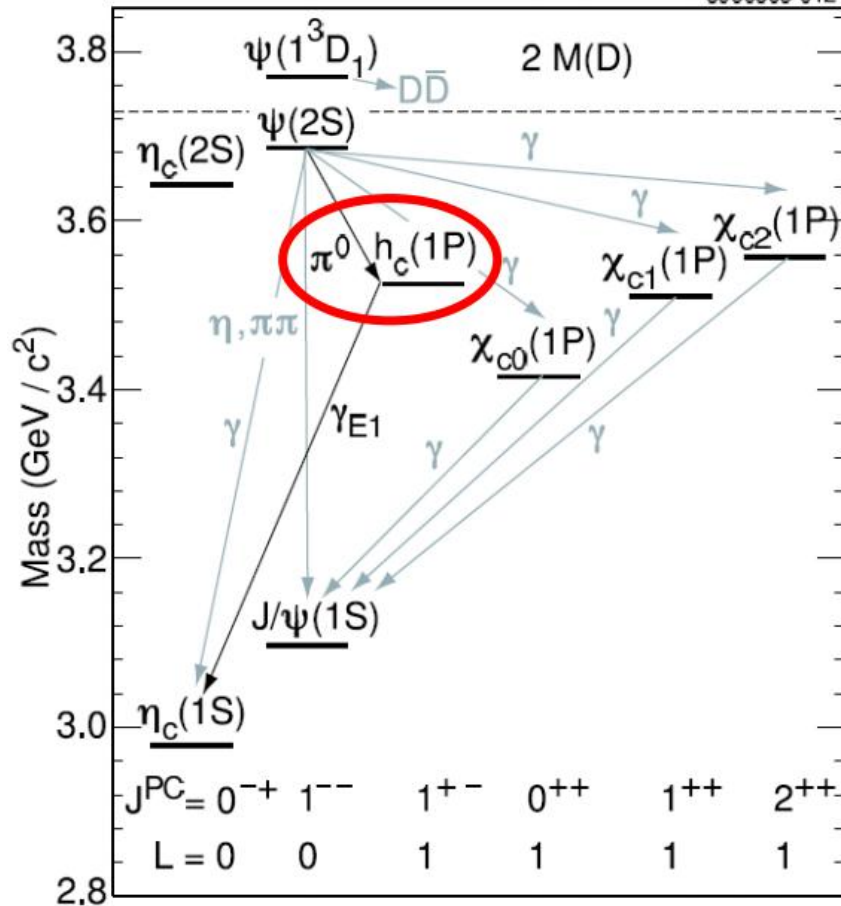


hc(1P) at BESIII

Liu Kai

hc(1P) in the charmonium family

3960805-012

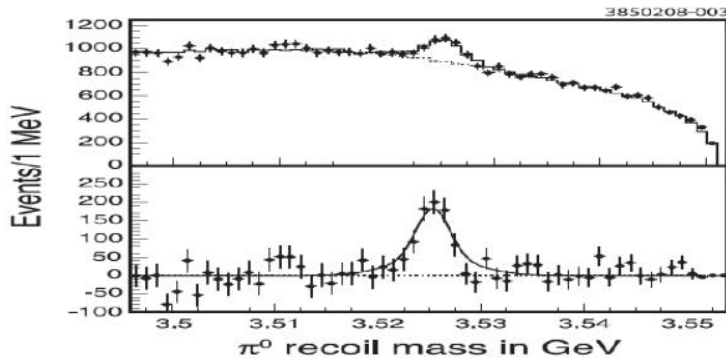


- P-wave singlet
- in this plot, hc is the last charmonium resonance confirmed experimentally.
- By now, the only known process of producing hc is $\psi(2S) \rightarrow \pi^0 h_c(1P)$

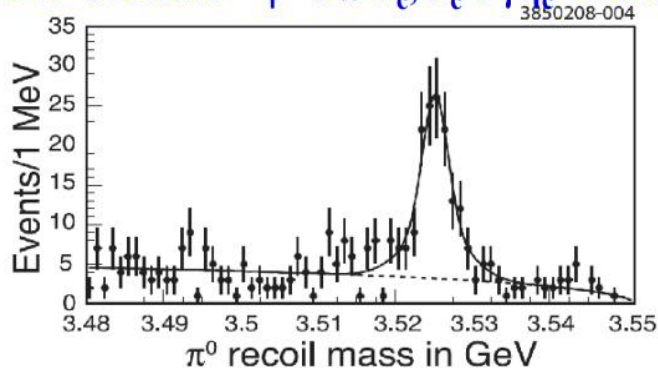
studies at CLEOc

PRL101,182003(2008)

