$K^+ \to \pi^+\gamma$ and exotics

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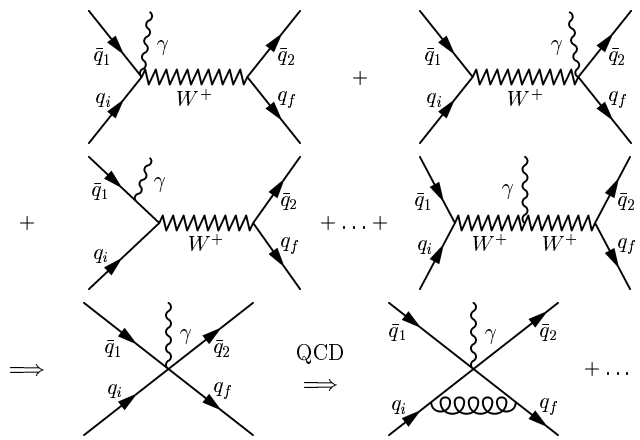
- spin 0→0 transition with a real photon, forbidden by
  - angular-momentum conservation
  - gauge invariance
- vacuum expectation value of vector fields
- nonlocal Superstring effects
- departured from Lorentz invariance
- non-commutative QED/SM
  (J.Trampetić, *hep-ph/0212309*)

Non-commutative QED/SM

$[\widehat{x}^\mu, \widehat{x}^\nu] = i\theta^{\mu\nu}$, non-cmmutative scale Λ_{NC}

- Photon does not act as the $U(1)$ gauge boson:
  - triple-photon coupling, $Z \to \gamma\gamma$, $Z \to gg$
  - "quarks $\times$ W $\times$ photon" coupling



$$BR(K^+ \to \pi^+\gamma) \simeq 0.8 \times 10^{-5} \frac{1}{\Lambda_{NC}(GeV)^4}$$

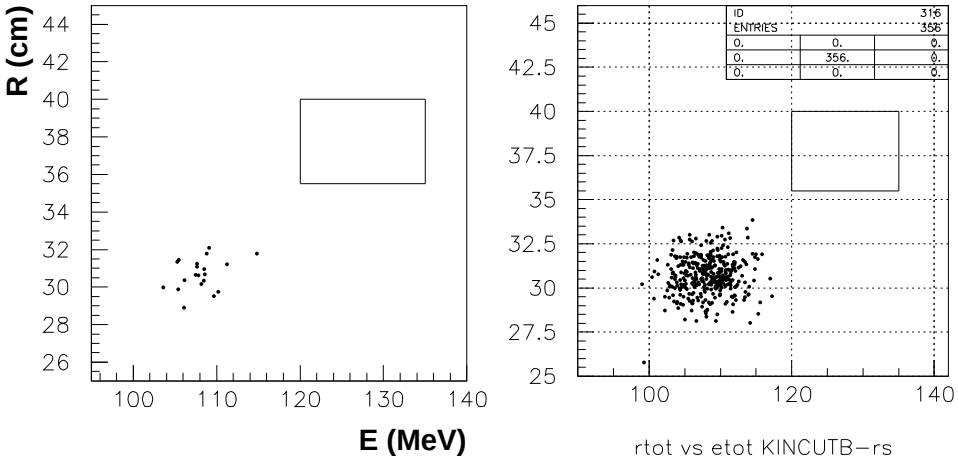
Λ_{NC} (GeV)	$BR(K^+ \to \pi^+\gamma)$	
≥ 2.2	$\leq 3.6 \times 10^{-7}$	90%C.L. limit by E787
100	0.8×10^{-13}	
250	2.0×10^{-15}	
500	1.3×10^{-16}	
1,000	0.8×10^{-17}	

* $BR(Z \to \gamma\gamma) < 5.2 \times 10^{-5} \longrightarrow \Lambda_{NC} > 118$GeV
(no big impact from $K^+ \to \pi^+\gamma$)

* This slide was revised on 2003Feb10,
due to the typos found in *hep-ph/0212309*.

E787 1γ-9697

$BR(K^+ \to \pi^+\gamma) \leq 3.6 \times 10^{-7}$ (left plot)



* w/o extra-photon veto cuts (right plot)
$\times$ 13.8 better sensitivity

prospects for $K^+ \to \pi^+\gamma$ in E949 γ-02 dataset

compared to E787 1γ-9697

	γ-02		1γ-9697
prescale	1		2450
ev/spill	25		1
N_{KB_L}/ps	11.6×10^{11}	($\times 1.7K$)	6.7×10^{8}
RS stopping layers	16,17		11 − 18
Trigger acceptance		($\times$0.308)	
S.E.S	2.8×10^{-10}	($\times$1/524)	1.46×10^{-7}
# of trigger	$12. \times 10^{6}$	($\times$7.5)	1.6×10^{6}

* bgd contribution from $K^+ \to \pi^+\gamma\gamma(1)$??