Introduction to the Comitato Italiano di Fisica session

Francesca De Mori, Isabella Garzia

La nostra agenda

16:30 → 18:30 **CIF**

Conveners: Francesca De Mori (Istituto Nazionale di Fisica Nucleare) , Isabella Garzia (Istituto Nazionale di Fisica Nucleare)

16:30 **Introduzione** — 15m
Speaker: Francesca De Mori (Istituto Nazionale di Fisica Nucleare)

16:45 **Psi(2S) –> tau tau** — 20m
Speaker: Isabella Garzia (Istituto Nazionale di Fisica Nucleare)

17:05 **Search for Zc(4430) in e+e- → Zc(4430) π → ψ(2S) π π → J/ψ 4π → 2l 4π** — 20m
Speaker: Marco Scodeggio (Istituto Nazionale di Fisica Nucleare)

17:25 **Phase measurement in e+e-->ppbar with J/psi scan data** — 20m
Speaker: Marco Destefanis (Universita' degli Studi di Torino and INFN)

17:45 **TBD** — 10m
Speaker: Simone Pacetti (University of Perugia)

Λ(1520)

What is missing?

- ✓ My contribution on $J/\psi \to K^+K^-$ via $\psi(2S) \to \pi^+\pi^- J/\psi$ w/o PID
- ✓ Measurement of $J/\psi \to \omega\pi^0$: Alessio M.
- ✓ Relative Phase measurements in $\psi(2S) \to \pi^+\pi^- J/\psi$ with $\psi(2S)$ scan (Giulio)


Physics analyses survey in CIF

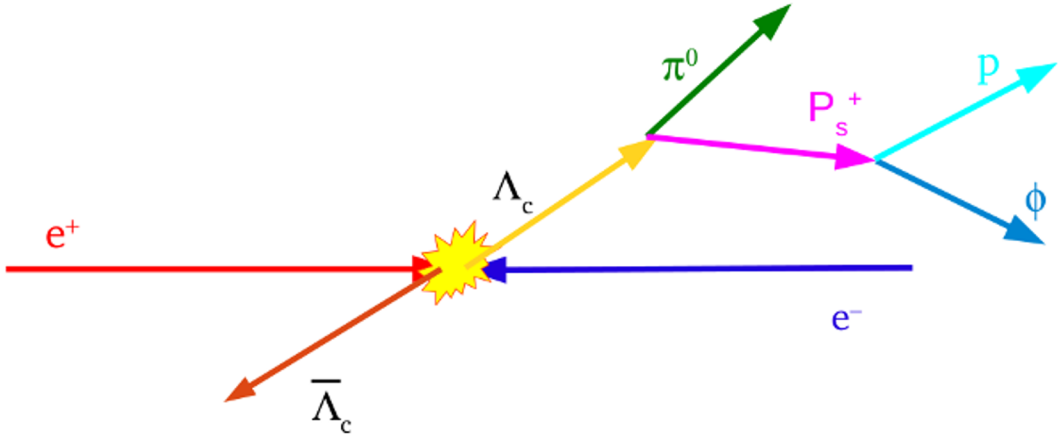
Survey of the analyses left behind

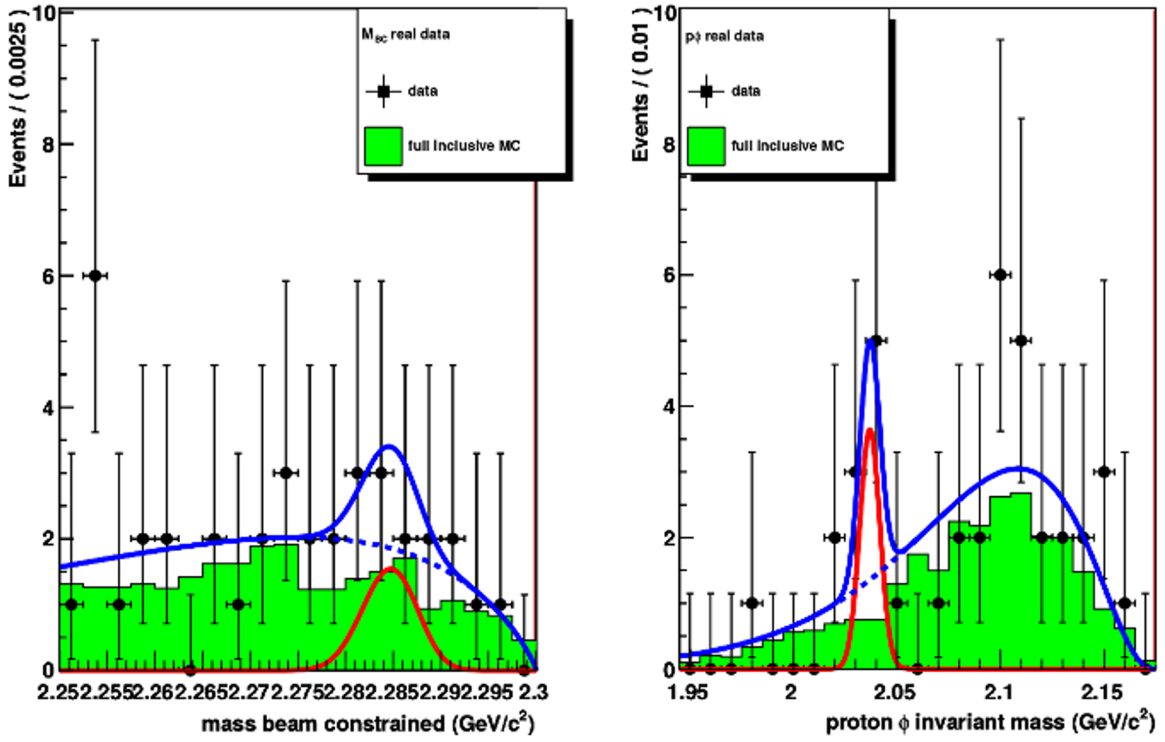
in standby or in which the principal author left or that can be pursued with full stat

- Pentaquark (Giulio)
- Analisi $h_c \rightarrow e^+e^-\eta$
- J/psi → ωη'ππ and search for X(1835)→η'ππ (update)
- Phase measurement in $\mathbf{J/\psi \rightarrow \omega\pi^\circ}$ (Liang)→analisi di Alessio alla J/Psi
- Phase measurement in $\mathbf{J/\psi \rightarrow K^+K^-}$ (Francesca)

Pentaquark searches in $\Lambda_c \to p\phi\pi^0$

G. Mezzadri





- Based on 567 pb^{-1} at 4.6 GeV (collected in 2014, ~ 106 × 10^3 $\Lambda c^+ \Lambda c^-$)

