

## 1. PREDICTIONS

These predictions are in prioritized order, starting with the ones that I would “hang my hat” on.

1. In the invariant mass of  $\psi(2S)\psi(2S)$  there will be prominent invariant mass peaks at  $\sim 7500$  and  $\sim 7700$  MeV, nearly as prominent as the 7200 peak seen in the invariant mass of  $J/\psi J/\psi$ .
2. More detailed measurement of the inclusive cross section for  $e^+e^- \rightarrow$  hadrons in the 6-8 GeV range will reveal resonances whose mass and width correspond to the X(6600) and X(7200).
3. Strong decays of  $Z_c^-(3900)$  to  $\pi^-X(3350)$  and  $\pi^0X^-(3350)$  will be observed, where  $X^-(3350)$  is the charged isospin partner of X(3350).
4. Similarly, strong decays of  $Z_c^0(3900)$  to  $\pi^0X(3350)$  and  $\pi^+X^-(3350)$  will be observed.
5. Strong decays of  $Z_c^-(4430)$  to  $\pi^-\psi(4230)$  and  $\pi^0X^-(4230)$  will be observed, where  $X^-(4230)$  is the charged isospin partner of  $\psi(4230)$ .
6. The strong decay  $\psi(4660) \rightarrow \pi^0\pi^0\psi(4230)$  will be observed. In this decay, a resonance in the invariant mass of  $\pi^0\psi(4230)$  at around 4430 MeV will be observed. This is the neutral isospin partner of  $Z_c^\pm(4430)$ .
7. In the invariant masses of  $X^+(3250)X^-(3250)$  and  $X^0(3250)\bar{X}^0(3250)$ , resonances corresponding to X(6600), X(6900) and X(7200) will be observed.
8. More detailed measurement of the inclusive cross section for  $e^+e^- \rightarrow$  hadrons in the 7-10 GeV range will reveal resonances that correspond to  $1^{--} f\bar{b}$  and  $b\bar{f}$  mesons.
9. In  $e^+e^- \rightarrow \pi BJ/\psi$  events above the production threshold, resonances will be found. Within those resonances, resonances in the invariant mass of  $BJ/\psi$  will also be found. These correspond to  $f\bar{b}$  and  $b\bar{f}$  mesons. The resonances will have similar branching ratios as compared observations of  $\psi(4230)$  and  $Z_c(3900)$ .
10. In invariant mass data involving  $D^\pm J/\psi$  or  $D_s^\pm J/\psi$ , a number of charged exotic hadron resonances will be found in the 5000 to 6000 MeV range. These correspond to  $f\bar{c}$  and  $c\bar{f}$  mesons.
11. The decay  $\bar{B}^0 \rightarrow X^-K^+ : X^- \rightarrow D^{*+}\pi^-\pi^-$  will be observed. The charged  $X^-$  will have mass and width equal to the  $T_{cc}^+(3875)$ . The first and second branching ratios will be about (i) 0.75 that of  $B^+ \rightarrow \chi_{c1}(3872)K^+$  and (ii) similar to  $\chi_{c1}(3872) \rightarrow \pi^0\chi_{c1}$ .
12. One or more of the following observations of X(3250) will be made (with branching ratios compared to all B decays):
  - (a)  $\bar{B}^0 \rightarrow X^0\pi^+\pi^- : X^0 \rightarrow D^+\pi^-$ ,  $Br = 3 \times 10^{-5}$ , see arxiv:1109.6831
  - (b)  $B^- \rightarrow X^0K^- : X^0 \rightarrow D^0\pi^+\pi^-$ ,  $Br = 2 \times 10^{-6}$ , see PRL 108, 161801.
  - (c)  $B^- \rightarrow X^0K^- : X^0 \rightarrow D^+\pi^-$ ,  $Br = 7 \times 10^{-7}$ , see arxiv:1503.02995.
  - (d) Analogous decays for the charged 3250.
13. The strong decay  $R(4407) \rightarrow Z_c^\pm(3900)K^\mp$  will be observed.
14. An  $f\bar{u}$  isospin partner will be found for each  $f\bar{d}$  meson listed in section 4 (and vice versa).
15. The undetermined  $J^{PC}$  values of the hadrons listed in section 4 will be determined to be consistent with the quark-model mappings in those sections.
16. More precision will cause the first-row unitarity calculation of the Standard-Model CKM matrix to differ from 1 by more than  $5\sigma$ .
17. More precision will cause the difference between vector-current and axial-vector-current measurements of  $|V_{us}|$ ,  $|V_{ub}|$  and ultimately  $|V_{cd}|$  and  $|V_{cs}|$  to exceed  $5\sigma$ .
18. More precision will cause the difference between inclusive and exclusive measurements of  $|V_{cb}|$  to exceed  $5\sigma$ .
19. Counts of very forward rapidity  $Z + c$  measurements in heavy ion collisions will significantly exceed predictions that use the PDFs that are able reproduce forward  $Z + c$  data in  $p\bar{p}$  and that also have equal amounts of intrinsic charm for protons and neutrons.
20. The cross section for  $e^+e^- \rightarrow \pi^+\pi^-$  for  $\sqrt{s} > 20$  GeV will be measured to be less by more than  $5\sigma$  than predictions using Standard-Model event generators that do not incorporate interference between  $u\bar{u}$  and  $d\bar{d}$  intermediate states.