Early Results and Prospects from BESIII

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Outline

Introduction: Collaborating in Beijing

Status: The BEPCII Accelerator & BESIII Detector

Selected Charmonium Physics Results

First Open Charm Data

Conclusions

more info: http://bes3.ihep.ac.cn/

Introduction:
Collaborating in Beijing

BESIII Collaboration

29 Chinese groups (IHEP host lab + Universities)

10 European groups (5 German, 2 Italian, 2 Russian, 1 Dutch)

6 US groups (CMU, Uminn, Roch, Indiana, Hawaii, Wash)

3 other Asian (Japan, S. Korea, Pakistan)

Still adding new groups...

First papers: 36 groups (of 45 listed above)

293 Authors; 148 from IHEP

CLEOns / other US @ BESIII

Carnegie Mellon: Briere

U. Minn: Poling, Cronin-Hennessy

U. Rochester: Thorndike

Indiana U.: Shepherd, Mitchell

Other US groups: (from before BESIII …)

Hawaii (F. Harris only PI; S. Olsen now in Korea),

U. Washington (small: 1 author)

Collaboration meetings

> 2 per year; 1 @ IHEP, 1 @ Chinese university
>
> recently: early summer & late fall
>
> 2 additional "physics/software" workshops per year

Lots of "video"conference meetings (or just audio +pdf)

Working in Beijing

My Trips to China: (mostly Beijing, + some train trips)

Mar07 (exploratory) Jan08 (join), Oct08
Mar09, Jul09, Oct09 Jun10, Oct10
Jun11

A few years ago, I thought I was "unlikely" to join…
But, after my first trip, I felt very comfortable with:

- People, lab, communication [enough English !]
- (real) Chinese food [incl. pigeon, jellyfish,duck tongue (!), …]
- Playing tourist in Beijing [many new subway lines: big help]

I did develop one new concern:

- Most senior people have another project !
  (Daya Bay, LHC, …)

BUT… it's a large collaboration, hard-working, …

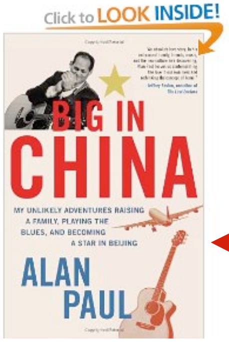
Welcoming signs…

Green Transportation…

Exotic foods…
(if scorpions:
live until fried)

Fred Gilman even found me
a Blues Band to jam with…

(really…he did!)



New book
By guitarist

Treasures at Panjiayuan
“Ghost Market” or “Dirt Market”

Yes, China is becoming more "capitalist"… but it's still a bit different than the West…

Text is:

Professional comment:
One of every six coffee drinkers
will love Brazil coffee!

Don't try that on Madison Ave. !

But 1/6 of the Chinese market would actually be pretty good…

More on (sic) Working in Beijing

Collaboration meetings

- 2 per year; 1 @ IHEP, 1 @ Chinese university
- 2 additional software workshops per year

Lots of "video"conference meetings (or just audio +pdf)

- Beijing is EDT+12 hrs (EST+13) easy to remember, hard to do !
- ~bi-weekly Physics/Software meeting
- ~bi-weekly analysis meetings (charm, charmonium, light hadrons)

I tried to take Chinese last fall, on sabbatical

- Characters and a tonal language: tough combination
- I did learn a lot more than I had picked up on the fly
- I can bargain with Chinese numbers now when I'm shopping
- Big improvement over just knowing: hello, thank you, beer

Status:
The BEPCII Accelerator
& BESIII Detector

BEPC II

Key features vs. CESR-c

- Two-Ring machine (BEPC → BEPCII)
- Smaller radius (built for low energy, unlike CESR-c)
  - So equal stored *current* is fewer particles than CESR…
  - But, *collision frequency* is correspondingly higher
- Smaller beam-energy spread
  - Greater effective J/ψ and ψ' cross-sections
  - Better beam-constrained mass distribution at $\psi(3770)$

Design: 10 x 10^{32} cm^{-2}s^{-1} Achieved: 5.5 x 10^{32} cm^{-2}s^{-1}

CLEO-c: 0.7 x 10^{32} cm^{-2}s^{-1}

What I miss:

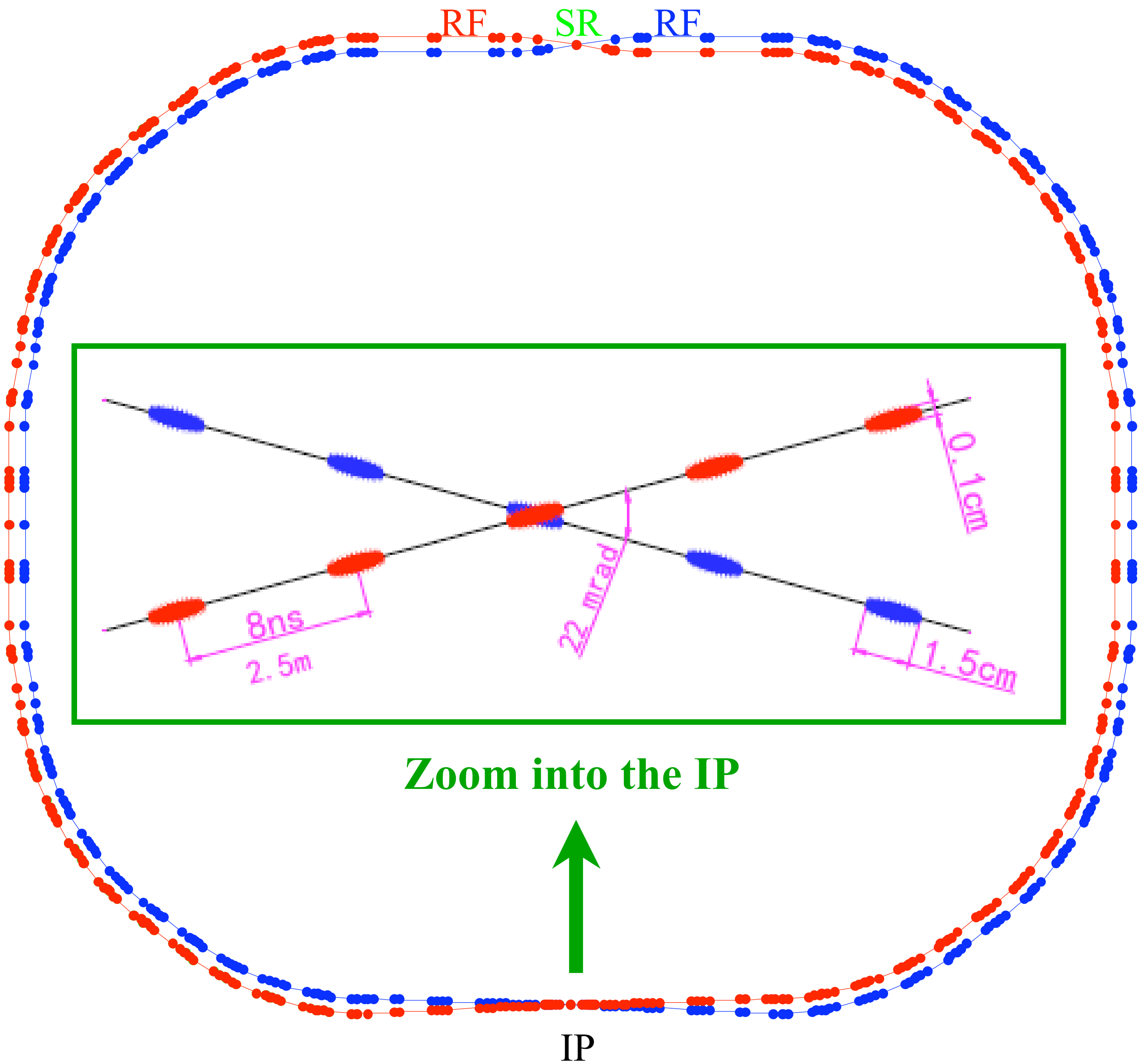
- Control room is not as close to counting room
- Can't read an online machine log

So… it's hard to get as good of a feeling of what's happening !

But I can see currents, luminosity, etc. in real time

BEPC II Storage ring:

Large crossing angle, double-ring



Beam energy:
1 - 2 GeV

Luminosity:
1 x 10^{33} $cm^{-2}s^{-1}$

Optimum energy:
1.89 GeV

Energy spread:
5.16 x 10^{-4}

No. of bunches:
93

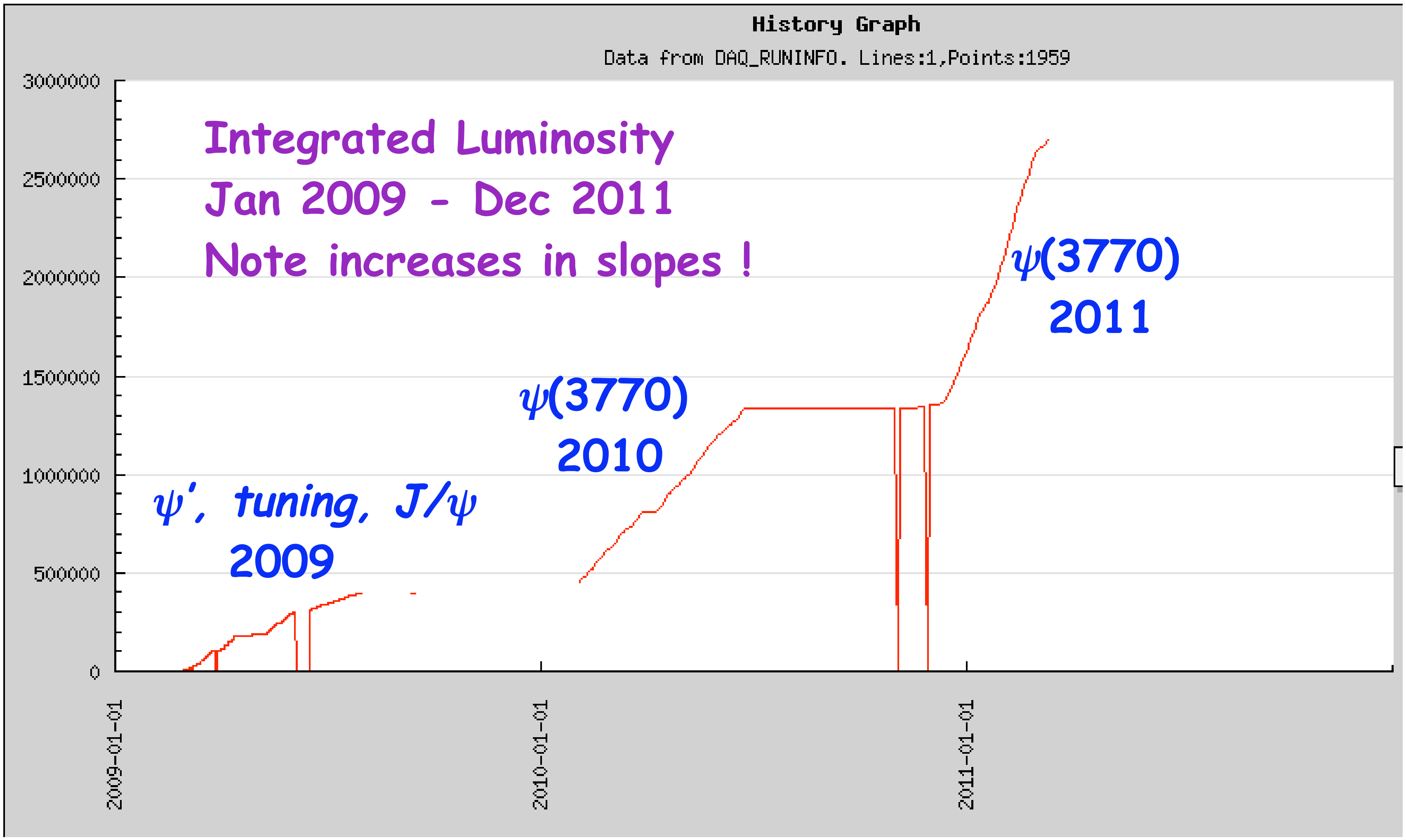
Bunch length:
1.5 cm

Total current:
0.91 A

SR mode:
0.25A @ 2.5 GeV

Progress Since Startup

NOTE: Luminosity is lower at J/ψ Energy
Machine is optimal near $\psi(3770)$



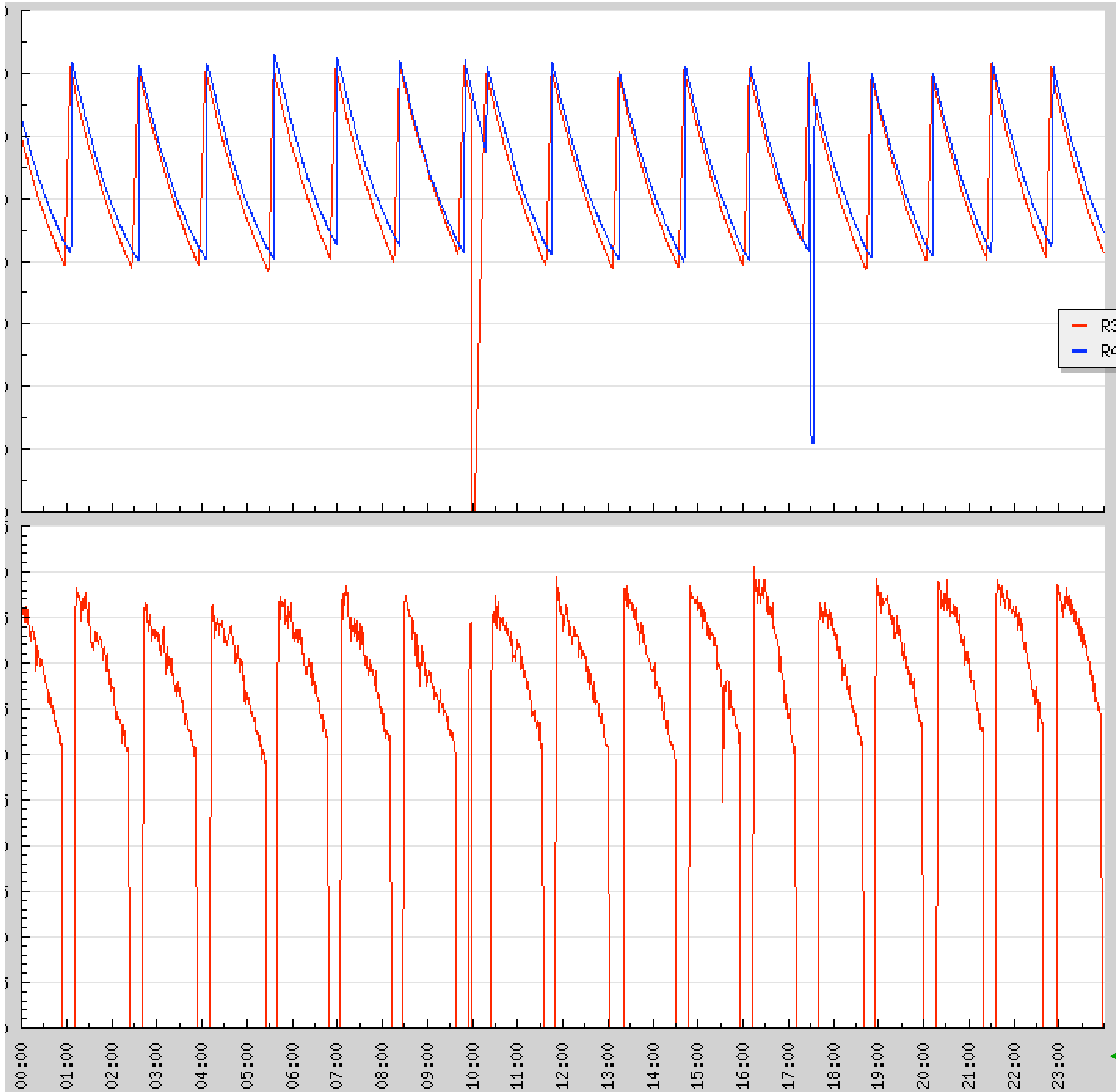
Currents and Inst. Luminosity (Best Day)

700 mA
Per beam

0 mA

0.5 x 10^{33}
$/cm^2/s$

0.0 x 10^{33}



1 hour
between
labels

Recent $\psi(3770)$ Running Parameters

Reference point: $\mathcal{L}$ = 5 x 10^{32} /cm^2/s

IF No lumi decay, gaps between fills, perfect efficiency:

this gives 0.5 nb/s = 43. pb^{-1}/day

Time filling beams, ramping HV: 20-25% loss (CLEO-c was smaller)

Luminosity decay, smaller peaks: 20-25% loss

Down-time: 5% loss

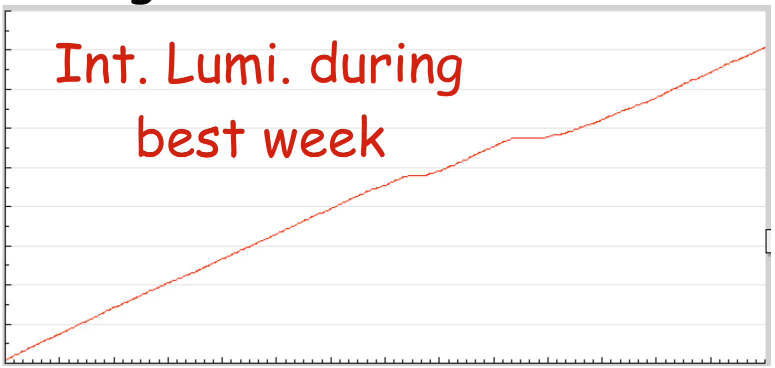
Our best WEEK averaged about 23. pb^{-1}/day

Our best MONTH averaged about 20. pb^{-1}/day 0.6 fb^{-1}/month !

