Check list for July 2024 CERN Beam Test

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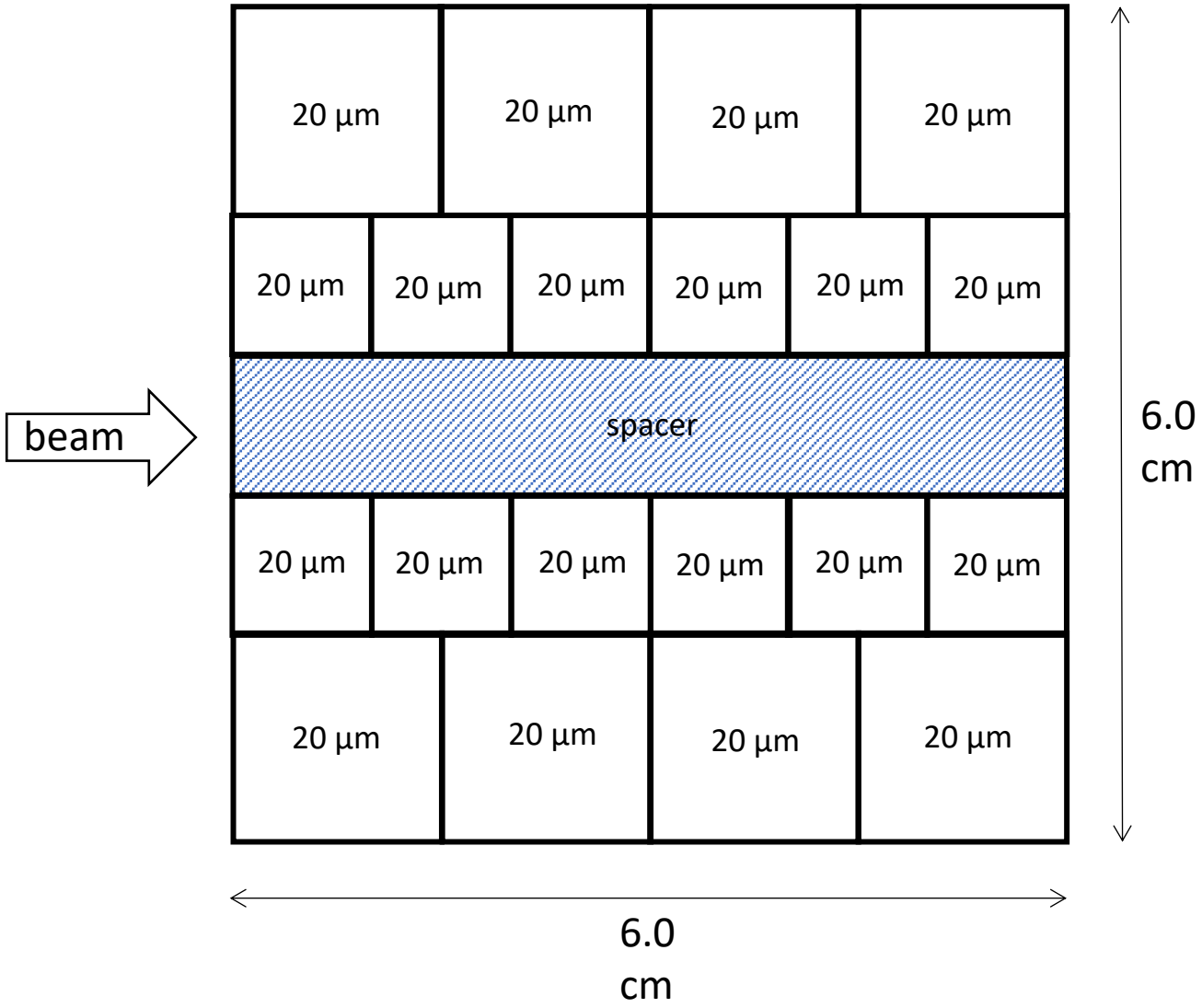
24.04.2024

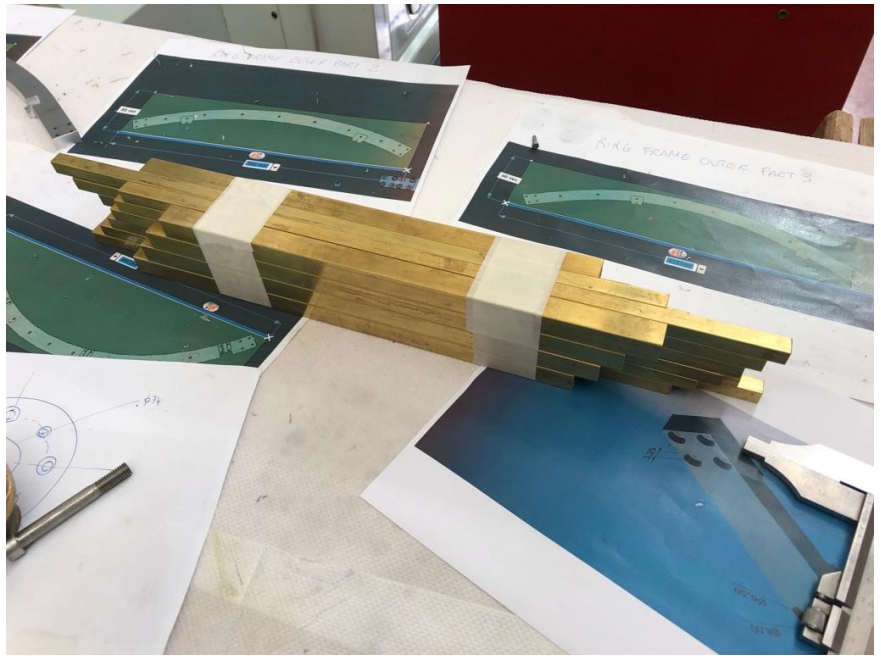
The following slides are modified from 2022 beam test preparation

