

Stato e prospettive per la HEP

(o almeno quella che afferisce alla CSN1)



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Indice

- Statistiche della CSN I
- I ricordi migliori del 2004
- Una considerazione preoccupata
- Prospettive
 - certe a breve termine
 - incerte a medio lungo termine
- Conclusioni

Le cifre della commissione I

Mostra Anticipi

Anticipi al Bilancio 2004

| Rich | Esperimento | MI | | ME | | CON | | SEM | TRA | | PUB | CAL | | MAN | | INV | | APP | | Parz | | TOT | DIF | |
|------|--------------------|-----|----|-----|----|-----|----|-----|-----|----|-----|-----|----|-----|----|-----|----|-----|------|------|------|-----|------|---|
| | | Ass | sj | Ass | sj | Ass | sj | | Ass | sj | | Ass | sj | Ass | sj | Ass | sj | Ass | sj | | | | | |
| 0 | Totale Esperimenti | 0 | 0 | 0 | 0 | 738 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 91 | 0 | 1930 | 0 | 2759 | 0 | 2759 | 0 |

Mostra Esperimenti

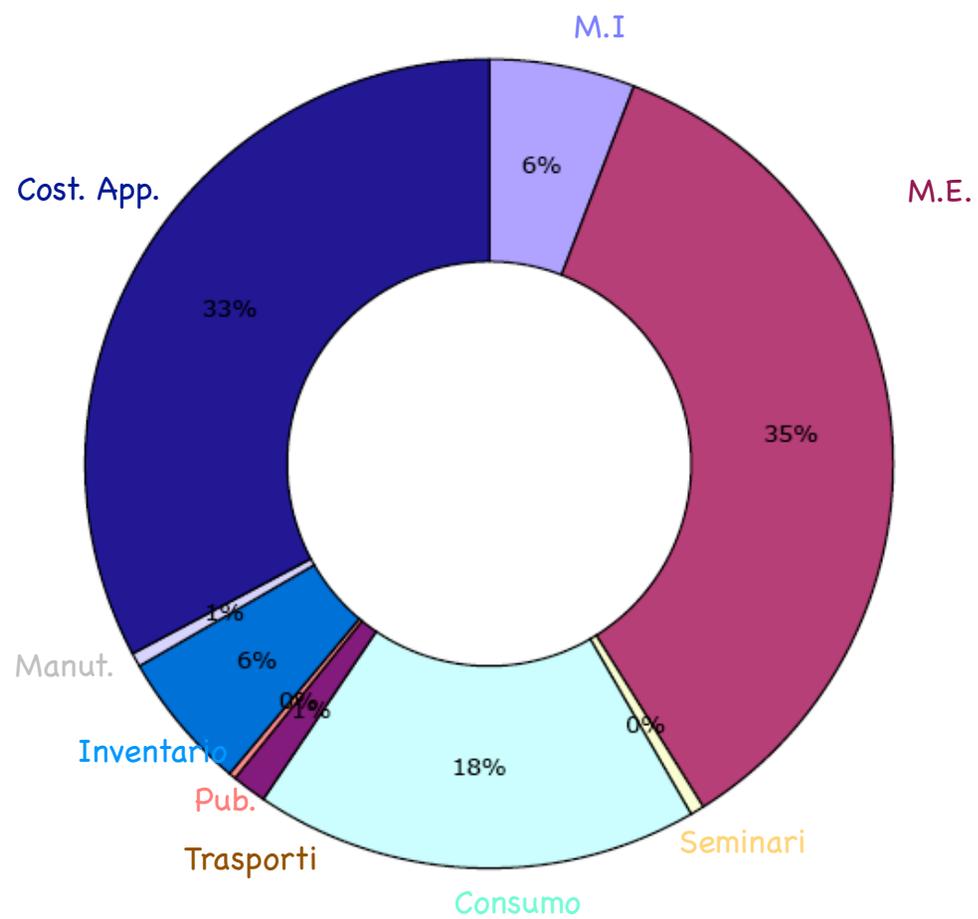
Bilancio 2005

| Rich | Esperimento | MI | | ME | | CON | | SEM | TRA | | PUB | CAL | | MAN | | INV | | APP | | Parz | | TOT | DIF |
|---------|--------------------|--------|-----|-------|------|--------|------|------|-----|-----|------|-----|-------|--------|----|--------|-----|-------|------|--------|------|--------|---------|
| | | Ass | sj | Ass | sj | Ass | sj | | Ass | sj | | Ass | sj | Ass | sj | Ass | sj | Ass | sj | Ass | sj | | |
| 42538.8 | Totale Esperimenti | 1197.5 | 170 | 7814 | 2173 | 3088.5 | 1185 | 0 | 325 | 124 | 0 | 0 | 0 | 159 | 0 | 446 | 369 | 5837 | 1941 | 18867 | 5962 | 24829 | 17709.8 |
| 0 | Totale Exp Dot | 18 | 0 | 73 | 5 | 12.5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 5 | 0 | 0 | 0 | 108.5 | 5 | 113.5 | -113.5 |
| 3832.7 | Totale Dotazioni | 416.5 | 0 | 560.5 | 10 | 453 | 0 | 93.5 | 0 | 0 | 45.5 | 0 | 0 | 29.5 | 0 | 628.5 | 0 | 0 | 0 | 2227 | 10 | 2237 | 1595.7 |
| 0 | Fondo Indiviso | 50 | 0 | 364.5 | 0 | 106 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 200 | 0 | 500 | 0 | 1220.5 | 0 | 1220.5 | |
| 46371.5 | Totale Gruppo 1 | 1682 | 170 | 8812 | 2188 | 3660 | 1185 | 93.5 | 325 | 124 | 45.5 | 0 | 0 | 188.5 | 0 | 1279.5 | 369 | 6337 | 1941 | 22423 | 5977 | 28400 | 17971.5 |
| | | 1852 | | 11000 | | 4845 | | 93.5 | 449 | | 45.5 | 0 | 188.5 | 1648.5 | | 8278 | | 28400 | | | | | |

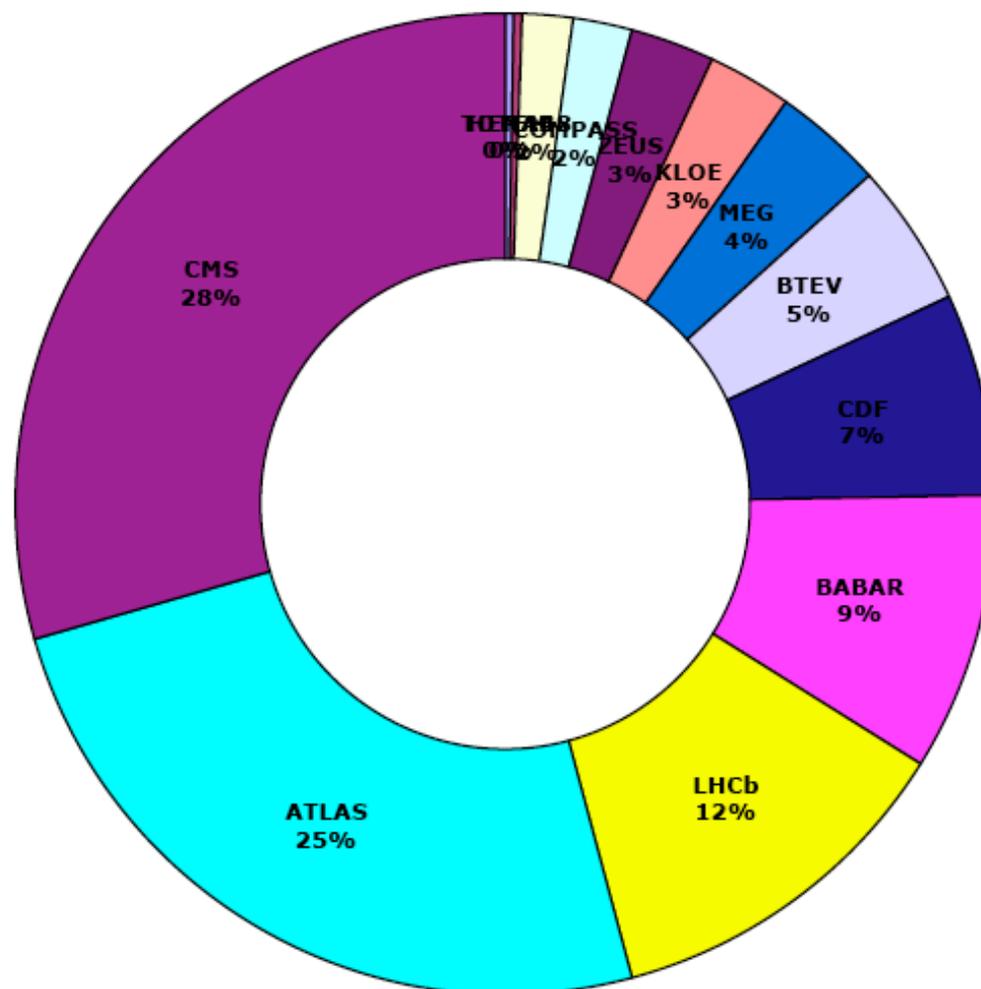
935 Ricercatori FTE 729

FTE/# = 78% Euro/FTE= 43k

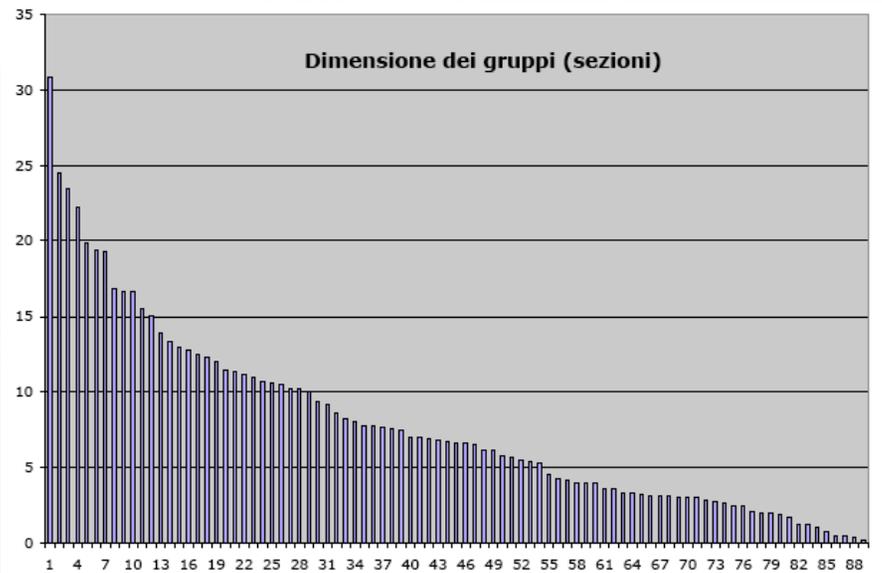
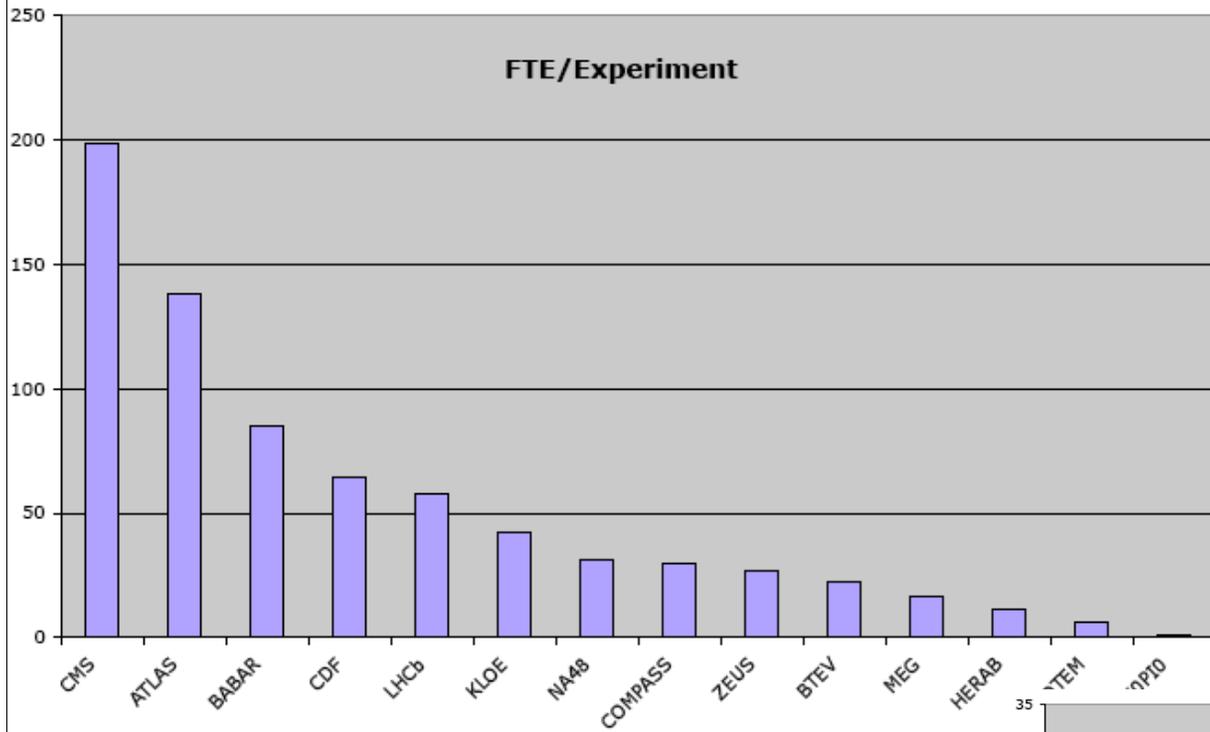
Bilancio in capitoli di spesa