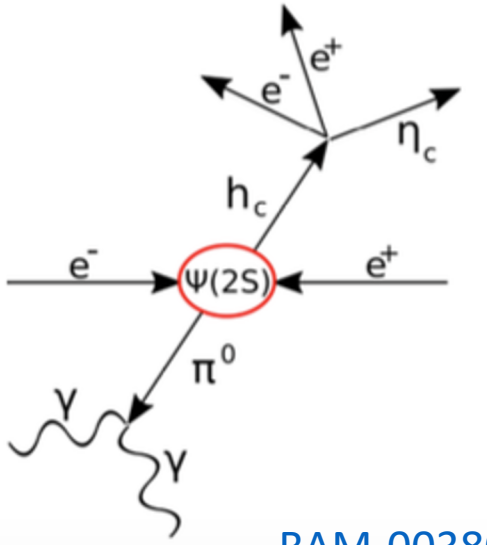
$$\mathcal{BF}(\Lambda_c^+ \to p\phi\pi^0) = (10 \pm 4) \times 10^{-5}$$

- Single tag analysis
- Low signal significance: ~ 2 σ
- New data set available: the analysis update will be able to increase the precision by a factor of ~ 2 ?

PhD thesis - https://docbes3.ihep.ac.cn/DocDB/0007/000706/004/Memo_pentaquark_v4.pdf

- $M_{P_s} = (2036 \pm 3)\,\mathrm{MeV}/c^2$
- $\sigma_{P_s} = (4 \pm 3)\,\mathrm{MeV}/c^2.$

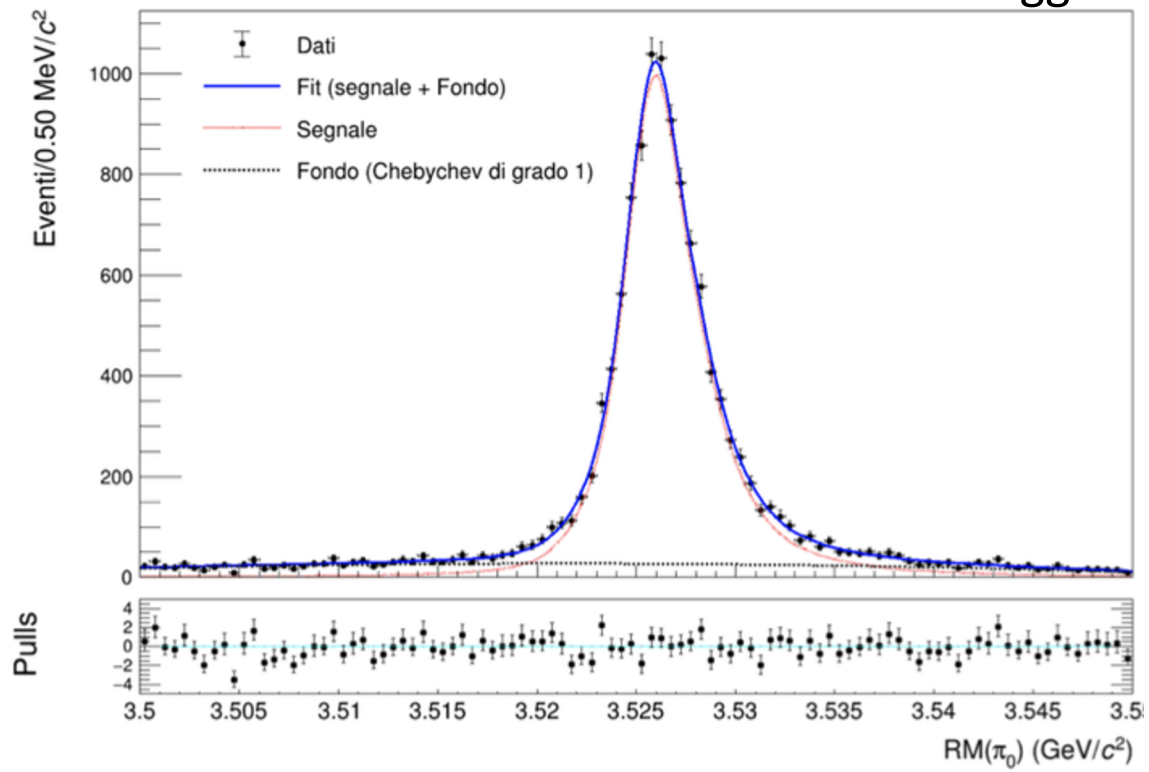
$h_c \rightarrow e^+e^-\eta_c$ (U. Zarantonello bachelor thesis)



BAM-00380

- ongoing analysis: PubCom edit since one year
- https://hnbes3.ihep.ac.cn/HyperNews/get/AUX/2021/04/17/03.47-75684-modified2_RM.pdf (April 17, 2021 last comments from Ryan M.) ???
  - analysis based on 2009 and 2012 data set + (4.23, 4.26, 4.36, 4.42) GeV cms energy points

M. Scodeggio



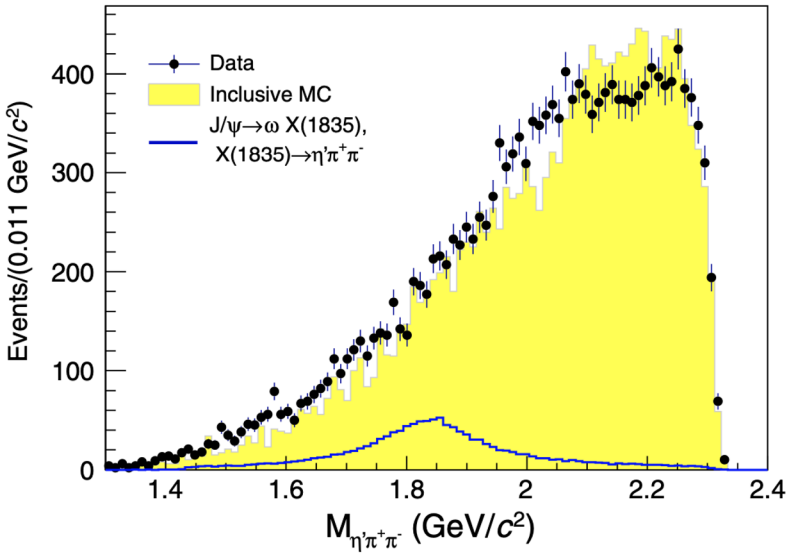
- Evidence (about 4.2 sigma)
- Observation with the full psi(2S) set?
- If there is someone interested in this analysis, we can try to investigate if there is someone active on it and try to start a collaboration

