DESY testbeam preparations

Using negative ions

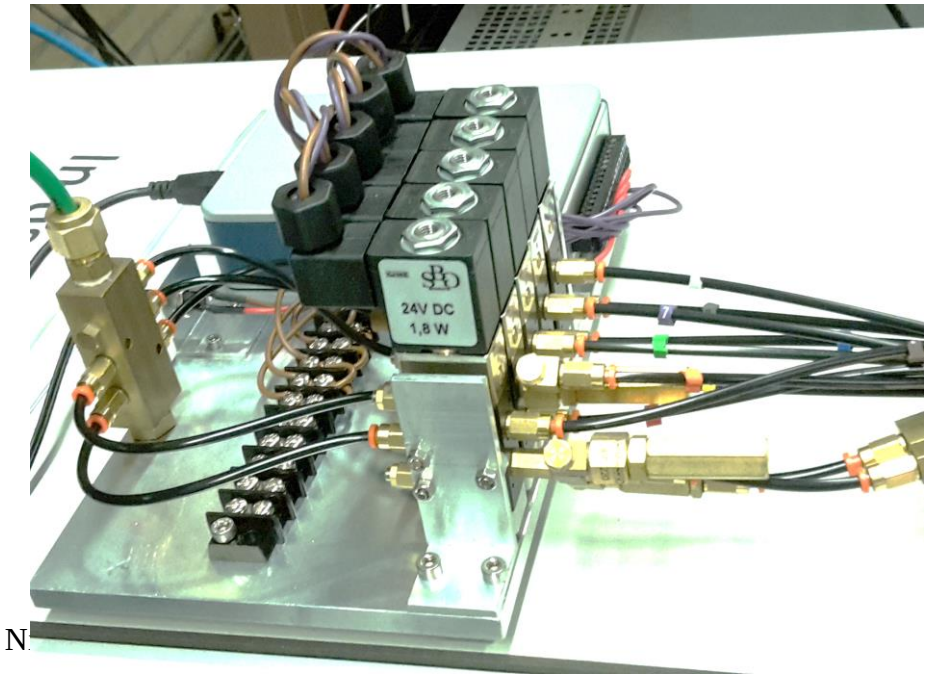
Fred Hartjes

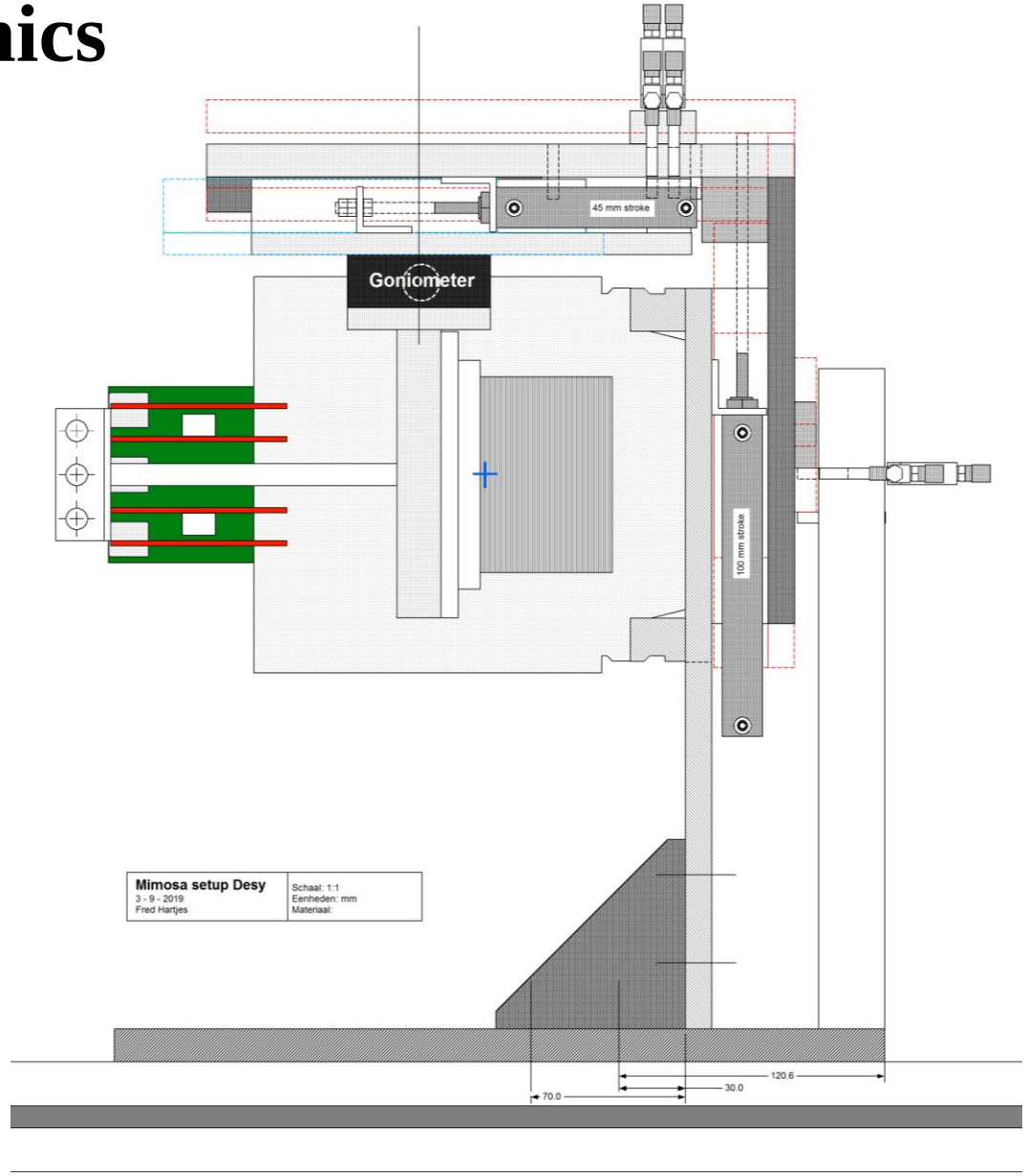
NIKHEF

Nikhef/Bonn LepCol meeting
December 2, 2019

Setup mechanics

- System completely operational
  - Including pneumatic control by LabVIEW
- In vertical direction (X coordinate) 3 positions
  - X = 0 – 20; 20 – 40; 40 – 60 mm
- Horizontal (Z coordinate) 4 positions
  - Z = 0 – 10; 10 – 20; 20 – 30; 30 – 40 mm





Fred Hartjes

DESY Test Beam Schedule 2020- Version 2 25/10/2019

Ralf Diener, Norbert Meyners, Marcel Stanitzki - DESY Test Beam Coordinators

	Week		TB21		TB22		TB24/1		TB24		
				DATURA		DURANTA	PCMAG	Telescope in PCMAG		AZALEA	
6-Jan-20	2		Shutdown								
13-Jan-20	3										
20-Jan-20	4										
27-Jan-20	5										
3-Feb-20	6										
10-Feb-20	7		Startup		Startup		Startup		Startup		Announced
17-Feb-20	8		EDIT-2020	X	Mu3e	X			ALICE-mTower	X	
24-Feb-20	9		EDIT-2020	X	CLIC Pixel	X			CMS-Pixel-Phase2	X	
2-Mar-20	10		FCAL	X	Belle-II PXD	X			CMS-Pixel-Phase2	X	
