# **DA\PhiNE Status**

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# **DAΦNE** Team

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4<sup>th</sup> KLOE Physics Workshop, Karlsruhe, May 31 - June 3, 2004

# Outline

- 2002 Kloe run results
- 2003 shutdown
- 2003 Finuda run results
- April 2004 shutdown
- Commissioning the new DAFNE configuration for KLOE
- Performances expectation & present results



# DA $\Phi$ NE DELIVERED $\mathcal{L}$ IN YEAR 2002

49 bunches separated by 1 bucket  $I_{tot}^{-} = .8 \text{ A}$   $I_{tot}^{+} = 1.1 \text{ A}$   $\mathcal{L}_{peak}^{-} = 7.7 \cdot 10^{31} \text{ cm}^{-2} \text{ s}^{-1}$   $\tau_{\mathcal{L}}^{-} = .6 \text{ h}$   $\mathcal{L}_{Jday}^{-} = 4.8 \text{ pb}^{-1}$   $\mathcal{L}_{J2002}^{-} = 300 \text{ pb}^{-1}$ acquisition on during injection KLOE 2002 achievements by optimizing:

- Linear & nonlinear optics
- Background & lifetime
- Collision fine tuning
- Curing the longitudinal Quad instability

I<sup>-</sup> limit due to a faulty injection kicker prevented better results

# **KLOE optics modification in 2002**

 $\beta_v^*$ 0.03 --> 0.026 m to increase  $\mathcal{L}$  $\beta_{x}^{*}$ 5.7 --> 2.7 m  $\Delta\beta_x \sim -50\%$  @ first parasitic crossing to get colliding 100 bunches  $\theta_{\mathsf{IP}}$ = 12.5 - 14.5 mrd ε<sub>x</sub> = .7 - .6 mm mrd Dispersion Chromatic Orbit Load Chromatic Orbit ÆRF [MHz] \$0.010000



... to improve major modifications required!

# HARDWARE DEVELOPMENTS

... from DEAR experience (runs 2002)

New Installations (Jan 1<sup>st</sup> ÷ June 30<sup>th</sup>):

- Kloe new I.R.
- Finuda new I.R.
- Finuda detector
- Element maintenance & upgrade
- Scrapers
- Bellows
- Ion clearing electrodes
- Wigglers

Long straight sections and kickers rearrangement

# ... 90% of the accelerator has been modified!

(parts grayed out)







# All the upgrades have been tested during the FINUDA runs

 $\kappa$ = .3% by using rotating QUADs

100 contiguous bunch in collision

 $\beta_x = 2.33$  m  $\beta_y = .024$  m

 $\varepsilon_x = .34 \text{ mm mrd}$ 

## e<sup>+</sup> Model & Measurements Nov 25<sup>th</sup> 2003





**Best FINUDA run** 

#### 100 colliding bunches

# Shutdown March 26<sup>th</sup> ÷ April 15<sup>th</sup> 2004

- FINUDA rollout & new vacuum chamber installation
- BTF upgrade
- Ordinary hardware maintenance



# **DAFNE Beam Test Facility**

Multi-purpose facility:

- H.E. detector calibration and setup
- Low energy calorimetry & resolution
- Low energy electromagnetic interaction studies
- High multiplicity efficiency
- Detectors aging and efficiency
- Beam diagnostics



In 2004: MEG, APACHE, AIRFLY, CAPIRE, NANO2...

to BTF to BTF to rmain rings to spectrometer to main rings Pulsed dipole: 7°/4°/ 0°

-ast dipole 3

April 22, 2004

Restart of operation whit user in June 2004

Restarting KLOE operations April 15<sup>th</sup> 2400

Storing the beam Beam vacuum conditioning Setup the new KLOE interaction region

 $\varepsilon_x = .38 \text{ mm mrd}$   $\varepsilon_x = .6 \text{ mm mrd in } 2002$ 

Horizontal crossing angle @ KLOE = 16.5 mrd

#### One Interaction Region only !

# **First KLOE Optics**

# Relaxed betatron function @ KLOE IP: $\beta_y^* = .026 \text{ m}$



# **Coupling Correction**

#### • First Step

by minimizing the coupling term of the measured Response Matrix using numerical algorithm

#### Second Step

looking at the colliding beams by minimizing:

