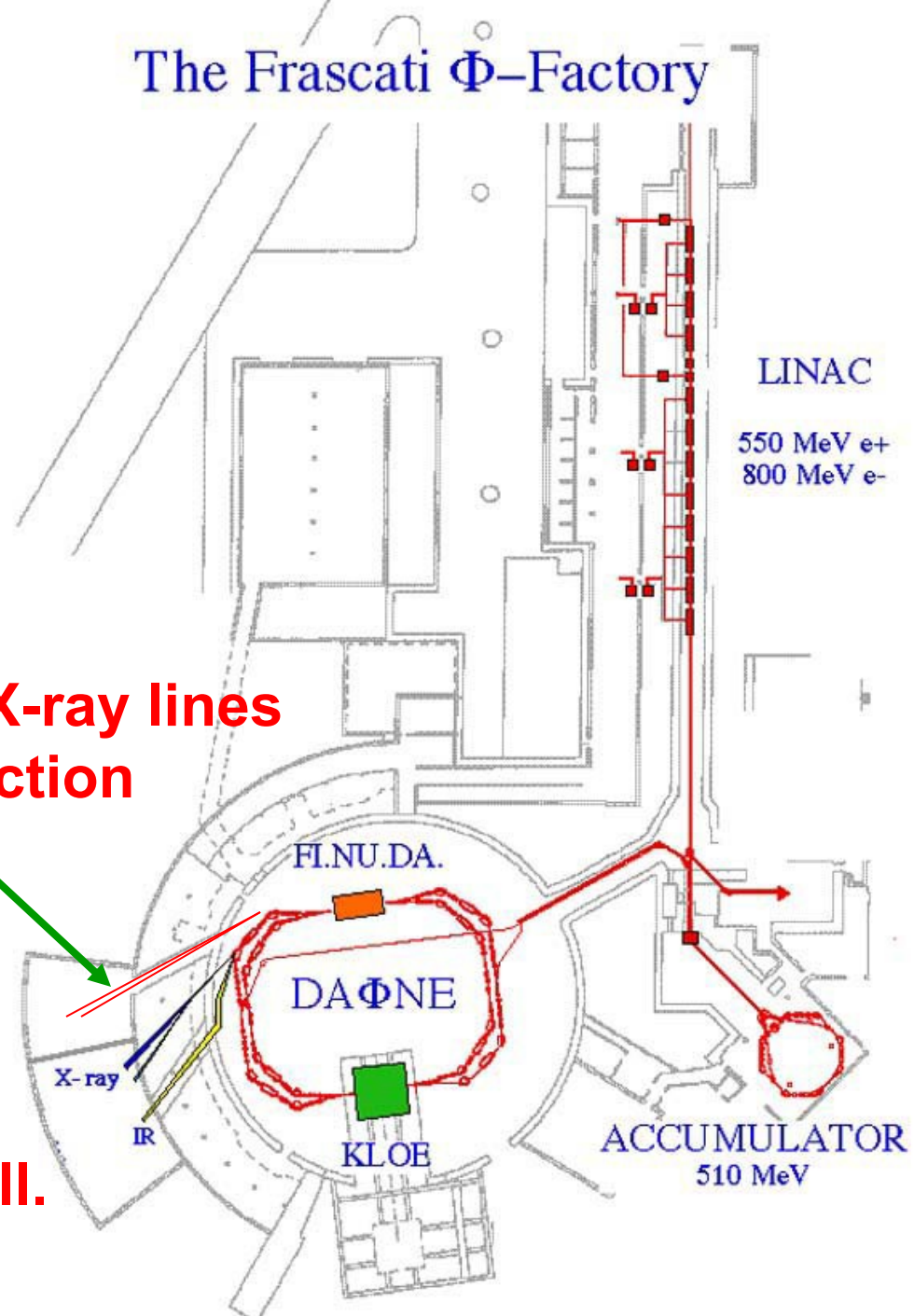
**DAFNE- LIGHT**

**Synchrotron light from DAFNE**

**SPARC**

**Conventional sources**

**Two new soft X-ray lines  
under construction**

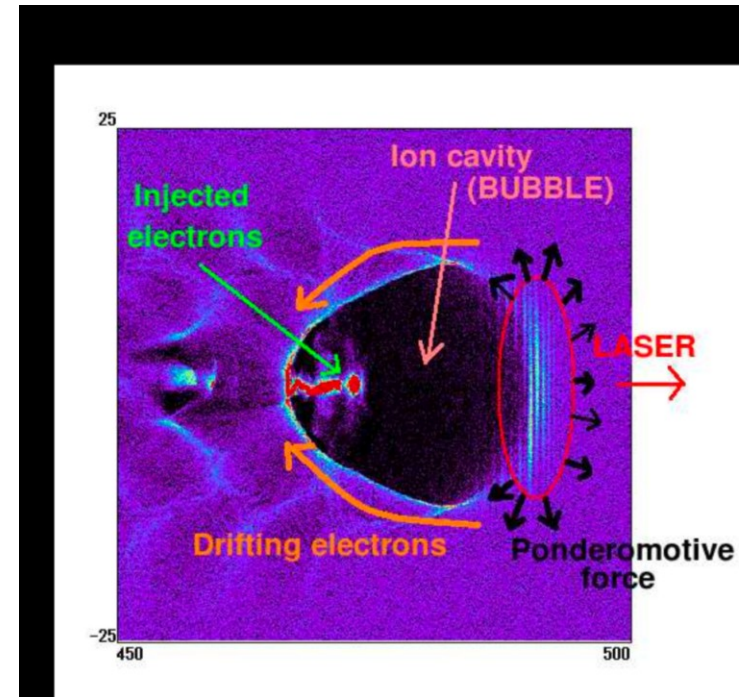
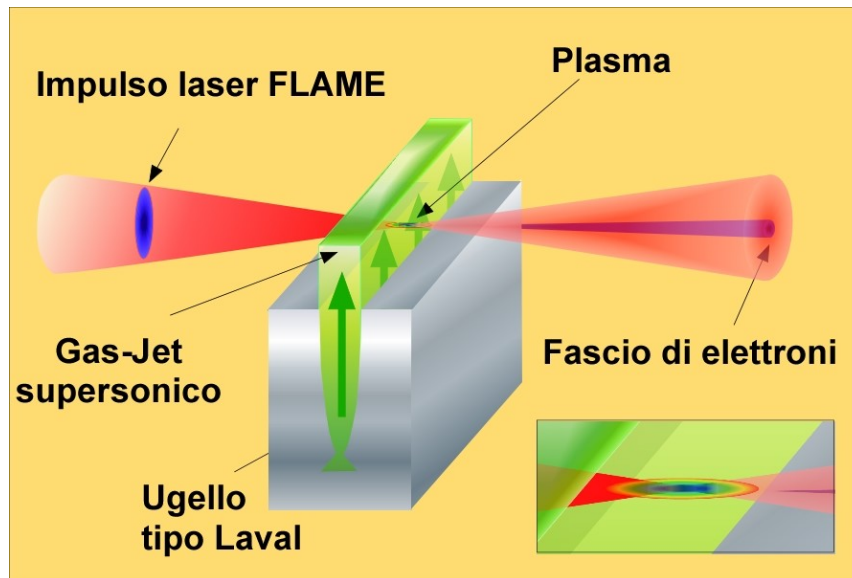


