V30

The Mannelli Tower in Florence & Vasari Corridor (emergency exit)

or

"The Bridge between experiment & theory"

Motto: The impact of Mannelli

Ikaros Bigi, Notre Dame du Lac

Pisa, Sept. 05 /2018

Mannelli was born in Florence and worked mostly in Pisa

"Mannelli tower"

"Galileo lamp"

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My speaking is not good in Italian; therefore I use the name of `Mannelli', not `Italo' – he is a Gentleman anyway.
Furthermore it is confusing: Italo-bus, Italo-treno

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direct CP violation in K_L decays

-- ε'/ε (NA31, NA48) --

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while `we' do not understand the underlying dynamics – New Dynamics –
and mention the soon future about truly rare decays $K^+ \to \pi^+ \nu \nu$ (NA62);

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-- ε'/ε (NA31, NA48) --,

while `we' do not understand the underlying dynamics – New Dynamics – and mention the soon future about truly rare decays $K^+ \to \pi^+ \nu \nu$ (NA62); the `company' can meet again for Mannelli's 90th birthday.

Add personal comment: Mannelli had told me long time ago he expects only from theorists speaking in good *faith*, *not* about *truth* all the time!

"Mannelli tower"

The plan for talking about $\Delta S \neq 0$

(I) Have-waving arguments about *direct* CP violation

(II) Theoretical `landscape' & NA31/NA48 vs. E731/KTeV

(III) Underlying dynamics?

(IV) The Future with $K^+ \to \pi^+ \nu \nu$ (& $K_L \to \pi^0 \nu \nu$)

(V) Summary

"Mannelli tower"

(I) Have-waving arguments for *direct* CP violation in K_L (D^0,B^0)

-- Once *indirect* CP violation was found, one has to go after *direct* CP violation!

-- Superweak dynamics is *not even* a model;
it is a classification: how close to zero values one can find it in a model or even a QFT.

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-- $\Delta S \neq 0$ for K_L: *one-loop* penguin diagram is based on *local operator* with α_s/π.

-- *indirect* CPV for $K_L \propto m_t^2/M_W^2$,
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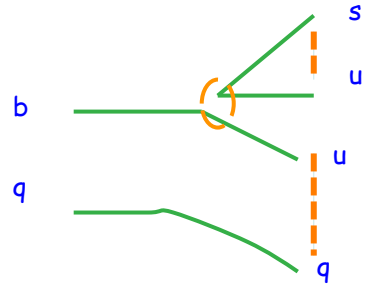
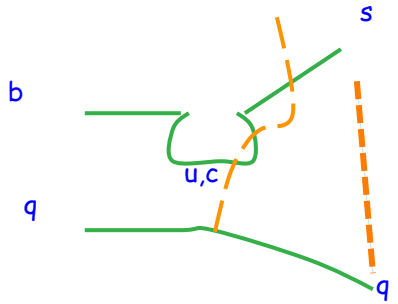
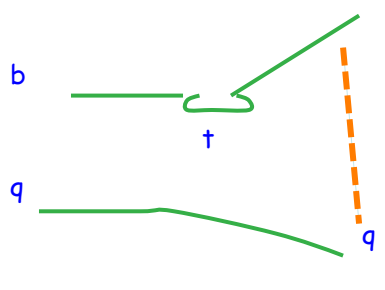
-- different landscape for $\Delta B \neq 0$: penguin *diagrams* vs. penguin *operators*.







(II) Theoretical `landscape' & NA31/NA48 vs. E731/KTeV

-- NA31: Re $(\varepsilon'/\varepsilon)$ = (3.3 +/- 1.1) x 10^{-3} -- (2.0 +/- 0.7) x 10^{-3}

E731: Re $(\varepsilon'/\varepsilon)$ = (3.2 +/- 3.0) x 10^{-3} -- (0.74 +/- 0.6) x 10^{-3}

-- $\mathrm{Re}(\varepsilon'/\varepsilon)|_{SM} < 0.001$ as a guess (? or !)

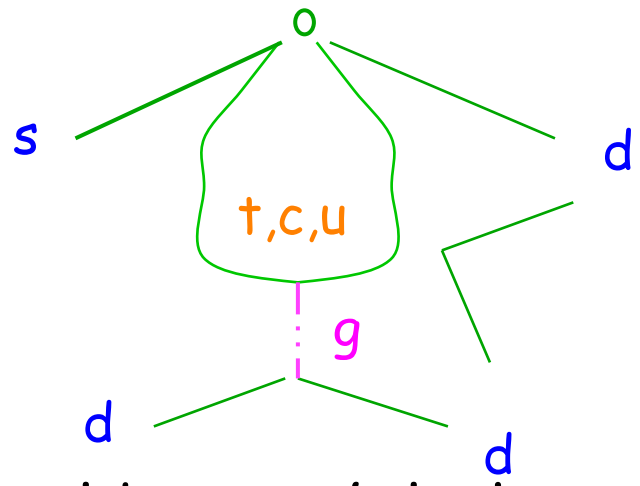
-- NA48: Re $(\varepsilon'/\varepsilon)$ = (1.47 +/- 0.22) x 10^{-3}