9-Mar-20	11		FCAL	X	Bonn-SiLAB	X	Lycoris				
16-Mar-20	12		CMS-Pixel-Phase2	X	ATLAS-ITk-Pixel	X			CALICE AHCAL	X	
23-Mar-20	13		CMS-Pixel-Phase2	X	ATLAS-ITk-Pixel	X			CALICE-SiW-ECAL	X	
30-Mar-20	14		MBI	X	ATLAS-HGTD	X			AFP-TOF	X	
6-Apr-20	15		MBI	X	ATLAS-HGTD	X			Telescope Dev	X	
13-Apr-20	16										
20-Apr-20	17		CMS-Pixel-Phase2	X	Mu3e	X			CLIC Pixel	X	
27-Apr-20	18		CMS-Pixel-Phase2	X	ATLAS-ITk-Strips	X			TPEX		
4-May-20	19		CMS Outer Tracker	X	ATLAS-ITk-Strips	X			TPEX		
11-May-20	20		CMS Outer Tracker	X	ATLAS-ITk-TJCMOS	X			LHCb-ECAL	X	
18-May-20	21		Telescope Dev	X	ATLAS-ITk-Pixel	X			LHCb-ECAL	X	
25-May-20	22				Setup Time						
1-Jun-20	23		MBI	X	ATLAS-ITk-Strips	X			CALICE AHCAL	X	
8-Jun-20	24		CLIC Pixel	X	ATLAS-ITk-Strips	X	CEPC-TPC				
15-Jun-20	25		CMS-Pixel-Phase2	X	Mu3e	X			TOTEM	X	
22-Jun-20	26		CMS-Pixel-Phase2	X	ATLAS-HGTD	X			NICA-SiPM		
29-Jun-20	27		ELAD	X	ATLAS-HGTD	X			NICA-SiPM		
6-Jul-20	28		Summer Shutdown								
13-Jul-20	29										
20-Jul-20	30										

