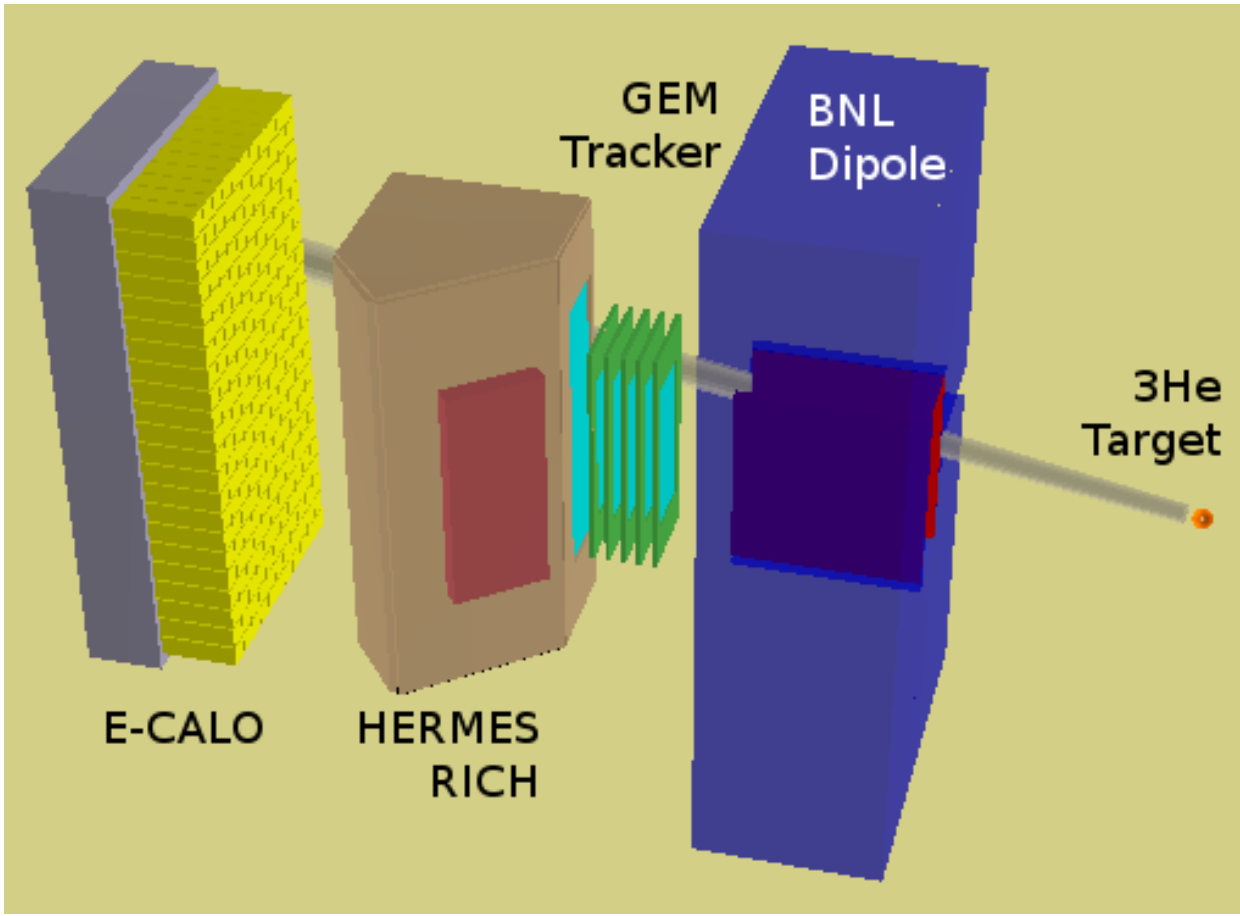
SBS First Tracker



Approved FF Experiments @ 12 GeV

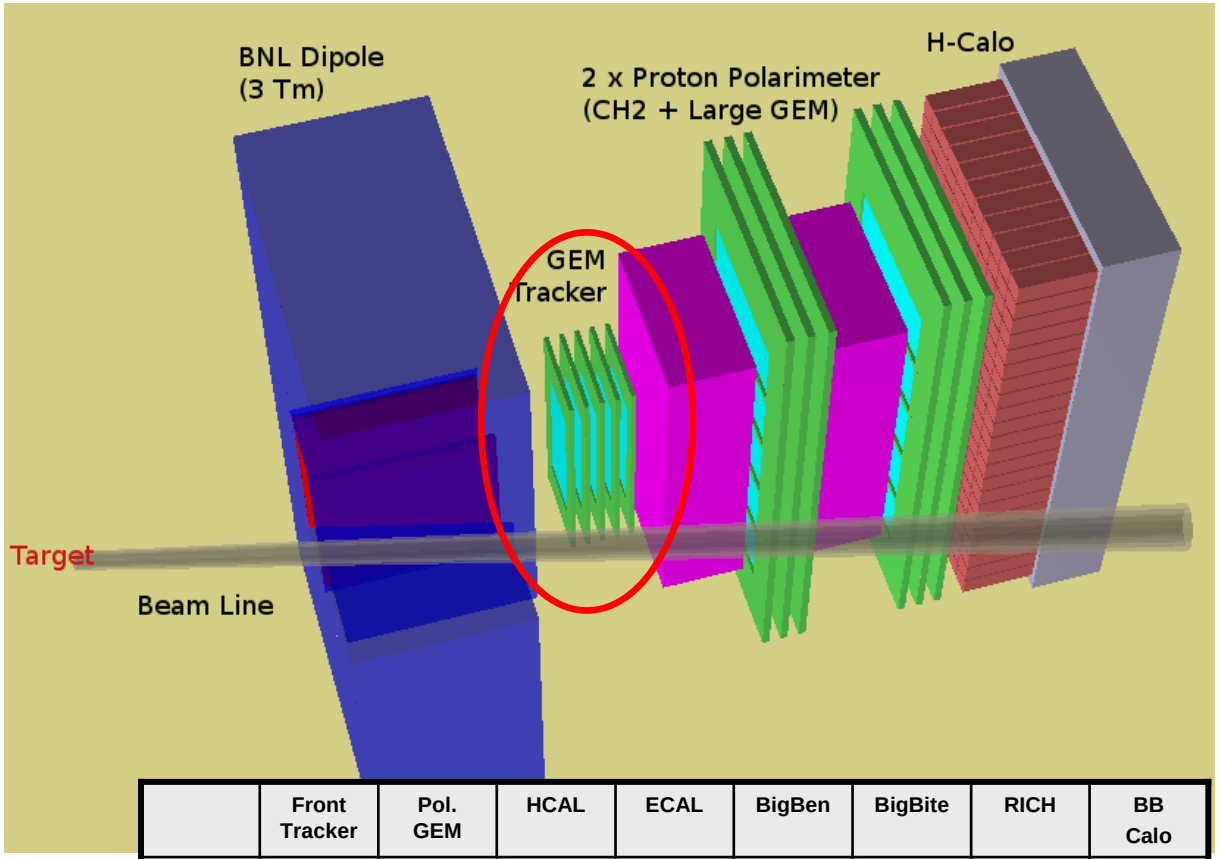
- E12-07-109: **GEp up to 14.5 GeV^2** by recoil-polarization
  - Require high lumi (low analyzing power and elastic cross section ~ E^2_{beam}/Q^{16}
- E12-09-016: **GEn/GMn up to 10 GeV^2** by beam-target double-polarization:
  - Polarized ^{3}He, neutron detector
  - Doulbe Spin Asymmetry ~ GE/GM
- E12-09-019: **GMn up to 13.5→18 GeV^2** by cross section ratio D(e,e'n)/D(e,e'p)
  - High luminosity; neutron detector

+ SIDIS @ 12 GeV (Conditionally approved)

⇒ **New SBS Spectrometer**

New SBS Spectrometer (GEP5 Conf.)

- Alta Luminosità (10^{38} /cm^2/s)
- Angoli molto in avanti
- Moderatamente larga accettanza
- Buona risoluzione in momento (0.5% a 4-8 GeV/c)
- Buona risoluzione angolare 0.2 mrad
- Flessibilità (possibilità di riconfugurare i rivelatori in modo ottimale)