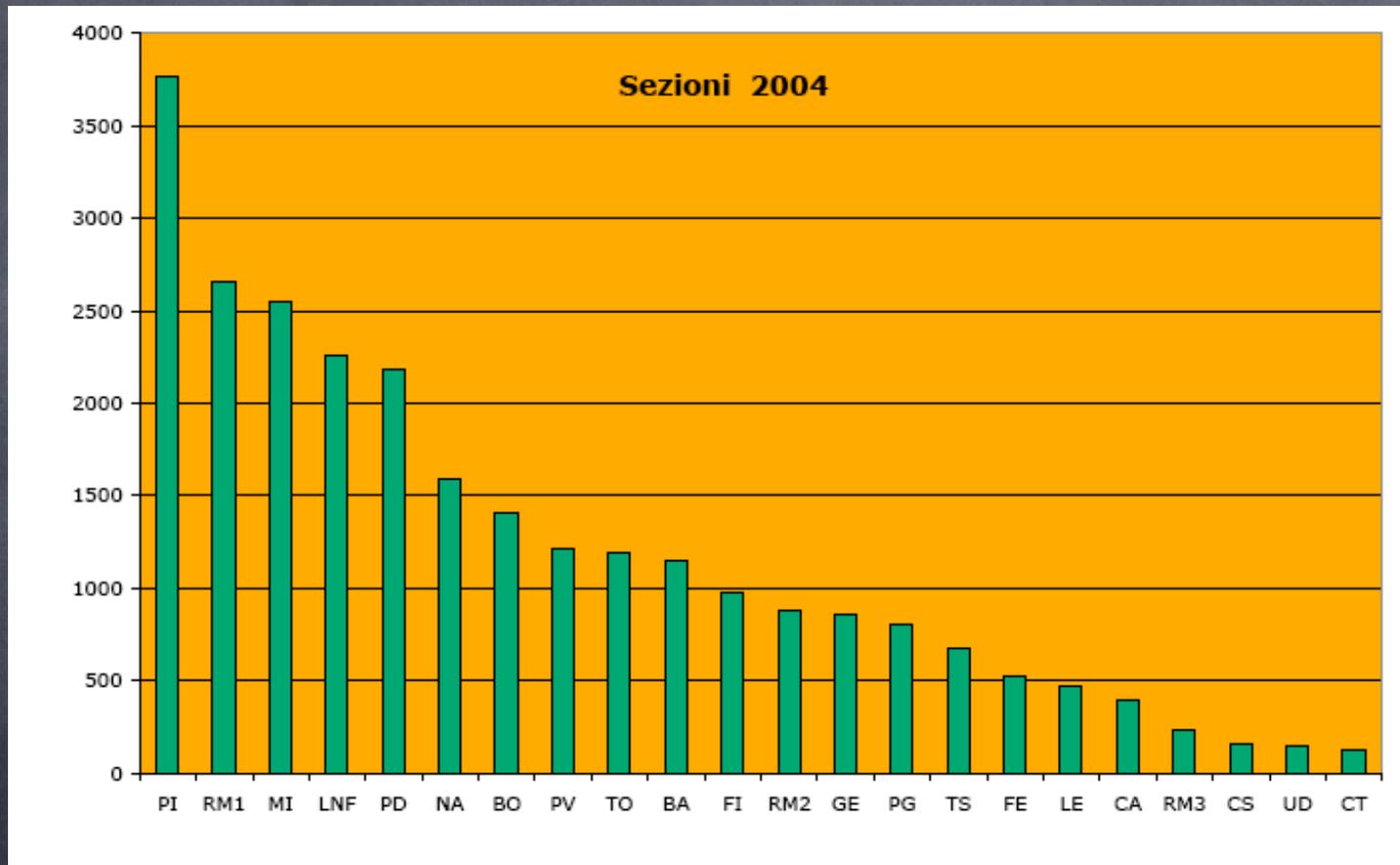
Bilancio per esperimento



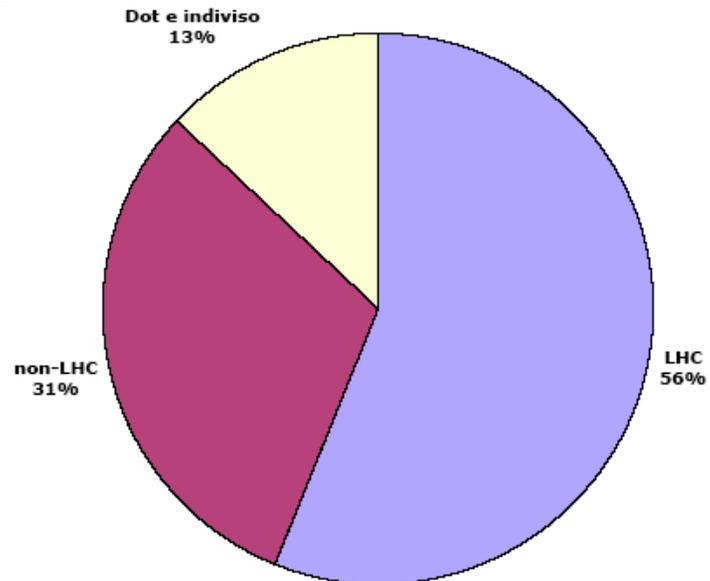
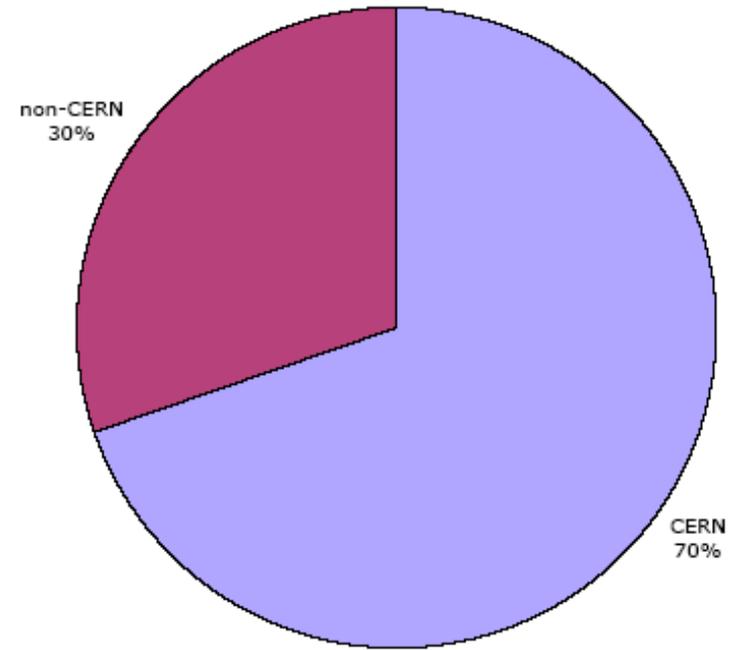
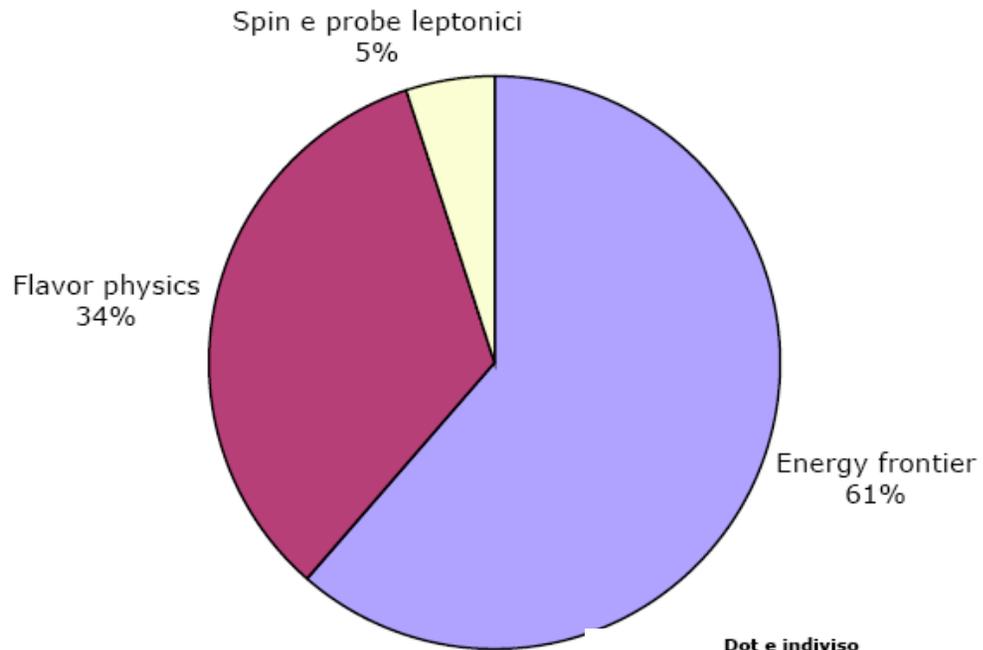
Ricercatori



Finanziamenti per Sezione



Divisioni varie



Gli esperimenti e gli acceleratori

ATLAS

LHC CERN

Energy frontier

CMS

LHC CERN

Energy frontier

LHCb

LHC CERN

Flavor physics

TOTEM

LHC CERN

Total x-section

LHCf

LHC CERN

Energy frontier

NA48/n

SPS CERN

Flavor physics

COMPASS

SPS CERN

Spin physics

ZEUS

HERA DESY

Lepton probe

HERAB

HERA DESY

Flavor physics

BaBar

PEPII SLAC

Flavor physics

CDF

TEVATRON FNAL

Energy frontier

BTeV

TEVATRON FNAL

Flavor physics

KLOE

DAΦNE LNF

Flavor physics

KOPIO

AGS Brookhaven

Flavor physics

MEG

SIN PSI

Flavor physics

ATLAS statistica

| Sezione | Ricercatori | | Tecnologi | | Tecnici | | Tot Sezione | |
|--------------|-------------|-------|-----------|-------|---------|------|-------------|--------|
| | # | FTE | # | FTE | # | FTE | # | FTE |
| CS | 14 | 10.6 | 0 | 0 | 2 | 1.2 | 16 | 11.8 |
| GE | 13 | 11.3 | 4 | 2.2 | 4 | 4 | 21 | 17.5 |
| LE | 12 | 11.4 | 2 | 1.2 | 7 | 4.5 | 21 | 17.1 |
| LNF | 13 | 10.5 | 10 | 7.9 | 5 | 5 | 28 | 23.4 |
| MI | 21 | 16.65 | 9 | 4.35 | 11 | 6.55 | 41 | 27.55 |
| NA | 17 | 15.05 | 1 | 0.3 | 1 | 0.25 | 19 | 15.6 |
| PI | 10 | 8 | 1 | 0.3 | 0 | 0 | 11 | 8.3 |
| PV | 13 | 12.3 | 1 | 0.7 | 0 | 0 | 14 | 13 |
| RM1 | 25 | 19.9 | 7 | 4.7 | 11 | 6.5 | 43 | 31.1 |
| RM2 | 10 | 7.6 | 1 | 0.4 | 4 | 3.1 | 15 | 11.1 |
| RM3 | 14 | 10.2 | 2 | 1.1 | 4 | 1.9 | 20 | 13.2 |
| UD | 6 | 4.2 | 2 | 1.2 | 0 | 0 | 8 | 5.4 |
| Totale ATLAS | 168 | 137.7 | 40 | 24.35 | 49 | 33 | 257 | 195.05 |

| Sez. & Suf. | MI | | | ME | | | CON | | | TRA | | | CAL | | | MAN | | | INV | | | APP | | | TOTALE | | |
|-------------|-------|----|-----|--------|-----|-----|-------|----|-----|-----|----|-----|-----|----|-----|-------|----|-------|--------|----|--------|--------|------|--------|--------|------|--|
| | | sj | ant | | sj | ant | | sj | ant | | sj | ant | | sj | ant | | sj | ant | | sj | ant | | sj | ant | | | |
| ATLAS | 275.9 | | | 3084.5 | 9 | | 848.4 | 43 | | 71 | 15 | | | | 8.5 | | | 380.5 | | | 5079.6 | | | 9748.4 | 67 | | |
| | 275.9 | | | 3093.5 | | | 891.4 | | | 86 | | | 8.5 | | | 380.5 | | | 5079.6 | | | 9815.4 | | | | | |
| | 181.5 | | | 1737.5 | 360 | | 480.5 | 43 | 331 | 49 | 34 | | | | 8.5 | | | 92 | 5 | 40 | 1605 | 258 | 1605 | 4154 | 700 | 1976 | |
| | 181.5 | | | 2097.5 | | | 523.5 | | | 83 | | | | | 8.5 | | | 97 | | | 1863 | | | 4854 | | | |

FTE/# = 82%

Euro/FTE = 50k

ATLAS Status: 10 December 2004



CMS statistica

| Sezione | Ricercatori | | Tecnologi | | Tecnici | | Tot Sezione | |
|------------|-------------|-------|-----------|------|---------|-------|-------------|--------|
| | # | FTE | # | FTE | # | FTE | # | FTE |
| BA | 28 | 24.5 | 4 | 2.7 | 9 | 6.2 | 41 | 33.4 |
| BO | 26 | 22.2 | 3 | 1.3 | 0 | 0 | 29 | 23.5 |
| CT | 10 | 7.8 | 1 | 1 | 7 | 3.1 | 18 | 11.9 |
| FI | 20 | 16.8 | 2 | 1.5 | 7 | 3.7 | 29 | 22 |
| GE | 1 | 0.2 | 5 | 1.6 | 0 | 0 | 6 | 1.8 |
| MI | 14 | 12.5 | 0 | 0 | 3 | 2.05 | 17 | 14.55 |
| NA | 7 | 5.35 | 0 | 0 | 1 | 0.1 | 8 | 5.45 |
| PD | 30 | 23.45 | 10 | 7.1 | 7 | 5.95 | 47 | 36.5 |
| PG | 15 | 11.2 | 3 | 2.5 | 11 | 3.25 | 29 | 16.95 |
| PI | 34 | 30.8 | 7 | 6.4 | 0 | 0 | 41 | 37.2 |
| PV | 11 | 10.2 | 1 | 0.3 | 0 | 0 | 12 | 10.5 |
| RM1 | 15 | 12 | 3 | 1.8 | 10 | 6.7 | 28 | 20.5 |
| TO | 25 | 19.4 | 3 | 1.7 | 0 | 0 | 28 | 21.1 |
| TS | 7 | 2.1 | 0 | 0 | 0 | 0 | 7 | 2.1 |
| Totale CMS | 243 | 198.5 | 42 | 27.9 | 55 | 31.05 | 340 | 257.45 |