May 2024: Estratto dalle casse → Ale M. deve disassemblare e ri-assemblare

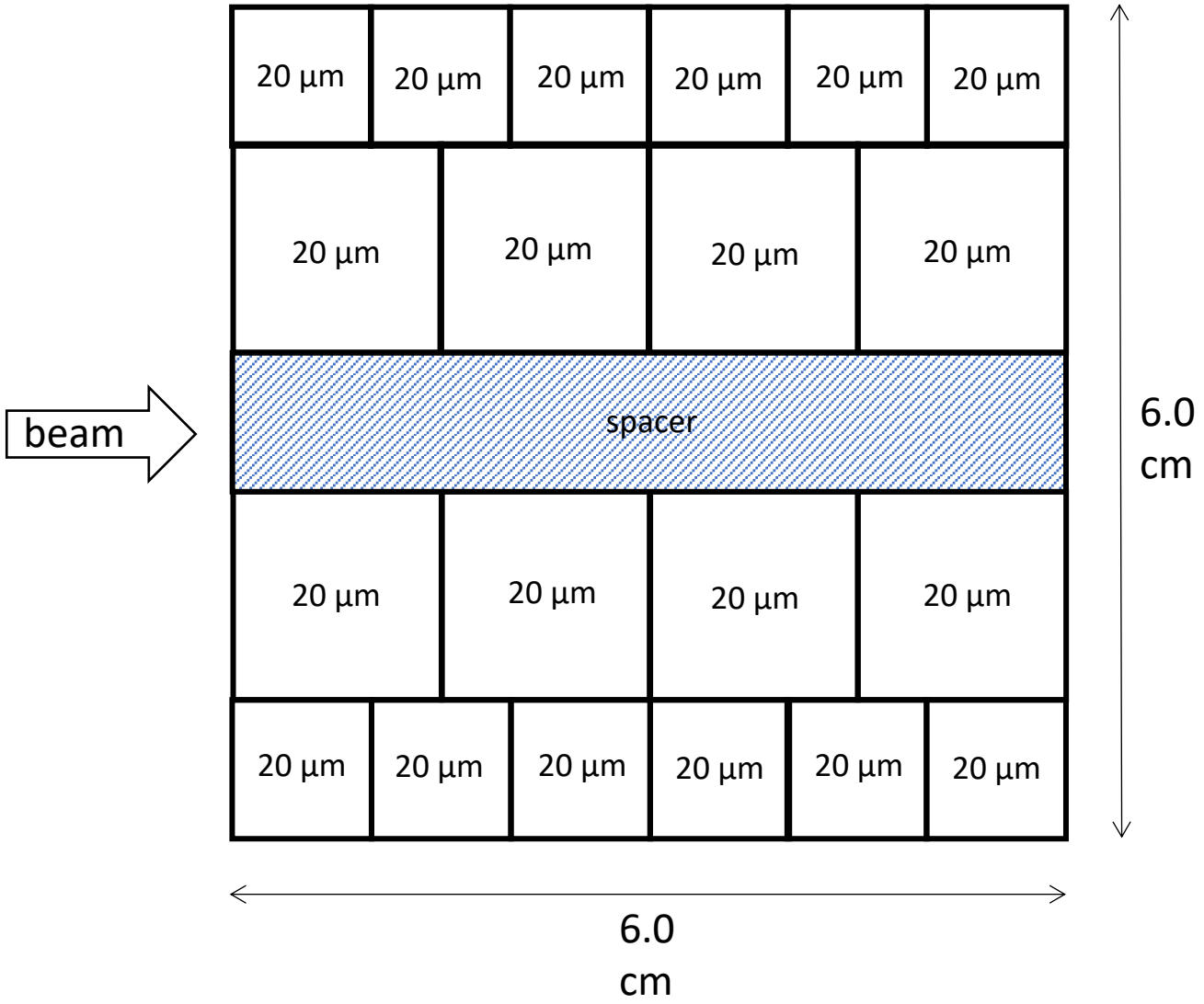
Optimal setup

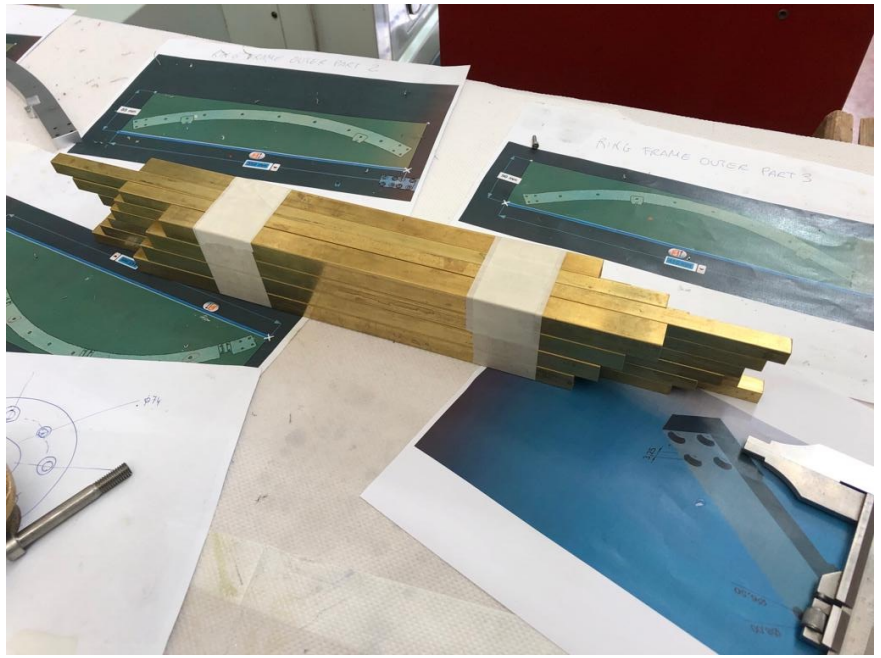
12 drift tubes 1.0 cm
8 drift tubes 1.5 cm