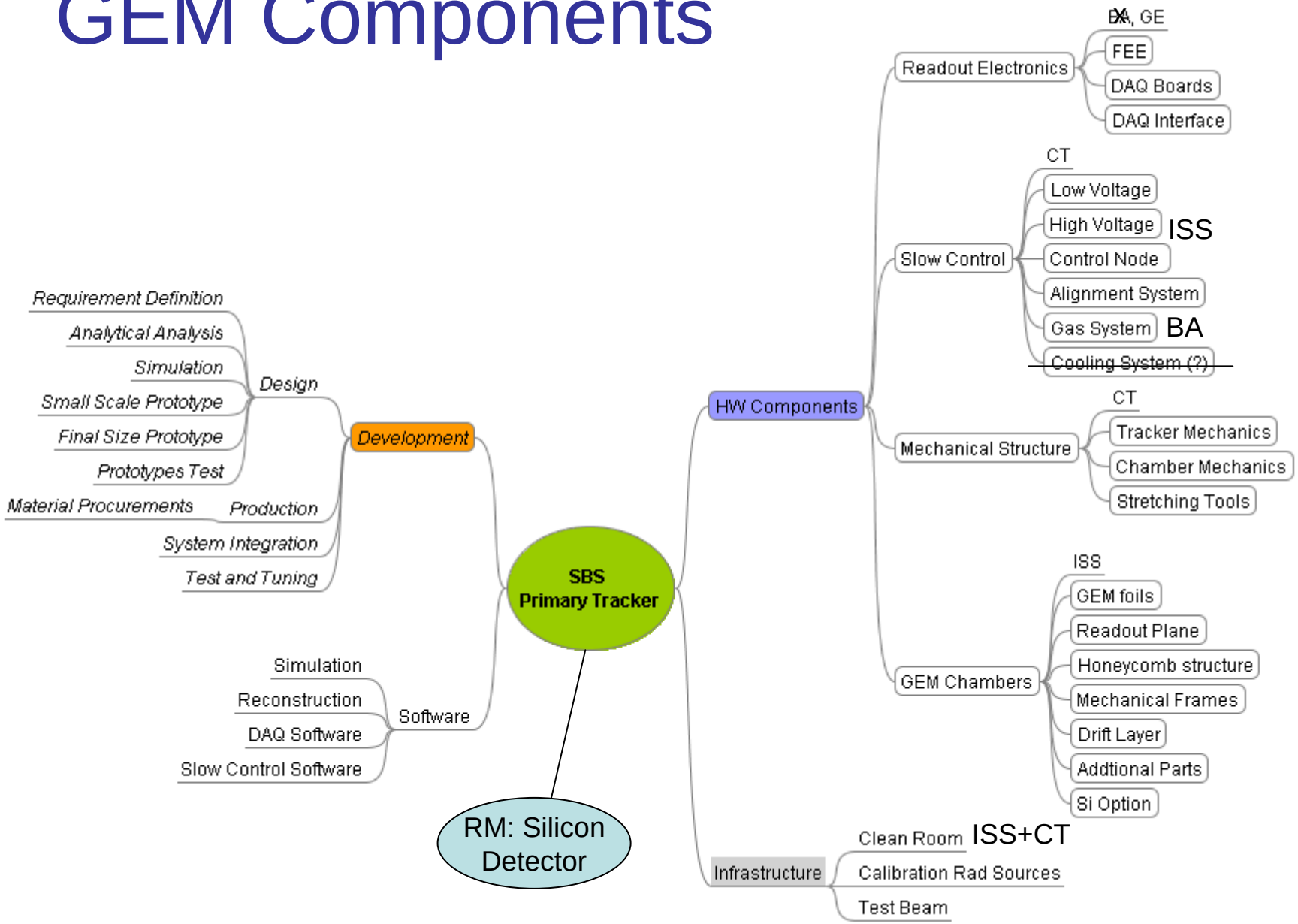


	Front Tracker	Pol. GEM	HCAL	ECAL	BigBen	BigBite	RICH	BB Calo
GEP	X	X	X	X		X		
GEN	X(BB)				X	X		X
GMN	X(BB)		X		X	X	X(gas)	X
SIDIS	X(BB)	X		X		X	X	X
A1n	X(BB)	X	X			X	X(gas)	X
A(Q2)	X(BB)	X	X			X	X(gas)	X
RCS	X	X	X	X	X	X		
SRC	X	X	X			X	X(gas)	
e,e'ϕ	X	X	X		X	X	X	X

Responsabili dello sviluppo del tracciatore GEM
+ design elettronica per tutti i rivelatori GEM

hallaweb.jlab.org/12GeV/SuperBigBite/

GEM Components



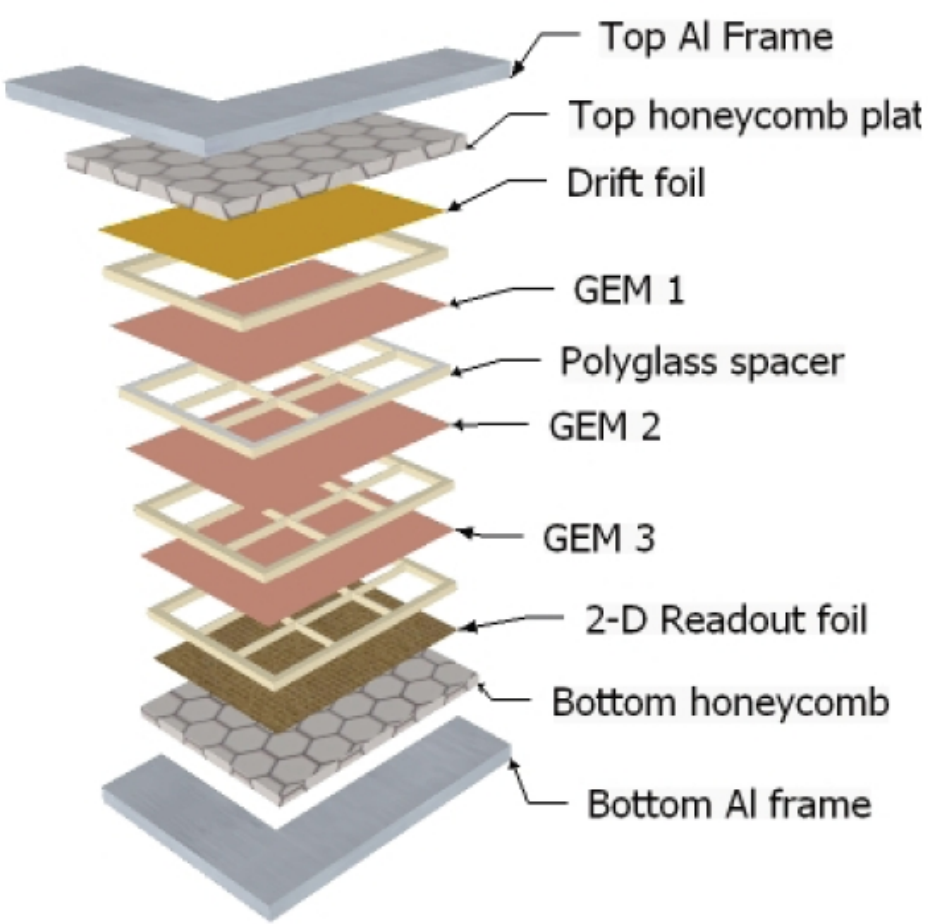
SBS Tracking Requirements

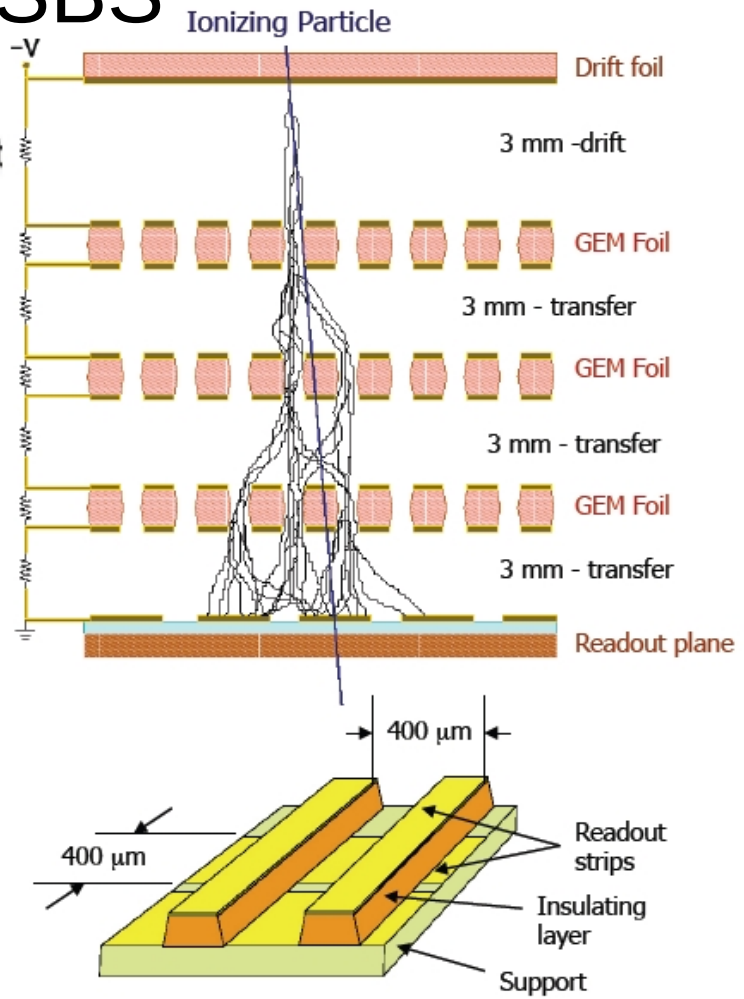
Requirements	Tracking Technology		
	Drift	**MPGD**	Silicon
High Rate: **0.55+0.17 MHz/cm^2**	NO	**MHz/mm^2**	**MHz/mm^2**
High Resolution: **<100 μm**	Achievable	**50 μm**	30 μm
Large Area: 40x80 and 100x200 cm^2 (min)	YES	**Doable**	Very Expensive

… and modular: reuse in different geometrical configuration

MPGD = Micro Pattern Gas Detector (GEM, Micromegas …)

