WGIII: spectroscopy

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SuperB physics retreat
Valencia, 12th Jan 2008

Sessions @ retreat

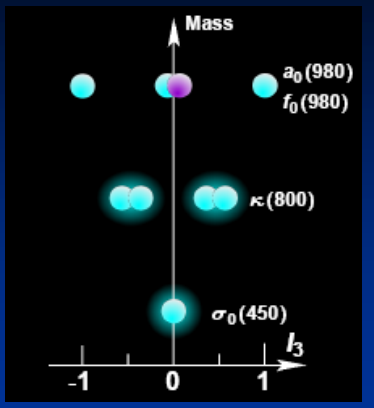
- Tuesday 14:30-16:30
  - Exotica searches in Bottomonium decays
- Tuesday 17:-19:00
  - Bottomonium spectroscopy
- Wednesday 9:30-13:00
  - Charmonium spectroscopy
- Wednesday 14:30-16:00
  - Joint with Tau-WG
- Wednesday 16:30-19:00
  - Light meson spectroscopy

Few presentations, lots of interesting discussions

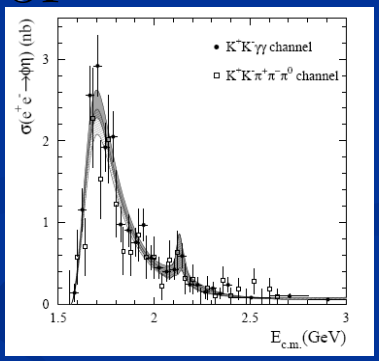
The physics case in few words

- There are indications that strong interactions do not only form mesons and baryons, but also other forms of aggregation
  - A major step forward in the understanding of nature
  - Converting these indications into a solid set of measurements is within the reach of SuperB
  - Twofold task:
    - Discriminate among possible interpretations (regular mesons, molecules, tetraquarks, hybrids,…)
    - Complete the picture
      - Very large number of missing states
  - Operatively we will assume the tetraquark model is correct and explore the observables that are unique to SuperB
- There are new physics models that predict Higgs bosons at masses below $2m_b$ to have escaped LEP searches.
  - We will explore which are the search channels that require SuperB statistics

Light mesons



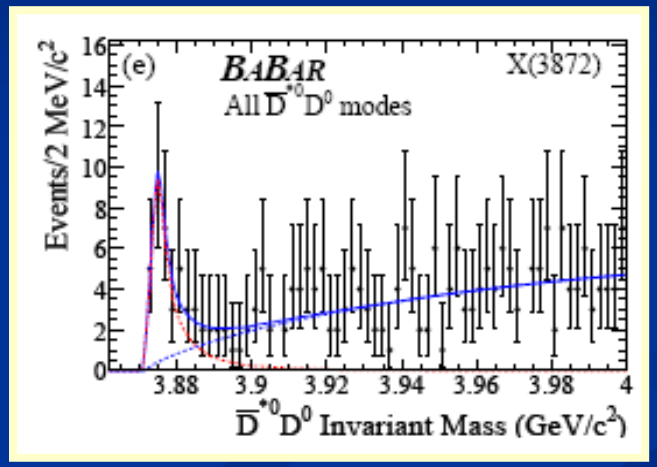
- The scalar nonet is the best candidate for tetraquarks so far
  - Strengthened by recent dispersion relation studies of BaBar+KLOE data
- Recent BaBar candidate for a 1^- excitation: Y(2175), observed in ϕf^0
  - Hints for Y→KsKπ, $\phi\eta$, maybe $\Lambda\Lambda$
  - Need much higher statistics to measure all BFs and conclude it is a tetraquark
- Room for investigating whether the f0(1500) is a glueball?

