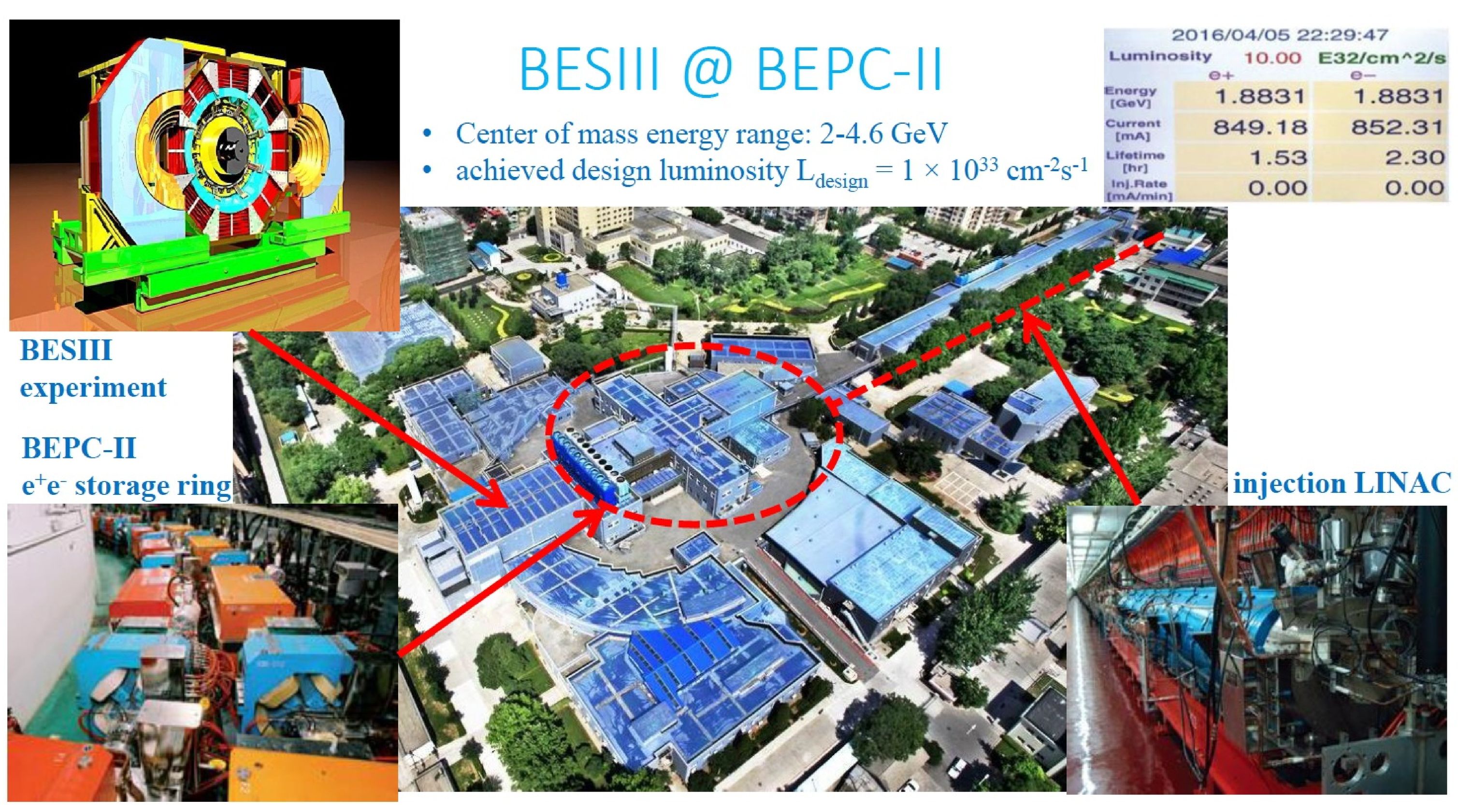
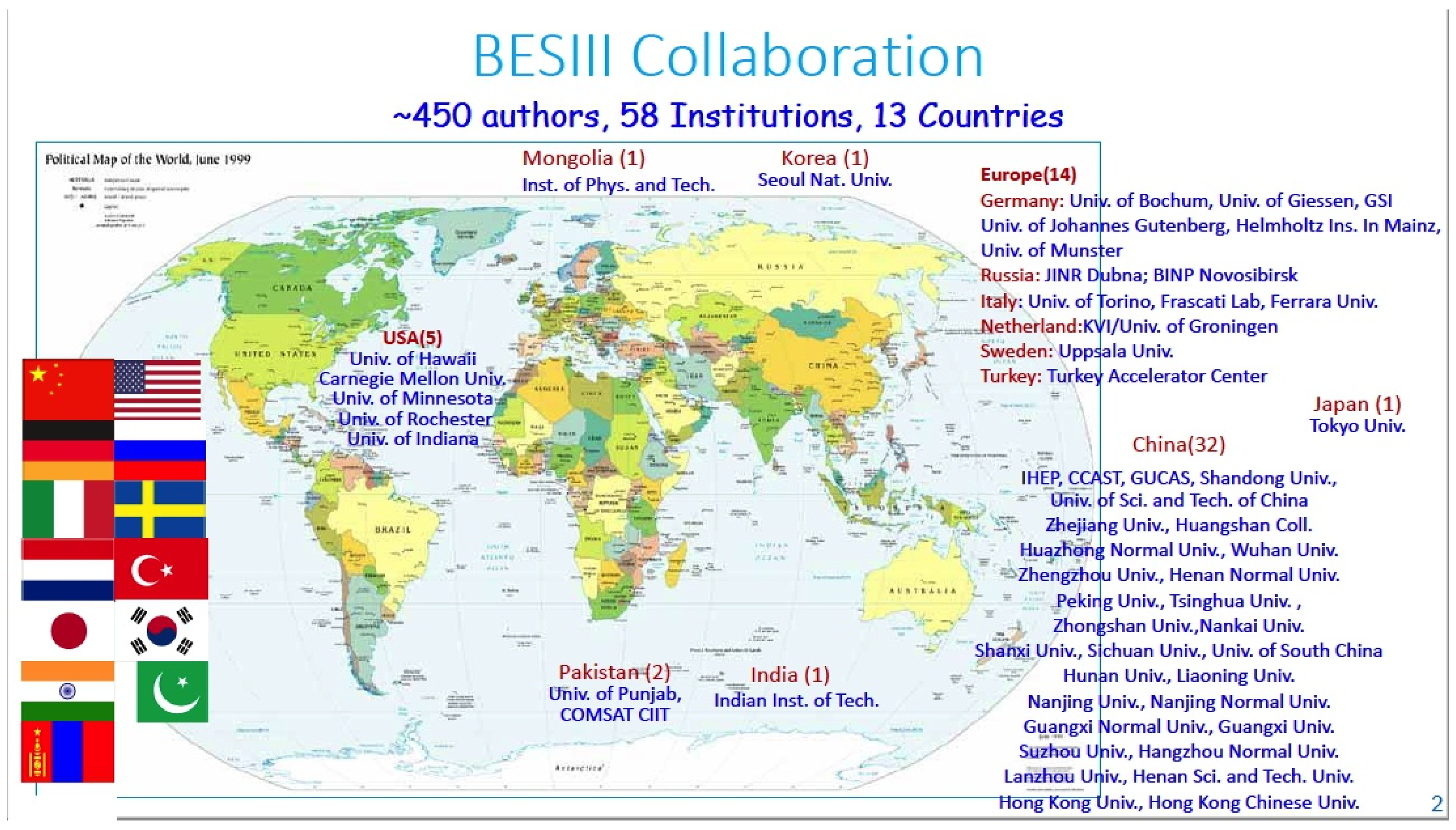