Biggest gains in view now:

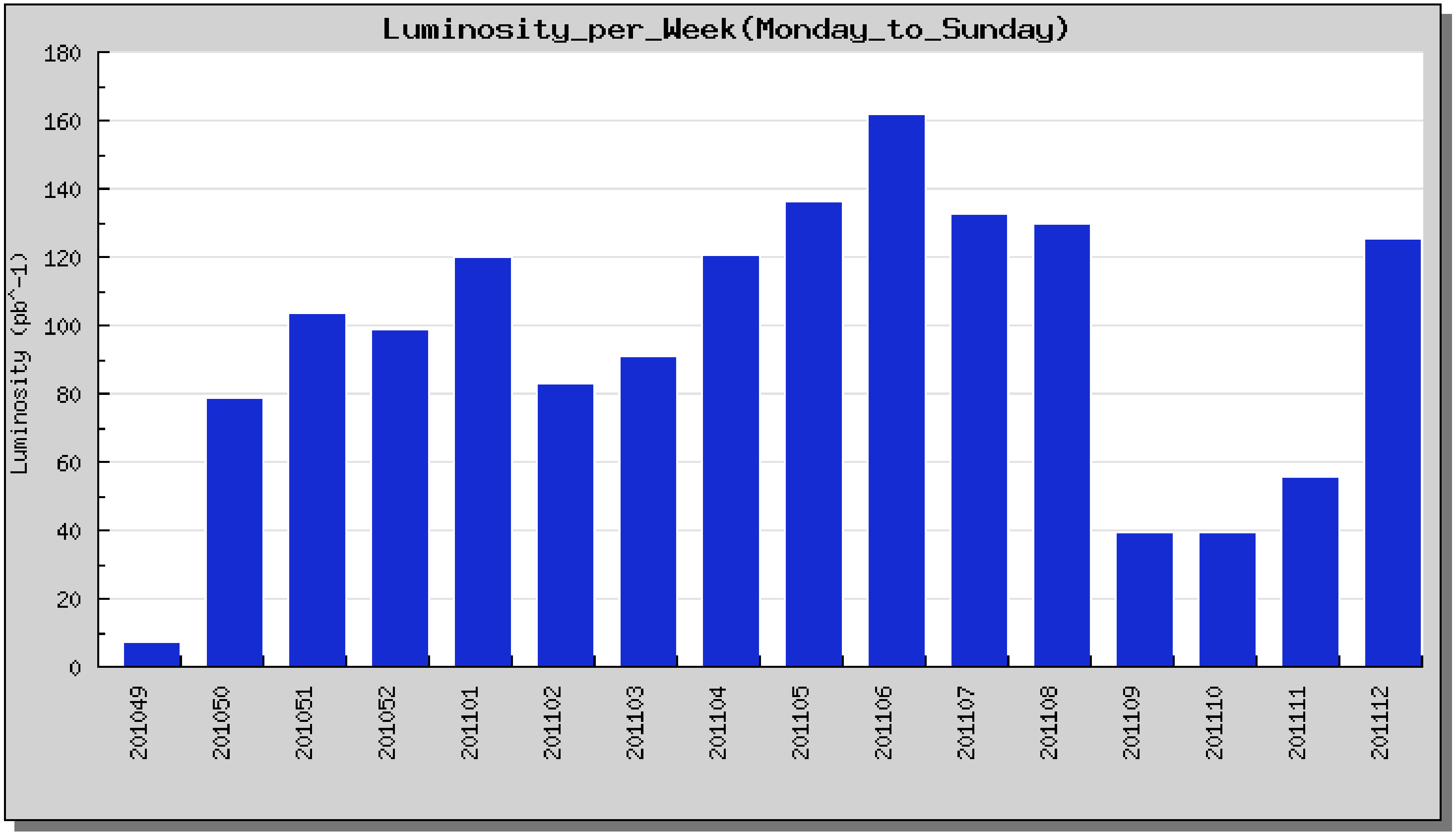
-- Have seen peak at 0.55 many times, and even near 0.60

-- Need to sustain the best week/month for longer!



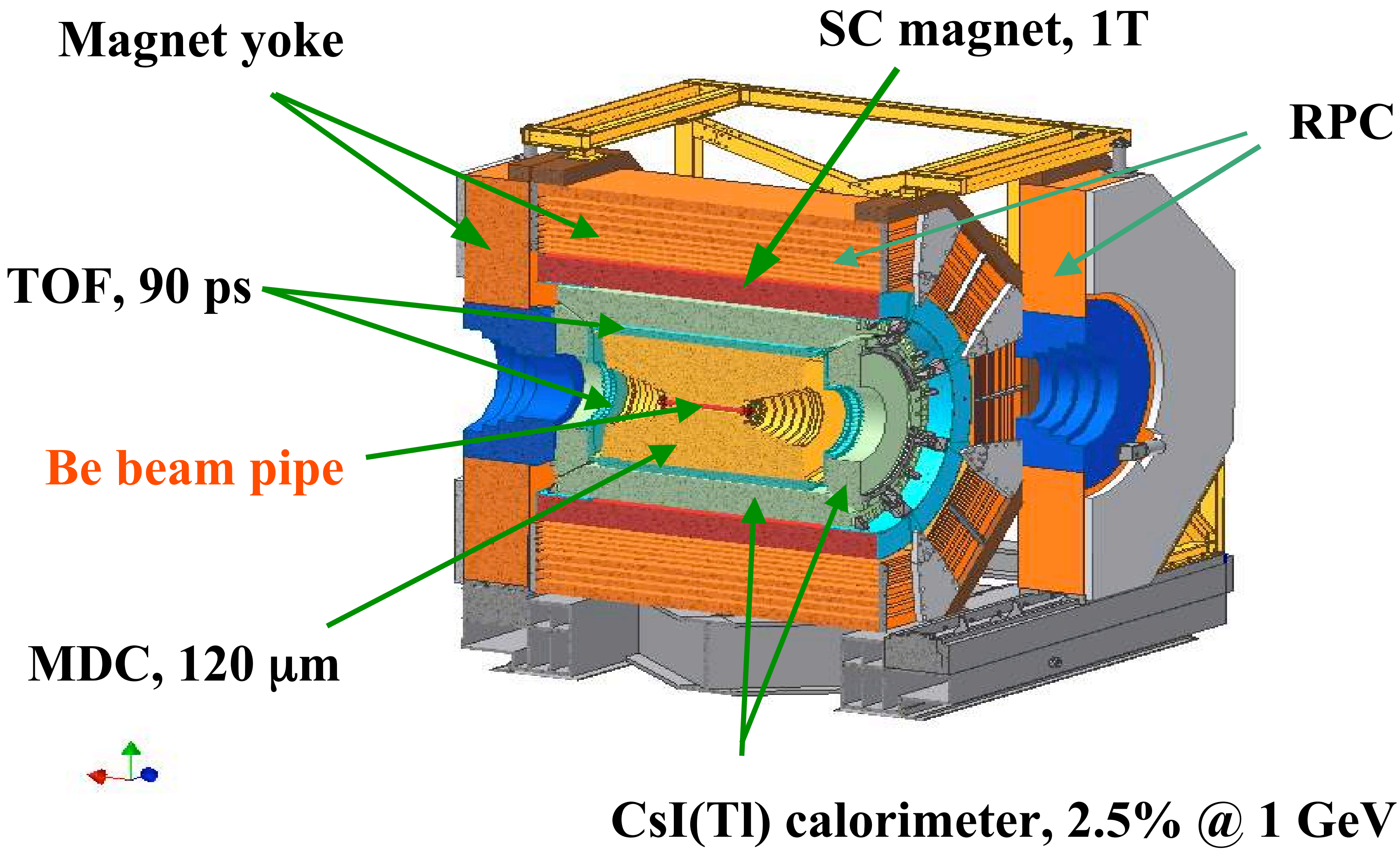
Luminosity per Week:
06Dec2010 - 27Mar2011

100 pb^{-1} →



*About 100 pb^{-1} was CLEO-c's best *month**

BESIII detector



BESIII Detector, vs. CLEO-c

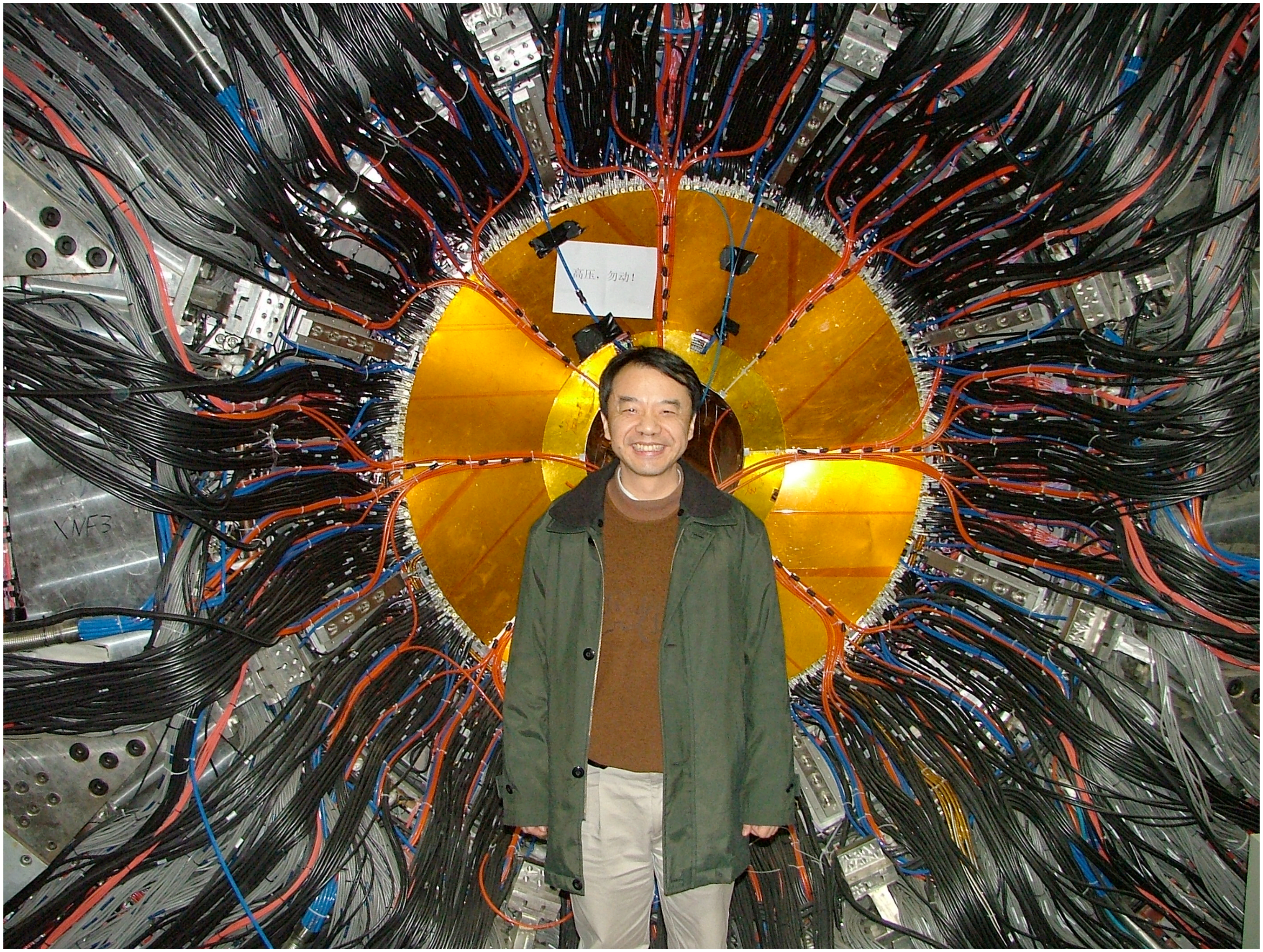
Key features vs. CLEO-c

- All-in-one drift chamber
- TOF, not RICH, to aid dE/dx fir particle ID
- Gap between CsI barrel and endcap
- More ambitious muon system

Design and Construction of the BESIII Detector
NIM A614 (2010) 345-399

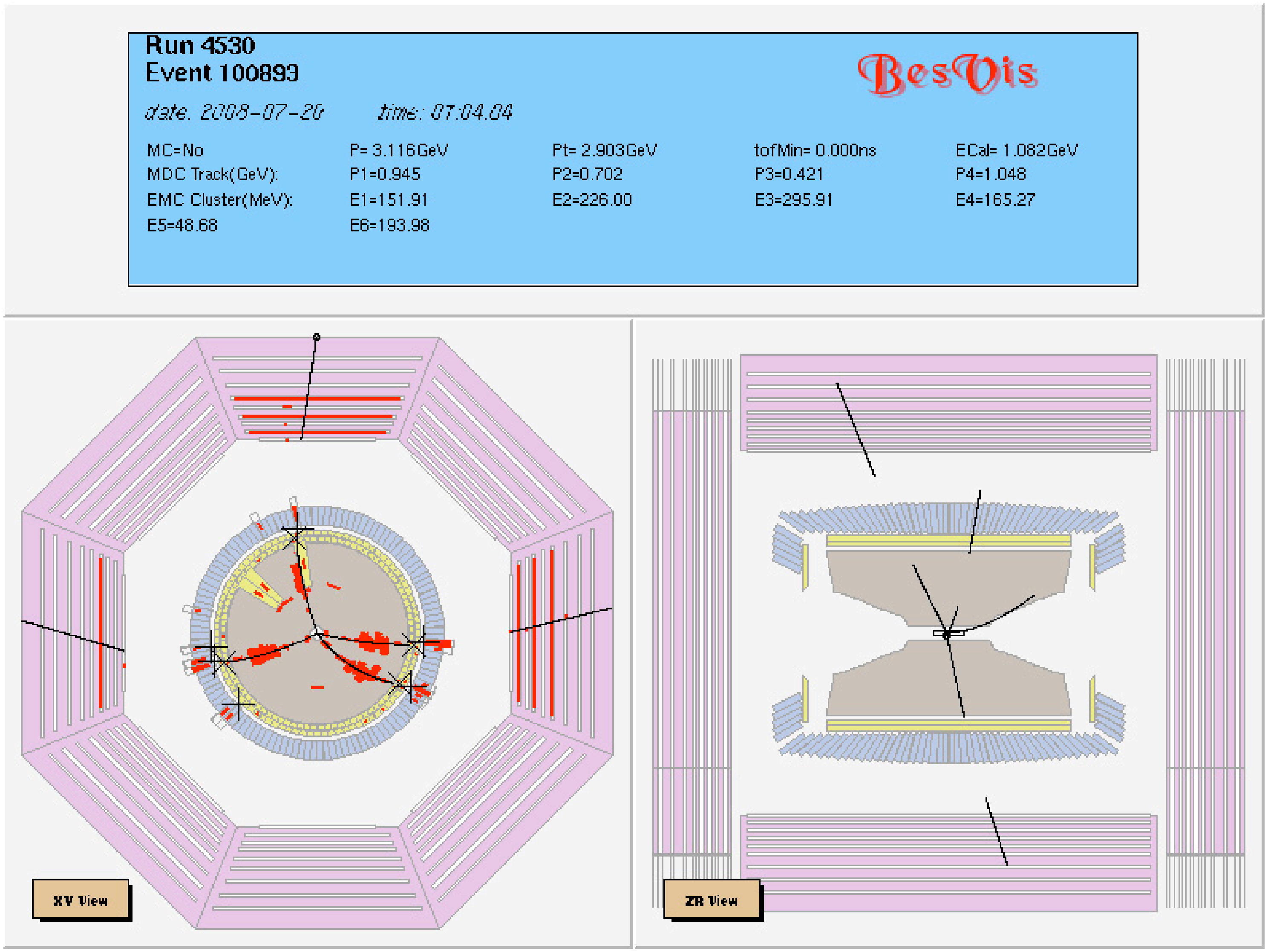
Chinese Physics C also has many (~20) articles on tests, software, calibration, MC studies, etc.