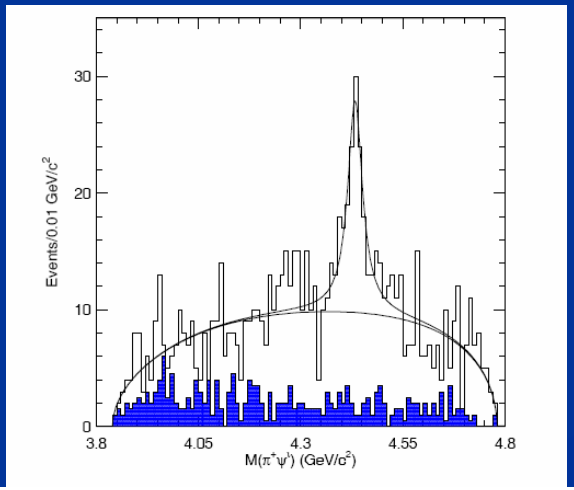


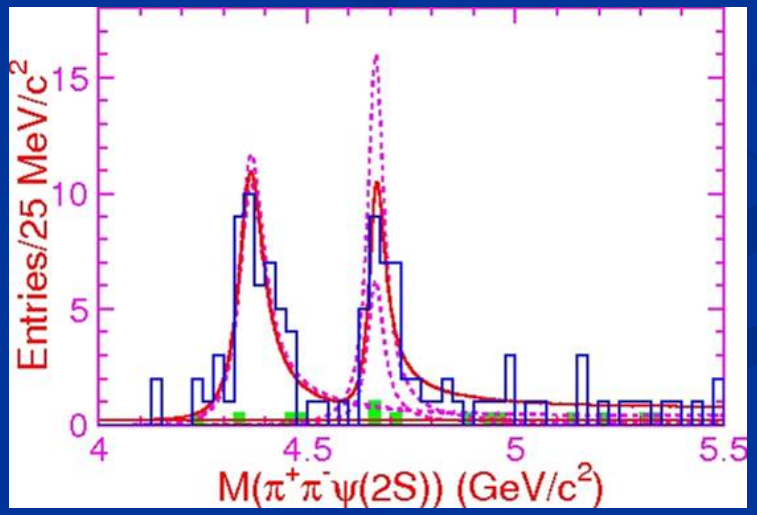
Charmonium

- Most likely tetraquark candidates:
  - X(3872/6)
  - Y(4360)
  - Y(4660)
  - Z(4330)

Low stat !!
(and these are the discovery modes)







Charmonium: SuperB observables

- The best way to discriminate between tetraquark and other models are the semileptonic decays

e.g. X(3872) → $D_s\pi^0$ln allowed only by tetraquark: a D*0D0 molecule could only go to D^{*0} Klν

  - Cabibbo suppressed + experimental challenge (ν)

- Critical measurements: BFs to two $D_{(s)}$ mesons
  - Low BF of observable final states → need high statistics

