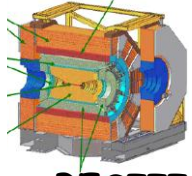
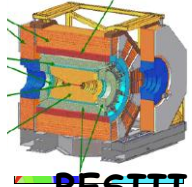


BESIII

Status di BESIII

M.Anelli ,R. Baldini Ferroli, M.Bertani, A. Calcaterra, Y.Wang, A. Zallo, (LNF)
S. Pacetti (PG)
M. Destefanis, M. Greco, L. Fava, M. Maggiora, S. Spataro (TO)

Roma, CSN1, 22 gennaio 2013



BESIII

Approvazione ufficiale PE MAE I-PRC!

EXECUTIVE PROGRAMME

FOR SCIENTIFIC AND TECHNOLOGICAL COOPERATION

BETWEEN THE ITALIAN REPUBLIC

AND THE PEOPLE'S REPUBLIC OF CHINA FOR THE YEARS 2013 - 2015

Signed in Beijing on January 16, 2013 in two originals in the English language, each text being equally authoritative.

For the Italian Party

Mr. Alberto Bradanini
The Ambassador of Italy
to the P.R.China

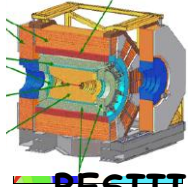
For the Chinese Party

Mr. Chen Linhao
Deputy Director-General
Department International
Cooperation
Ministry of Science and
Technology

应用科学（包括物理、化学、数学等）/Applied sciences	用于带电粒子径迹探测的模拟读出圆筒 GEM 探测器模型的建造 Construction of a cylindrical-shaped prototype of charged track detector employing the GEM technique with analog readout	欧阳群 OUYANG Qun	中国科学院高能物理研究所 Institute of high energy physics, Chinese Academy of Sciences	Alessandro Calcaterra	意大利国家核物理研究院 (INFN) Frascati 国家实验室 Frascati National Laboratories of the INFN (National Institute for Nuclear Physics)
应用科学（包括物理、化学、数学等）/Applied sciences	强相互作用与电磁相互作用之间相角的实验研究 Experimental study of the phase between strong and electromagnetic interactions	王平 WANG Ping	中国科学院高能物理研究所 Institute of High Energy Physics	Marco Maggiora	意大利原子核研究院 Istituto Nazionale di Fisica Nucleare

EXECUTIVE PROGRAMME:

http://www.esteri.it/MAE/IT/Politica_Estera/CooperScientificaTecnologica/ProgrammiEsecutivi/ElencoProgrammiEsecutivi.htm



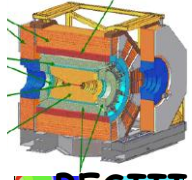
Attività BESIII Italia

NEWS:

- ***siglato a Pechino l'accordo MAE: entrambi i progetti Italia-Cina (grande rilevanza scientifica –CGEM; mobilità scientifica) APPROVATI!!***
- ***ZDD unico luminometro online dell'esperimento!***
- ***contatti in corso per l'allargamento di BESIII Italia***
- ***studi in corso a TO per deployment Offline BESIII su infrastruttura CLOUD***

LNF: M.Anelli ,R. Baldini Ferroli, M.Bertani, A. Calcaterra, Y.Wang, A. Zallo (3FTE)
PG: S. Pacetti (30% su DTZ)
TO: M. Destefanis, M. Greco, L. Fava, M. Maggiora, S. Spataro (2.3 FTE)
Grazie a Monica Bertani per l'ottimo lavoro fatto nello scorso biennio!!

- status ZDD
- analisi dati:
  - $J/\psi \rightarrow$ nnbar, ppbar (pubblicato *PRD86 (5) 032014 2012*)
  - J/ψ scan per misura fase: notevoli progressi nell'analisi
  - ψ', ψ'' $\rightarrow$ n nbar, p pbar (in corso)
  - $e^+e^- \rightarrow$ n nbar scan bassa energia e e+e- $\rightarrow$ $\Lambda\Lambda$bar e $\Sigma\Sigma$bar in programma
- upgrade di BESIII:
  - proposta da LNF camera interna cilindrica a GEM, geometria da definire
  - per il 2013 piccole richieste s.j. grosso del finanziamento da progetto MAE
- Infrastruttura CLOUD con interfacciamento GRID proposta a TO presso il CdC

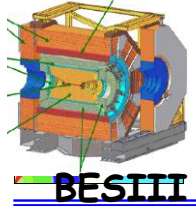


BESIII timeline

- **Luglio 2008: prime collisioni e^+e^- in BESIII**
- **Nov 2008: ~14M ψ(2S) eventi per calibrazione**
- **2009: 106M ψ(2S) 4xCLEOc**
  225M J/ψ 4xBESII
- **2010-11: 2.9 fb^{-1} ψ (3770) 3.5xCLEOc**
- **2011: 0.5 fb^{-1} @ 4.01GeV (D_s, XYZ)**
- **2012: 0.4B ψ(2S)**
  J/ψ: 1B eventi, lineshape
  scan sottosoglia per misura della fase relativa ampiezze e.m e forte della J/ψ , richieste dalla collab italiana, 14pb^{-1}/pto, tot 5 punti
  R scan @ 2.4, 2.8, 3.4 GeV
- **2013: 515 pb^{-1} @ 4260 MeV**

il piu` grande set di
J/ψ, ψ(2S) e ψ(3770)
al mondo

- **luminosità di picco raggiunta: 6.5x10^{32} $cm^{-2}s^{-1}$ @ 3770 MeV**



BESIII plans

- **Run in corso: dicembre 2012 – giugno 2013**
  - **5 days Y(4260) scan**
  - **>500 pb^{-1} @ 4360 MeV**
  - **5 days Y(4360) scan**
  - **60 days R scan: ~ 100 pts > 3.8 GeV, 5-8 pb^{-1}/pt, precisione 2-3%**
  - **10 days τ scan**

- **luminosità attesa: → 10^{33} $cm^{-2}s^{-1}$ @ 3770 MeV**

Risultati pubblicati

χ_{cJ} decays and transitions

Sottomesso o pubblicato dopo la CSN1 di settembre

1) Search for hadronic transition $\chi_{cJ} \to \eta_c \pi^+\pi^-$ and observation of $\chi cJ \to K\bar{K}\pi\pi\pi$. PRD87, 012002 (2013)
2) Measurement of χ_{cJ} decaying into $p\bar{p}\pi^-$ and $p\bar{p}\pi^-\pi^0$. PRD86, 052011 (2012)
3) Observation of χ_{cJ} Decays to $\Lambda\bar{\Lambda}\ \pi^+\pi^-$. PRD86, 052004 (2012)
4) Two-photon widths of the $\chi_{c0,2}$ states and helicity analysis for $\chi_{c2} \to \gamma\gamma$. PRD85, 112008 (2012)
5) Observation of χ_{c1} decays into vector meson pairs $\phi\phi$, $\omega\omega$, and $\omega\phi$. PRL107, 092001 (2011)
6) Study of χ_{cJ} radiative decays into a vector meson. PRD83, 112005 (2011)
7) First Observation of the Decays $\chi_{cJ} \to \pi^0\pi^0\pi^0\pi^0$. PRD83, 012006 (2011)

Studies of η, η', $\eta(1405)$, η_c and η_c' mesons

8) observation of $\eta^c(2S)$ in $\psi' \to \gamma K_s K^+ \pi^+\pi^-\pi^-$. [arXiv:1301.1476]
9) Search for weak decays of η and η' in $J/\psi \to \phi\eta(\eta')$. [arXiv:1211.3600]
10) Measurements of Baryon pair decays of χ_{cJ} mesons. [arXiv:1211.2283]
11) Observation of η_c decaying into $\Sigma^+\ \Sigma^-$ and $\Xi^-\Xi^+$. [arXiv:1210.2831]
12) The analysis on h_c exclusive decays into $\gamma\eta_c$. PRD86, 092009 (2012)
13) Search for η and η' Invisible Decays in $J/\psi \to \phi\eta$ and $\phi\eta'$. [arXiv.1209.2469]
14) Observation of $e^+e^- \to \eta J/\psi$ at center-of-mass energy $s^{1/2}$=4.009 GeV. PRD86, 071101 (2012)
15) Evidence for $\eta_c \to \gamma\gamma$ and Measurement of $J/\psi \to 3\gamma$. [arXiv.1208.1461]
16) First observation of $\eta(1405)$ decays into $f^0(980)\pi^0$. PRL108,182001 (2012)
17) Measurements of the mass and width of the ηc using $\psi' \to \gamma\eta c$. PRL108, 222002 (2012)
18) Search for η'_c decays into vector meson pairs. PRD84, 091102 (2011)
19) $\eta\pi^+\pi^-$ Resonant Structure around 1.8 GeV/c^2 and $\eta(1405)$ in $J/\psi \to \omega\eta\pi^+\pi^-$. PRL107, 182001 (2011)
20) Search for CP and P violating pseudoscalar decays into $\pi\pi$. PRD84, 032006 (2011)
21) Measurement of the Matrix Element for the Decay $\eta' \to \eta\pi^+\pi^-$. PRD83, 012003 (2011)

Risultati pubblicati

Decays of $c\bar{c}$ mesons

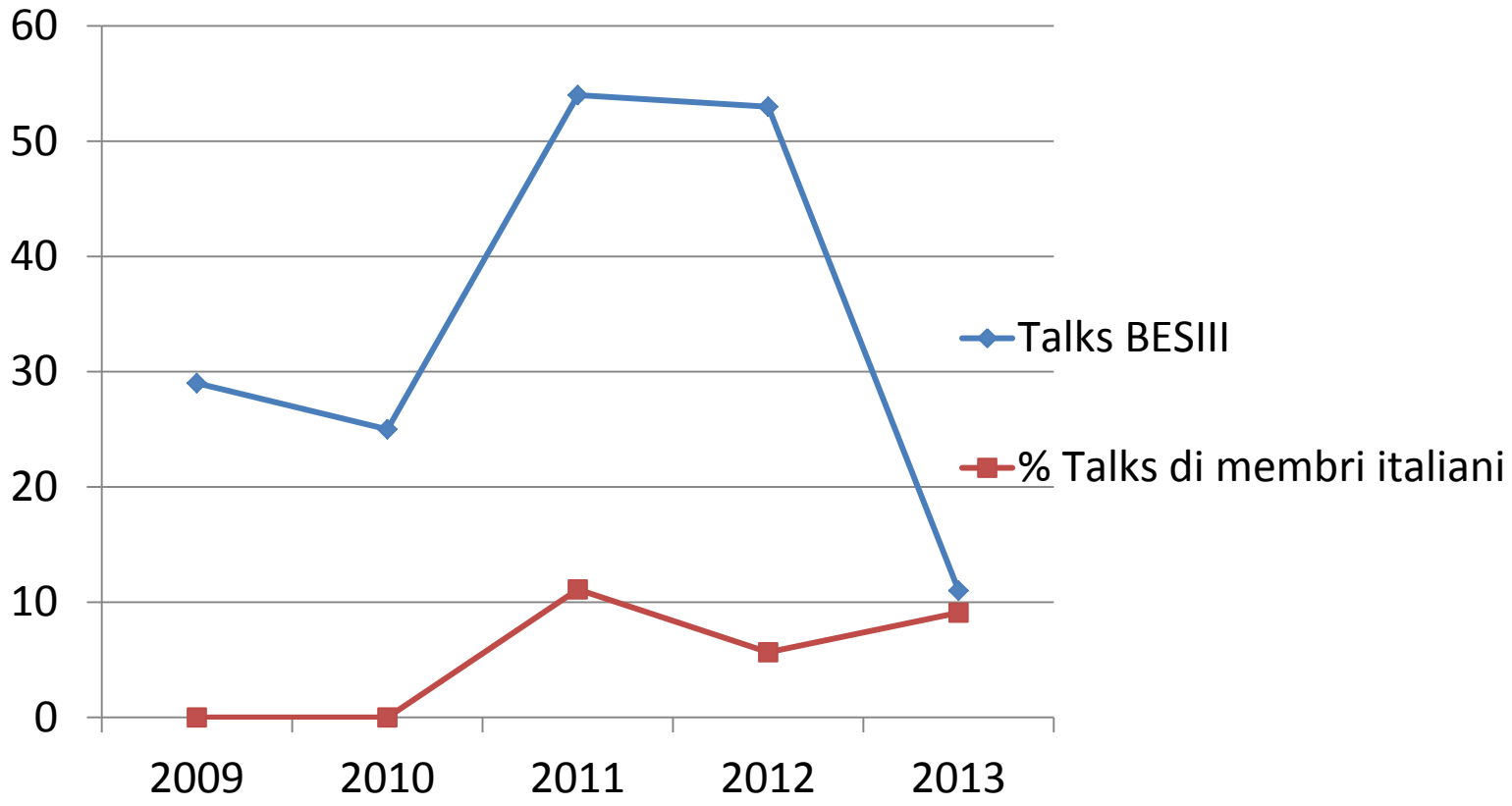
Sottomesso o pubblicato dopo la CSN1 di settembre

22) Partial wave analysis of J/ψ→γηη. [arXiv:1301.0053]
23) PWA of J/ψ → γφω. [arXiv:1211.5668]
24) Measurement of ψ' → γpKΛ. [arXiv:1211.563] accepted by PRD
25) Measurement of branching fractions for J/ψ an ψ(3686) to to $\Lambda\bar{\Lambda}\pi^0$ and ΛΛη. [arXiv:1211.4682]
26) Precision measurement of branching fractions of ψ' → π^0 J/ψ and η J/ψ. PRD86, 092008 (2012)
27) Determination of the number of ψ(2S) events at BesIII. [arXiv:1209.6199]
28) Experimental study of ψ' decays to $K^+K^-\pi^0$ and $K^+K^-\eta$. PRD86, 072011 (2012)
29) First observation of the isospin violating decay J/ψ→$\Lambda\bar{\Sigma}^-_0$+c.c.. PRD86, 032008 (2012)
30) Determination of the number of J/ψ events with J/ψ→inclusive decays. [arXiv:1207.2865]
31) Observation of two new N* resonances in ψ (3686) → $p\bar{p}\pi^0$. [arXiv:1207.0223]
32) First observation of the M1 transition ψ(3686)→γηc(2S). PRL109, 042003 (2012)
33) Study of J/ψ→$p\bar{p}$ and J/ψ→$n\bar{n}$ [arXiv:1205.1036] PRD86 (5), 032014 (2012)
34) Evidence for the Direct Two-Photon Transition from ψ' to J/ψ. [arXiv:1204.0246]
35) Precision measurement of the branching fractions of J/ψ → $\pi^+\pi^-\pi^0$ and ψ' →$\pi^+\pi^-\pi^0$. PLB710, 594 (2012)
36) Spin-Parity Analysis of $p\bar{p}$ Mass Threshold Structure in J/ψ and ψ' Radiative Decays. PRL108 112003 (2012)
37) Higher-order multipole amplitude measurement in ψ(2S)→γχc2. PRD84, 092006 (2011)
38) Evidence for ψ' decays into γπ^0 and γη. PRL105 261801 (2010)

Scalar mesons and new states

39) Search for a light Higgs-like boson A_0 in J/ψ radiative decays. PRD85 092012 (2012)
40) Study of $a_0^0(980)$–$f_0(980)$ mixing. PRD83, 032003 (2011)
41) Confirmation of the X(1835) and observation of the resonances X(2120) and X(2370) in J/ψ→$\gamma\pi^+\pi^-\eta'$. PRL106, 072002 (2011)

Comunicazioni a conferenze

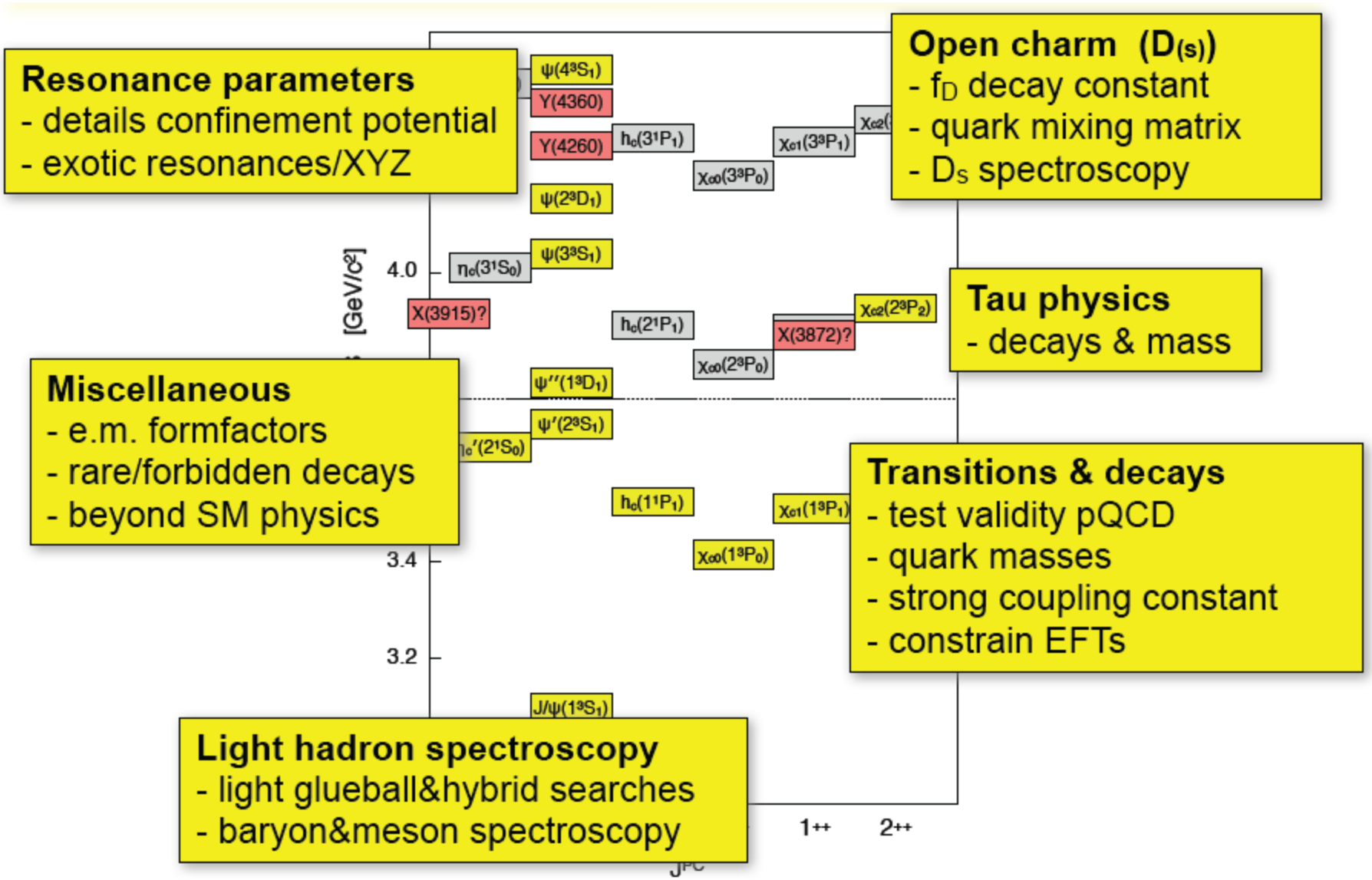


Costante riconoscimento da parte della Collaborazione per i membri di BESIII-Italia:

ITALIA 11 firme, 3.0%:

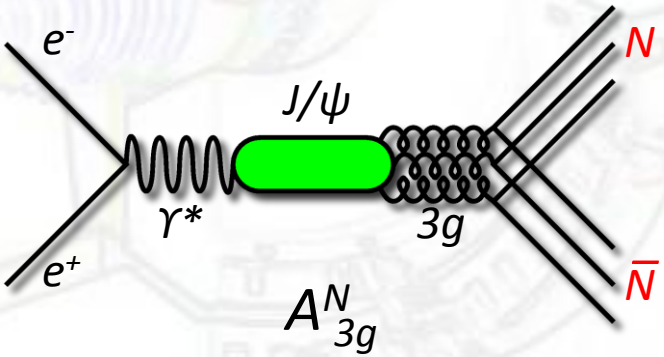
presentano 6 ÷ 11% dei contributi a conferenza

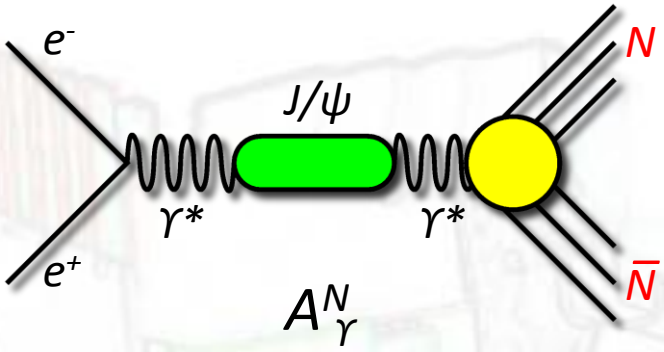
Charmonium BESIII potentials



Charmonium BESIII potentials

Risultati per $J/\psi \to p\bar{p}$ e $J/\psi \to n\bar{n}$





- Il canale dei tre gluoni è dominante: $|A^N_{3g}| > |A^N_{\gamma}|$
- Senza interazione elettromagnetica, la simmetria di isospin $\Longrightarrow$ $|A^p_{3g}| = |A^n_{3g}|$
- Le ampiezze EM del protone e neutrone sono opposte come i momenti magnetici
- Nell'ipotesi pQCD di ampiezze reali, il rapporto tra le frazioni di decadimento è

$$R = \frac{BR(J/\psi \to p\bar{p})}{BR(J/\psi \to n\bar{n})} = \left| \frac{A^p_{3g} + A^p_{\gamma}}{A^n_{3g} + A^n_{\gamma}} \right|^2 \simeq 2$$

Recente risultato di BESIII

$BR(J/\psi \to p\bar{p}) = (2.112 \pm 0.004 \pm 0.027) \times 10^{-3}$

$BR(J/\psi \to n\bar{n}) = (2.07 \pm 0.01 \pm 0.14) \times 10^{-3}$

[PRD86 (5), 032014 (2012)]

$A^N_{3g} \perp A^N_{\gamma}$

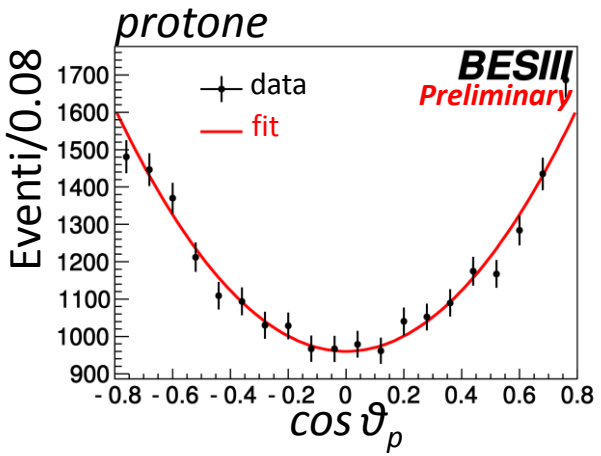
Fase relativa $\sim 90^o$

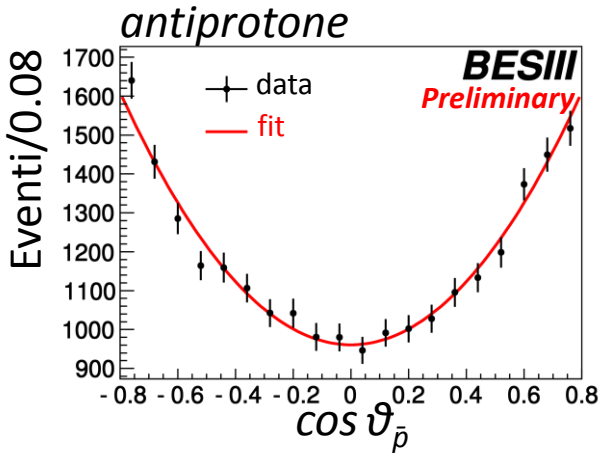
In corso ai LNF: $\psi' \to p\bar{p}$ e $\psi' \to n\bar{n}$

- La fase relativa tra B^N_{3g} e B^N_γ è consistente con zero [Suzuki, PRD63, 054021 (2001)]
- La teoria non prevede differenze tra J/ψ e $\psi' \Longrightarrow B^N_{3g} \perp B^n_\gamma$ [Gerard, Weyers, PLB462 324 (1999)]
- La distribuzione angolare nel canale $N\bar{N}$ è $\propto(1+\alpha \cos^2\vartheta)$
  - $\alpha = 1$ implica la conservazione dell'elicità (pQCD)
  - $\alpha < 1$ potrebbe indicare effetti di violazione di isospin [Claudson, Glashow, Wise, PRD25, 1345 (1982)]

- PDG: $BR(\psi' \to p\bar{p}) = (2.76 \pm 0.12) \times 10^{-4}$
- Il decadimento $\psi' \to n\bar{n}$ non è stato mai osservato

Distribuzioni angolari del protone e antiprotone



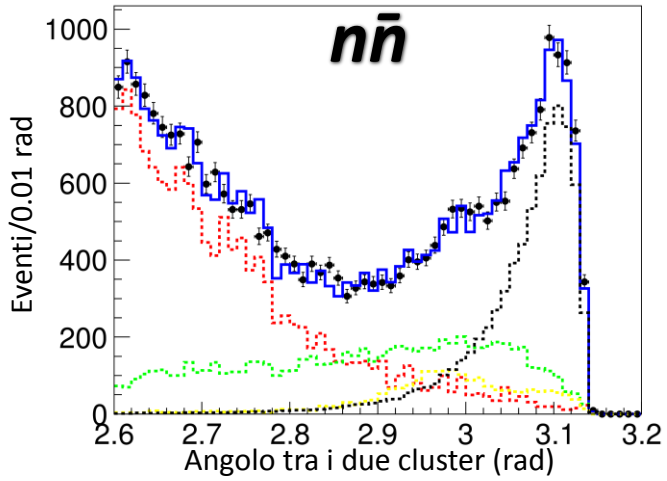


BESIII Preliminare

$BR(\psi' \to p\bar{p}) = (3.09 \pm 0.02 \pm 0.11) \times 10^{-4}$

$\alpha = 1.06 \pm 0.06 \pm 0.01$

In corso ai LNF: $\psi' \to p\bar{p}$ e $\psi' \to n\bar{n}$



Contributi del fondo

- $\psi' \to n\bar{n}$
- Continuo
- MC inclusivo
- $\psi' \to \gamma\chi_{cJ}, \chi_{cJ} \to n\bar{n}$
- Totale

Molto Preliminare (stat. err. only)

$BR(\psi' \to n\bar{n}) = (3.24 \pm 0.03) \times 10^{-4}$

$$\frac{BR(J/\psi' \to p\bar{p})}{BR(J/\psi' \to n\bar{n})} \simeq 0.95 \pm 0.11$$

prima misura !