GEM for SBS

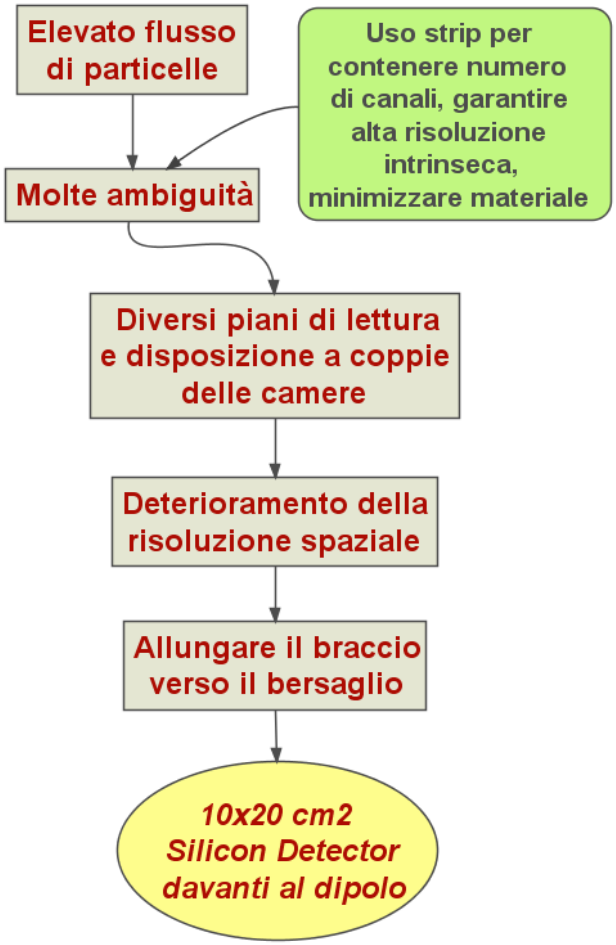


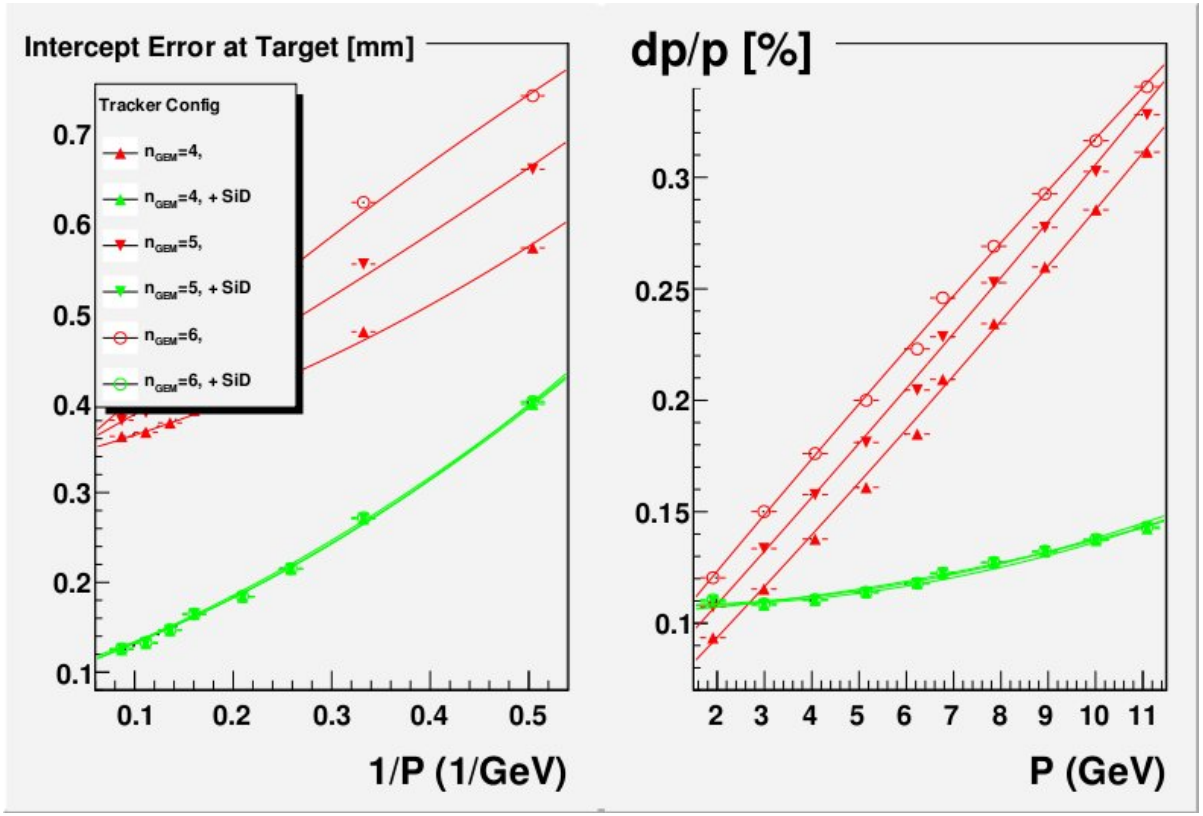


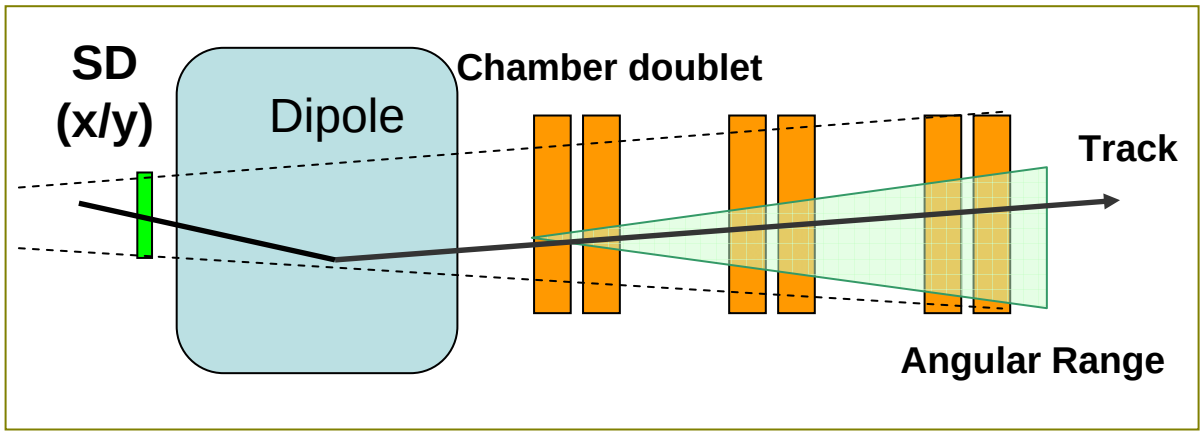
- **Standard 3 GEM foils**
- **2D Readout plane, 0.4 mm pitch**
- **Approx. 50000 channels**
- **40x100 cm² chambers made by 40x50 cm² adjacent modules**

- **Minimize frames (8 mm width)**
- **Minimize front-end electronics size**
- **Minimize cabling**
- **Optimize HV distribution**