Charmonium: large wealth of states

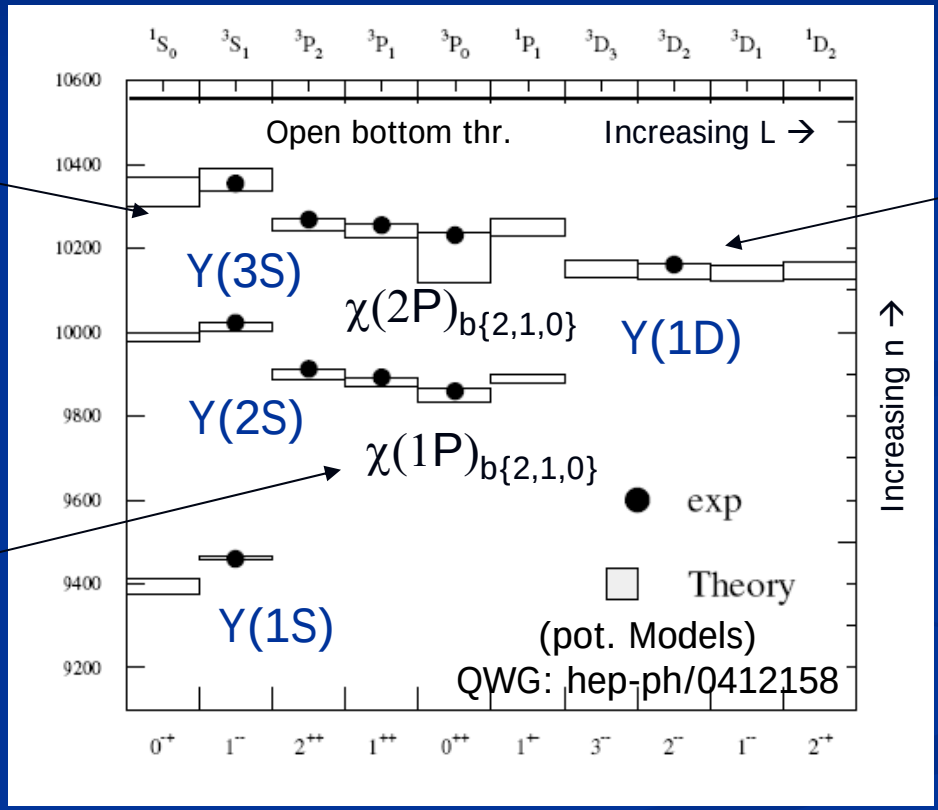
JPC	Mass	Production	Main decay
0++	3720	$\gamma\gamma$, recoil	$\eta_c\pi$
0++	3832	$\gamma\gamma$,recoil	DD
1+-	3750	χ recoil	$J/\psi\pi,\omega$
1++	3872	B dec	$J/\psi\rho$
1+-	3882	χ recoil	$J/\psi\pi,\omega$
2++	3952	$\gamma\gamma$	$DD^*,J/\psi\ \rho$
1--	3840		
1--	3950		

Predicted by tetraquark model – each represents a nonet of states !!!

Bottomonium

η_b (x3) completely missing

Unconfirmed J assignments of all the χ_b s

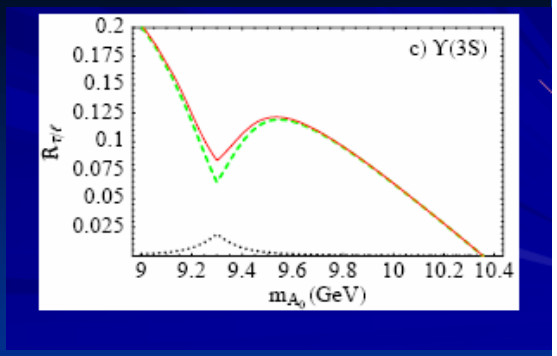


2 h_b and 3 D wave states are narrow but not observed

8 narrow resonances still missing !

The large number of missing states is due to low individual BFs and large background

Exotica



- $\Upsilon \rightarrow A\,\gamma\; A \rightarrow \tau\tau$
  - Two possible experimental approaches:
    - Measure $R = BF(\Upsilon \rightarrow \tau\tau n\gamma)/BF(\Upsilon \rightarrow ll n\gamma)$
    - Tag explicitely the monochromatic photon and the τ-pair
  - Might be systematics limited
- $\Upsilon \rightarrow$ invisible
  - Several modes beyond the SM predict Υ to decay to particles which are not observed (typically neutral LSPs)

Do B-Factories already saturate the discovery potential?

Running at different energies

Identified energies of interest:

- Y(3S) run
  - 0.3 ab^{-1} (<2 months) would already decuplicate the BF sample
- Energy scan in 4-5 GeV range?
  - Produce the plot of $R_c=\sigma(c)/\sigma(ll)$, with c=several channels of interest (e.g. $J/\psi\,\pi\pi$, …)
  - BES does not reach these energies

Conclusions

- It was a good opportunity to start a very interesting work
- Statistics is a limiting factor in this land
- A one-pager is ready for the document of next week
  - More work is needed (and indicated in the one-pager) to produce a comprehensive document. Time scale ~2-3months?