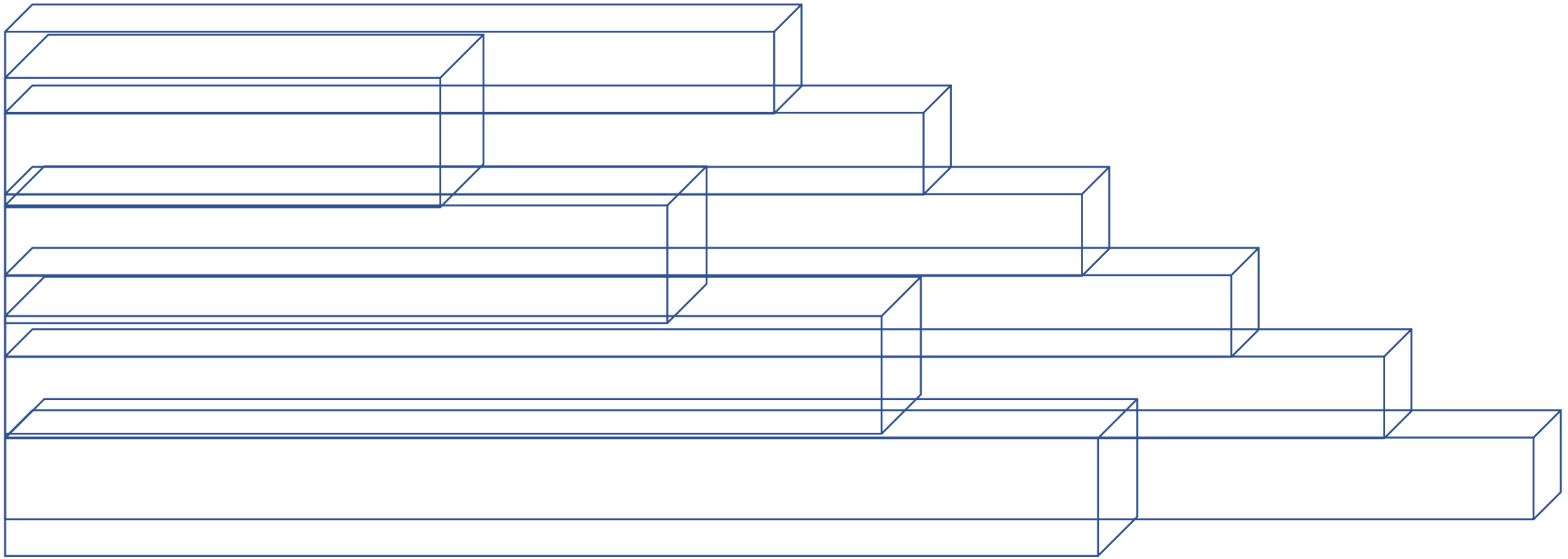


Alternative setup (2023)