Uno studio preliminare di BESIII del processo $e^+e^- \to p\bar{p}$ alla massa della $\psi(3770)$ ha mostrato un inatteso fenomeno di interferenza distruttiva della stessa $\psi(3770)$ con Il fondo non-risonante.

La misura di $e^+e^- \to n\bar{n}$ alla $\psi(3770)$ può confermare tale fenomeno con maggiore statistica (attesa interferenza positiva); per confronto con $e^+e^- \to p\bar{p}$ *permette* la **prima misura del fattore di forma magnetico del neutrone a $q^2=(3.77$ GeV$)^2$**

J/ψ Strong and Electromagnetic Decay Amplitudes

- If both real (pQCD) , they must interfere ($\Phi_p \sim 0°/180°$)
- On the contrary $\Phi_p \sim 90° \rightarrow$ No interference, Im strong amplitude

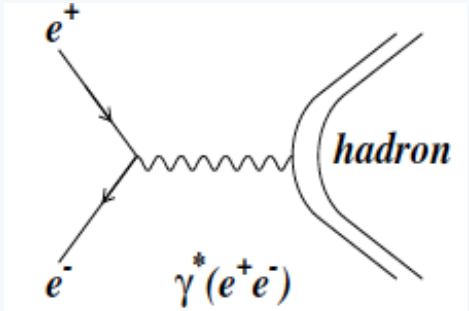
$J/\psi \rightarrow N\bar{N}\ (\frac{1}{2}^+\frac{1}{2}^-)$ $\Phi_p = 89° \pm 15°$ [1]; $89° \pm 9°$[2]

$J/\psi \rightarrow$ VP (1^-0^-) $\Phi_p = 106° \pm 10°$ [3]

$J/\psi \rightarrow$ PP (0^-0^-) $\Phi_p = 89.6° \pm 9.9°$ [4]

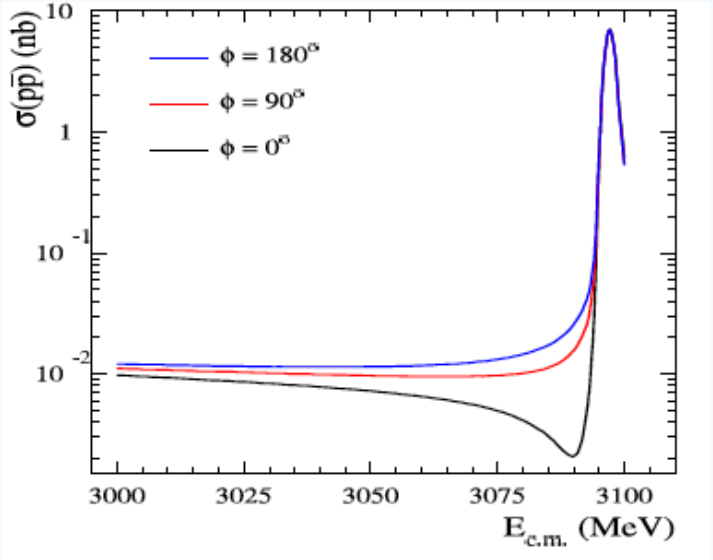
$J/\psi \rightarrow$ VV (1^-1^-) $\Phi_p = 138° \pm 37°$ [4]

- Results are model dependent
- Model independent test:
- look for interference pattern between resonant amplitude and the non resonant continuum



pQCD regime

$A_{EM} \in \Re$



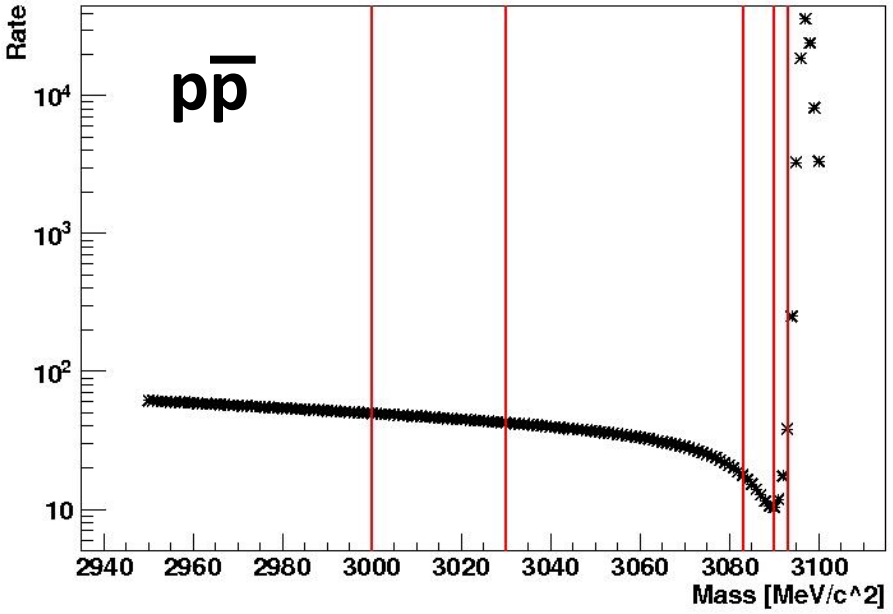
[1] R. Baldini, C. Bini, E. Luppi, Phys. Lett. B404, 362 (1997); R. Baldini et al., Phys. Lett. B444, 111 (1998)
[2] J.M. Bian et al., J/ψ -> ppbar and J/ψ -> nnbar measurement by BESIII, Phys. Rev. D86, 032014 (2012).
[3] L. Kopke and N. Wermes, Phys. Rep. 174, 67 (1989); J. Jousset et al., Phys. Rev. D41,1389 (1990).
[4] M. Suzuki et al., Phys. Rev. D60, 051501 (1999).

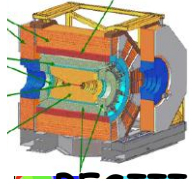
J/ψ scan: investigated processes for energy points selection

- Exclusive scenario: could see interference effects

• $e^+e^- \rightarrow J/\psi \rightarrow p\bar{p}, n\bar{n}$	$N\bar{N}$	BR ~ 2.17×10^{-3}	σ_{cont}~ 11 pb
• $e^+e^- \rightarrow J/\psi \rightarrow \rho\pi$	VP	BR ~ 1.69%	σ_{cont}~ 20 pb
• $e^+e^- \rightarrow J/\psi \rightarrow 2(\pi^+\pi^-)\ \pi^0$		BR ~ 5.5%	σ_{cont}~ 500 pb

- Maximum interference: 0°
  - 2 pts at low W
    - fix the continuum
    - fix the slope
  - 2 pts at dip positions
  - 1 pt Beginning of the BW





2012 data for J/ψ phase scan

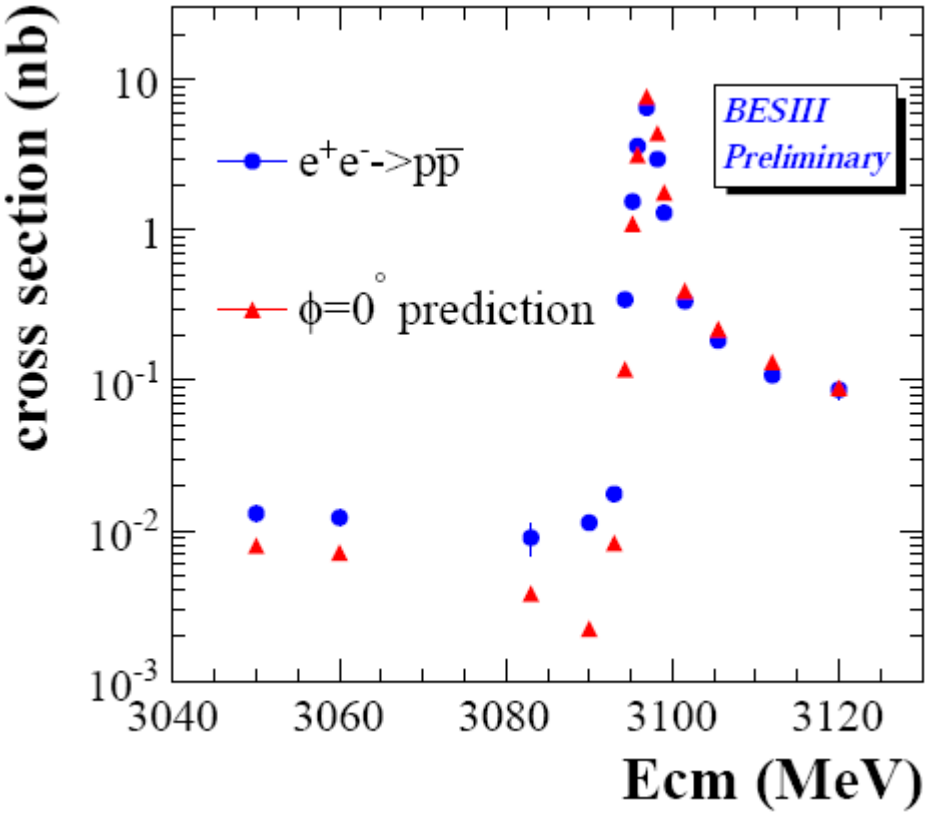
Dati raccolti a maggio 2012, analisi in corso ai LNF e a TO

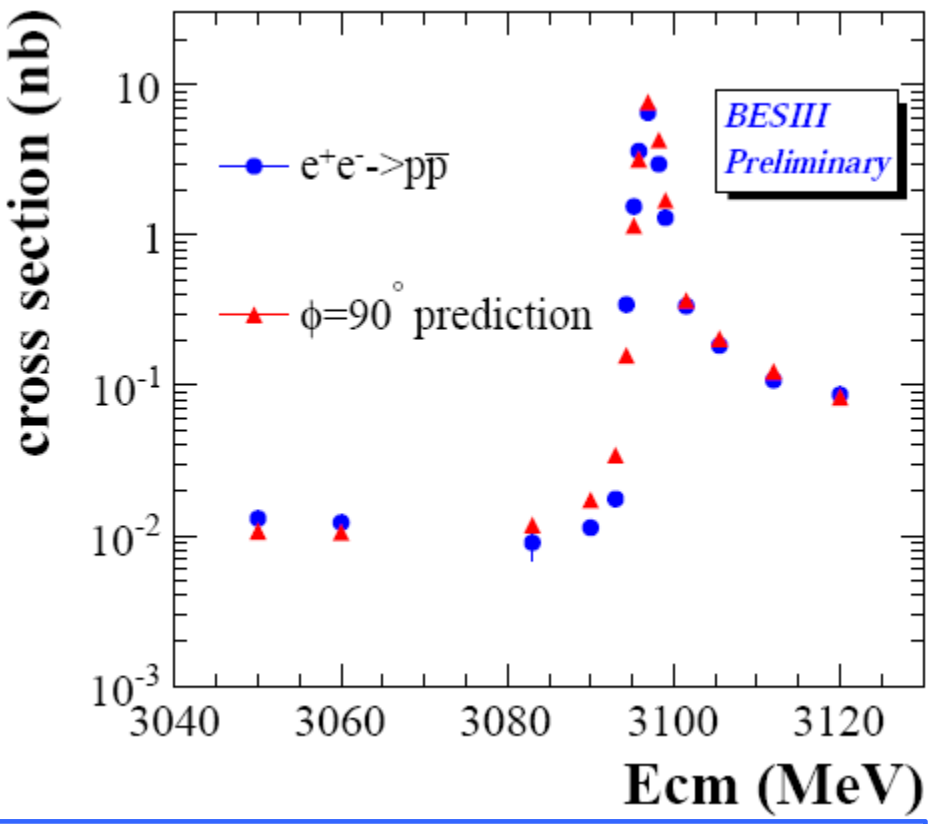
Energy requested [MeV]	Energy collected [MeV]	L_{int} [pb^{-1}]
3050	*3046*	*14.0*
3060	*3056*	*14.0*
3083	*3086*	*16.5*
3090	*3085*	*14.0*
3093	*3088*	*14.0*
3097	3097	79.6

preliminary

2012 data for J/ψ phase scan: N Nbar

Dati raccolti a maggio 2012, analisi in corso ai LNF e a TO

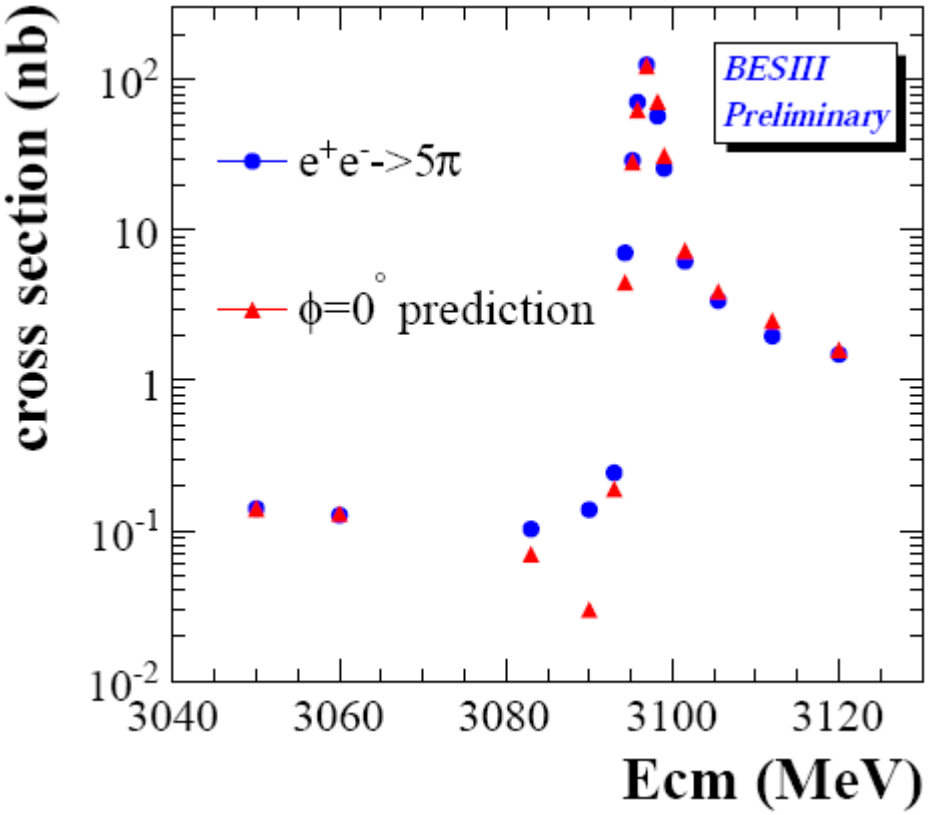


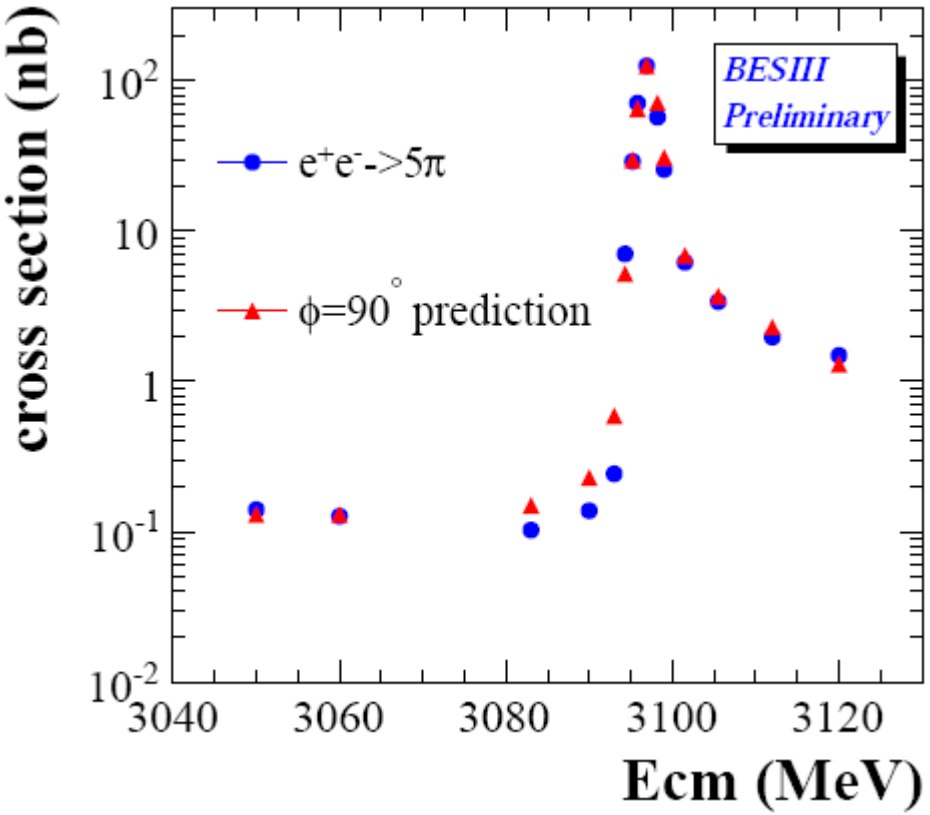


- PRELIMINARY DATA for p pbar (n nbar in progress):
  - fine energy calibration is missing
  - preliminary evaluation of efficiencies
  - preliminary evaluation of luminosities
- large phase scenario (no interference) seems to be confirmed!

2012 data for J/ψ phase scan: 5π

Dati raccolti a maggio 2012, analisi in corso ai LNF e a TO

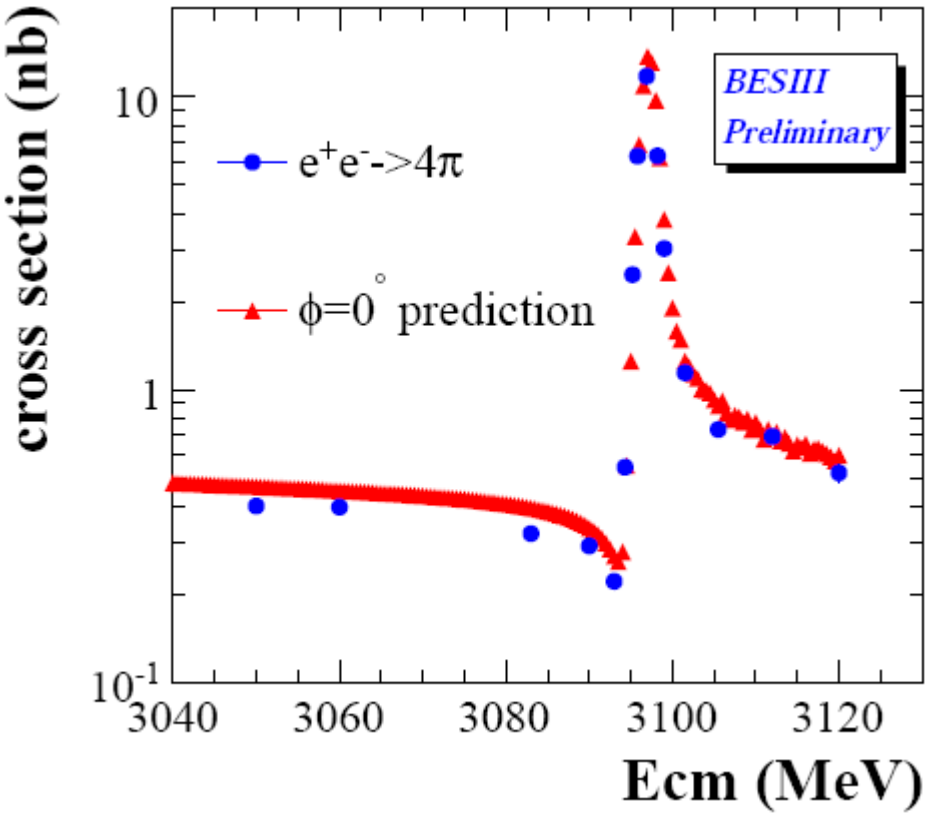


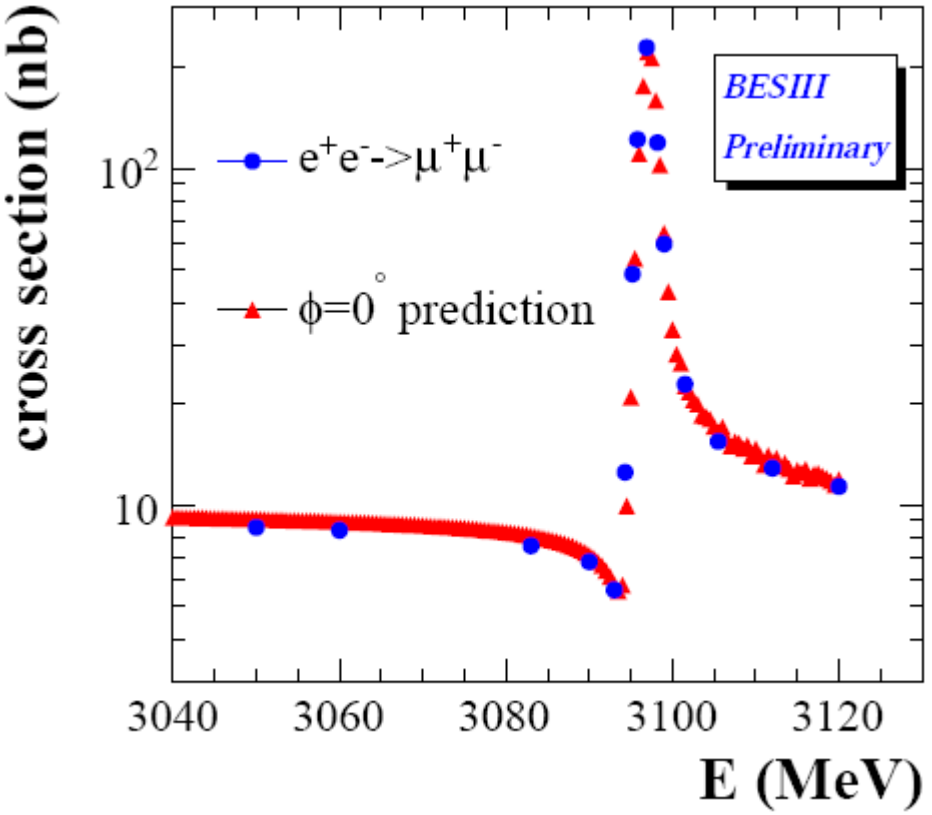


- PRELIMINARY DATA:
  - fine energy calibration is missing
  - preliminary evaluation of efficiencies
  - preliminary evaluation of luminosities
- large phase scenario (no interference) seems to be confirmed!

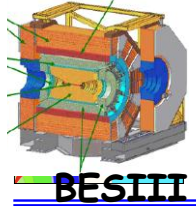
2012 data for J/ψ phase scan: 4π / μμ

Dati raccolti a maggio 2012, analisi in corso ai LNF e a TO





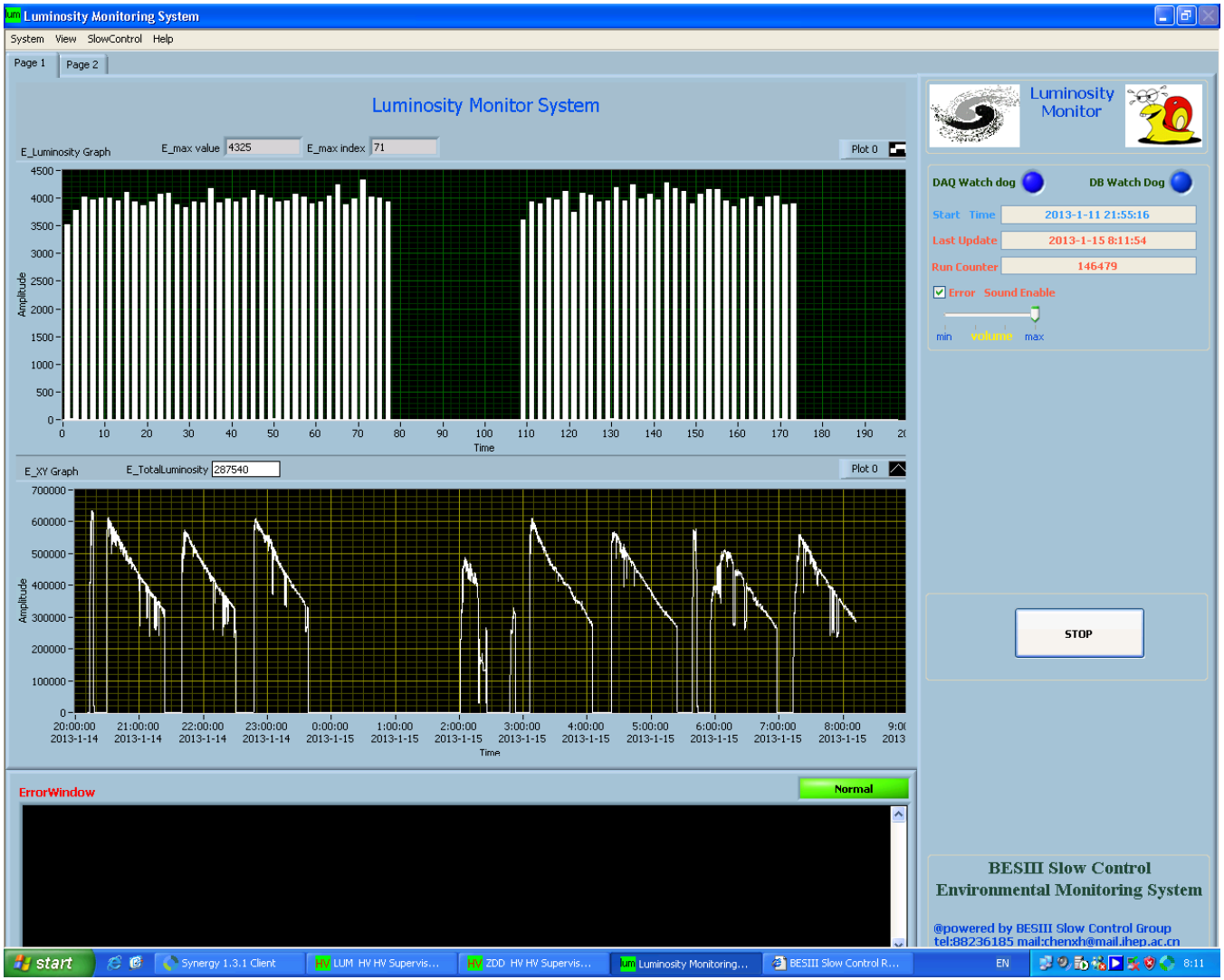
- PRELIMINARY DATA:
  - fine energy calibration is missing
  - preliminary evaluation of efficiencies
  - preliminary evaluation of luminosities
- Interference observed as expected!