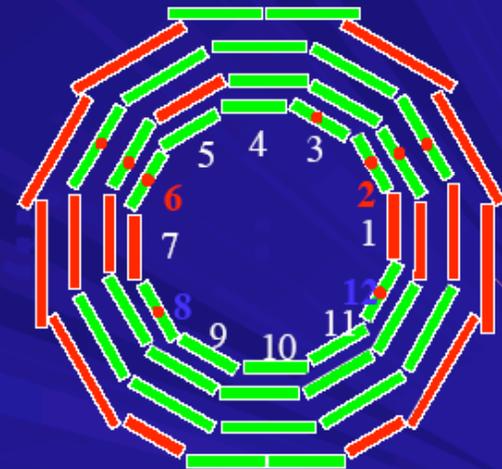
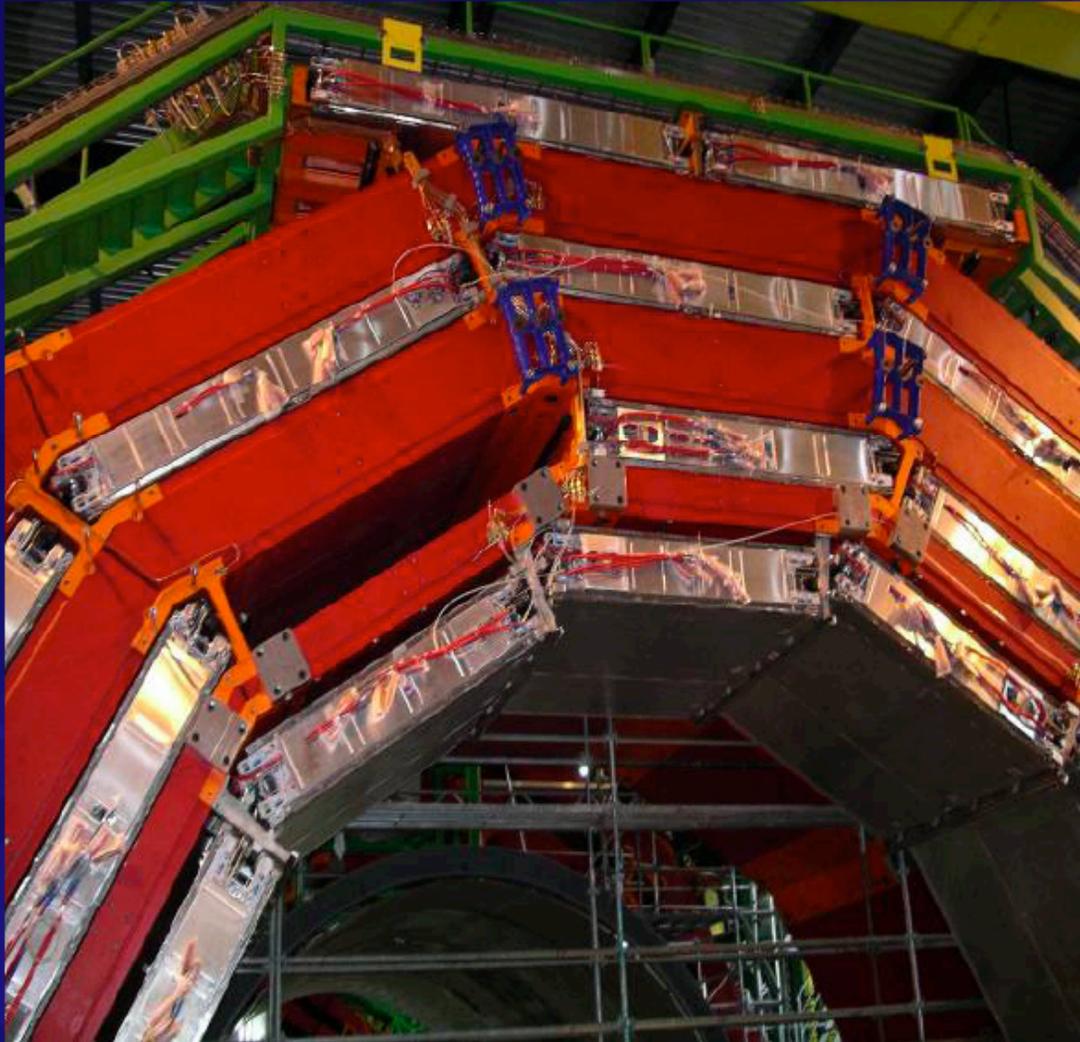
Richieste in blu & Assegnazioni in rosso

| Sez. & Suf. | MI | | ME | | CON | | TRA | | CAL | | MAN | | INV | | APP | | TOTALE | |
|-------------|-------|-----|--------|-----|--------|-----|-----|-----|-----|-----|-----|-----|-------|-----|------|-----|---------|--------|
| | sj | ant | sj | ant | sj | ant | sj | ant | sj | ant | sj | ant | sj | ant | sj | ant | sj | ant |
| CMS | 682.6 | 35 | 3371.5 | 519 | 2190.1 | 65 | 367 | 86 | | | | | 586.5 | 17 | 5357 | 203 | 12554.7 | 925 |
| | 717.6 | | 3890.5 | | 2255.1 | | 453 | | | | | | 603.5 | | 5560 | | 13479.7 | |
| | 414 | 160 | 1850.5 | 691 | 951.5 | 845 | 207 | 65 | | | | | 190.5 | 26 | 2083 | 300 | 5696.5 | 2087 |
| | 574 | | 2541.5 | | 1796.5 | | 103 | 272 | | | | | 216.5 | | 2383 | | 195 | 7783.5 |

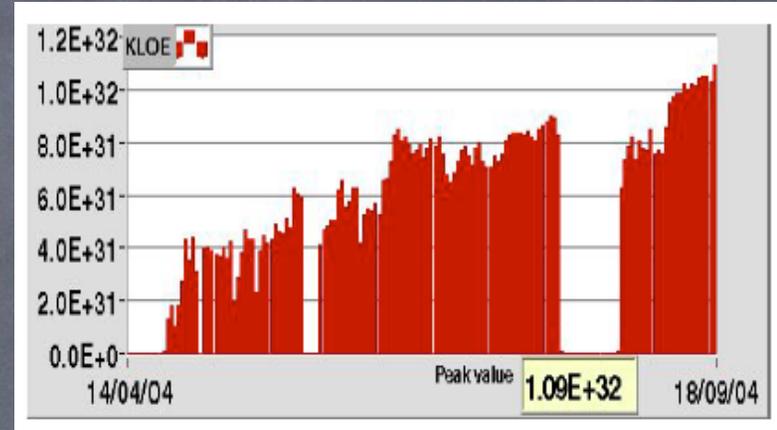
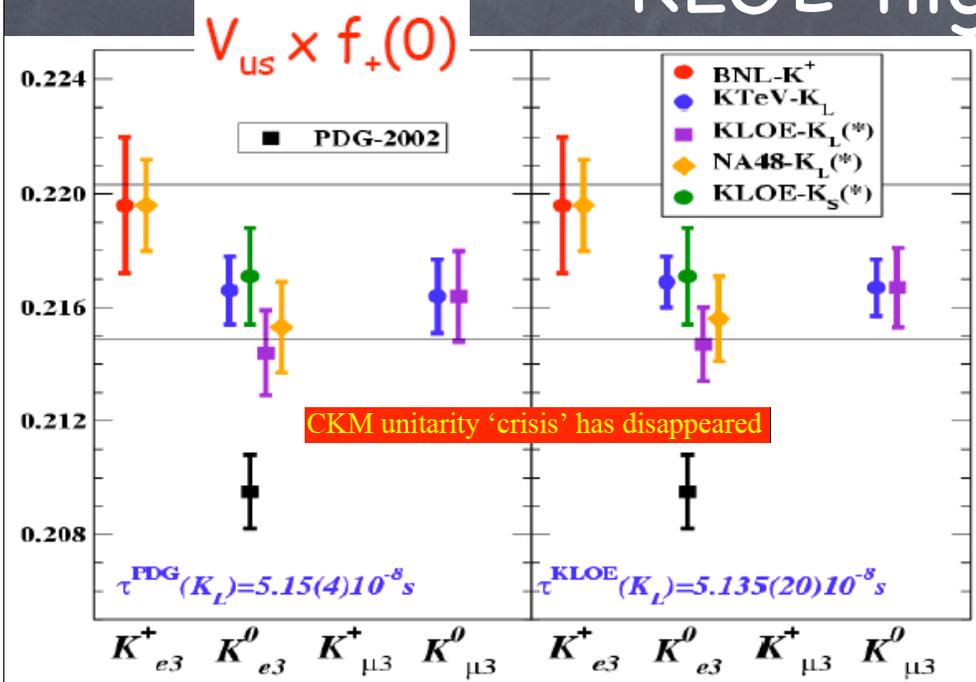
FTE/# = 82%

Euro/FTE= 41k

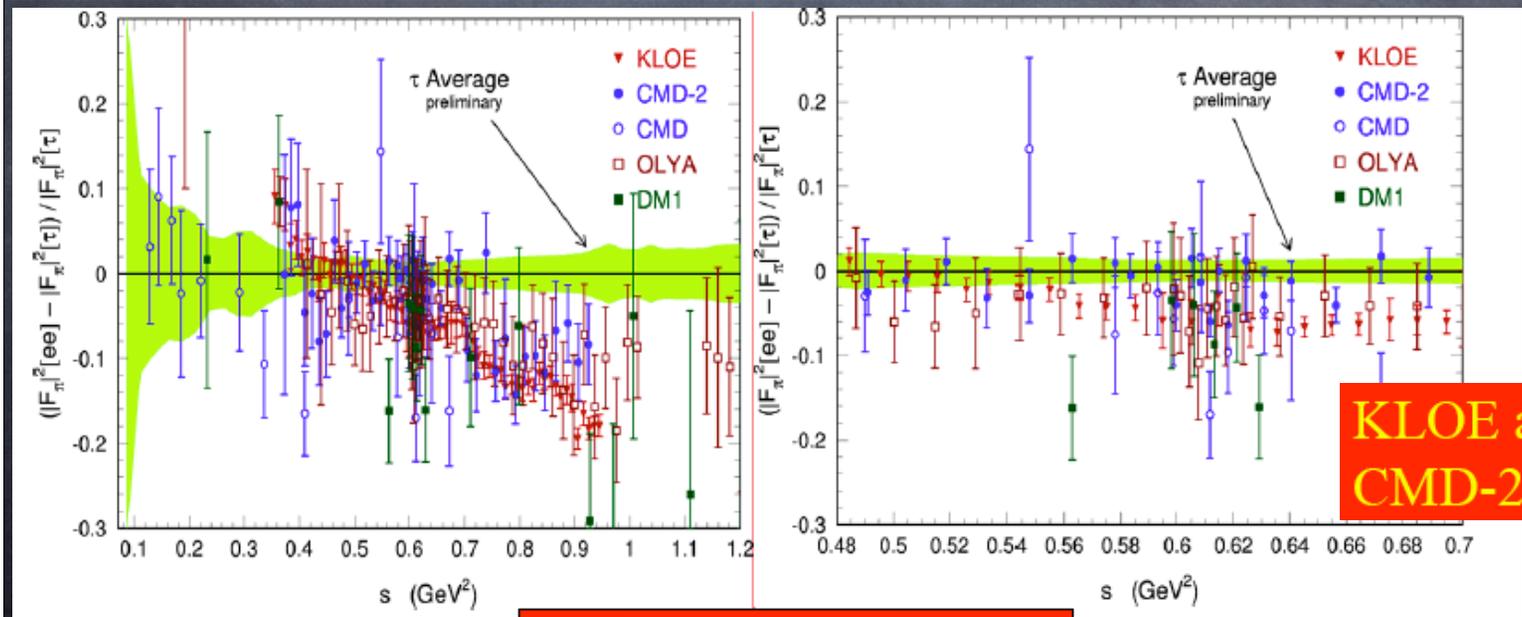
CMS: Muon DT + RPC



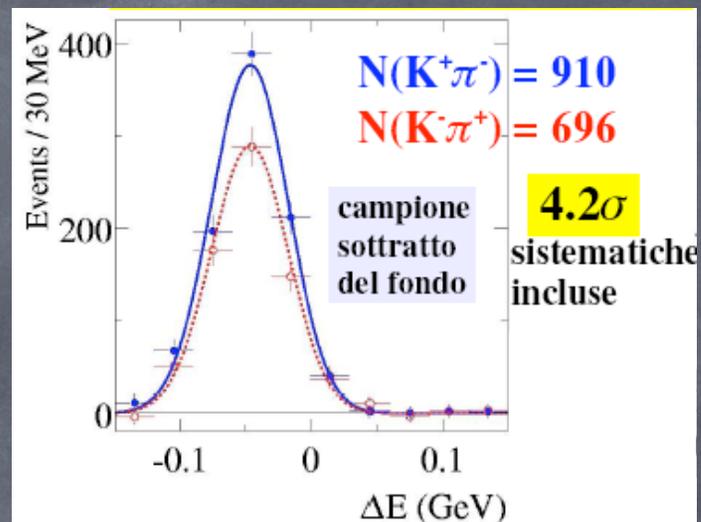
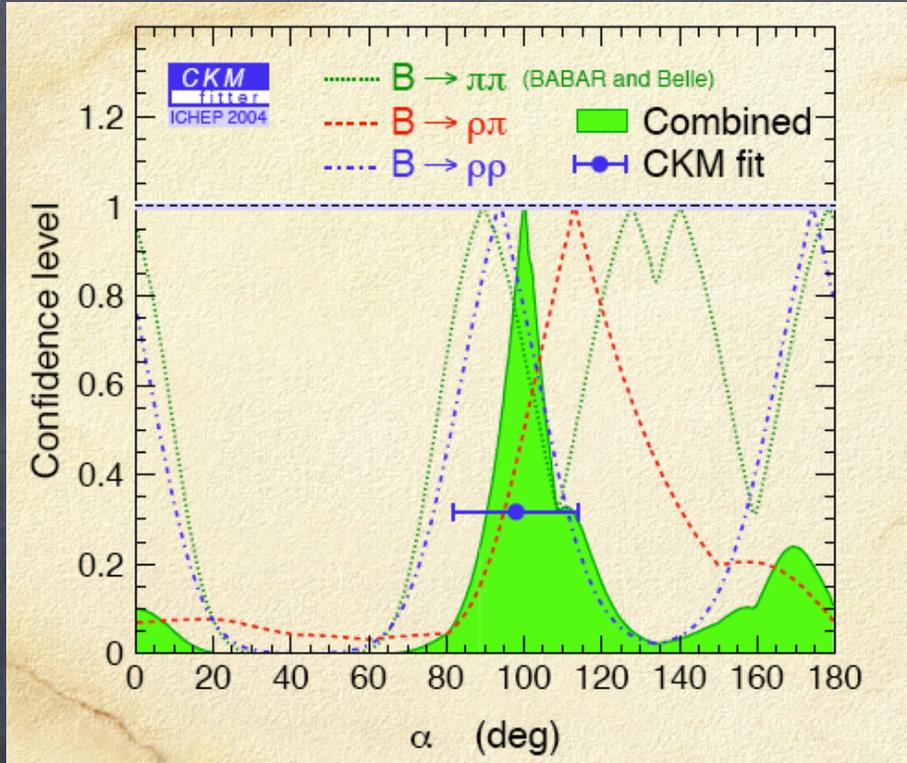
KLOE highlights