Using negative ions instead of electrons

- Several papers report on negative ionic drift
- Using strongly electronegative gases like SF6 and CS2
- SF6 is an extremely strong greenhouse gas
  - 23000 stronger than CO2 (1 kg has the same environmental effect as the emission of a petrol car during it whole life time)
  - => for the time being I put it aside
- CS2 has no strong environmental drawbacks
  - Emissions up to 500 g/day allowed
  - It is poisonous but not extremely

Safety aspects CS2

- **Strong smell**
  - In pure state: chloroform
  - In less pure state: rotting radish
  - Detection limit by **smelling**: **1 – 2 ppM**

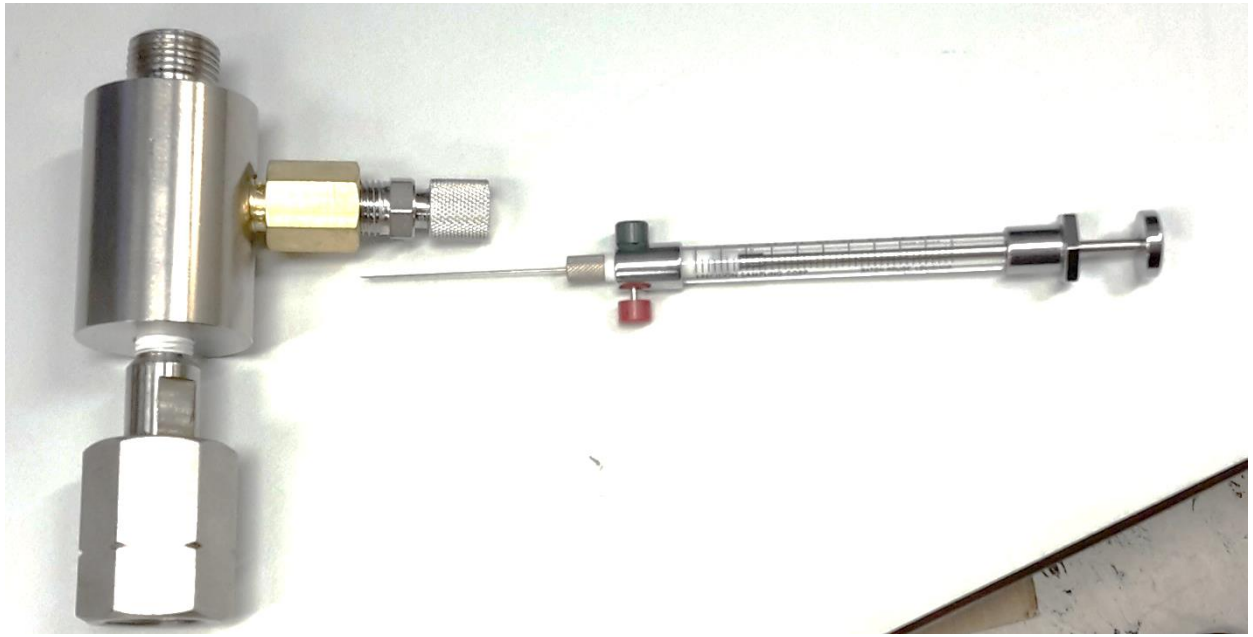
- **Long term exposure** limit for an employee during 8 h a day: **4.7 ppM**
  - => it is safe as long as you don't smell it
- **350 ppM** during 15 min => dizziness, light headache
- **800 ppM** during 1.5 – 3 h => unmotivated laughing, severe headache
- From **4800 ppM** => possibly deadly

How to prepare a He/CS2 mixture?