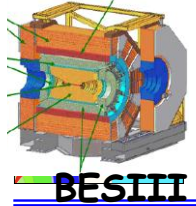


ZDD-Luminometro

- BESIII aveva 2 luminometri a cristallo (E,W)
- Perduto il PM del luminometro Est nel corso del 2010, il suo posto fu preso dallo ZDD nello shutdown estivo del 2011.
- All'inizio del run 2013 ha ceduto anche il PM del luminometro West!
- Lo ZDD è attualmente **l'unico luminometro online funzionante** a BESIII

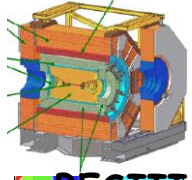
Rate dallo ZDD per 72 bunches





ZDD-Calorimetro

- Lo ZDD è in corso di integrazione nel DAQ ufficiale di BESIII a cura degli esperti IHEP e i suoi dati vengono scritti nel datastream
- Prodotte (LNF-SELF) e installate 2 schede VME:
  - Level-shifter/Fanout dell'L1 trigger di BESIII
  - Scheda gestione protocolli DAQ-BESIII
- Lavori in corso:
  - Produzione in versione VME (sempre LNF-SELF) dei preamplificatori, con l'obiettivo di abbandonare del tutto il crate NIM



Upgrade Camera Deriva interna

Run 2012: problemi di noise e di invecchiamento della camera a deriva interna in parte migliorati con aggiunta di vapore acqueo

Prevista comunque una sostituzione della camera per i run successivi al 2013, 2 soluzioni possibili:

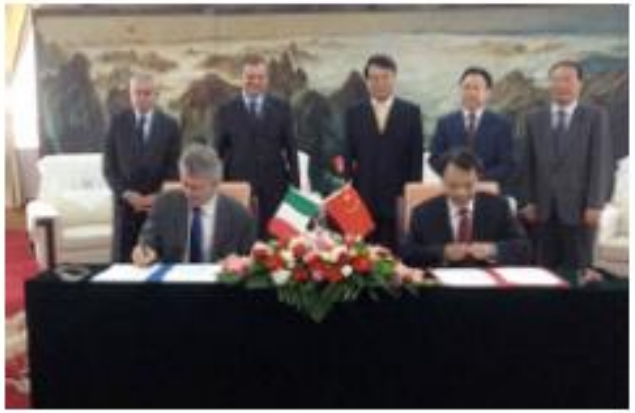
1. una camera a deriva analoga
2. una camera a GEM cilindrica a la KLOE-2, proposta dal gruppo LNF, da costruire in Cina (?)
   - Workshop operativo su CGEM a LNF 24-27 ottobre 2012
   - Richieste S.J. a CSN1 e ai servizi LNF per il 2013 di 3Ke per R&D su prototipo GEM piana ($10x10cm^2$) con lettura analogica (consulenza di G.Bencivenni)
   - Progetto MAE grande rilevanza approvato (ufficiosamente)

- La collaborazione BESIII effettuerà l'opzione durante il Collaboration Meeting estivo

Prototype construction goals

- **Design,construction and test of a CGEM prototype, in case first layer of a new CGEM Inner Tracking**
- **Design,construction and test of an analog readout system to achieve < 100 μm xy and < 200 μm z resolutions**
- **Budget (euros) requested to Foreign Affairs Ministry, following the Agreement of scientific cooperation for a Joint laboratory "INFN-IHEP " :**

INFN 1st year expenditure	40000	33.3%
Italian Ministry of FA expenditure	40000	33.3%
Foreign Institution expenditure	40000	33.3%
More funds	0	0%
1st year project cost	120000	



BESIII Winter Collaboration Meeting,Guilin

Requirements for the inner drift chamber upgrade

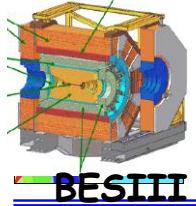
- **Rating capability:** $\sim 10^4$ Hz/cm^2
- **Spatial resolution:** $\sigma_{xy} \sim 100\mu m$; $\sigma_z \sim 1mm$;
- **Momentum resolution:** $\sigma_{pt}/p_t \sim 0.5\%$ @1GeV;
- **Efficiency:** $\varepsilon \sim 98\%$
- **Material budget:** $< 1.5\%$ all layers
- **Coverage:** $93\%\ 4\pi$
- **Operation duration:** ~ 5 years

QUN OUYAN

at the CGEM workshop

Possible options:

- **CGEM:** based on KLOE-2 technology, collaboration between Italian and Chinese groups
- **Monolithic pixels:** CPS developed by IPHC in Strasburg



Material budget

KLOE2

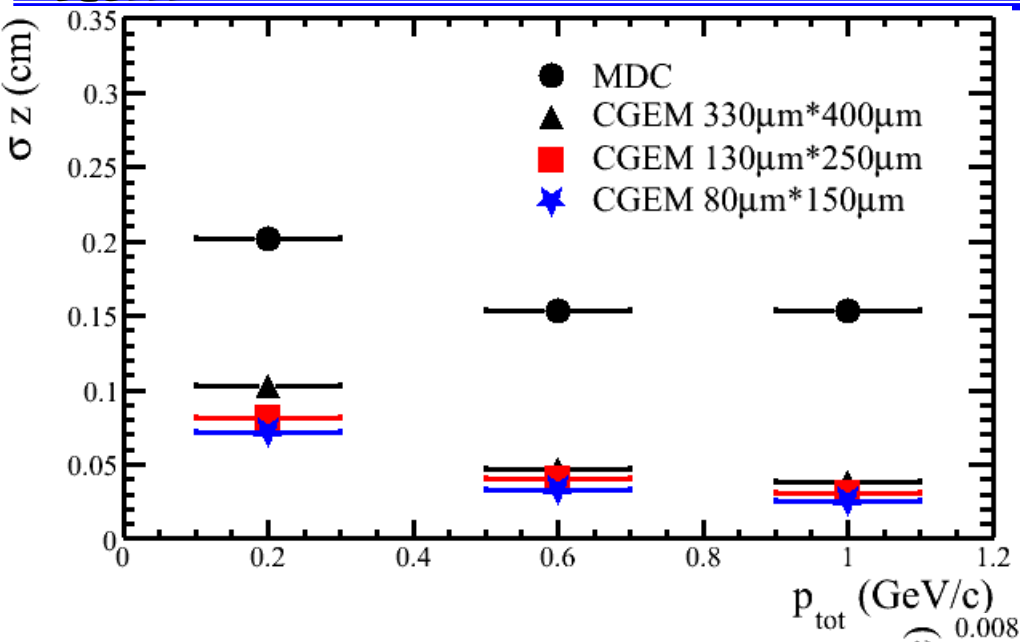
		% of X_0
CATHODE	Copper: 2*3 *1 Kapton: 2*50*1 Honeycomb: 1*3000*1	0.0420 0.0350 0.0240 Total= 0.101
GEM foils	Copper: 6*3 *0.8 Kapton: 3*50 *0.8	0.1007 0.0420 Total= 0.143
ANODE	Copper: 3.5+1.5+3 Kapton: 1*225 *1 Gold : 2*0.1 *1 Epoxy: 2*10 *1	0.0559 0.0787 0.0061 0.0060 Total=0.147
CF Shield	CF: 2*90 *1 Honeycomb: 1*5000*1	0.0429 0.0400 Total=0.0829
		1 Layer:0 .48 4 Layers:1.92

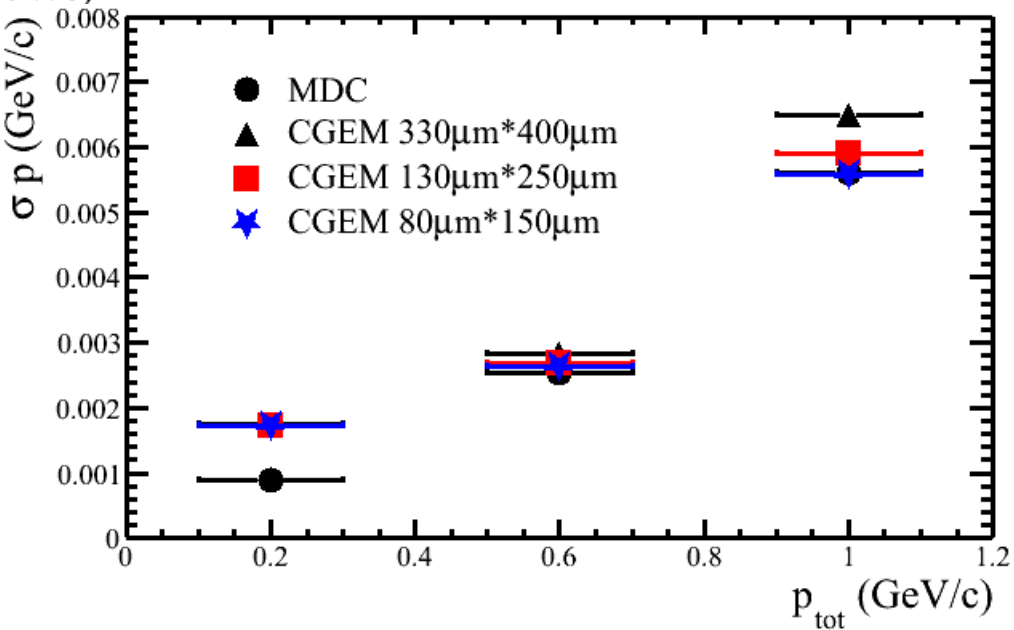
BESIII

		% of X_0
CATHODE	Copper: 2*2 *1 Kapton: 2*50*1 Honeycomb: 1*3000*1	0.0280 0.0350 0.0240 Total= 0.0870
GEM foils	Copper: 6*2 *0.8 Kapton: 3*50 *0.8	0.0671 0.0420 Total= 0.109
ANODE	Copper: 2.5+1.5+2 Kapton: 1*225 *1 Gold : 2*0.1 *1 Epoxy: 2*10 *1	0.0420 0.0787 0.0061 0.0060 Total= 0.133
CF Shield	Kapton: 2*50 *1 Honeycomb: 1*3000*1	0.0350 0.0240 Total= 0.0590
		1 Layer: 0.39 4 Layer:**1.56**

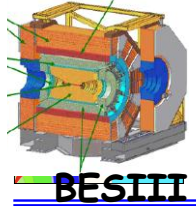
Nuova proposta a catodo condiviso: ~1.3% X_0

Z and momentum resolutions





Liangliang talk, Guilin Coll. Meet.



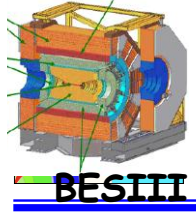
LNF CGEM mini-workshop

- October 2012 : 2 days Cylindrical GEM workshop at LNF with Chinese collaborators,KLOE2 ,BARI,CMD3 and CERN (Rui de Oliveira) https://agenda.infn.it/conferenceDisplay.py?confId=5502

- G. Bencivenni (LNF) and collaborators presented the status of KLOE2 Inner Tracking CGEM detector

- A. Ranieri (Bari University) presented the analog version of KLOE2 GASTONE digital readout

- The second day was dedicated to visit the CGEM laboratory, where a practical assembly procedures demonstration was given



A preliminary guess for layer 1 BESIII prototype construction

- BESIII CGEM layer 1 (smallest!) hardware needed:
  - construction tools — available
  - molds — 5
  - GEM planes — 3
  - anode plane — 1
  - fiberglass rings — 10
  - GASTONE32 — 90
  - peak sensing ADC — 3000

Layer number	Internal diameter (mm)	Length (mm)	GEM foils
1	126	870	3
2	192	870	6
3	258	870	6
4	324	870	6

- Construction time : 1-2 years (starting from funding approval)
- Analog readout development should be done in parallel

A 120 K€ budget seems a reasonable estimation

BESIII computing in Italy today

- **Italian mirror BES3 DB @ TO:** online since 09/2010
- **Italian BESIII computing farm @ TO (SLC 5.6/64):**
  - WN: **64 cores Xeon 2.13/2.53GHz;** servers: **DB 8 cores; open access (SSH) 8 cores**
  - storage: **12TB NFS/ISCSI**
  - activities: **J/Ψ phase studies; BOSS analysis $e^+e^- \rightarrow p\,\bar{p}, n\,\bar{n}$**
- **BOSS framework full documentation @ TO (single worldwide):**
  - doxygen updated to BOSS 6.6.2, hosted by TO INFN central web server:
    - http://bes3.to.infn.it/BESIII_Doxygen_Documentation.html
- **BOSS 6.6.2 released:**
  - validated

Distributed computing requirements

- **BESIII current computing resources: ~ 3300** CPU cores, **~1000** more under deployment

- **assuming:**
  - CPU usage rate: **78%**
  - working efficiency: **90%**

  to process both real data processing and MC generation @ IHEP,

  120 days are needed for each single BOSS version!

- **institutions should provide external sites for distributed computing**
- **BESIII Collaboration goal from distributed computing in the near future is:**

  25,000 CPUcores * day (i.e. 1/6 of total CPU power)

  enough to provide the generation of ~1 G Ψ'' MC
- **if goal won't be reached: BESIII will purchase CPU time elsewhere**

  (Amazon Web Services, Tsinghua University, etc)
- **contributions to distributed computing count as service work**

Sites status

Site	Type	Job slots	Storage	Status
JINR **2.5% (R 4.1 %)**	GLite	2100 (shared with LHC)	3.5 TB	Active for BOSS grid jobs
UCAS	PBS	80 (+64)	20 TB	Active for BOSS grid jobs
IHEP-PBS	PBS	96 (+200)	1 (200) TB	Active for BOSS grid jobs
PKU	PBS	168	> 10 TB	Active for BOSS grid jobs
USTC	PBS / Condor	128	160 TB	Active for BOSS grid jobs
UMN 1% (USA 5.5%)	SGE	400	> 100 TB	Active for BOSS grid jobs
WHU	PBS	(100)	(25 TB)	In progress
SDU	PBS	>100	>2TB	In progress
TOTAL USABLE NOW		~ 1200	493.5 TB	

6 sites are able to accept BOSS jobs
new sites can accept since the very beginning simple grid jobs by CVMFS installation for BOSS deployment
2 more new sites are joining

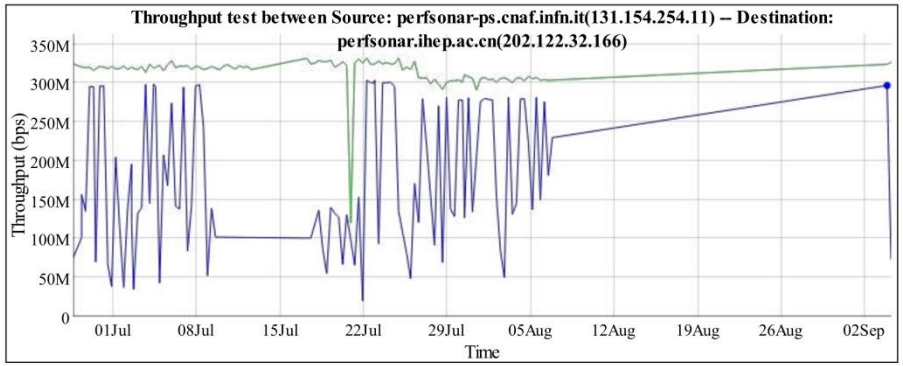
ITALIA 11 firme, 3.0%: richiesta 100 cores, 21TB

BESIII Minimum requirements to distributed computing sites

- **minimal computing resources:**
  - CPU: **>100 cores SLC5-64 (2K HS06)**
  - GRID enabled storage (SE): **> 5 TB**
  - storage to host random trigger real data: **~ 25 TB**
  - network to and from IHEP: **> 80 Mbit/s**
- **basic service level:**
  - provide grid system or at least local cluster system with BOSS deployed: **accept MC and analysis jobs**
  - provide grid enabled storage system:
    - **temporary store MC results**
    - **accept DST data for analysis**
  - ensure enough bandwidth:
    - **allow data transfer with IHEP**
    - **cooperate on improving network performances (thanks to INFN-TO CC!!)**
  - Shared file system among WNs to store random trigger data:
    - **enable background mixing in production jobs**

Network performances getting better and better

INFN – IHEP
Giugno/Settembre
200 Mb/s Goal
Reached thanks to
INFN-TO CC
and IHEP CC!



2012/09/03 21:48:54:
Throughput(Src-Dst):297.06Mbps

Graph Key

Src-Dst throughput

Dst-Src throughput

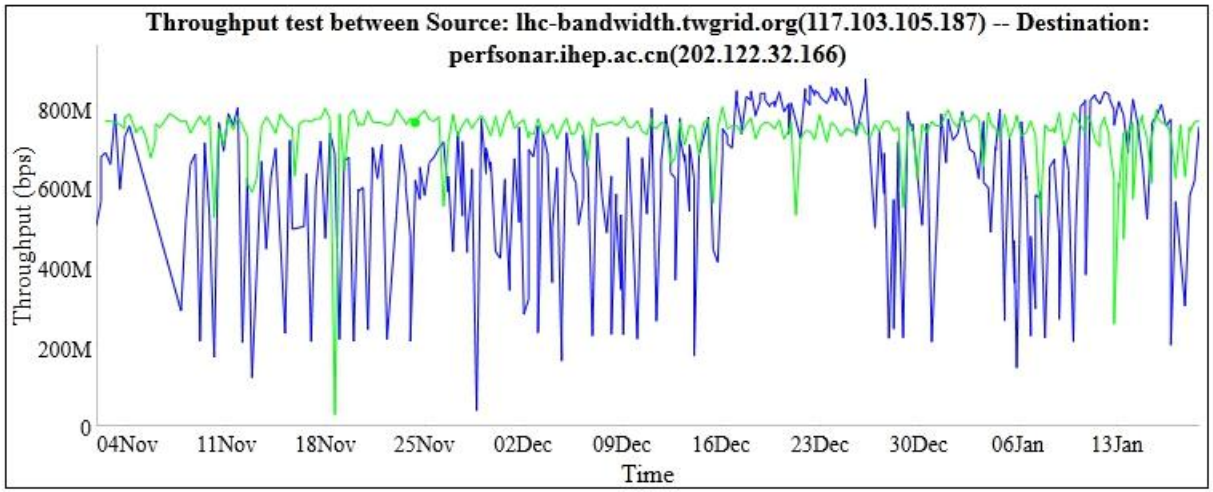
<- 1 month

1 month ->

Timezone: GMT+0200 (CEST)

INFN – IHEP

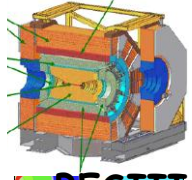
Mean bandwith
618.54 Mb/s
INFN → IHEP
736.45 Mb/s
IHEP → INFN



Richieste alla CSN1 per la creazione nel CdC-TO di un'infrastruttura CLOUD con accesso prioritario a BESIII

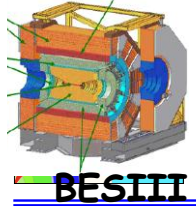
- **WNs:**
  - CPU: **2000 HS06, costo standard GRID-INFN: 28 K€**
- **server/WNs:**
  - storage: **21TB netti, costo standard GRID-INFN: 7.5 K€**
  - server per SE: 2x8 cores xeon, FC: **4.5 K€**
- **richieste decadute:**
  - tapelibrary: **i referee del calcolo suggeriscono l'utilizzo di nastri al CNAF**

- **infrastruttura CLOUD:**
  - assegnata in pratica **alla sezione**: **VM con distribuzioni diverse possono coesistere**
  - front-end lato BESIII: **(per ora) interfacciamento GRID**
- **piena integrazione (oggi) con il CdC-TO e (domani) con altri esperimenti:**
  - documento scientifico per il progetto: **verrà presentato alla CSN1 entro fine Aprile**
  - partecipazione di: **Stefano Bagnasco, Fabrizio Bianchi**
- **richieste finanziarie:**
  - richiesta di discussione dell'iniziativa a maggio/giugno: **sblocco di 40K€ dalla tasca**



Conclusioni - 1

- **presa dati procede spedita e senza problemi; le statistiche disponibili sono 10x-20x quelle in letteratura**
- **dopo aver completato le Y(4260) e Y(4360) si procederà con l'R scan ad energie > 3.8 GeV**
- **~ 20 articoli pubblicati da gennaio 2012!**
- **analisi dati in corso:**
  - J/ψ → ppbar, nnbar pubblicati
  - ψ' → ppbar, nnbar in corso
  - valutazione della fase in vari canali presto in fase di referaggio
- **ZDD:**
  - **unico luminometro dell'esperimento!**
  - **inserimento del DAQ in corso (gestione IHEP)**
- **CGEM:**
  - **progetto MAE approvato (120 K€: 40 K€ / 40 K€ / 40 K€)**
  - **specifiche richieste rispettabili**

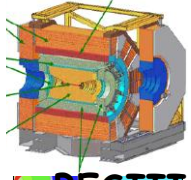


Conclusioni - 2

- computing:
  - analsi effettuate utilizzando risorse italiane
  - documentazione SW e mirror operativi
  - infrastruttura CLOUD @ CdC-TO:
    - insfrastruttura di sezione! con accesso prioritario BESIII
    - soddisfa requirements GRID BESIII
    - contributo in kind richiesto ai gruppi non-IHEP
    - iniziativa condivisa con CdC-TO
    - contributo da Fabrizio Bianchi all'iniziativa
    - richiesta di finanziamento da tasca verrà avanzata a maggio/giugno 2013
    - documento scientifico verrà presentato alla CSN1 ad aprile

- vasto programma di fisica:
  siamo ansiosi di accogliere nuovi membri in BESIII Italia

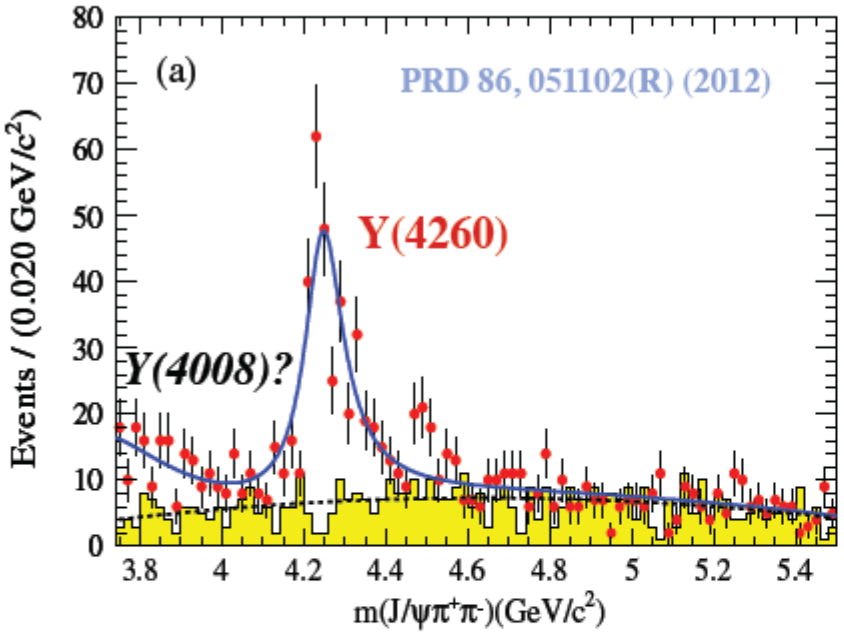
- (per ora) NON CI SONO statui richiesti COMMON FUNDS!!



spares

Y(4260) and Y(4360) status

$e^+e^-(\gamma_{ISR}) \to \pi^+\pi^- J/\psi$ at BaBar



BaBar, PRD 86, 051102(R) (2012)

