

Kaon Decays in Particle Physics

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High Energy Physics Committee

- To draw a grand picture of future HEP in Japan, they are studying future projects.
- Sent questions to JLC, SuperB, Neutrino, K experiments
- Expecting answers by end of August and presentation at JPS meeting in September

Questions from HEP Committee on K

- Questions from Nishikawa & Sumiyoshi
- Overall strategy at J-Parc
- Questions on $KL \rightarrow \pi^0 nn$, $K^\pm \rightarrow \pi^\pm nn$, T-violation, ...
 - Physics
 - Experimental techniques and strategies

Physics questions on $KL \rightarrow \pi^0 nn$

- How many events are necessary to determine the Unitarity Triangle? Can you compete with B experiments?
- $\sin 2\beta$: What is the contribution from J-Parc when it is measured by Belle, BTeV, LHC-B, and KOPIO?
- What are the examples of New Physics that are not found by B-factories and LHC, but in $KL \rightarrow \pi^0 nn$?

Answers are in...

- “Waiting for Precise Measurements of $K^{+-} \rightarrow \pi^+ n n$ and $K_L \rightarrow \pi^0 n n$ ”
by A.J.Buras, F.Schwab, and S.Uhlig,
hep-ph/0405132
- and references therein

B scenarios

	now	Bfactories	LHCB
beta	23.7 ± 2.1	23.5 ± 1.0	± 0.5
gamma	63.0 ± 6.0	± 5.0	± 2.0
eta	0.354 ± 0.027	0.340 ± 0.009	0.358 ± 0.007
rho	0.187 ± 0.059	0.209 ± 0.017	0.182 ± 0.011

K scenarios

	K-I (2010)	K-II (beyond)
$B(K^+)/10^{-11}$	8.0 ± 0.8	8.0 ± 0.4
$B(K_L)/10^{-11}$	3.0 ± 0.3	3.0 ± 0.15
$m_t(\text{GeV})$	168 ± 3	168 ± 1

B vs K

	Bfact.	LHCB	K-I	K-II
$\text{Im } V_{ts}^* V_{td} / 10^{-4}$	1.35 ± 0.05	1.42 ± 0.04	1.39 ± 0.08	1.39 ± 0.04
eta	0.340 ± 0.009	0.358 ± 0.007	0.351 ± 0.022	0.351 ± 0.011

K experiments on SM

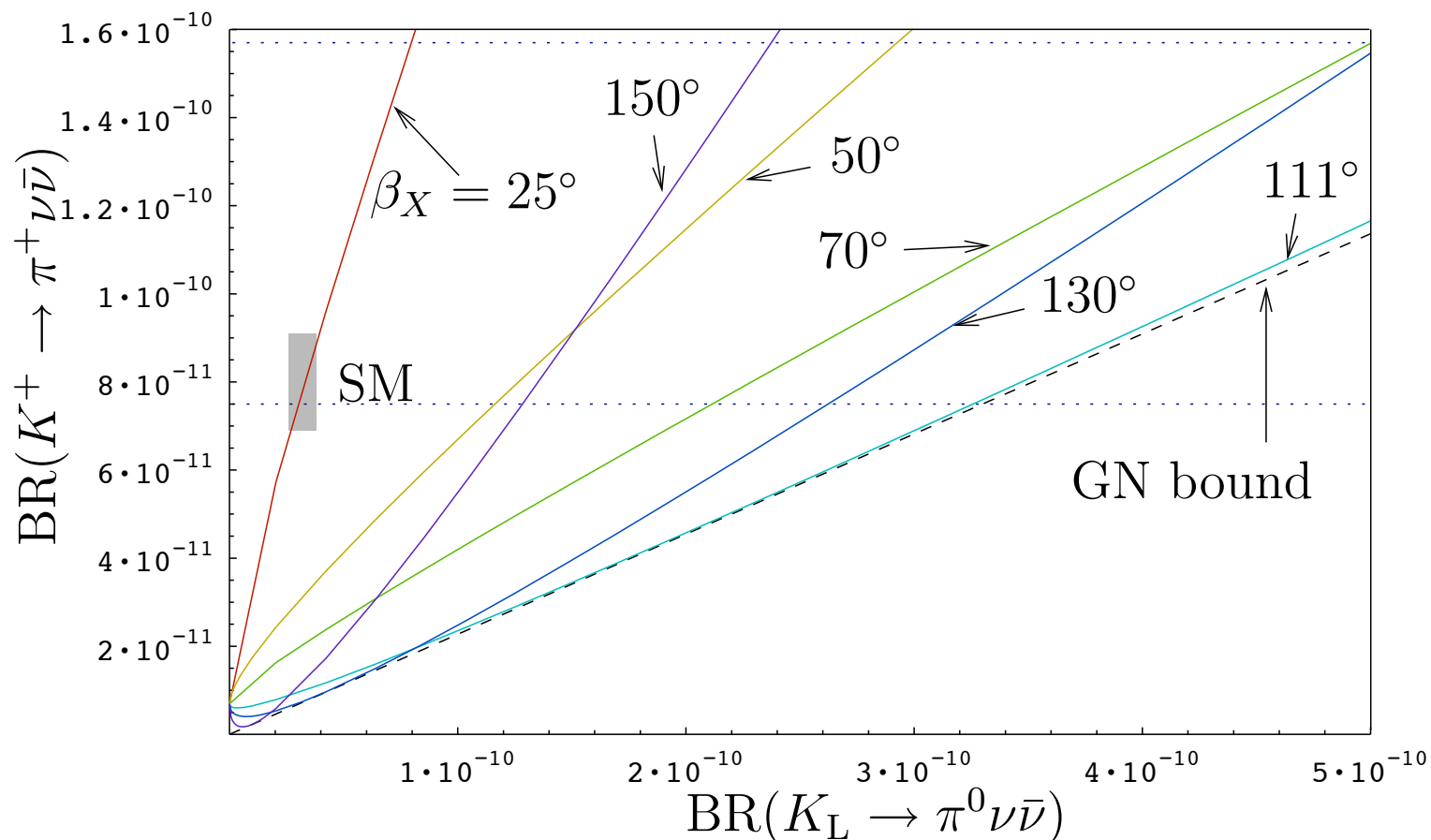
- 10% BR measurements have errors $\sim x2$ of LHCb
- 5% BR measurements $\sim$ LHCb
- Should aim for ~ 400 events

Beyond SM

- Model independent short distance function

$$X = |X|e^{i\theta_X}$$

$$\beta_X \equiv \beta - \beta_s - \theta_X,$$



Various models

- Minimum Supersymmetric Model
 - $1/2 < \text{BR}(\text{MSSM})/\text{BR}(\text{SM}) < 1$
- General Supersymmetric Model
 - $\text{BR}(\text{SSM})/\text{BR}(\text{SM}) < 10, \dots$
- Extra dimensions, lepton flavor mixing, ...
- new complex phase ($B \rightarrow \pi K$)

BSM in B

- $B \rightarrow X_{s,d} \nu \bar{\nu}$
 - clean but very difficult
- $B \rightarrow X_{s,d} \gamma$, and $B \rightarrow X_{s,d} l^+ l^-$
 - clean, but 10% at best

Summary

- SM Unitarity Triangle
 - ~ 400 events (5%) to compete with LHCb
- Beyond SM
 - Difference from B and others
 - still the best accuracy