

54th International Winter Meeting on Nuclear Physics  
Bormio, 25-29 January 2015

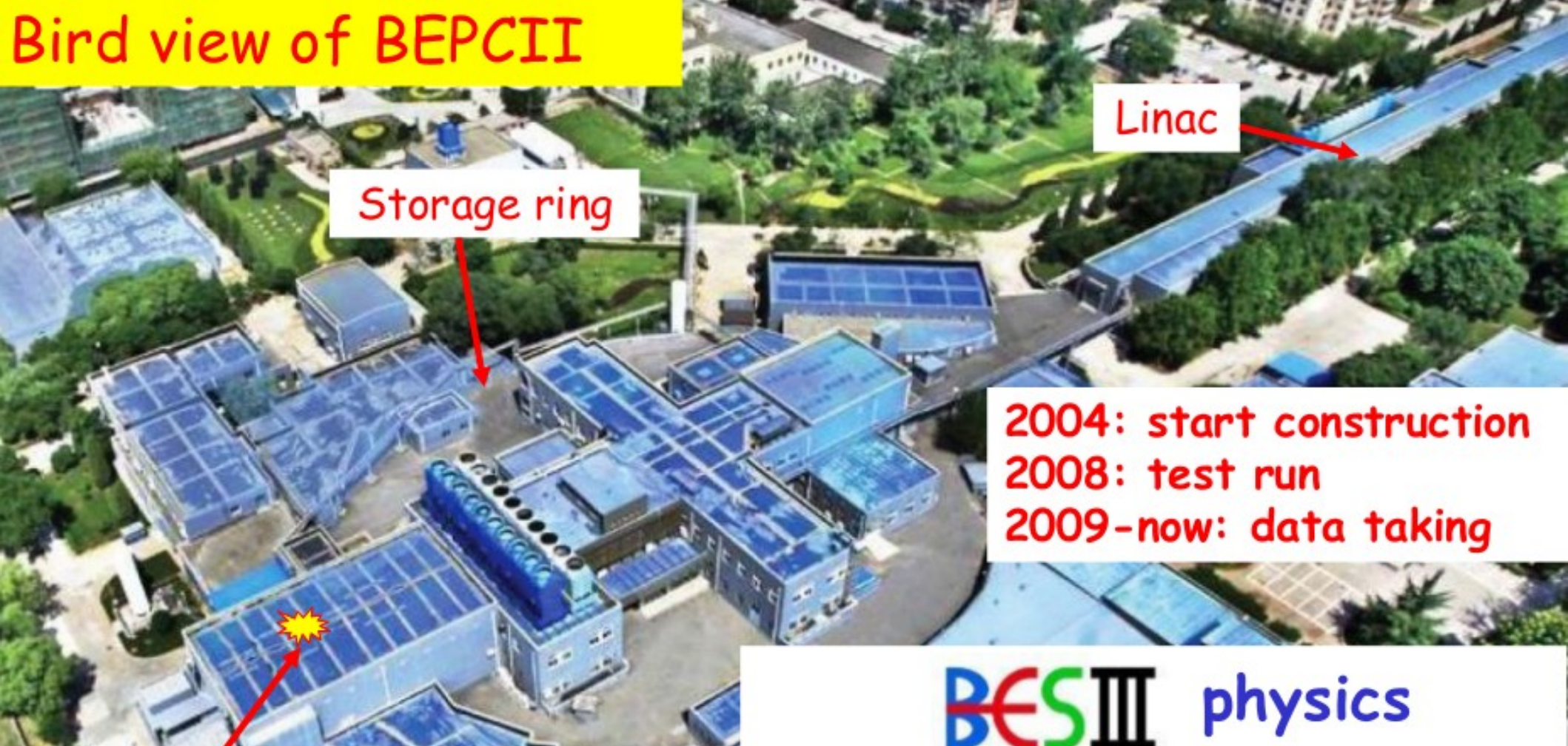
# Progress in Light Hadron Spectroscopy

Giulio Mezzadri  
INFN Ferrara

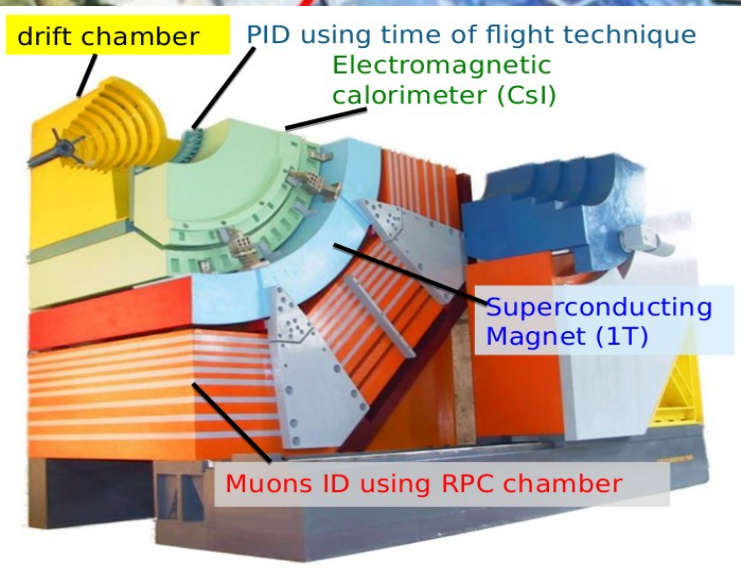
On behalf of BESIII collaboration

The logo for the BESIII experiment, featuring the letters 'B', 'E', 'S', and 