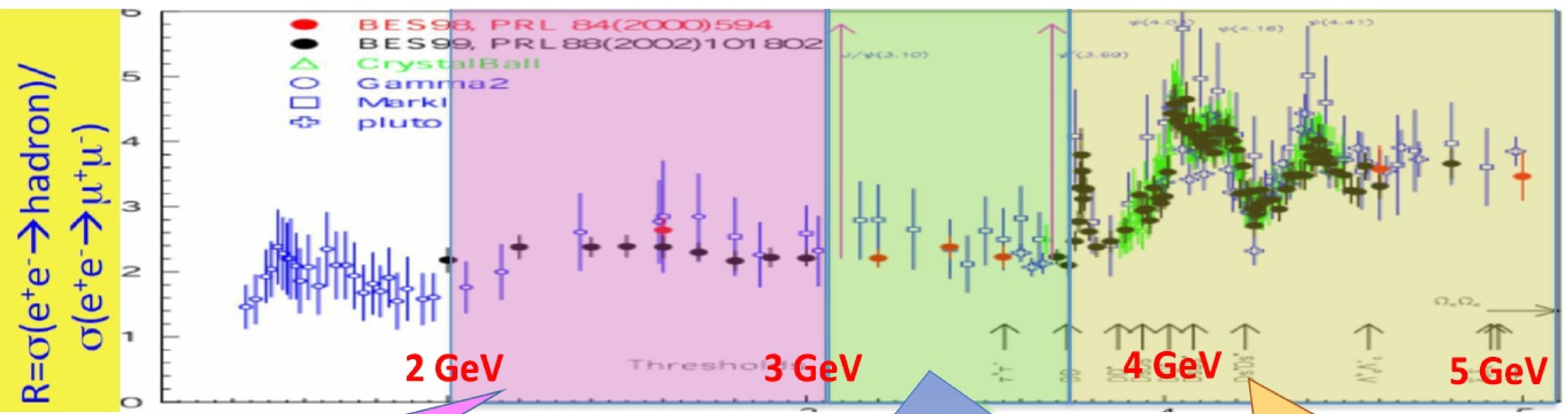
BESIII: un esperimento nel cuore della Cina alla ricerca di nuove particelle