1. The CS2 liquid is put into a 100 ml bottle closed with a cover with a septum (rubber membrane)
2. A small amount of liquid is suck by a syringe through the septum
3. Subsequently the CS2 liquid is injected through another septum into the gas stream while filling a JSP bottle with He

- 1 ml CS2 liquid into a JSP bottle at 21 bar abs => ~ 0.1 % CS2 concentration
- Max concentration is 1.5% CS2 at 21 bar
- For higher CS2 concentrations we have to reduce the bottle pressure

- Ready around December 6?



Fred Hartjes

Experimental setup

- PROTLA testbox with place for 4 chips with InGrid or micromegas
- Covered with coppered Kapton foil to provide a drift field and a gas enclosure
- Using electrically broken TPX3 chips with good grid
- All chips are individually supplied with grid voltage
- At gas gain at a few thousand we get a current of a few nA with a 90Sr source
- 55Fe spectrum can be collected by a preamp from the induced signal on the grid (strip amplifier)

Fred Hartjes

Can we get gas gain from CS2?

- Martoff paper: from 40 to 200 Torr CS2, He 0 – 500 Torr.
  - Ionic drift from ionization by a flash UV lamp
  - Ions collected by anode wires, but no mentioning of any gas gain
- Phan paper: from 30 to 60 Torr CS2, no other gas added
  - General remark: avalanche fields required are 10 x that for gases like P10 (Ar + 10% CH4)
  - Gas gain at 30 and 40 Torr (2000 – 3000) observed with 0.4 and 1 mm TGEM
  - Avalanche fields about 10 kV/cm (0.4 mm THEM) and 20 (1 mm THGEM) kV/cm @ 30 – 40 Torr
- But what if we add He to raise the gas pressure from 30 Torr (40 mbar) to 1 bar?
- Alternatives O2??

We just have to try it out

Reference

Constraints on the organization of the DESY testbeam

- Nov 18: start magnet cooling
  - => Final decision on having the December testbeam
  - **Will we run with one or two quads if the DAQ or the LV supplies are not running at that date??**
  - Start mockup setup at Nikhef

- Installation at DESY cannot start later than on Dec 2

- People are not allowed to work alone in the DESY testbeam area or hut

DESY TEST BEAM.