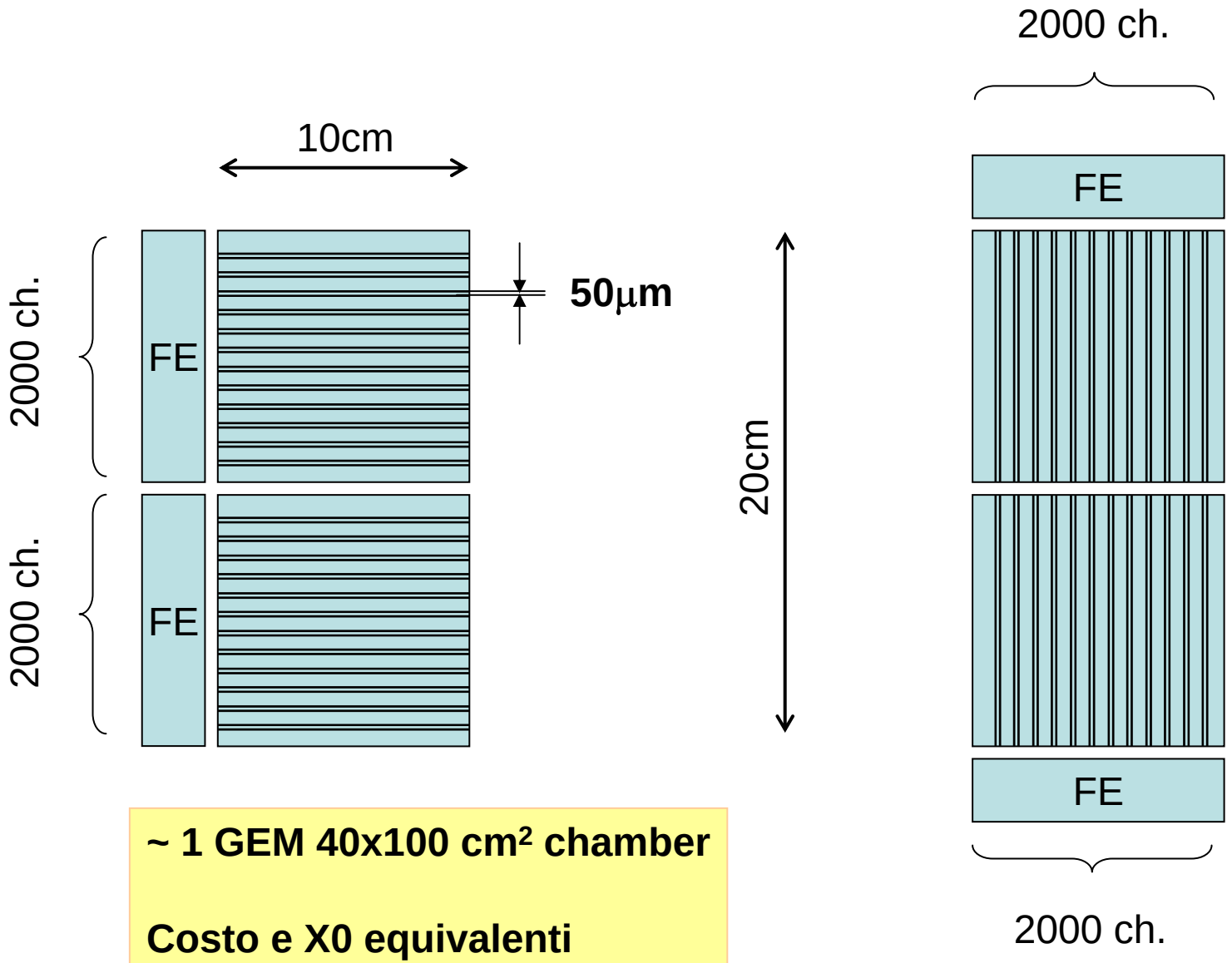
+ Small Silicon Detector







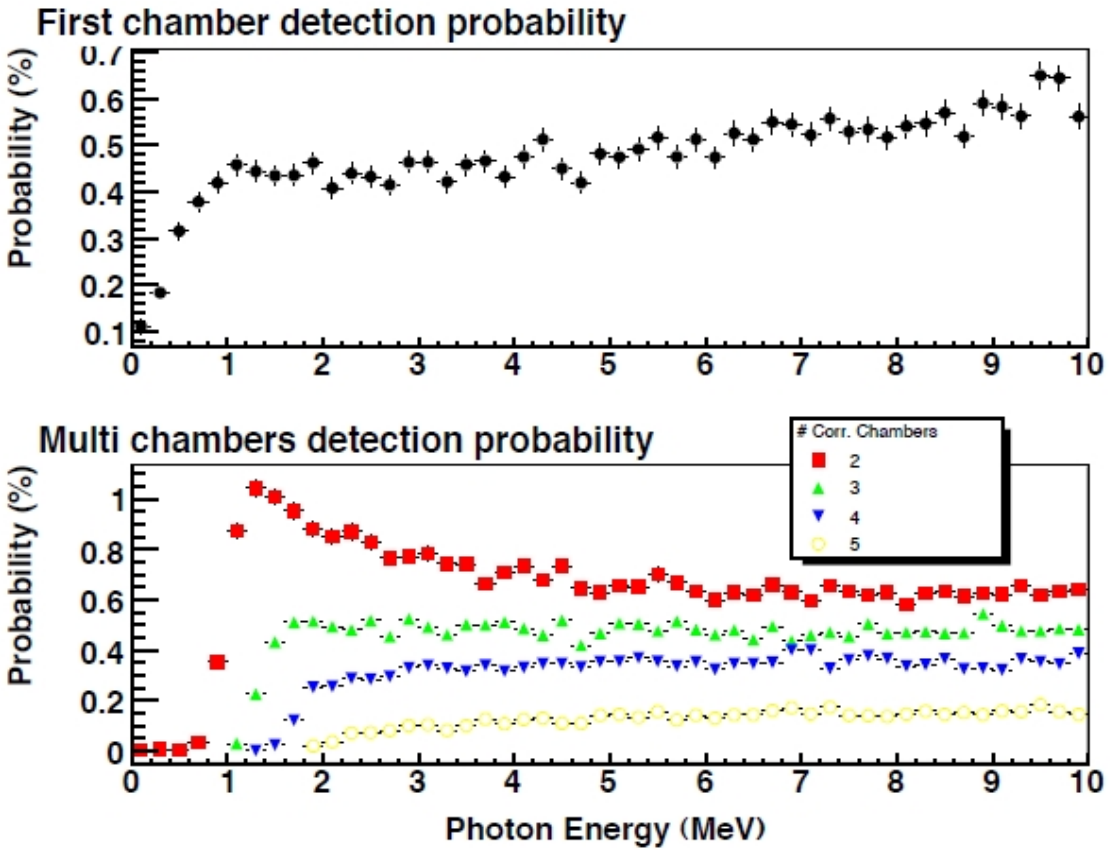
SD Detector / Idea di principio



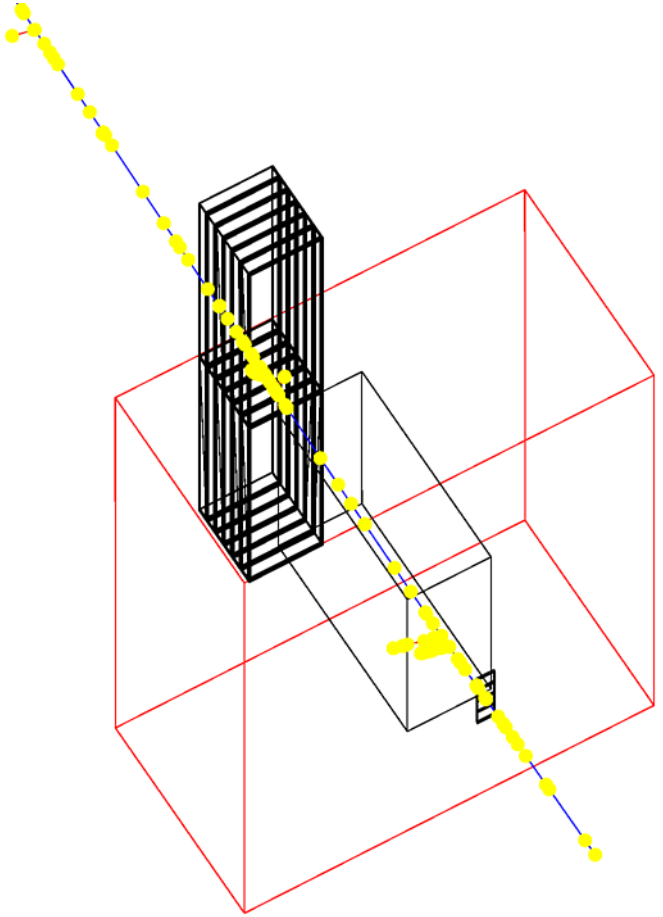
~ 1 GEM 40x100 cm² chamber

Costo e X0 equivalenti

SBS Front Tracker: Montecarlo



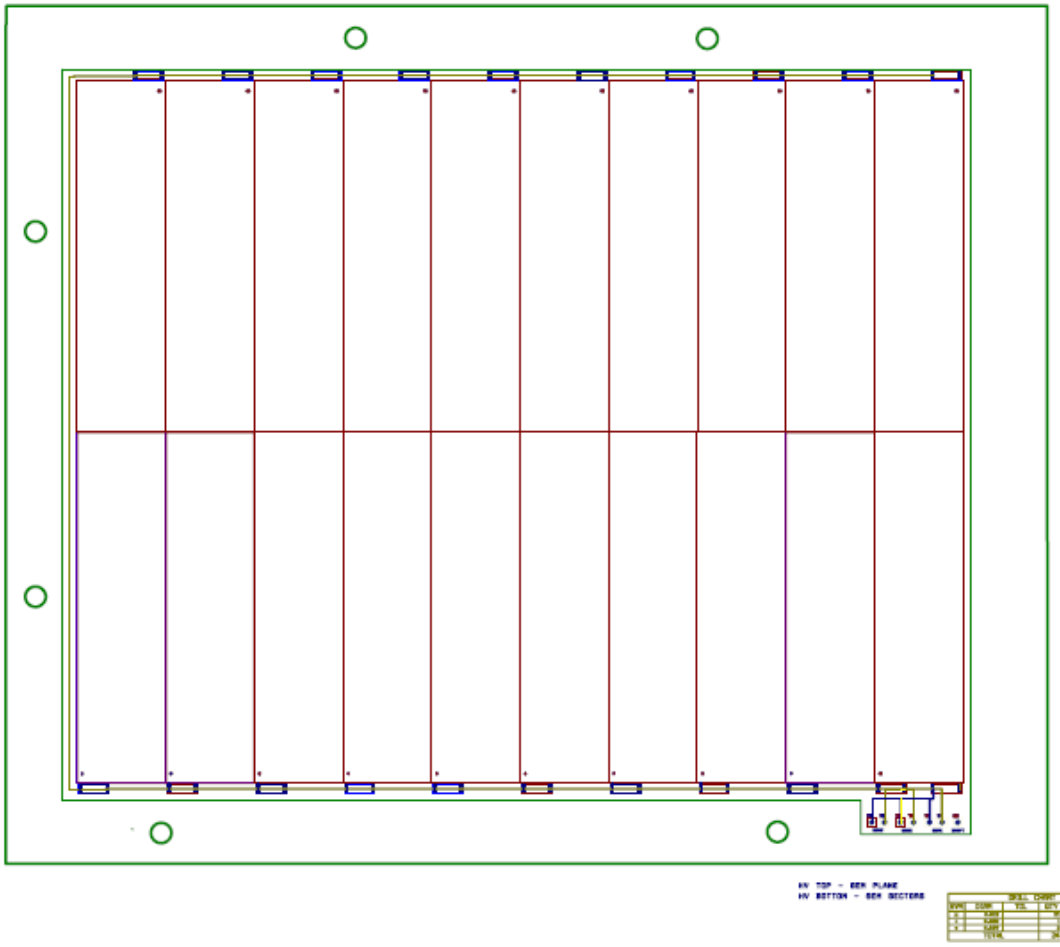
Photons largest background (80%)



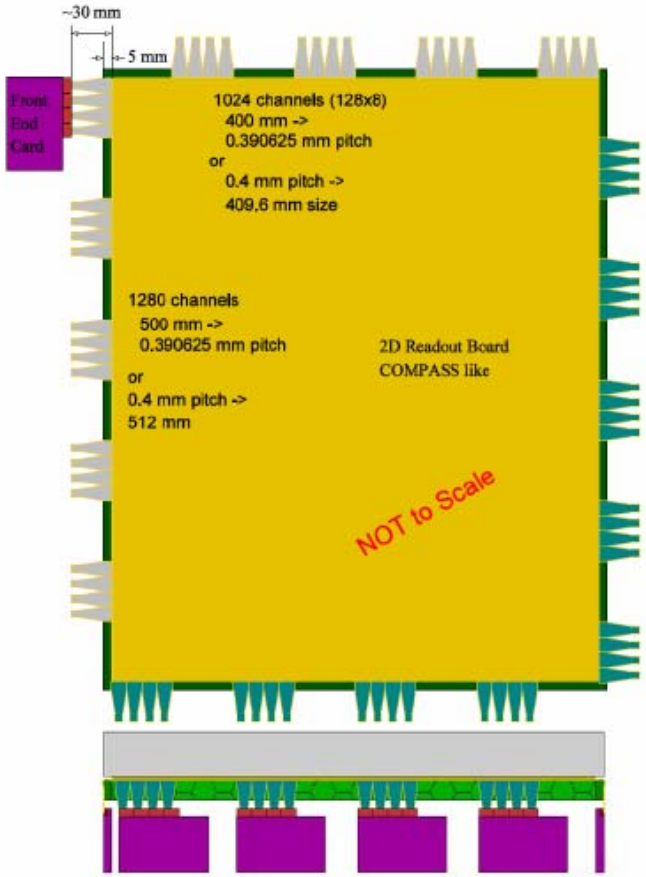
GEANT4 + Root

GEM Foil

- Cornice 8 mm deve trovar posto la distribuzione delle 7 HV + resistenze di protezione per 20+1 settori
- Final layout under
- detailed design by CERN