$g_\mu - 2: e^+e^-$ Data vs τ Data



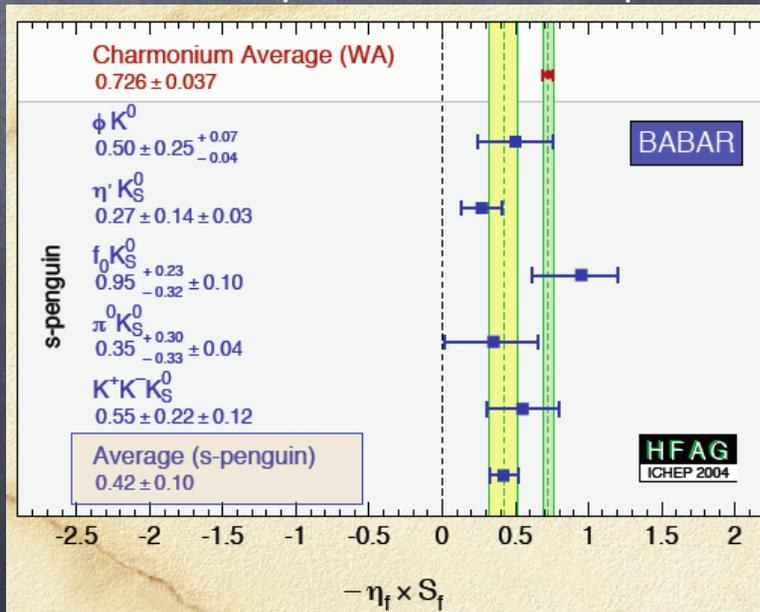
BaBar highlights



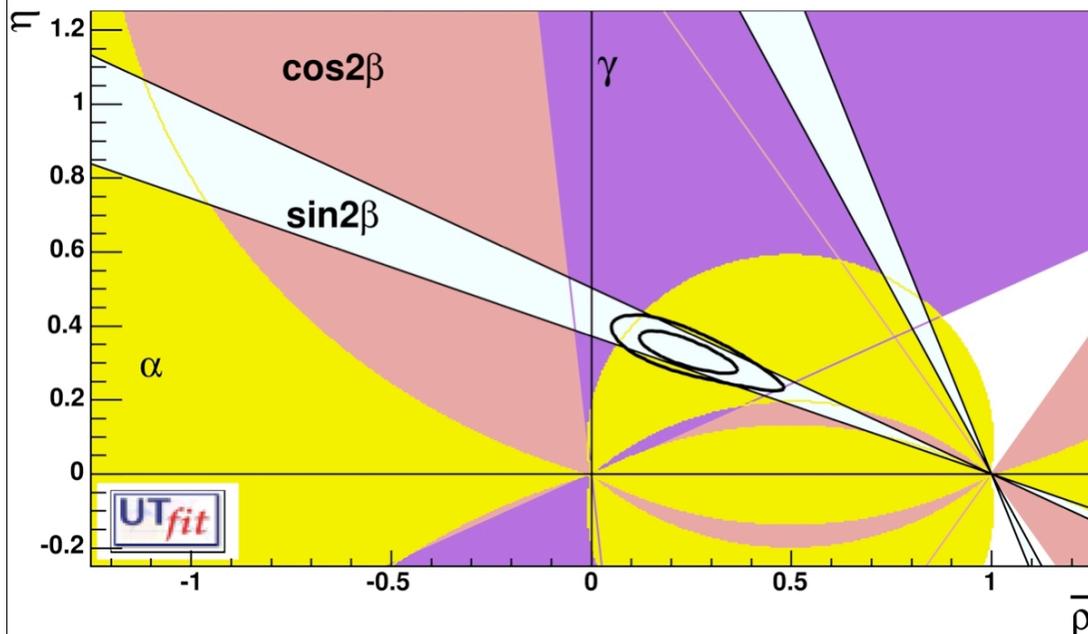
$$A_{K\pi} = -0.133 \pm 0.030 \pm 0.009$$

suggestivo: 40 anni per i K e 4 anni per i B

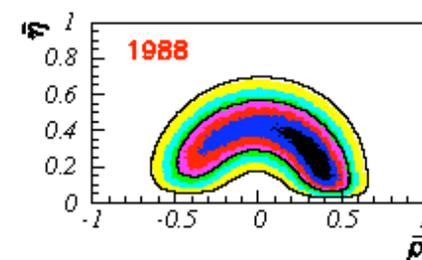
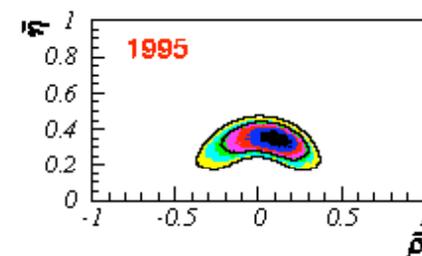
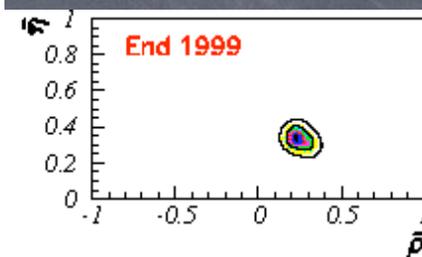
Violazione di CP diretta
 Indizi di discrepanze in β
 Prime misure di γ
 Una buona misura di α



La violazione di CP dai soli angoli

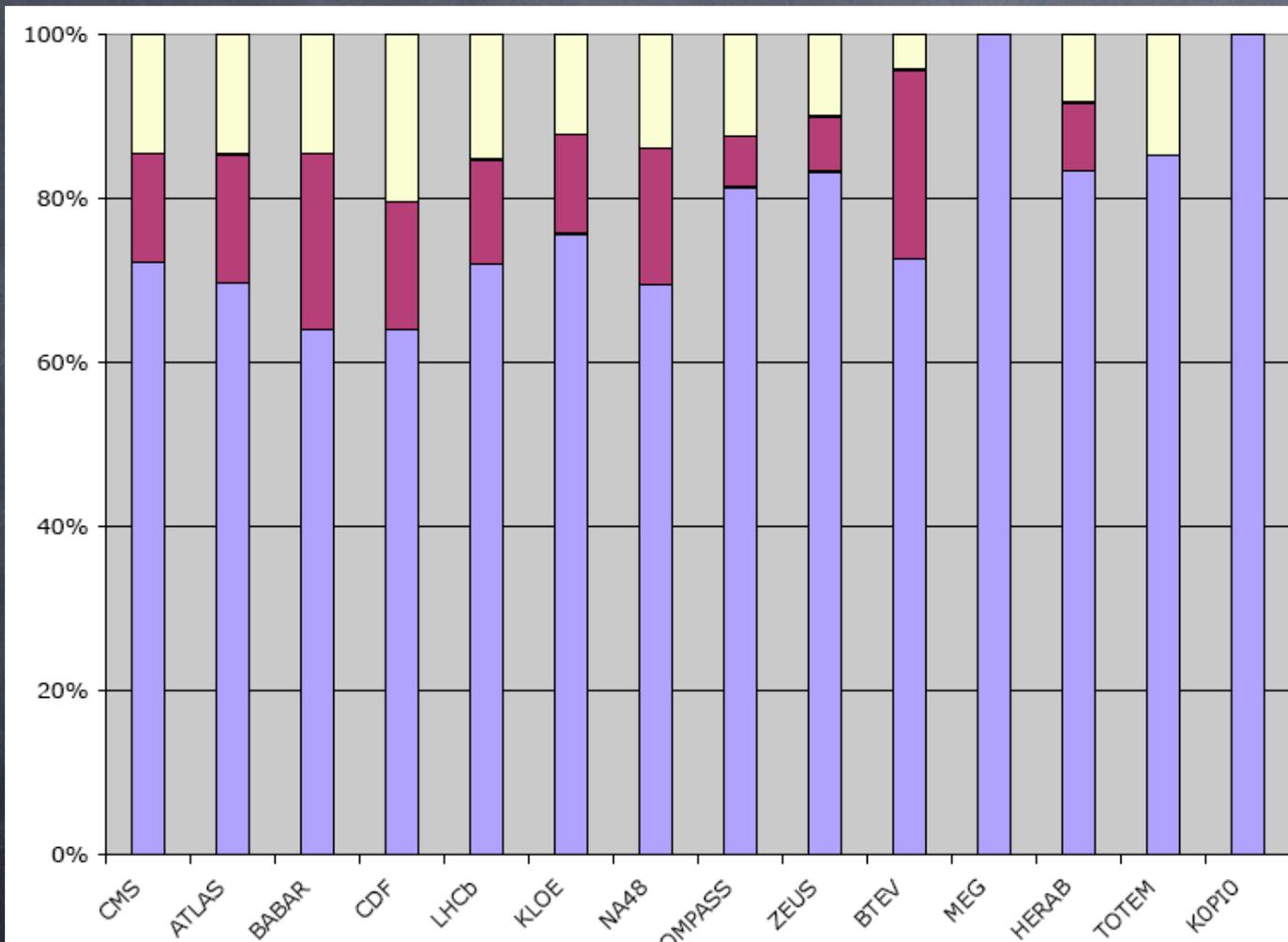


Altrettanto buona di quanto non fosse all'inizio dell'avventura



The allowed region for ρ and η from 1988 to the end of 1999

L'armata invisibile



Staff
PhD
PostDoc

Con 4 anni di lifetime
per i PhD e 2 per i
postdoc ne risultano:

~90 giovani

che dovranno
cambiare contratto
quest'anno

The 25th hour

2005: 110 Ph.D. 113 PostDoc

in realta' e' anche peggio

un esempio per tutti:

BaBar ha 95 fisici partecipanti. Secondo i criteri INFN corrispondono a 85 FTE. Di questi 20 sono Ph.D. e 14 PostDoc.

In realta' 33 sono Universitari, secondo il conteggio (non irrealistico) del Ministero essi valgono la meta'.

Quindi:

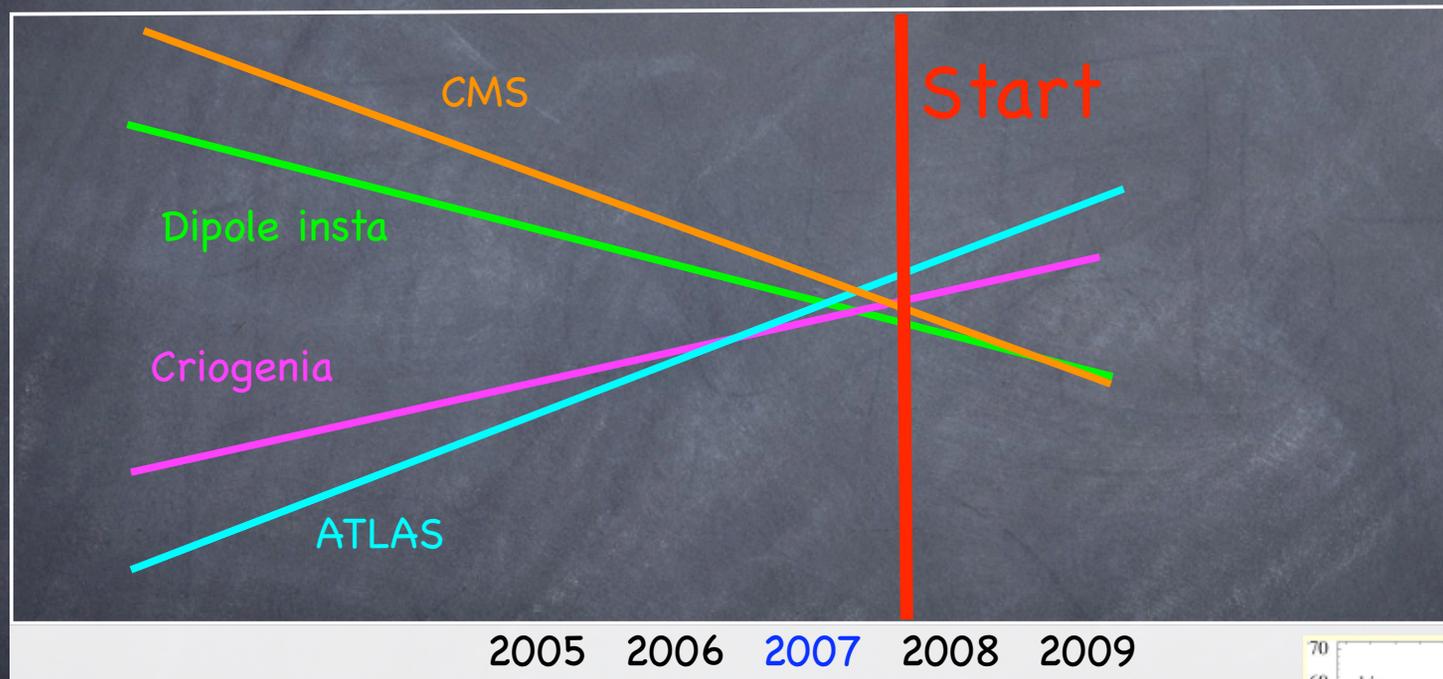
| # | FTE (INFN) | FTE (MIUR) | Staff (INFN) | Staff (MIUR) | Studenti |
|----|------------|------------|--------------|--------------|----------|
| 95 | 85 | 71 | 51 | 37 | 34 |
| | | 100% | | 52% | 48% |

verbatim dal report del CVI

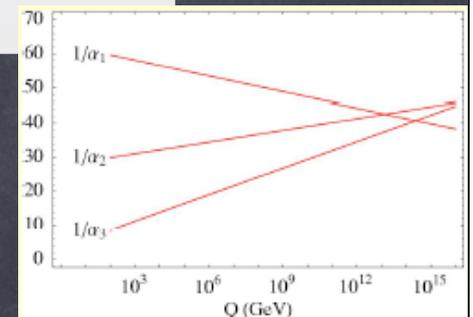
This creates a real danger of a worsening of the human capital (mainly young researchers), which is as important as physical capital; in fact in the research field, physical and human capital are not substitutes for each other;