$M(Y(4260)) = 4245 \pm 5 \pm 4$ MeV/c²

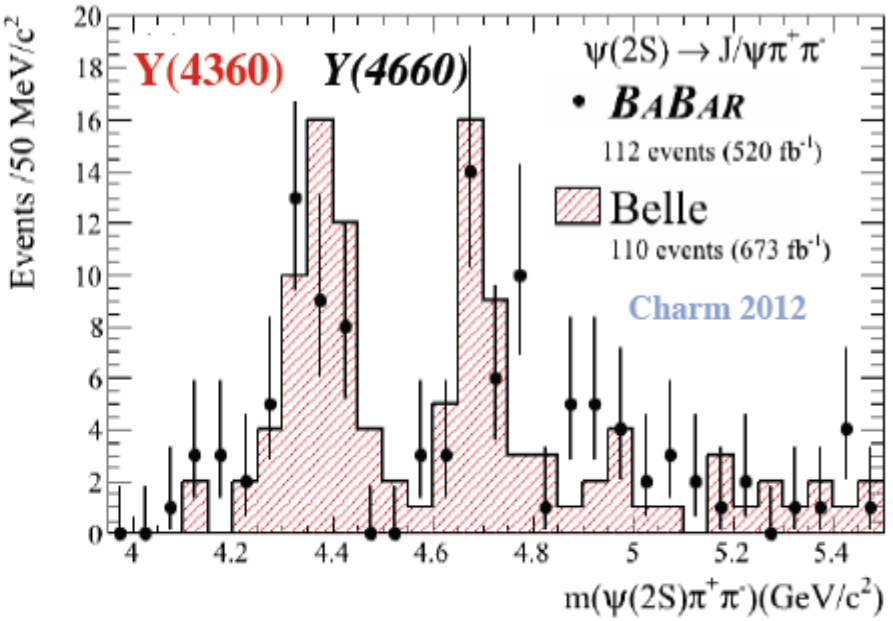
$\Gamma(Y(4260)) = 114^{+16}_{-15} \pm 7$ MeV

Belle, PRL 99, 182004 (2007)

$M(Y(4008)) = 4008 \pm 40\ ^{+114}_{-28}$ MeV/c²

$\Gamma(Y(4008)) = 226 \pm 44 \pm 87$ MeV

$e^+e^-(\gamma_{ISR}) \to \pi^+\pi^- \psi(2S)$ at BaBar and Belle

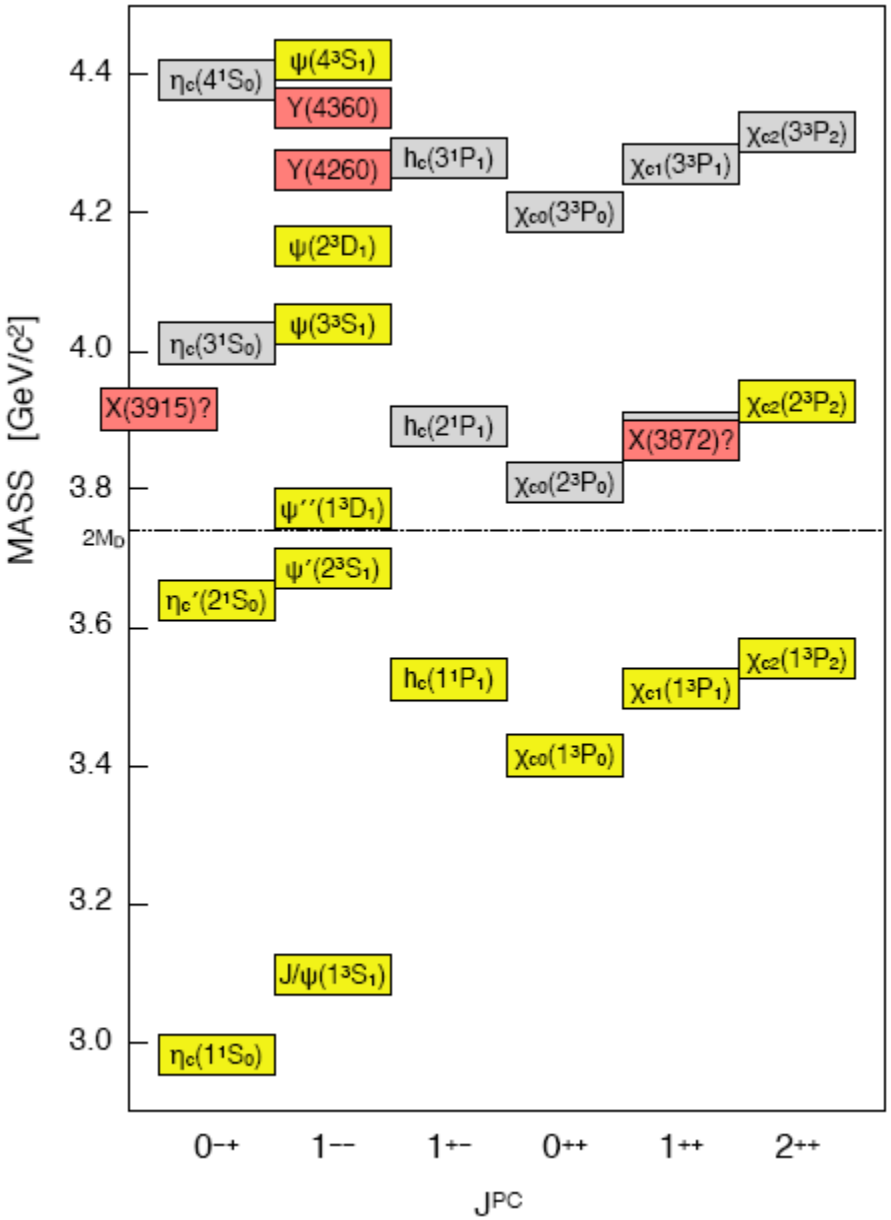


Belle, PRL 99, 142002 (2007)

$M(Y(4360)) = 4361 \pm 9 \pm 9$ MeV/c²

$\Gamma(Y(4360)) = 48 \pm 15 \pm 3$ MeV

Y(4260) and Y(4360) status



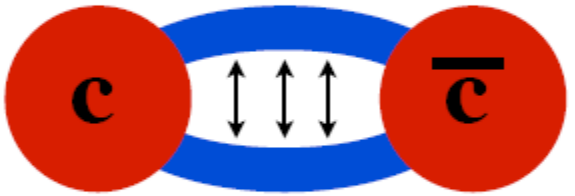
Why are the Y(4260) and Y(4360) interesting?

* they are 1^{--} but:

  they don't fit into the quark model

  decays to open charm are suppressed

* they are hybrid charmonium candidates:

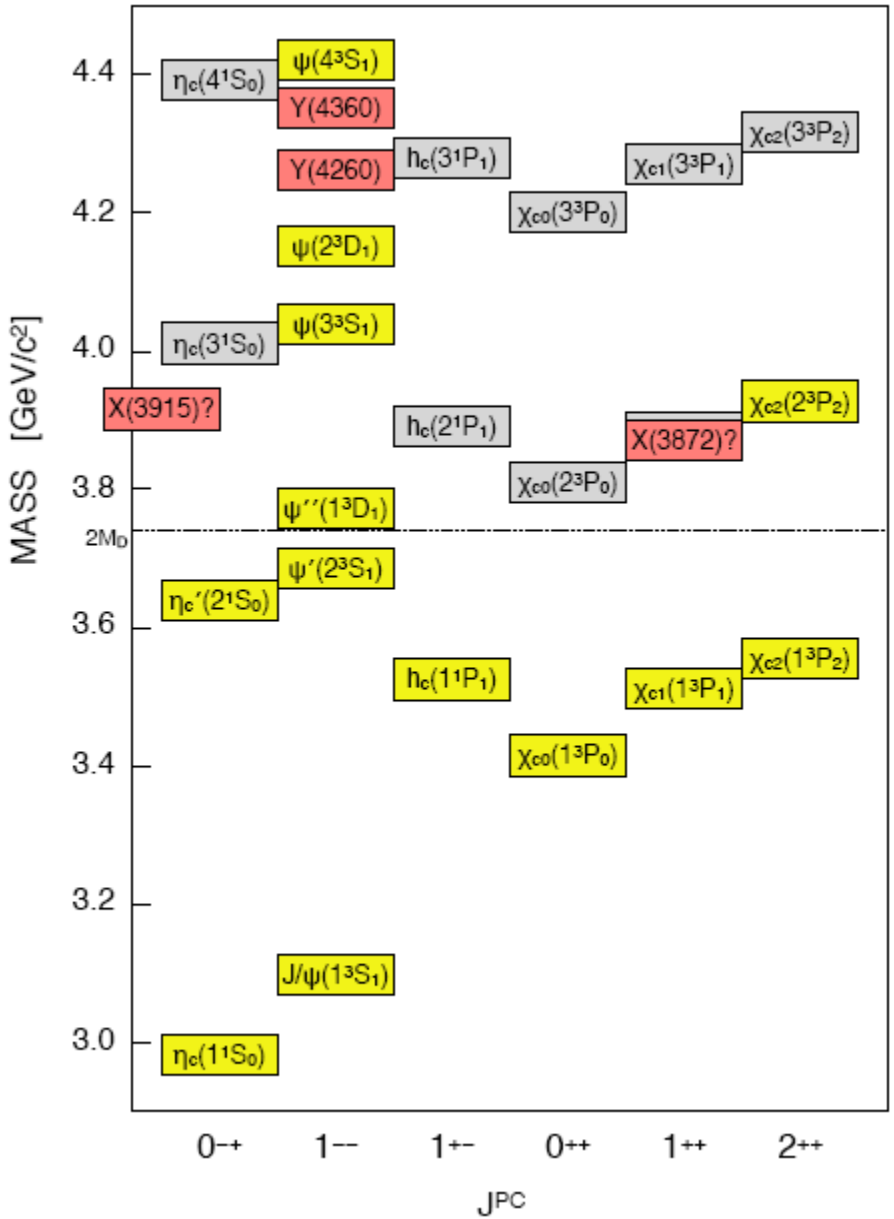


HYBRID CHARMONIUM

How can we learn more?

* find more decay modes
* *more precisely measure their parameters*

Y(4260) and Y(4360) opportunities



A few key analyses:

1. Dalitz analyses of $Y(4260) \to \pi^+\pi^- J/\psi$ and $Y(4360) \to \pi^+\pi^- \psi(2S)$
   to look for charged Z_c states

2. Measurement of
   $B(Y(4260) \to \pi^+\pi^- h_c(1P))/B(Y(4260) \to \pi^+\pi^- J/\psi)$
   to help determine the quark spin-alignment of the Y(4260)

3. Measurement of
   $B(Y(4360) \to \pi^+\pi^- h_c(2P))/B(Y(4360) \to \pi^+\pi^- \psi(2S))$?
   to discover the $h_c(2P)$?
   to test $S = 0$ vs. $S = 1$

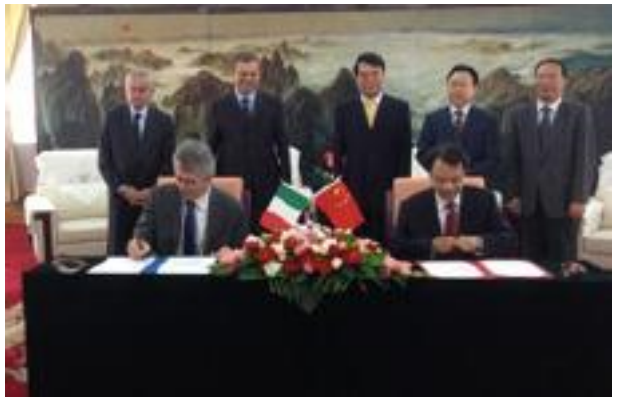
4. Measurement of
   $B(Y(4260) \to \gamma\chi_{c0})/B(Y(4260) \to \gamma\eta_c)$
   to test lattice QCD
   to test $S = 0$ vs. $S = 1$

(and searches for any other decay modes)

IHEP-INFN

BESIII

FIRMATO L'ACCORDO DI PECHINO
Lunedì 18 Giugno 2012 10:00



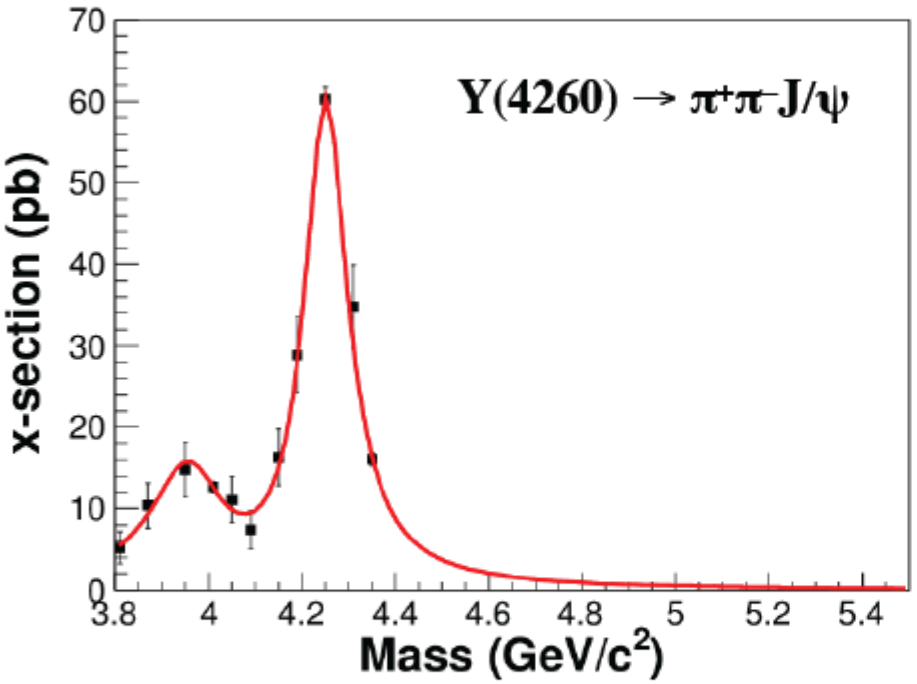
E' stato firmato nella mattina del 18 giugno a Pechino - la notte tra domenica e lunedì in Italia - l'accordo tra l'INFN e l'Istituto cinese per le alte energie (IHEP) per la realizzazione di una collaborazione tra le due strutture di ricerca scientifica. L'accordo - che è stato firmato nell'ambito del viaggio del ministro Profumo in Cina - riguarda sia la ricerca che la formazione dei giovani. In particolare, l'insieme delle collaborazioni tra INFN e IHEP si configurerà coma un vero e proprio istituto di ricerca virtule unificato.

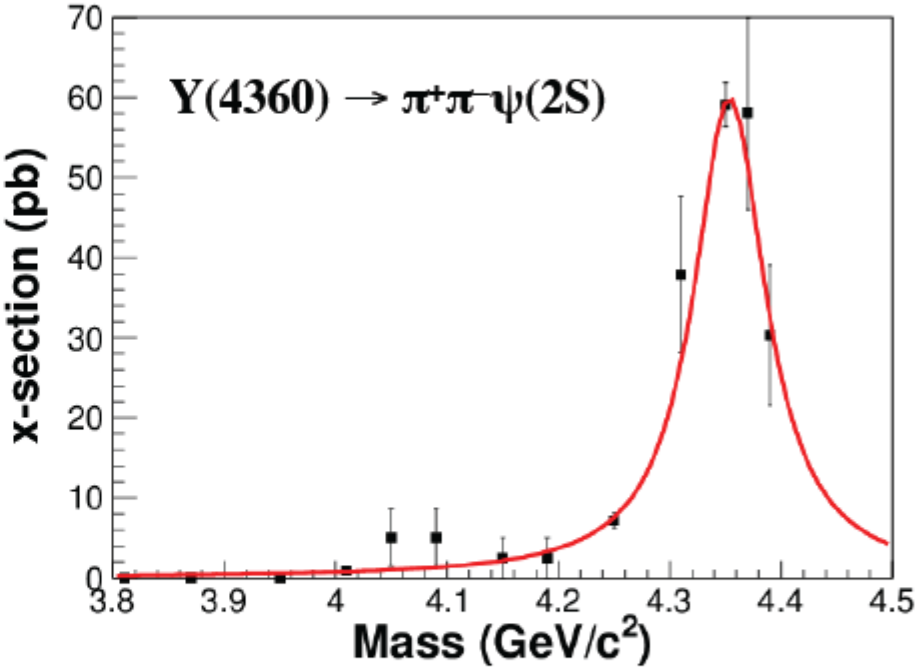
Un istituto virtuale che svilupperà la collaborazione scientifica tra l'Italia e la Cina in un settore in cui il nostro paese è all'avanguardia nel mondo. L'Istituto Nazionale di Fisica Nucleare e L'Istituto per la Fisica delle Alte Energie (IHEP) di Pechino hanno ratificato, in un incontro a Roma, il loro protocollo di accordo per la ricerca e per la formazione dei giovani. Una collaborazione che entrerà nell'agenda del prossimo viaggio del ministro Profumo in Cina a giugno.L'insieme delle concrete iniziative comuni costituirà, appunto, una sorta di Istituto virtuale unico di ricerca: anche per questo un italiano andrà a Pechino, presso l'IHEP, a rappresentare stabilmente l'INFN e coordinarne i rapporti con gli omologhi cinesi.L'incontro di Roma ha messo in luce il forte interesse cinese a realizzare esperimenti congiunti su neutrini e materia oscura ai Laboratori del Gran Sasso e da parte italiana un analogo interesse per il laboratorio cinese di Dayabay. Si collaborerà anche sulla fisica degli acceleratori e il computing (approfondendo il lavoro comune che si sta già facendo sulla GRID). La collaborazione continuerà anche su esperimenti già avviati come ARGO (che si trova sull'altopiano tibetano) e AMS, il rivelatore di raggi cosmici che è stato portato un anno fa sulla Stazione Spaziale Internazionale.Un discorso a parte riguarda la formazione, sia per i giovani dottorandi che per il post-doc. INFN e IHEP hanno già scambi di giovani ricercatori (sono presenti ad esempio giovani cinesi ai laboratori di Frascati e del Gran Sasso), ma i due istituti vogliono approfondire questo impegno comune, utilizzando per questo anche il neonato Gran Sasso Science Institute, la nuova scuola sperimentale di dottorato internazionale di cui l'INFN è il soggetto attuatore.

Y line shapes

Add 10 extra points with 25pb^{-1} of data each:

3810, 3870, 3950, 4050, 4090, 4150, 4190, 4310, *4370, 4390* MeV





error on M(Y(4260)) = **~14** MeV/c^2
*(compare to previous of ~**5** MeV/c^2)*

error on Γ(Y(4260)) = **~8** MeV
*(compare to previous of ~**15** MeV)*

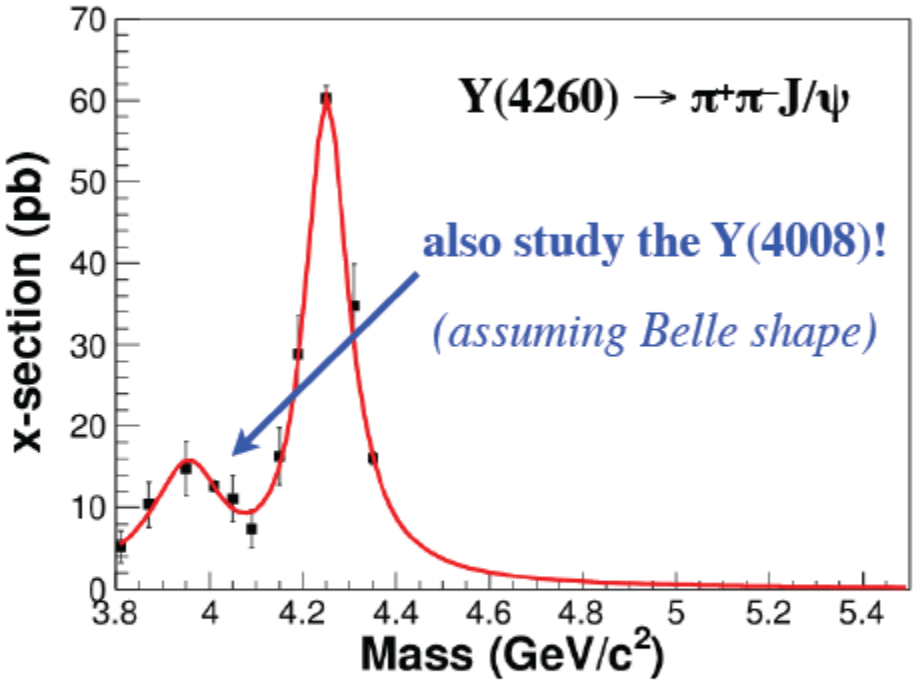
error on M(Y(4360)) = **~6** MeV/c^2
*(compare to previous of ~**9** MeV/c^2)*

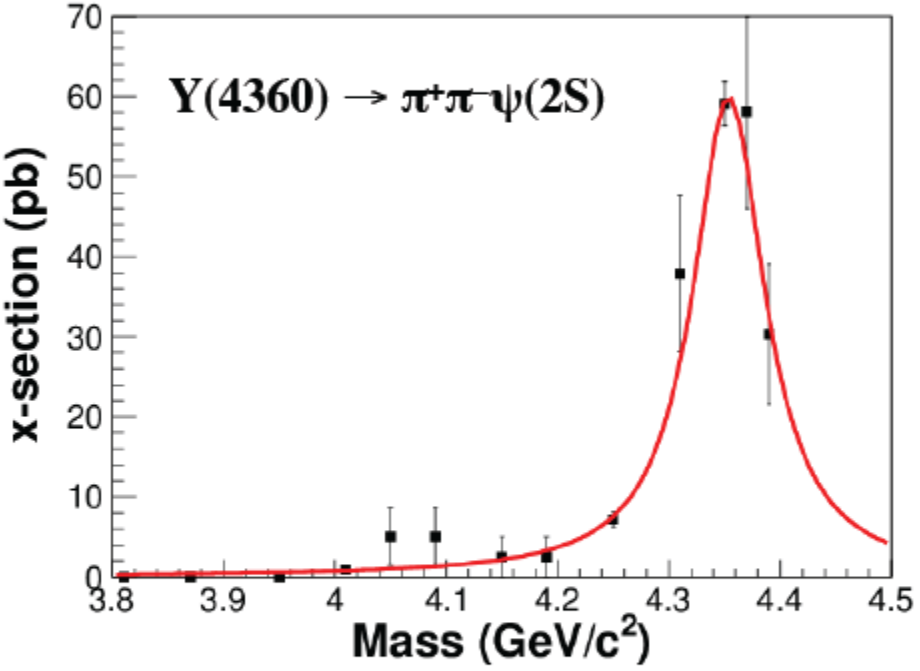
error on Γ(Y(4360)) = **~6** MeV
*(compare to previous of ~**15** MeV)*

Y line shapes

Add 10 extra points with 25pb^{-1} of data each:

3810, 3870, 3950, 4050, 4090, 4150, 4190, 4310, *4370, 4390* MeV





error on M(Y(4008)) = **~27** MeV/c^2
(compare to previous of ~40 MeV/c^2)

error on Γ(Y(4008)) = **~50** MeV
(compare to previous of ~44 MeV)

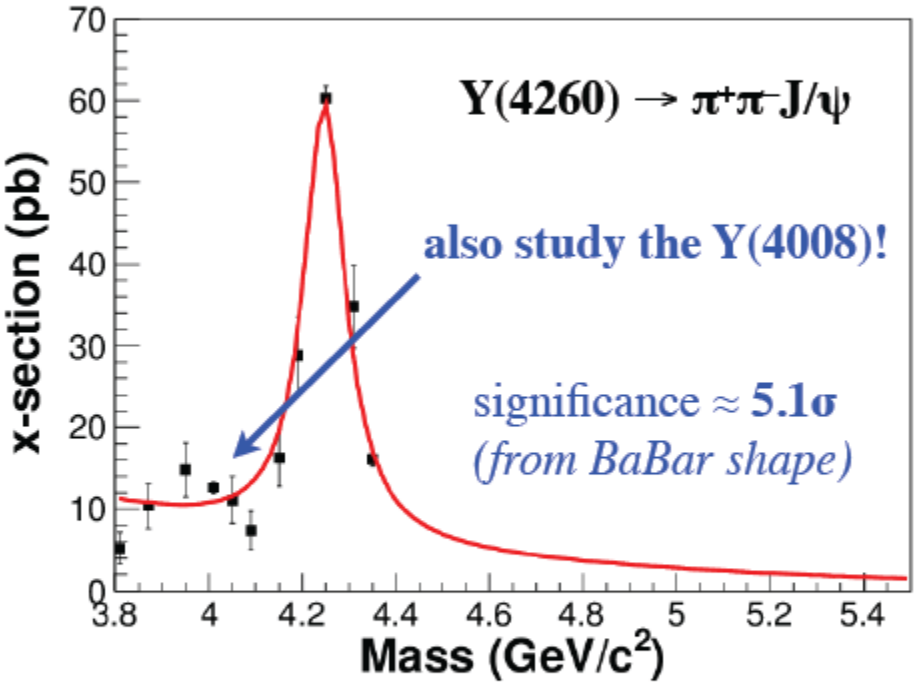
error on M(Y(4360)) = **~6** MeV/c^2
(compare to previous of ~9 MeV/c^2)