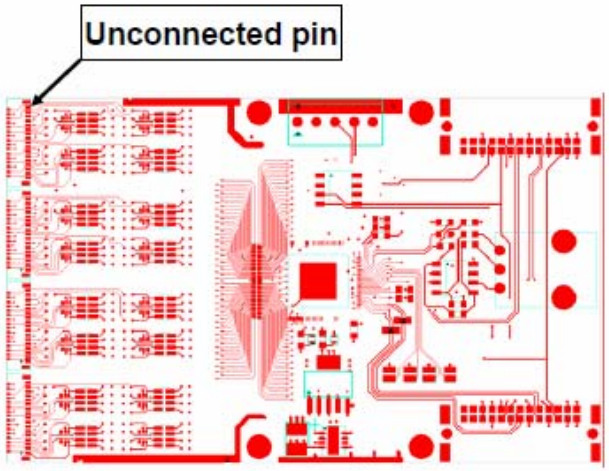


Readout and electronics lavout



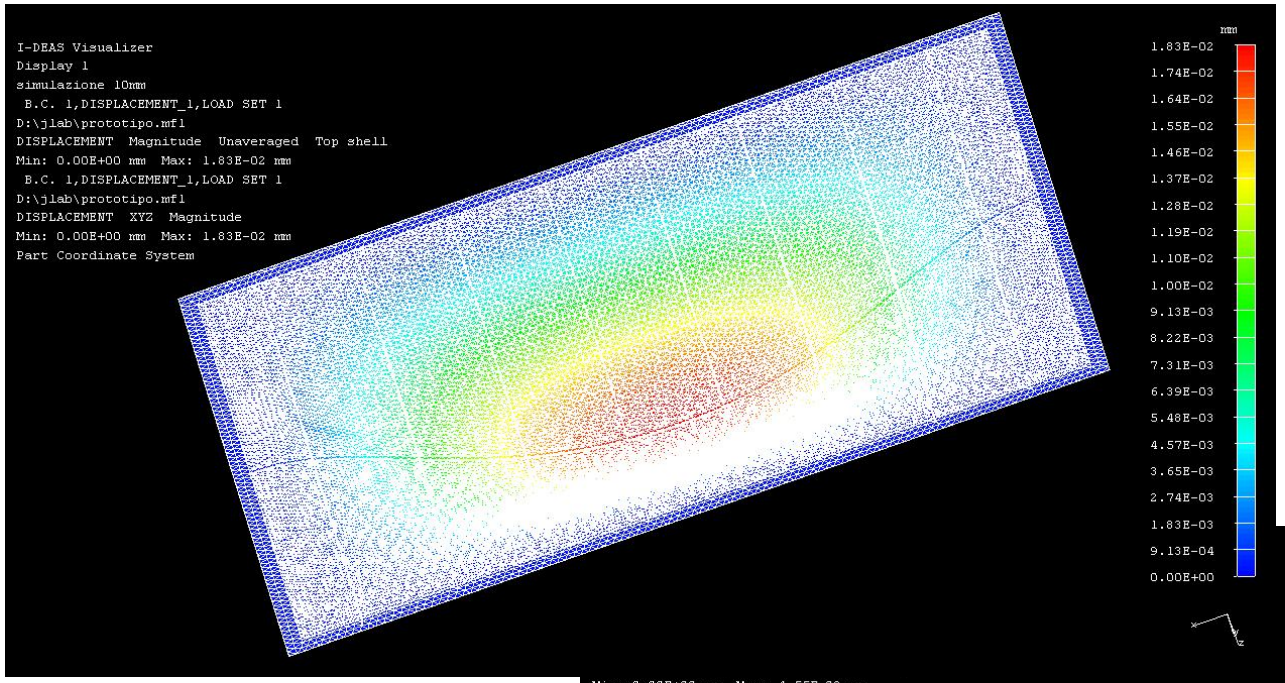
Elettronica a 90 gradi
Uso di connettori ZIF a basso profilo
Ridotti ingombri

Layout completed



Connectors side view

Modellizzazione Elementi Finiti

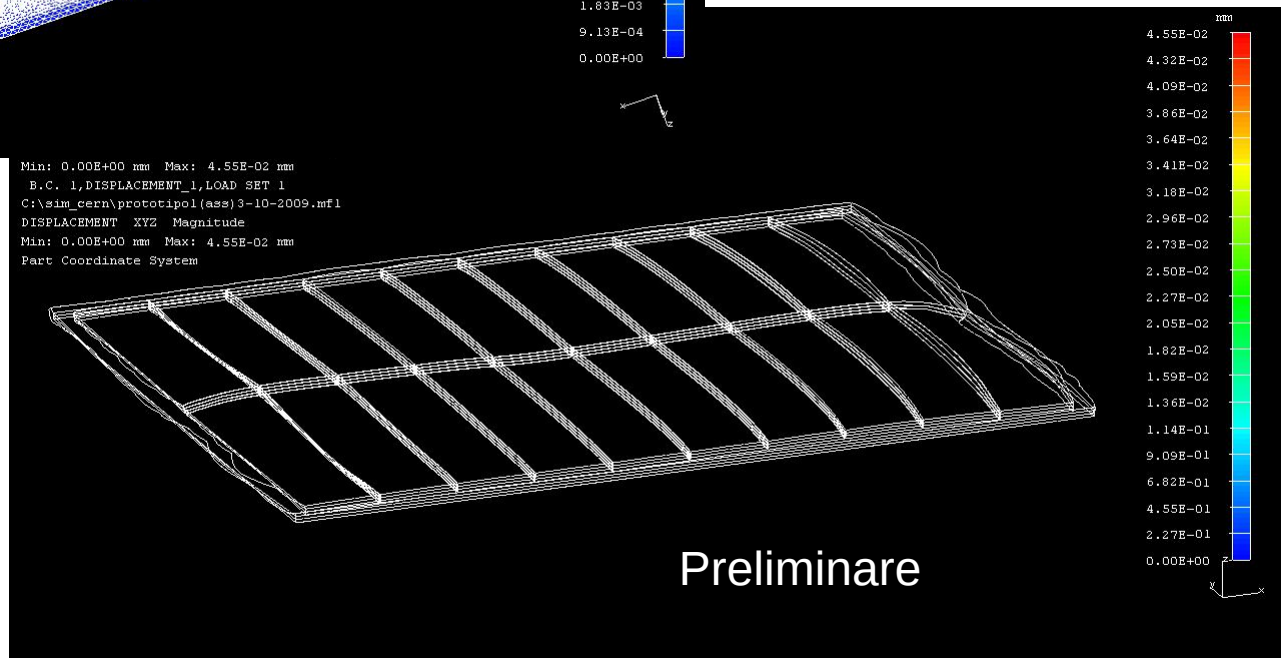


⇐ Singolo foglio sottoposto a forza elettrostatica circa 10x di quella attesa

Distorsione max: 19 μm (1% distanza GEM)

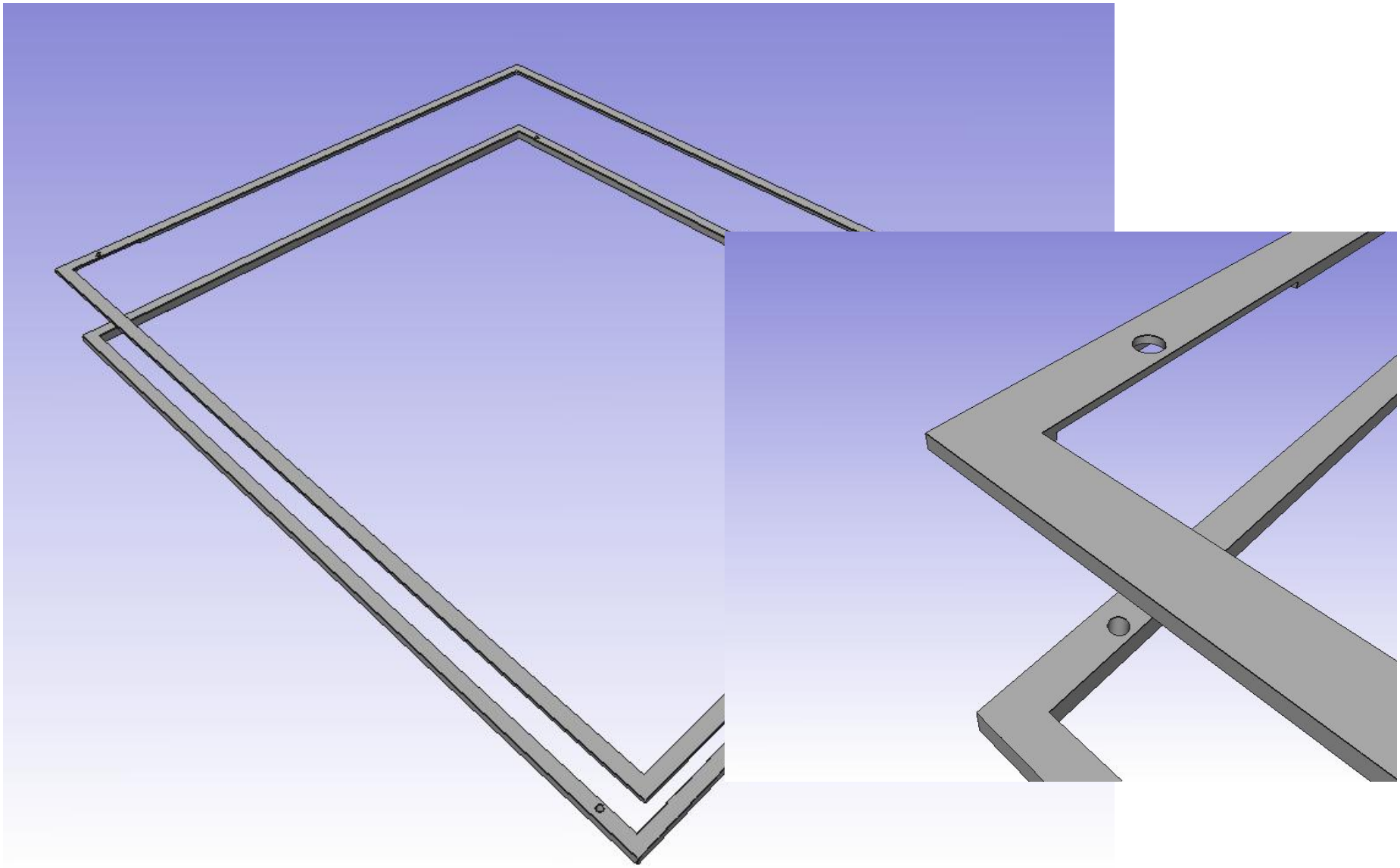
Camera GEM con forze elettrostatiche interne e peso