Spokesperson Yifang Wang in front of BESIII (Jan'08)



BESIII Counting Room

First collision event on July 19, 2008



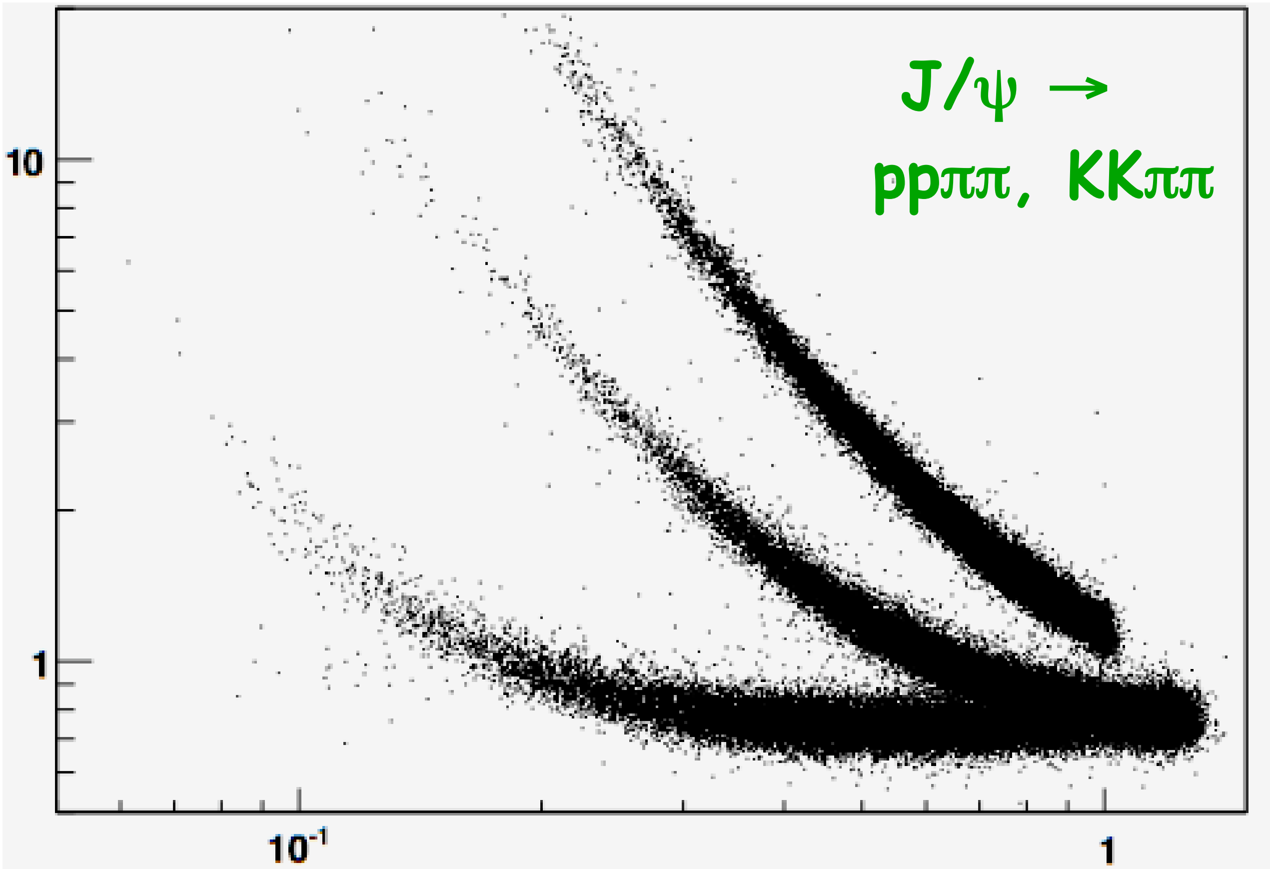
13 Million ψ(2S) events collected in 2008 (engineering data)

dE/dx Calibration

Manpower:

postdoc Chunlei Liu & RAB from CMU

and a few IHEP people (typically student + supervisor)



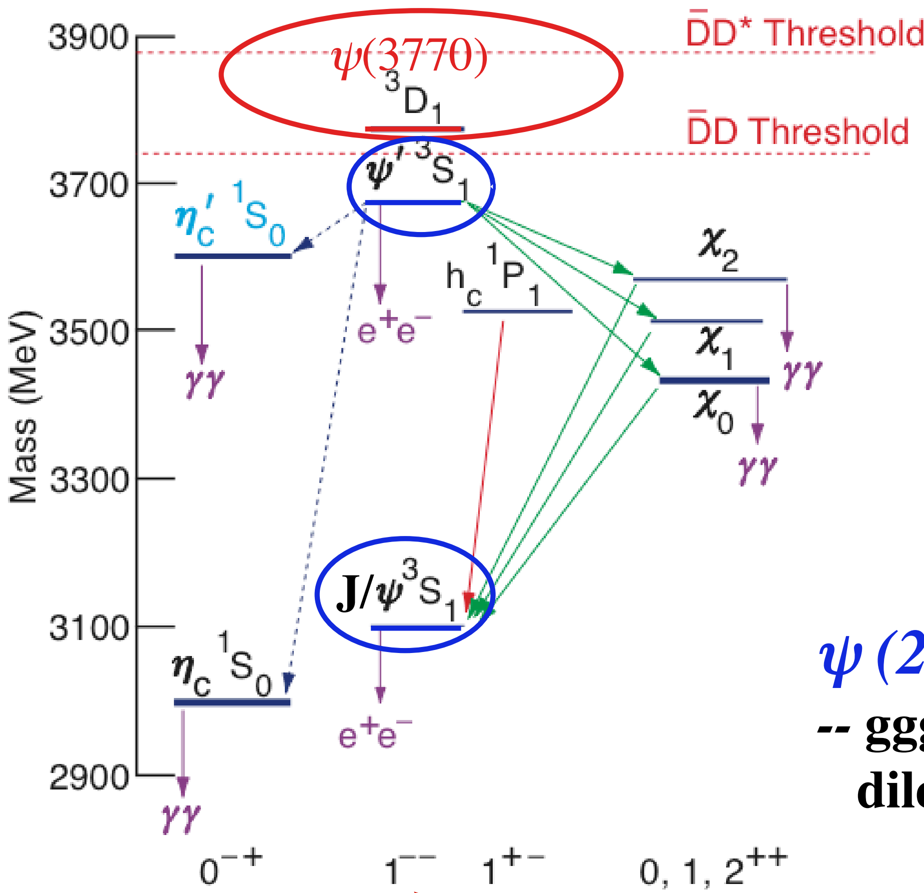
Note: I've looked at J/ψ data with 2 undergrads; good practice for me…

Charmonium Physics

Charmonium Spectrum

Two narrow charmonium states: spectroscopy, low-mass hadrons

Open charm phyiscs $\psi(3770)$ is a good source of D mesons.

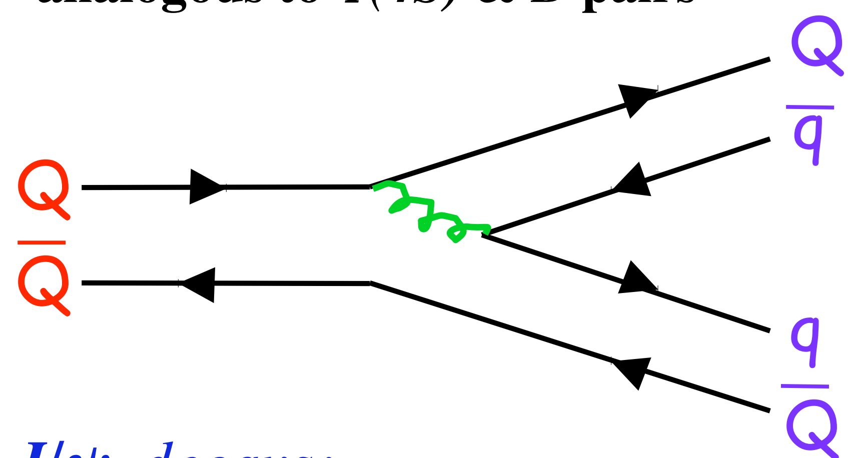


Direct e+e- production

ψ (3770) decays:

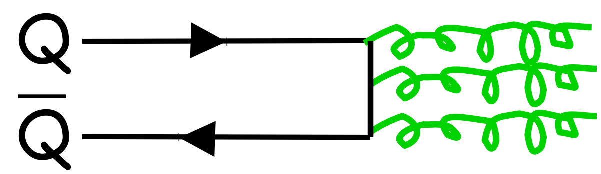
-- mostly to *D* pairs

-- analogous to *Υ(4S)* & *B* pairs



ψ (2S), J/ψ decays:

-- ggg+ggγ ; other charmonia;
dileptons ; radiative



Charmonium Samples

2008:

Startup in July, only engineering data in '08

2009:

~105 M ψ' (vs. 27 M @ CLEO-c)

~225 M J/ψ (vs. 58 M @ BESII: w/ poor EMC)

Also, intensive tuning to reach benchmark luminosity goal (30% design) to satisfy funding agencies

Beam-energy spread a bit smaller than CESR-c, so effective cross-section is a bit higher… [~10% ?]

Synchrotron runs are separate; about 5+ months of HEP physics running per calendar yea

(like CLEO-c, some things never change… though synch. is low-E here…)

h_c : Introduction

Last low-lying charmonium state; found by CLEO-c 2005
(hints at Fermilab p-bar accumulator exp't)

$^{2S+1}\mathcal{L}_J$: $\psi\ {}^3S_1$ $\chi_c\ {}^3P_{0,1,2}$ $\eta_c\ {}^3S_1$ $h_c\ {}^1P_1$

BES analysis:

Inclusive: $\psi' \to \pi^0 h_c$ using π^0 recoil mass

E1-tagged: inclusive, plus see γ from $h_c \to \gamma\ \eta_c$

Use both to get separate absolute Branching Fractions

Data Samples:

(106 ± 4) Million ψ'

42.6 pb^{-1} @ 3.65 GeV

h_c Analysis Cuts

Barrel γ: $E_\gamma > 25$ MeV $|\cos\theta| < 0.80$

Endcap γ: $E_\gamma > 50$ MeV $0.86 < |\cos\theta| < 0.92$

Isolation: $>10^o$ from any track

π^0: 120 - 145 MeV (about -1.5 to +2.0 σ)

1-*C* kinematic fit improves E resolution

raise barrel cut to $E_\gamma > 40$ MeV

[also "no other π^0 veto" for all transition γ, plus π^0 in incl. analysis]

Candidate events:

a) at least two tracks, at least one passing:

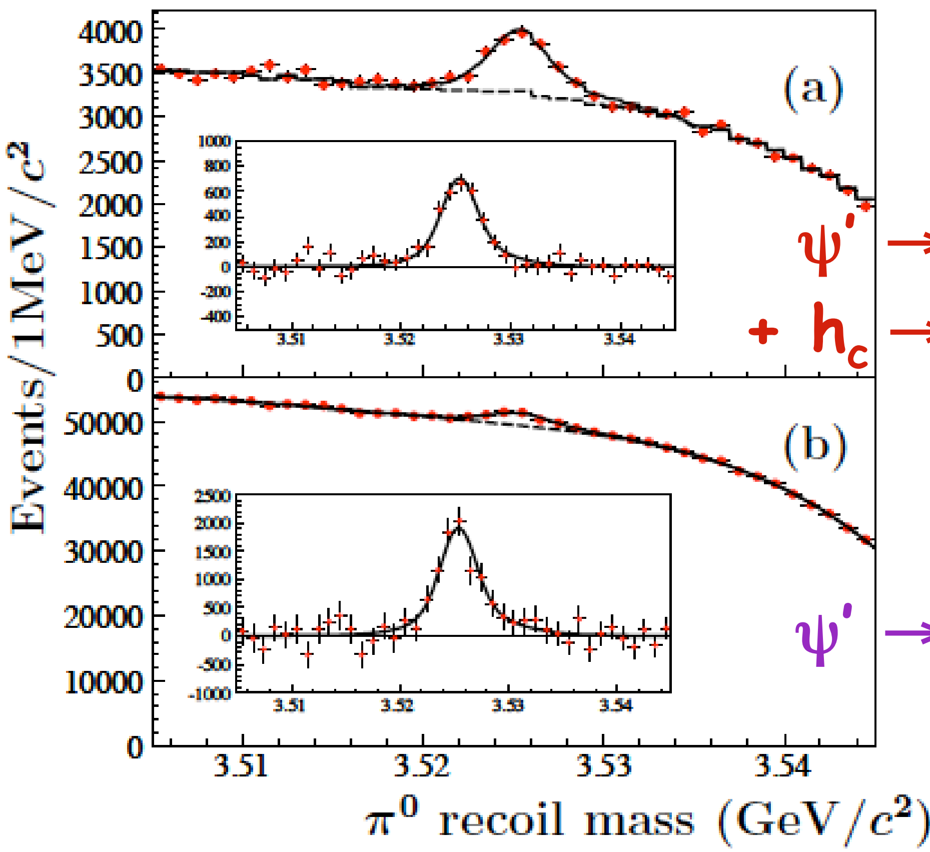
$|\cos\theta| < 0.93$ $|\Delta z| < 10$ cm $|\Delta r| < 1$ cm

b) >0.6 GeV in EMC

Background suppression (di-pion transitions) :

$\pi^+\pi^-$ ($\pi^0\pi^0$) recoil mass >7 (>15) MeV from J/ψ mass

h_c Recoil-Mass Plots



$\psi' \to \pi^0\, h_c$
$+\ h_c \to \gamma\, \eta_c$

$\psi' \to \pi^0\, h_c$

FIG. 1: (a) The π^0 recoil mass spectrum and the fit for the $E1$-tagged analysis of $\psi' \to \pi^0 h_c, h_c \to \gamma\eta_c$; (b) The π^0 recoil mass spectrum and fit for the inclusive analysis of $\psi' \to \pi^0 h_c$. Fits are indicated by solid lines, background by dashed lines. The respective background-subtracted spectra are shown in the insets.

E1-tagged:

- 3679 ± 319 events
- fit χ^2 = 33.5/36
- efficiency = 7.57 %

Gives product BF

Inclusive:

- 10353 ± 1097
- fit χ^2 = 24.5/34
- efficiencies:
  - 12.89% (E1 h_c)
  - 10.02% (hadr. h_c)

Gives h_c production BF, but efficiency weighting depends on h_c decay BF!

h_c Systematics

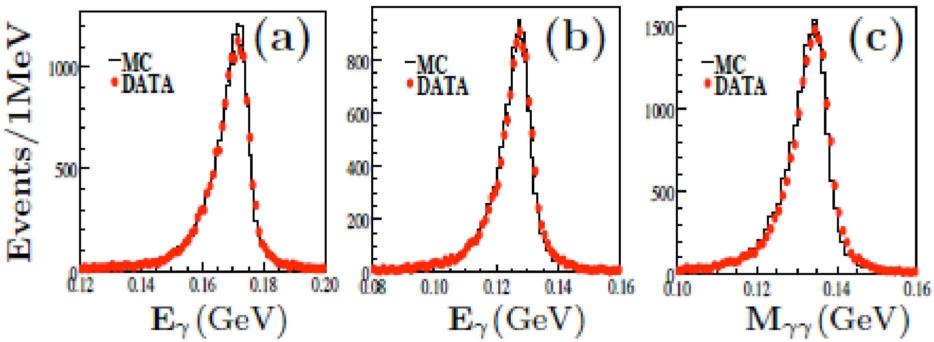


FIG. 2: Comparisons between MC (lines) and data (dots): (a) energy distribution of the radiative photon in $\psi' \to \gamma\chi_{c1}, \chi_{c1} \to \gamma J/\psi, J/\psi \to l^+l^-$; (b) energy distribution of the radiative photon in $\psi' \to \gamma\chi_{c2}, \chi_{c2} \to \gamma J/\psi, J/\psi \to l^+l^-$; (c) invariant mass distribution of π^0 in $\psi' \to \pi^0\pi^0 J/\psi, J/\psi \to l^+l^-$;

Study Samples:

π^0 efficiency, resolution

$\psi' \to \pi^0\pi^0 J/\psi$, $J/\psi \to ll$

E1 photon selection:

$e^+e^- \to e^+e^-\gamma$

(normalize with recoil mass)

TABLE I: Summary of systematic errors.

Source	$M(h_c)$(MeV/c^2)	$\Gamma(h_c)$(MeV/c^2)	$\mathcal{B}_1(10^{-4})$	$\mathcal{B}_1 \times \mathcal{B}_2(10^{-4})$	$\mathcal{B}_2$(%)
Background shape and fit range	$\boxed{0.11}$	$\boxed{0.23}$	0.4	$\boxed{0.22}$	$\boxed{4.4}$
Energy scale, position reconstruction and 1-C fit	$\boxed{0.13}$	0.06	0.5	0.10	$\boxed{2.1}$
Energy resolution	0.00	$\boxed{0.15}$	0.2	0.03	1.0
Background veto	0.05	0.03	0.0	0.03	0.3
π^0 efficiency	0.00	0.00	0.3	0.14	0.0
$E1$ photon efficiency	0.00	0.00	0.0	0.10	1.2
Number of π^0	0.00	0.00	0.6	$\boxed{0.35}$	0.6
Number of charged tracks	0.00	0.00	0.1	0.06	0.1
$N(\psi')$	0.00	0.00	0.4	$\boxed{0.19}$	0.0
$M(\psi')$	0.03	0.02	0.0	0.00	0.0
$M(\eta_c)$ and $\Gamma(\eta_c)$	0.00	0.00	0.0	0.01	0.3
Total systematic error	0.18	0.28	1.0	0.50	5.2

h_c Results

$B(\psi' \to \pi^0 h_c) = (8.4 \pm 1.3 \pm 1.0) \times 10^{-4}$

$B(h_c \to \gamma \eta_c) = (54.3 \pm 6.7 \pm 5.2)\ \%$ **

$M(h_c) = (3525.40 \pm 0.13 \pm 0.18)$ MeV

[CLEO: $3525.20 \pm 0.18 \pm 0.12$]

Hyperfine splitting: [$\langle M(^3P_1)\rangle$ is the spin-weighted mass]

$\langle M(^3P_1)\rangle - M(^1P_1) = -0.10 \pm 0.13 \pm 0.18$

$\Gamma(h_c) < 1.44$ MeV 90% CL (0.73 ± 0.45) MeV **

** Similar to values for $B(\chi_{c1} \to \gamma J/\psi)$ and $\Gamma(\chi_{c1})$

$\chi_{c0}, \chi_{c2} \rightarrow \pi^0\pi^0,\ \eta\eta$: Analysis

χ_{c1} modes forbidden by spin-parity

Cuts generally similar to h_c analysis…'

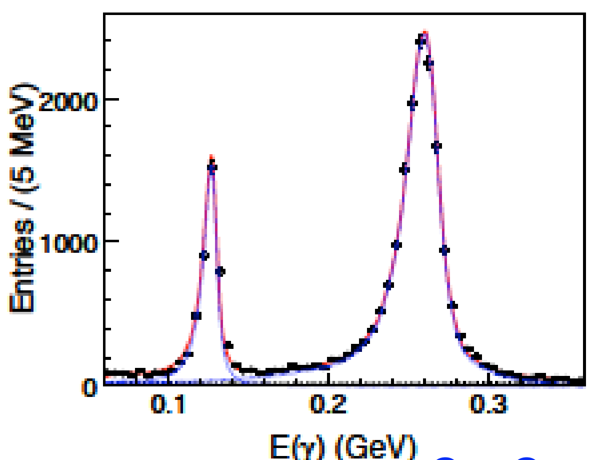
Use decay angle cuts on π^0, η

5 or 6 photons, no charged tracks

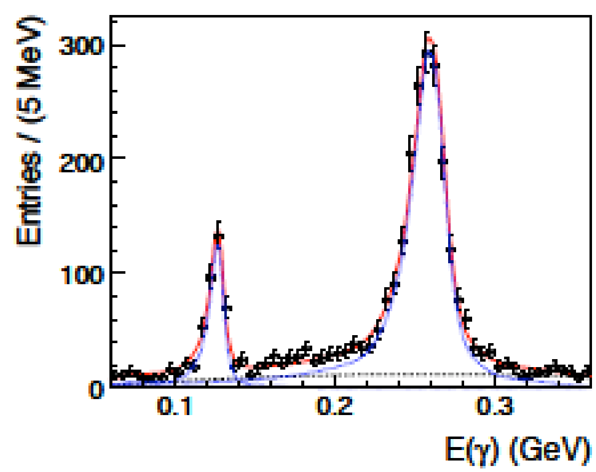
efficiencies ~ 50% (no need for isolation cuts!)

A "p_t^2" cut reduces missing particle background

(based on angle between $\pi^0\pi^0$ recoil and radiative photon)



$\chi_c \rightarrow \pi^0\pi^0$



$\chi_c \rightarrow \eta\eta$

$\chi_{c0}, \chi_{c2} \to \pi^0\pi^0, \eta\eta$: Systematics

TABLE II: Systematic uncertainties expressed in percent.