'III' in a stylized, colorful font. The 'B' is blue, the 'E' is red, the 'S' is green, and the 'III' is black.

# Bird view of BEPCII



2004: start construction  
2008: test run  
2009-now: data taking



## BESIII physics

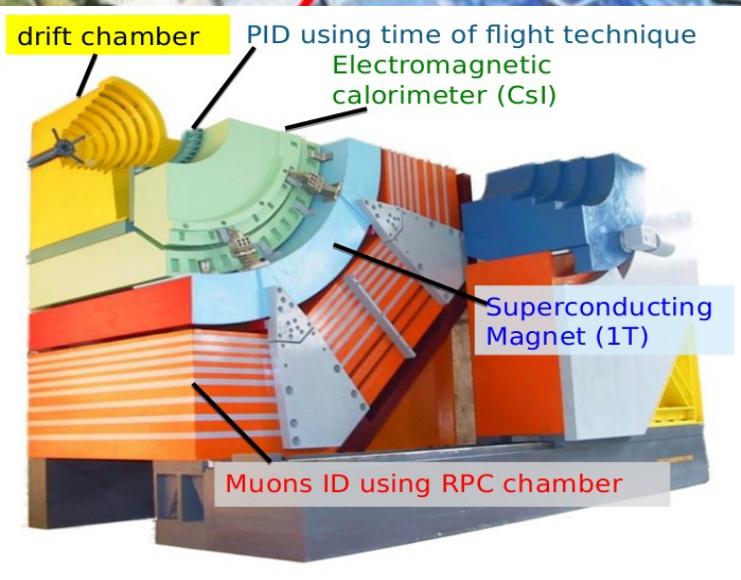
- Charmonium(-like) physics
- Light hadron spectroscopy
- Charm physics
- $\tau$  physics