Distorsione max: 46 μm

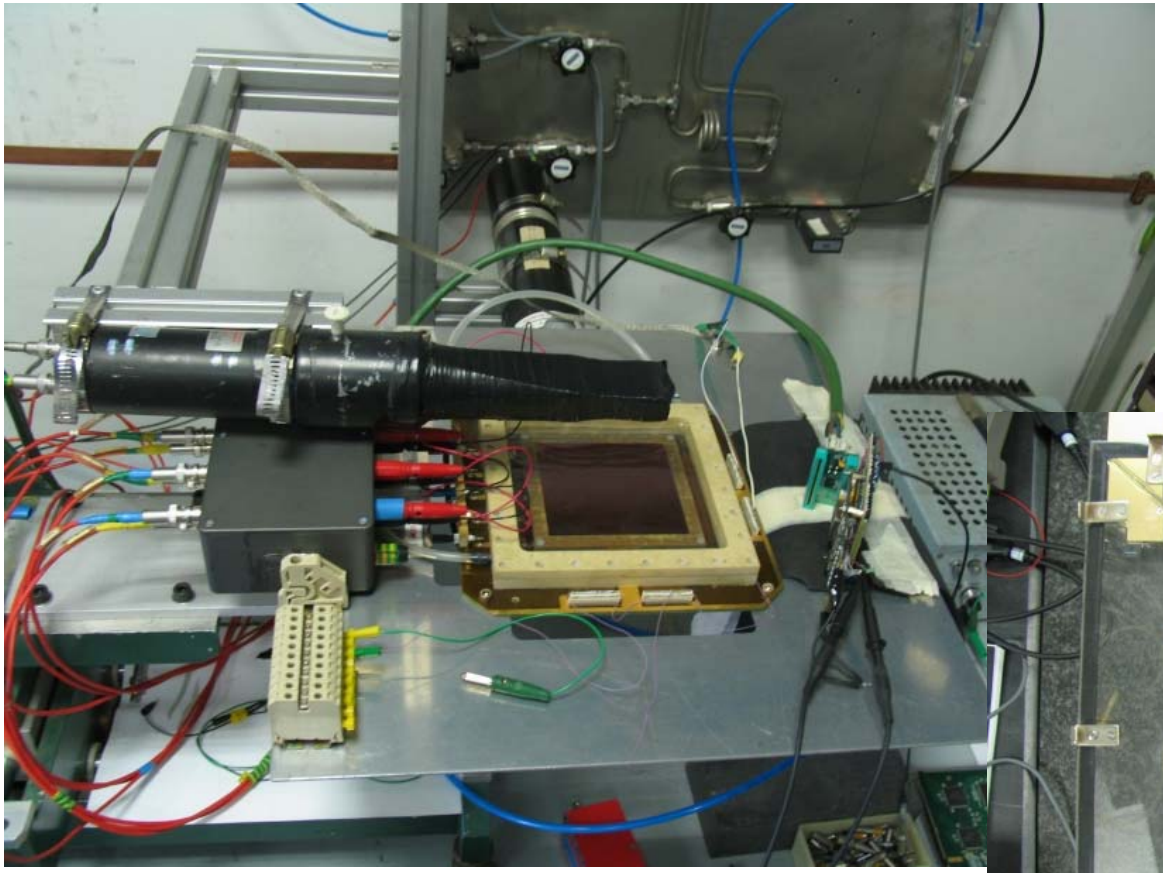


Francesco Noto

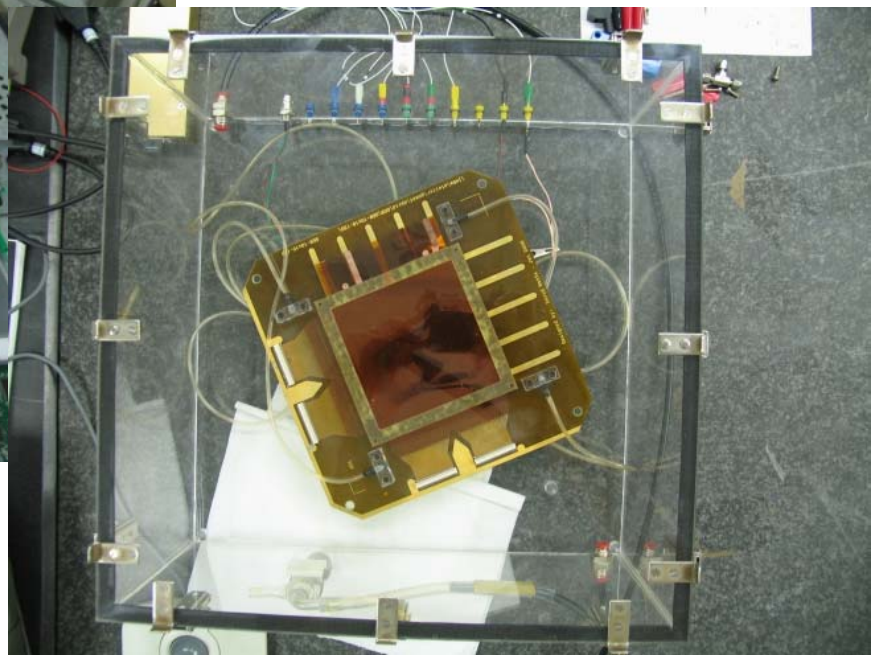
Distribuzione GAS



GEM: Prototype 0 and 1



- First 10x10 prototypes under cosmic test
- Using 70/30 Ar/CO_2 gas mixture
- 7 Independent HV levels up to ~ 5000 V

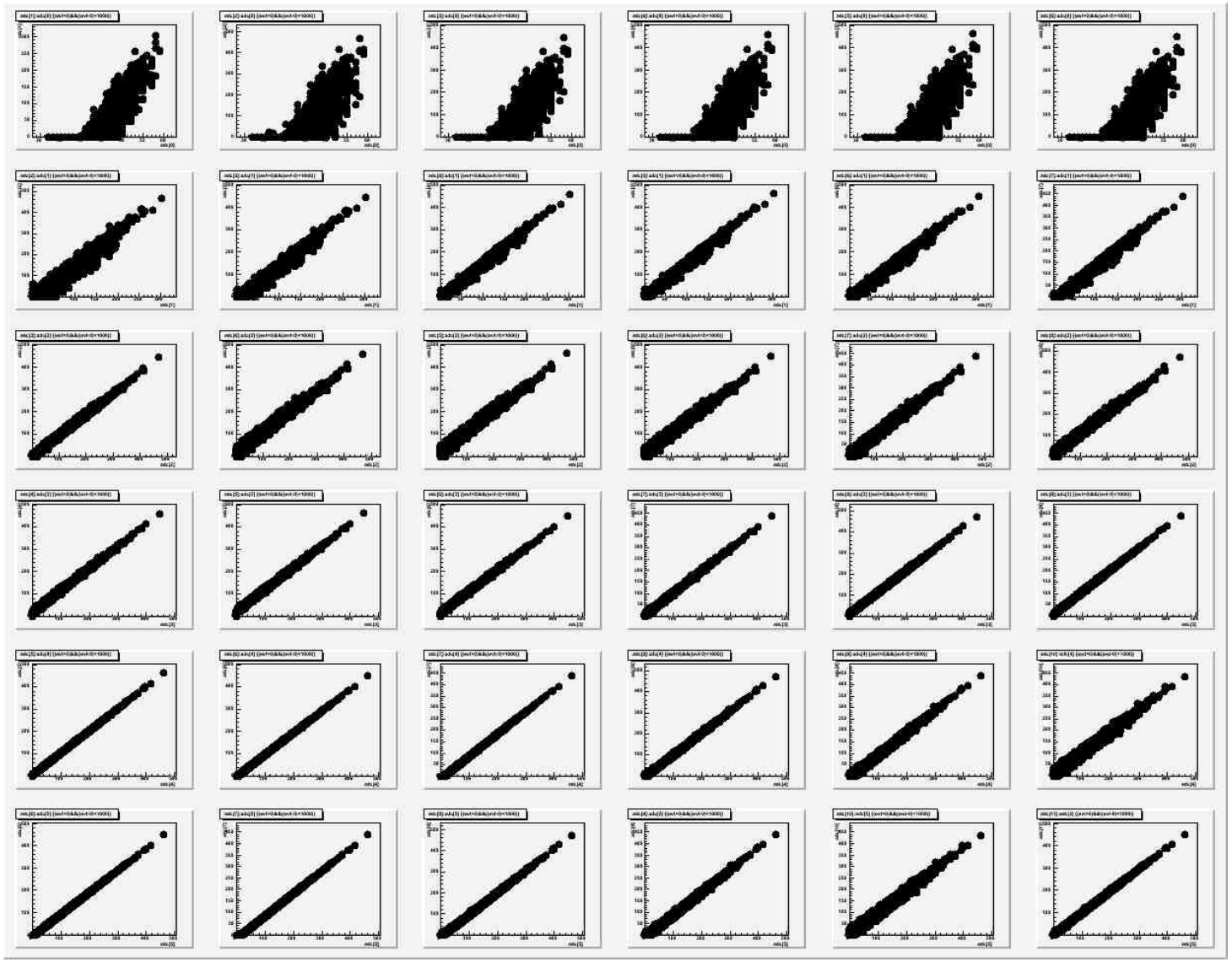


Assembling the GEM chambers parts require a careful quality control at several check points and specific tools for gluing, heating, testing, cleaning