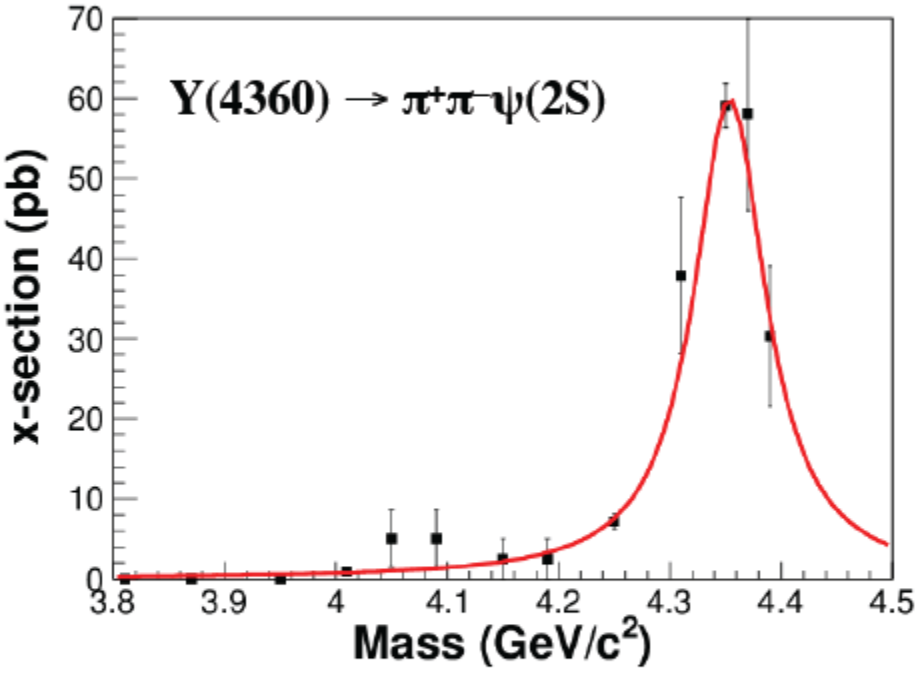
error on Γ(Y(4360)) = **~6** MeV
(compare to previous of ~15 MeV)

Y line shapes

Add 10 extra points with 25pb^{-1} of data each:

3810, 3870, 3950, 4050, 4090, 4150, 4190, 4310, *4370, 4390* MeV





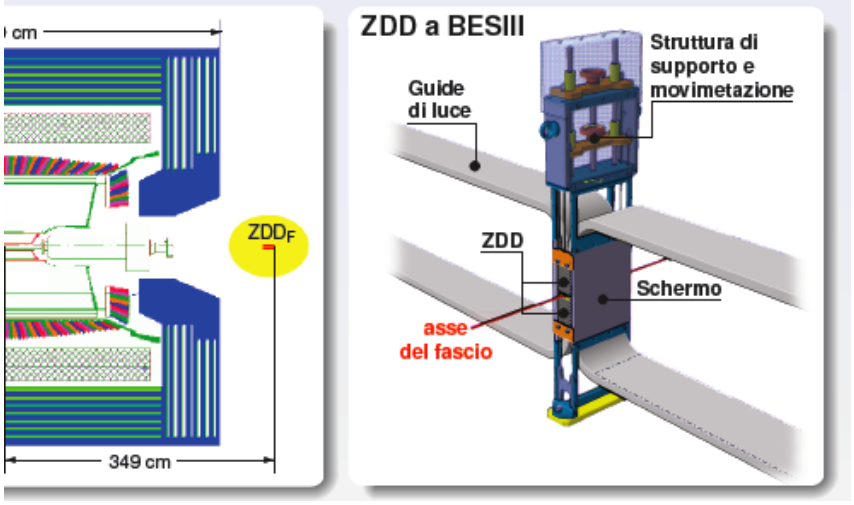
error on M(Y(4008)) = ~27 MeV/c^2
(compare to previous of ~40 MeV/c^2)

error on Γ(Y(4008)) = ~50 MeV
(compare to previous of ~44 MeV)

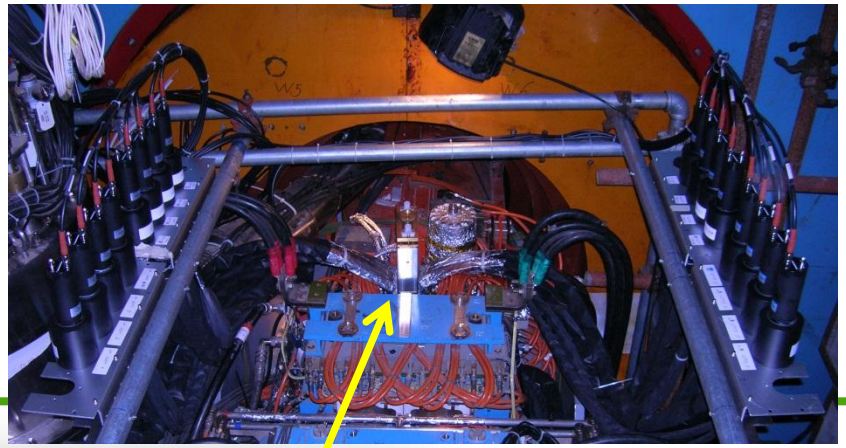
error on M(Y(4360)) = ~6 MeV/c^2
(compare to previous of ~9 MeV/c^2)

error on Γ(Y(4360)) = ~6 MeV
(compare to previous of ~15 MeV)

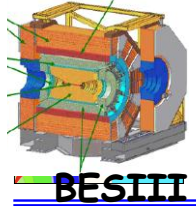
ZDD timeline e status



ZDD: Pb(40%/) Sci.Fi (60%)
2 moduli, sopra e sotto beam pipe
dimensioni: 14x4x6 cm^3
segnale portato ai PM da bundle di fibre in chiaro (2m)



- **01-06/2011: costruzione e messa in opera della stazione ZDD a LNF**
- **06-08/2011: test con raggi cosmici e BTF @ LNF: σ_E/E=12.4% @E=450MeV**
- **agosto 2011:spedizione a Pechino e installazione a BEPCII**
- **2012: debugging con cosmici e dati on-line @ BEPCII**
  - **ha funzionato come luminometro**
  - **presa dati stand-alone su PC dedicato con trigger L1 di BESIII**
  - **problemi hardware/firmware CAEN FADC e risoluzioni**
  - **inserimento nel DAQ a cura del gruppo online di BESIII**



ZDD-Calorimetro

- Permangono purtroppo i 2 problemi visti l'anno scorso col self-DAQ basato sul PC:
  - Inconsistenza fra il n. di trigger acquisiti dalle 2 schede (+ grave, si perde l'intero run dal 1° «disaccordo» in poi)
  - Sporadica (ordine 10^{-4}) corruzione del raw buffer (- grave)
- La frequenza del fenomeno dipende dalla lunghezza della finestra temporale trattata dai 2 V1721.
- Test in corso per trovare la massima lunghezza che permetta di ridurre il problema a ≤ $(1\text{-}2\ \text{ore})^{-1}$.
- Si tratterà in seguito di posizionare correttamente la finestra rispetto ai dati

BESIII CGEM expected spatial resolution

Digital readout

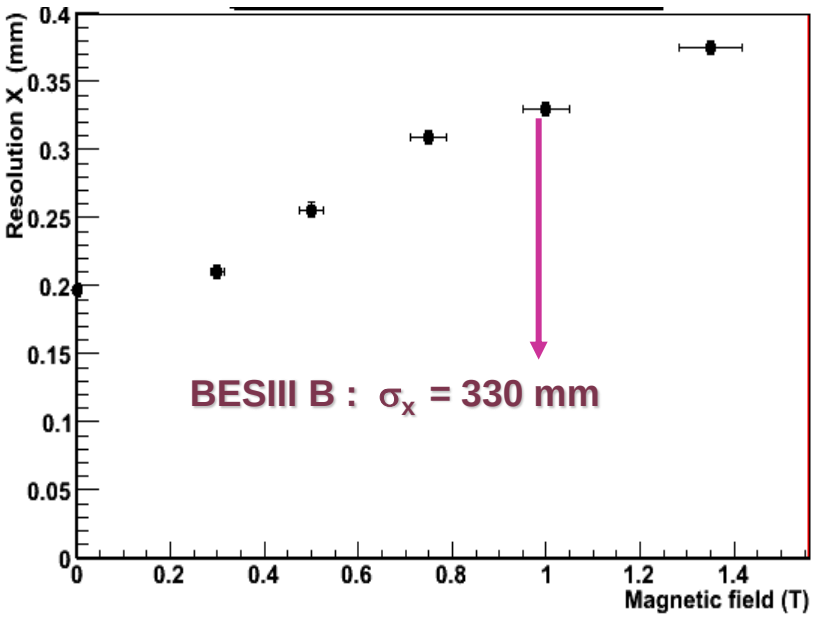
KLOE2 (650 μm pitch)

σ_x =190 μm σ_z ~ 350 μm

Magnetic field effect :

charge spread over the readout plane

190 μm → 330 μm



Analog readout

high spatial resolution: down to 50μm (COMPASS ,400 μm pitch)

Hopefully no magnetic Field effect,
since analog readout measures the centroid of the induced charge

σ_x ~ 650/400 • 50 ~ 80 μm

σ_z ~ 80 • 350/190 ~ 150 μm

GASTONE32 with analog readout

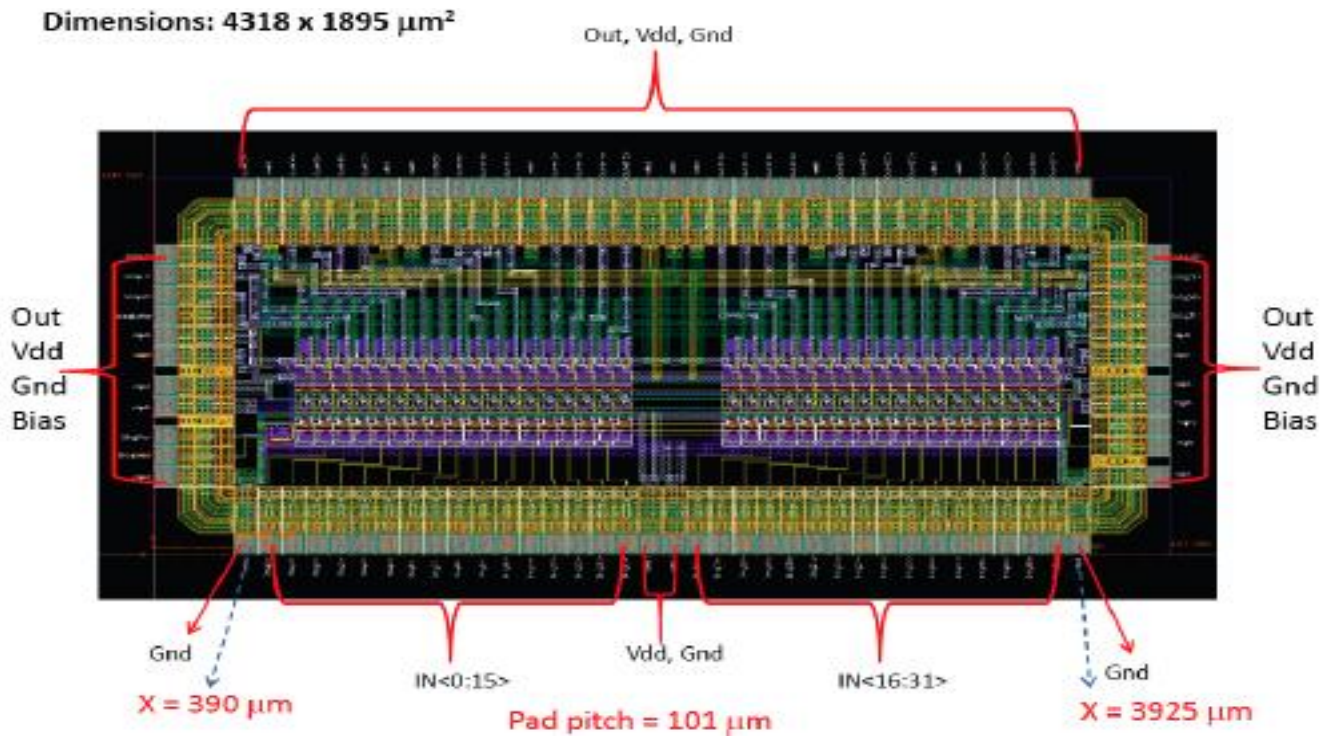
- GASTONE32, a 32 channels board with analog readout, already available.

  It produces an amplified and shaped output of the detector input.

  (See workshop A. Ranieri presentation)

- Funding request to INFN for a small planar (10•10)cm^2 3-GEM

  (Bari group board in next slide)



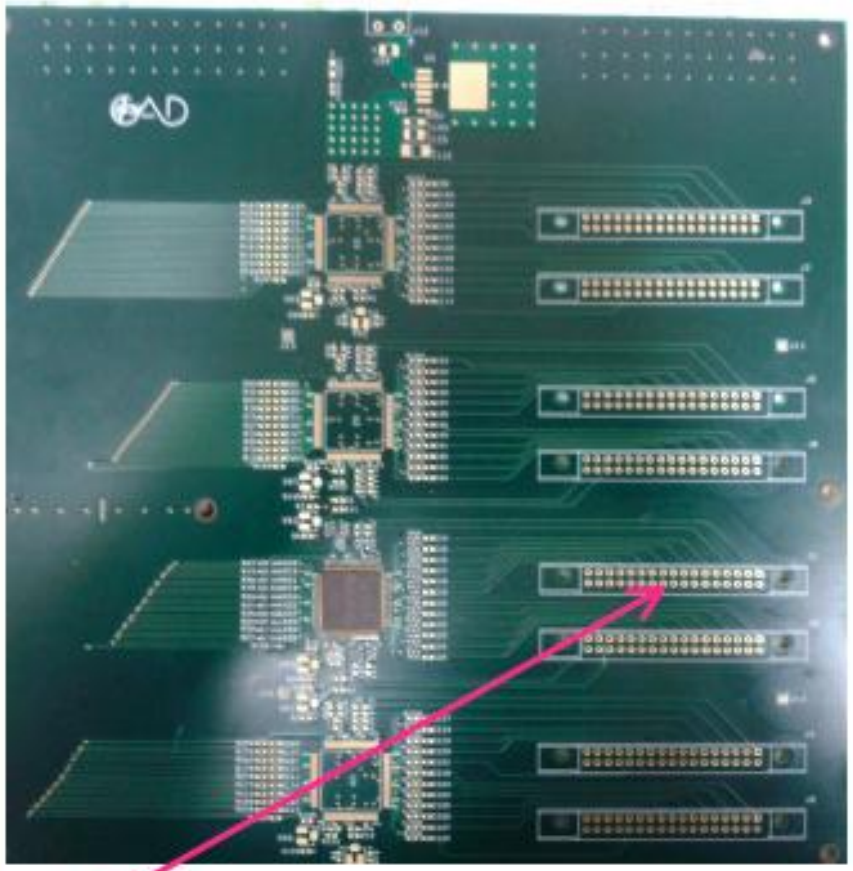
GASTONE32 Board

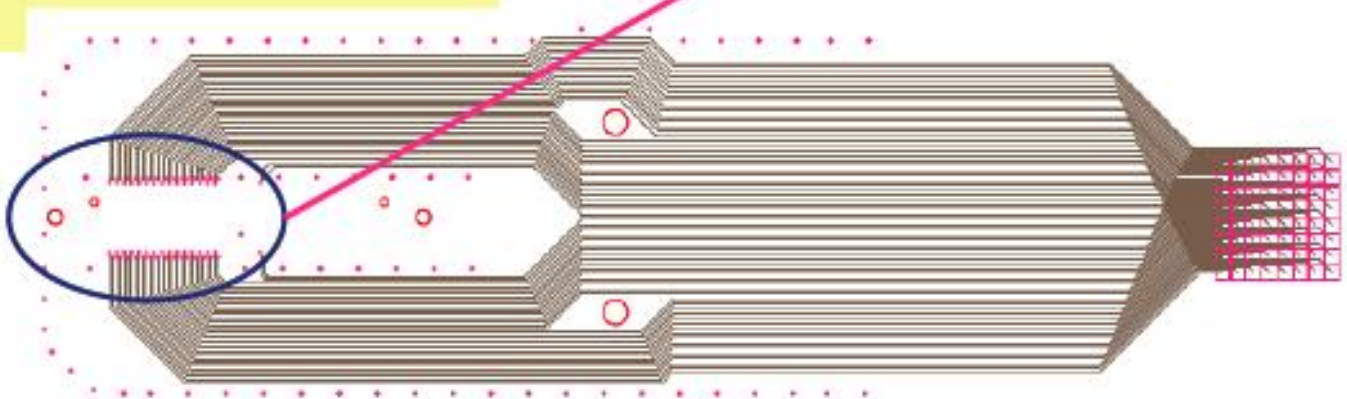
•GASTONE 32 Board ready to be mounted on a small planar 3-GEM with resistive 2x2 mm^2 pad readout; total # pad 8x8=64
total area of 16.5x16.5 mm^2 (*charge dispersion* readout method)

•A total of 128 channels are to be fully instrumented to readout a total area of 272 mm^2

• The analog output will be read out through a "Peak Sensing" ADC for charge *center of gravity* analysis

•It's a project to be further developed for what concern the readout architecture i.e.:
i.Do we need to develop an ADC per channel or for a group of channels?
ii….and something more



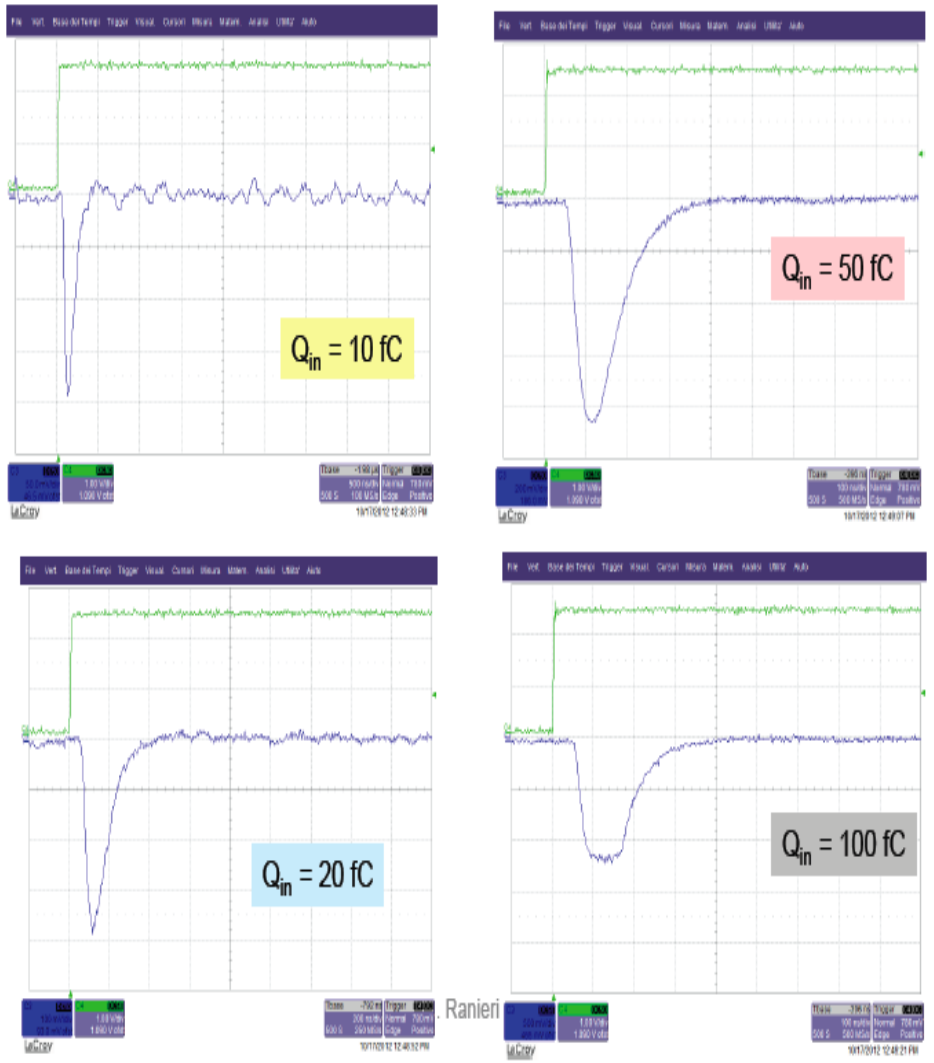


GASTONE32: some test results

- Ar/CO2=70/30
- G ~ 10^4
- 10 primary clusters/3 mm
- Clsize ~ 2.3 el/primary

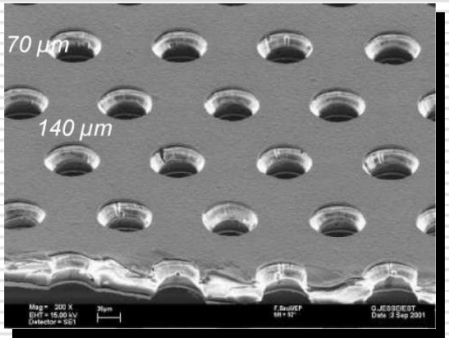
Charge/mip ~ 36 fC

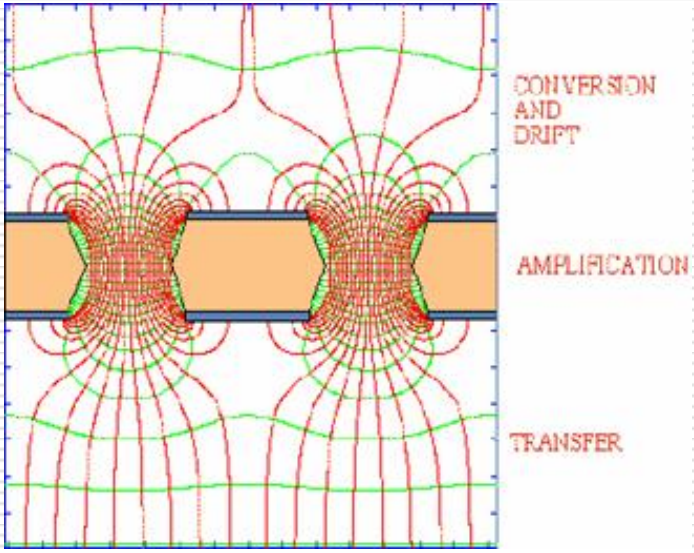
Charge/mip/strip ~ 9 fC



GEM: principle of operation

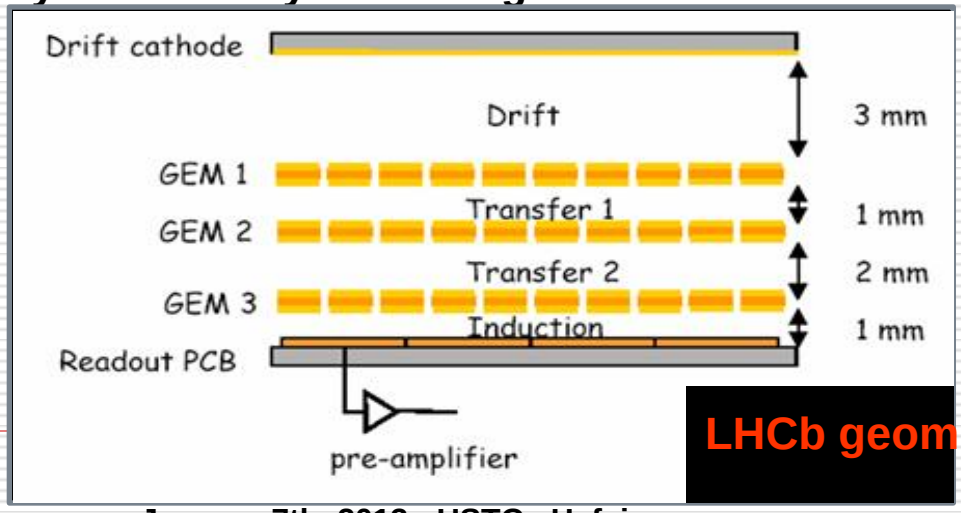
The GEM (Gas Electron Multiplier) [F.Sauli, NIM A386 (1997) 531] is a thin (50 μm) metal coated by a kapton foil perforated by a high density of holes (70 μm diameter, pitch of 140 μm) → standard photo-lithographic technology.





By applying 400-500 V between the two copper sides, an electric field as high as ~100 kV/cm is produced into the holes which act as multiplication channels for electrons produced in the gas by a ionizing particle.

Gains up to 1000 can be easily reached with a single GEM foil. Higher gains (and/or safer working conditions) are usually obtained by cascading two or three GEM foils.



A Triple-GEM detector is built by inserting three GEM foils between two planar electrodes, which act as the cathode and the anode.