CLEO's Result $-\psi' \rightarrow \pi^0 h_c, h_c \rightarrow \gamma \eta_c$ E1 tagged



CLEO's Result $-\psi' \rightarrow \pi^0 h_c, h_c \rightarrow \gamma \eta_c$ exclusive



CLEOc obtained:

	Inclusive	Exclusive
Counts	1146 ± 118	136 ± 14
Significance	10.0σ	13.2σ
$M(h_c)$ (MeV)	$3525.35 \pm 0.23 \pm 0.15$	$3525.21 \pm 0.27 \pm 0.14$
$\mathcal{B}_1 \times \mathcal{B}_2 \times 10^4$	$4.22 \pm 0.44 \pm 0.52$	$4.15 \pm 0.48 \pm 0.77$

$$M(h_c) = 3525.28 \pm 0.19(\text{stat.}) \pm 0.12(\text{syst.}) \text{ MeV},$$

$$\mathcal{B}(\psi(2S) \rightarrow \pi^0 h_c) \times \mathcal{B}(h_c \rightarrow \gamma \eta_c) = (4.19 \pm 0.32 \pm 0.45) \times 10^{-4}$$

$\mathcal{B}(\psi' \rightarrow \pi^0 h_c)$ and the width of h_c
have not been measured

Some studies at BESIII

DATA Sample:

- $\sim 106\text{M}$ $\psi(2\text{S})$ events collected by BES-III at BEPC-II in March and April 2009

E1-tagged analysis of $\psi(2\text{S}) \rightarrow \pi^0 h_c$, $h_c \rightarrow \gamma \eta_c$

- Tag the E1 photon ($\sim 503\text{MeV}$) emitted in $h_c \rightarrow \gamma_{\text{E1}} \eta_c$. No further constraints on the final states of the h_c are imposed. The h_c signal in π^0 recoil mass spectrum will be improved significantly.

Inclusive analysis of $\psi(2\text{S}) \rightarrow \pi^0 h_c$

- Identify the h_c signal by searching for an enhancement in the **inclusive recoiling mass spectrum of π^0**

Study of $\psi(3686) \rightarrow \pi^0 h_c$, $h_c \rightarrow \gamma \eta_c$ via η_c exclusive decays

first PRL paper at BESIII

PRL **104**, 132002 (2010)