KTeV: Re $(\varepsilon'/\varepsilon)$ = (2.07 +/- 0.28) x 10^{-3}

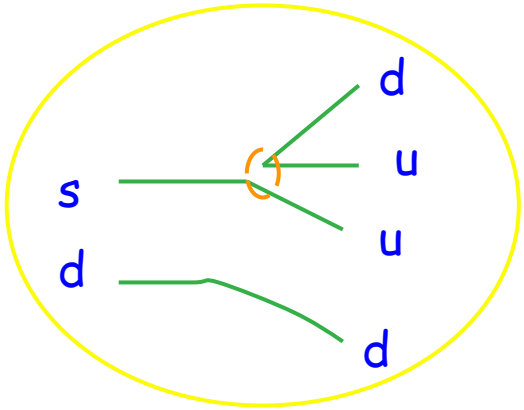
Averaged: Re $(\varepsilon'/\varepsilon)$ = (1.67 +/- 0.16) x 10^{-3}

-- $\mathrm{Re}(\varepsilon'/\varepsilon)|_{SM}$ = ? or !

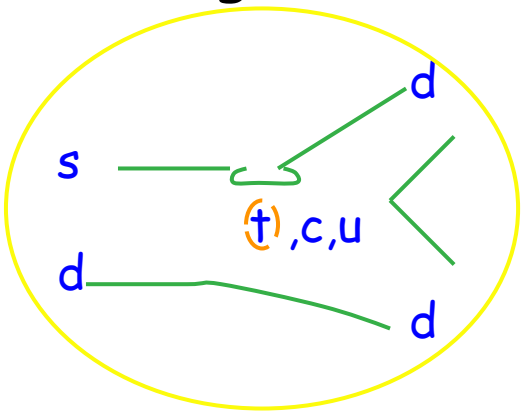
`penguin' diagrams



One should *not only* look on diagrams



local operator



local penguin *operator* for $K^0 \to 2\pi$
-- with weak phase

"Mannelli tower"

(III) Underlying dynamics?

-- $\mathrm{Re}(\varepsilon'/\varepsilon) < 0.001$ as a guess ?

-- I was *surprised* by $\mathrm{Re}\,(\varepsilon'/\varepsilon)|_{data} = (1.67 +/- 0.16) \times 10^{-3}$ -
but that is life

W.K.H. Panofsky Prize in Experimental Particle Physics
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[one lesson: B. Winstein, L. Wolfenstein, Rev.Mod.Phys.65 (1993)]

↑
Cardinal !

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-- $Re(\varepsilon'/\varepsilon)|_{SM}$ = ? with full tool box

-- my Bavarian Buras had said at seminars: $Re(\varepsilon'/\varepsilon)\ |_{SM} < 0.001$
- Epiphany Conference, Cracow, Jan. 2018:
$Re(\varepsilon'/\varepsilon)\ |_{SM} = (0.5 +/- 0.2\ ) \times 10^{-3}$
-- LQCD: $Re(\varepsilon'/\varepsilon)\ |_{SM} = (0.138 +/- 0.515 +/- 0.459\ ) \times 10^{-3}$

-- sign of New Dynamics ?
-- these statements are based on some connections between
the `Buras school' & LQCD


(IV) The Future with $K^+ \to \pi^+ \nu \nu$ (& $K_L \to \pi^0 \nu \nu$)

-- NA62 goal is to find $K^+ \to \pi^+ \nu \nu$ ~ 80 SM events
as predicted by the SM.

The `Buras school':

$$BR(K^+ \to \pi^+ \nu \nu) \sim (8.39 \pm 0.30) \times 10^{-11};$$

now the load is on the shoulders of our experimenters

Career of Mannelli

NA31 → NA48 →... → NA62: *Mannelli's 90th birthday!*

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Re(ε'/ε) found — Re(ε'/ε) established — !!!

? impact of ND ?

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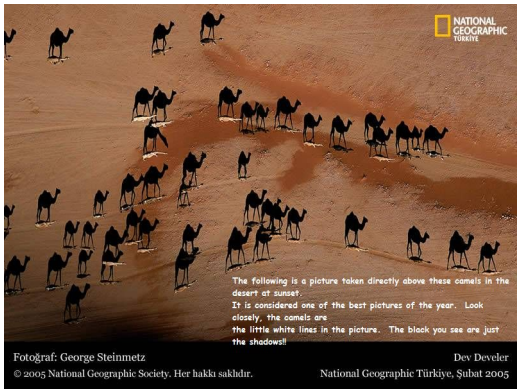
NA62: $K^+ \to \pi^+$ + massless dark photon

NA62: $K_L \to \pi^0 \nu \nu$?

(V) Summary

-- data: Re (ε'/ε) = (1.67 +/- 0.16) x 10^{-3} : they are *pro's*



data vs. background

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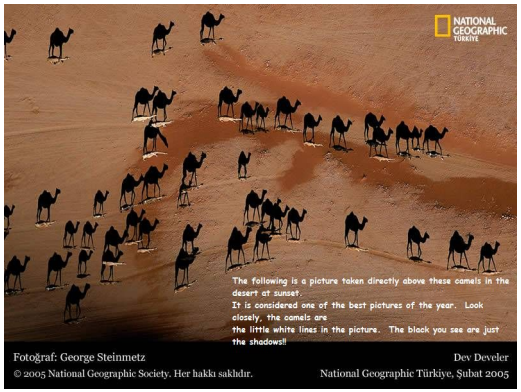

data vs. background

-- they are *pro's* also on the theoretical side

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  [Three Kings' (Day) <-> Three Colors]

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!!! Mannelli's 90th birthday !!!