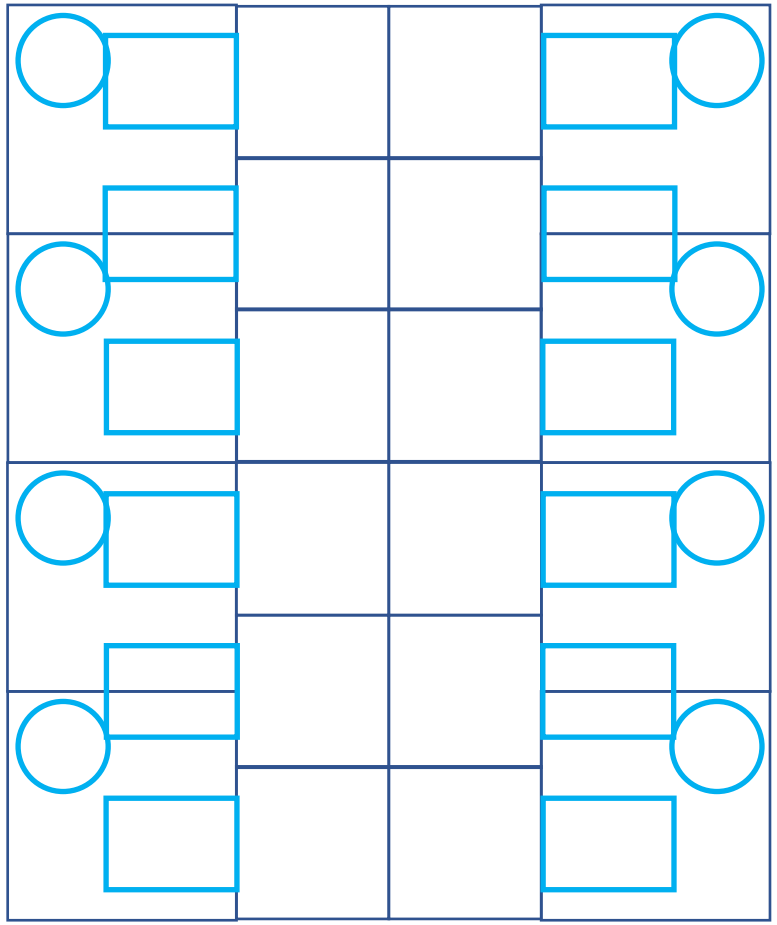


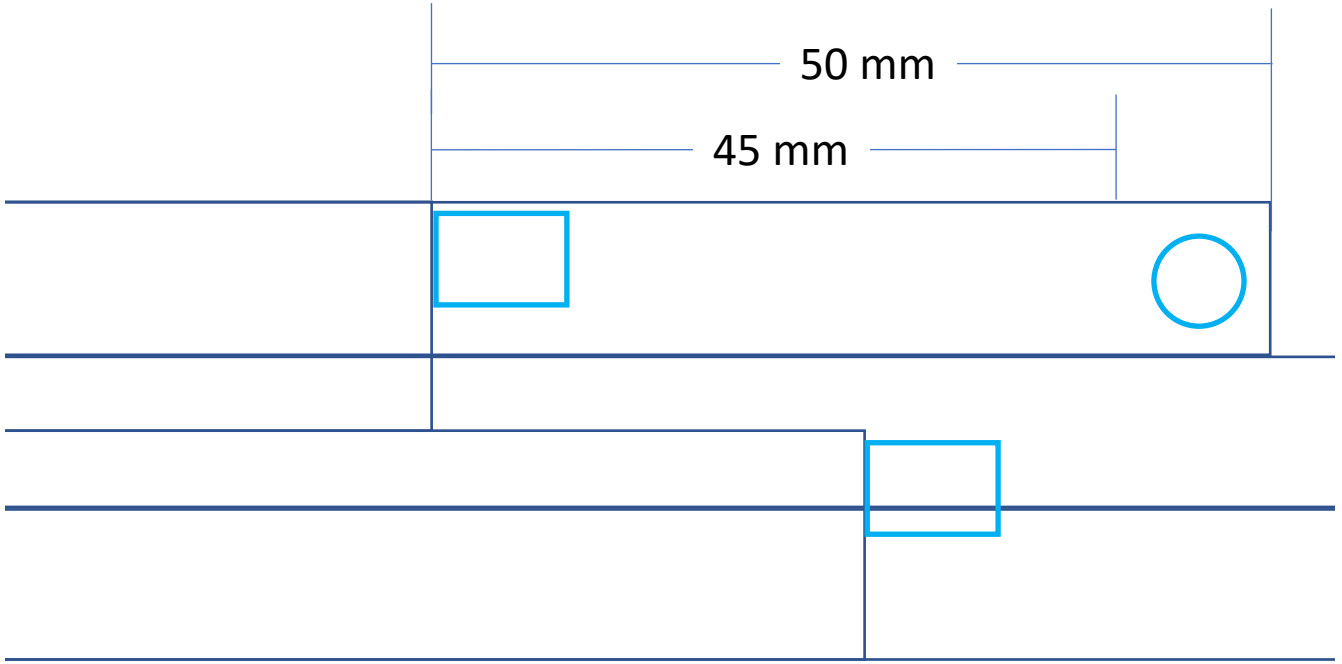


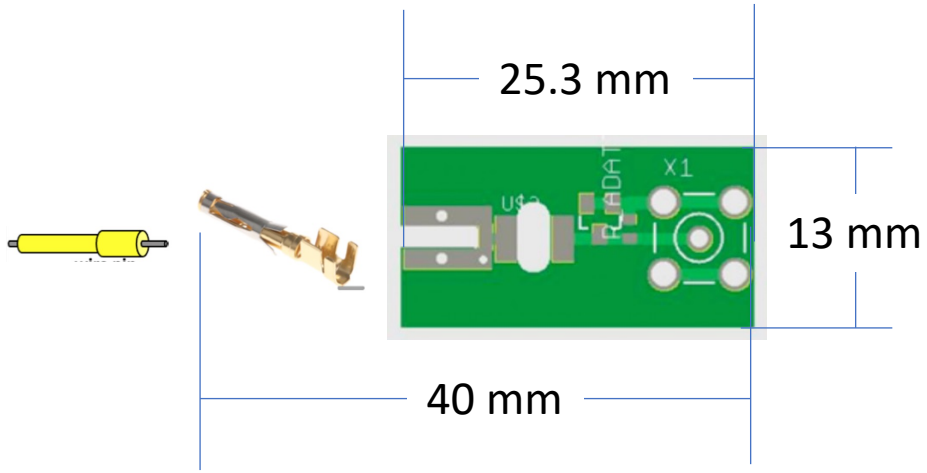
Tube staggering for gas inlet interferences