Mode	$\chi_{c0} \to \pi^0\pi^0$	$\chi_{c2} \to \pi^0\pi^0$	$\chi_{c0} \to \eta\eta$	$\chi_{c2} \to \eta\eta$
photon detection	5	5	5	5
$\pi^0(\eta)$ reconstruction	2	2	2	2
$p_{t\gamma}^2$	0.9	1.2	0.1	0.3
$\chi_{\eta\eta}$	-	-	0.6	2.6
signal shape	1.6	1.2	1.4	1.5
background shape	0.5	0.5	0.2	0.3
fitting range	0.3	0.3	0.8	1.3
trigger	0.1	0.1	0.1	0.1
$N_{\psi'}$	4	4	4	4
Total	7.0	6.9	6.9	7.5

Study Samples:

π^0, η selection:

$J/\psi \to \pi^+\pi^-\pi^0$

$J/\psi \to \eta\, p\, \bar{p}$

(recoil mass)

photon detection, conversion:

$J/\psi \to \rho^0\pi^0$

& $e^+ e^- \to \gamma\gamma$

$\chi_{c0}, \chi_{c2} \to \pi^0\pi^0,\ \eta\eta$: Results

TABLE III: Branching fraction results (in units of 10^{-3}) for each decay mode. The uncertainties are statistical, systematic due to this measurement, and systematic due to the branching fractions of $\psi' \to \gamma\chi_{cJ}$, respectively. CLEOc results are determined using their own branching fractions for $\psi' \to \gamma\chi_{cJ}$, while ours are determined using branching fractions from the PDG. If we use the CLEOc branching fractions, we find $Br(\chi_{c0} \to \pi^0\pi^0) = 3.29 \times 10^{-3}$, $Br(\chi_{c0} \to \eta\eta) = 3.51 \times 10^{-3}$, $Br(\chi_{c2} \to \pi^0\pi^0) = 0.78 \times 10^{-3}$, and $Br(\chi_{c2} \to \eta\eta) = 0.58 \times 10^{-3}$.

Mode		χ_{c0}	χ_{c2}
$\pi^0\pi^0$	This Work	$3.23 \pm 0.03 \pm 0.23 \pm 0.14$	$0.88 \pm 0.02 \pm 0.06 \pm 0.04$
	CLEOc [2]	$2.94 \pm 0.07 \pm 0.32 \pm 0.15$	$0.68 \pm 0.03 \pm 0.07 \pm 0.04$
	PDG [10]	2.43 ± 0.20	0.71 ± 0.08
$\eta\eta$	This Work	$3.44 \pm 0.10 \pm 0.24 \pm 0.13$	$0.65 \pm 0.04 \pm 0.05 \pm 0.03$
	CLEOc [2]	$3.18 \pm 0.13 \pm 0.31 \pm 0.16$	$0.51 \pm 0.05 \pm 0.05 \pm 0.03$
	PDG [10]	2.4 ± 0.4	< 0.5

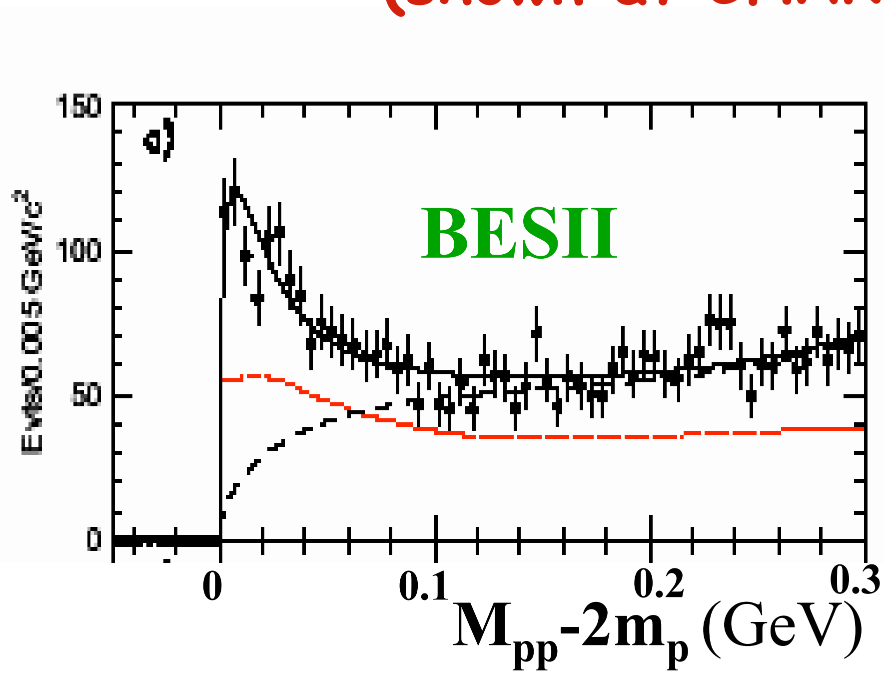
3 errors

Bit higher than CLEO; closer when consistent $\psi' \to \gamma\chi_c$ BF used

BUT: we both agree old PDG is mostly too low… (3 of 4 cases)

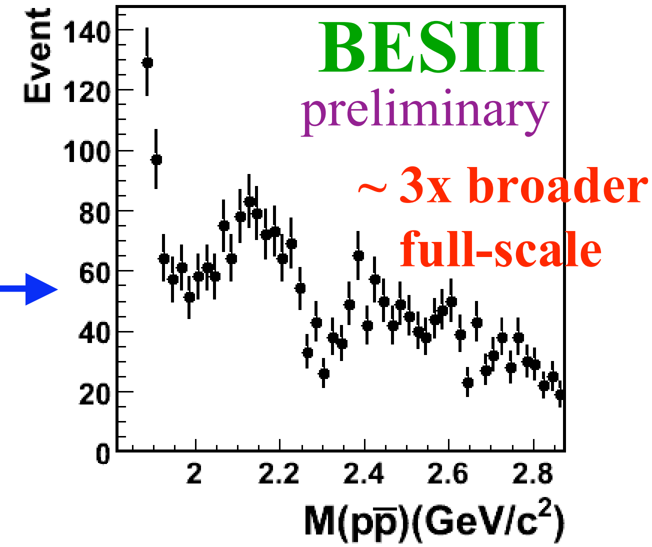
$J/\psi \rightarrow \gamma\, p\, \bar{p}$: "Teaser Plots"

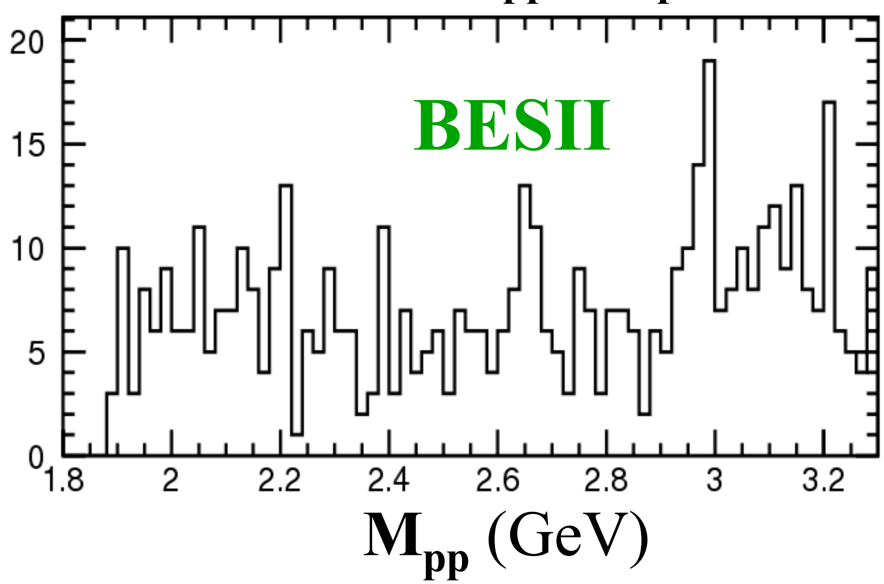
(shown at CHARM 2009, FPCP2009)



J/ψ

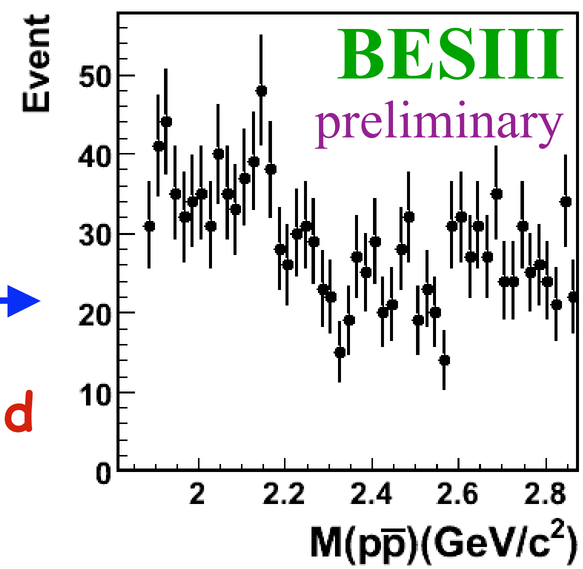
Threshold resonance!





ψ'

NO threshold resonance!



$J/\psi \rightarrow \gamma\ p\ \bar{p}$

Low-mass ppbar enhancement seen in BESII

But, NOT seen in ψ' decays

Ironically, we confirm with ψ'-tagged J/ψ , with no mention of analogous ψ' decay in the paper…

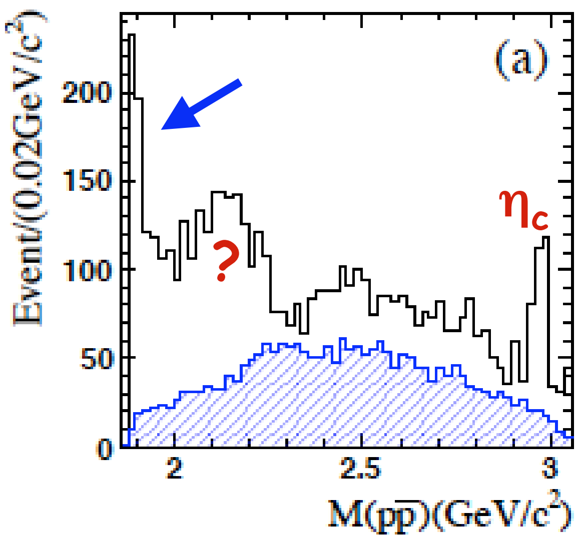
(but it's still absent! You saw "teaser plots" from '09 confs)

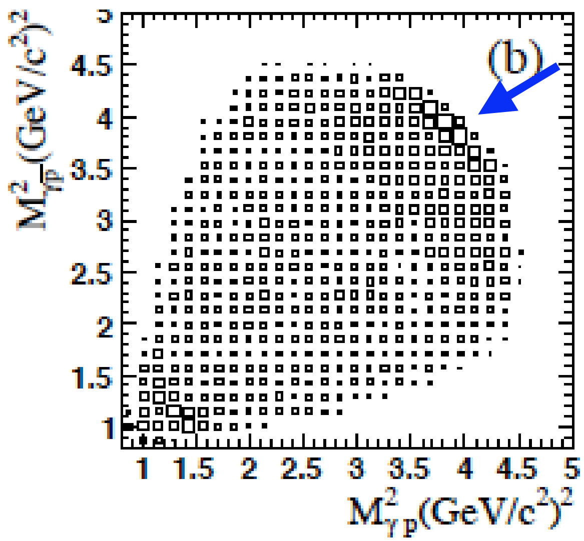
Also NOT observed in other cases:

$p\bar{p}$ cross-sections, B decays, $\Upsilon \rightarrow \gamma\ p\ \bar{p}$ $J/\psi \rightarrow \omega\ p\ \bar{p}$

Dis-favors a pure final-state interaction (FSI) explanation

New BESIII data:





$J/\psi \to \gamma\, p\, \bar{p}$

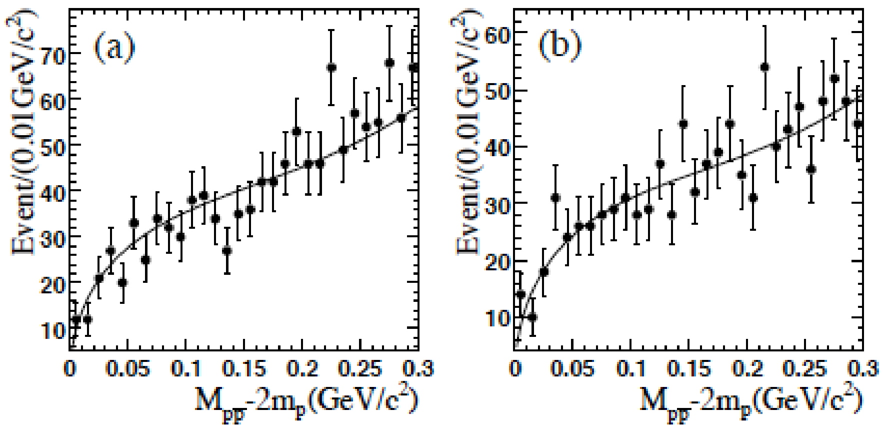


FIG. 2: The $p\bar{p}$ mass spectrum near threshold for: (*a*) selected $\psi' \to \pi^+\pi^- J/\psi(J/\psi \to \pi^0 p\bar{p})$ events for the same real data sample. (*b*) phase-space MC $\psi' \to \pi^+\pi^- J/\psi(J/\psi \to \gamma p\bar{p})$ events that satisfy the $\gamma p\bar{p}$ selection criteria. The smooth curves are the results of the fit described in the text.

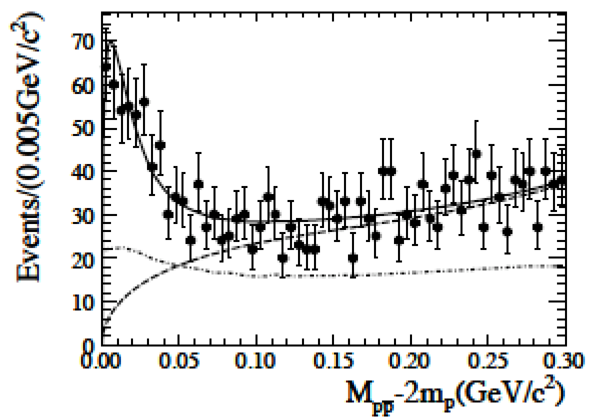


FIG. 3: The $p\bar{p}$ invariant mass spectrum for the $\psi' \to \pi^+\pi^- J/\psi(J/\psi \to \gamma p\bar{p})$ after final event selection. The solid curve is the fit result; the dashed curve shows the fitted background function, and the dash-dotted curve indicates how the acceptance varies with $p\bar{p}$ invariant mass.

Control sample:

$J/\psi \to \pi^0\, p\, \bar{p}$

S-wave B-W fit:

$M = 1861^{+6}_{-13}{}^{+7}_{-26}$ MeV

$\Gamma < 38$ MeV

It's certainly fair to discuss the best way to fit this, but clearly something is happening near threshold !

2010-11:
First Open Charm Data Runs

Open Charm: Statistics

2010 Data sample:

$920\ pb^{-1}$ (on peak) CLEO-c = $818\ pb^{-1}$

$75\ pb^{-1}$ (scan)

2011 Data sample:

$>1500\ pb^{-1}$ (thru Sunday 27 Mar)

300-$500\ pb^{-1}$ (next few weeks**)

Then, running at ~4010 MeV, few x 100 pb^{-1}

(for spectroscopy, D_s physics)

and ~ 2 weeks for tau mass

(BEPCII/BESIII has new beam-energy measurement system)

>> 2010-11 $\psi(3770)$ Data sample: already 3x CLEO-c

2012: likely back to J/ψ -- go for 1 Billion

(take that, Dr. Evil)

** not clear when switchover will be...

Open Charm: Tagging

Only enough energy for D Dbar pair:
can't even have one additional pion !

"D tagging": fully reconstruct one hadronic D decay:
10-15% (efficiency x BF) per D

Key variables: (just like B factories!)

