### Implication on Chirality Structure of Squarks from CP Asymmetry of B Decays

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ME,Kakizaki,Yamaguchi,PLB583(2004)186 ME,Kakizaki,Yamaguchi,PLB594(2004)205 ME,Mishima,Yamaguchi,to appear in PLB

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### Identification of Chirality Structure

- SM conts. to FCNC are induced by W boson
  - → Left-Handed currents
- New Phys. conts. have chirality dependence
  - Interference with SM leads to characteristic pattern of experimental signals
- In supersymmetric SM, chirality structure arises also in squark mixings
  - → We can study LH/RH structure of squarks by using experimental data

We provide SUSY interpretation of anomaly in the current data of mixing-induced CP asymmetry of b-s decay modes

*Left-Handed* squark mixings can easily correct the SM prediction

RH currents require large contributions comparable to the SM ones

special value of magnitude and angle

[Larson,Murayama&Perez]

 $\rightarrow$  Experimental bounds from Br( $b \rightarrow s\gamma$ ) and EDMs

#### Current Status of Mixing-Induced CP Asymmetry of b-s Decay Modes [Y.Sakai,talk at ICHEP2004;EX/0408072,0408090]



○ Apparent deviations in multiple modes → New Phys.

 $\circ$  S<sub>b-s</sub> deviates to same side for both final-state parities

### Sign of Contributions by Final-state Parity

• Effective Hamiltonian  $H_{eff} \sim C_i O_i + (\tilde{C}, \tilde{O} : R \leftrightarrow L)$ 



• Decay Amplitude  $\langle f | \tilde{O}_i | B_d \rangle = -(-1)^{P_f} \langle f | O_i | B_d \rangle$  $A \sim \left[ C_i - (-1)^{P_f} \tilde{C}_i \right] \langle f | O_i | B_d \rangle$ 

$$A_{i}^{\mathsf{NP}}(\phi K) \propto [C_{i}^{\mathsf{SM}} + C_{i}^{\mathsf{NP}} + \tilde{C}_{i}^{\mathsf{NP}}]\langle \phi K | O_{i} | B_{d} \rangle$$
$$A_{i}^{\mathsf{NP}}(\eta' K) \propto [C_{i}^{\mathsf{SM}} + C_{i}^{\mathsf{NP}} - \tilde{C}_{i}^{\mathsf{NP}}]\langle \eta' K | O_{i} | B_{d} \rangle$$
$$\mathsf{Kagan; Khalil\& Kou}]$$

### b-s Squark Mixings

• There are 4 mixings distinguished by chirality LH  $-\mathcal{L}_{mass} = (\tilde{s}_L \tilde{s}_R)^* \begin{pmatrix} (\tilde{m}_{LL}^2)_{23} & (\tilde{m}_{LR}^2)_{23} \\ (\tilde{m}_{RL}^2)_{23} & (\tilde{m}_{RR}^2)_{23} \end{pmatrix} \begin{pmatrix} \tilde{b}_L \\ \tilde{b}_R \end{pmatrix}$ 

• LH squark mixings dominantly contribute to  $C_i$ , while RH mixings to  $\tilde{C}_i$ 

RH



#### SUSY Contributions to Wilson Coefficients

 Double MI w/ LL(RR) / LR(RL) dominate in wide parameter region



# SUSY Contributions to $S_{b-s}$

- SUSY contributions behave as corrections
  - $\rightarrow$  Deviation of  $S_{b-s}$  reflects sign of the conts.
- Parity

$$\begin{cases} A_i^{\tilde{g}}(\phi K) \propto [C_i^{\mathsf{SM}} + C_i^{\tilde{g}} + \tilde{C}_i^{\tilde{g}}] \langle \phi K | O_i | B_d \rangle \\ A_i^{\tilde{g}}(\eta' K) \propto [C_i^{\mathsf{SM}} + C_i^{\tilde{g}} - \tilde{C}_i^{\tilde{g}}] \langle \eta' K | O_i | B_d \rangle \end{cases}$$

- Squark mixing : <u>left-handed</u> <u>right-handed</u>
- Current data imply smaller  $S_{b-s}$  for both parities — *Left-handed squark mixing!!*

#### Numerical Estimation of $S_{b-s}$ in Supersymmetric SM



favored by current results from B-factories  $(1\sigma)$ 

Result based on GF

- CP phases in LH squark mixings are dominant
- RH squark mixings are suppressed
- LL mixing is implied to be
  O(0.1) for these params.

[ME, Mishima&Yamaguchi]

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[ME, Mishima&Yamaguchi]

## LH or RH Squark Mixings from EDMs

- Suppressed RH squark mixings are favored
- $\circ$  S<sub>b-s</sub> can deviate sizably by LH mixings even considering EDM bounds
- <u>LH dominance is consistent with EDMs</u>



[Hisano and Shimizu]



**Implications on Flavor Models** 

universal scalar mass models are disfavored
 ex: mSUGRA, GMSB, AMSB, ...

flavor mixing is induced by RG effects with CKM ----- LL squark mixing but no additional CP

 $^{\circ}~$  SUSY SU(5) GUT+ $\nu_{R}$  models are disfavored

----- new CP phase but in RR squark mixing [Moroi]





The result do not imply RG origin of flavor mixings

In supersymmetric SM, chirality structure arises in squark mixings

We provided SUSY interpretation of anomaly in the current data of mixing-induced CP asymmetry of b-s decay modes

Left-Handed squark mixings are shown to be able to correct the SM prediction easily