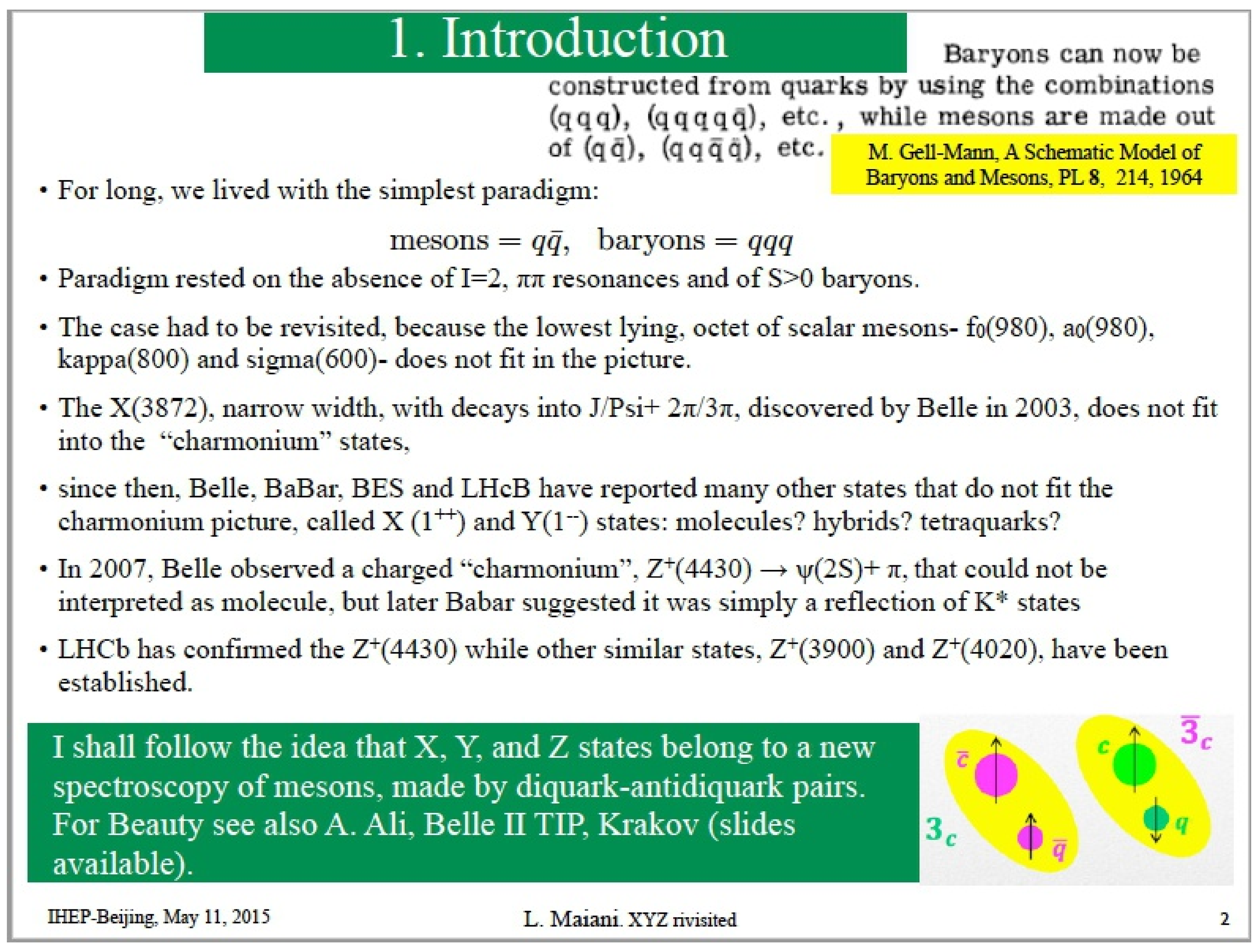
La fisica di BESIII



- Hadron form factors
- Y(2175)
- Zs states?
- QCD test

- Light hadron spectroscopy
- Glueballs, hybrids, multi-quark states
- Rare decays
- Tau physics

- XYZ
- D and Ds physics (f_D and f_{Ds}, mixing, CP)
- Charmed baryons



1. Introduction

Baryons can now be constructed from quarks by using the combinations (qqq), $(qqqq\bar{q})$, etc., while mesons are made out of $(q\bar{q})$, $(qq\bar{q}\bar{q})$, etc.

M. Gell-Mann, A Schematic Model of Baryons and Mesons, PL 8, 214, 1964

- For long, we lived with the simplest paradigm:

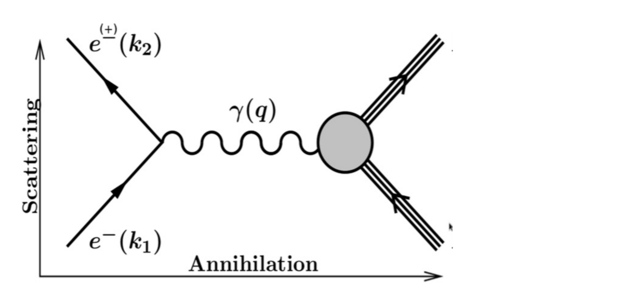
$$\text{mesons} = q\bar{q}, \quad \text{baryons} = qqq$$