GEM detector features

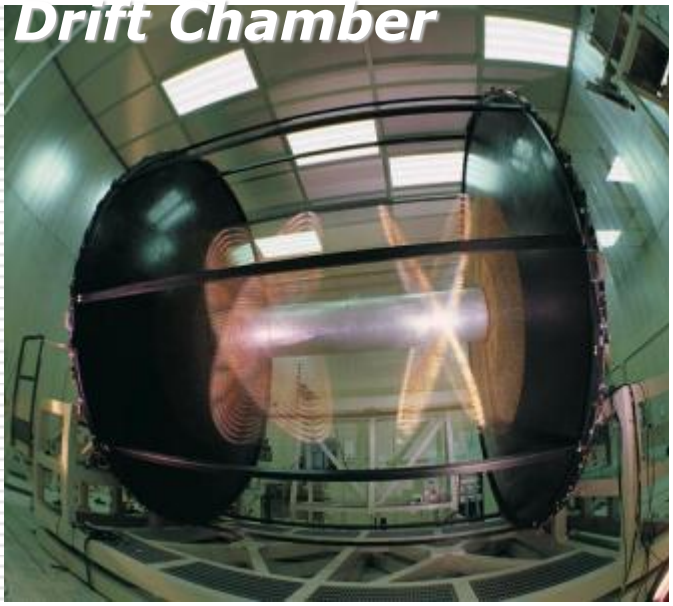
- **flexible geometry** → arbitrary shape: rectangular, cylindrical …
- **ultra-light structure** → very low material budget: <0.5% X0/chamber
- **gas multiplication separated from readout stage** → arbitrary readout pattern: pad, strips (XY, UV), mixed …
- **high rate capability:** >50 MHz/cm2
- **high safe gains:** > 10^4
- **high reliability:** low discharge, $P_d < 10^{-12}$ per incoming particle
- **rad hard:** up to 2.2 C/cm^2 integrated over the whole active area without permanent damages (corresponding to 10 years of operation at LHCb1)
- **high spatial resolution:** down to 60μm (COMPASS with analog readout **Nucl.Phys.Proc.Suppl. 125 (2003) 368-373**)
- **good time resolution:** down to 3 ns (with CF_4)

KLOE at upgraded DAΦNE φ-factory (1020 MeV)

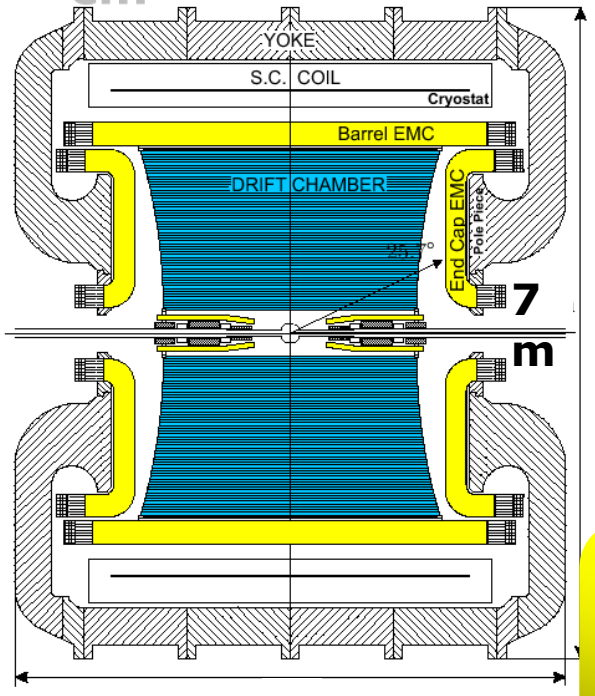
- 4 m diameter × 3.3 m length
- 90% helium, 10% isobutane
- 12582/52140 sense/tot wires
- All-stereo geometry

λ_{KS} = 0.6 cm λ_{KL} = 340 cm $\lambda_{K\pm}$ = 95 cm

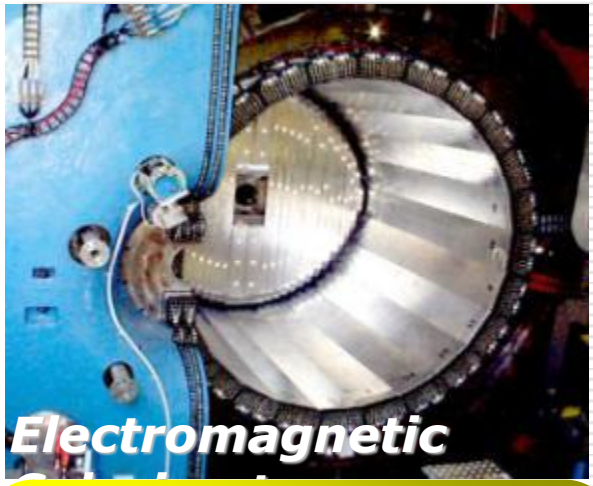
- Lead/scintillating fiber
- 98% coverage of solid angle
- 88 modules (barrel + end-caps)
- 4880 PMTs (two side read-out)



$\sigma_{r\phi}$ = 150 μm σ_z = 2 mm
σ_v = 3 mm σ_p/p = 0.4 %



B = 0.52 T



σ_E/E = 5.4%/$\sqrt{E(GeV)}$

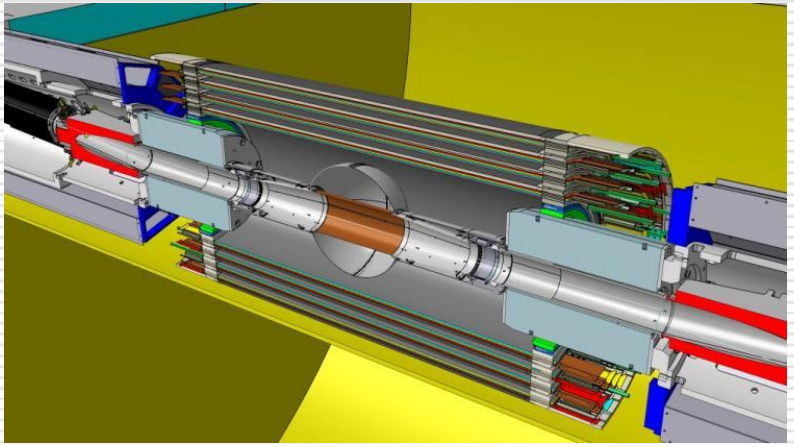
σ_t = 54 ps$\sqrt{E(GeV)}$

⊕ 100 ps(calib)

KLOE2 Inner Tracker

To improve vertex reconstruction of **K_S , η and η'** and **K_S- K_L interference measurements:**

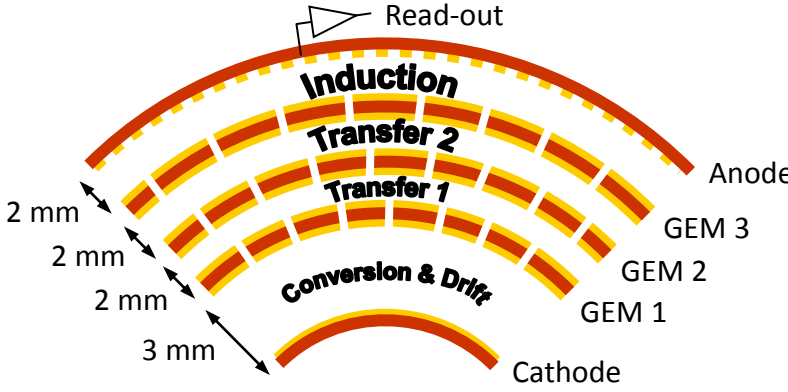
1. **$\sigma_{r\varphi} \sim 200$ μm and $\sigma_z \sim 350$μm**
2. **low material budget**: < 2% X_0



Cylindrical GEM detector is the adopted solution

- **4 CGEM** layers :from IP to DC Inner wall
- **700 mm** active length
- **XV strips-pads readout (~40° stereo angle)**
- **<2%X_0** total radiation length in the active region

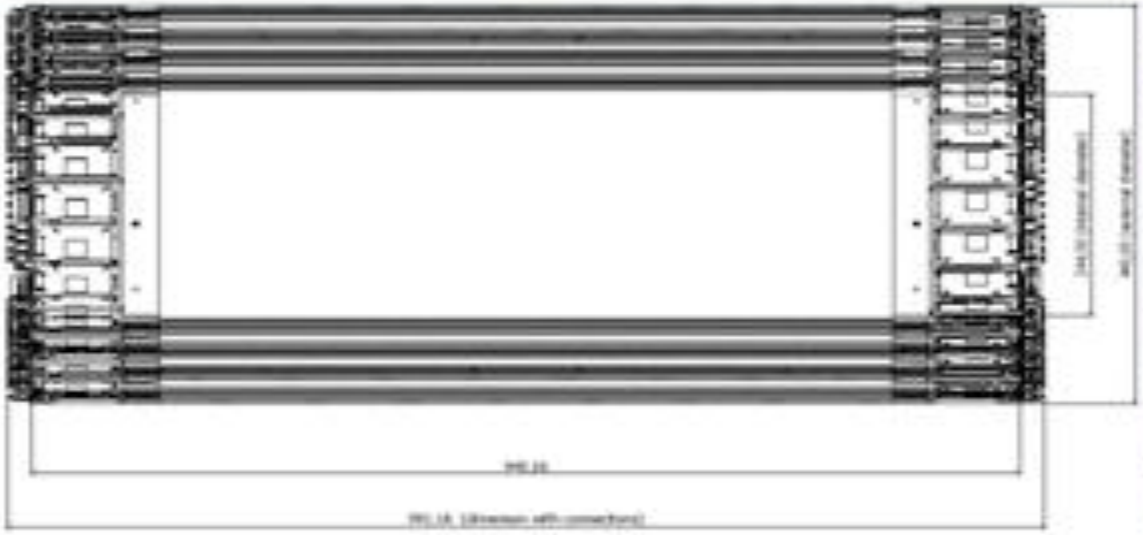
Cylindrical Triple GEM



$K_S \rightarrow \pi^+ \pi^-$ vertex resolution **will improve of about a factor 3** from present **6mm**

KLOE - IT dimensions

	Ext diam (mm)	Int diam (mm)
Layer 1	290	244
Layer2	340	294
Layer3	390	344
Layer4	440	394

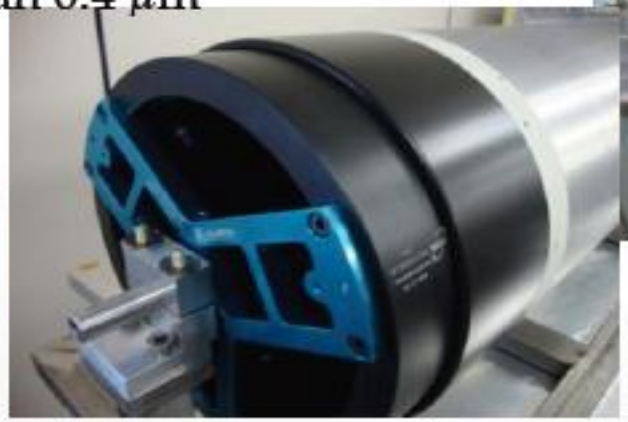


Total lenght 945,16 mm + connectors ~ 991,16 mm

Cylindrical Molds

- To obtain cylindrical electrodes we wrap the foils around molds
- There is one mold for each of the 5 electrodes needed in a triple-GEM (cathode/3 GEM/readout): 20 different molds

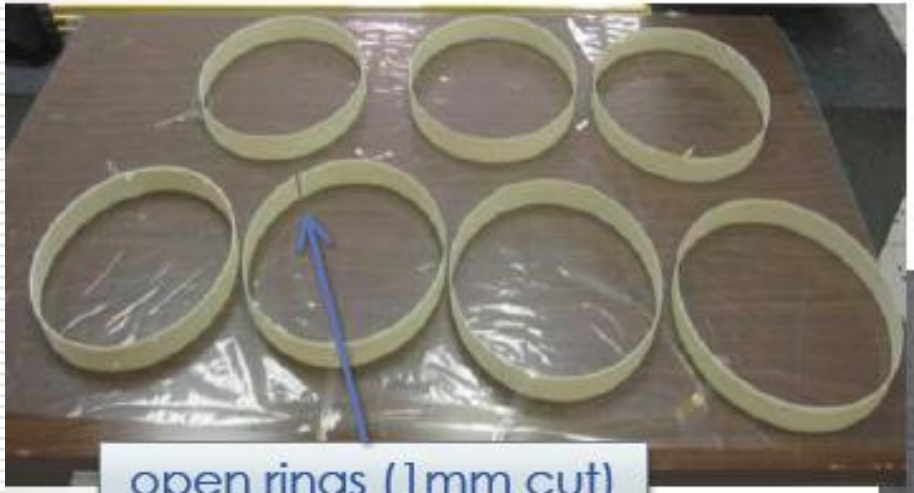
- Molds are realized in Aluminum with precision machined surface
- A Teflon (HST-FEP-HT) cladding 0.5 mm thick provides a low-friction and non-sticking surface.
- Tolerance on the final diameter is 0.02 mm
- Roughness is less than 0.4 μm



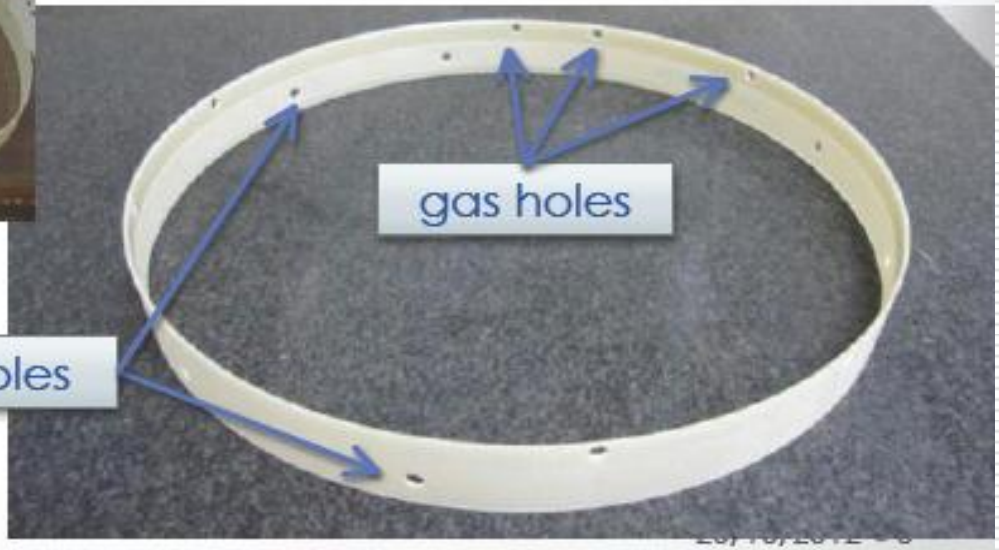
Algra, Bergamo, IT
Cecom, Rome, IT

Fiberglass rings

- At the far ends of the cylinder we place annular rings to provide mechanical support and spacing between the gaps (3/2/2/2)
- They also allow the sealing of the detector and hosts the pinholes for the positioning of the electrodes
- The material is Durostone, a stratified glass epoxy composite (EPGC22)

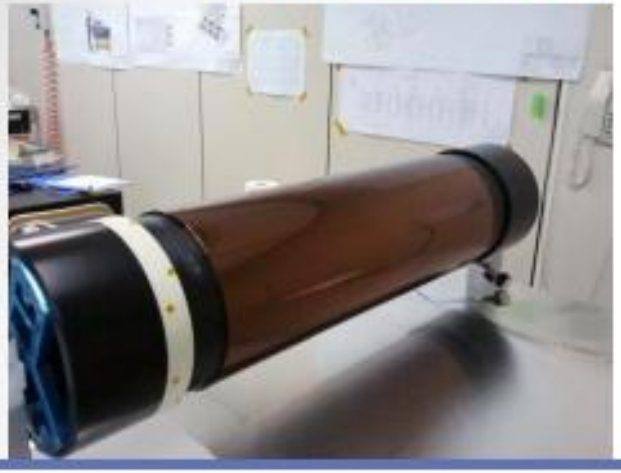


- The preparation procedure foresees: dimensional check, brushing, US cleaning w/DI water, passivation w/Araldite 2011

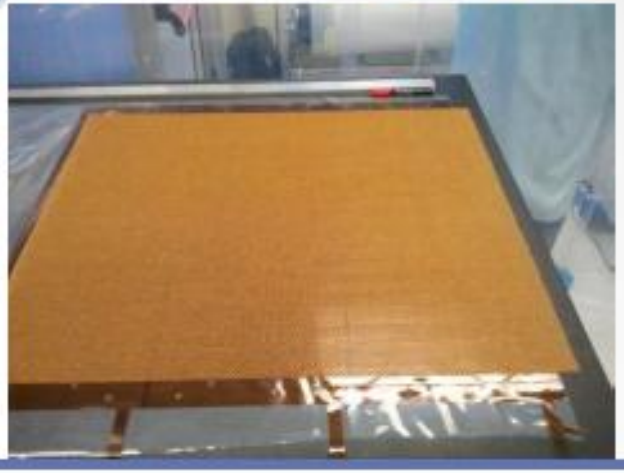


Resarm Engineering Plastics, Barchon, B

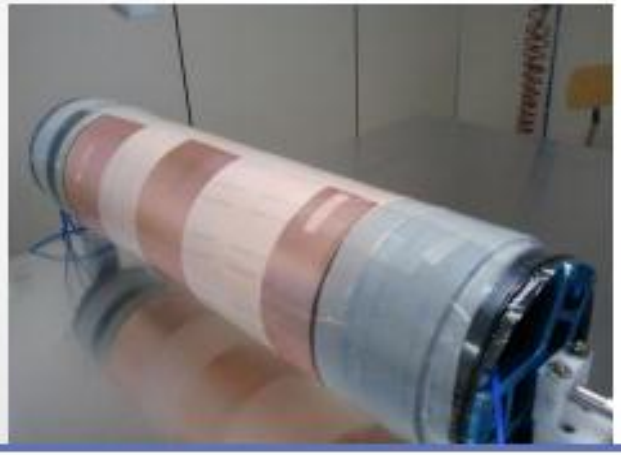
Manufacturing a Cathode



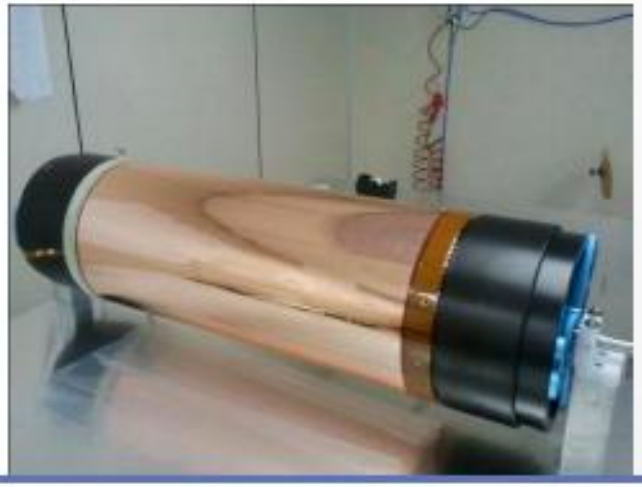
We place an inner cylindrical kapton layer on the mold



Nomex honeycomb 3 mm thick is glued on the back of the cathode



Cathode (made by 3 foils) is wrapped around the mold and closed with a vacuum bag



Final cathode is ready with both internal and external rings

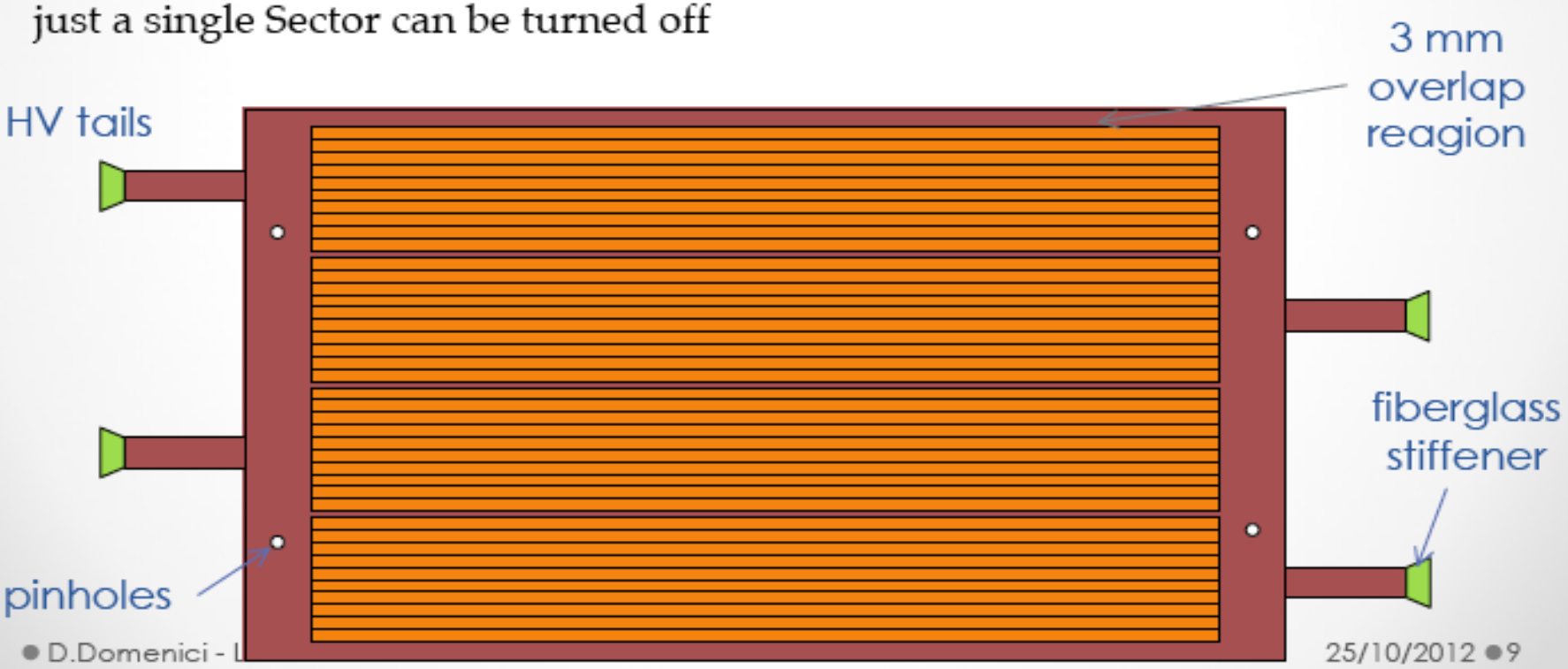
GEM Foils

- GEM foils by CERN TE-MPE-EM with a single-mask chemical etching tuned to produce large size GEM
- Present size 1.2m x 0.5m (active area) Future max size 2m x 0.5m
- The hole shape is double conical (70-50-70) with a slight asymmetry

GEM Foil	Thickness (μm)	Radiation Length
Copper	3	2.1E-04
Polyimide	50	1.75E-04
Copper	3	2.1E-04
	56	5.95E-04

Layout of a GEM

- Bottom side of the active area is divided in 4 Macro-Sectors (MS), each with its own HV connection tail
- Top side of MS is furthermore divided in 10 Sectors, all independentely supplied
- HV tails have 11 connections (1 bottom MS + 10 top S) ending on 0.8 mm fiberglass stiffener
- Sectorization is for minimizing damage in case of discharge
- Sector HV independance is for minimizing loss in case of damage: just a single Sector can be turned off

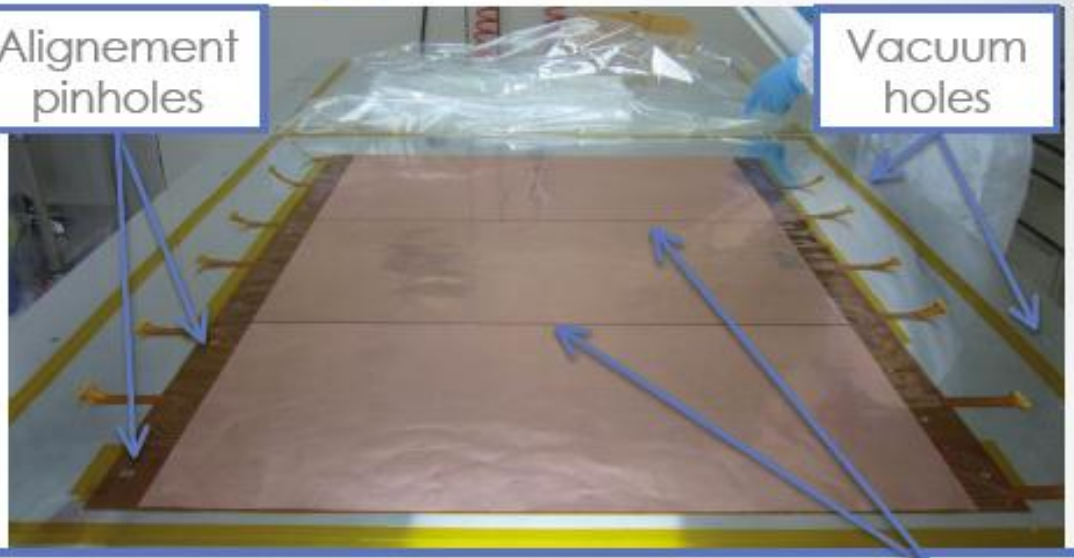


Manufacturing a C-GEM

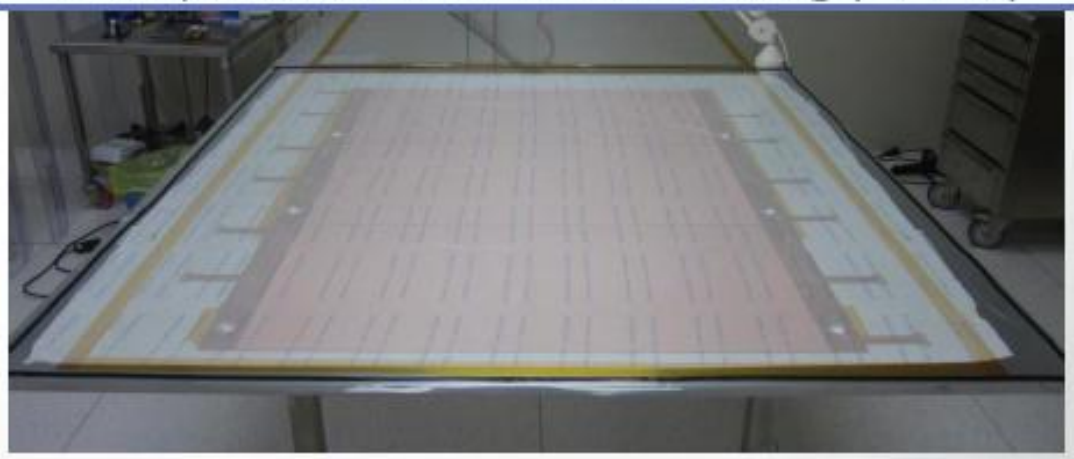
Epoxy glue (Araldite 2011) is distributed by hand on a 2 mm wide line