- the beam aspect ratio measured at the SLM
- the 2 beams convoluted rms transverse dimensions beam-beam scan



#### Oscillation amplitude transfer from one plane to the orthogonal one





#### Oscillation amplitude transfer from one plane to the orthogonal one





- $\Sigma_y = 7.25 \mu$  now  $\Sigma_y = 7.8 \mu$  best in 2002
- $\kappa = .3 \%$  now
- $\kappa = .2 \%$  best in 2002
- Measurements from 2 calorimeters

# Beam - Beam scan with Transverse Feedback off



.... even better



### e<sup>-</sup> Tune shift with Energy



- Ring energy acceptance increased by a factor 2
- $\xi$ " reduced

## **Beam Dynamic Issues**

 All the Transverse & Longitudinal Feedbacks are fully operative repaired 2 Power Amplifier for the Transverse FDBs Horizontal Transverse FDB installed (with respect to 2002)

• Maximum current in collision:

I<sup>-</sup> = 1200 mA & I<sup>+</sup> = 880 mA

Stable but not at the same time

# $\mathcal{L}_{\text{peak}}$ versus bunch pattern



- \* 10 bunches 8 buckets spaced
- n<sub>b</sub> contiguous bunches

- no parasitic crossing is observed
- Feedbacks need progressive tuning with current

.. still the vacuum must be improved



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 $v_x^{-} = 0.11 \quad v_y^{-} = 0.15$  $v_x^+ = 0.15 v_v^+ = 0.21$  $\mathcal{L}_{\text{bunch}} \sim 1.6 \cdot 10^{30} \text{ cm}^{-2} \text{s}^{-1}$ 

KLOE 2004 WP:



# **Background optimization**



Background rates in collision comparable with the ones in 2002

## Background rates in collision



...still the the background at the injection must be optimized (100 ÷ 150 KHz )

#### Measured Bunch Distributions

e+Ring





#### Broadband Impedance for e<sup>+</sup> Ring



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# Conclusions

- The machine upgrades WORK
- Good results have been obtained during the FINUDA runs and the KLOE ring configuration is much simpler
- The nonlinear terms in the WGL field have been reduced
- The KLOE optics is flexible, all Twiss parameter:  $\beta_x^* \beta_y^* \alpha_x^* \alpha_y^* \alpha_c \nu_x \nu_y \varepsilon_x$  can be fearly tuned
- The coupling can be corrected by rotating the permanent magnet quadrupoles (now .3% ~ as in 2002)
- Contiguous bunches can collide without major problems (90 b)

#### What has been obtained (45 days)

- $\kappa = .3 \% \div .4 \%$   $\kappa = .2 \% \div .3 \%$  (in 2002)
- $\mathcal{L}_{\text{peak}} = 6.1 \cdot 10^{31} \text{ cm}^{-2} \text{ s}^{-1}$   $\mathcal{L}_{\text{peak}} = 7.74 \cdot 10^{31} \text{ cm}^{-2} \text{ s}^{-1}$  (in 2002)

 $\mathcal{L}_{\int 1h} = 145 \text{ nb}^{-1}/h$  --->  $\mathcal{L}_{\int day} = 3.5 \text{ pb}^{-1}/day$ 

 $\mathcal{L}_{\text{Jday}}$  can be increased by topping up

#### KLOE Luminosity History: 30/05/2004



## Concerns

#### About:

- The vacuum has to be improved (we are working)
- maximum e<sup>+</sup> storable current : 750 mA single beam 880 mA in collision (limited by e<sup>-</sup> blowup) limitation on I<sup>+</sup> observed during the FINUDA runs also

# Where from here?

 $\mathcal{L}_{peak}$  = 1 • 10<sup>32</sup> cm<sup>-2</sup> s<sup>-1</sup> possible by: Solving the I<sup>+</sup> limitation Optimizing the present situation

 $\mathcal{L}_{peak}$  = 2 • 10<sup>32</sup> cm<sup>-2</sup> s<sup>-1</sup> asks for a careful tuning of:

- $\xi$  tune shift
- $\boldsymbol{\epsilon}_{x}$  emittance
- $\alpha_{\rm c}$  momentum compaction
- $\boldsymbol{\theta}_{x}$  crossing angle



#### Bunch Length Measurements on 18/03/2004