DESY Test Beam Schedule 2019 - Version 8 02/08/2019

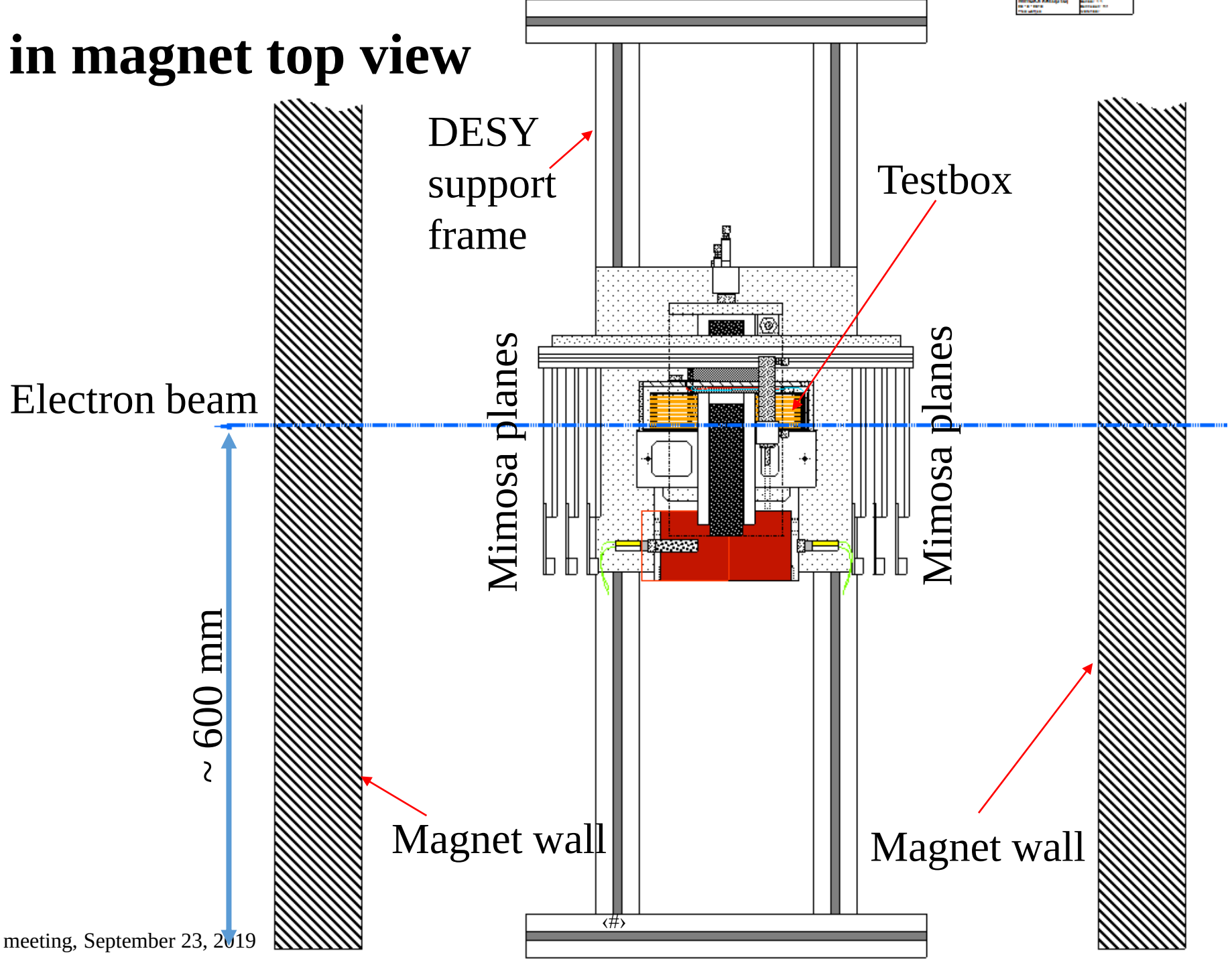
Ralf Diener, Norbert Meyners, Marcel Stanitzki - DESY Test Beam Coordinators

	Week		TB21		TB22		TB24/1		TB24	
				DATURA		DURANTA	PCMAG	Telescope in PCMAG		AZALEA
7-Oct-19	41									
14-Oct-19	42		BL4S	X	SHiP-SplitCAL				ATLAS-ITk-TJCMOS	
21-Oct-19	43		BL4S	X	SHiP-SciFi				EDIT2020 Preparations	X
28-Oct-19	44		CMS-Pixel-Phase2	X	SHiP-SciFi+SHiP-Emulsion				Ship-SBT	
4-Nov-19	45		CMS-Pixel-Phase2	X	ATLAS-HGTD	X			LHCb-ECAL	X
11-Nov-19	46		FCAL	X	ATLAS-HGTD	X			LHCb-ECAL	X
18-Nov-19	47				Setup Time					
25-Nov-19	48		CMS Outer Tracker	X	ATLAS-ITk-Strips	X			ATLAS-ITk-Pixel	X
2-Dec-19	49		CMS Outer Tracker	X	ATLAS-ITk-Strips	X			ATLAS-ITk-Pixel	X
9-Dec-19	50		ELIOT		CMS-Pixel-Phase2	X	LCTPC-Pix		Mu3e	X
16-Dec-19	51	Beam till 20/12 0800	ELIOT		CMS-Pixel-Phase2	X			CLIC PIXEL	X
23-Dec-19	52		Shutdown							
30-Dec-19	1									

- **Safety course** is only held each Monday morning.
- We cannot start **installation** or have **access** to the hall before that.
- => We (Fred and Kees) have to be at DESY on Dec 2.