Final 40x50 cm^2 module finalized; GEM foils and readout ordered

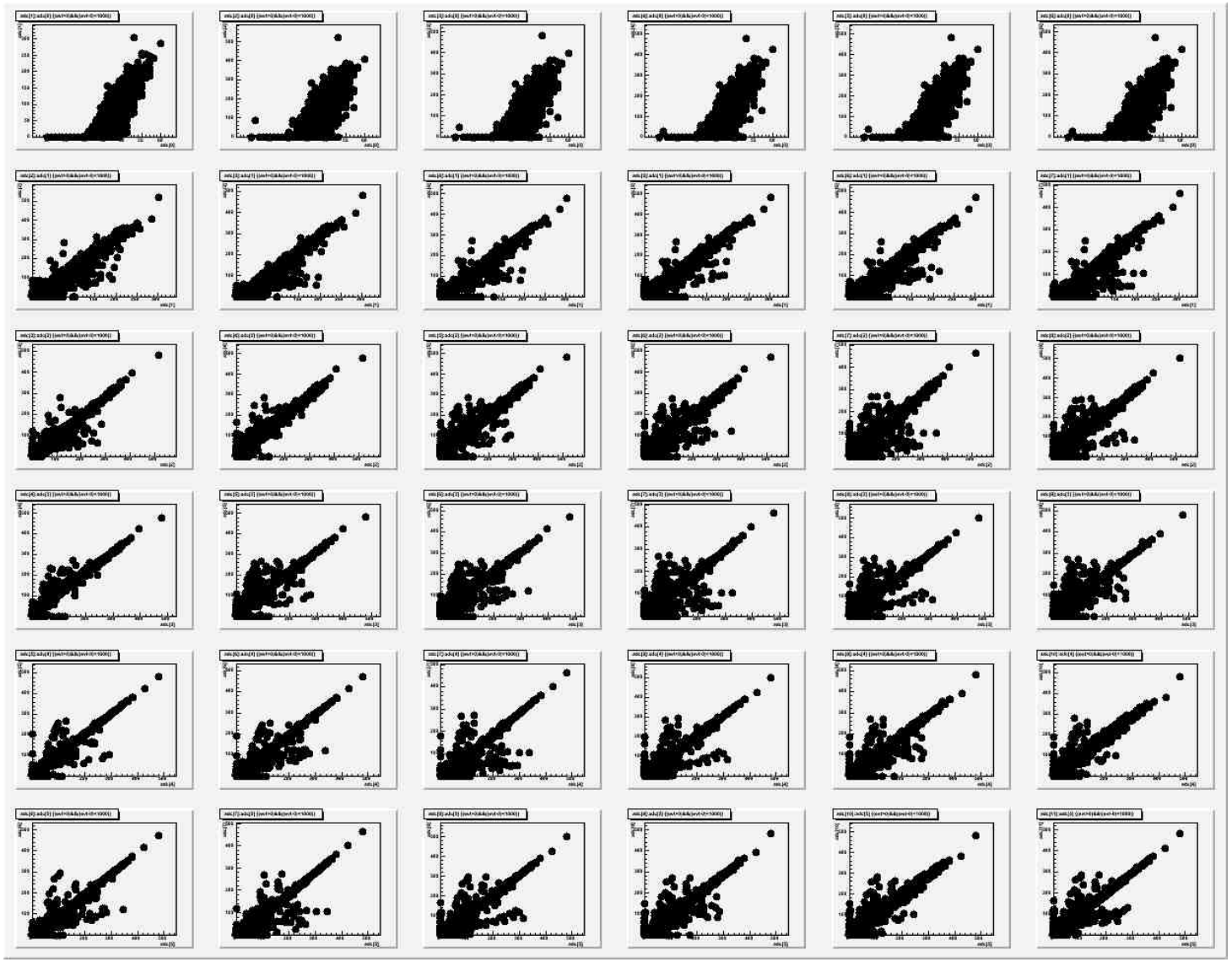
Elettronica ALTRO: correlazione segnali **senza** sorgente

Piedistalli



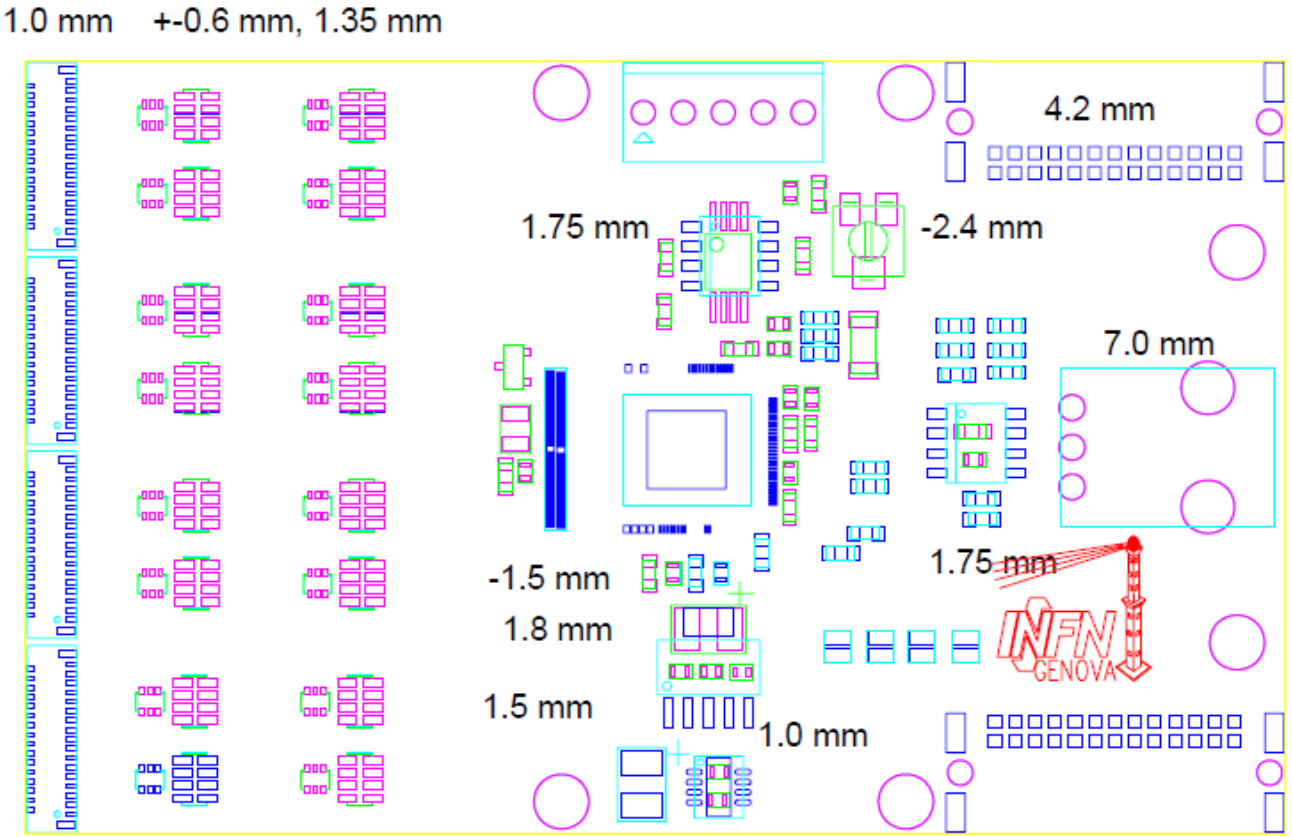
Elettronica ALTRO: correlazione segnali **con** sorgente β