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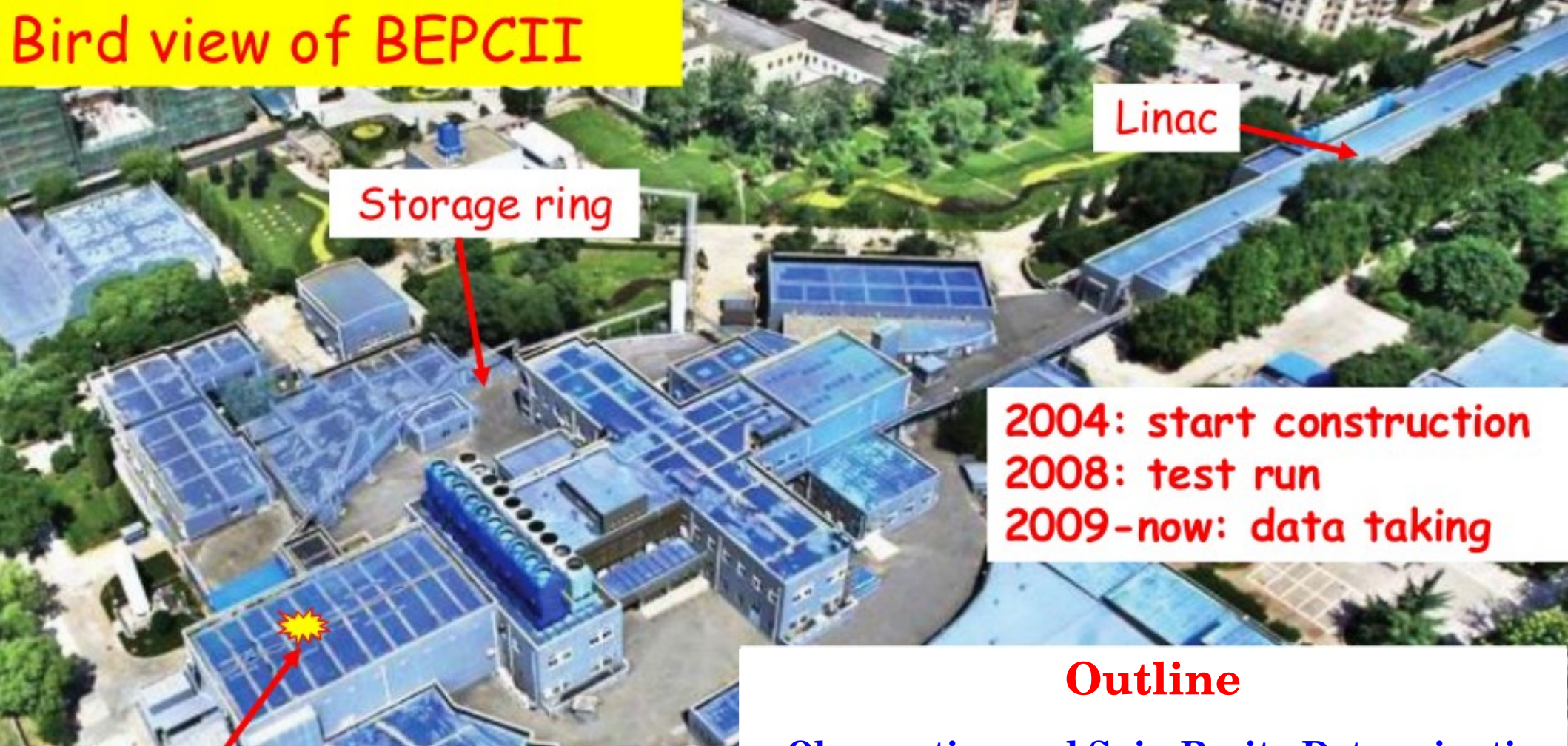


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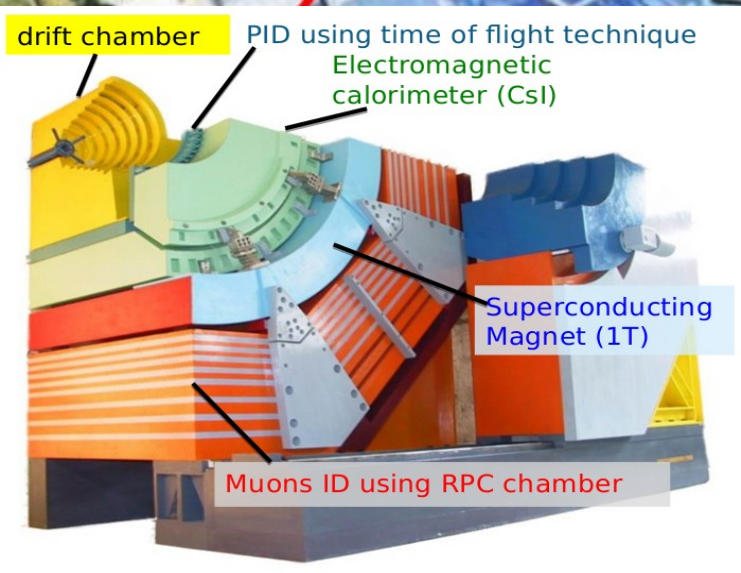
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## Outline

- **Observation and Spin-Parity Determination of the X(1835) in  $J/\psi \rightarrow \gamma K_S^0 K_S^0 \eta$**
- **Amplitude analysis of the  $\pi^0 \pi^0$  system produced in radiative  $J/\psi$  decays**
- **Study of  $\eta' \rightarrow \gamma \pi^+ \pi^-$  decay dynamics**
- **Measurements of  $\psi(3686) \rightarrow K^- \Lambda E^+ + c.c.$  and  $\psi(3686) \rightarrow \gamma K^- \Lambda E^+ + c.c.$**



# PWA in $\pi\pi$ systems

Historically:

- Charged, rather neutral
- Model dependent analyses (Breit-Wigner)
- Parametrization of  $\pi\pi$  scattering amplitude