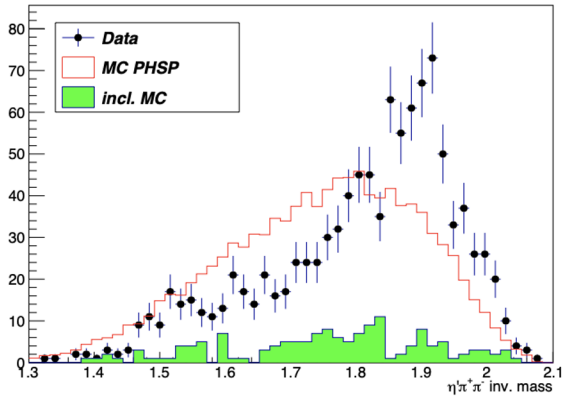
X(1835)

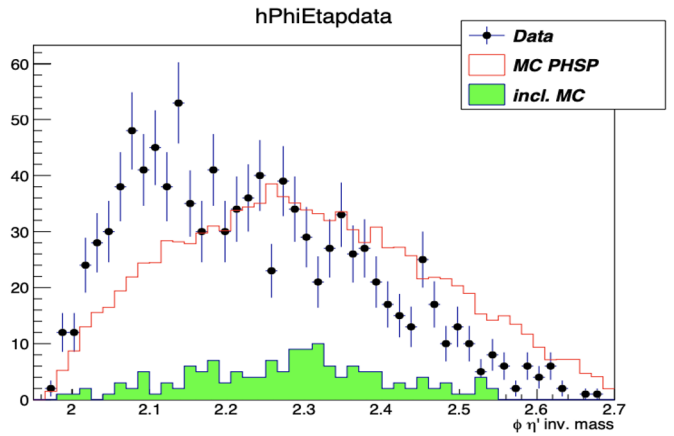
- **J/psi → ωη'ππ and search for X(1835)→η'ππ**
  - 2009+2012 data sample used: https://doi.org/10.1103/PhysRevD.99.07110
  - update the analysis with the full 10 Billion of J/psi data

I. Garzia

$$\mathcal{B}(J/\psi \to \omega X(1835), X(1835) \to \eta'\pi^+\pi^-) < \frac{N^{UL}}{N_{J/\psi} \cdot \epsilon' \cdot \mathcal{B}_{\rm int} \cdot (1-\sigma_{\rm sys})} = 6.2 \times 10^{-5},$$

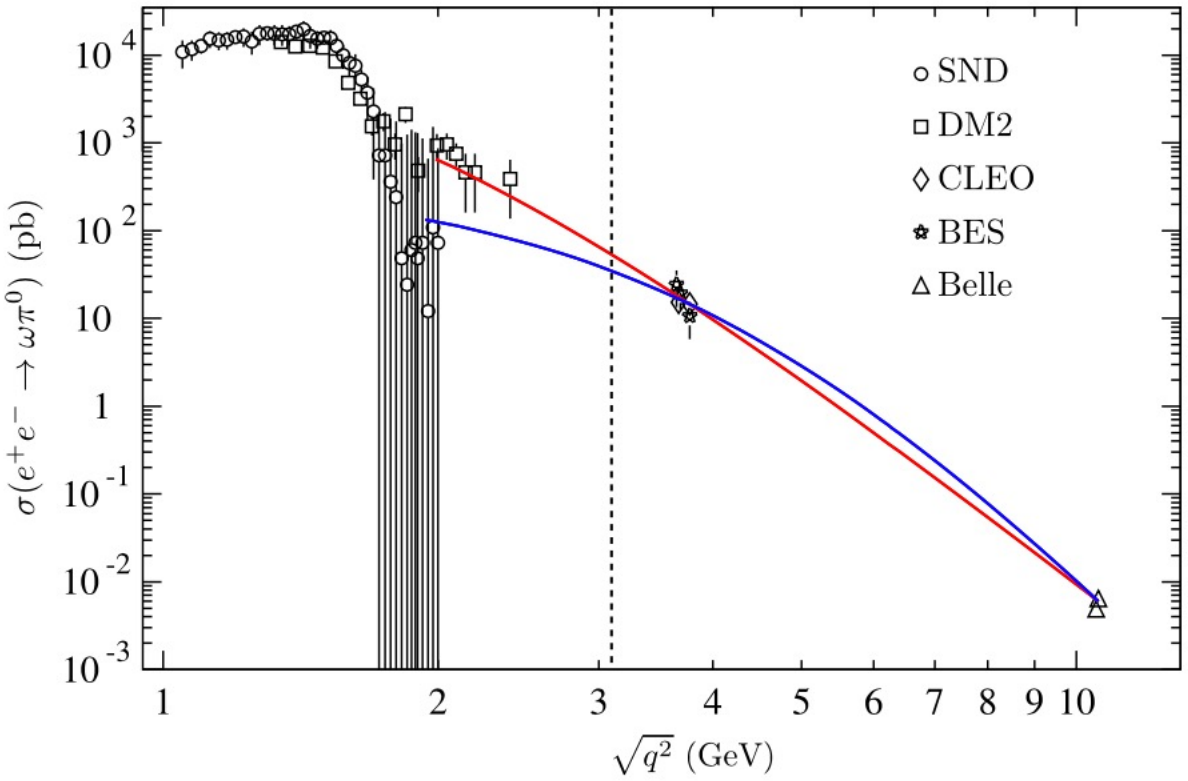






- **J/psi → ϕη'ππ and search for X(1835)→η'ππ**
  - using the full 10 Billion of J/psi data
  - chinese group already started this work, but no update since long time

Phase measurement in J/ψ → ωπ°



Isospin violation process, the continuum contribution might be sizable in this channel

$$\sigma(e^+e^- \to \omega\pi^0)\left(\sqrt{q^2}\right) \underset{q^2\to\infty}{\propto} |F_{\omega\pi^0}(q^2)|^2 \underset{q^2\to\infty}{\propto} (q^2)^{-4}.$$

J/ψ →VP,
ω-> $\pi^+ \pi^- \pi^\circ$
π°–>γγ
Scan data analysis
Alessio's analysis with J/ψ data sample

Phys. Rev. D 95, 034038 (2017)

