

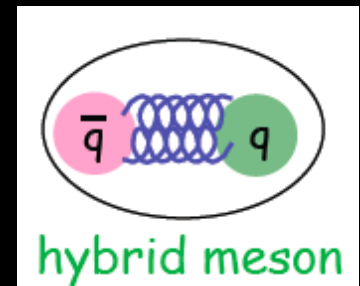
# Hadron spectroscopy and Hybrids

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LTS2014 Elba 21-23 may 2014

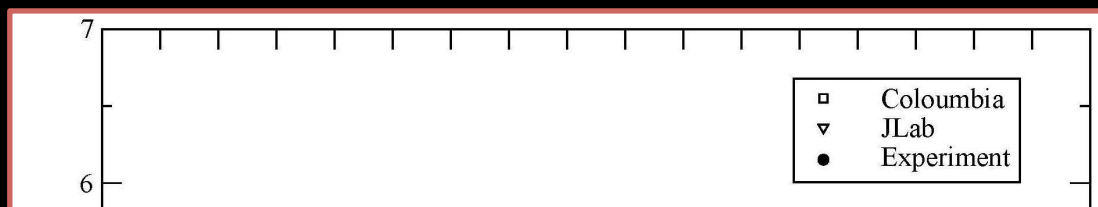
- Theory on hybrids
- Hybrids important to understand confinement
- Experiments on hybrids present and future
- Aspect: hadron spectroscopy center @genoa (experimentalists and theoreticians collaboration)



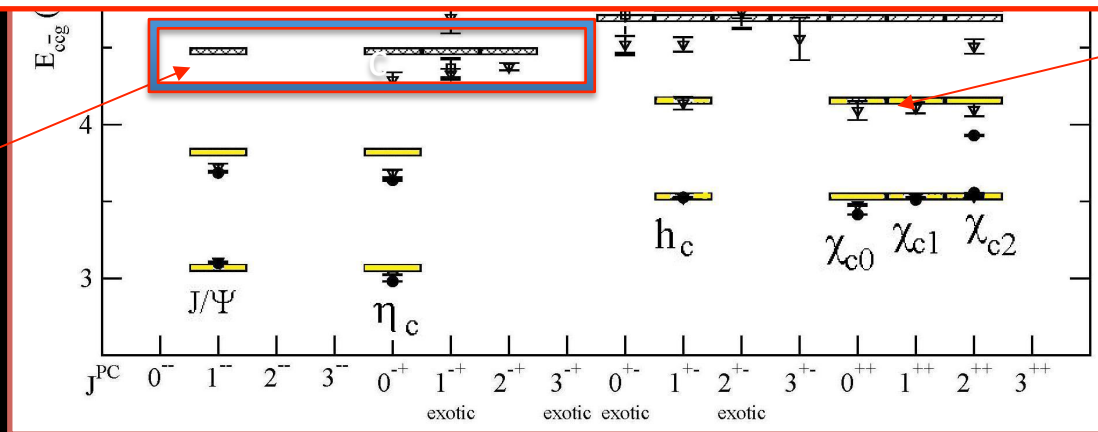
# Charmonia & hybrids $c\bar{c}g$

QCD in physical gauge: P.Guo,A.Szczepaniak,E.Santopinto,PRD78,056003(2008 )  
 Predictions also for bottomonia and hybrid bottomonia in the same article.  
 The lightest hybrid multiplets due to the non abelian nature of QCD

