# PDG Meson Team

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OUTLINE:

- Team/responsibilities
- Activities for RPP2012
- $c\bar{c}$ fit
- Problems
- Conclusions

# Meson Team

| Person | Affiliation | Responsibilities |
|---|---|---|
| Claude Amsler | Bern | Notes |
| Michael Doser | CERN | Management, notes |
| Simon Eidelman | Novosibirsk | Literature, notes |
| Thomas Gutsche | Tübingen | Theory, notes |
| Christoph Hanhart | Julich | Theory, notes |
| Brian Heltsley | Cornell | Notes |
| Juan-Jose Hernández-Rey | Valencia | Notes |
| Alberto Masoni | Cagliari | Notes |
| Sergio Navas | Granada | $c\bar{c}$ fit, notes |
| Claudia Patrignani | Genova | $c\bar{c}$ fit, notes |
| Stefan Spanier | Knoxville | Notes |
| Nils Törnqvist | Helsinki | Theory, notes |
| Graziano Venanzoni | Frascati | Notes |

# Responsibilities

- We are all "encoders" and "overseers" for unstable mesons (LBL terminology)
- In addition, everybody takes care of specific $J^{PC}$ (vectors, scalars, heavy quark, ... states)
- We are also authors and reviewers of our minireviews
- Regular meetings at CERN twice a year (autumn, spring)

# Notes – I

- Papers selected (literature search every 2 months) are assigned to a first reader who writes a note specifying what and how should go to the database
- The first reader sends the note to a randomly selected second reader who adds his/her criticism and comments. Iterations continue until both readers agree
- The note approved by both readers is sent to Piotr to be implemented in the database
- The readers check the input
- In special cases, the whole group discusses the subject

# Notes – II

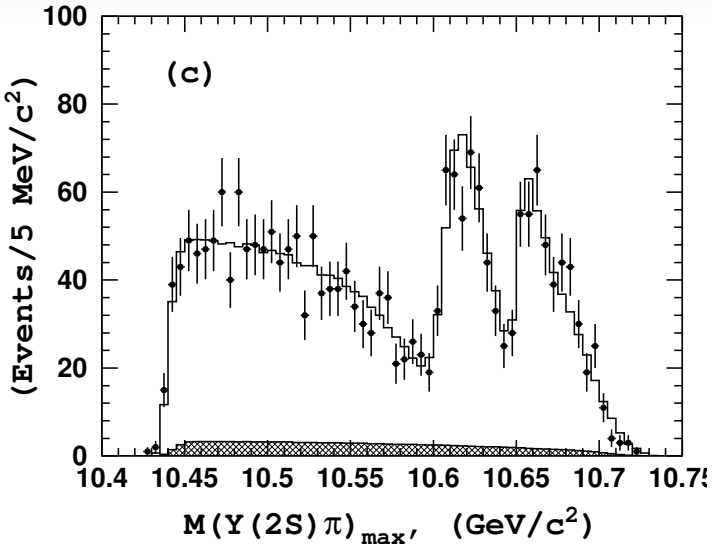
There are three types of papers:

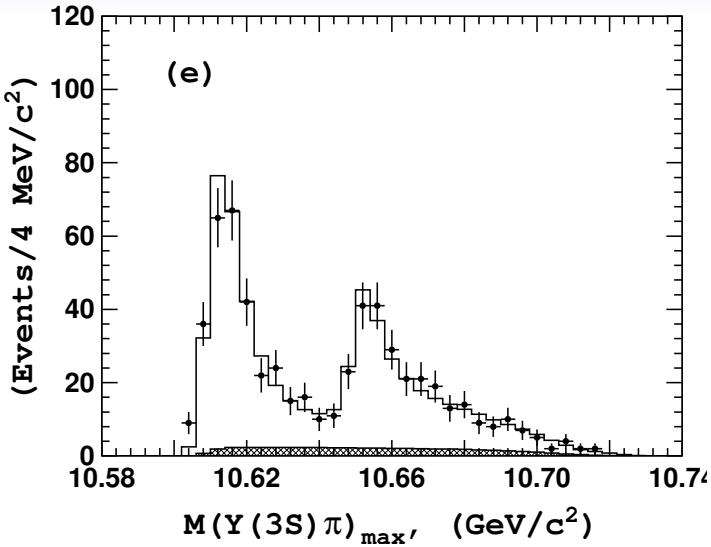
- There are data to quote – a usual note is written
- No data to quote, but may be useful for some minireview – a brief note to keep trace of the paper.
  Goes to a special ORP (Other related papers) file regularly checked by the minireview authors, but NOT to the database.
  This system replaced the old one with (often numerous) ORP's going to the database.
  A big flow of theory/phenomenology papers,
  reduce the length of the Book!
- "Useless" (selected by mistake) – declared empty