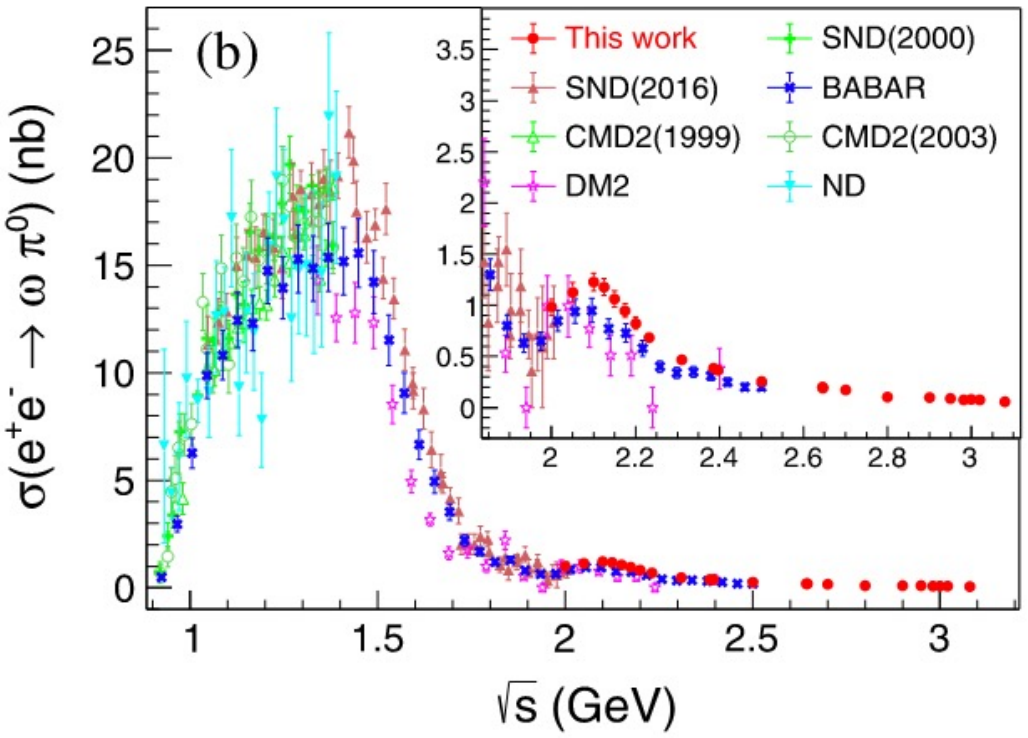
$$\mathcal{B}_\gamma(J/\psi \to \omega\pi^0) = \mathcal{B}(J/\psi \to \mu^+\mu^-)\frac{\sigma(e^+e^- \to \omega\pi^0)}{\sigma^0(e^+e^- \to \mu^+\mu^-)}\Big|_{\sqrt{q^2}=M_{J/\psi}}$$

$$= \begin{cases} (3.53 \pm 0.18) \times 10^{-4} & \text{DM2 case} \\ (2.29 \pm 0.40) \times 10^{-4} & \text{SND case} \end{cases},$$

to be compared with $\mathcal{B}_{\rm PDG}(J/\psi \to \omega\pi^0) = (4.5 \pm 0.5) \times 10^{-4}$.

The decay $J/\psi \to \omega\pi^0$, with a branching fraction $\mathcal{B}_{\rm PDG}(J/\psi \to \omega\pi^0) = (4.5 \pm 0.5) \times 10^{-4}$ [4], could be another channel where G parity is violated.

Phase measurement in $J/\psi \to \omega\pi^0$

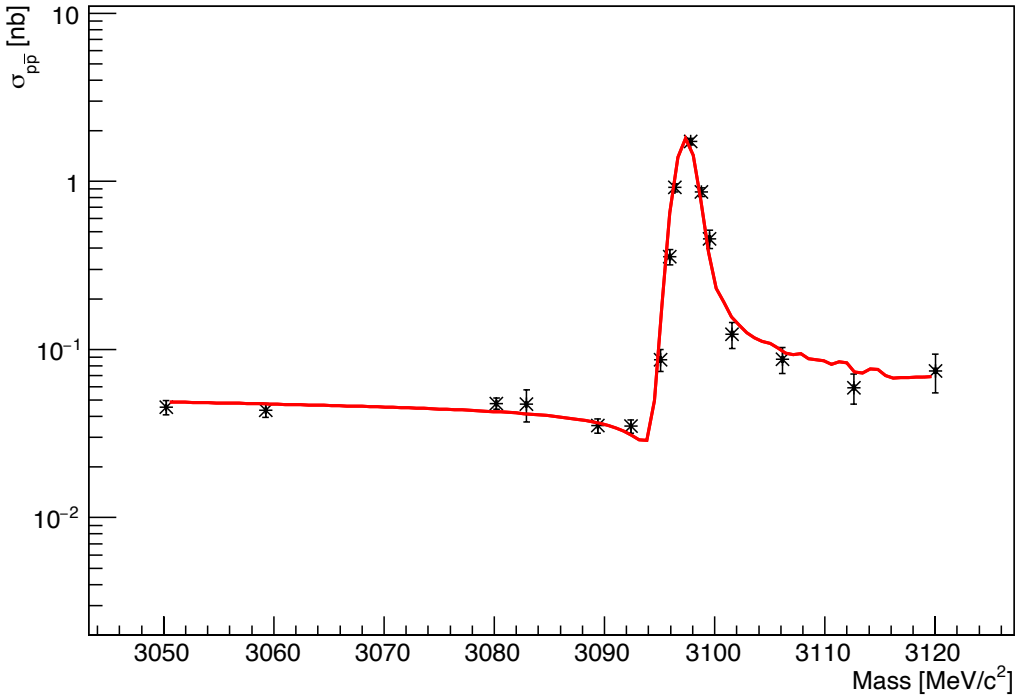


https://doi.org/10.1016/j.physletb.2020.136059

Table 3
The Born cross sections of the $e^+e^- \to \omega\pi^0$ process. The symbols are the same as those in Eq. (1). In the column of the Born cross section σ, the first uncertainty is statistical and the second one is systematic.

$\sqrt{s}$ (GeV)	N_{sig}	$\mathcal{L}$ (pb^{-1})	$\varepsilon \cdot (1+\delta)$	σ (pb)
2.0000	1677 ± 50	10.1	0.202	946 ± 28 ± 70
2.0500	652 ± 31	3.34	0.205	1086 ± 52 ± 73
2.1000	2614 ± 62	12.2	0.209	1181 ± 28 ± 80
2.1250	22627 ± 180	108	0.211	1136 ± 9 ± 76
2.1500	539 ± 28	2.84	0.213	1021 ± 52 ± 55
2.1750	1840 ± 51	10.6	0.217	914 ± 26 ± 59
2.2000	2064 ± 54	13.7	0.218	791 ± 21 ± 54
2.2324	1508 ± 46	11.9	0.222	659 ± 20 ± 43
2.3094	1846 ± 51	21.1	0.223	452 ± 13 ± 30
2.3864	1601 ± 48	22.5	0.222	366 ± 11 ± 26
2.3960	4553 ± 80	66.9	0.222	352 ± 6 ± 19
2.5000	53.8 ± 8.2	1.10	0.228	247 ± 38 ± 18
2.6444	1335 ± 42	33.7	0.234	195 ± 6 ± 11
2.6464	1274 ± 41	34.1	0.233	184 ± 6 ± 12
2.7000	34.9 ± 6.5	1.03	0.238	163 ± 30 ± 10
2.8000	21.2 ± 6.3	1.01	0.239	101 ± 30 ± 7.0
2.9000	2096 ± 54	105	0.243	93.8 ± 2.4 ± 5.3
2.9500	302 ± 20	15.9	0.244	89.0 ± 5.8 ± 5.2
2.9810	254 ± 19	16.0	0.246	74.0 ± 5.5 ± 4.1
3.0000	256 ± 18	15.9	0.244	76.1 ± 5.3 ± 4.1
3.0200	268 ± 18	17.3	0.242	73.3 ± 5.0 ± 4.3
3.0800	1513 ± 40	126	0.223	61.8 ± 1.7 ± 4.1