**A new UV clean exp-hall in coll.  
with the Florence university**

# GeV ACCELERATION WITH SELF INJECTION

## Main set up parameters

$L_{gas\ jet}$ [mm]	$n_e$ [e/cm <sup>3</sup> ]	$\tau$ [fs]	$I_0$ [W/cm <sup>2</sup> ]	$w_0$ [ $\mu$ m]
4	$3 \cdot 10^{18}$	30	$5.2 \cdot 10^{19}$	16





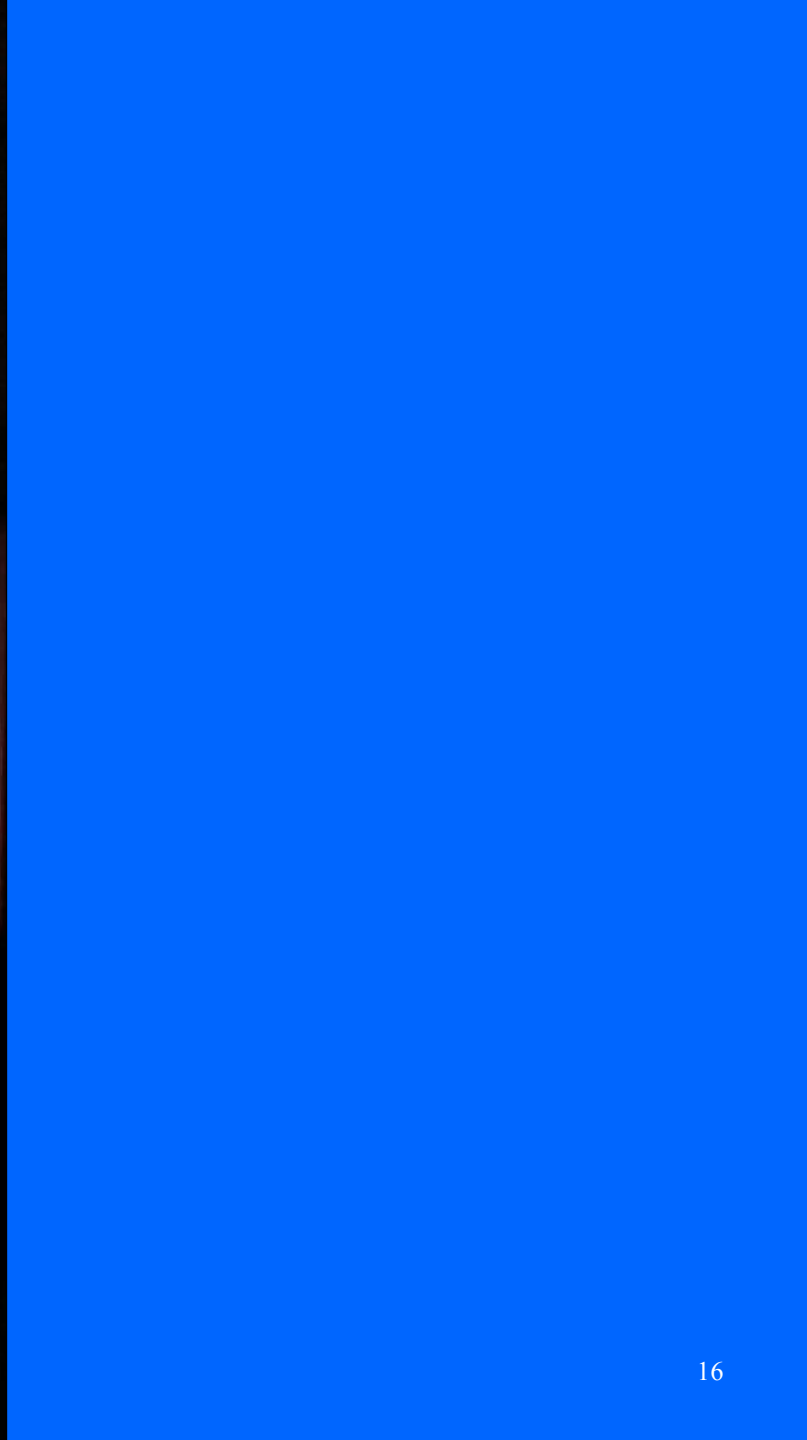
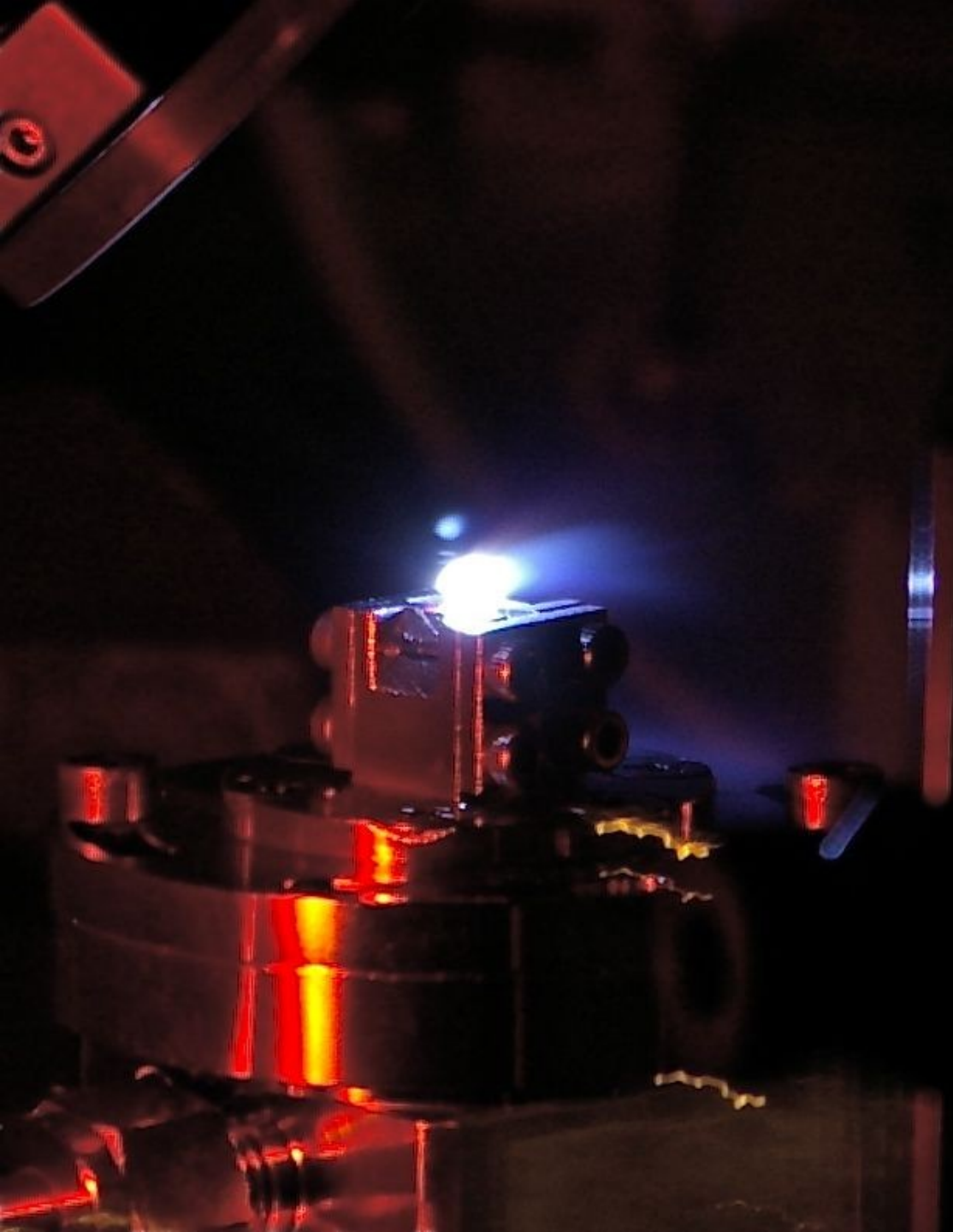
# 2007 - FLAME High Power Lasers Lab