- Paradigm rested on the absence of I=2, ππ resonances and of S>0 baryons.
- The case had to be revisited, because the lowest lying, octet of scalar mesons- $f_0(980)$, $a_0(980)$, kappa(800) and sigma(600)- does not fit in the picture.
- The X(3872), narrow width, with decays into J/Psi+ 2π/3π, discovered by Belle in 2003, does not fit into the "charmonium" states,
- since then, Belle, BaBar, BES and LHcB have reported many other states that do not fit the charmonium picture, called X (1^{++}) and Y(1^{-}) states: molecules? hybrids? tetraquarks?
- In 2007, Belle observed a charged "charmonium", $Z^+(4430) \to \psi(2S) + \pi$, that could not be interpreted as molecule, but later Babar suggested it was simply a reflection of K* states
- LHCb has confirmed the $Z^+(4430)$ while other similar states, $Z^+(3900)$ and $Z^+(4020)$, have been established.

I shall follow the idea that X, Y, and Z states belong to a new spectroscopy of mesons, made by diquark-antidiquark pairs. For Beauty see also A. Ali, Belle II TIP, Krakov (slides available).

IHEP-Beijing, May 11, 2015 L. Maiani. XYZ rivisited 2

Fattori di forma time-like dei barioni...

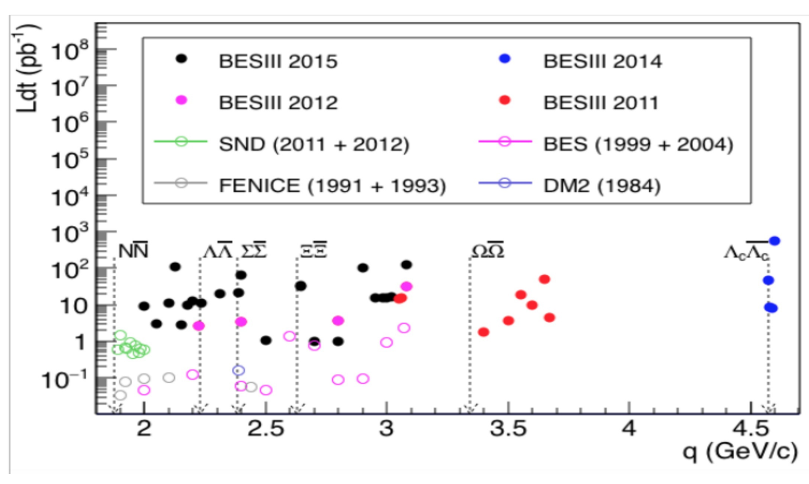


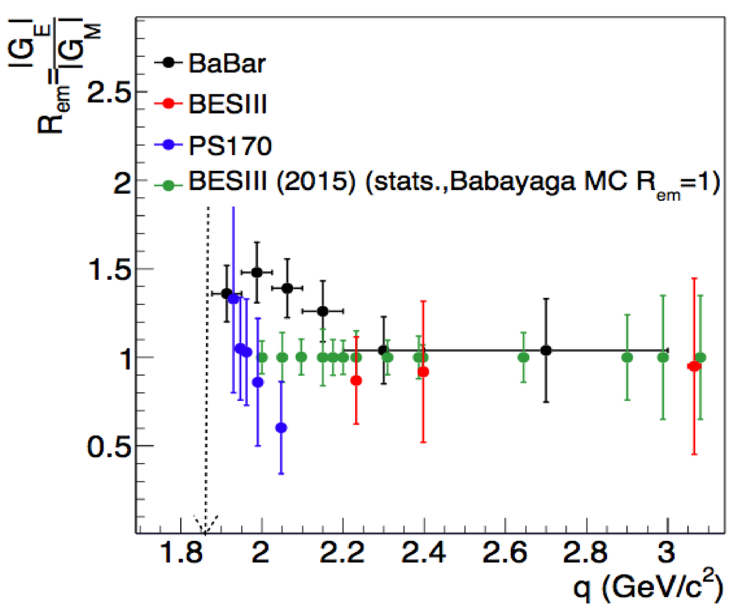
I fattori di forma F_1 e F_2 descrivono l' accoppiamento del fotone virtuale con una coppia barione-antibarione

$$\Gamma_\mu = e\bar{u}(p')[F_1(q^2)\gamma_\mu + \frac{\kappa}{2M_N}F_2(q^2)i\sigma_{\mu\nu}q^\nu]u(p)e^{iqx}$$