This time, study of small regions of  $\pi\pi$  invariant mass

**First model independent analysis!**

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$\eta' \rightarrow \gamma\pi^+\pi^-$  decay

- Extensive experimental and theoretical efforts dedicated
- Is the reaction  $\eta' \rightarrow \gamma\rho^0, \rho^0 \rightarrow \pi^+\pi^-$  the whole story?
- Two different parametrization may allow to deepen our knowledge

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## $\Xi^*$ systems in baryon spectroscopy

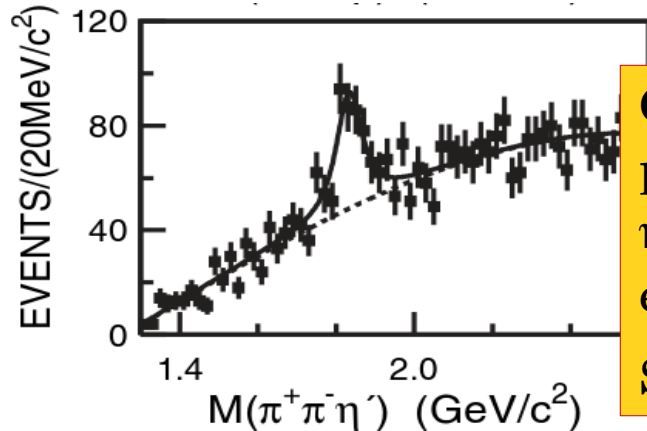
- Only 11  $\Xi^*$  states discovered
  - Most  $\Xi^*$  hyperon results have limited statistics
- Studying charmonium decay opens new possibilities (high statistics/low background vs limited phase space)
- Precise measurements can clarify decay mechanism



## X(1835)

Firstly observed in BESII:

PRL 95, 262001 (2005)



Glueball?  
 $\bar{p}p$  bound state??  
 $\eta$  second radial  
excitation??  
Spin-Parity?

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# Thanks for the attention!



**Progress in Light Hadron Spectroscopy**  
Giulio Mezzadri (gmezzadri@fe.infn.it)  
On behalf of the BESIII Collaboration


The BESIII experiment at the electron positron collider BEPCII in Beijing is successfully operating since 2008

- It has collected large data samples in the  $\tau$ -charm region:
  - \* world's largest data samples at the  $J/\psi$  and  $\psi'$ .
- Using decays of these two resonances, it can take profit of a rich and clean environment to:
  - \* study hadrons consisting out of light quarks
  - \* search for exotics.

Light Hadron spectroscopy is a key tool to investigate QCD

- \* test QCD in the non-perturbative regime
- \* provide insights into the fundamental degrees of freedom
- \* understand origin of the hadron masses

**Bird view of BEPCII**

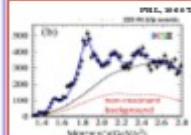


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2009: new data taking

**BESIII physics**

- Charmonium(-like) physics
- Light hadron spectroscopy
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**Observation and Spin-Parity Determination of the  $X(1835)$  in  $J/\psi \rightarrow \psi(1S) K^0 \bar{K}^0$  (PRL 115, 091803 (2015))**

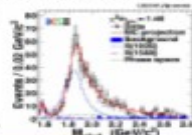


• The  $X(1835)$  is a new  $0^{-+}S_0$  state, the first observation of a new  $0^{-+}S_0$  state, the first observation of a new  $0^{-+}S_0$  state.

• It is observed in  $J/\psi \rightarrow \psi(1S) K^0 \bar{K}^0$  decays.

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**Amplitude analysis of the  $\psi(3686)$  system produced in radiative  $J/\psi$  decays (PRD 92, 052003 (2015))**

• Light  $\psi(3686)$  is a new  $1^{--}S_0$  state, the first observation of a new  $1^{--}S_0$  state.

• It is observed in  $J/\psi \rightarrow \psi(3686) \pi^+ \pi^-$  decays.

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**Study of  $\eta' \rightarrow \pi^+ \pi^- \pi^0$  decay dynamics**

• The  $\eta'$  is a new  $0^{-+}S_0$  state, the first observation of a new  $0^{-+}S_0$  state.

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**Measurements of  $\psi(3686) \rightarrow \pi^+ \pi^- \pi^0$  and  $\psi(3686) \rightarrow \pi^+ \pi^- \pi^0$  (PRD 91, 092006 (2015))**

• The  $\psi(3686)$  is a new  $1^{--}S_0$  state, the first observation of a new  $1^{--}S_0$  state.

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# HOPE TO SEE YOU AT MY POSTER!