# 2009 - FLAME High Power Lasers Lab





**FLAME - S.I.T.E.**  
**Preliminary**  
**DATA**

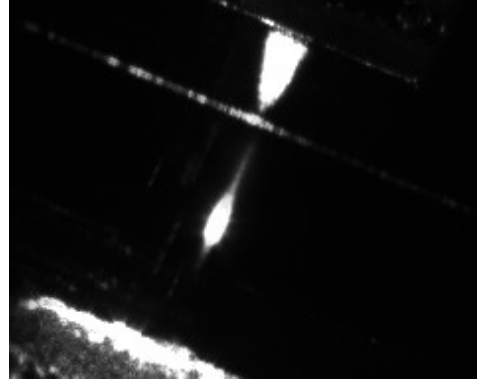
**No**  
electrons collimation



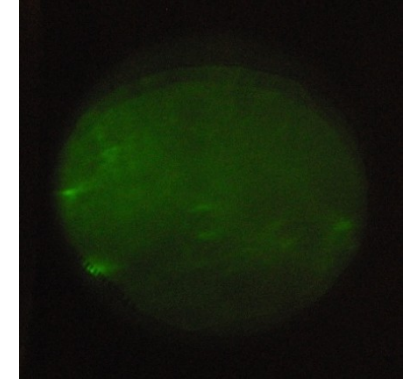
**Transmitted**  
**Light**



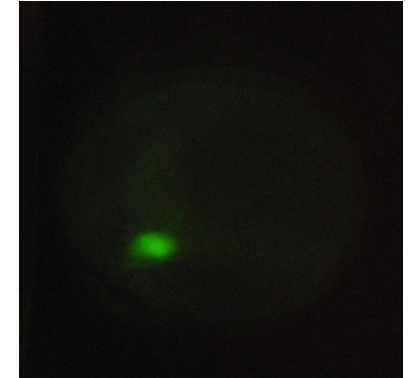
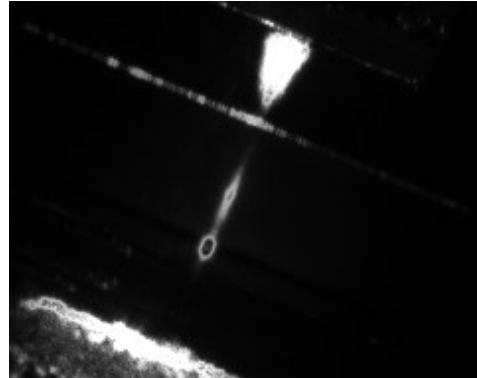
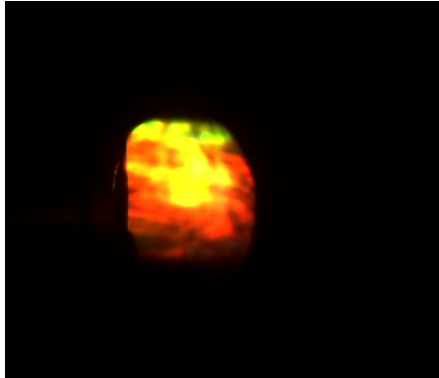
**Thomson**  
**Light**