Human resources are a key issue for the institute. INFN has demonstrated its capability as a fertile training ground for highly competent researchers with a top class Ph.D. program as its base. Nevertheless, the career path for physicists in INFN is hampered by the external constraints imposed by the fiscal laws

LHC : Il futuro prossimo venturo



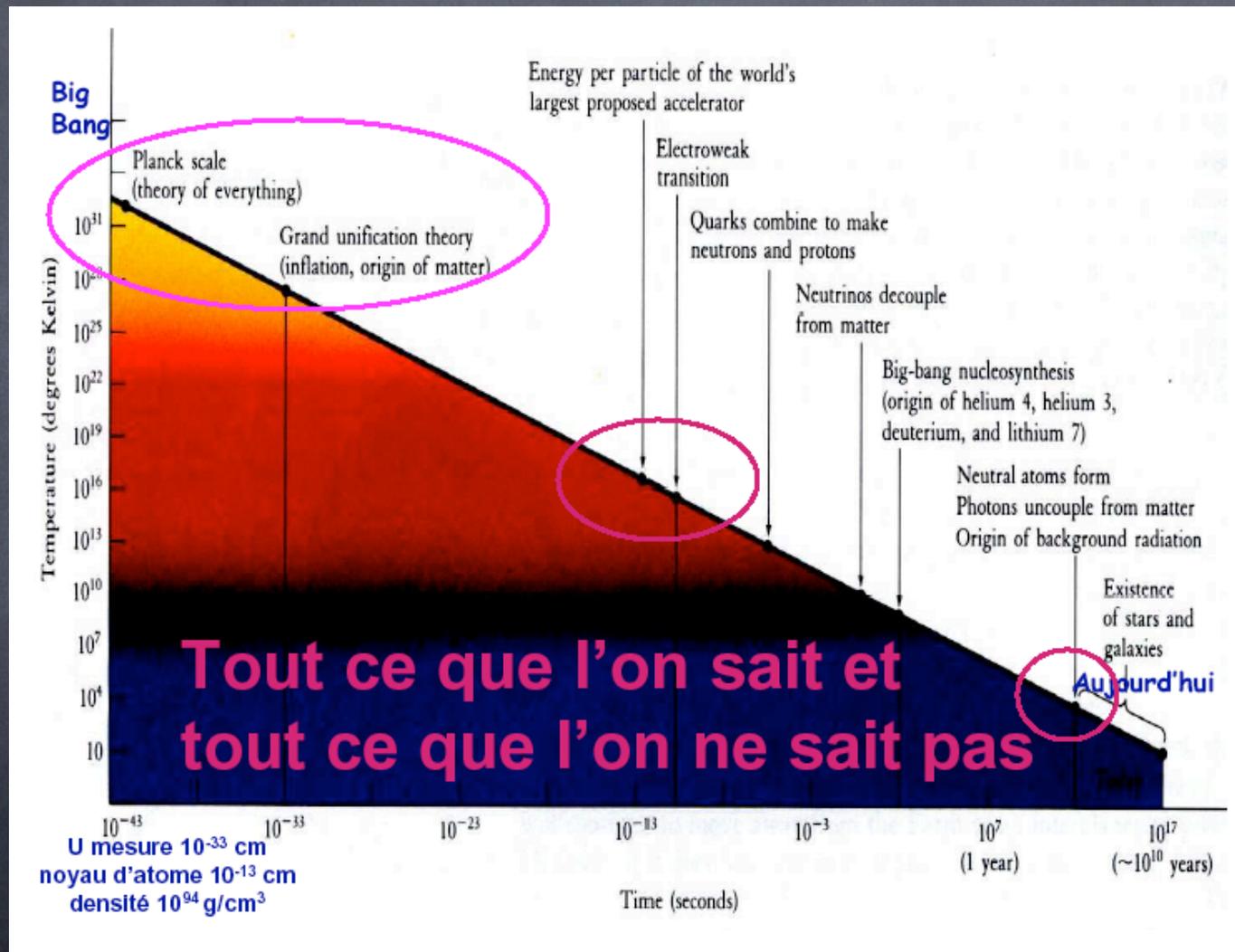
in fondo se credete che la costanti d'accoppiamento si incontrano a una qualche scala potete ben credere che cio' avverra' !



Pronti, via !



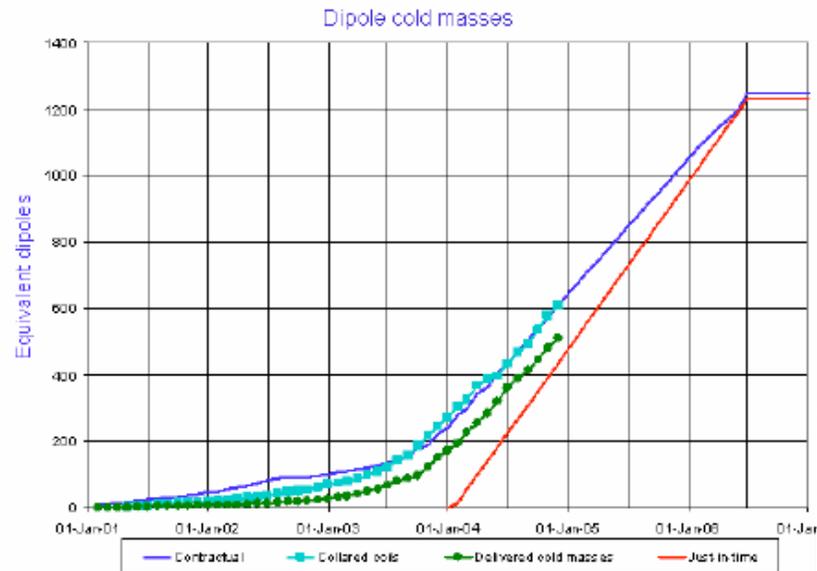
LHC : il grande salto nel passato



Hic Rhodus, hic saltus



LHC Progress
Dashboard



Issue: increase the rate of component manufacture in order to install 2 sectors in parallel, possibly 3

QRL in sector 7-8



Il salto nel vuoto



La roadmap del fisico a LHC

Goal # 1

Understand and calibrate detector and trigger in situ using well-known physics samples

e.g. - $Z \rightarrow ee, \mu\mu$ tracker, ECAL, Muon chambers calibration and alignment, etc.
- $t\bar{t} \rightarrow b\bar{v} bjj$ 10^3 evts/day after cuts \rightarrow jet scale from $W \rightarrow jj$, b-tag perf., etc.

Understand basic SM physics at $\sqrt{s} = 14$ TeV \rightarrow first checks of Monte Carlos
(hopefully well understood at Tevatron and HERA)

e.g. - measure cross-sections for e.g. minimum bias, W, Z, $t\bar{t}$, QCD jets (to $\sim 10-20\%$),
look at basic event features, first constraints of PDFs, etc.
- measure top mass (to 5-7 GeV) \rightarrow give feedback on detector performance

Note : statistical error negligible after few weeks run

Goal # 2

Prepare the road to discovery:

-- measure backgrounds to New Physics : e.g. $t\bar{t}$ and W/Z+ jets (omnipresent ...)
-- look at specific "control samples" for the individual channels:
e.g. $t\bar{t}jj$ with $j \neq b$ "calibrates" $t\bar{t}bb$ irreducible background to $t\bar{t}H \rightarrow t\bar{t}bb$

Goal # 3

Look for New Physics potentially accessible in first year (e.g. SUSY, some Higgs ? ...)

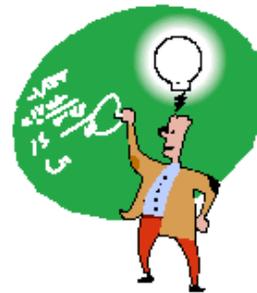
Nel migliore dei mondi possibili

What about early discoveries ?

An easy case : a new resonance decaying into e^+e^- , e.g. a Z' $\rightarrow ee$ of mass 1-2 TeV



An intermediate case : SUSY



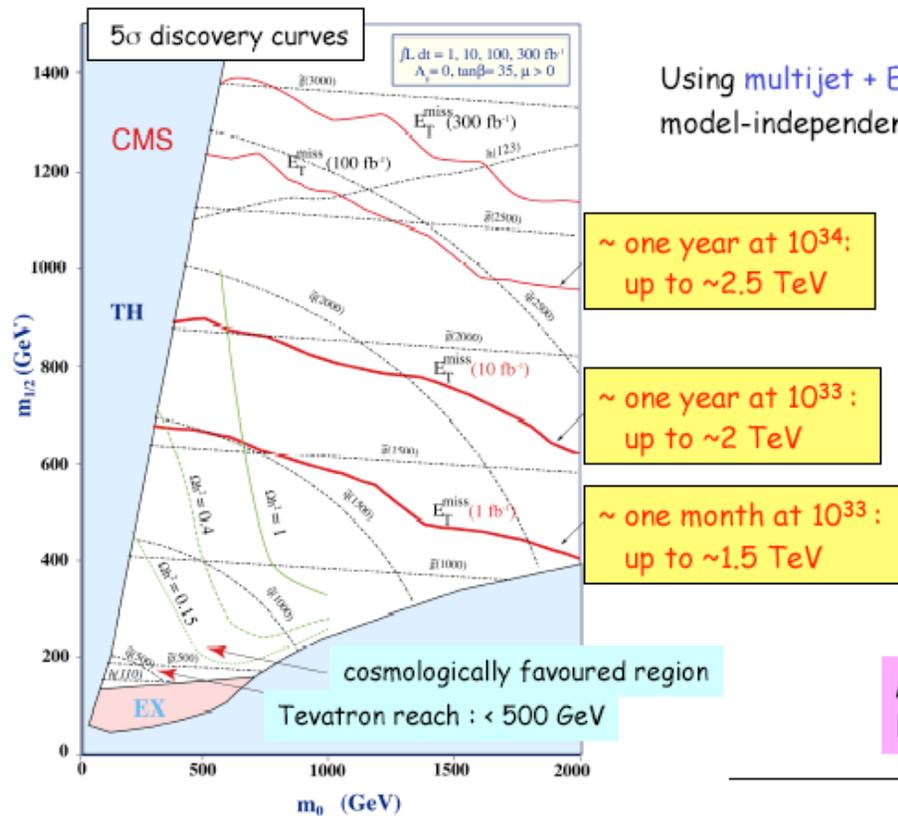
A difficult case : a light Higgs ($m \sim 115$ GeV)



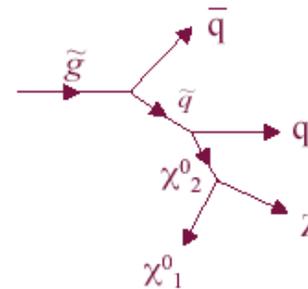
La competizione sara' una gara di velocita' (sempre nel migliore dei mondi possibili)

An "intermediate case" : SUPERSYMMETRY

Large $\tilde{q}\tilde{q}, \tilde{q}\tilde{g}, \tilde{g}\tilde{g}$ cross-section $\rightarrow \approx 100$ events/day at 10^{33} for $m(\tilde{q}, \tilde{g}) \sim 1$ TeV
 Spectacular signatures \rightarrow SUSY could be found quickly



Using multijet + E_T^{miss} (most powerful and model-independent signature if R-parity conserved)



Measurement of sparticle masses likely requires > 1 year. However ...

La buona notizia e' che meta' dello spazio delle fasi accessibile puo' essere acceduto in 1 mese di funzionamento (modulo la comprensione del rivelatore). Speriamo che non sia anche la notizia cattiva.

ma forse proprio perche':

a) sembra troppo facile

b) gia' l'ora s'avvicina

Andrea Romanino
CERN

- On the other hand, the possibility that naturalness is not relevant for physics at the TeV scale is worth not being neglected, also in the light of the failure of naturalness in the case of the CC
- Split Supersymmetry then emerges as a simple, compelling option
- In particular, the dark matter constraint shows that signals at LHC are likely but not guaranteed. A multi-TeV linear collider would on the contrary cover all the parameter space of the model.

Lo spettro della SpS compare a turbare i nostri sonni (e a rendere piu' tranquilli quelli dei colleghi teorici)



C'e' altro oltre a LHC ?

Houston, we have a problem

| | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 |
|-------|------|------|------|------|------|------|
| BTeV | | | | | | |
| KLOE | | | | | | |
| ZEUS | | | | | | |
| BaBar | | | | | | |
| CDF | | | | | | |

La via verso il futuro

- Completare la fisica dei K (NA48/2+n|_{n>0}): 2007-2013
- Upgrade di Luminosità di LHC : 2012-2020
- Fisica dello spin al GSI (PAXASSIA): 2013-2020
- Un futuro a Frascati (1 o 2 o 4 GeV ?): 2008-2020
- Un PS++ : 2013-2025
- una Super B Factory: dove ? (temo di saperlo); 2010 ?
- International Linear Collider : come ? dove ? quando ?