Tube staggering



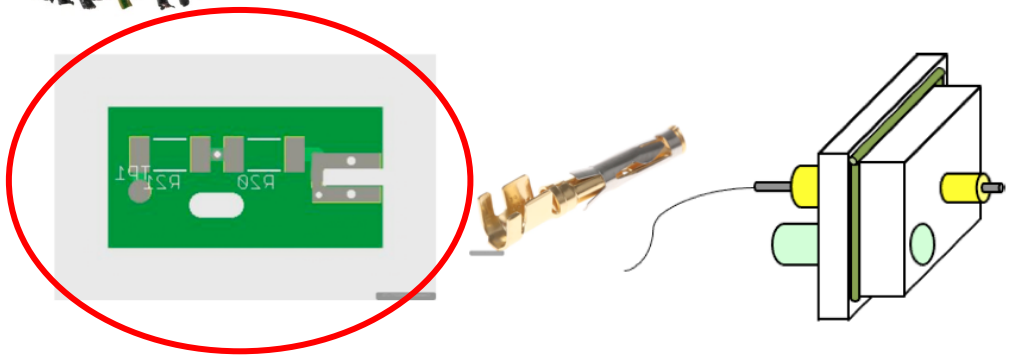


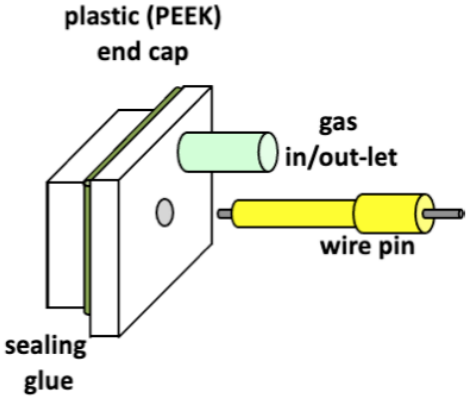


Inventario di elettronica fatto → Ale C. ha fatto gli ordini

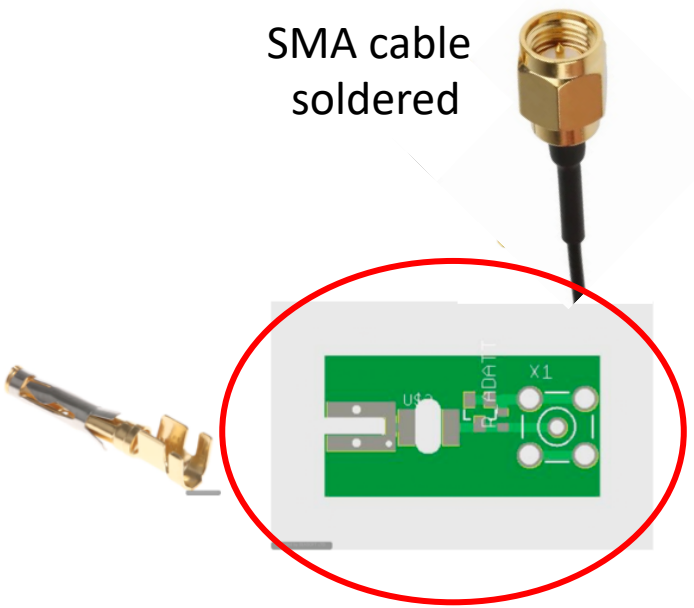
Pin connecting scheme

HV multipolar CAEN cable (24) soldered





SMA cable soldered



NEW

HV distribution board

connecting pin

drift tube end cap

drift tube end cap

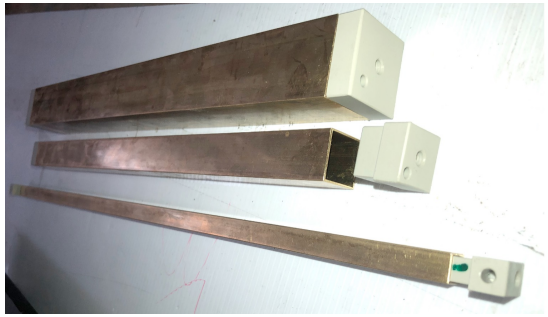
connecting pin

NEW

HV decoupling board

Inventario di elettronica fatto → Ale C. ha fatto gli ordini

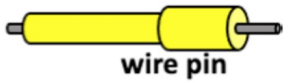
Material list



✓ 8 brass tubes 1.5 cm x 30 cm cut to size
✓ 12 brass tubes 1.0 cm x 40 cm cut to size

all (ultrasound) cleaned

✓ 16 peek end caps 1.5 cm
✓ 24 peek end caps 1.0 cm



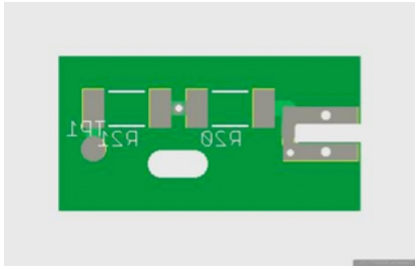
✓ 32 wire pins

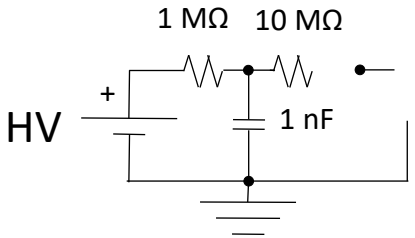
✓ 32 connecting pins

✓ 10 SMA cables 100 cm long cut in half

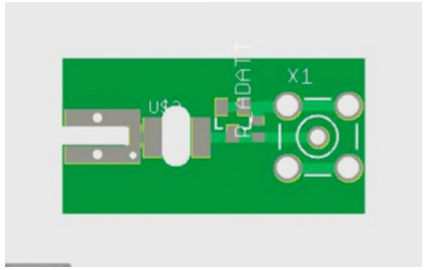
New PCB: check list of components

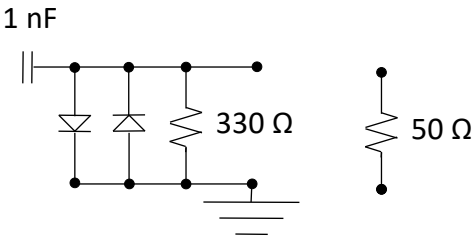
Old PCB





✓ 10 HV distribution boards
✓ 10 x (1MΩ + 10 MΩ resistors)
✓ 10 x 1nF capacitor





✓ 10 x 330 Ω resistors)
✓ 10 x 1nF capacitor
✓ 10 x diode bridge

SY 1527 ancora nella cassa, sara' tolto per testarlo

HV

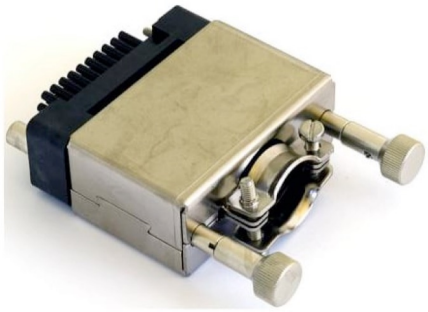
SY 1527 Mainframe ✓

1535P 24ch ✓

HV mainframe fully functional.
Must resume HV setting and monitoring program.

Macro to be checked

24 poles HV cable crimped to the Radiall connector.