> $E = E_{cand} - E_{beam}$ peaks @ 0 : E conservation
> $M_{bc} = sqrt(E_{beam}^2 - p_{cand}^2)$ peaks @ M_D : p conservation

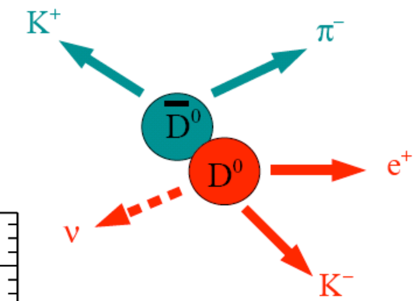
Result:

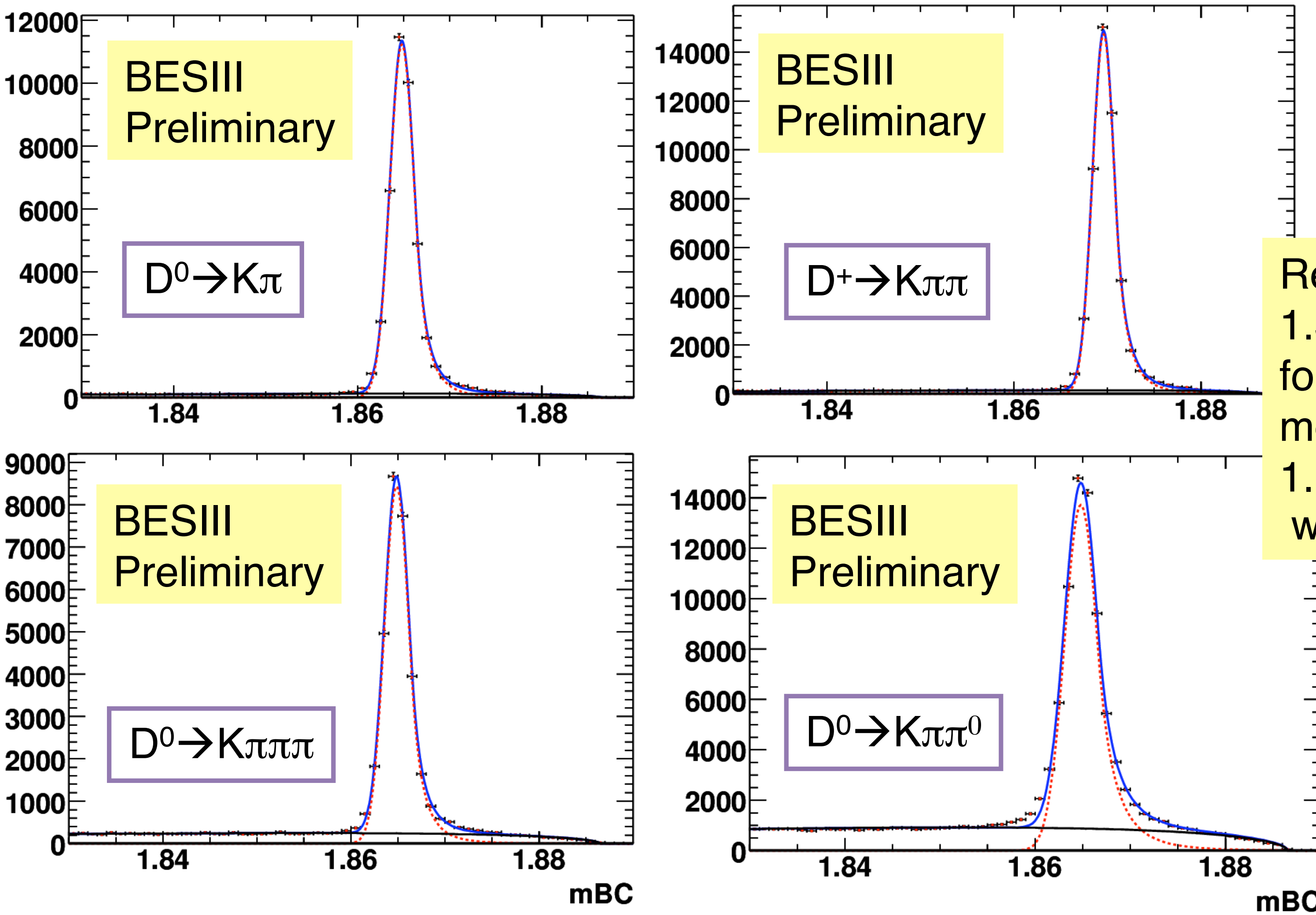
> Remove continuum very effectively
> Know direction of other D (magnitude of p known a priori)
> Can do final states with neutrinos by 4-mom. balance
> Can get precision absolute hadronic BFs

single vs. double tags: # DD pairs is cancelled by algebra

BESIII Single Tags

@$\psi(3770)$ with $420 pb^{-1}$ first clean single tagging sample:

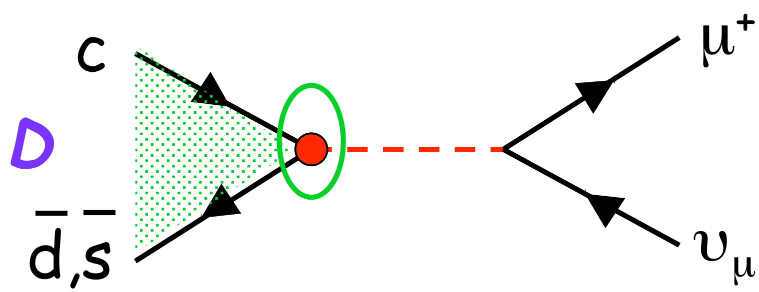




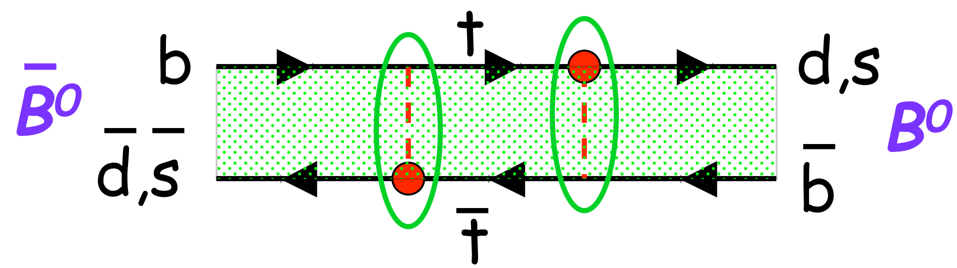
Resolution:
1.3 MeV
for pure charged modes;
1.9 MeV for modes with one π^0.

Charm as a QCD Lab I

Leptonic D Decays



f_D LQCD = exp't ?



use LQCD f_B here

$\boxed{\text{for } V_{td},\ V_{ts}}$

f_D is a "decay constant":

chance that quarks are at same place

~$|\psi(0)|^2$: square of wavefunction at origin

(need quark overlap, since weak interaction is short-range)

Precision Lattice QCD test: need LQCD for f_B, f_{Bs}

NOTE: B factories only do D_s, not D^+ -- want both !!

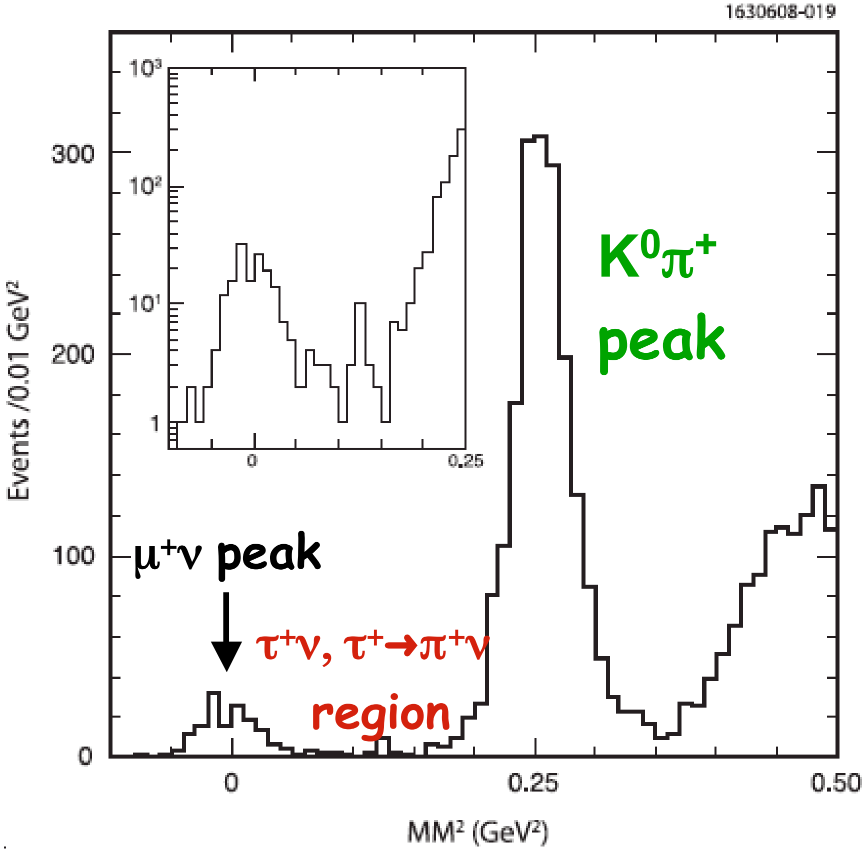
CLEO-c $D^+ \rightarrow \mu^+ \upsilon$

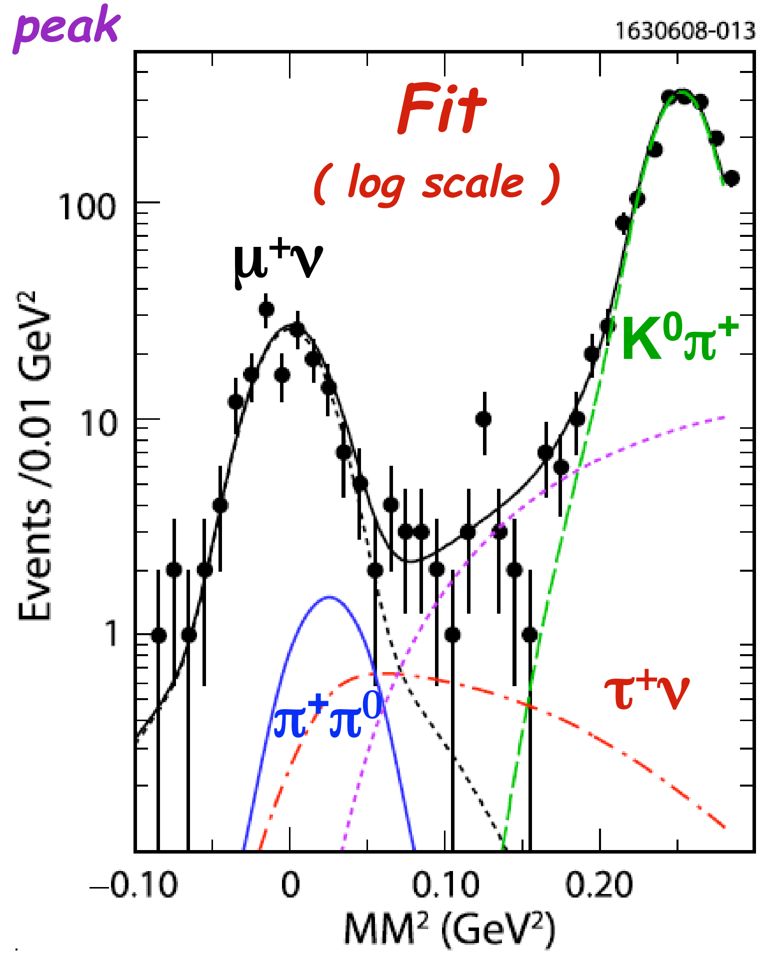
PRD 78, 052003
2008 818 pb^{-1}

Neutrino from 4-momentum balance
can plot (missing mass)^2: MM^2

Signal side is one track + unobserved neutrino
Veto on extra unmatched showers > 250 MeV

>>> D-tagging gives a clean, isolated signal peak

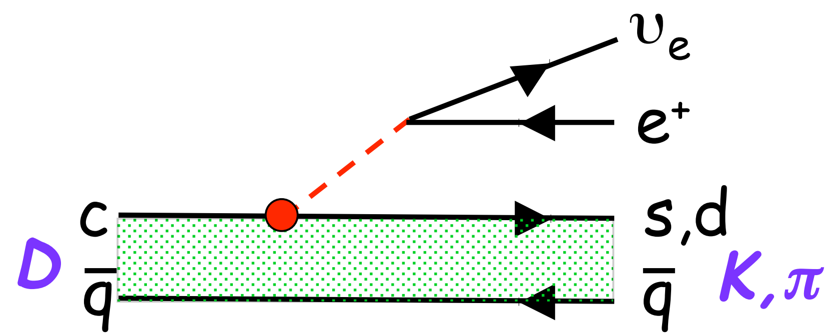




Charm as a QCD Lab II

Semileptonic D Decays

Form factors, CKM
FF help w/ B decays



"Form Factor":

~ *Chance that quarks stay bound into a given final state*

Relate $B \Rightarrow \pi e \upsilon$ to $D \Rightarrow \pi e \upsilon$

for V_{ub}

Also, ratios of $D \Rightarrow \pi e \upsilon$ to $D \Rightarrow \mu \upsilon$

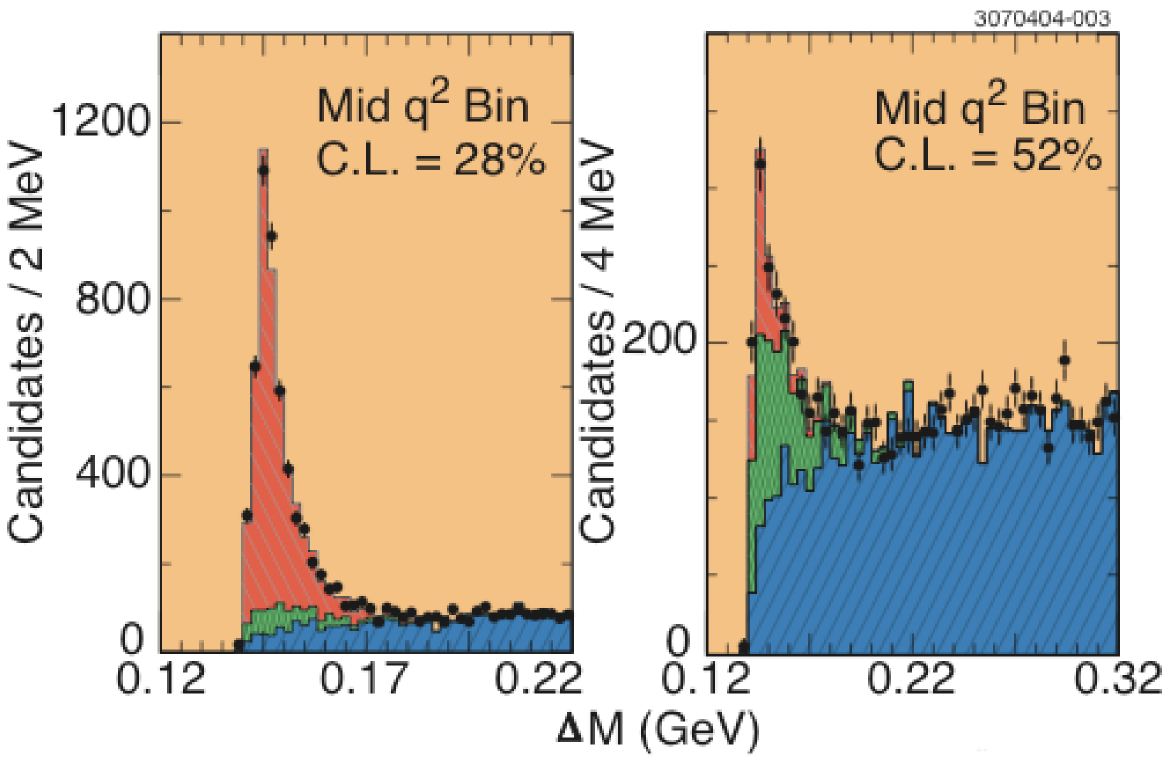
and $D \Rightarrow K e \upsilon$ to $D_s \Rightarrow \mu \upsilon$

cancel CKM elements: Pure LQCD tests...

Pre-CLEO-c Semileptonic results

PRL 94, 011802 (2005)

$D^0 \to K^- e^+ \nu$ $\quad$ $D^0 \to \pi^- e^+ \nu$



Recent CLEO
@ 10.6 GeV

World's best when done...

But note Kaons under pion peak ! (even w/ RICH...)

Decays with K are 10x more common than π :

Separate via "particle ID" techniques (hard)

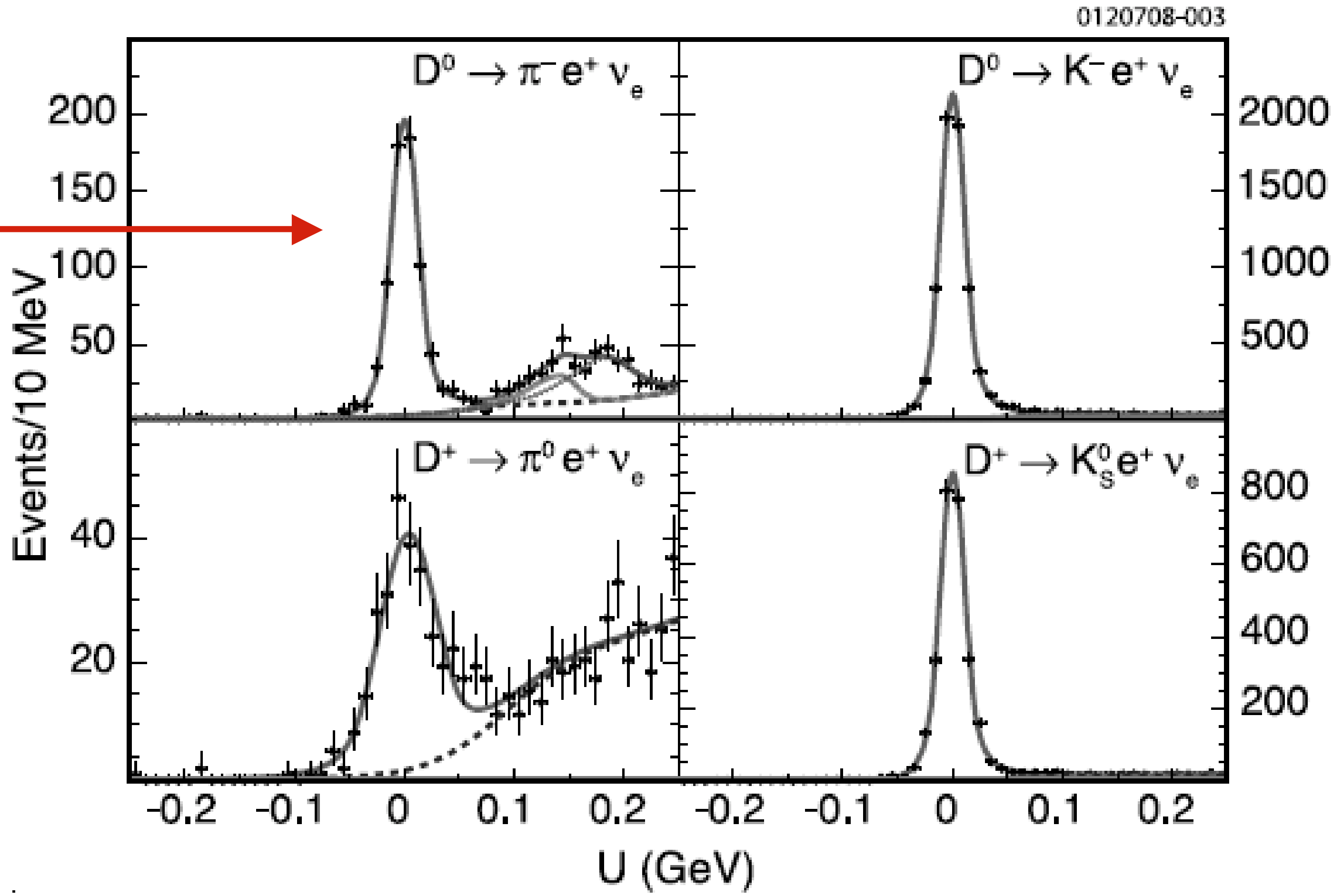
CLEO-c: excellent **kinematic** *separation!*

CLEO-c $D^{0,+} \to h\ e^{+}\ \upsilon$

PRD 79, 052010
2008 281 pb^{-1}

Threshold charm: Gives **kinematic** separation of K, π

Very clean, considering:
- Cabibbo-suppressed
- neutrino !



$$U = E_{miss} - p_{miss}$$

(Similar to missing-mass^2)

Prospects for Flavor Physics

Look at the size of the stat / syst / FSR errors from CLEO-c

$\psi(3770)$: D^0 and D^+ physics with 818 pb^{-1}

** f_D $(D^+ \rightarrow \mu\nu)$: $(\pm 4.1 \pm 1.2)\%$

$\psi(3770)$: D^0 and D^+ physics with 281 pb^{-1}

** $f(q^2=0)$ $(D^0 \rightarrow \pi l \nu)$: $(\pm 5.0 \pm 0.9 \pm 0.4)\%$ [3-par. series fit]

$Br(D^0 \rightarrow K\pi)$: $(\pm 0.9 \pm 1.5 \pm 0.9)\%$

$Br(D^+ \rightarrow K\pi\pi)$: $(\pm 1.1 \pm 1.8 \pm 0.8)\%$

@4170 MeV: D_s physics with ~ 600 pb^{-1}

* f_{Ds} $(D_s^+ \rightarrow \mu\nu, \tau\nu)$: $(\pm 2.5 \pm 1.2)\%$

* $Br(D_s^+ \rightarrow KK\pi)$: $(\pm 4.2 \pm 2.9)\%$

Often significant gains to be made with increased data samples, even if systematic errors are simply matched, not improved.