# Activities for RPP12

- 161 papers selected (300 in 2010, 302 in 2008)
  Preliminary selection strongly decreased the number of "theory" papers
- 527 (684,794) new or re-encoded measurements:
  - 99 (161,261) – unflavored mesons
  - 8 (12,19) – other mesons
  - 12 (17,27) – strange mesons
  - 24 (34,39) – charmed mesons
  - 247 (300,396) – $c\bar{c}$ mesons
  - 137 (160,52) – $b\bar{b}$ mesons
- 16 minireviews and notes in the listings:
  (5 updated, 4 unchanged, 7 old hidden)

# Highlights – I



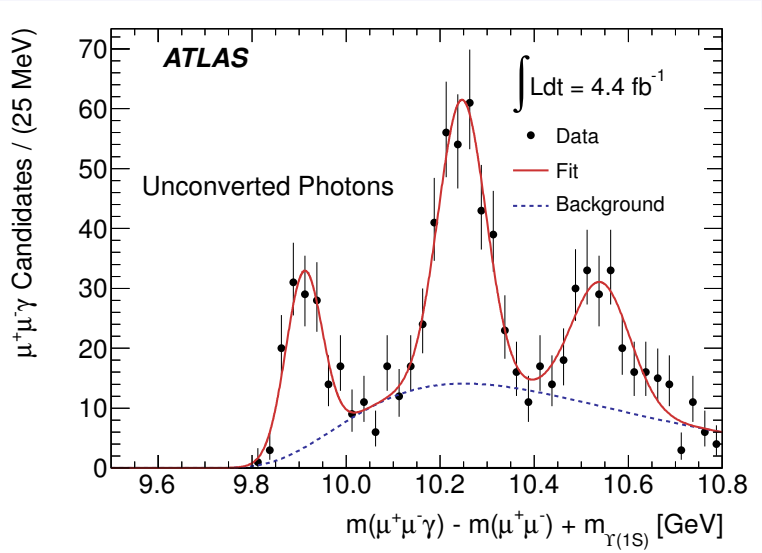

Belle confirms $h_b(1P)$ and discovers $h_b(2P)$,

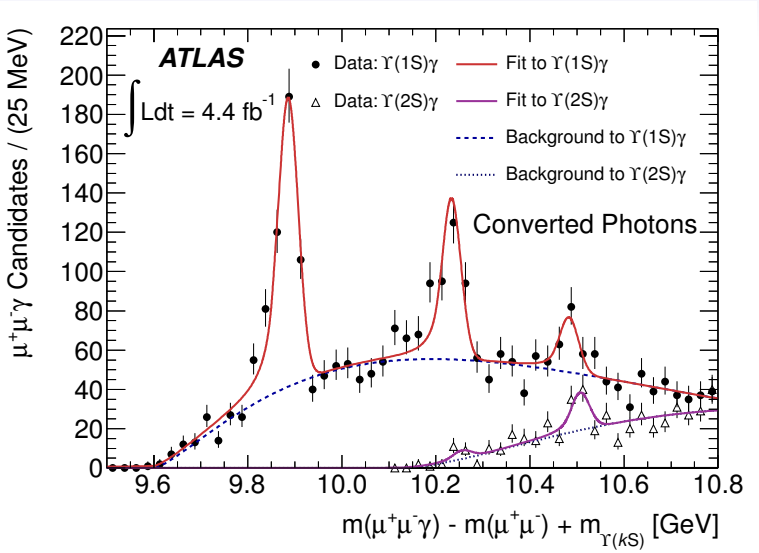
I. Adachi et al., Phys. Rev. Lett. 108, 032001 (2012)