Trigger to the 16-ch DRS board

Select and test two good pairs of scintillators
6 cm x 12 cm

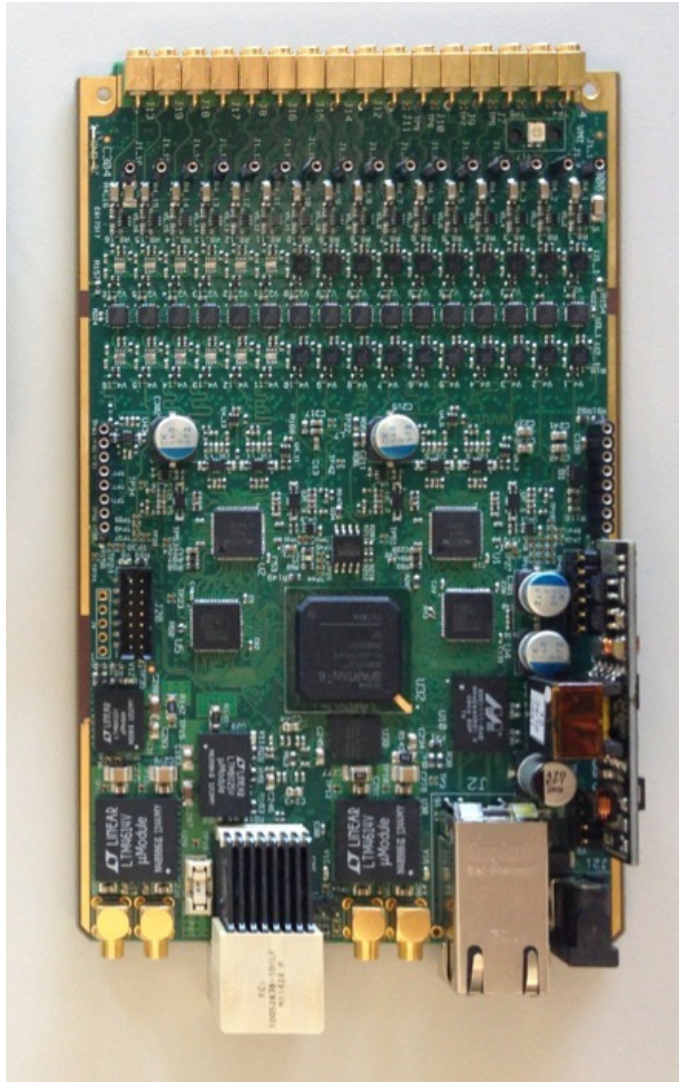
Need 4 MCX long cables for DRS trigger

Alternative trigger made with
ArduSiPM 5 cm x 5 cm

Check compatibility with DRS

DRS ritrovato, ma non sappiamo usarlo, scritto a Brunella e Francesco P. per suggerimenti

16-ch DRS board



16 channels board ✓

CERN ethernet line ✓

Gigabit switch ✓

cat8 cable ✓

MacBook for DAQ ✓

— realizzare connettori LVDS per estrarre i segnali dei singoli canali e il segnale delle coincidenze triple che provengono dagli scintillatori CAEN (Alessandro)
— realizzare cavi di prolunga per allontanare il controller degli scintillatori dai tubi (1 metro) (Alessandro)

Trigger to the Teledyne-Lecroy oscilloscope

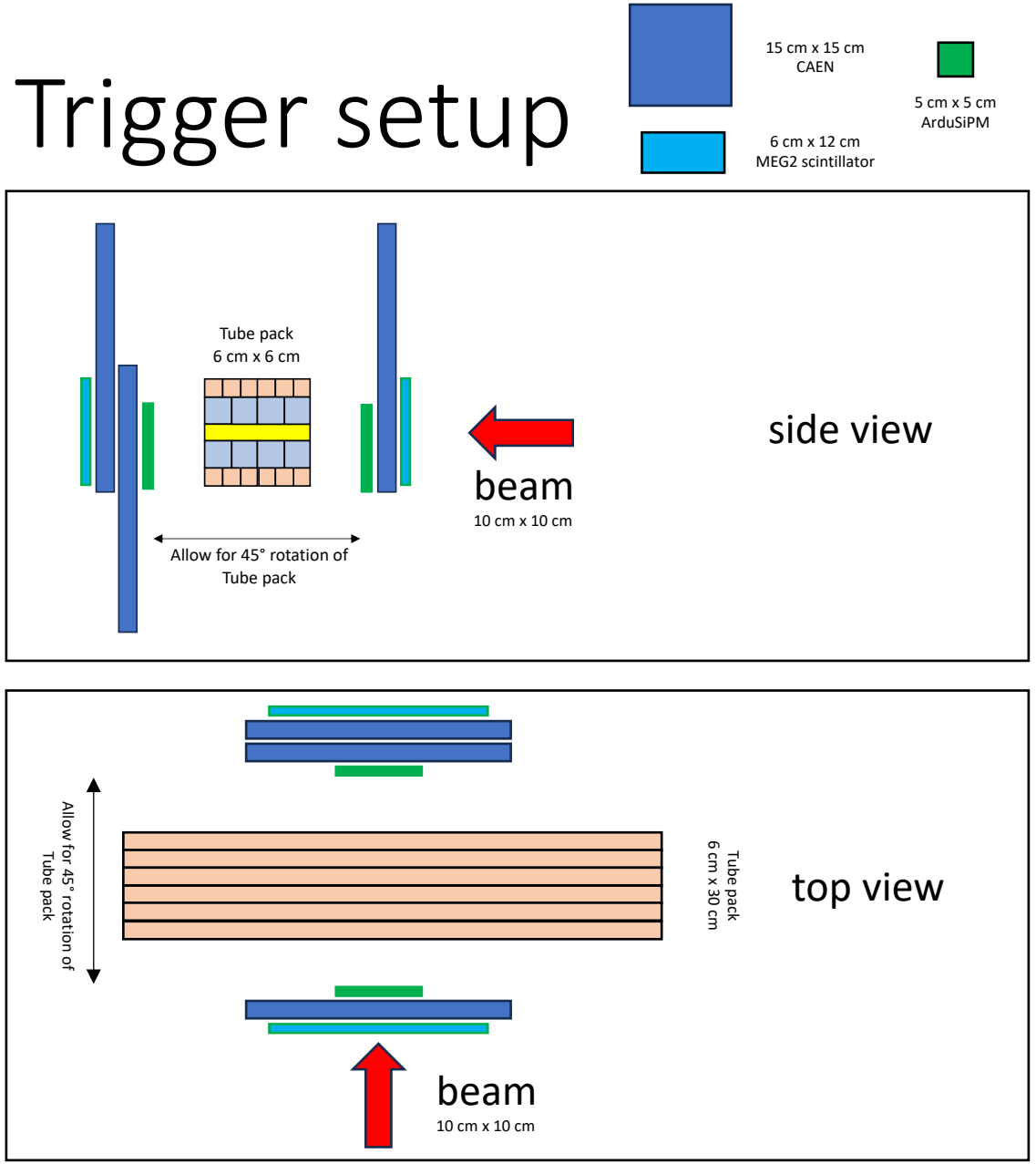
Trigger need to be anticipated by 800 ns appoximately
Check timing with drift tubes

Need very long cables from the SP5622 scintillator tiles to the coincidence module unit
to keep the very noisy coincidence unit far from the drift tubes

Check the ouput of the coincidence unit (if TTL need to translate to NIM for o-scope trigger)

8-ch Teledyne Lecroy

Trigger setup



Summary of to-be-done operations

Mechanics:

- Tubes refurbishing
- Tubes: check HV and signal connections
- Check length of ground spider (2x10 leads) HV side
- 10 mm compensation plates for tubes pack
- Assemble the drift tube pack
- Gas inlet and outlet manifold assembly
- 20x6mm x 2 rilsan inlet/outlet tubes (soft!)
- Prepare bubbler at the output of the outlet manifold
- Check the entire system for gas leaks
- Trigger scintillators for DRS + bosch support
- Trigger scintillators for oscilloscope + bosch support
- Common support for upstream and downstream ?