Alignement pinholes

Vacuum holes

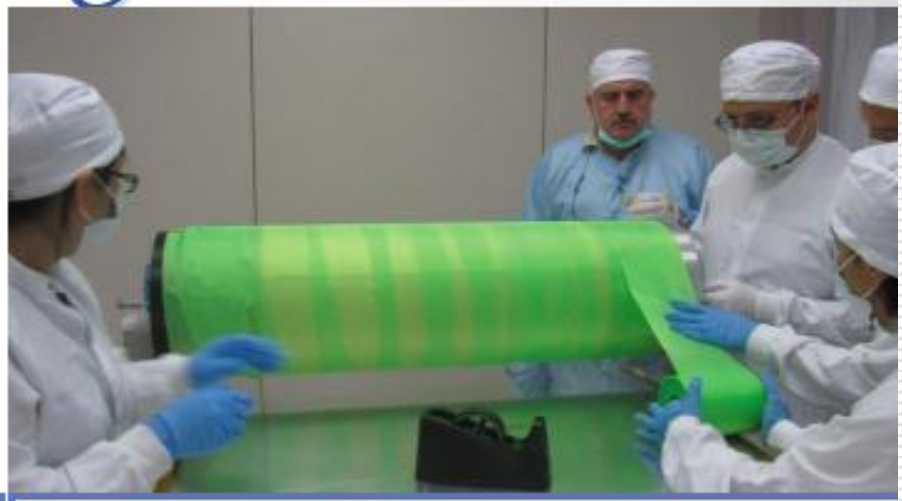


3 GEM foils are spliced together with a 3 mm overlap and closed in a vacuum bag (0.9 bar)



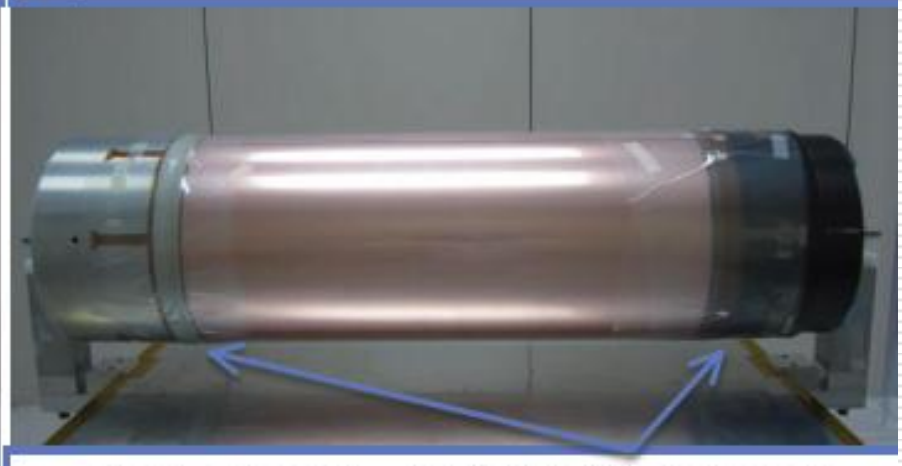
Manufacturing a C-GEM

GEM is protected with a Mylar sheet and wrapped on the cylindrical mold



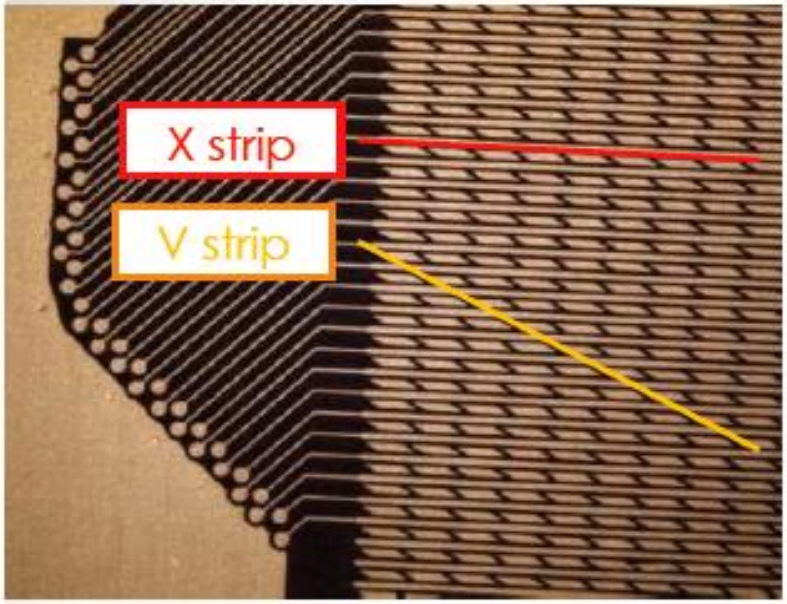
Transpirant tissue (PeelPly from RiBa) is placed around to distribute vacuum

Vacuum bag envelope



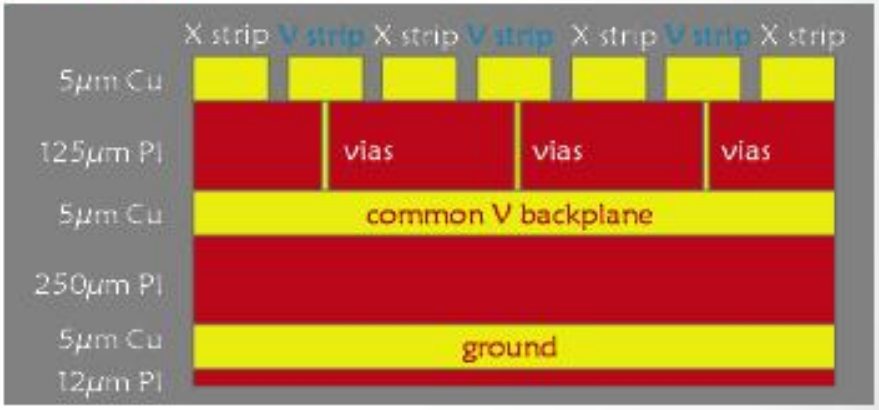
Final cylindrical GEM with internal and external rings

Readout Plane



Readout plane is realized at CERN TE-MPE-EM
It is a kapton/copper multilayer flexible circuit
Provides 2-dimensional readout with XV strips on the same plane

- X are realized as longitudinal strips
- V are realized by connection of pad through conductive holes and a common backplane
- Pitch is 650 μm for both

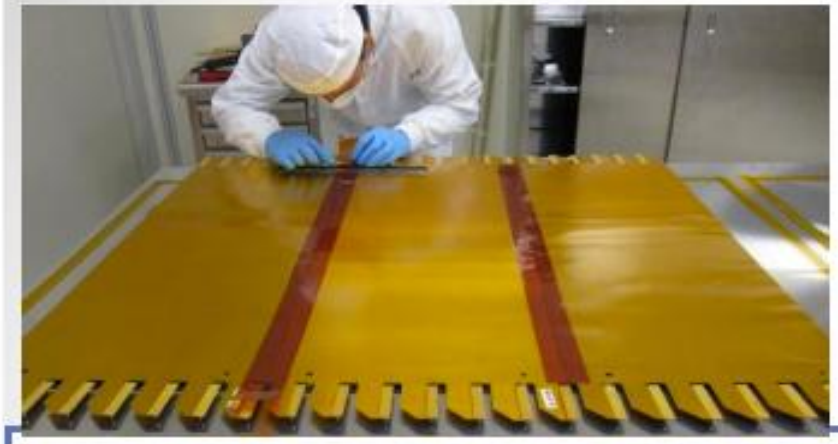


X pitch 650μm → X res 190μm

V pitch 650μm → Y res 350μm

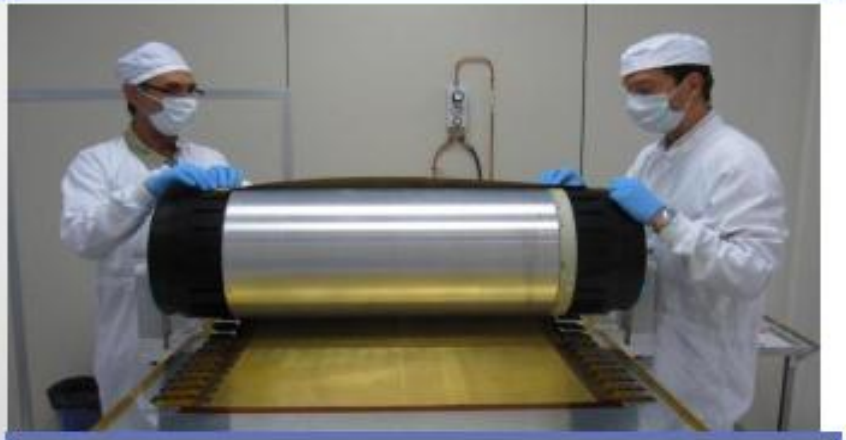
25/10/2012 ● 17

Manufacturing the Readout



3 foils are spliced without overlap: kapton strips (6 cm) are glued on the back of head-to-head joints

Final foil is ~1m long with three ~1mm wide dead zones

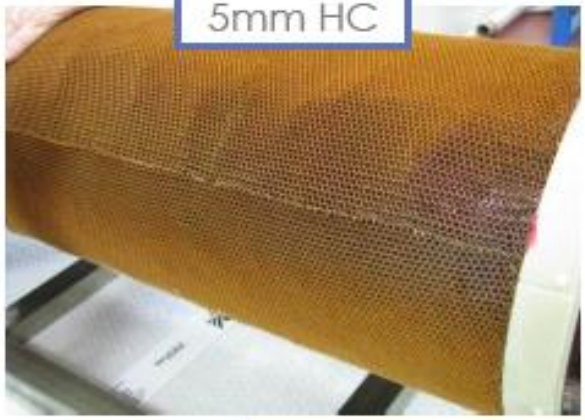


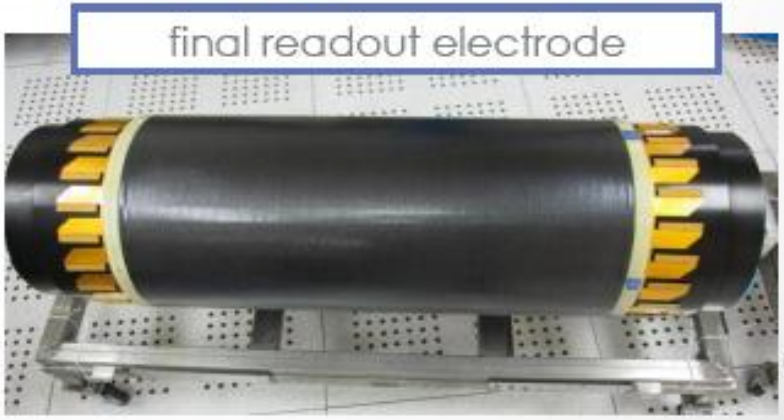
Foil is wrapped on the mold

...to obtain cylindrical electrode

Readout CF Lamination

- The readout is shielded with a very ligth Carbon fiber composite structure realized by RiBa Composites, Faenza, IT
- The shield is composed by a sandwich of two 90 μm thick carbon foils prepreg with epoxy (Carbon-Epoxy 90g/m2 58% Fibra T300) spaced by a 5 mm thick Nomex honeycomb (ECA-I 4.8-48 3/16-3.0)





0/2012 ●21

Assembling a triple-GEM

- A dedicated assembling machine has been designed and realized to perform the insertion of the electrodes one into the other
- It is an Aluminum structure with a bottom plate and a top flange running vertically on linear bearings
- Axial alignment has a precision of 0.1mm/1.5m
- The structure can rotate by 180° around its central horizontal axis

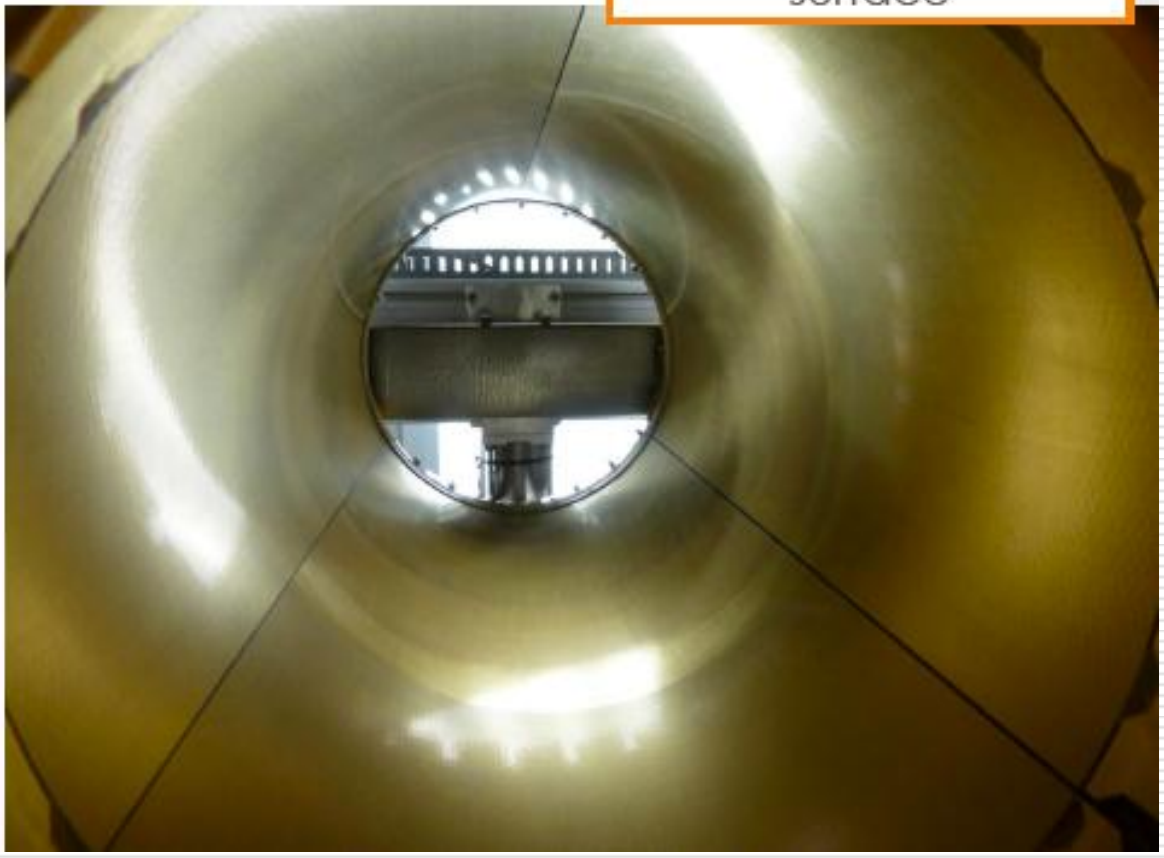
The first electrode (the readout) is fixed with its mold on the bottom plate

The top ring is grabbed with pins by the top flange

Assembling a triple-GEM

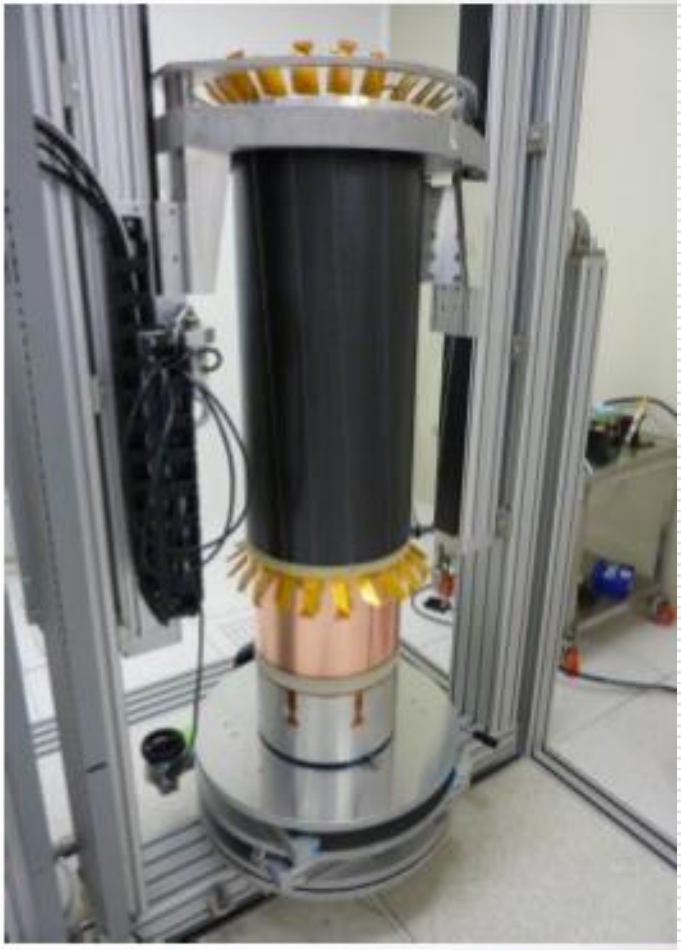
The electrode is extracted from its mold by moving up the flange

internal readout surface



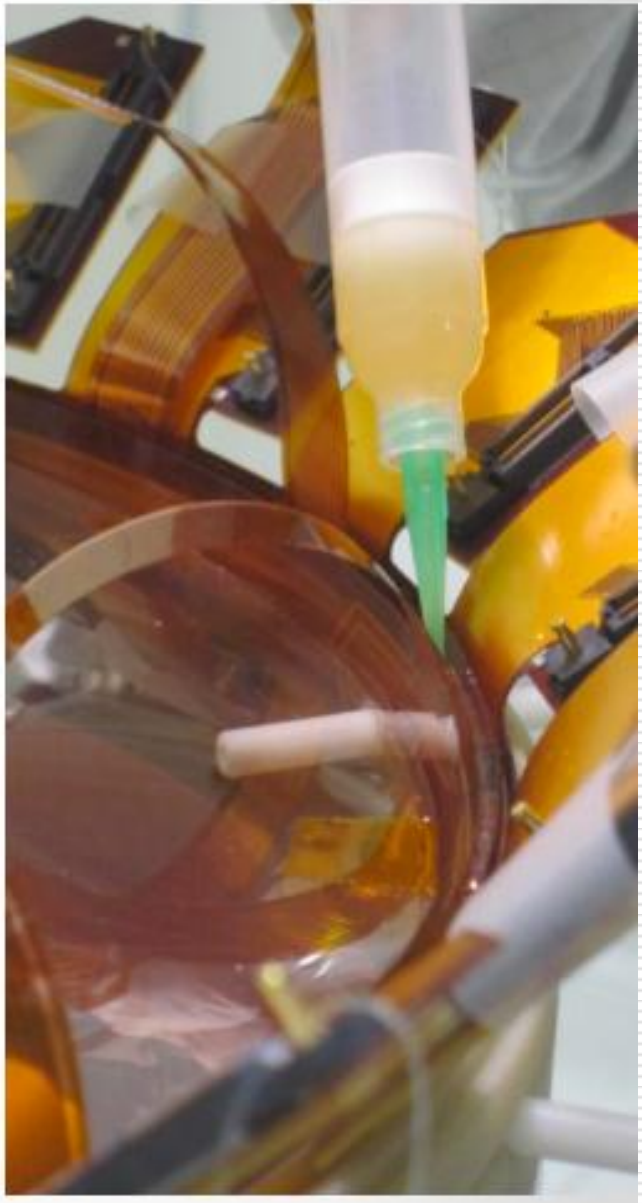
● D.Domenici - LNF

Assembling a triple-GEM



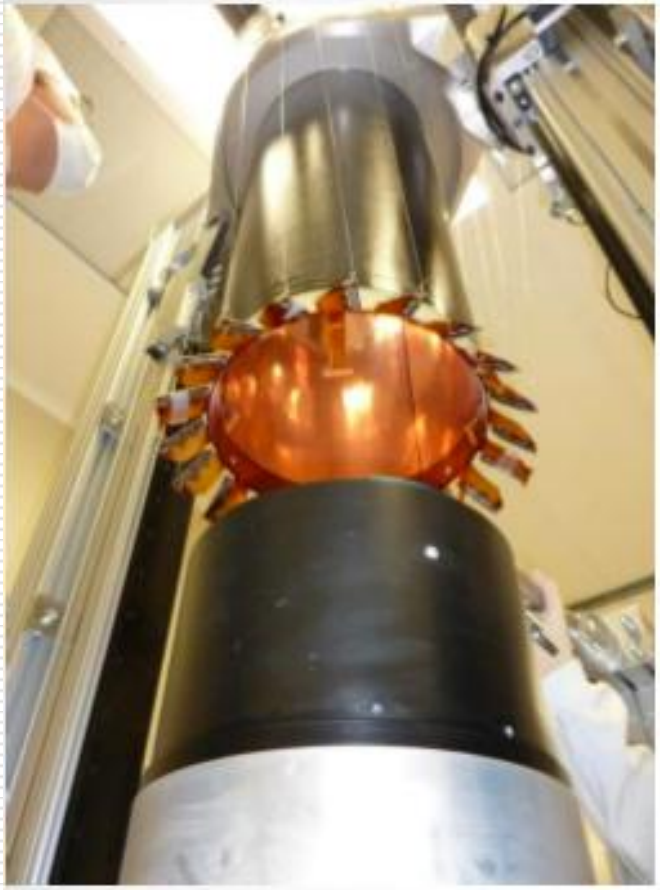
1. The second electrode (GEM3) is placed on the machine with its mold and
2. Fixed to the bottom plate
3. The top flange with Readout is moved down around the GEM

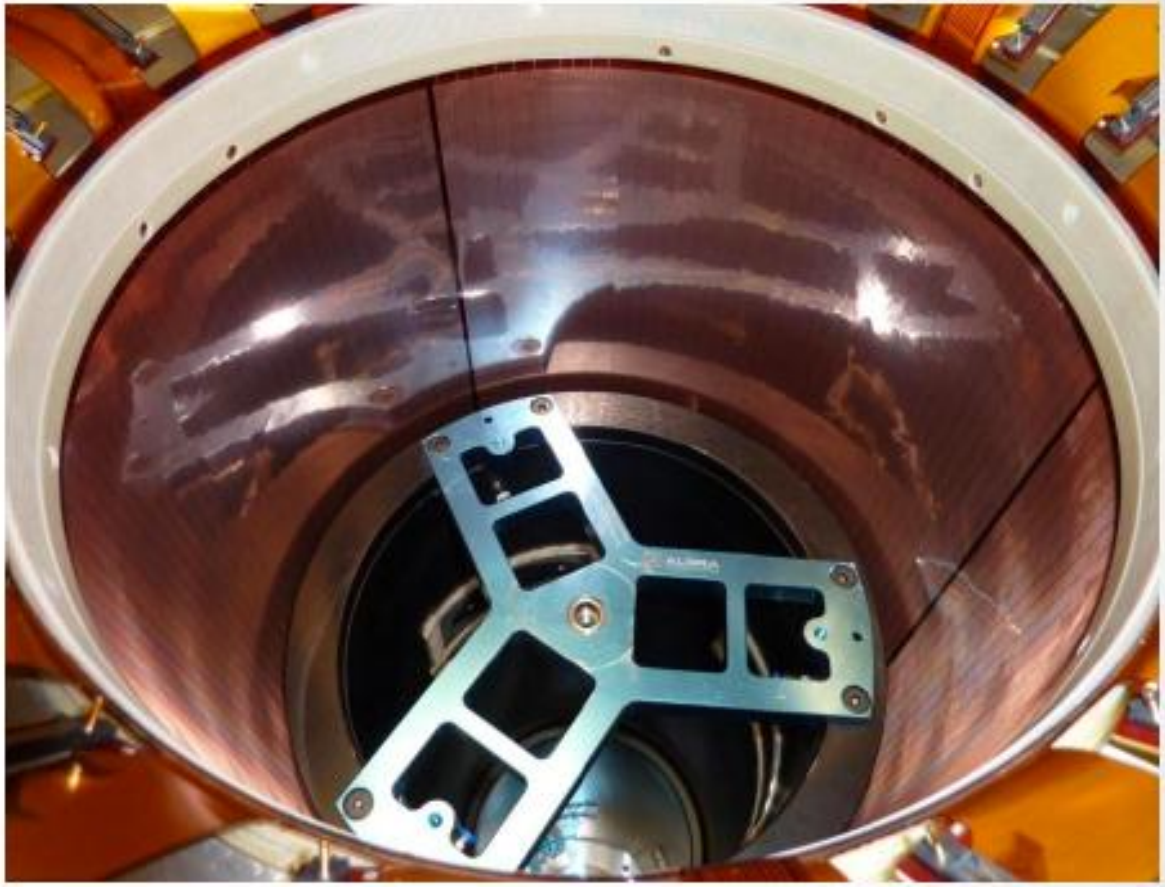
Detector sealing



The top side of the detector is sealed with epoxy adhesive (Araldite 2011) flowed into the 0.35 mm reservoir with a dispencer.
Curing cycle lasts 24h