also observes 2 exotic charged bottomonium-like states in $\Upsilon(5S)$ decays to $Z_b(10610)^{\pm}\pi^{\mp}$, $Z_b(10650)^{\pm}\pi^{\mp}$ followed by $Z_b$ decays into 5 different final states: $\Upsilon(1S)\pi^{\pm}$, $\Upsilon(2S)\pi^{\pm}$, $\Upsilon(3S)\pi^{\pm}$, $h_b(1P)\pi^{\pm}$, $h_b(2P)\pi^{\pm}$,

A. Bondar et al., Phys. Rev. Lett. 108, 122001 (2012)

# Highlights – II




ATLAS observes for the first time a cluster of three (presumably) $\chi_{bJ}(3P)$ states in $pp$ collisions in the radiative decays to $\Upsilon(1S)\gamma$ and $\Upsilon(2S)\gamma$,

G. Aad et al., Phys. Rev. Lett. 108, 152001 (2012)

Already confirmed by D0 at Tevatron,

V.M. Abazov et al., Phys. Rev. D86, 031103 (2012)

# $c\bar{c}$ Fit – I

- Experiments measure a product (or a ratio) of the branching ratios, often involving more than one particle
- Values quoted by experiments are often based on RPP averages rather than direct measurements
  $\Rightarrow$ Hidden non-trivial correlations
- RPP02 introduced a new fit using directly measured quantities
  $\Rightarrow$ cross-particle fit, non-standard procedure, standalone fit
- When a branching fraction is measured in different products/ratios, it is necessary to include it as a new fit parameter
- New measurements of branching fractions by different techniques can result in reentering old measurements in the database

# $c\bar{c}$ Fit – II

- The fit originally done by hand is now performed at LBNL, special thanks to Piotr and Orin!
- A separate minireview is describing a new fit providing all details and should be updated for each edition
- Today it covers $\psi(2S)$ and $\chi_{cJ}(1P)$. In 2012 (2010) the fit includes 4 (4) total widths, 1 (1) partial width, 25 (24) combinations of partial widths, 7 (7) branching ratios, 77 (75) combinations of $\mathcal{B}$ of which 57 (52) involve more than one particle,
  223 (213) measurements and 57 (47) parameters determined
- Already considering cross-particle fitting for
  - $J/\psi$ and $\eta_c$
  - bottomonium transitions

# Problems

- No data entered directly,
  The new PDG software will soon change that
- Proofreading incomplete (no ideograms)
- Cross-particle fitting limited
- Limited automatic rescaling
- Should current structure of the entries be expanded to take into account new "properties"?
- New $c\bar{c}$ states are referred to as $X$, $Y$, $Z$ by the community, but are required to be X(mass) by PDG until $J^{PC}$ are known

# Conclusions

## Still very active field

- Enormous luminosity of B-factories gives access to hadronic systems with different quantum numbers:
  radiative return – $J^{PC} = 1^{--}$,
  $2\gamma$ production – $J^{PC} = 0^{-+},\ 0^{++}, 2^{++}, \ldots$
  double charmonium production, $B$ decays
- BaBar and Belle collected large $\int Ldt$ at $\Upsilon(1,2,3,4,5S)$, still publishing at good rate
  Super-KEKB starts in 2015 and Super-B in 2020
- CLEO-c and BESII stopped, but BES-III is already producing a lot
- VEPP-2000 published the very first paper,
  KLOE-2 at DAFNE started taking data
- In the more distant future – Gluex (JLAB), PANDA (GSI)
- LHC experiments will also contribute to $c\bar{c}$, $b\bar{b}$,
  2 papers with results on mesons from LHCb and 1 from ATLAS appeared