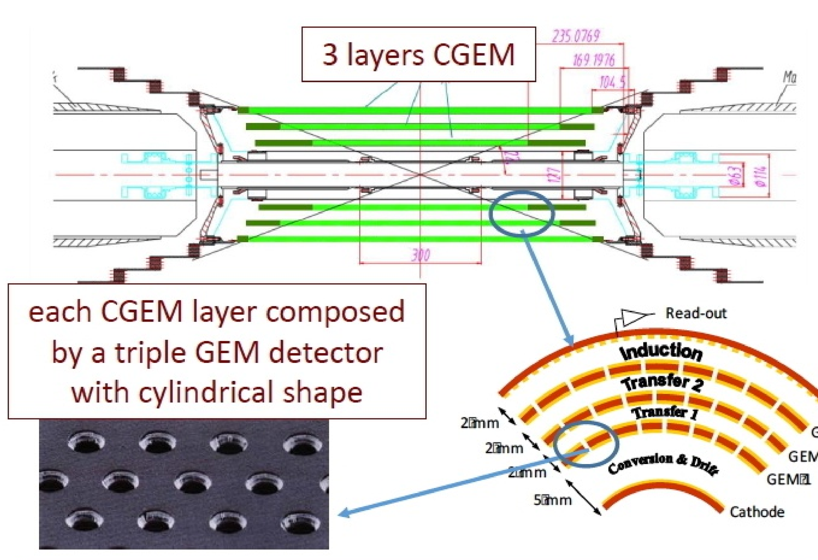
	Dirac	Pauli
	$F_1^p(q^2=0)=1$	$F_2^p(q^2)=1$
	$F_1^n(q^2=0)=0$	$F_2^n(q^2)=1$
Sachs	$G_E = F_1 + \frac{\kappa q^2}{4M^2}F_2$	$G_M = F_1 + \kappa F_2$

Con un' adeguata statistica si può usare la distribuzione angolare per risolvere i contributi G_M e G_E . BESIII è stato il primo esperimento in grado di ottenere questo risultato.