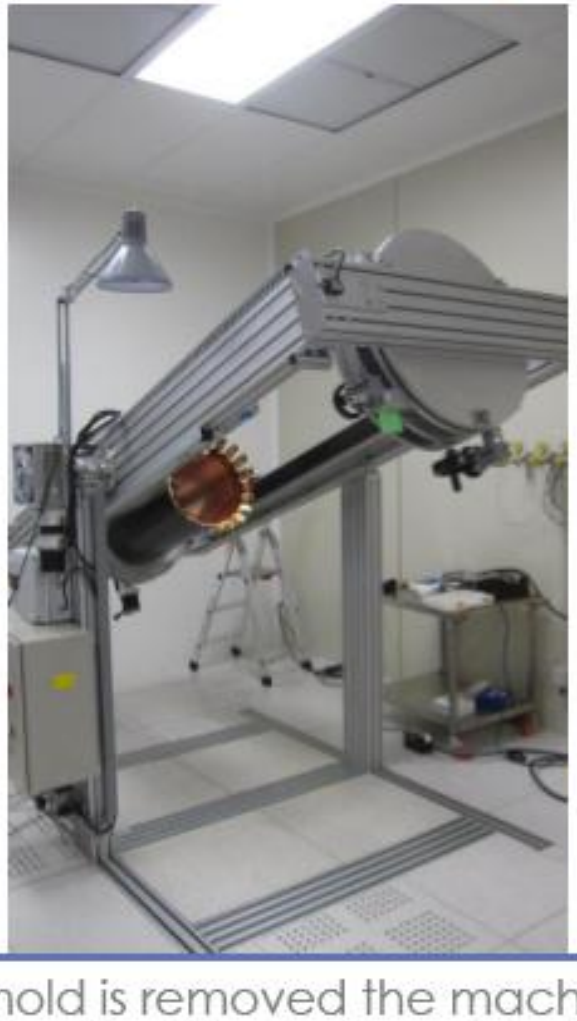
Assembling a triple-GEM





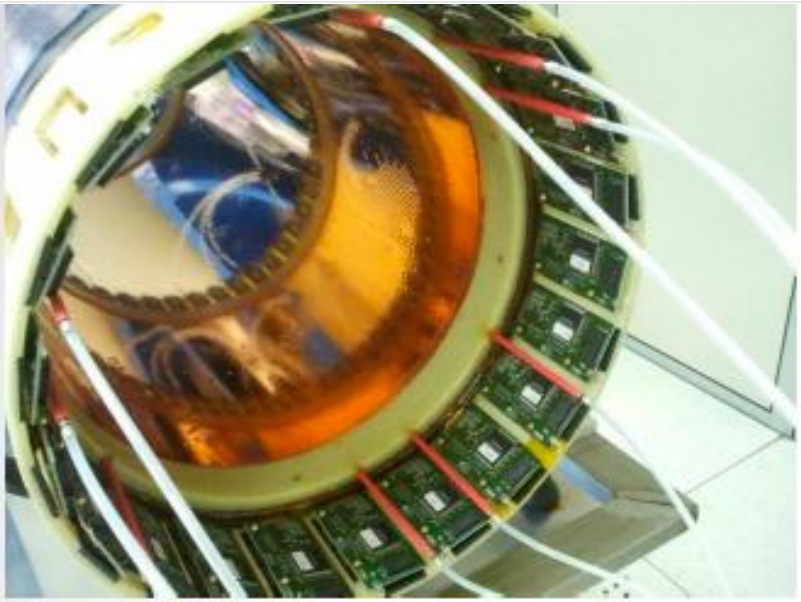
The top flange with both Readout and GEM3 is moved up
The naked mold is left downside

Assembling a triple-GEM



Once the mold is removed the machine is rotated by 180° so that the bottom side becomes accessible and can be sealed

Detector assembled

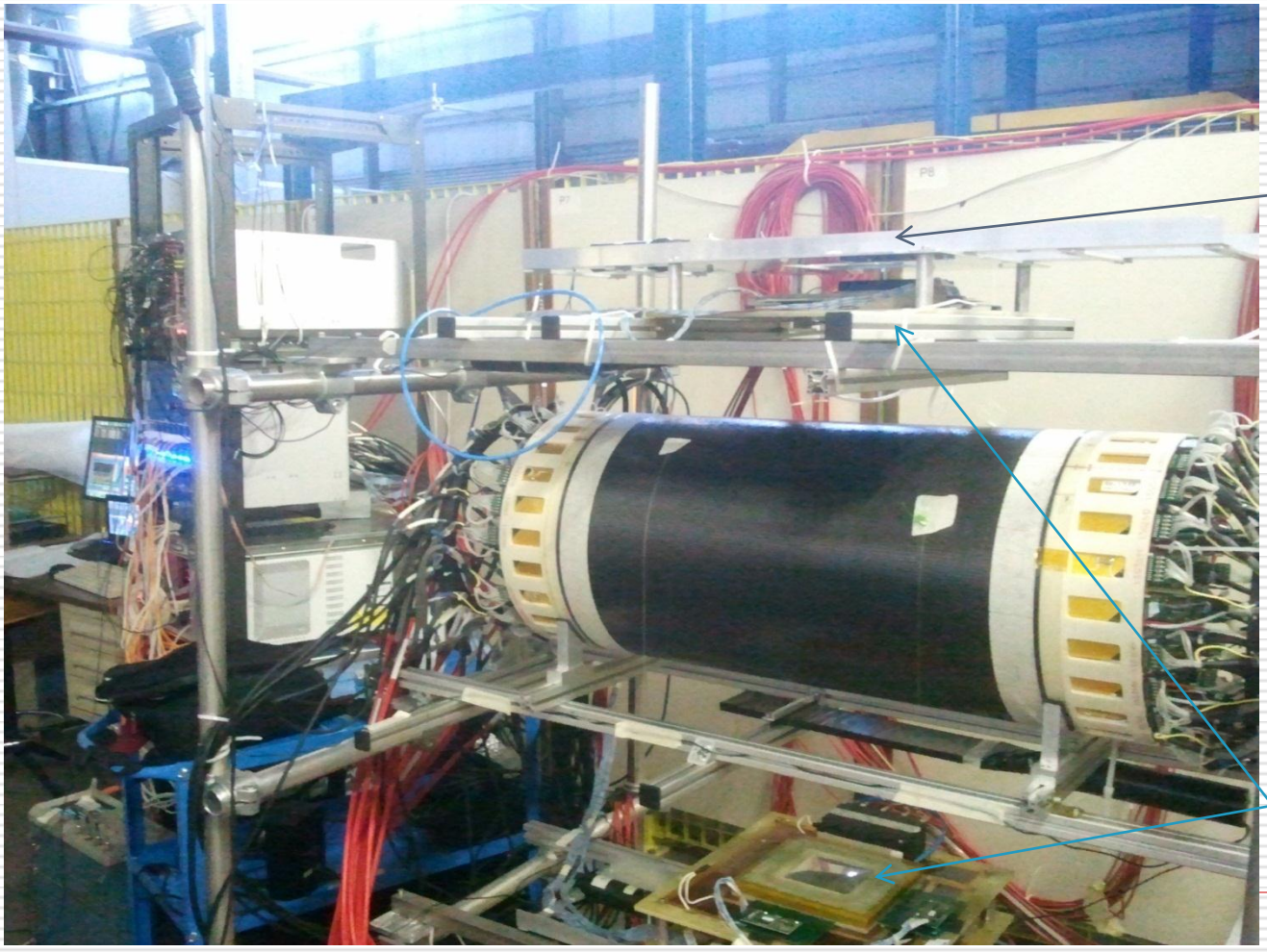


Layer2 equipped with FEE

FEE is supported by 2 fiberglass outer rings

Cosmic rays test

Test with final HV cables , distributors, FEE and DAQ system



top/bottom scintillators for trigger

tracking provided by external 10x10 cm² Triple-GEM

KLOE-2 IT Construction Status

Layer2

- ❑ Built and sealed
- ❑ Tested with source
- ❑ Equipped with GASTONE-FEE
- ❑ Equipped with Blocking-Capacitor
- ❑ Tested with cosmic-ray muons

Layer1

- ❑ Built and sealed
- ❑ Tested with source in Current Mode
- ❑ Equipped with Blocking-Capacitor

Layer3

- ❑ Built and sealed
- ❑ Spacer grid inserted
- ❑ Tested with source
- ❑ Equipped with Blocking-Capacitor
- ❑ Under Test with cosmic-ray muons

Layer4

- ❑ material delivery from CERN: Nov 2012
- ❑ construction completion : Jan 2013

Layers Integration

- Insertion L1/L2/L3 and test with cosmic-rays: Dec 2012
- Integration of detector w/beam pipe: Mar 2013

Mass production of simulated RAW events

- **BESIII experiment organised activity:** mostly performed (now) @ IHEP batch computing farm

- **mass simulation of the RAW events (to be performed for a single BOSS version):**
  - each job generates a single file: **50K events**
  - processing time: **14 – 19 h**
  - input: **a few parameters**
  - output: **a single file, 255 – 350 MB, ROOT, *.rtraw**
  - output ratio: **5 - 10 KB/s**
  - final destination: **IHEP storage**

- **cumulated volume of simulated RAW data (for a single BOSS version:**
  - J/ψ : **1.1 TB**
  - ψ' : **0.65 TB**
  - ψ'' : **1.12 TB**

Reconstruction of simulated RAW events

- **BESIII experiment organised activity:** performed @ IHEP batch computing farm

- **mass simulation of the RAW events (to be performed for each BOSS version):**
  - processing time: **8 – 12 h**
  - input: **one .rtraw file (simulated data) and some random trigger files (raw data)**
  - input file sizes: **255 – 350 MB (simulated), 1.5 – 2 GB (random trigger)**
  - read mode: **sequential (simulated), random (raw data)**
  - output: **one file, 900 MB, ROOT, *.dst**
  - output ratio: **< 50 KB/s**
  - location input and output files: **local or IHEP storage (simulated), IHEP storage (50TB raw data)**

- **cumulated volume of simulated RAW data (for a single BOSS version:**
  - J/ψ : **3.8 TB**
  - ψ' : **2.3 TB**
  - ψ'' : **4.0 TB**

Mass simulation and reconstruction

	Simulation				Reconstruction			
event type	event size [KB]	wall time per Ev [sec]	output file size [MB]	wall time per file [hours]	event size [KB]	wall time per Ev [sec]	output file size [MB]	wall time per file [hours]
J/ψ	5.1	1.0	255	14	18	0.6	900	8
ψ′	6.5	1.28	325	18	23	0.8	1150	10
ψ″	7.0	1.4	350	19	25	0.9	1250	12

- **simulations significantly contributes to BESIII data size:**
  - current BESIII storage @ IHEP: **2.3 PB (1.2 PB used by ~ 100M files)**
- **expected cumulated data growth up to 2020: 6.4 PB**
  - real data (.raw): **3.6 PB**
  - reconstructed data (.dst): **1.8 PB**
  - simulated and reconsctructed data (.rtraw + ..dst): **1.0 PB**

Computing requirements

Assuming 2000 cores with 10% error jobs and 100% working efficiency

J/ψ inclusive mc: 1 s/event	J/ψ inclusive rec: 0.6 s/event
ψ' inclusive mc: 1.28 s/event	ψ' inclusive rec: 0.8 s/event
ψ'' inclusive mc: 1.4 s/event	ψ'' inclusive rec: 0.9 s/event

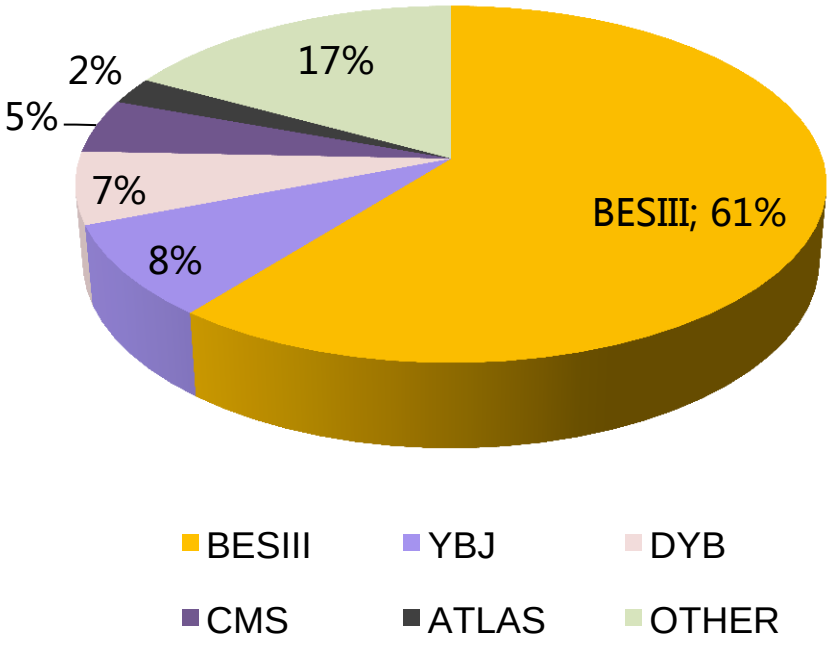
real data	1.2 G J/ψ (days)	500 M ψ' (days)	2.9 fb $^{-1}$ ψ'' (days)
CPU time	~ 16	~ 10	~ 26

MC data	simulation (days)	reconstruction (days)	total (days)
1.2 billion J/ψ inclusive	7	5	12
500 million ψ' inclusive	4.5	2.5	7
1 billion ψ'' events	8	5	13

Job statistics

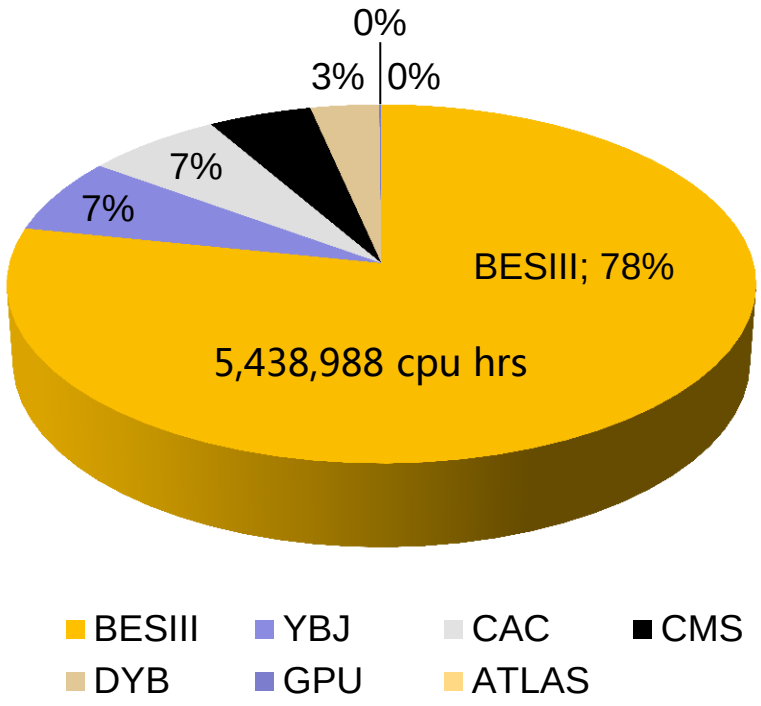
2012/01 — 2012/05

CPU Resources



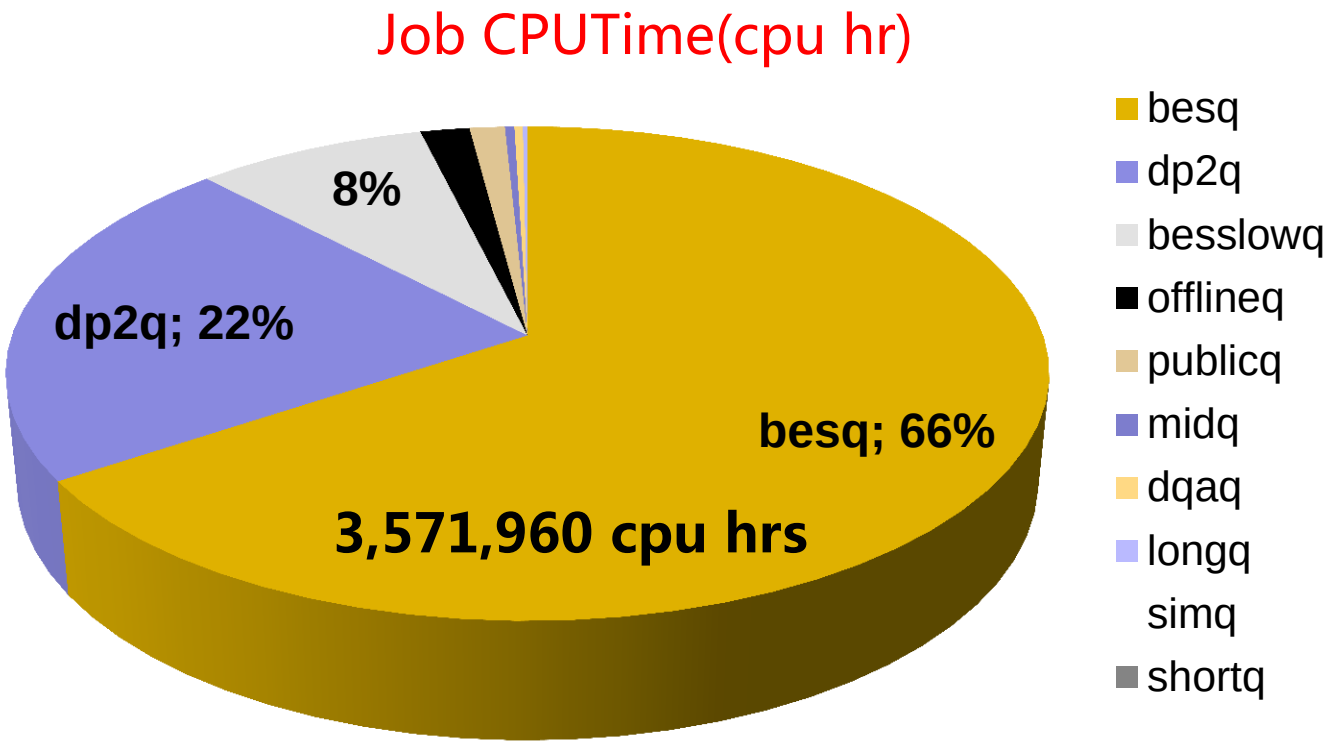
Total： 5,202 cores
BESIII： 3,196 cores
Others: 2,006 cores

Job CPU Time (cpu hr)



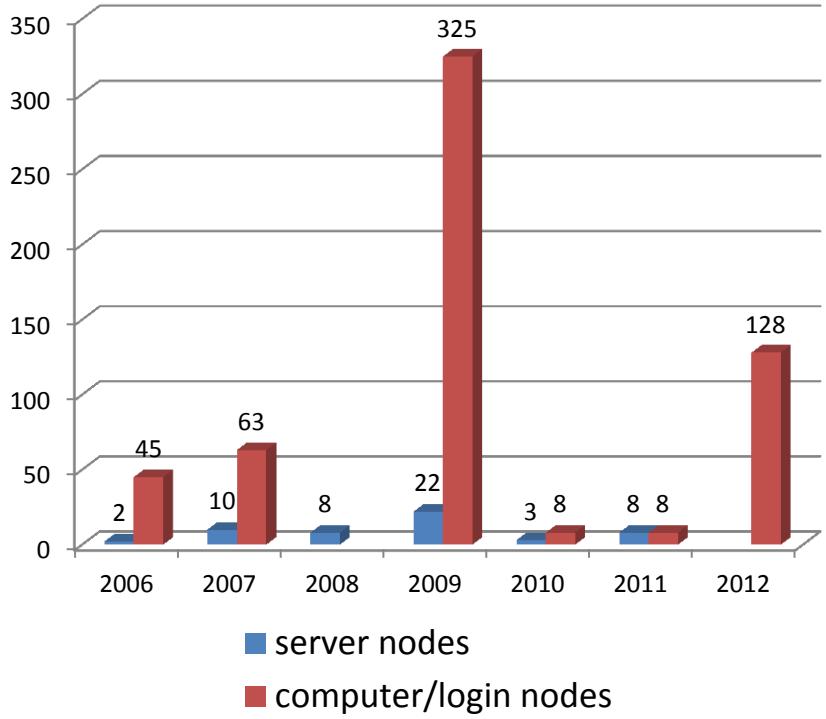
Total： 6,980,368 cpu hrs
BESIII：5,438,988 cpu hrs
Others: 1,541,380 cpu hrs

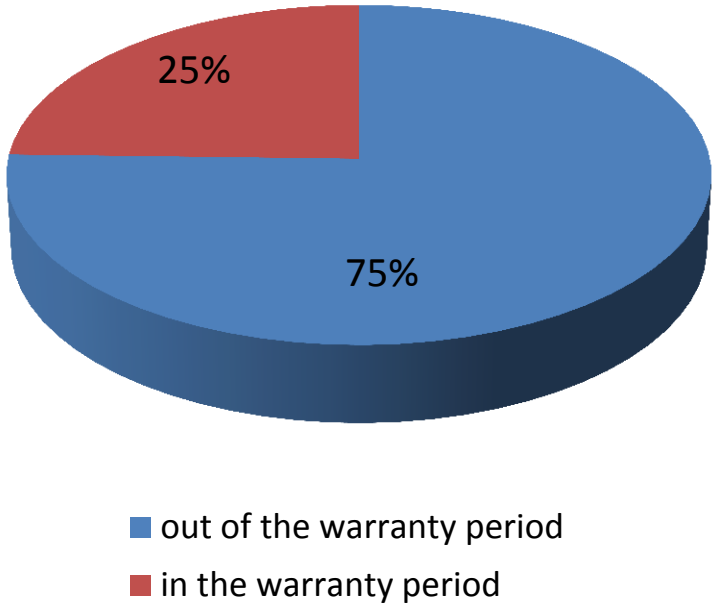
BES3 Queue Statistics



- Total : 3,196 cores
- besq : 3,571,960 cpu hrs dp2q: 1,205,392 cpu hrs

BESIII @ IHEP computing resources status



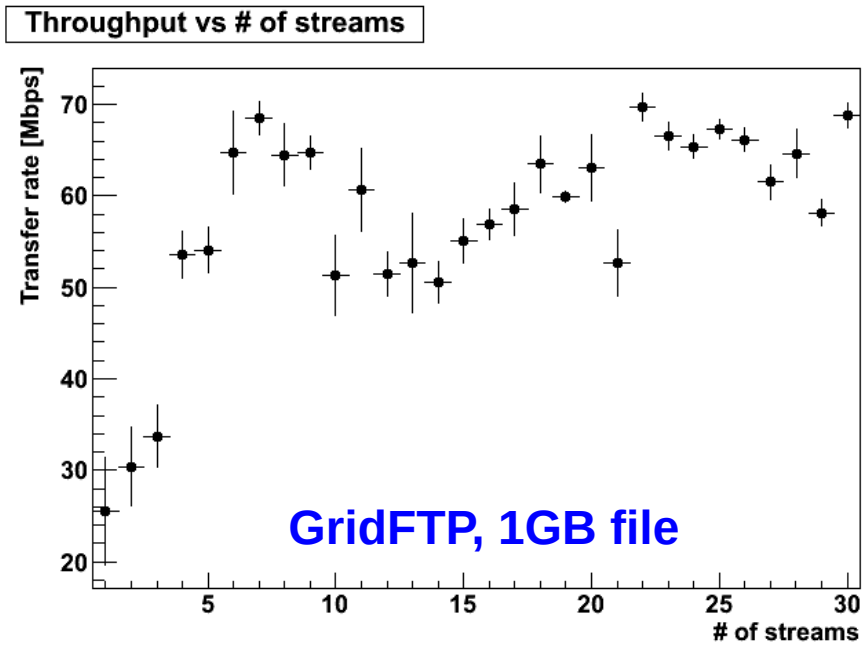


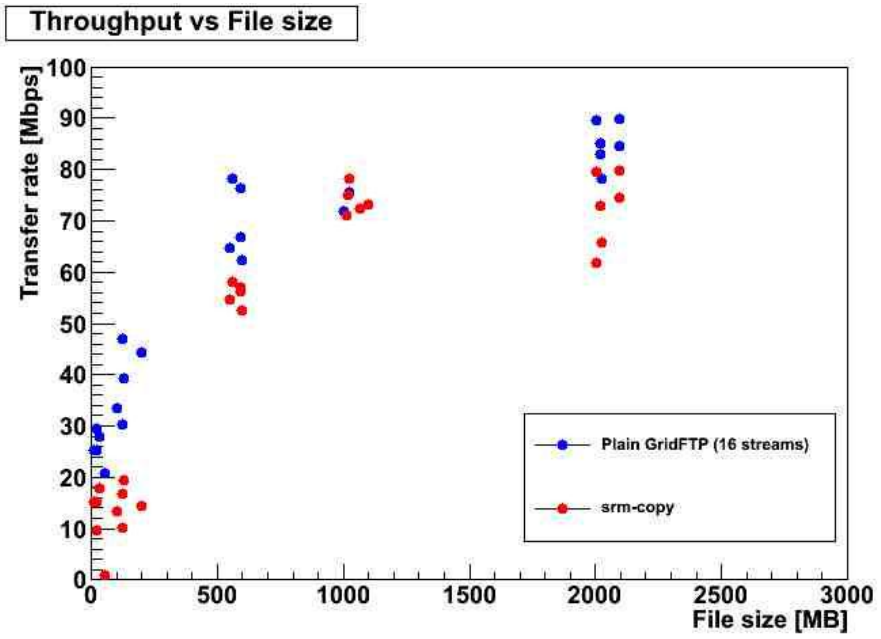
Warranty period： 3 years

About 75% of resources should be discontinued!

Network performances

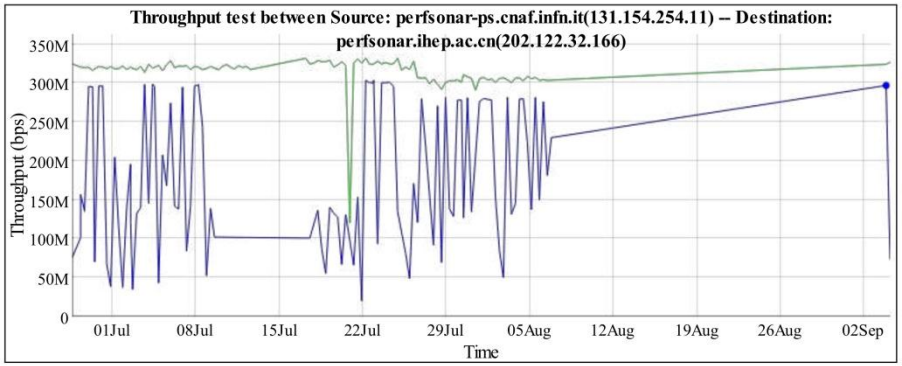
JINR - IHEP





INFN – IHEP

Goal reached thanks to INFN-TO CC and IHEP CC!



2012/09/03 21:48:54: **Throughput(Src-Dst)**:297.06Mbps

Graph Key

Src-Dst throughput

Dst-Src throughput

<- 1 month

1 month ->

Timezone: GMT+0200 (CEST)