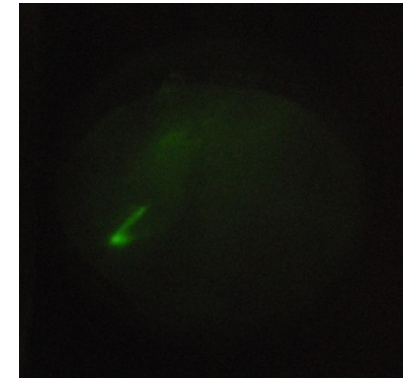
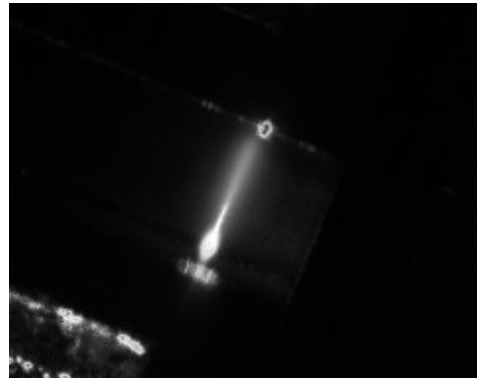
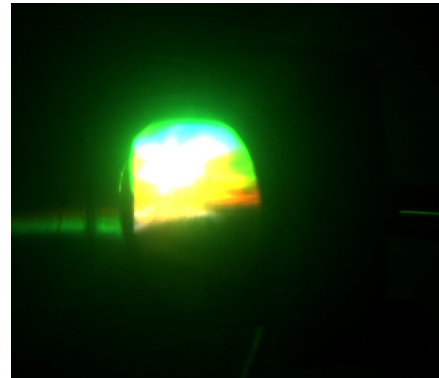
**Electrons on**  
**LANEX**



**Medium**  
electrons collimation



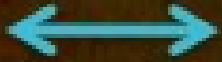
**HIGH**  
electrons collimation



**Bye, Tazio Levato**



20 mrad



Electrons from  
FLAME SELF INJECTION

2010 - FIRST ACCELERATION OF ELECTRONS AT 200MEV

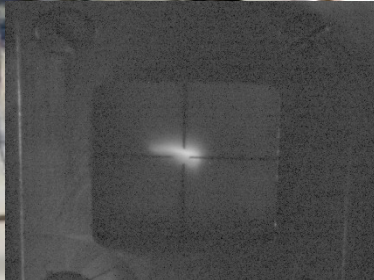


Now:

- 1) Learn how to obtain stable beams and multiple accelerations ( $10^8$  electrons/bunch in 100fs)
- 2) External injection
- 3) Electron beam self-acceleration with plasma waves



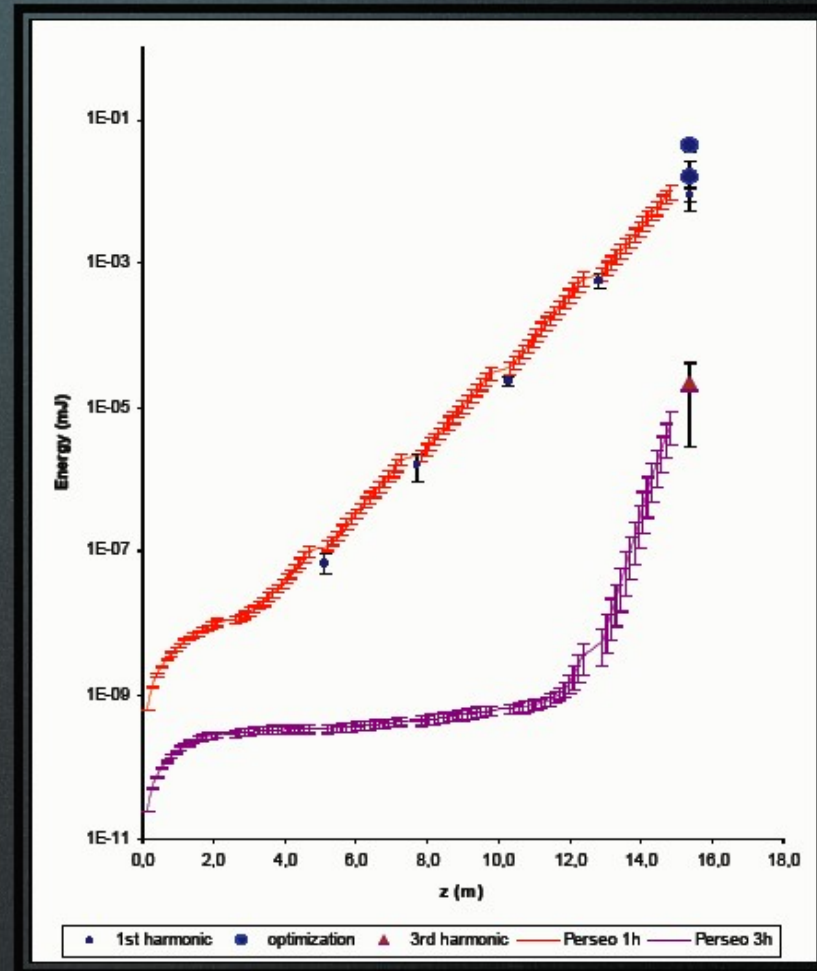
# SPARC - FEL





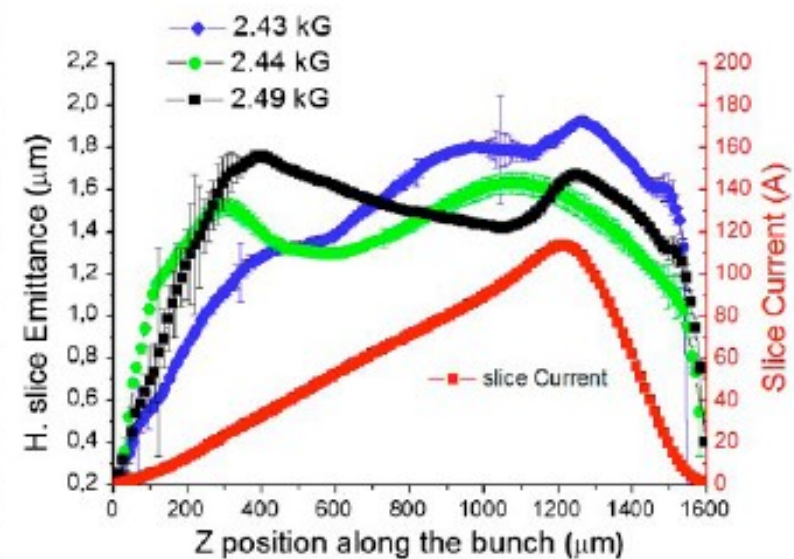
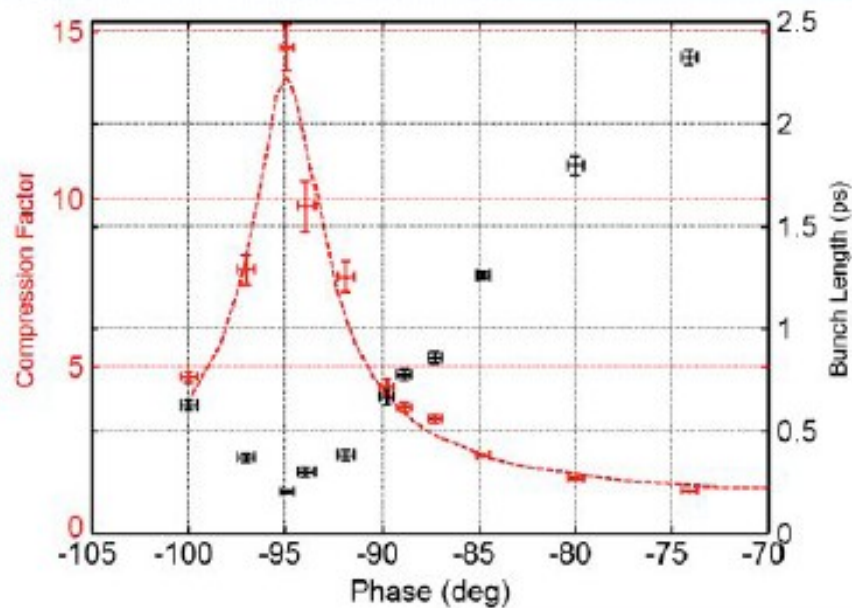
# Comparison with simulations