Work started by Liang long time ago



$\phi = 16 \pm 11°$

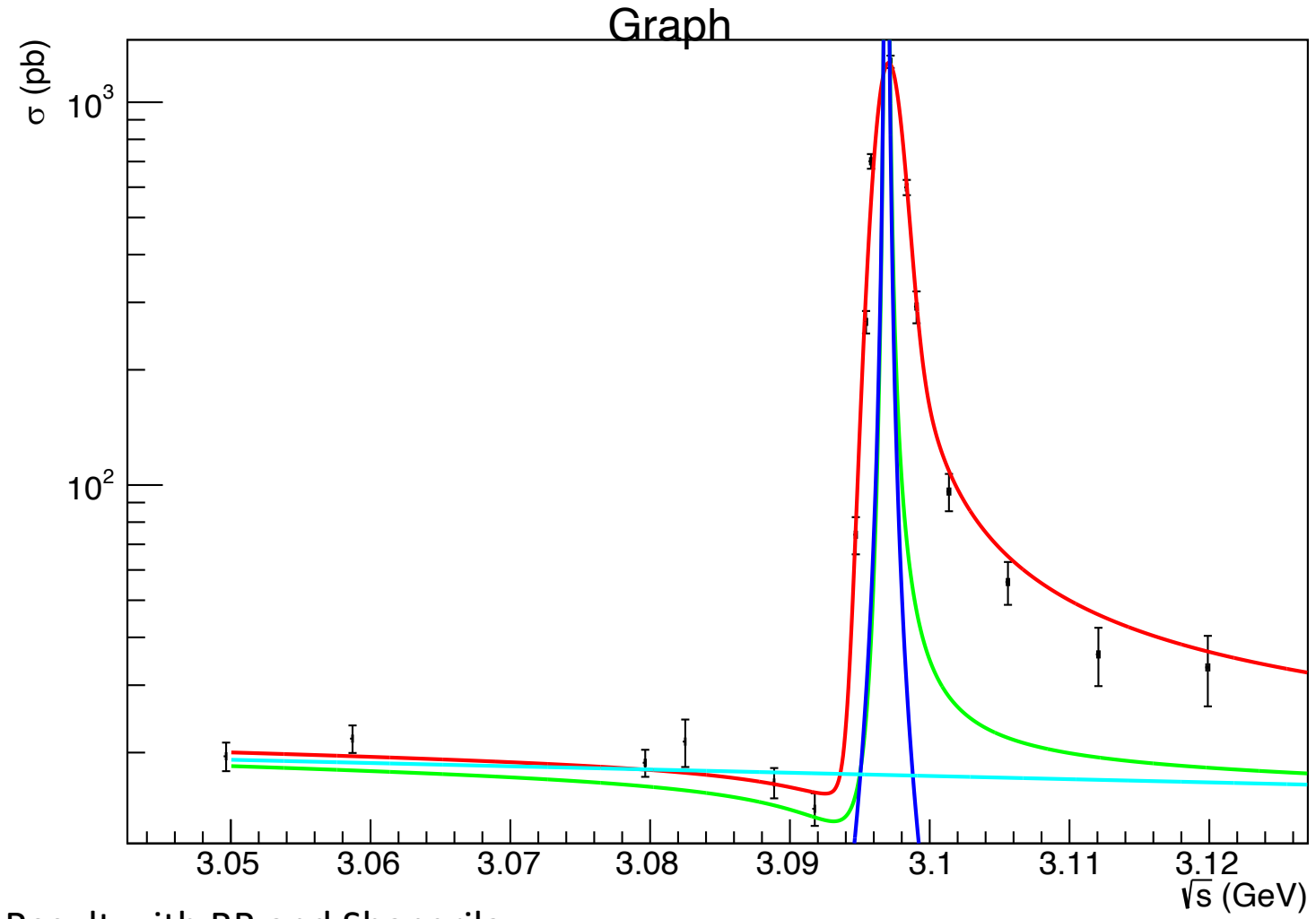
Cross(3 GeV)= 55.2 ± 2.7 pb

$B_{out} = (4.8 \pm 0.3) \times 10^{-4}$

Compatible with PDG

Energy[MeV]	L_{int} [pb^{-1}]	Eff (%)	Events Number
3050	14.936	32 Liang	190 ± 18
3060	15.049	32	187 ± 17
3083	4.749	32	64 ± 14
3085.6	17.507	33	238 ± 18
3090	15.569	32	155 ± 15
3093	15.221	33	154 ± 14
3094.3	2.143	33	54 ± 8
3095.2	1.814	32	182± 19
3095.8	2.152	33	575 ± 31
3096.9	2.090	32	1022 ± 41
3098.2	2.191	32	539 ± 30
3099.0	0.755	33	99 ± 12
3101.5	1.608	33	57 ± 10
3105.5	2.098	32	52 ± 9
3112.0	1.718	33	30 ± 6
3120.0	1.259	33	27 ± 7