Electronics:

- HV and signal new PCB cards (20 + 20 +spares)
- Signal boards component loading
- SMA signal cable soldering
- HV ground spider checking ripristinare o uno nuovo da 20 poli
- HV boards component loading
- HV leads soldering (CAEN 24-leads cable)
- Connect HV and signal cards to drift tubes, check for continuity
- Resume HV setting and monitoring program and check for shorts
- Selection of 2 scintillators for trigger and testing for noise for the DRS
- Test trigger chain for oscilloscope with the CAEN SP5620CH system
- Check DAQ chain both for DRS and oscilloscope
- Prepare data duplicating and storage system

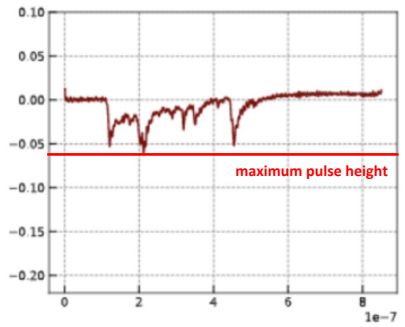
Propedeutic checks in lab

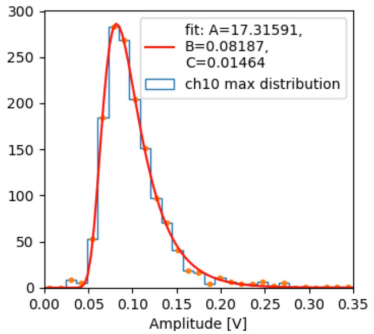
- Check reliability of DAQ with MacBook and DRS's
- Check reliability of DAQ with Teledyne-LeCroy scope
- Define sampling rates (1.25 for DRS, 2.5 for o-scope)
- Define a cosmic ray trigger
- Check trigger delays and waveform windows (400 ns for 1.0 cm and 600 ns for 1.5 cm)
- Check reliability of the existing portable gas system
- Confirm reliability of HV system
- Define details of the beam test work plan
- Define transport logistic

HV settings

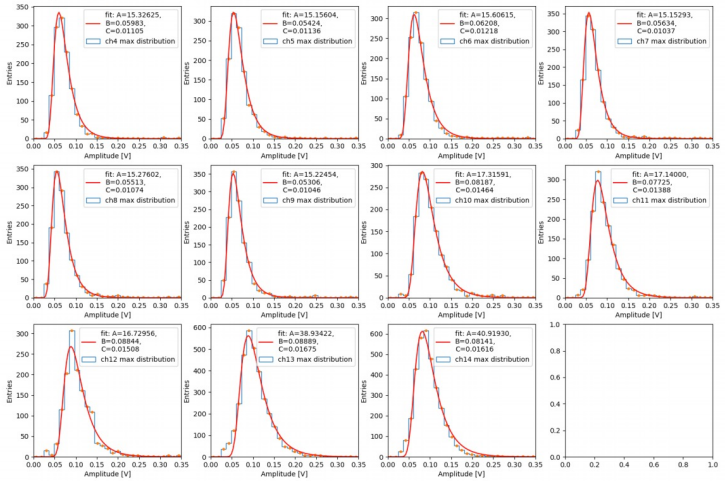
Define HV0 working point:

- plot maximum pulse height
- fit the distribution with a Landau
- adjust HV to get a **MPV ≈ 60 mV with Γ ≈ 10 mV**





- Max amplitude/ per channel distribution, fitted with a landau - **11Nov_45angle_HVnominal_1p2GSPS_10k_LANDAU**
  - https://github.com/clacaputo/drifttubes_analysis/blob/main/landau_fit.py
- More of these plots: https://cernbox.cern.ch/index.php/s/yjoJLkgUbPC1ELG



Educated guess – to be checked

HV vs gas gain for 90%He/10%iC_4H_{10} – 760 torr

	2x10^5	3x10^5	4x10^5
1.0 cm – 20 µm	1480	1500	1520
1.5 cm – 20 µm	1580	1600	1620

HV vs gas gain for 85%He/15%iC_4H_{10} – 760 torr

	2x10^5	3x10^5	4x10^5
1.0 cm – 20 µm			
1.5 cm – 20 µm			

HV vs gas gain for 80%He/20%iC_4H_{10} – 760 torr

	2x10^5	3x10^5	4x10^5
1.0 cm – 20 µm			
1.5 cm – 20 µm			

Work plan

Logistics:

- Define list of participating people (now!)

- Assign tasks (for needed and preparatory work)
- Prepare list of materials and tools to be shipped to CERN
- Decide how to ship:
  - use a shipping agent (both ways)
  - ~~rent a truck (need to find drivers for both ways)~~
- Freeze beam test program
- Define a data taking program
- Define shifts
- On-line checks and data pre-analysis

Participating people:

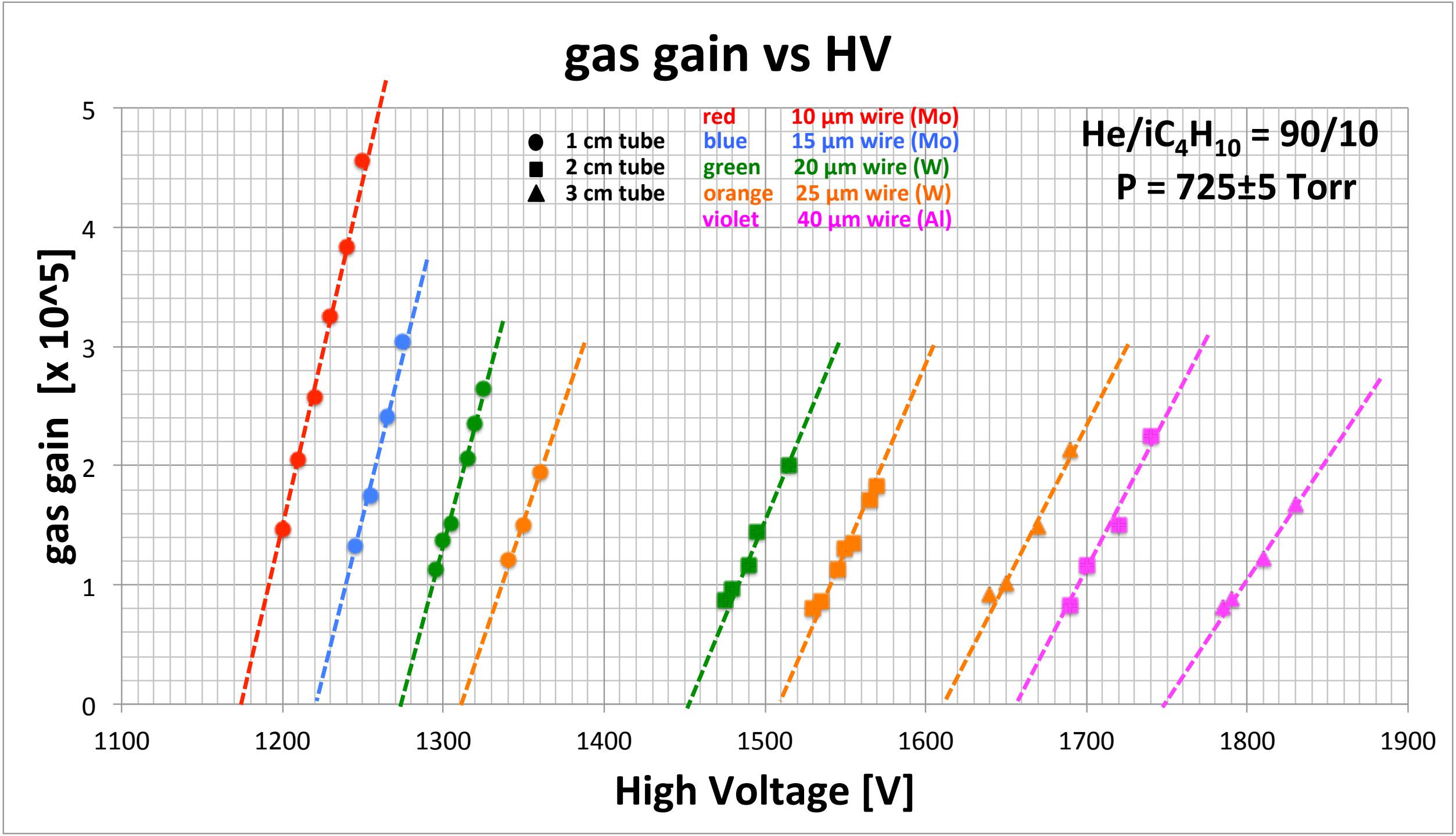
- M. Abbrescia
- A. Corvaglia
- B. D'Anzi
- N. De Filippis
- W. Elmetenawee
- E. Gorini
- F. Grancagnolo
- S. Grancagnolo
- F. Gravili
- A. Miccoli
- M. Panareo
- M. Primavera
- A. Ventura
- (others from Bari ?, ATLAS-Lecce ?)

- **China (?)**
- **USA (?)**

Work plan

Tasks to be accomplished during test (beam test program):

1. Initial setup (IS):
   - beam momentum 10 GeV/c (BM = 10)
   - gas mixture 90%He - 10%iC_4H_{10} (GM = 90/10),
   - gas pressure at 760 torr, gas flow rate at 20 Nl/h (1 volume (5 Nl) exchange every 15 minutes)
   - sampling rate (SR) at 1.25 GSa/s (DRS) and 2.5 GSa/s (o-scope)
   - gas gain (GG) at $3x10^5$ (HV=HV0) - Define HV0 working point
   - beam angle (BA) 45°
2. Run at IS and HV = HV0 (30000 triggers: sum of DRS + o-scope triggers), HV0 + 20V (GG = $4x10^5$)(10000 triggers), HV0 – 20V (GG = $2x10^5$) (10000 triggers) (1 long run + 2 medium runs)
3. Repeat 2. with BA = 0° (1 long run + 2 medium runs)
4. Repeat 2. and 3. with BM = 8, 6, 4, 2 GeV/c (total of 10 long runs + 20 medium runs)
5. Repeat 2., 3., 4. with GM = 85/15 and GM = 80/20 (total of 30 long runs (900000 triggers) + 60 medium runs (600000 triggers) for 1.5 million triggers)


gas gain vs HV
red 10 µm wire (Mo)
blue 15 µm wire (Mo)
green 20 µm wire (W)
orange 25 µm wire (W)
violet 40 µm wire (Al)
1 cm tube
2 cm tube
3 cm tube
He/iC4H10 = 90/10
P = 725±5 Torr
gas gain [x 10^5]
High Voltage [V]
0
1
2
3
4
5
1100
1200
1300
1400
1500
1600
1700
1800
1900

Work plan

Estimated run time:

1. Last November: DAQ → ~80 events/spill (5 s), ~2 spills/minute
   beam rate ~1500 μ /spill/100 cm^2 x 36 cm^2 (trigger coverage) = 540 expected μ/spill → DAQ efficiency = **15%!** → 2.7 μ/s (average) ≅ 30 min/run (5000 events)
2. Next June: improve DAQ efficiency! Improve trigger coverage to > 50 cm^2. Goal is reaching 15 min/run (10.000 events) (1 event ≅ 4 or 6 tubes hit)
3. Tasks 2. and 3. (28 runs 10.000 each) will take 1 shift (7 hours)
4. Task 4. (8 runs 20.000 each) will take 4 hours
5. Task 5. (10 runs 20.000 each) will take 5 hours
6. Total per GM = 16 hours → allow for 2 days (> 50% contingency)
7. 3 x GM → 6 days

Bombola isobutano 3.5?