- Third harmonic measured only with 6 undulators
- Perseo 1h & Perseo 3h represent 50 Perseo TD simulations
- Error bars represent 1 standard deviation



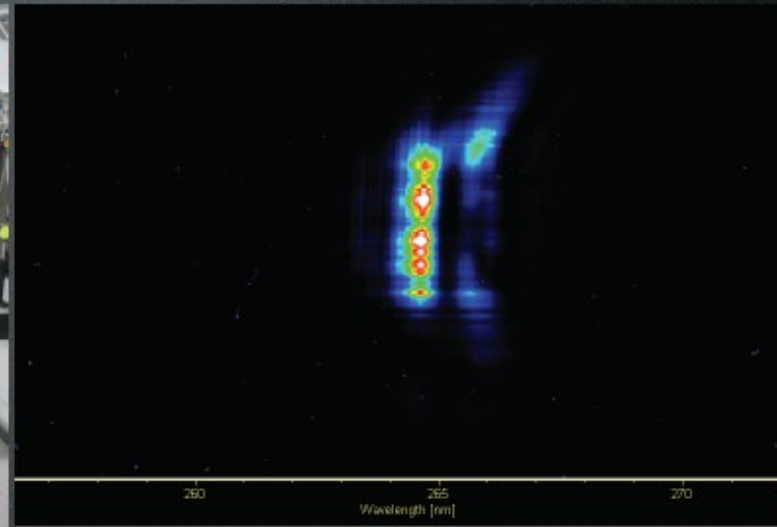
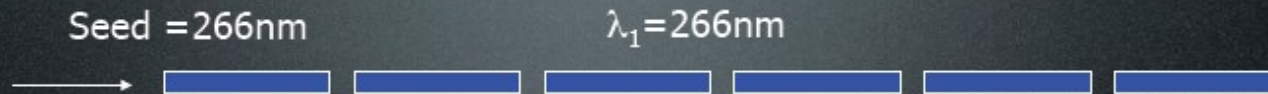
## Experimental Demonstration of Emittance Compensation with Velocity Bunching

M. Ferrario,<sup>1</sup> D. Alesini,<sup>1</sup> A. Bacci,<sup>3</sup> M. Bellaveglia,<sup>1</sup> R. Boni,<sup>1</sup> M. Boscolo,<sup>1</sup> M. Castellano,<sup>1</sup> E. Chiadroni,<sup>1</sup> A. Cianchi,<sup>2</sup> L. Cultrera,<sup>1</sup> G. Di Pirro,<sup>1</sup> L. Ficcadenti,<sup>1</sup> D. Filippetto,<sup>1</sup> V. Fusco,<sup>1</sup> A. Gallo,<sup>1</sup> G. Gatti,<sup>1</sup> L. Giannessi,<sup>4</sup> M. Labat,<sup>4</sup> B. Marchetti,<sup>2</sup> C. Marrelli,<sup>1</sup> M. Migliorati,<sup>1</sup> A. Mostacci,<sup>1</sup> E. Pace,<sup>1</sup> L. Palumbo,<sup>1</sup> M. Quattromini,<sup>4</sup> C. Ronsivalle,<sup>4</sup> A. R. Rossi,<sup>3</sup> J. Rosenzweig,<sup>5</sup> L. Serafini,<sup>3</sup> M. Serluca,<sup>6</sup> B. Spataro,<sup>1</sup> C. Vaccarezza,<sup>1</sup> and C. Vicario<sup>1</sup>





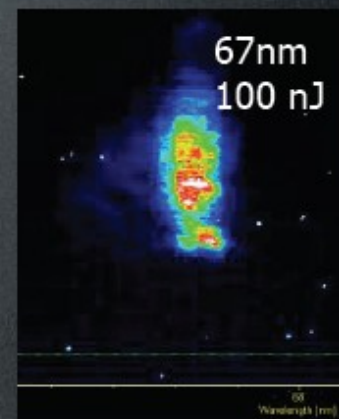
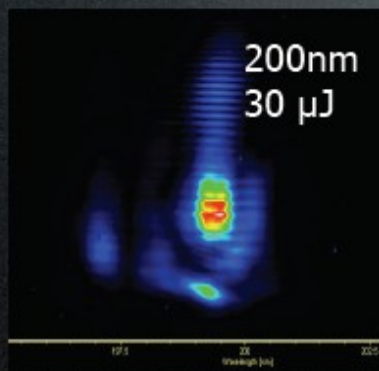
# Seeding at 266 nm from Ar gas, 50 nJ 6 undulators on resonance at 266 nm



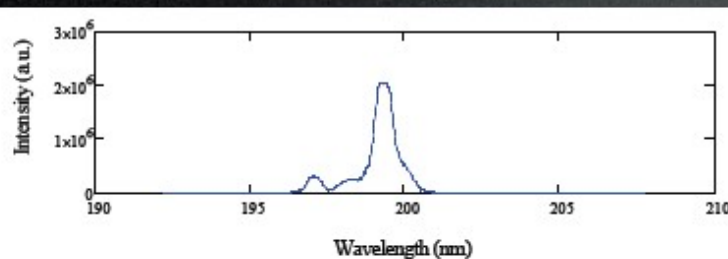
# Seeding at 400 nm from Crystal, $2 \mu\text{J}$ 5 undulators on resonance at 200 nm