**c-bar states (yellow)**  
**hybrids (gray-dashed)**

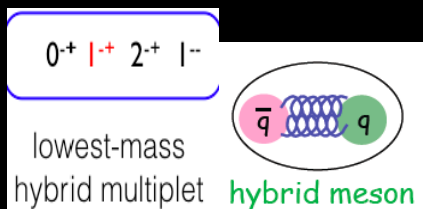


The lightest hybrid  $(0,1,2)^- 1^+$  supermultiplets

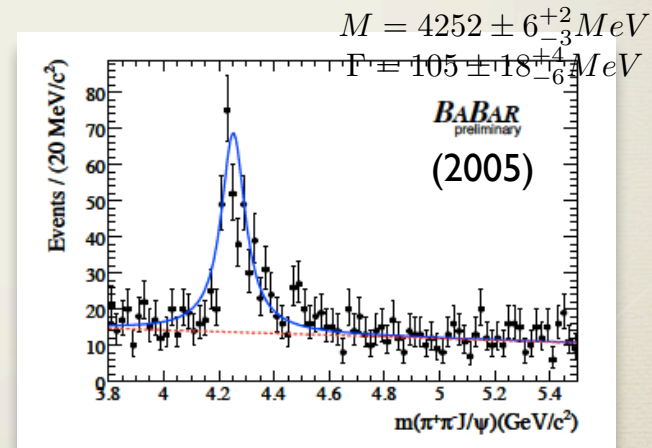
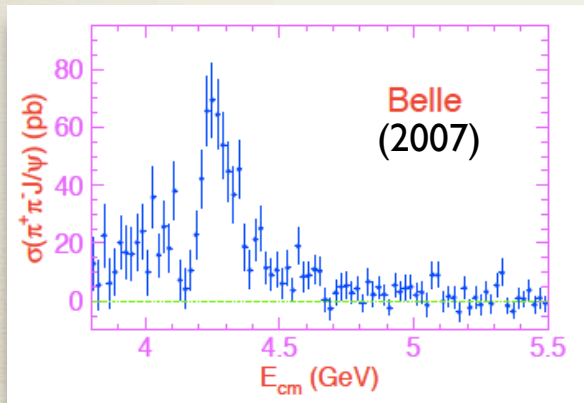
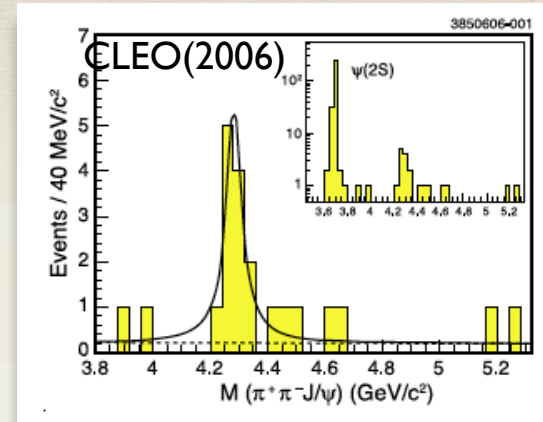
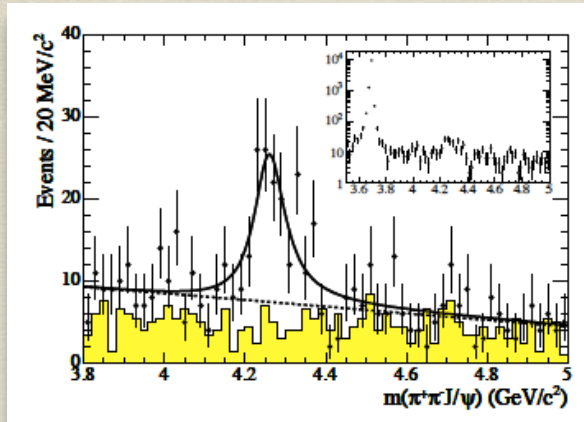


Y(4260)

X(3872)



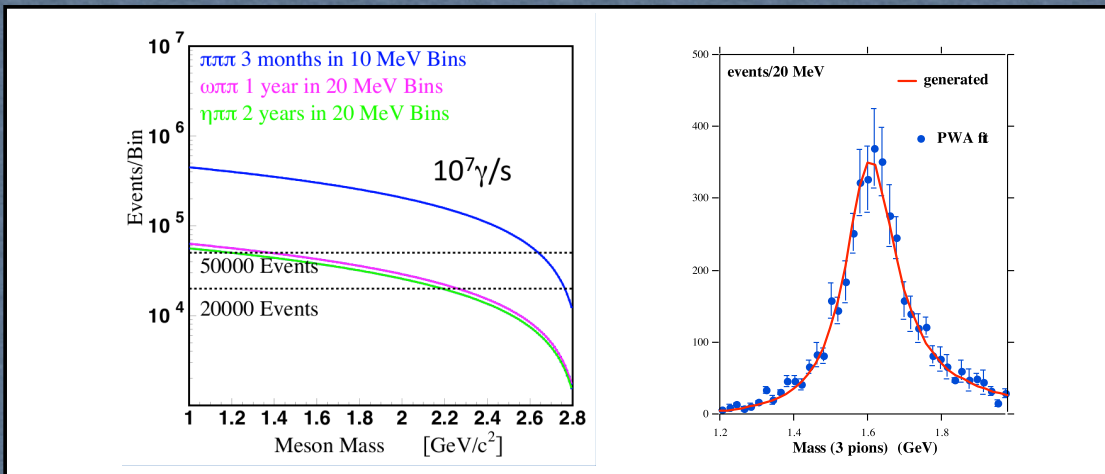
- **$Y(4260)$  discovered by BaBar in  $J/\psi \pi^+\pi^-$  (2005) confirmed by CLEO, Belle other modes from BaBar  $J^{PC}=1^{--}$  (from  $e^+e^-$ ) width  $O(100\text{MeV})$**