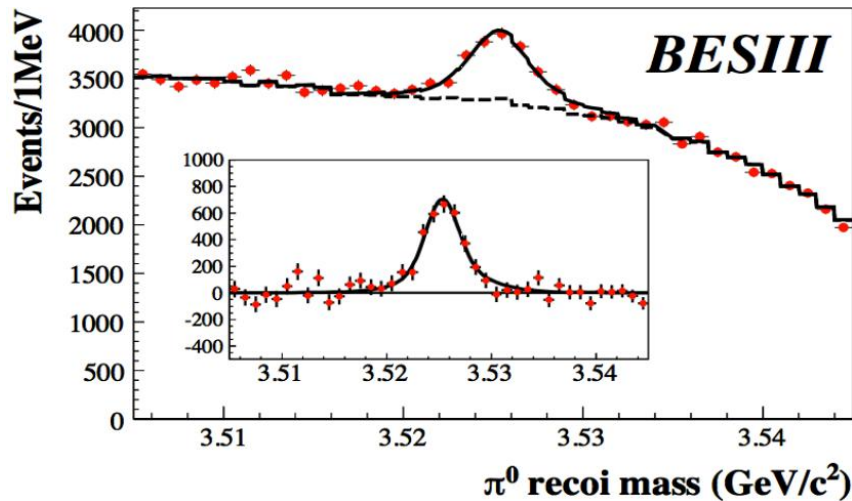
PHYSICAL REVIEW LETTERS

week ending
2 APRIL 2010

Measurements of $h_c(1P_1)$ in ψ' Decays

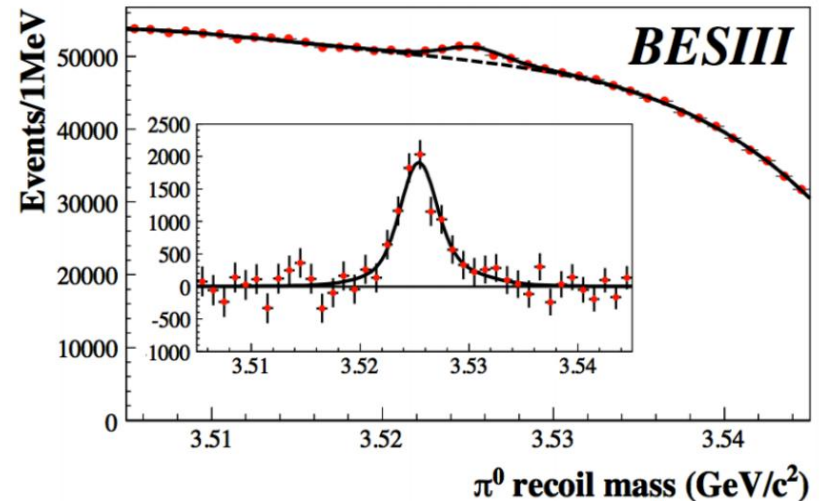
M. Ablikim,¹ M.N. Achasov,⁵ L. An,⁹ Q. An,³¹ Z. H. An,¹ J. Z. Bai,¹ Y. Ban,¹⁸ N. Berger,¹ J. M. Bian,¹ I. Boyko,¹³

E1 tagged analysis



$N(h_c) = 3679 \pm 319$

inclusive analysis



Significance = 9.5σ

$N(h_c) = 10353 \pm 1097$

$\chi^2/\text{d.o.f} = 24.5/34$

exclusive study

PHYSICAL REVIEW D **86**, 092009 (2012)

Study of $\psi(3686) \rightarrow \pi^0 h_c, h_c \rightarrow \gamma \eta_c, \eta_c \rightarrow X_i$ via η_c exclusive decays

M. Ablikim,¹ M. N. Achasov,⁵ O. Albayrak,³ D. J. Ambrose,³⁹ F. F. An,¹ Q. An,⁴⁰ J. Z. Bai,¹ Y. Ban,²⁷ J. Becker,² J. V. Bennett,¹⁷ M. Bertani,^{18a} J. M. Bian,³⁸ E. Boger,^{20,*} O. Bondarenko,²¹ I. Boyko,²⁰ R. A. Briere,³ V. Bytev,²⁰ X. Cai,¹ O. Cakir,^{35a} A. Calcaterra,^{18a} G. F. Cao,¹ S. A. Cetin,^{35b} J. F. Chang,¹ G. Chelkov,^{20,*} G. Chen,¹ H. S. Chen,¹ J. C. Chen,¹

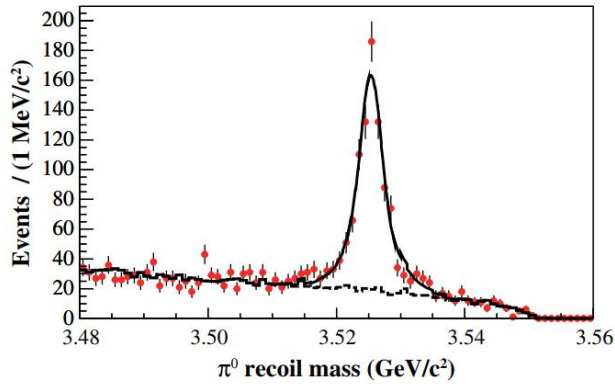


FIG. 1 (color online). The π^0 recoil mass spectrum in $\psi(3686) \rightarrow \pi^0 h_c, h_c \rightarrow \gamma \eta_c, \eta_c \rightarrow X_i$ summed over the 16 final states X_i . The dots with error bars represent the π^0 recoil mass spectrum in data. The solid line shows the total fit function and the dashed line is the background component of the fit.