Seed = 400nm  $\lambda_1 = 400\text{nm}$

$\lambda_2 = 200\text{nm}$

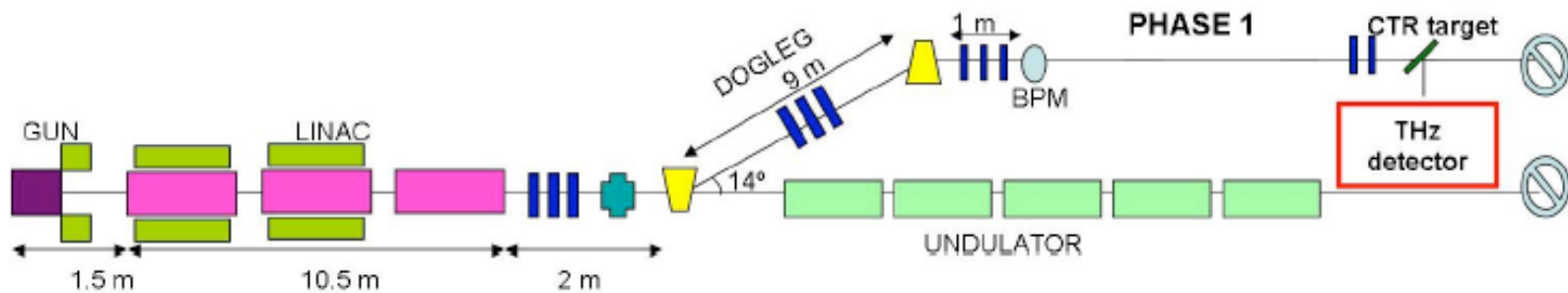
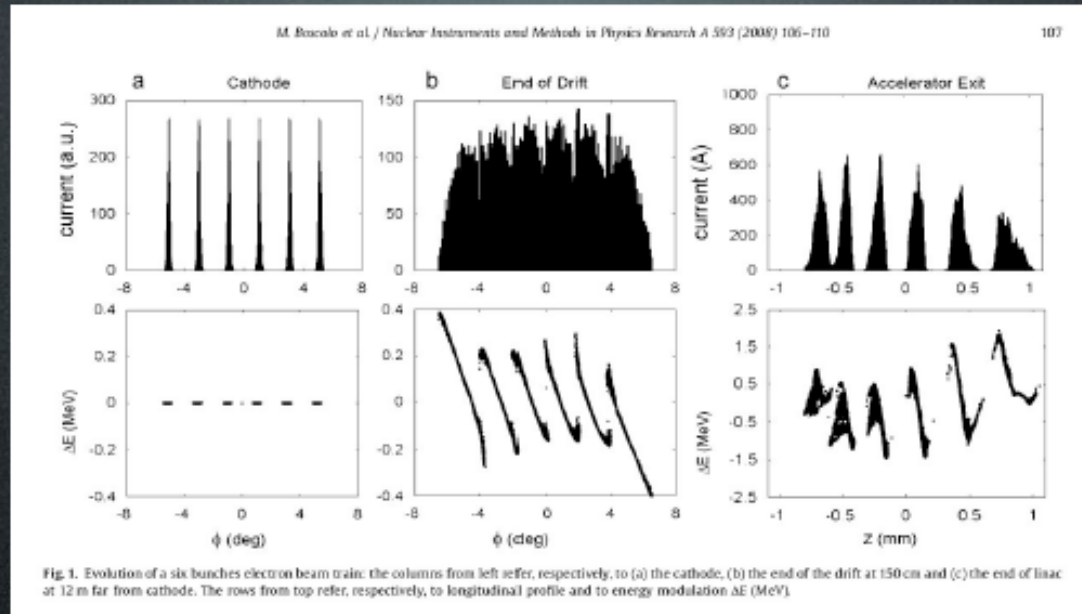


Third  
Harmonic





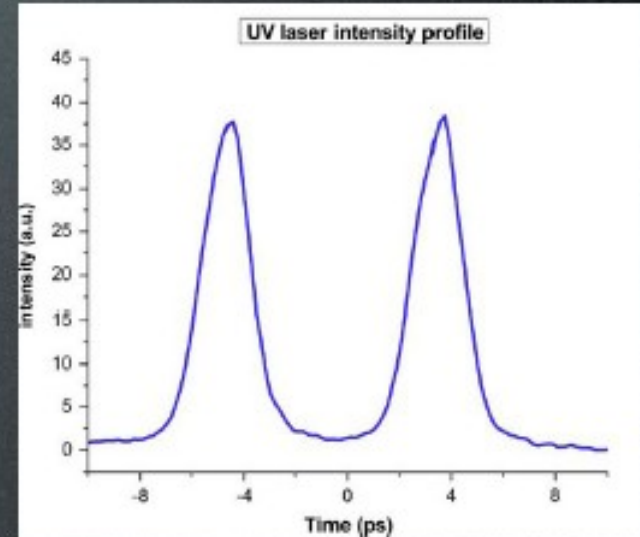
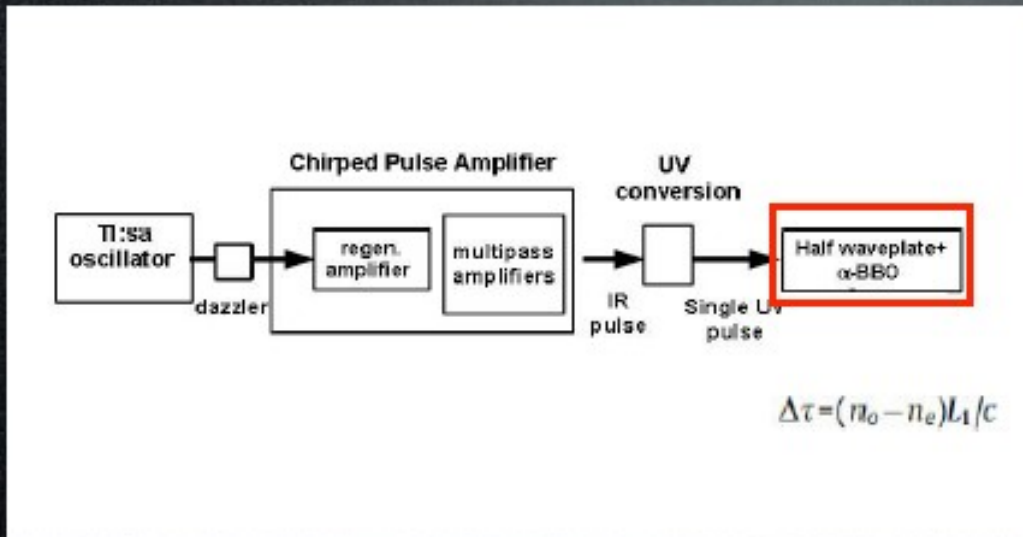
# Laser Comb: a train of THz bunches



- P.O.Shea et al., Proc. of 2001 IEEE PAC, Chicago, USA (2001) p.704.

