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Gerhard Ecker

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University of Vienna

Euridice Startoff Meeting

Oct. 18 - 20, 2002
Frascati

Members of the Vienna group

◊ **Chiral perturbers**

Gerhard Ecker

Helmut Neufeld

Heinz Rupertsberger

René Unterdorfer (PhD student)

◊ **Quantum engineers**

Reinhold Bertlmann

Katharina Durstberger (PhD student)

Walter Grimus

Beatrix Hiesmayr

◊ **RTN-Fellow**

to be (found and) hired

Scientific projects

QM and discrete symmetries

- Decoherence effects

  modification of QM due to interaction with "environment" (quantum gravity, stochastic decoherence models,...)

  Technique:

  modified von Neumann equation with one-parameter dissipative term of Lindblad type $\Rightarrow$ mixing and decoherence

  entangled $K^0\overline{K^0}$ pairs $\Rightarrow$ quantitative bounds on validity of QM from exp. data

- CP violation

  Bell inequalities and CP violation

  $K^0\overline{K^0}$: CP violation in mixing excludes "local realistic theories"

  $B^0\overline{B^0}$: Bell inequalities constrain CP-violating phases

- CPT violation in $M^0\overline{M^0}$ mixing

disentangle CPT violation (θ) from

$$\Delta F = \Delta Q \text{ violation } (\lambda_+, \overline{\lambda}_-) \quad \Rightarrow$$

correlated decay rates $R_C(l^\pm, t_1; l^\pm, t_2)$ for semileptonic decays of $C = \pm 1$ states

Dass, Grimus, Lavoura

- Characterization of entanglement

decoherence $\leftrightarrow$ entanglement loss

generalized Bell inequalities to classify entanglement, extension to multiparticle states

- Geometric phases in entangled systems

Berry phase in entangled systems: adiabatic transformations of (part of) system before measurement

dependence of Bell inequalities on Berry phase

Chiral perturbation theory

♣ Isospin violation

i. Semileptonic decays

$K_{l3} \quad \Rightarrow \quad V_{us}$

Marseille, Valencia, Vienna

pion β decay $\quad \Rightarrow \quad$ theoretically cleanest determination of V_{ud}

Marseille, PSI, Valencia, Vienna

K_{l4} Marseille, Valencia, Vienna, ...

ii. Two-pion contribution to a_μ

clarify possible discrepancy (Davier et al.)
between τ and e^+e^- data for hadronic
vacuum polarization Valencia, Vienna

iii. $K \to \pi\pi$ Valencia, Vienna

numerical analysis near completion
important new input from KLOE :

$$\Gamma(K_S \to \pi^+\pi^-)/\Gamma(K_S \to \pi^0\pi^0) \quad \Rightarrow$$

$$\delta_0^0 - \delta_0^2 = (48.5 \pm 2.6)^\circ \text{ (isospin limit)}$$

♣ 1-loop functional for chiral $SU(3)$

PhD thesis (Unterdorfer)
closed form for loop functional with up to three propagators, including non-leptonic weak interactions, extension of previous work for SU(2) ($\rightarrow$ J. Schweizer)

♣ Triple chiral logs

leading infrared singularities of $O(p^8)$ in closed form (functional)

Lund, Vienna

♣ Chiral vs. high-energy structure

matching under control for 2- and 3-point functions, more work needed for 4- and 5-point functions (e.g., $\tau \rightarrow \nu 3\pi$, $e^+e^- \rightarrow 4\pi$)

Valencia, Vienna

Conclusions

1. We are looking forward to four productive years of **EURIDICE**

2.

WANTED

hard-working postdoc