Phase measurement in $J/\psi \to K^+K^-$



Result with BB and Shangrila

BR = (3.22 +/- 0.09) 10^{-4}
phi_s = (83.6 +/- 9.7) °
s_cn = 25.3 +/- 1.3 pb

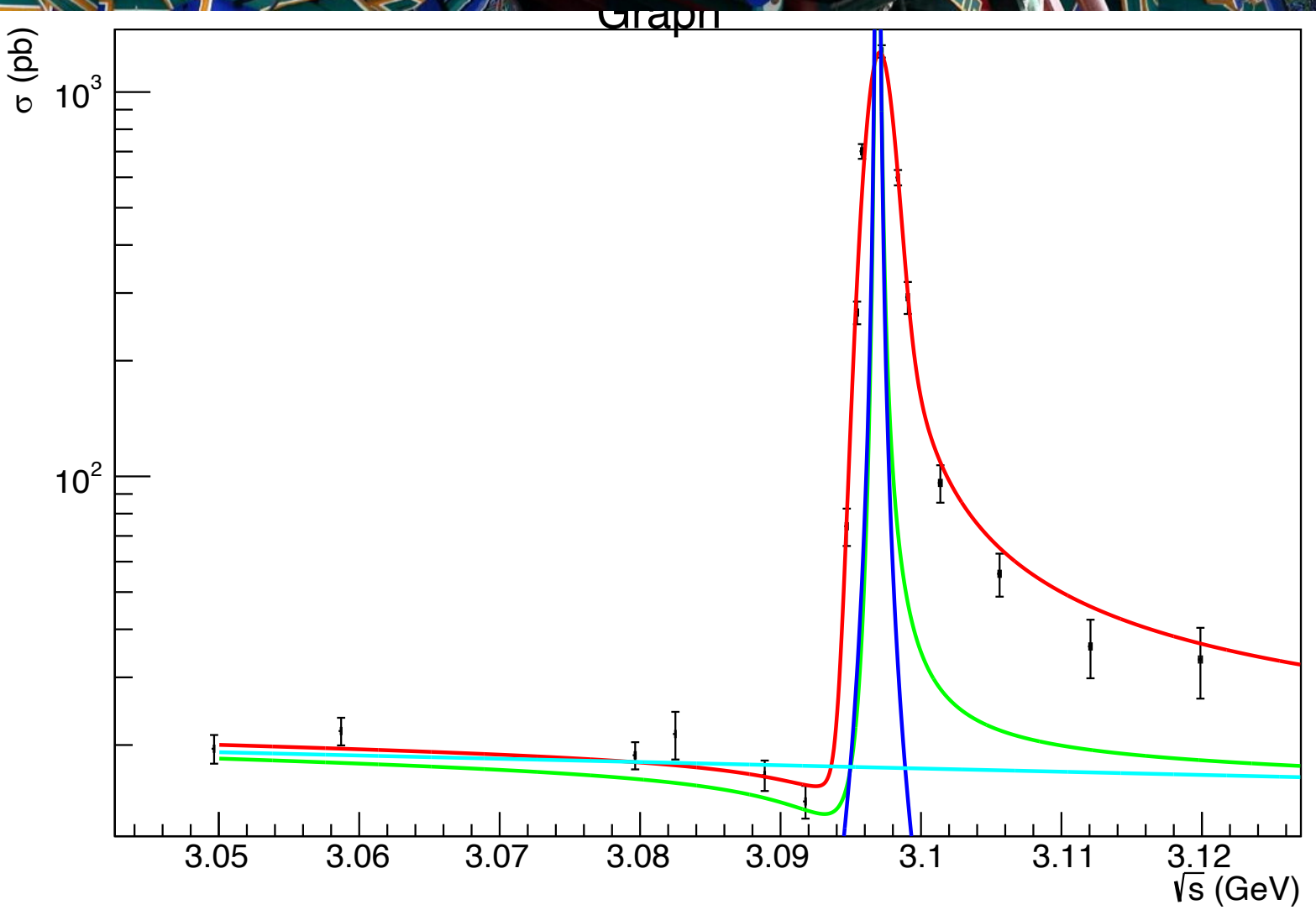
Last updates in november

chi2 is 17.6545/(16-3)

Print results from minuit
BR = (3.11+/- 0.09)10^{-4}
phi_s = 59.3715 +/- 9.81403
s_cn = 21.1526 +/- 1.11367
spread = 0.000911 +/- 0

USTC base program with our parametrization
And other modifications
(ISR treatment in primis)

Not too bad, PHASE NOT 90



Negative phase

chi2 is 17.6545

Print results from minuit
BR = 0.000338739 +/- 1.02829e-05
phi_s = -60.7655 +/- 9.38169
s_cn = 21.1528 +/- 1.11359
spread = 0.000911 +/- 0
0.000338739, -60.7655, 21.1528,

My nominal
BR = (3.47 +/- 0.09) 10^{-4}
phi_s = (-83.6 +/- 9.7) °
s_cn = 25.3 +/- 1.3 pb


NEWS FROM LAST P&S

Data taking at $\psi(2S)$ & $\psi(3770)$

Table 7.1: List of data samples collected by BESIII/BEPCII up to 2019, and the proposed samples for the remainder of the physics program. The most right column shows the number of required data taking days in current (T_C) or upgraded (T_U) machine. The machine upgrades include top-up implementation and beam current increase.

Energy	Physics motivations	Current data	Expected final data	T_C / T_U
1.8 - 2.0 GeV	R values Nucleon cross-sections	N/A	0.1 fb^{-1} (fine scan)	60/50 days
2.0 - 3.1 GeV	R values Cross-sections	Fine scan (20 energy points)	Complete scan (additional points)	250/180 days
J/ψ peak	Light hadron & Glueball J/ψ decays	3.2 fb^{-1} (10 billion)	3.2 fb^{-1} (10 billion)	N/A
$\psi(3686)$ peak	Light hadron & Glueball Charmonium decays	0.67 fb^{-1} (0.45 billion)	4.5 fb^{-1} (3.0 billion)	150/90 days
$\psi(3770)$ peak	$D^0/D^{\pm}$ decays	2.9 fb^{-1}	20.0 fb^{-1}	610/360 days
3.8 - 4.6 GeV	R values XYZ/Open charm	Fine scan (105 energy points)	No requirement	N/A
4.180 GeV	D_s decay XYZ/Open charm	3.2 fb^{-1}	6 fb^{-1}	140/50 days
4.0 - 4.6 GeV	XYZ/Open charm Higher charmonia cross-sections	16.0 fb^{-1} at different $\sqrt{s}$	30 fb^{-1} at different $\sqrt{s}$	770/310 days
4.6 - 4.9 GeV	Charmed baryon/XYZ cross-sections	0.56 fb^{-1} at 4.6 GeV	15 fb^{-1} at different $\sqrt{s}$	1490/600 days
4.74 GeV	$\Sigma_c^+\bar{\Lambda}_c^-$ cross-section	N/A	1.0 fb^{-1}	100/40 days
4.91 GeV	$\Sigma_c\bar{\Sigma}_c$ cross-section	N/A	1.0 fb^{-1}	120/50 days
4.95 GeV	Ξ_c decays	N/A	1.0 fb^{-1}	130/50 days