\* Theory: Hybrid candidate

# Why a hadron spectroscopy analysis center?

GlueX- Hall D  $\gamma p \rightarrow (n) \pi^+ \pi^+ \pi^-$   $X$  (exotic)  $\rightarrow \rho \pi^+ \rightarrow \pi^+ \pi^+ \pi^-$



Present:

$e^+e^-$ : BESIII and KLOE

B decay: LHCb

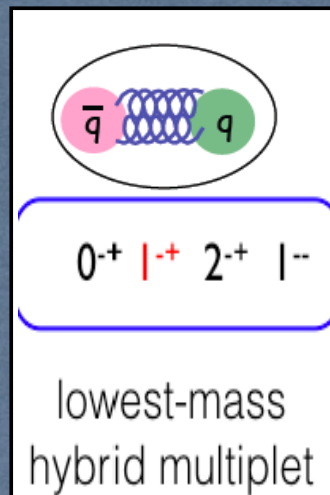
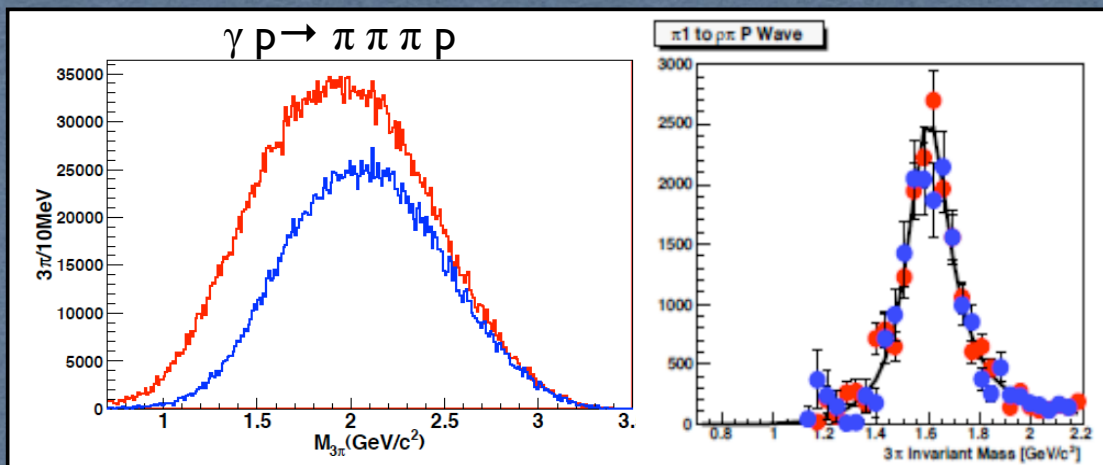
Belle, CLEO, BABAR

Future: **CMS, ATLAS?**

Photoproduction at JLab:

$p$   $\bar{p}$  at GSI: PANDA

MesonEx - Hall B



We all need a sound analysis fw!

# The HASPECT Project

## Hadron SPEctroscopy CenTer in Genoa

### Haspect: example of collaboration between experimentalists and theoreticians

- M. Battaglieri, R. De Vita, E. Santopinto (*Genova*)
- A. Sczpaniack and V. Mathiew (*Indiana U. and Jlab*)
- D. Glazier (*U. Glasgow*)
- D. Watts and S. Hugs (*U. Edinburgh*)
- A. Filippi (*INFN Sezione di Torino*)
- S. Lombardo (*Indiana University*)
- J. Ferretti (*UNAM*)
- S. Fegan, A. Celentano (*INFN sezione di Genova*)
- A. d'Angelo and A. Rizzo (*Roma Tor Vergata*)

# Future:

CMS and ATLAS ?

golden channels can be identified

hybrids strong and radiative decays important

Thank you!