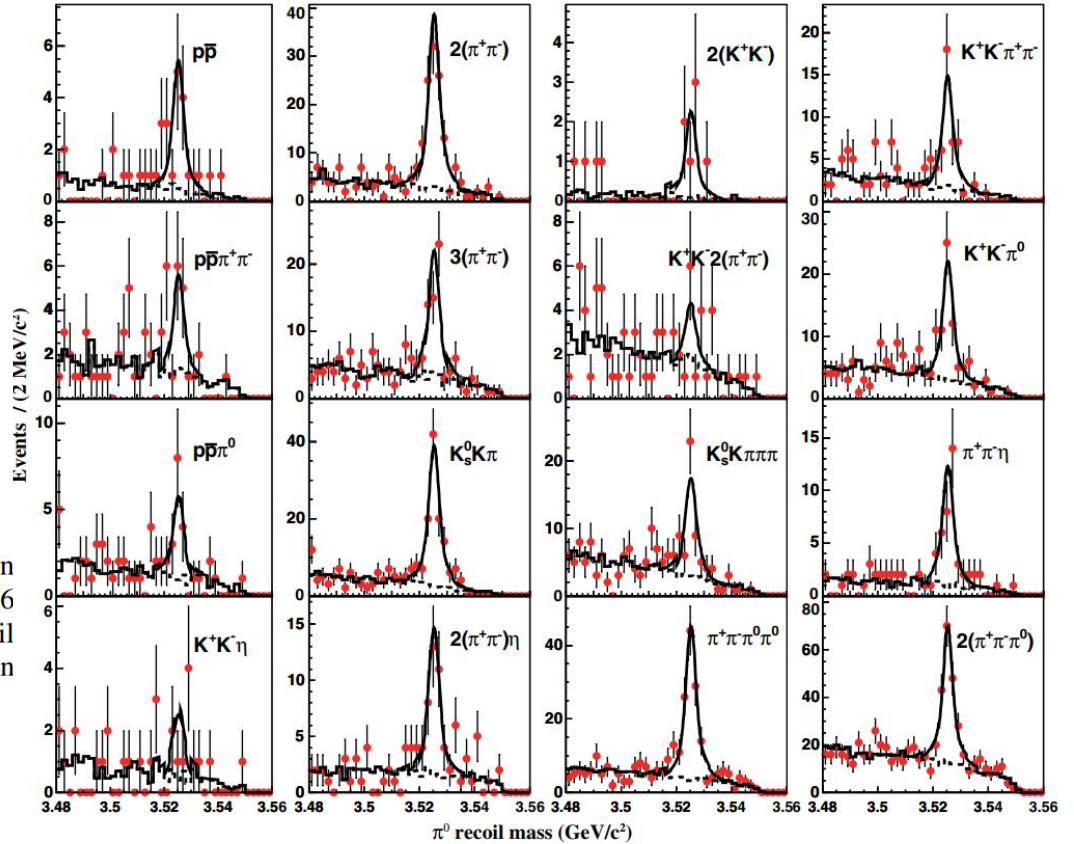


FIG. 2 (color online). The simultaneously fitted π^0 recoil mass spectra in $\psi(3686) \rightarrow \pi^0 h_c, h_c \rightarrow \gamma \eta_c, \eta_c \rightarrow X_i$ for the 16 final states X_i .

BESIII data taking status & plan (run ~ 8-10 years)

	Previous data	BESIII present & future	Goal
J/ψ	BESII 58M	1.2 B 20* BESII	10 B
ψ'	CLEO: 28 M	0.5 B 20* CLEOc	3B
ψ''	CLEO: 0.8/fb	2.9/fb 3.5*CLEOc	20 /fb
Above open charm threshold	CLEO: 0.6/fb @ $\psi(4160)$	0.5/fb @ $\psi(4040)$ 2.3/fb@~4260, 0.5/fb@4360 0.5/fb@4600, 1/fb@4420 Scan from 4.19 – 4.28, 10 MeV step, 500 pb ⁻¹ /point, 7 points	5-10 /fb
R scan & Tau	BESII	3.8-4.6 GeV at 105 energy points 2.0-3.1 GeV at 20 energy points	
$\Upsilon(2175)$		100 pb ⁻¹	
$\psi(4160)$		3 fb ⁻¹	
J/ψ		6 – 8 Billion	

borrowed from Shen Xiaoyan's slide

Summary

- three ways to study hc at BESIII with psi(2S) data sample
- larger sample already have and more data is on the way.

THANKS