Ho volontariamente omesso la fisica del neutrino.
Merita un seminario a se (ed e' della CSN 2).

pare che il futuro non sara' USA

- La 'sudden death' di BTeV grida vendetta per la brutalita' e l'inefficienza del meccanismo
- La conversione di SLAC a Luce chiude un'epoca gloriosa
- Fermilab non ha ancora un progetto per la prossima decade
- La bizzarria di KOPIO mascherata in RSVP prelude a un altro bagno di sangue ?

Si impone una riflessione sulle collaborazioni con
DOE/NSF

Una lezione da non dimenticare
quando si progetta
il futuro

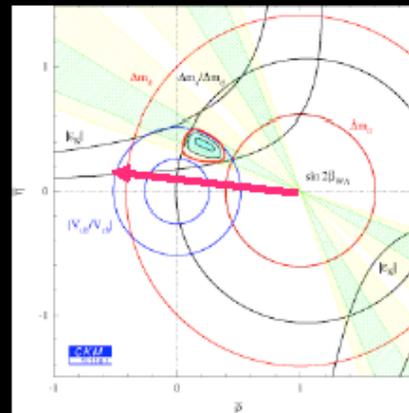
Why are B factories so productive?

We computed luminosity needed
on the basis of 15% CPV

Need about 400 events to get the asymmetry
 $B\bar{B} \rightarrow (B \rightarrow l^+ X)(\psi K_S) \quad \psi \rightarrow \mu^+ \mu^-; \quad K_S \rightarrow \pi^+ \pi^-$
to get a result $.15 \pm .05 \Rightarrow 3\sigma$

$L = 10^{34} \text{ sec}^{-1} \text{ cm}^{-2}$
It was 70%

To propose \$300M
project, you have to be conservative



Asym > 15%

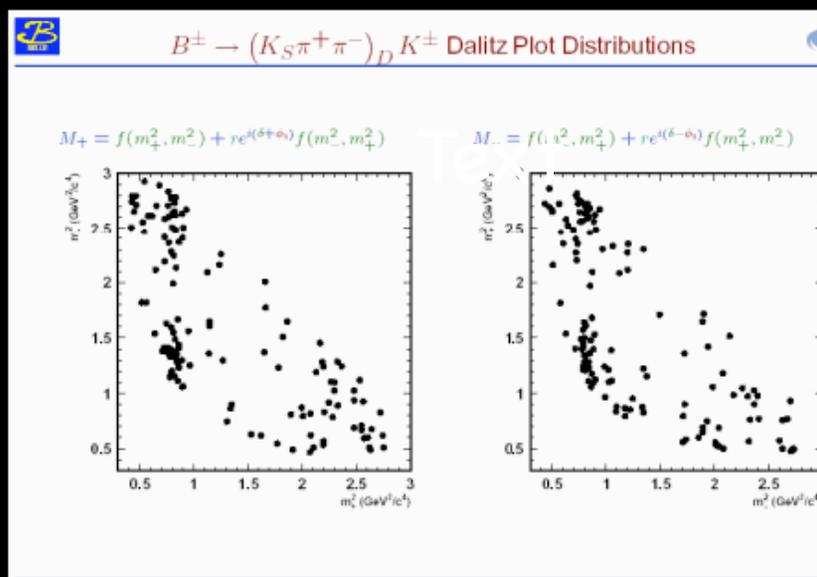
A.I. Sanda
Nagoya University

La luminosita' integrata* e' la chiave che apre
(quasi) tutte le porte

Who would have thought that:

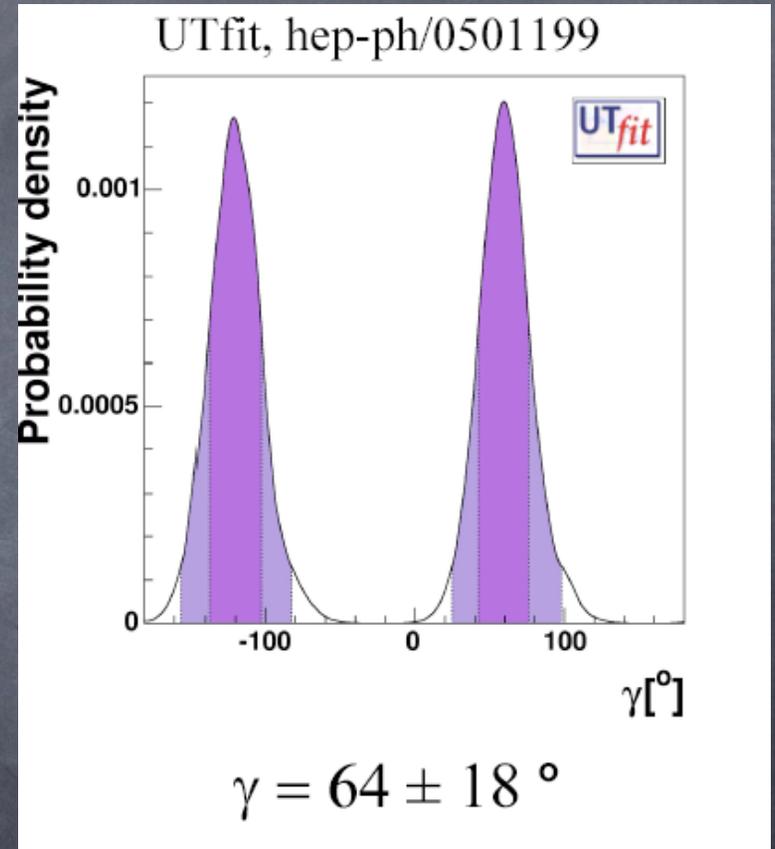
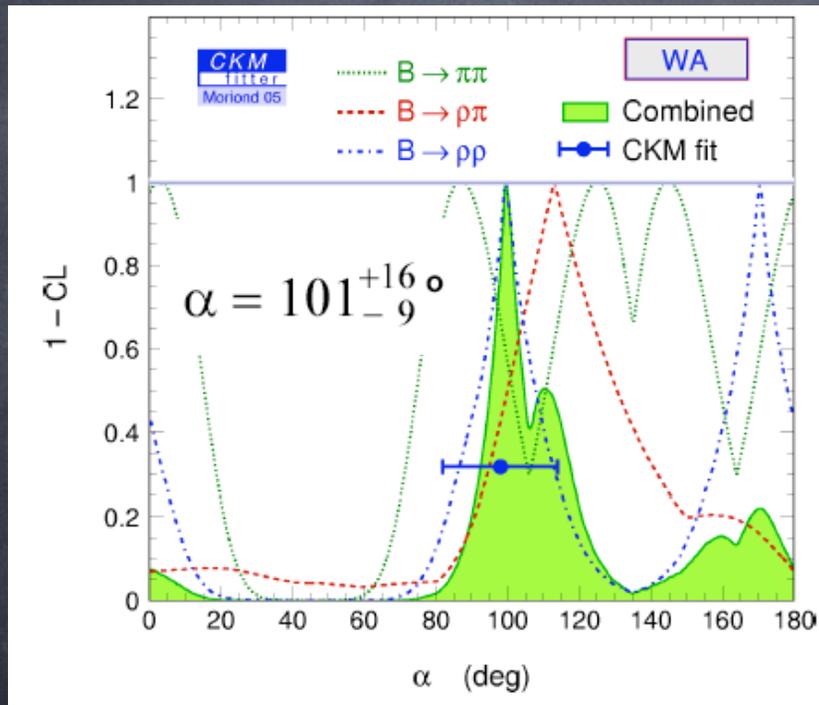
✱ We would be doing CPV on a point by point on
Dalitz plot

*o il numero di protoni
disponibili



Who would have thought that
we would be doing CPV in $B \rightarrow K_S K_S K_S$?

Et voila'



$$\sin 2\beta(c\bar{c}) = 0.725 \pm 0.037 \quad (23.2 \pm 1.5^\circ)$$

e alla fine della fiera

- Project current status to 4 ab^{-1} (2010-2011?) This is $\sim 10\times$ what we have now so error/3
- α is hard to project due to $B \rightarrow \rho^0 \rho^0$ unknown. Guess $\delta\alpha \sim 3^\circ$
- γ is likely to improve more than with statistics. New methods will improve but GGSZ (DP) method hard to project $\delta\gamma \sim 5^\circ$
- $\delta(\sin 2\beta) \sim 0.01$ ($\delta\beta \sim 0.5^\circ$)
 - Penguin modes
 - $\eta' K^0 \delta(\sin 2\beta) \sim 0.03$
 - All penguin average $\delta(\sin 2\beta) \sim 0.02$
 - Will it agree with $c\bar{c}K^0$ value?

pensando al futuro

HF04 High Intensity Frontier Workshop
La Biodola, Isola d'Elba, 5-8 June 2004

HF05

High Intensity Frontier Workshop
La Biodola. Isola d'Elba (Italy)
May 28 - June 1, 2005

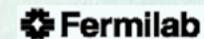
A Summary for
F. Cervelli (INFN)
Villars Meeting, September

Scientific Secretariat
L.Lilli
C.Tofani
R.Chiaratti

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Topics:

- kaon physics
- muon physics
- neutrino physics
- hadronic and nuclear studies
- CP violation
- future proton drivers
- future e+e- colliders
- detectors for high intensity beams
- applications of high intensity beams
- hadron beams



Rare Kaon Decays

- Search for explicit violation of Standard Model
 - Lepton Flavour Violation
- Probe the flavour sector of the Standard Model
 - FCNC
- Test fundamental symmetries
 - CP,CPT
- Study the strong interactions at low energy
 - Chiral Perturbation Theory, kaon structure

ν Physics

ν oscillations are the most important discovery in hep of the last 15 years.

They measure fundamental parameters of the standard model. Mixing angles, neutrino masses and the CP phase δ_{CP} are fundamental constants of the standard model.

They are a probe of the GUT scales . The smallness of neutrino masses is connected to the GUT scale through the see-saw mechanism.

They are directly linked to many fields in astrophysics and cosmology : baryogenesis, leptogenesis, galaxies formation, dynamic of supernovae explosion, power spectrum of energy anisotropies, etc.

They open the perspective of the measure of **leptonic CP violation**.

Future Muon Dipole Moment Measurements

- at a high intensity muon source

The Renaissance in Hadron Spectroscopy

Quite a number of new narrow states just in the last two years!

η'_c from Belle, CLEO, BaBar

Narrow DsJ BaBar, CLEO, Belle

X(3872) from Belle, CDF, D0, BaBar

$\Theta^+(1540)$ a confused experimental scenario

Evidence not confirmed

Ξ_{cc}^+ Selex

$D_{sJ}^+(2632)$ Selex

The Renaissance of Hadron Spectroscopy

■ Quarkonium

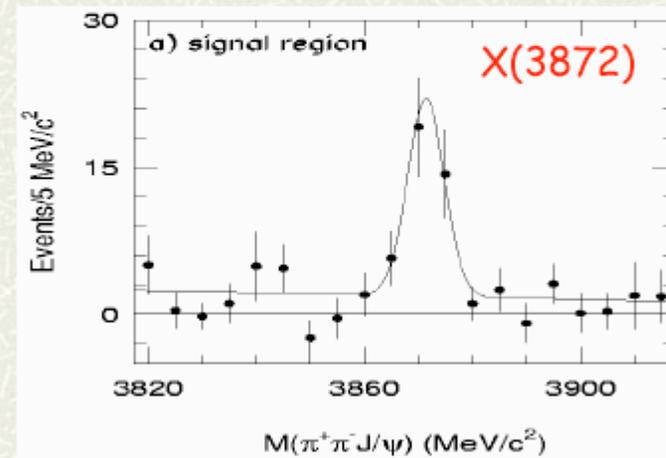
- η'_c (Belle, BaBar, CLEO)
- X(3872) (Belle, CDF, D0, BaBar)

■ Narrow Charmed States

- D_{sJ} (BaBar, CLEO, Belle)
- $D_{sJ}(2632) \rightarrow \eta D_s^+$ (Selex ?)
- Ξ_{cc} (Selex ?)