ALSO: analyses using Quantum Correlation, C-tags, etc. are ALL statistics-starved at CLEO-c

Peak Scan and non-DDbar Decays

These will likely be the first results from the $\psi(3770)$ data

Scan:

- Much more data than KEDR, CLEO-c
- Lineshape: 2 DD thresholds, may be interesting state?
- D^0/D^+ production ratio vs. Energy

Non-DD decays:

- Some modes seen (radiative, dipion, …)
- Some disagreement (BESII vs. CLEO-c) on inclusive non-DD
- 3x CLEO-c data to search further

BESIII Physics Papers

BESIII Publications

Observation of a $p\overline{p}$ Mass Threshold Enhancement in $\psi' \to \pi^+\pi^- J/\psi(J/\psi \to \gamma p\overline{p})$ Decay
M. Ablikim *et al.*, Chinese Physics C **34**, 421 (2010).

Branching Fraction Measurements of χ_{c0} and χ_{c2} to $\pi^0\pi^0$ and $\eta\eta$
M. Ablikim *et al.*, Physical Review D **81**, 052005 (2010).

Measurements of $h_c(^1P_1)$ in ψ' Decays
M. Ablikim *et al.*, Physical Review Letters **104**, 132002 (2010).

Evidence for ψ' Decays into $\gamma\pi^0$ and $\gamma\eta$
M. Ablikim *et al.*, Physical Review Letters **105**, 261801 (2010).

Measurement of the Matrix Element for the Decay $\eta' \to \eta\pi^+\pi^-$
M. Ablikim *et al.*, Physical Review D **83**, 012003 (2011).

First Observation of the Decays $\chi_{cJ} \to \pi^0\pi^0\pi^0\pi^0$
M. Ablikim *et al.*, Physical Review D **83**, 012006 (2011).

Study of $a_0(980) - f_0(980)$ Mixing
M. Ablikim *et al.*, Physical Review D **83**, 032003 (2011).

Confirmation of the $X(1835)$ and Observation of the Resonances $X(2120)$ and $X(2370)$ in $J/\psi \to \gamma\pi^+\pi^-\eta'$
M. Ablikim *et al.*, Physical Review Letters **106**, 072002 (2011).

Conclusions

Detector and accelerator successfully commissioned;
a few teething pains, but no show-stoppers

World's best Charmonium data samples;
already publishing results

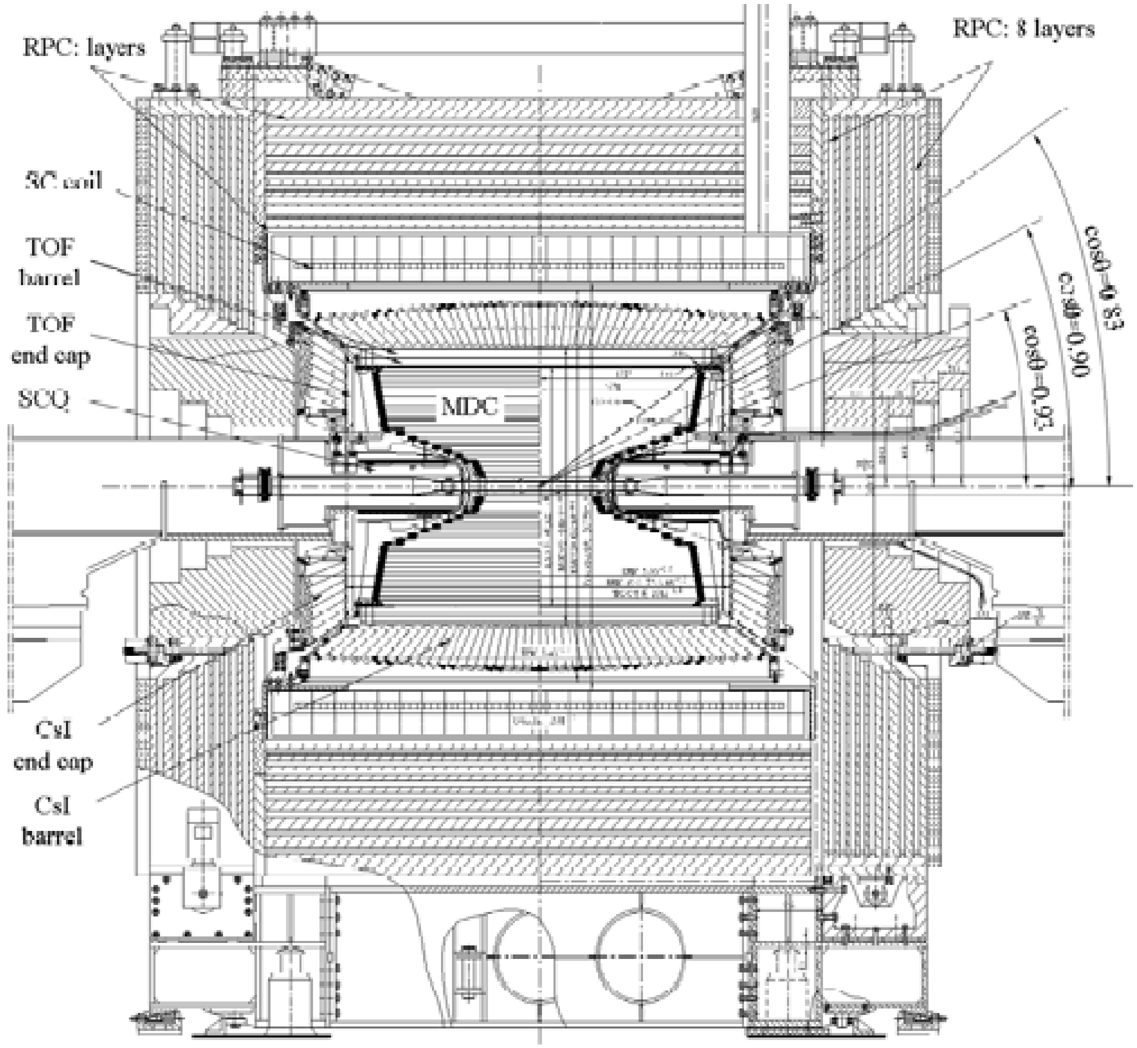
High-statistics open-charm physics data run in progress

Stay tuned for more! Should be a big wave of results for summer conferences…

BACKUP SLIDES

Some performance numbers
are plots are out-dated…
Included mostly for pictures !

BESIII Detector



Design and Construction of the BESIII Detector
NIM A614 (2010) 345-399

Drift chamber

- **To measure the momentum of charged particles by its bended curvature in a magnetic field**
- **7000 Signal wires: 25 μm gold-plated tungsten**
- **22000 Field wires: 110 μm Al**
- **Gas: He + C_3H_8 (60/40)**
- **Momentum resolution@1GeV:**

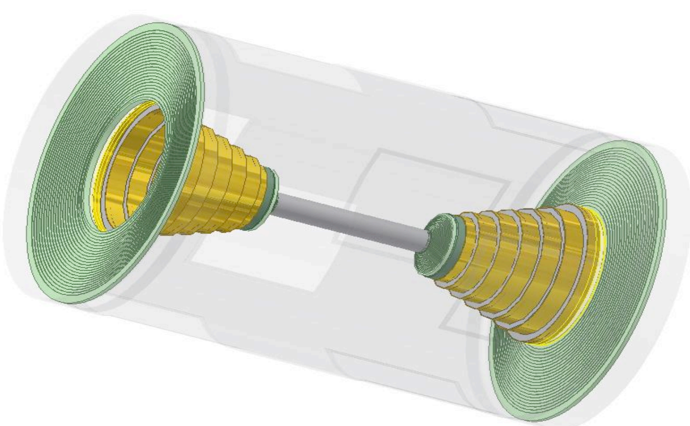
$$\frac{\sigma_{P_t}}{P_t} = 0.32\% \oplus 0.37\%$$

Babar: ~ 110 μm

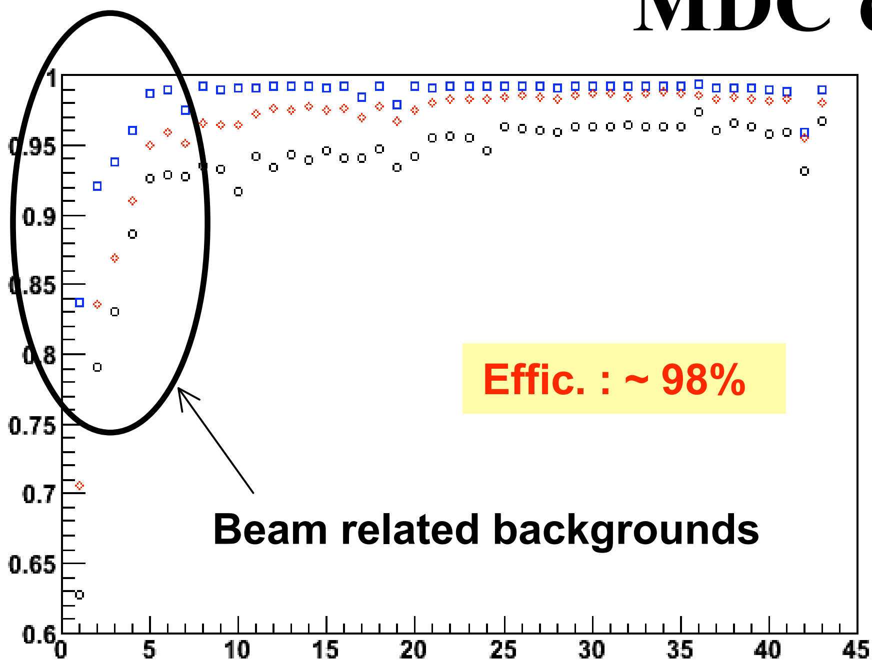
BELLE: ~ 130 μm

CLEO: ~ 110 μm

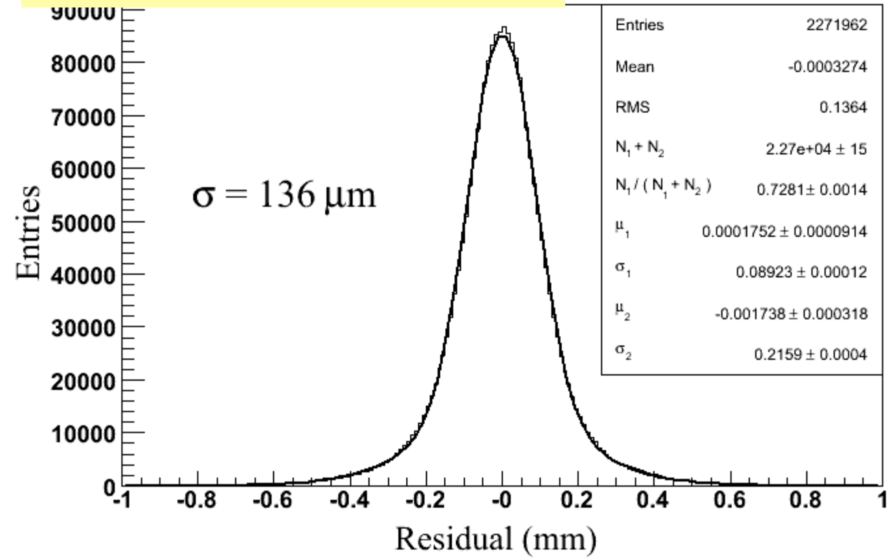
BESIII: ~ 130 μm



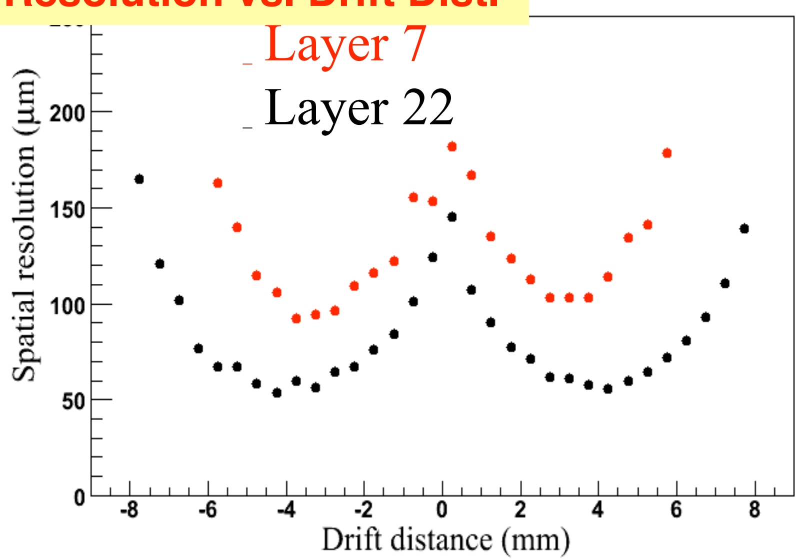
MDC calibration



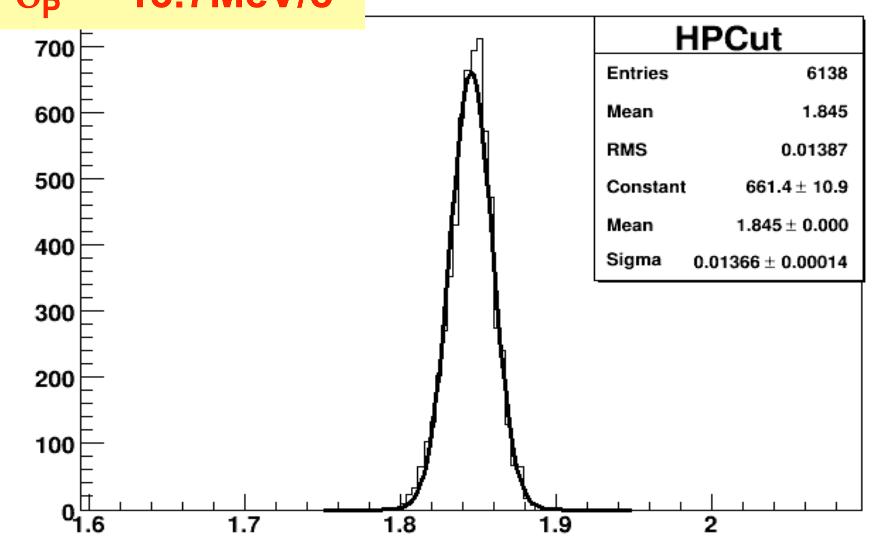
Hit Resolution: 136 μm



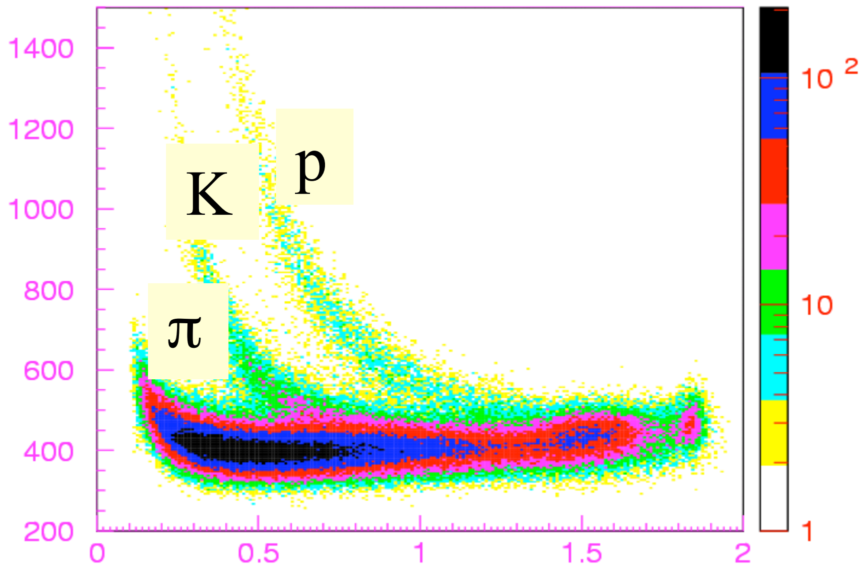
Resolution vs. Drift Dist.