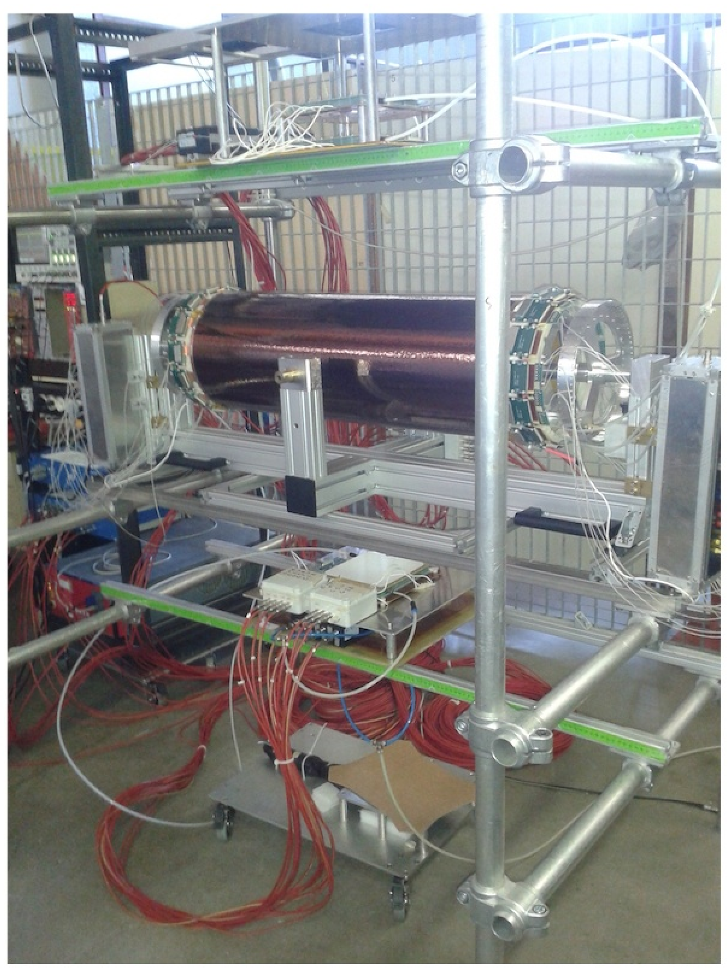




Inner Tracker a C-GEM di BESIII

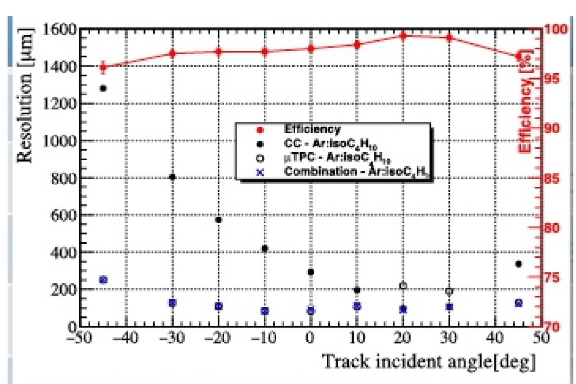


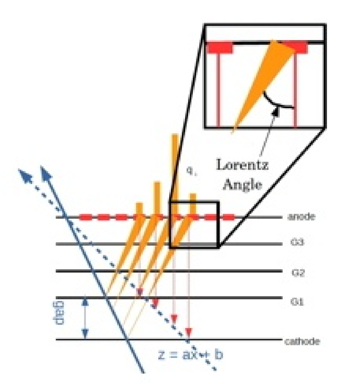
- Low Material budget ≤ 1.5% of X_0 for all layers
- Momentum resolution:: σ_{pt}/P_t =~0.5% @1 GeV
- High Rate capability: ~10^4 Hz/cm^2
- Coverage: 93%
- Spatial resolution $s_{r\phi}$ 130 μm, s_z <1 mm
- **1 T magnetic field**
- Operation duration at least 5 years



Peculiarità delle C-GEM di BESIII

	BESIII	action
Number of detector layers	3	→ 5 mm drift gap
Drift gap	5 mm	also for μTPC
Material budget per layer	0.4% X_0	rohacell and anode
Momentum resolution @1 GeV	σ_{pt}/P_t =~0.5%	
Rate capability – radiation hardness	few 10 kHz/cm^2	
Spatial resolution ϕ	100-150 μm (B=1T)	with μTPC
Spatial resolution Z	<500 μm	with μTPC
Magnetic filed	B = 1 T	→ μTPC
Internal/external diameter	156/356 mm	higher rate
Readout	charge + time	new ASIC chip





SOMMARIO

I dati raccolti da BESIII offrono l' opportunità di studiare la fisica adronica in barioni e nuovi stati esotici a 4 o 5 quark con abbondanza statistica molto maggiore che in passato.

L' Inner Tracker realizzato con C-GEM e microTPC porterà su BESIII una tecnologia tra le più avanzate, e che avrà future applicazioni sia nella ricerca di base che nella diagnostica industriale e medica.

BESIII prenderà dati almeno fino al 2025, mentre la Cina definirà i futuri sviluppi nel campo della fisica delle alte energie.

La partecipazione italiana a BESIII fa parte di un' ampia collaborazione in molti campi della fisica, che garantirà ai ricercatori dell' INFN un ruolo rilevante nei grandi esperimenti del XXI secolo.