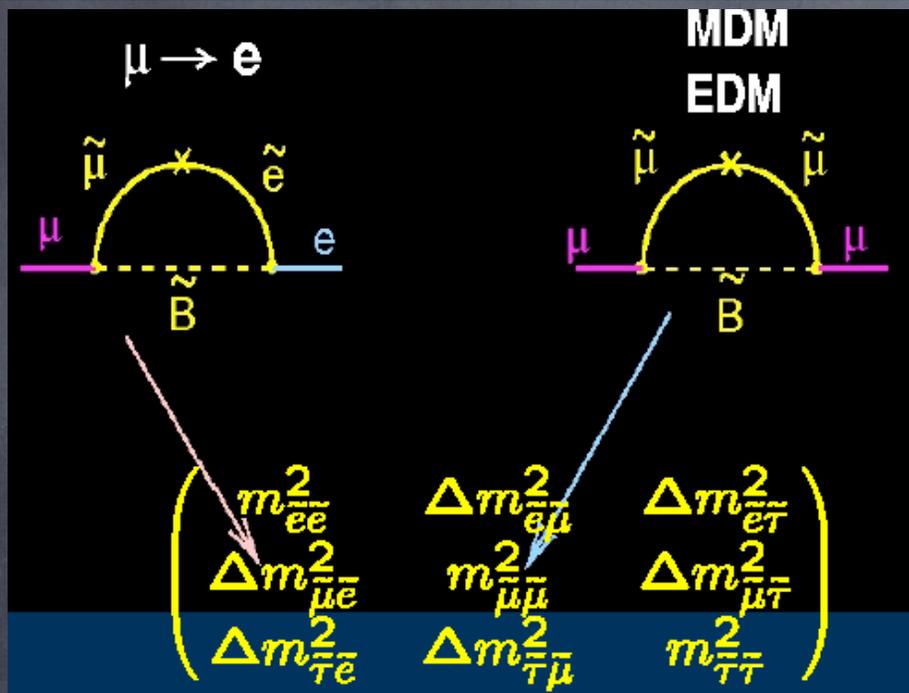
■ Pentaquark candidates

- $\Theta^+(1540)$
- $\Xi^-(1862)$
- $\Theta_c^+(3100)$



$M = 3872.0 \pm 0.6 \pm 0.5 \text{ MeV}$
 $\Gamma < 2.3 \text{ MeV (90 \% C.L.)}$

Future Muon Dipole Moment Measurements



μ Fluxes

| Experiment | N_μ | p_μ (MeV) | $\Delta p_\mu / p_\mu$ (%) | sensitivity | $I_{\text{off}} / I_{\text{on}}, \delta T, \Delta T$ |
|---------------------------------|-----------------|---------------|----------------------------|-------------------------|--|
| $\mu^+ \rightarrow e^+ e^- e^+$ | 10^{17} | < 30 | < 10 | $\text{BR} = 10^{-15}$ | DC beam |
| $\mu^+ \rightarrow e^+ \gamma$ | 10^{17} | < 30 | < 10 | $\text{BR} = 10^{-15}$ | DC beam |
| $\mu^- - e^-$ pulsed | 10^{21} | < 80 | < 5 | $\text{BR} = 10^{-19}$ | $10^{-10}, < 100\text{ns}, > 1\mu\text{s}$ |
| $\mu^- - e^-$ continuous | 10^{20} | < 80 | < 5 | $\text{BR} = 10^{-19}$ | DC beam |
| μEDM | $10^{16} / P^2$ | 300 – 500 | < 5 | 10^{-24} e cm | pulsed beam |
| $g - 2$ | 10^{16} | 3100 | < 2 | $< 0.1\text{ppm}$ | pulsed beam |

Acceleratori a protoni possibili futuri

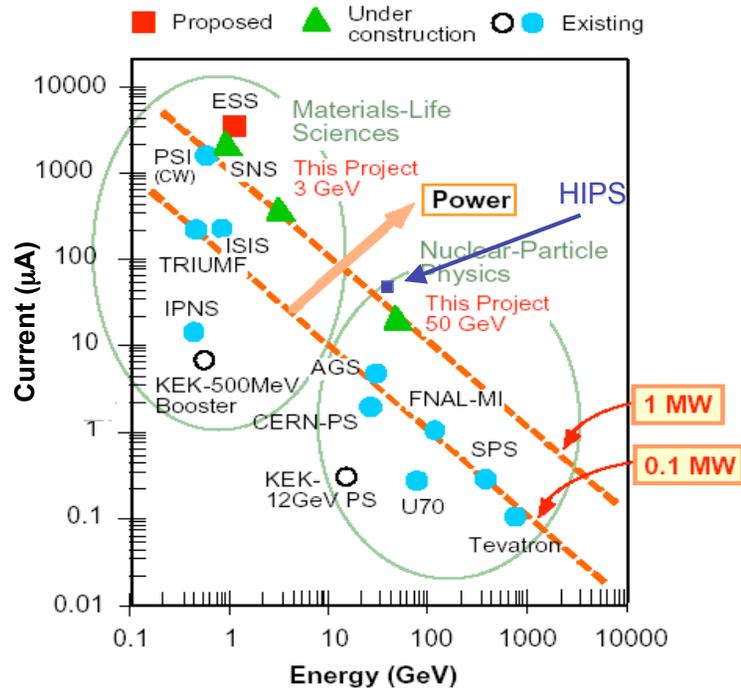
| | INTEREST FOR | | | |
|---------------------------|--|---|---------------------------------|---|
| | LHC upgrade | Neutrino physics beyond CNGS | Radioactive ion beams (EURISOL) | Others ** |
| SPL * (>2 GeV – 50 Hz) | Valuable | Very interesting for super-beam + beta-beam | Ideal | Spare flux ⇒ possibility to serve more users |
| RCS (30 GeV – 8 Hz) | Valuable | Very interesting for neutrino factory | No | Valuable |
| New PS (30 GeV) | Valuable | No | No | Valuable |
| New LHC injector (1 TeV) | Very interesting for doubling the LHC energy | No | No | Potential interest for kaon physics |

Un aspetto non trascurabile

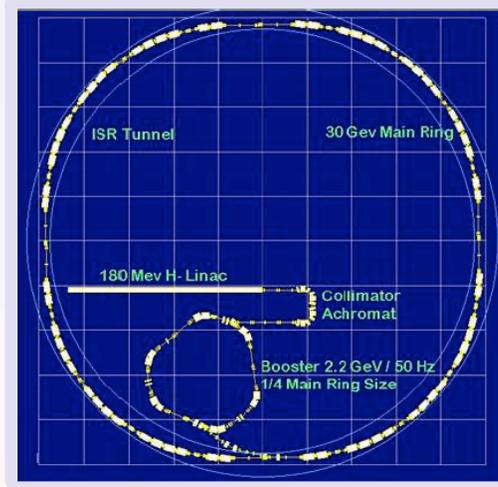
- Sociology of particle physics should not be neglected.
- Higher Energy machines will host fewer experiments:
 - personal satisfaction of physicists
 - difficulties in incorporating new and innovative ideas
 - difficulties for proper training of graduate students

A HIPS will host a large number of experiments, each with a “moderate” number of experimenters. Some risky innovative experiments will be possible. Graduate students will be able to grasp all aspects of an experiment.

PS++



A 30 GeV, 8 Hz Synchrotron as Possible Replacement for CERN PS

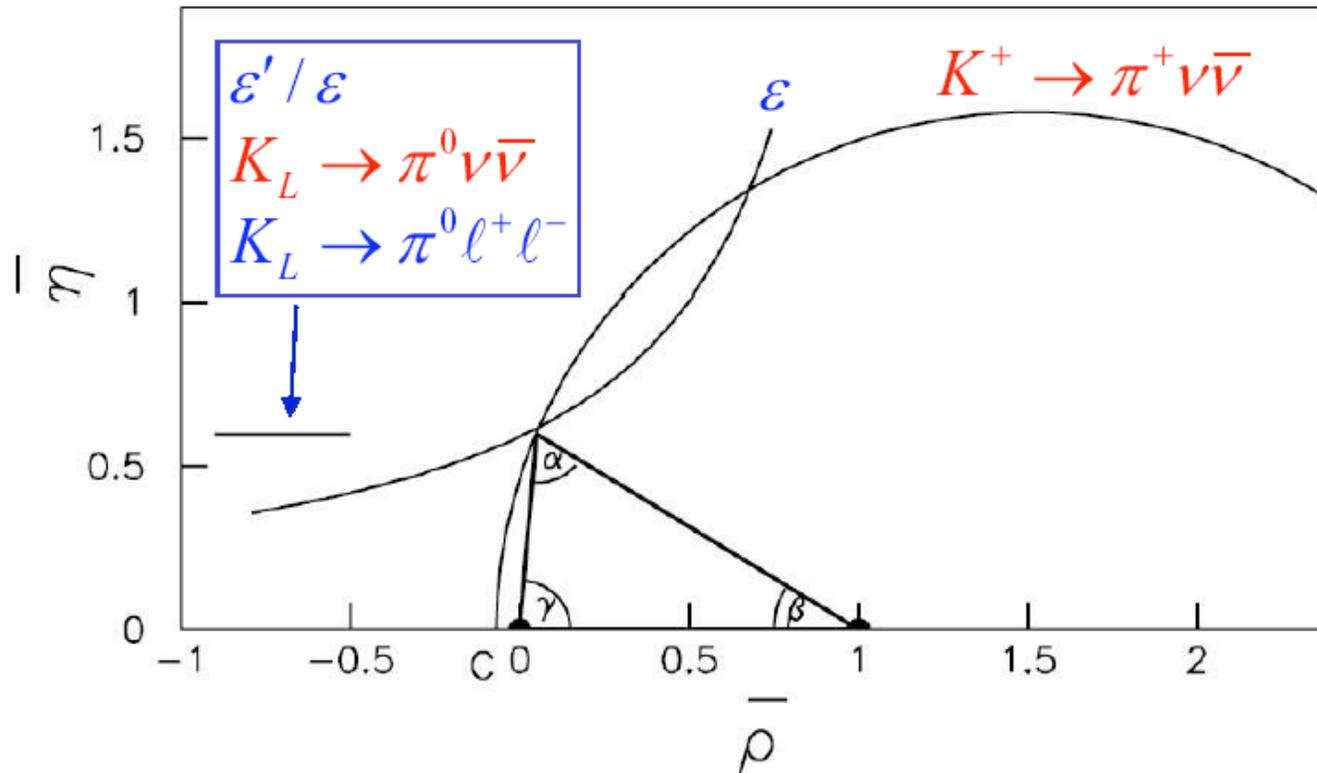


- 180 MeV H^- Linac with 2.5 MeV fast beam chopper
- Achromatic arc with high normalised dispersion
- Momentum ramping for injection painting
- bunch compression



Funzionale all'upgrade di luminosita' di LHC

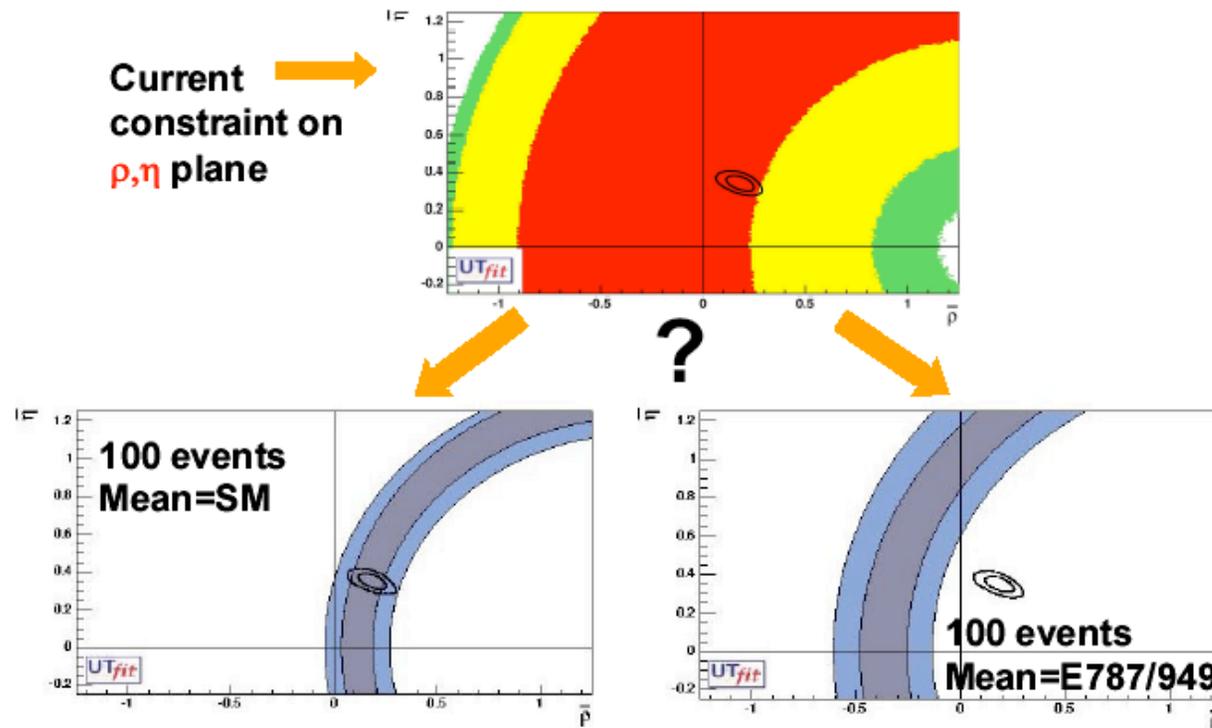
I K sono immortali



- CP, CPT & K_L - K_S interf.
- V_{us} from K_{l2} & K_{l3}
- Rare K_S decays
- $\pi\pi$ phases (CHPT)

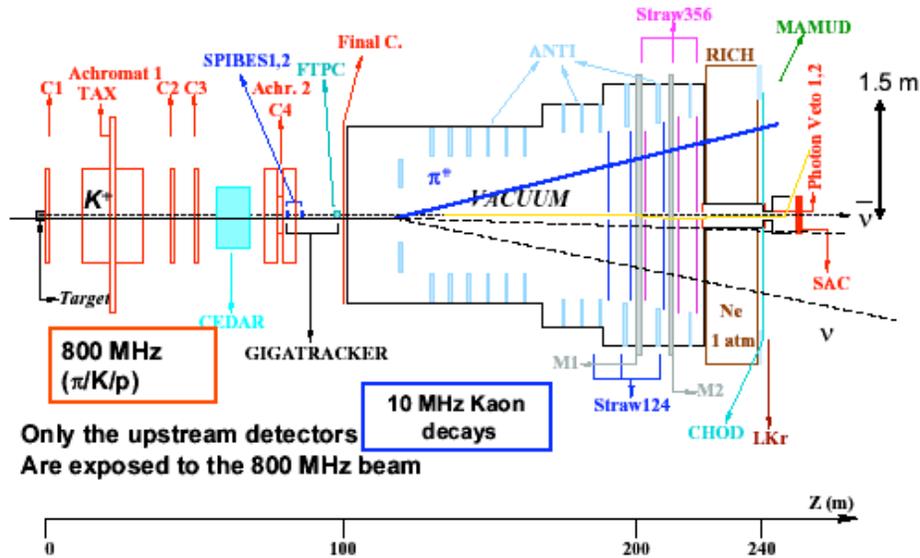
ma il gioco si fa duro

Setting the bar for the next generation of $K^+ \rightarrow \pi^+ \nu \bar{\nu}$ experiments



e i duri vogliono giocare

(Latest) NA48/3 Detector Layout



Only the upstream detectors
Are exposed to the 800 MHz beam

10 MHz Kaon decays

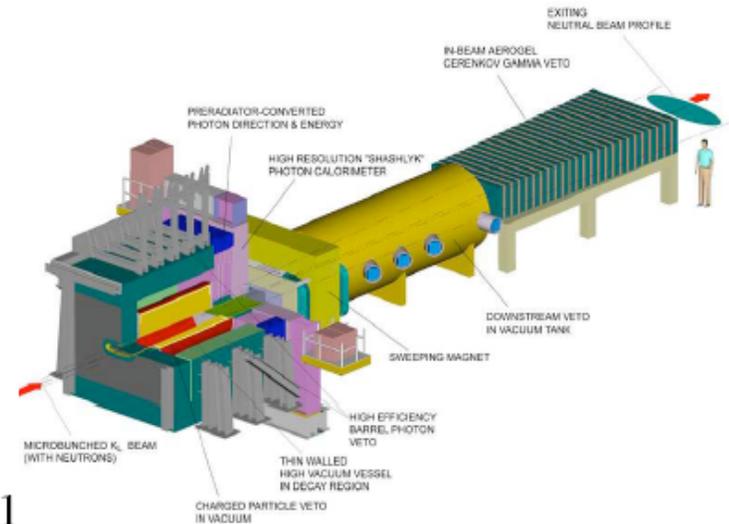
LNF, March 23, 2005

A. Ceccucci, CERN

21



L'apparato sperimentale



$$BR(K^+ \rightarrow \pi^+ \nu \bar{\nu}) = \underline{(8.0 \pm 1.1) \times 10^{-11}}$$