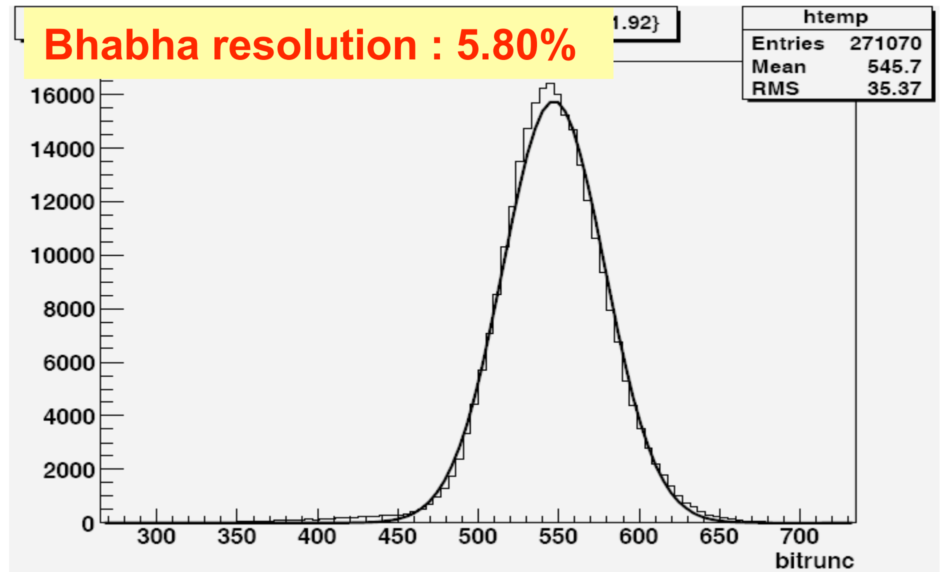
σ_P = 13.7MeV/c



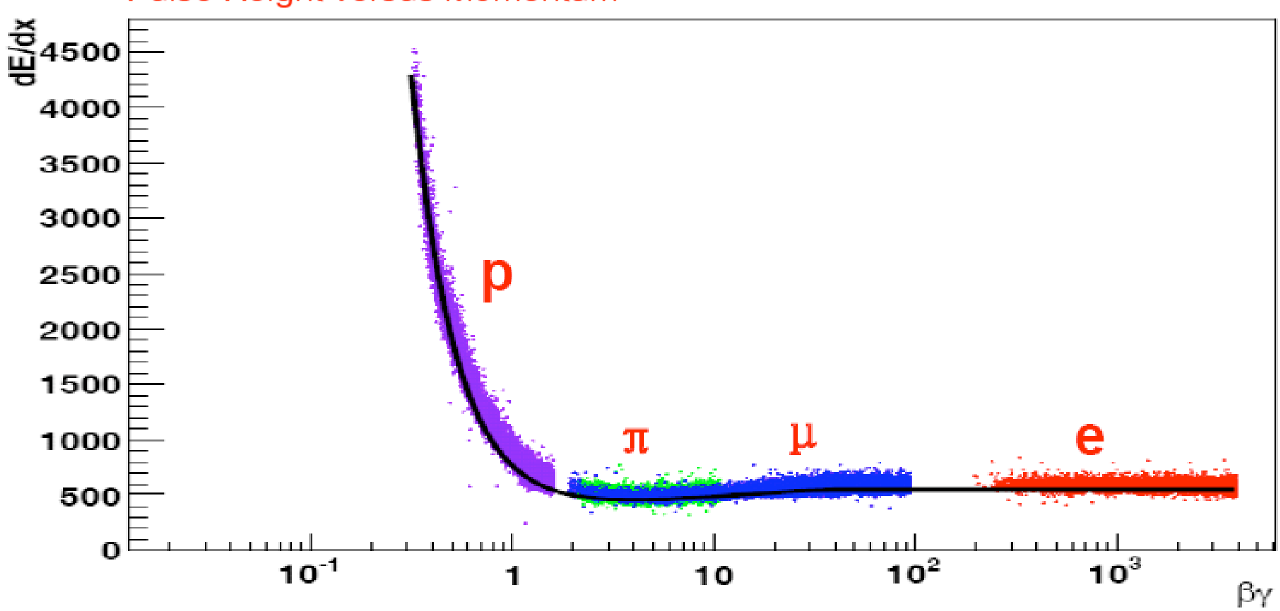
dE/dx Performance



Pulse Height versus Momentum



Current resolution closer to 5.0 %



BESIII CsI(Tl) crystal calorimeter

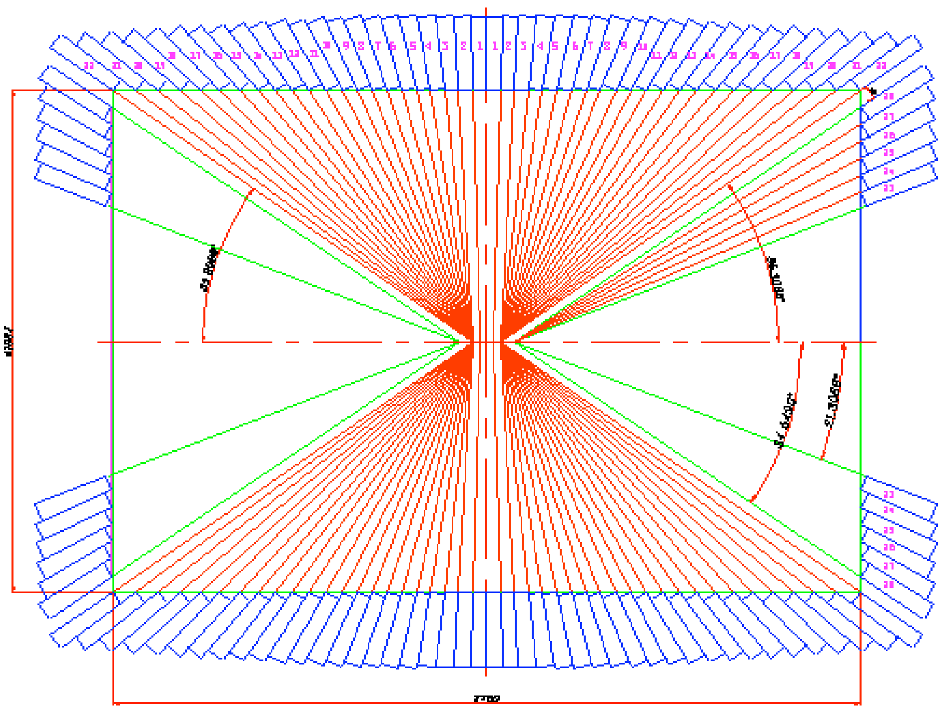
- To measure the energy of electromagnetic particles
- Barrel: 5280 crystals_Endcap: 960 crystals
- Crystal: (5.2 x 5.2 – 6.4 x 6.4) x 28 cm^3
- Readout: 13000 Photodiodes, 1 cm × 2 cm,
- Energy range_20MeV – 2 GeV
- position resolution: 6 mm @ 1 GeV
- Tiled angle: theta ~ 1 - 3^o, phi ~ 1.5^o