10% continuum data

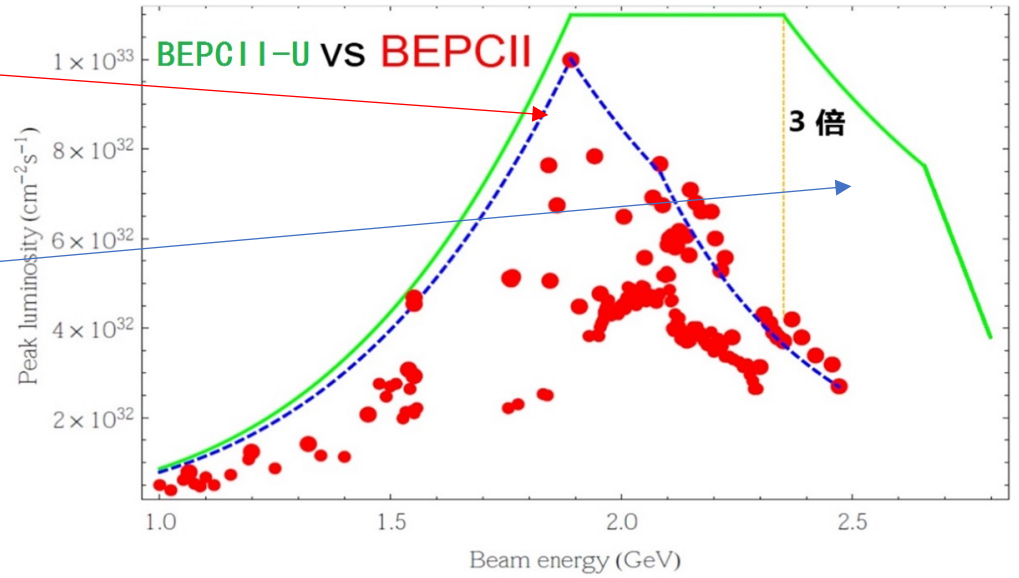
$\psi(2S)$, 1.825GeV, 400 pb^{-1} → 24 days **Finished**

$\psi(2S)$, 1.841GeV, 400 pb^{-1} → 17 days **Finished**

$\psi(3770)$, 1.886GeV, 2.6 fb^{-1} of 5.2 fb^{-1} → 88 days

For the remaining 2.6 fb^{-1} we have 96 HEP days

Integral luminosity 6 fb^{-1}



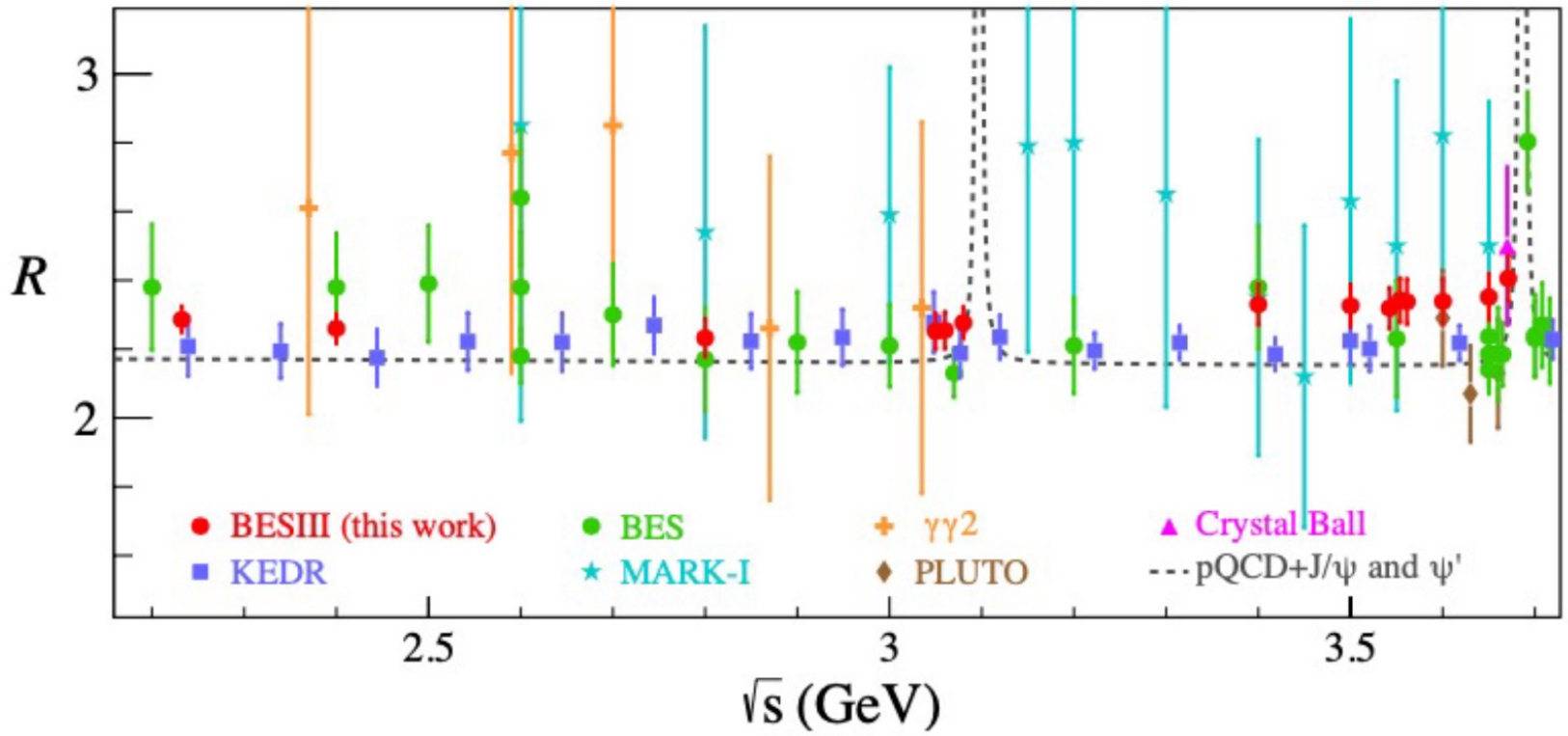
Nel programma psi(3770)17 fb-1 (2023)

Physics and publication highlights

PRL128, 062004 (2022)

First round R value measurements.
Comparing BESIII R values with previously published results for the 14 energies in 2.2324-3.6710GeV (data taken: 2012-2013).

Milestone achievement from efforts of many people in many years



Measurement of the Ratio of σ(e+e−→Hadrons) And (e+e−→μ+μ-) from 2.2324 to 3.6710 GeV

- The accuracy is better than 2.6% below 3.1 GeV and 3.0% above.
- Larger than the pQCD prediction by 2.7σ between 3.4 3.6 GeV.