L'elettronica sopprime la carica negativa



Elettronica / FEC

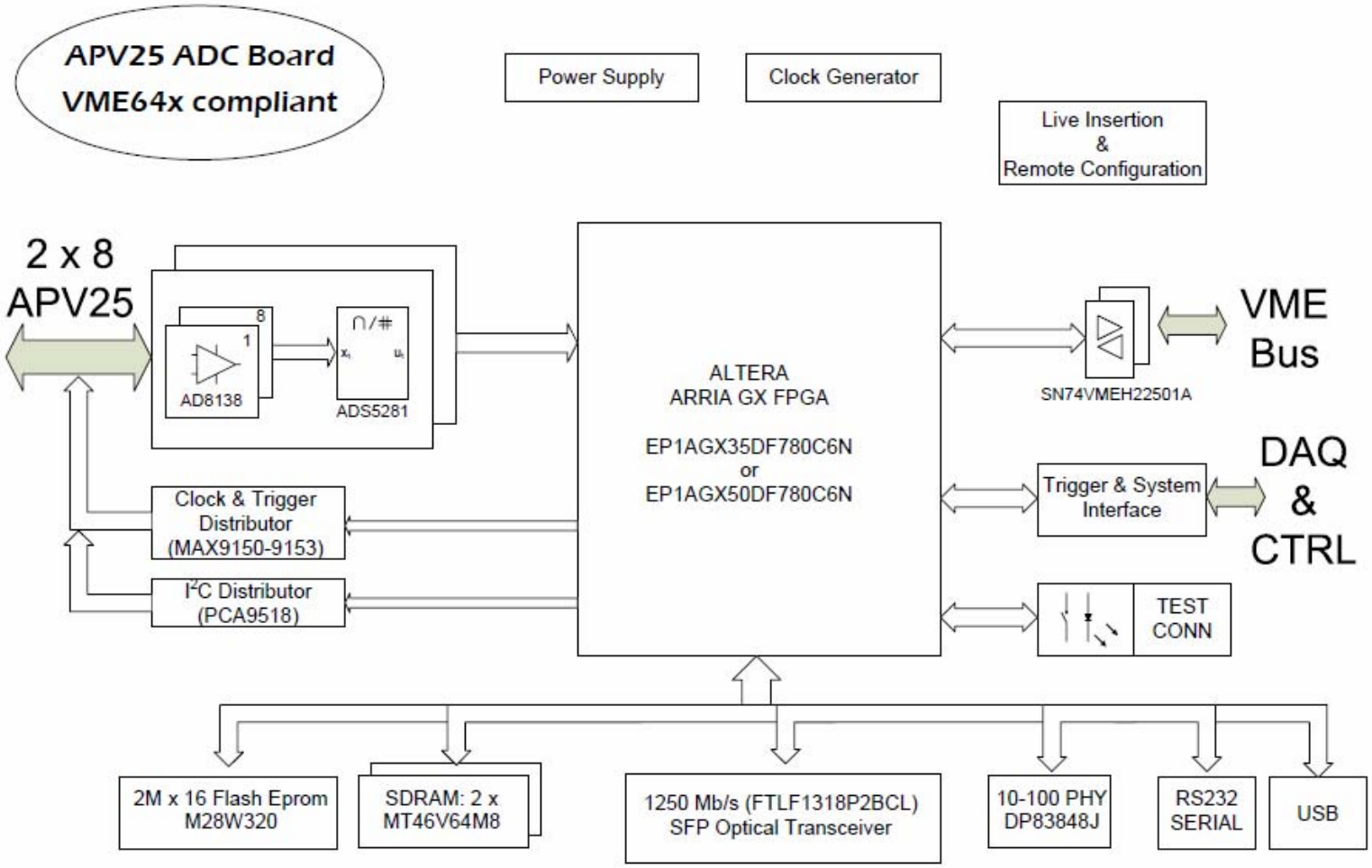
GEM ⇒ FEC ⇒ VME Controller ⇒ DAQ



Valori > 0 ➔ lato superiore
Valori < 0 ➔ lato inferiore

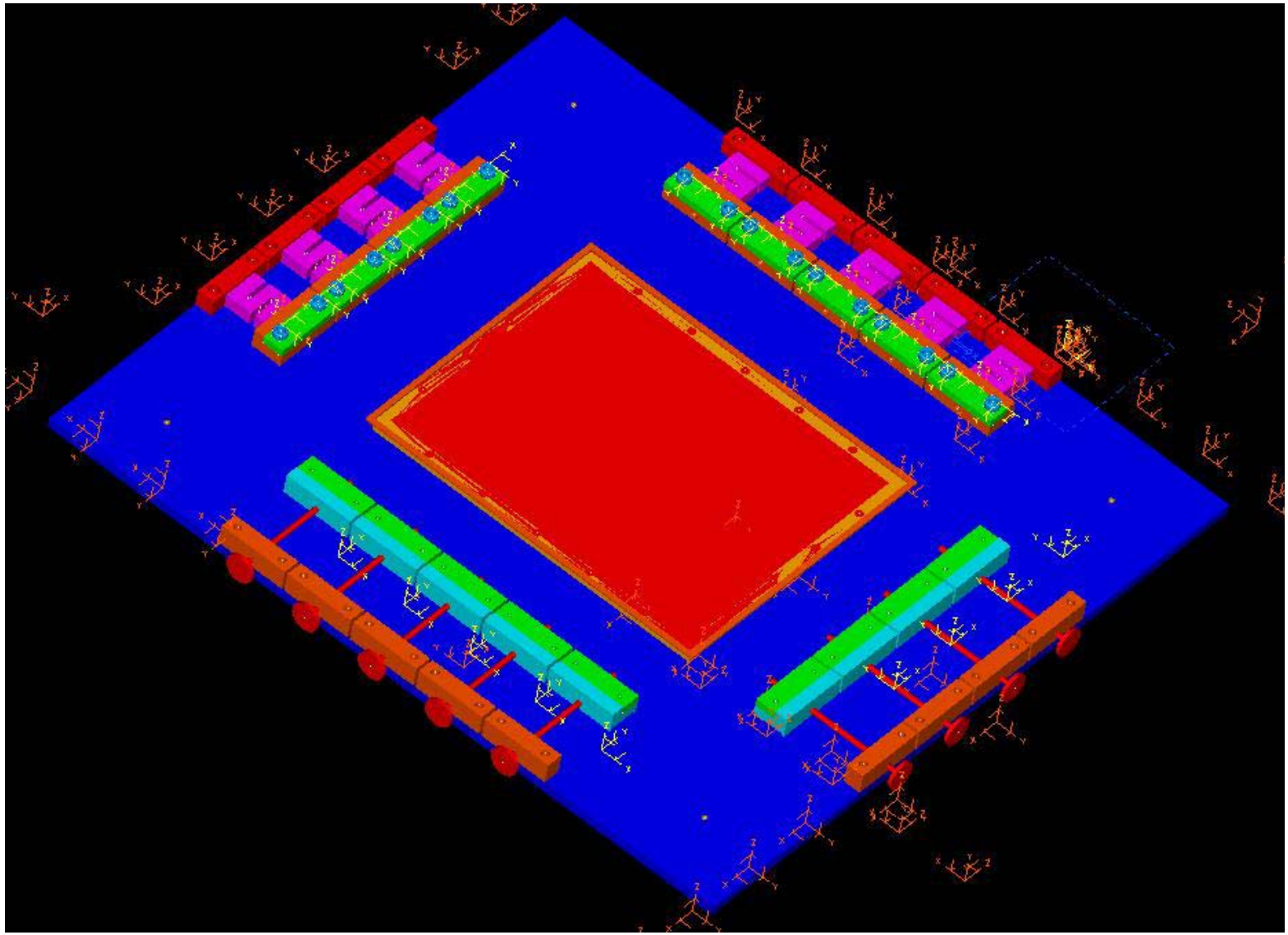
Spessore PCB = 1.0 mm
Dimensioni estreme: 49.5 x 80 mm

VME64x Controller



Paolo Musico

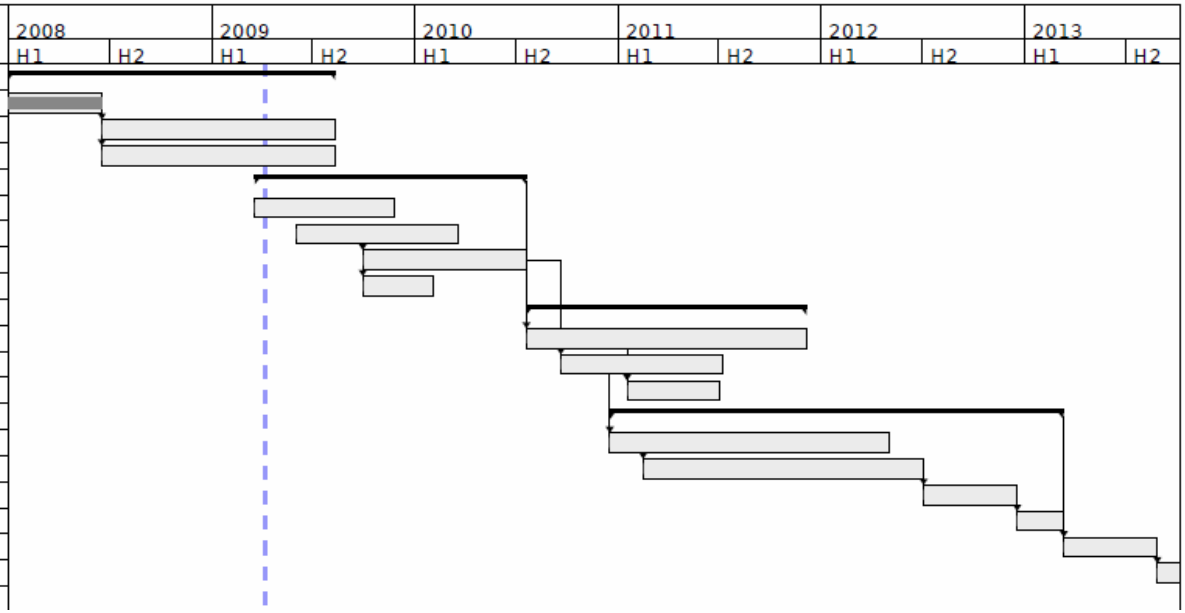
TendiGEM



Francesco Noto; derivato da Bencivenni @ al. (LNT)

SBS Front Tracker Project

Name	Work
Preliminary Studies	**660d**
Conceptual Design	60d
Detailed Design	240d
Small area Tracking Telescope	360d
Full Scale Prototyping	**540d**
Electronic Design and Prototyping	180d
Full scale GEM module	120d
Detailed Design Revised	150d
HV System Design	90d
Production	**660d**
Tracking Modules	360d
Readout Electronics	180d
Other components	120d
Integration	**541d**
Modules	1d
Modules Tests	360d
System	120d
System Tests	60d
Installation	120d
Commissioning	120d



BA: Gas system (qualche mese di ritardo)
CA: Mechanics + Test + MC + Slow Control
GE: Electronics
ISS/RM: Prototyping, Test, Digitization + Reconstruction, SiD, Coordination

I gruppi americano stanno sottomettendo una richiesta di circa 3 MUSD al DOE per il resto di SBS