Babar: 2.67% @1GeV

BELLE: 2.2% @1GeV

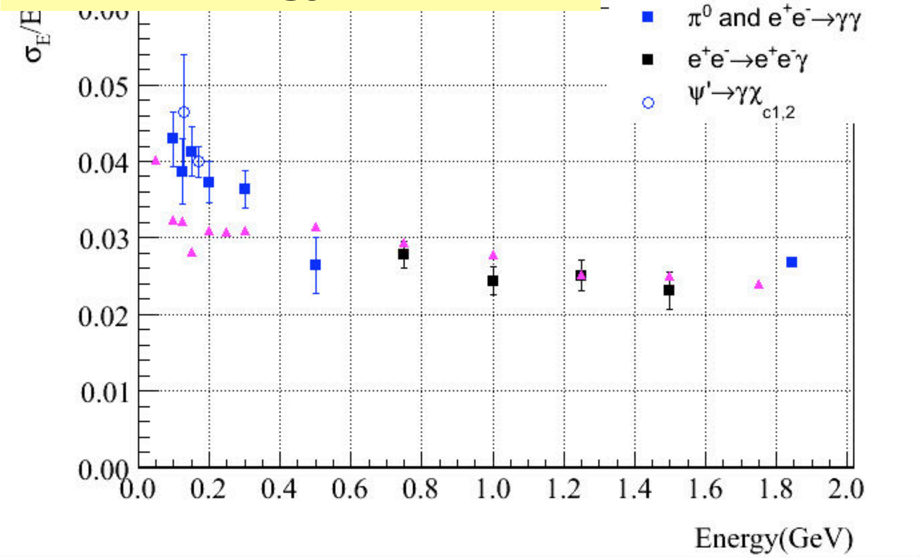
CLEO: 2.2% @1GeV

BESIII: 2.5%@1GeV

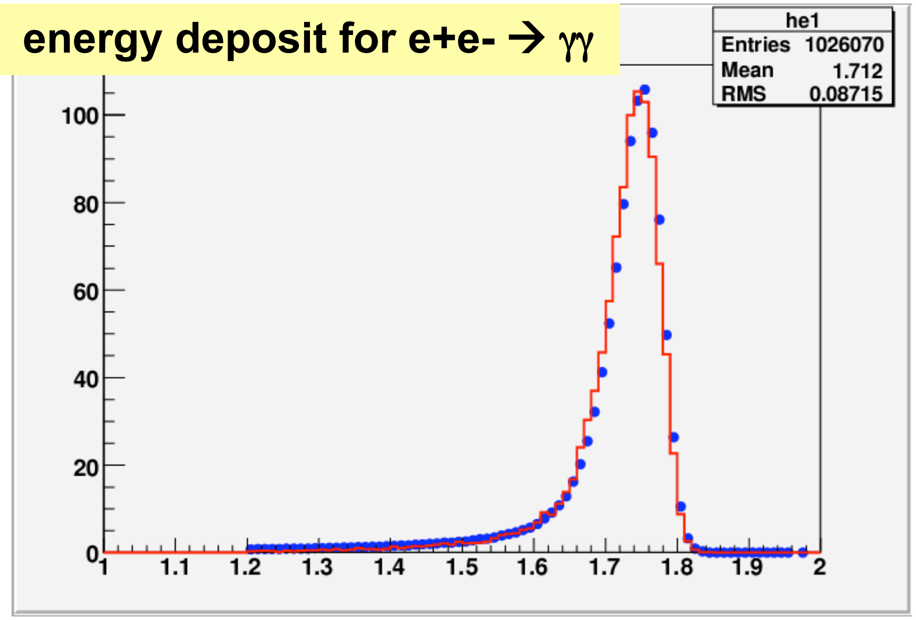


EMC calibration

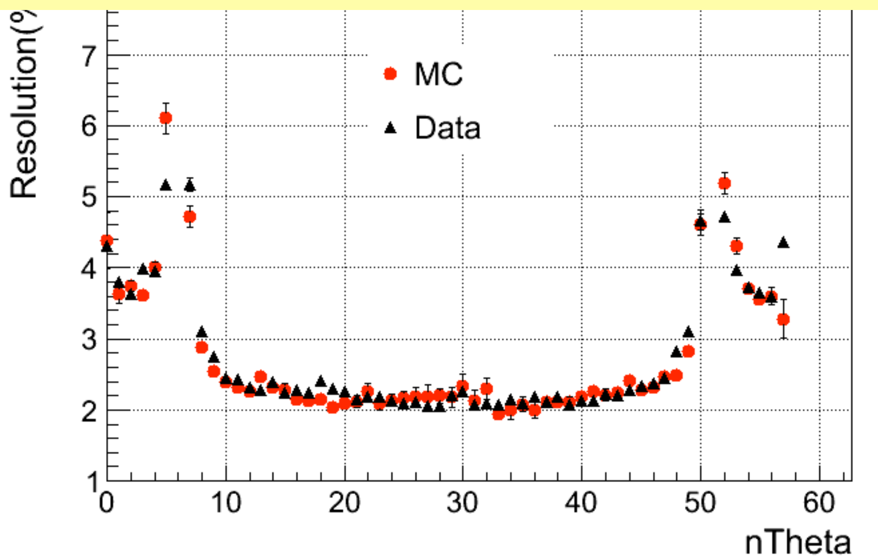
Barrel energy resolution



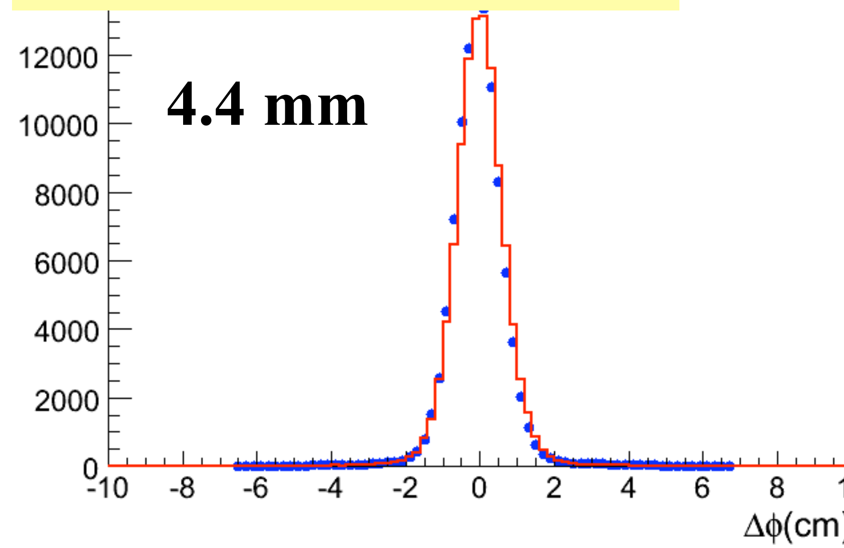
energy deposit for e+e- → γγ



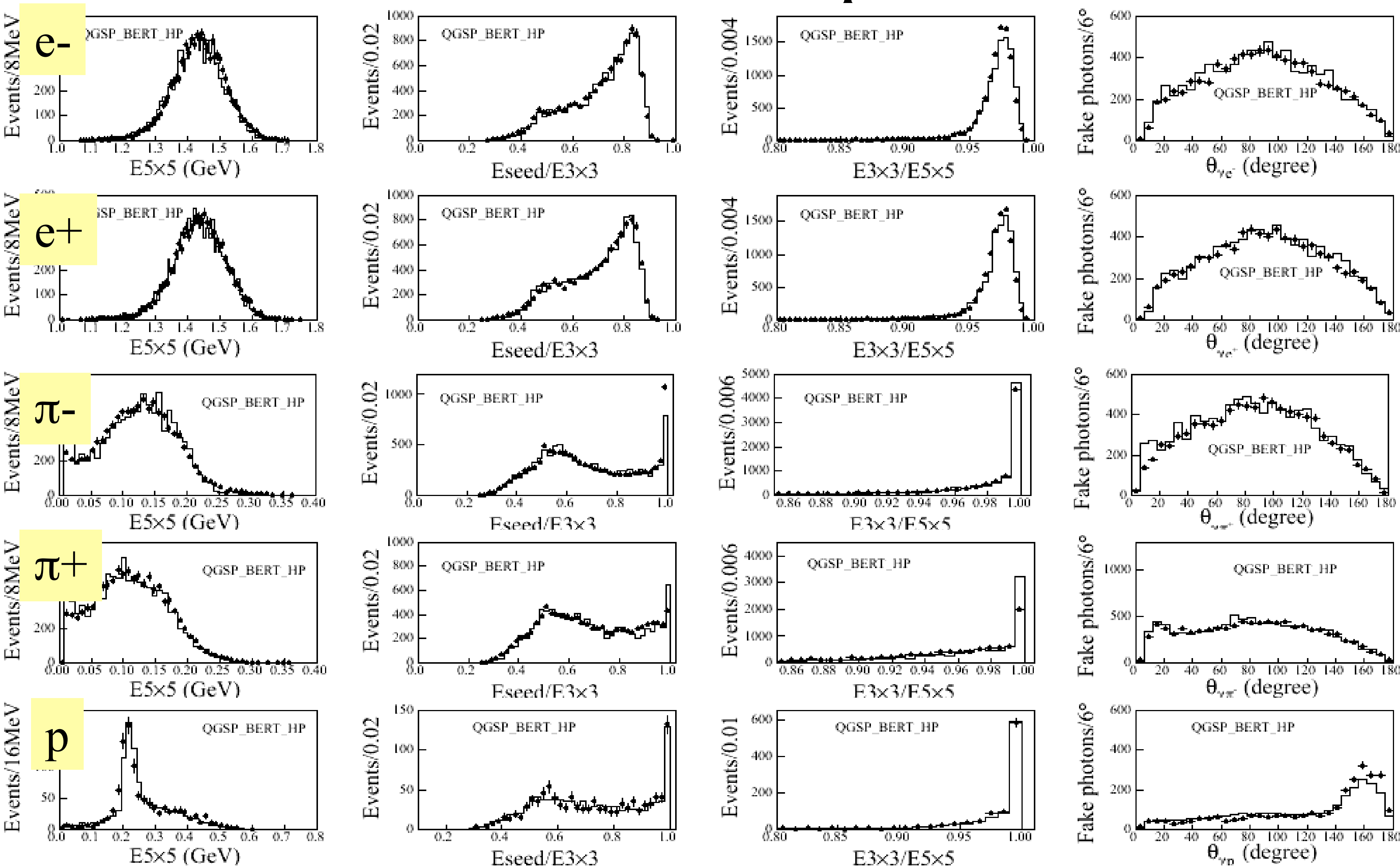
energy resolution for Bhabha events



Position resolution for Bhabha



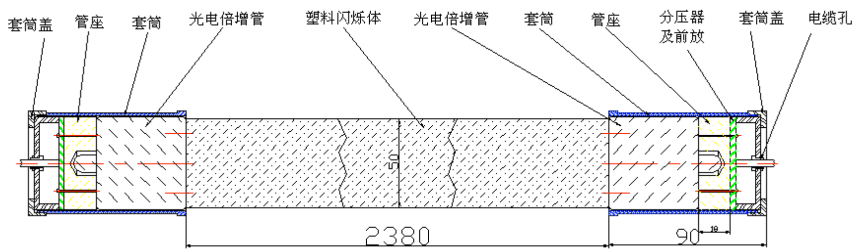
Data / MC comparison

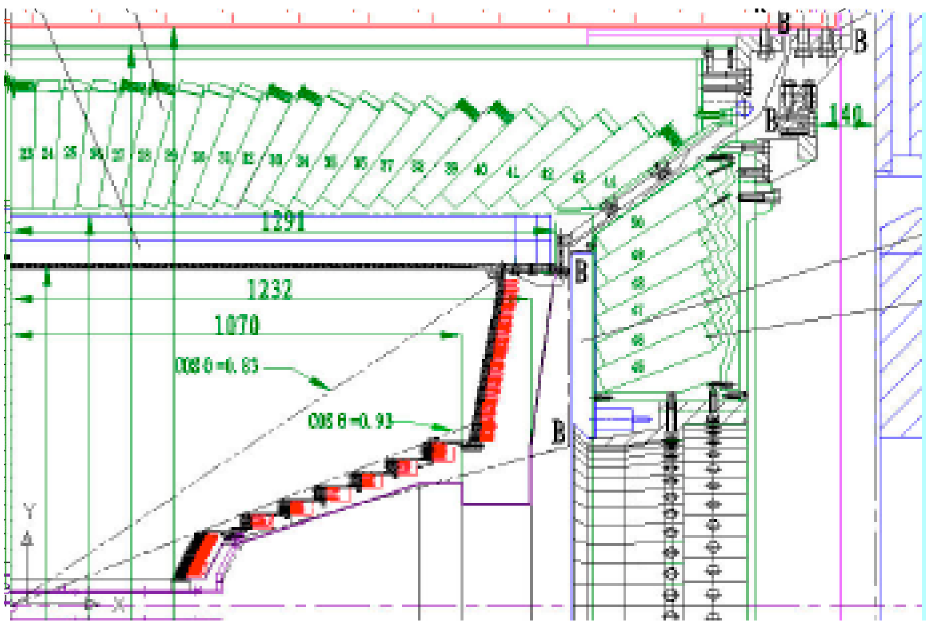


PID: TOF system

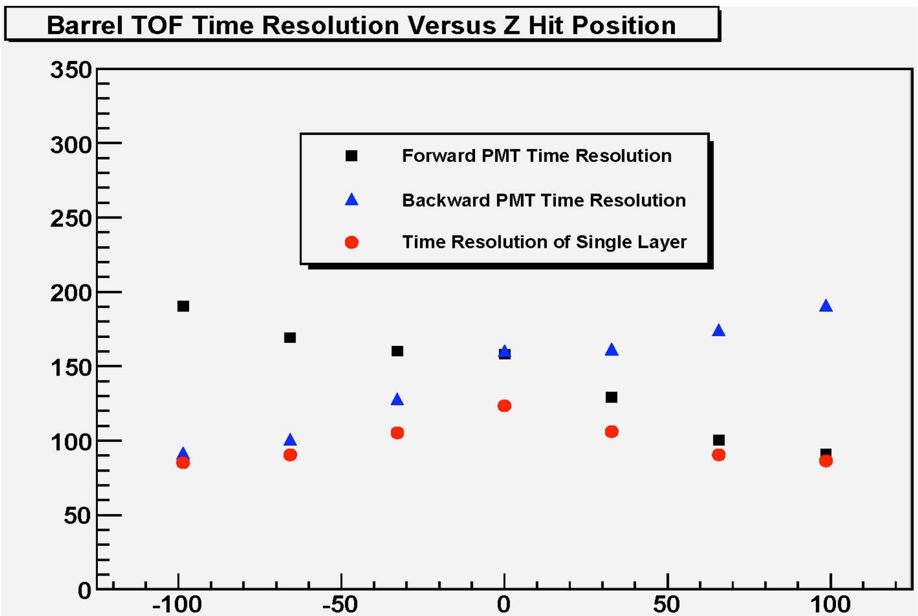
- **Barrel: 2 x 88 BC408, 2.4 m long x 5 cm thick**
- **Endcap: 2 x 48 BC408**
- **PMT: Hamamatzu R5942**

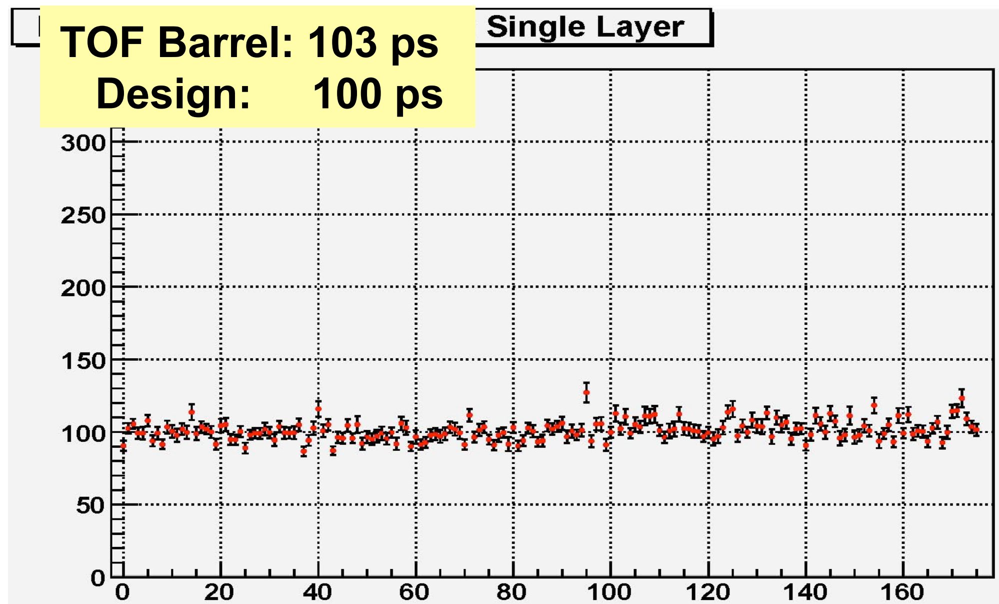
Expt.	L (cm)	Resolution
BESIII	240	90 ps
CLEOII	280	139 ps
OBELIX	300	170 ps
BELLE	255	90~100 ps
CDFII	279	100 ps
HARP	180-250	160 ps

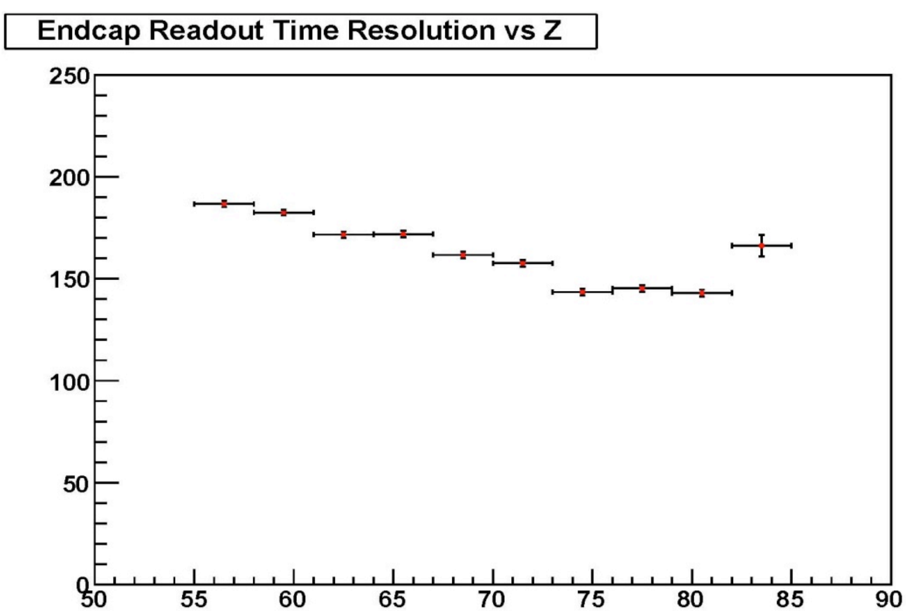


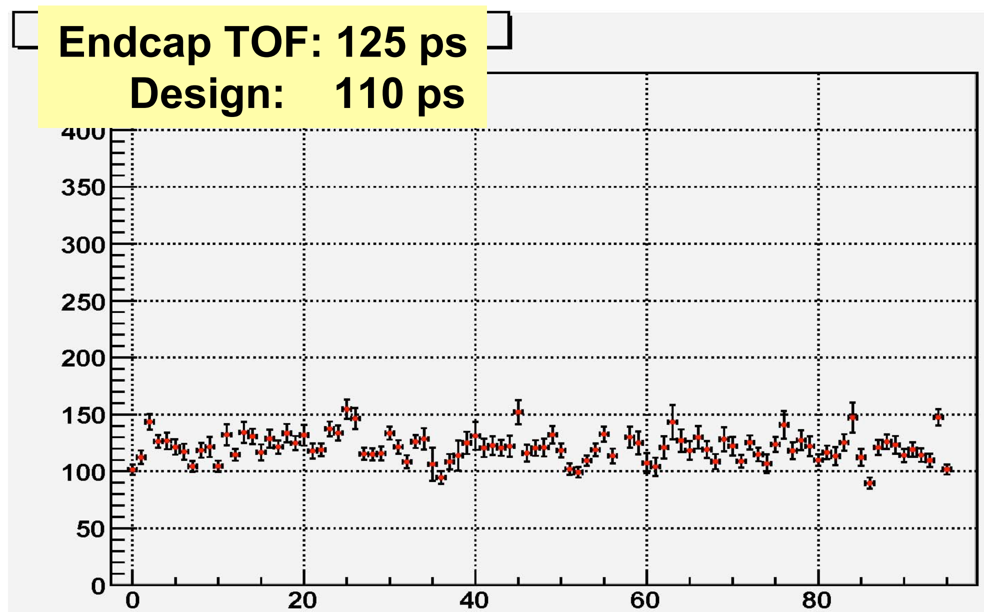


TOF calibration



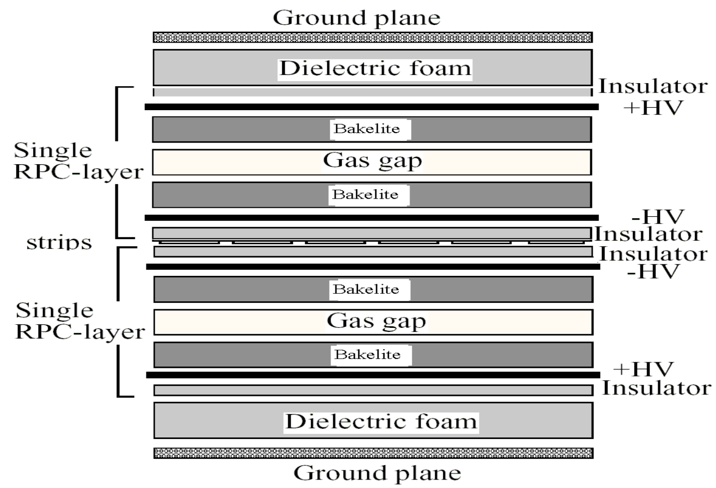


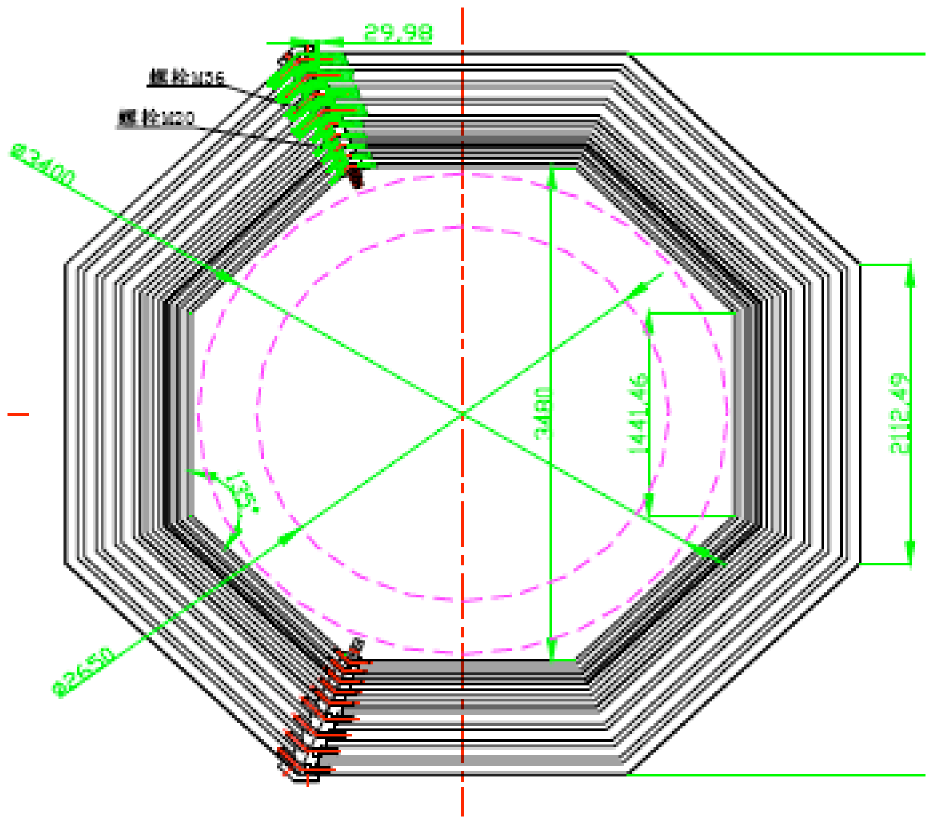


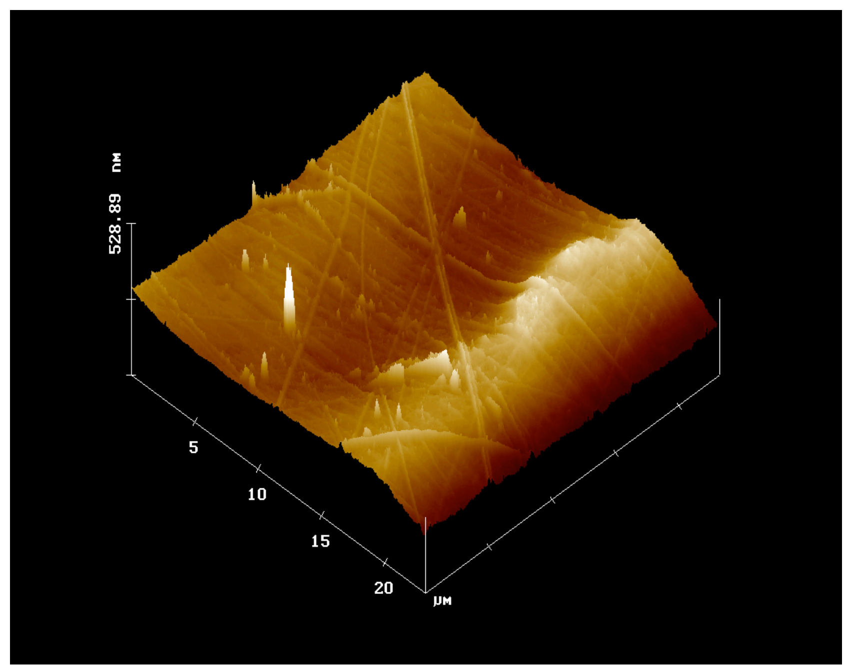


μ system : RPC

- 9 layer, 2000 m^2
- Special bakelite plate w/o lineseed oil
- 4cm strips, 10000 channels
- Noise less than 0.1 Hz / cm^2

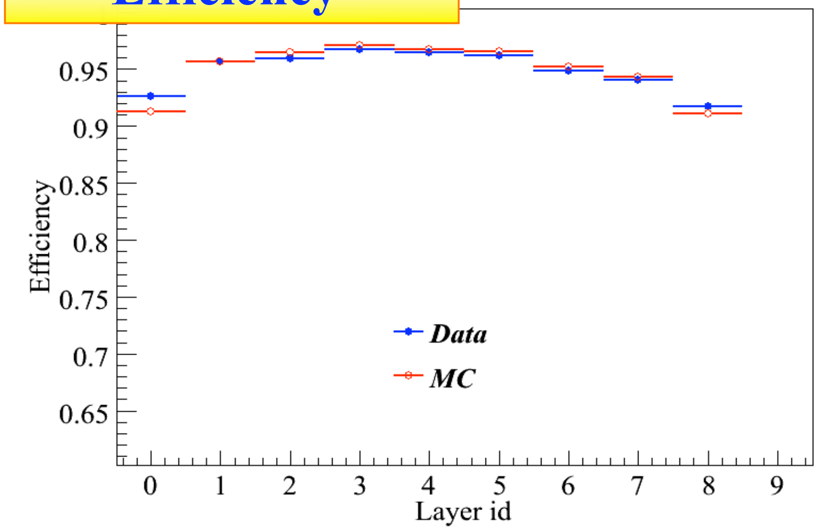




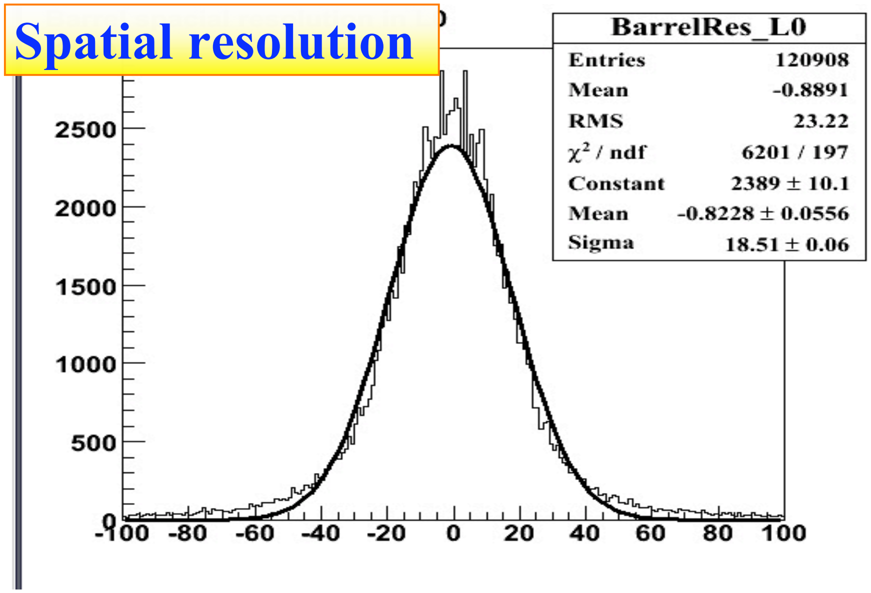


MUON Chamber

Efficiency



Spatial resolution



Single counting rate