



## Decays and spectroscopy at $\Upsilon(1S,2S)$ at Belle

Thursday 5 July 2012 13:45 (15 minutes)

Using samples of 102 million  $\Upsilon(1S)$  and 158 million  $\Upsilon(2S)$  events collected with the Belle detector at the KEKB asymmetric-energy  $e^+e^-$  collider, we study hadronic exclusive decays of these two bottomonium resonances to the three-body final states  $\phi KK$ ,  $\omega\pi\pi$  and  $K^{*0}(892)K^-\pi^+$  + c.c., as well as two-body processes including the Vector-Tensor ( $\phi f_2'(1525)$ ,  $\omega f_2(1270)$ ,  $\rho a_2(1320)$ ,  $K^{*0}(892)\bar{K}_2^{*0}(1430)$  + c.c.) and Axial-vector-Pseudoscalar ( $K_1(1270)^+K^-$  + c.c.,  $K_1(1400)^+K^-$  + c.c.,  $b_1(1235)^+\pi^-$  + c.c.) modes. Branching fractions are determined for processes with a statistical significance greater than  $3\sigma$ ; otherwise, the upper limits on the branching fractions are set at 90% confidence level. The ratios of the branching fractions of  $\Upsilon(2S)$  and  $\Upsilon(1S)$  decay into the same final state are used to test the perturbative QCD prediction.

The hadronic decays of the narrow  $\Upsilon(nS)$  resonances ( $n = 1, 2, \text{ or } 3$ ) produce large numbers of  $u\bar{u}, d, \text{ and } s$  quark pairs concentrated in a limited space volume, which makes them ideal for searching for multi-quark states with non-zero strangeness. Here we report on high-statistics searches for the  $\Xi^-$  pentaquark baryon  $\Xi^{--}$  and six-quark  $H$  dibaryon using the 102 million event  $\Upsilon(1S)$  and 158 million event  $\Upsilon(2S)$  data samples collected with the Belle detector at the KEKB asymmetric-energy  $e^+e^-$  collider. The  $\Xi^{--}$  search concentrates on the  $\Xi^- \rightarrow \Xi^- \pi^-$  decay mode and has a branching fraction sensitivity at the  $10^{-5}$  level; the  $H$ -dibaryon search includes the  $H \rightarrow \Xi^- p, \Lambda\Lambda$  and  $\Lambda p \pi^-$  decay channels with branching fraction sensitivities approaching  $10^{-6}$ . Decay branching fractions and momentum distributions for topologically similar inclusive processes  $\Upsilon(nS) \rightarrow \Xi^0(1530)X$  and  $\Xi_c^0 X$  are measured for the first time.

Using samples of 102 million  $\Upsilon(1S)$  and 158 million  $\Upsilon(2S)$  events collected with the Belle detector at the KEKB asymmetric-energy  $e^+e^-$  collider, we search for the first time for double charmonium decays from  $\chi_{bJ}$ ,  $\Upsilon(1S)$  and  $\Upsilon(2S)$  states. No significant signal is observed in these modes and the upper limits on the decay rates are obtained at the 90% confidence level. These limits are consistent with calculations using the NRQCD factorization approach.

Using samples of 158 million  $\Upsilon(2S)$  events collected with the Belle detector at the KEKB asymmetric-energy  $e^+e^-$  collider, we study the hadronic exclusive decays of  $\Upsilon(1, 2S)$  to baryon-antibaryon ( $p\bar{p}, \Lambda\bar{\Lambda}, \Sigma\bar{\Sigma}, \Xi\bar{\Xi}$ ) and 0, 1, or 2 mesons ( $\pi^0, \eta, \text{ and } \pi^\pm$ ). Branching fractions are determined for processes with statistical significance greater than  $3\sigma$ ; otherwise, the upper limits on the branching fractions are set at 90% confidence level. The ratios of the branching fractions of  $\Upsilon(2S)$  and  $\Upsilon(1S)$  decay into the same final state are used to test the perturbative QCD prediction.

The double cascade radiative transitions  $\Upsilon(2S) \rightarrow \gamma\chi_{bJ} \rightarrow \gamma\gamma\Upsilon(1S)$  have been studied using a sample of 158 million  $\Upsilon(2S)$  decays recorded with the Belle detector at the KEKB asymmetric-energy  $e^+e^-$  collider. These provide the most precise measurement to date of the branching ratios  $\text{cal}B(\chi_{b0,1,2}(1P) \rightarrow \gamma\Upsilon(1S))$  and limits on the total widths of the  $\chi_b$  states. Results are compared with potential models and recent NRQCD predictions.

**Primary authors:** Dr BARRETT, Matthew (University of Hawai'i at Manoa); BARRETT, Matthew (Brunel University)

**Presenter:** Dr BARRETT, Matthew (University of Hawai'i at Manoa)

**Session Classification:** TR5 & TR7 - Room 220 - B Physics and CP Violation, etc.

**Track Classification:** Track 7. CP Violation, CKM, Rare Decays, Meson Spectroscopy