- M. Ferrario, M. Boscolo et al., Int. J. of Mod. Phys. B, 2006 (Taipei 05 Workshop)

Laser comb with velocity bunching: Preliminary results at SPARC



35 pC/pulse

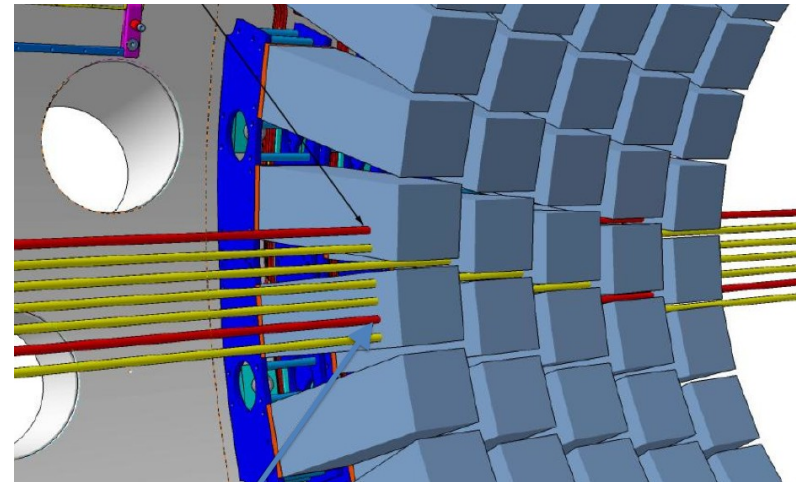
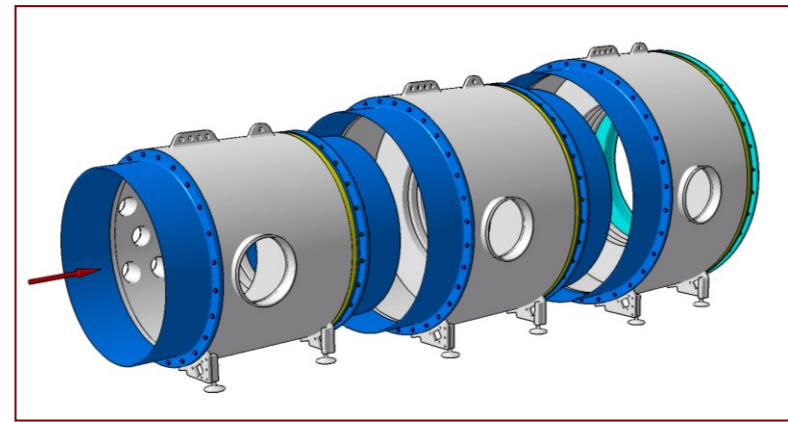
The technique used for this purpose relies on a birefringent crystal, where the input pulse is decomposed in two orthogonally polarized pulses with a time separation proportional to the crystal length.

The crystal thickness is 10.353 mm

# LAV layout and FEE

12 stations of increasing diameter to cover hermetically the range  $\theta = 7-50$  mrad

Mass construction started in 2009, 3 stations completed as of November 2010



New FE electronics,  
responsibility of LNF

Read  $\sim 3000$  ch's, allow dynamic range of  $\sim 2$

Linearity maintained @ better than %  
 $\sigma E/E = 9\%/\sqrt{E(\text{GeV})} + 5\%/E(\text{GeV}) + 2.5\%$

LNF - NA62 PHOTON VETO CONSTRUCTION



# NA62 IN LNF WORKSHOP AT LNF

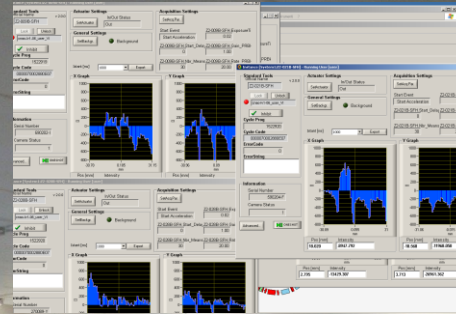




# CNAO – The Accelerator Complex

First H<sup>+</sup> accelerated beam in the “Z” treatment room  
October 26, 2010