1.9 σ from KDER

- First bunch of R-scan data was collected in 2012:
  - 4 energy points from 2.2324 to 3.4 GeV for the pilot run.
  - luminosity of $1.7 \sim 3.7$ pb^{-1} corresponds to 30k~100k produced hadronic events.
  - 10 data points collected in 2011 $\sim$ 2013 are added to the program

Done

- Second group of R-scan data was collected in 2013~2014.
  - 104 energy points from 3.85 to 4.60 GeV with covering the open-charm region.
  - luminosity of 8 pb^{-1} corresponds to 150k produced hadronic events.

- Third group of R-scan data was collected in 2015.
  - 21 energy points from 2.00 to 3.08 GeV.
  - luminosity of $1 \sim 100$ pb^{-1} corresponds to 20k~2000k produced hadronic events.
  - shared by many exclusive studies and fruitful results are produced.

Publication Statistics

- In total: **412** submitted, **380** published
- In 2021: **64** and **62** , **A New Record**

Current status: since last CM

26 papers submitted, 17 published/accepted

16 papers in pipeline: PubCom(11) SP(5)

15 drafts at CWR

http://hnbes3.ihep.ac.cn/publications_php.php

22 new analyses into RC review(BAM-00564 ~ 00585)

NEW!!!!!!!

- Since February CIF takes place quite regularly on Friday every 3 weeks

- The indico page is changed https://agenda.infn.it/event/30537/ Presentations and minutes of CIF meetings can be found there.


grazie per l'attenzione!!

backup

➢ https://hnbes3.ihep.ac.cn/HyperNews/get/AUX/2021/04/17/03.47-75684-modified2_RM.pdf (April 17, 2021 last comments from Ryan M.)

FIG. 1. The π^0 recoil mass spectra for $\psi(3686) \to \pi^0 h_c$ with (a) $h_c \to e^+e^-\eta_c$ and (b) $h_c \to \gamma\eta_c$, respectively. The $\pi^+\pi^-$ recoil mass spectra for the $e^+e^- \to \pi^+\pi^- h_c$ with (c) $h_c \to e^+e^-\eta_c$ and (d) $h_c \to \gamma\eta_c$, respectively. The curves are the results of the fit described in the text.

alla Psi(2S)

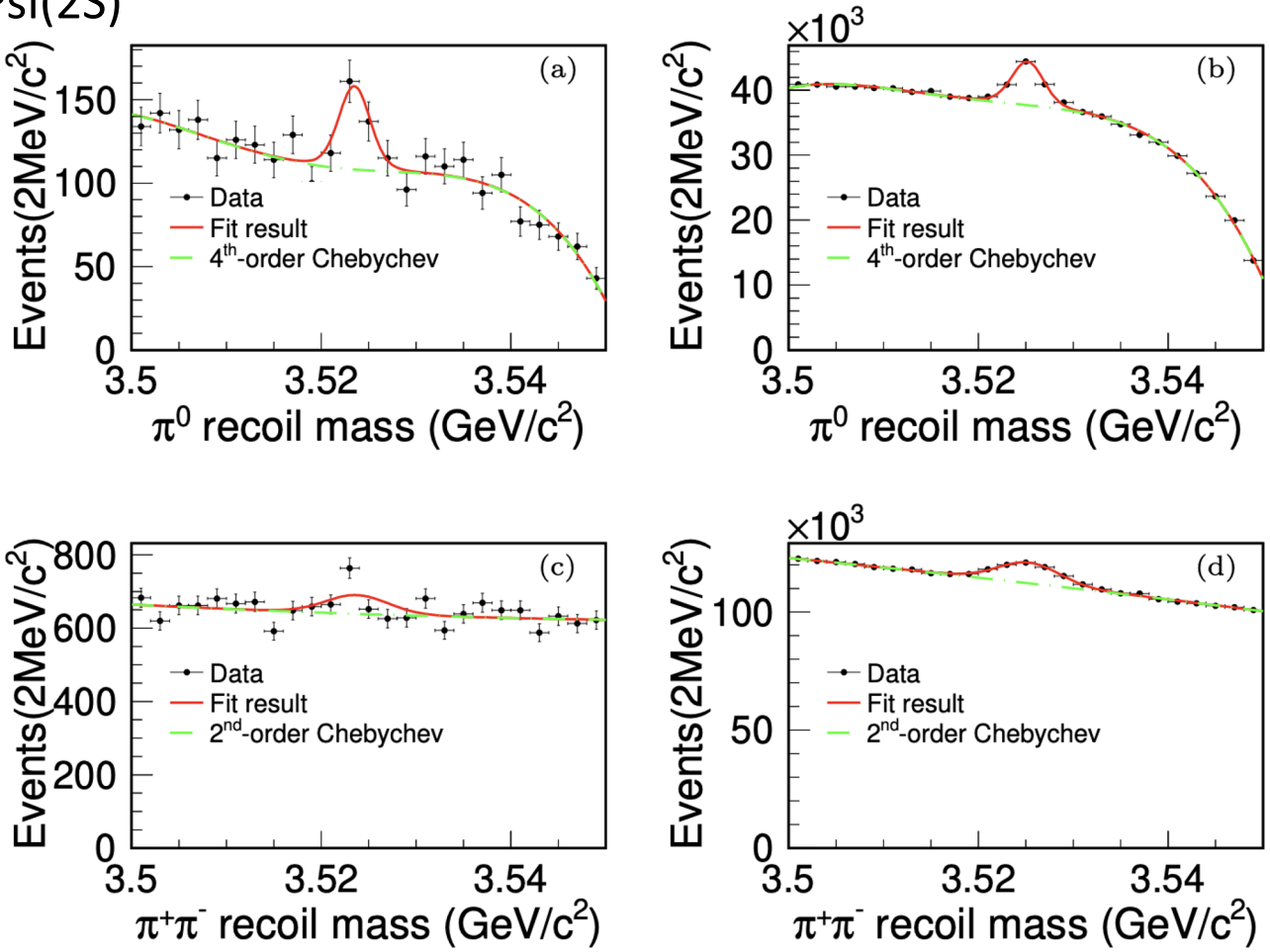


TABLE I. Summary of the fit results and the measured $\mathcal{R}$ for Mode I and Mode II.

Mode	$N^{\rm obs}_{e^+e^-\eta_c}$	$N^{\rm obs}_{\gamma\eta_c}$	$\epsilon_1(\%)$	$\epsilon_2(\%)$	$\mathcal{R}(\%)$
Mode I	112 ± 28	15174 ± 491	5.10	7.54	$1.09 \pm 0.28 \pm 0.19$
Mode II	220 ± 96	37007 ± 1247	20.89	33.35	$0.95 \pm 0.42 \pm 0.11$

XYZ data