A.Nappi - KOPIO - Roma 11/3/05

$$BR(K_L^0 \rightarrow \pi^0 \nu \bar{\nu}) = \underline{(3.0 \pm 0.6) \times 10^{-11}}$$

Un universo possibile per Frascati

The physics case of a high-intensity Φ factory with $L [\text{cm}^{-2}\text{s}^{-1}] \gtrsim 10^{33}$ is worth to be explored:

Not a unique outstanding goal, but a series of interesting meas. in the K sector:

- clear targets [V_{us} & K_{l3} f.f., rare K_S decays, CPT tests]
- less clear targets [K^\pm -asym., interferometry, K_{l4} , ...]
 \Rightarrow more work on real data needed to better quantify the potential impact
- + non-K program at the Φ [f_0 , a_0 , η , η'] [clear]
- + kaonic atoms / hypernuclei [compatibility with the K prog. to be explored]



In addition to the natural machine and experimental considerations the time schedule of this program represents a **key point**

Un esempio di fisica dei Ks

2. The rare $K_S \rightarrow \pi^0 l^+ l^-$ decays

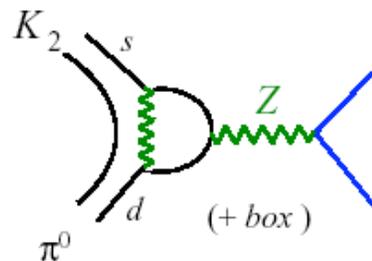
Within kaon physics we can identify 4 golden modes [channels where it is possible to extract interesting & complementary short-distance info about flavour mixing]:

| | |
|---------------------------------------|-------------------------------------|
| $K^+ \rightarrow \pi^+ \nu \bar{\nu}$ | $K_L \rightarrow \pi^0 e^+ e^-$ |
| $K_L \rightarrow \pi^0 \nu \bar{\nu}$ | $K_L \rightarrow \pi^0 \mu^+ \mu^-$ |

In the case of the two $K_L \rightarrow \pi^0 l^+ l^-$ channels, it is necessary to measure also the corresponding $K_S \rightarrow \pi^0 l^+ l^-$ rates in order to extract the interesting s.d. info:

Direct CPV amplitude

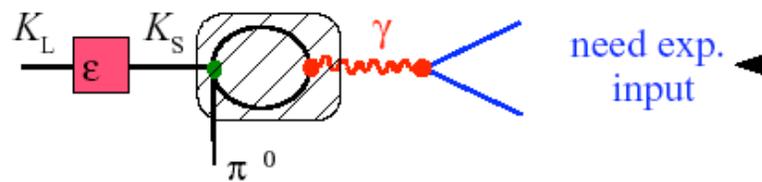
- short-distance dominated
- very similar to $K_L \rightarrow \pi^0 \nu \bar{\nu}$



interference

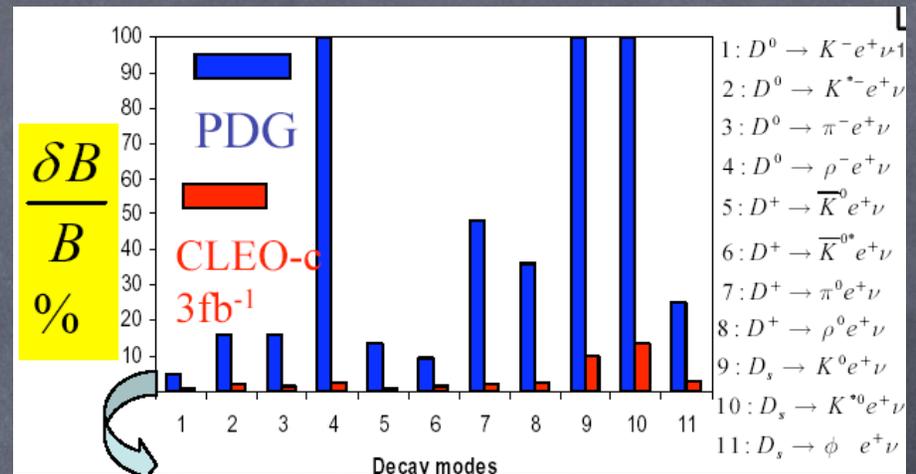
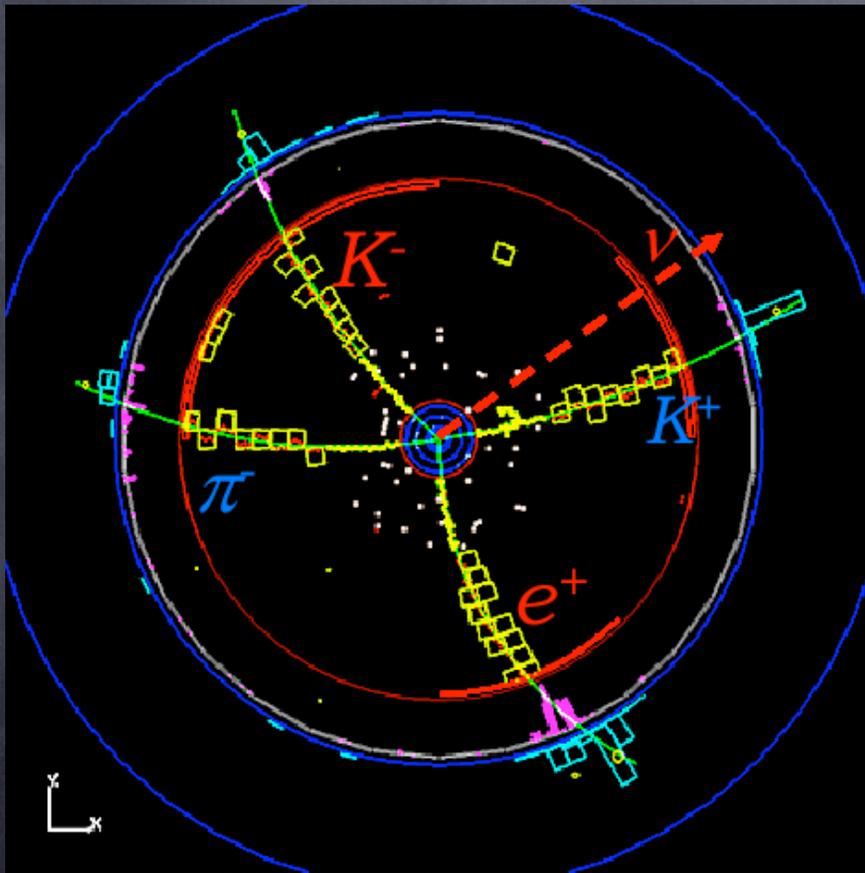
Indirect CPV amplitude

- determined by $K_S \rightarrow \pi^0 l^+ l^-$
- + theory to fix the sign



Un universo parallelo per Frascati

D CP violation, mixing & rare decays



$$B(D^+ \rightarrow \mu \nu) / \tau_{D^+} = (\text{const.}) f_{D^+}^2 |V_{cd}|^2$$

with 3 fb^{-1} : f_{D^+} to 2.3%

f_{D_s} to 1.9% @ $\sqrt{s} \sim 4140 \text{ MeV}$

What should we be shooting for at SUPERB?

B precision physics
New physics
SUSY couplings

Today

- $\beta(c\bar{c}) = 23.2 \pm 1.5^\circ$

- $\gamma = 63_{-13}^{+15}^\circ$

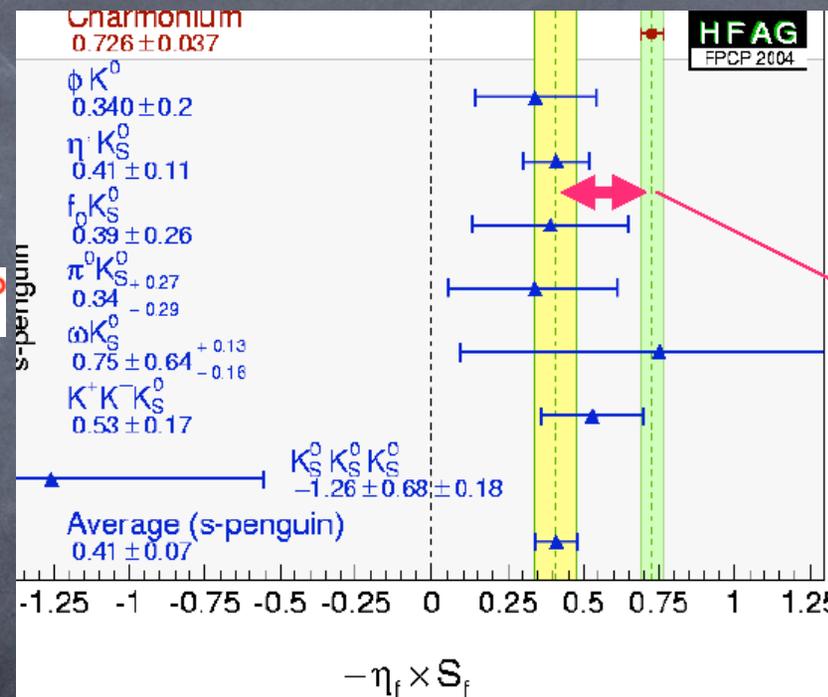
- $\alpha = 101_{-9}^{+16}^\circ$

sum of angles = 187°

and a factor 5-10 in statistics still to go

- $\sin 2\beta(c\bar{c}) = 0.725 \pm 0.037$

- $\sin 2\beta(\text{penguins}) = 0.43 \pm 0.07$



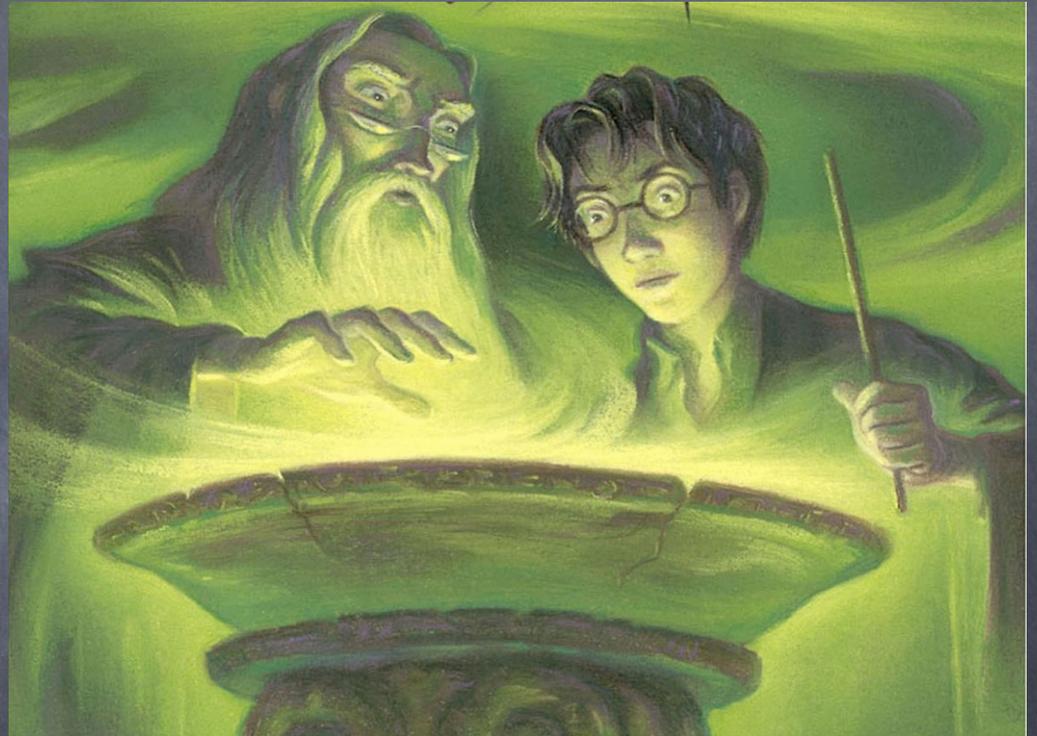
Asymmetry in ϕK

New Physics? *?!

Interesting but too big for new physics!
Prepare to push toward 3%

International Linear Collider

- ◉ Mi dispiace, ma non ho la palla di vetro. Prego rivolgersi a Harry.



Gli esperimenti nel 2010

ATLAS

LHC CERN

Energy frontier

CMS

LHC CERN

Energy frontier

LHCb

LHC CERN

Flavor physics

e forse

NA48/n

SPS CERN

Flavor physics

COMPASS

SPS CERN

Spin physics

Cerchiamo di lavorare tutti per un futuro migliore, questo sarebbe insufficiente

Conclusioni

- LHC si avvicina. Le possibili (ed auspicabili) scoperte saranno un boost per HEP.
- La fisica del flavour e' viva e vivace e dovrebbe poter avere un futuro (acceleratori a protoni, superB-factory, superDaΦne) qualora si possa garantire il teorema 'Sanda' To propose \$300M project, you have to be conservative
- Una macchina a protoni ad alta intensita' in Europa garantirebbe una diversificazione delle opportunita' altamente desiderabile
- Abbiamo bisogno dell'entusiasmo e delle idee in particolare dei giovani che hanno sempre reso ricco questo Incontro