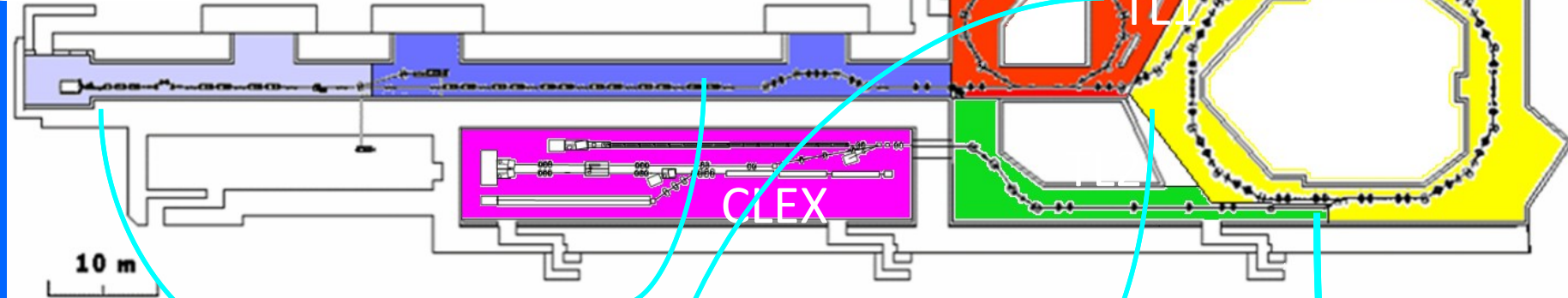
C.Sanelli C.Biscari



...and Thanks to the LNF staff



# Measured currents in CTF3: [28A in CR]





# Proposal for taking data with the KLOE-2 detector at the DAΦNE collider upgraded in energy

D. Babusci<sup>a</sup>, C. Bini<sup>b</sup>, F. Bossi<sup>a</sup>, G. Isidori<sup>a</sup>, D. Moricciani<sup>c</sup>, F. Nguyen<sup>d</sup>, P. Raimondi<sup>a</sup>,  
G. Venanzoni<sup>a</sup>, D. Alesini<sup>a</sup>, F. Archilli<sup>c</sup>, D. Badoni<sup>a</sup>, R. Baldini-Ferroli<sup>a,r</sup>,  
M. Bellaveglia<sup>a</sup>, G. Bencivenni<sup>a</sup>, M. Bertani<sup>a</sup>, M. Biagini<sup>a</sup>, C. Biscari<sup>a</sup>, C. Bloise<sup>a</sup>,  
V. Bocci<sup>d</sup>, R. Boni<sup>a</sup>, M. Boscolo<sup>a</sup>, P. Branchini<sup>d</sup>, A. Budano<sup>d</sup>, S.A. Bulychjev<sup>e</sup>,  
B. Buonomo<sup>a</sup>, P. Campana<sup>a</sup>, G. Capon<sup>a</sup>, M. Castellano<sup>a</sup>, F. Ceradini<sup>d</sup>, E. Chiadroni<sup>a</sup>,  
P. Ciambrone<sup>a</sup>, L. Cultrera<sup>a</sup>, E. Czerwinski<sup>a</sup>, E. Dané<sup>a</sup>, G. Delle Monache<sup>a</sup>, E. De  
Lucia<sup>a</sup>, T. Demma<sup>a</sup>, G. De Robertis<sup>f</sup>, A. De Santis<sup>b</sup>, G. De Zorzi<sup>b</sup>, A. Di Domenico<sup>b</sup>,  
C. Di Donato<sup>g</sup>, B. Di Micco<sup>d</sup>, E. Di Pasquale<sup>a</sup>, G. Di Pirro<sup>a</sup>, R. Di Salvo<sup>c</sup>, D. Domenici<sup>a</sup>,  
A. Drago<sup>a</sup>, M. Esposito<sup>a</sup>, O. Erriquez<sup>f</sup>, G. Felici<sup>a</sup>, M. Ferrario<sup>a</sup>, L. Ficcadenti<sup>a</sup>,  
D. Filippetto<sup>a</sup>, S. Fiore<sup>b</sup>, P. Franzini<sup>b</sup>, G. Franzini<sup>a</sup>, A. Gallo<sup>a</sup>, G. Gatti<sup>a</sup>, P. Gauzzi<sup>b</sup>,  
S. Giovannella<sup>a</sup>, A. Ghigo<sup>a</sup>, F. Gonnella<sup>c</sup>, E. Graziani<sup>d</sup>, S. Guiducci<sup>a</sup>, F. Happacher<sup>a</sup>,  
B. Höistad<sup>h</sup>, E. Iarocci<sup>a,i</sup>, M. Jacewicz<sup>h</sup>, T. Johansson<sup>h</sup>, W. Kluge<sup>j</sup>, V.V. Kulikov<sup>e</sup>,  
A. Kupsc<sup>h</sup>, J. Lee Franzini<sup>a</sup>, C. Ligi<sup>a</sup>, F. Loddo<sup>f</sup>, P. Lukin<sup>k</sup>, F. Marcellini<sup>a</sup>,  
C. Marchetti<sup>a</sup>, M.A. Martemianov<sup>e</sup>, M. Martini<sup>a</sup>, M.A. Matsyuk<sup>e</sup>, G. Mazzitelli<sup>a</sup>,  
R. Messi<sup>c</sup>, C. Milardi<sup>a</sup>, M. Mirazzita<sup>a</sup>, S. Miscetti<sup>a</sup>, G. Morello<sup>l</sup>, P. Moskal<sup>m</sup>,  
S. Müller<sup>n</sup>, S. Pacetti<sup>a,r</sup>, G. Pancheri<sup>a</sup>, E. Pasqualucci<sup>b</sup>, M. Passera<sup>o</sup>, A. Passeri<sup>d</sup>,  
V. Patera<sup>a,i</sup>, A.D. Polosa<sup>b</sup>, M. Preger<sup>a</sup>, L. Quintieri<sup>a</sup>, A. Ranieri<sup>f</sup>, P. Rossi<sup>a</sup>, C. Sanelli<sup>a</sup>,  
P. Santangelo<sup>a</sup>, I. Sarra<sup>a</sup>, M. Schioppa<sup>l</sup>, B. Sciascia<sup>a</sup>, M. Serio<sup>a</sup>, F. Sgamma<sup>a</sup>,  
M. Silarski<sup>m</sup>, B. Spataro<sup>a</sup>, A. Stecchi<sup>a</sup>, A. Stella<sup>a</sup>, S. Stucci<sup>l</sup>, C. Taccini<sup>d</sup>, S. Tomassini<sup>a</sup>,  
L. Tortora<sup>d</sup>, C. Vaccarezza<sup>a</sup>, R. Versaci<sup>p</sup>, W. Wislicki<sup>q</sup>, M. Wolke<sup>h</sup>, J. Zdebik<sup>m</sup>,  
M. Zobov<sup>a</sup>

## **FUTURE:**

- 1) THREE YEARS OF DAFNE RUNNING WITH KLOE**
- 2) SPARC, PLASMONX, COMB, LIFE**
- 3) LHC EXPERIMENTS AND NA62**
- 4) CONCLUSION OF CDF DATA TAKING**
- 5) BTF AND DAFNE-L EXPLOITATION**
- 6) PHYSICS IN SPACE**
- 7) NAUTILUS RUNNING**
- 8) JLAB EXPERIMENTS**
- 9) DETECTOR R&D (Gruppo 5° )**

**DAFNE UPGRADE WITH KLOE2 (AND AMADEUS)  
SECOND GENERATION EXPERIMENTS AT LIFE**

**SPARCX?  
SECOND CNAO IN ITALY?**