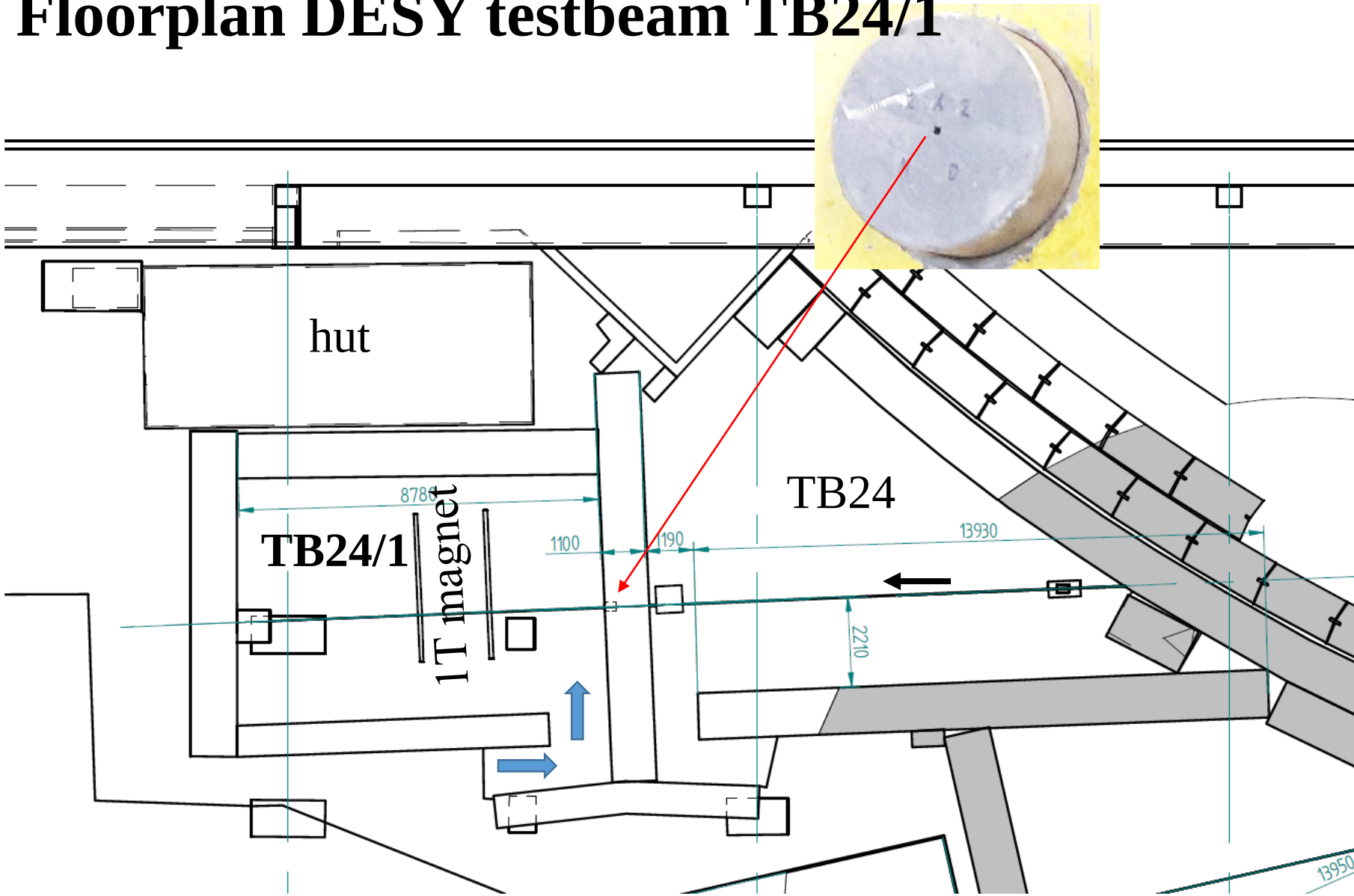
DESY testbeam Hall 2

Testbox in magnet top view



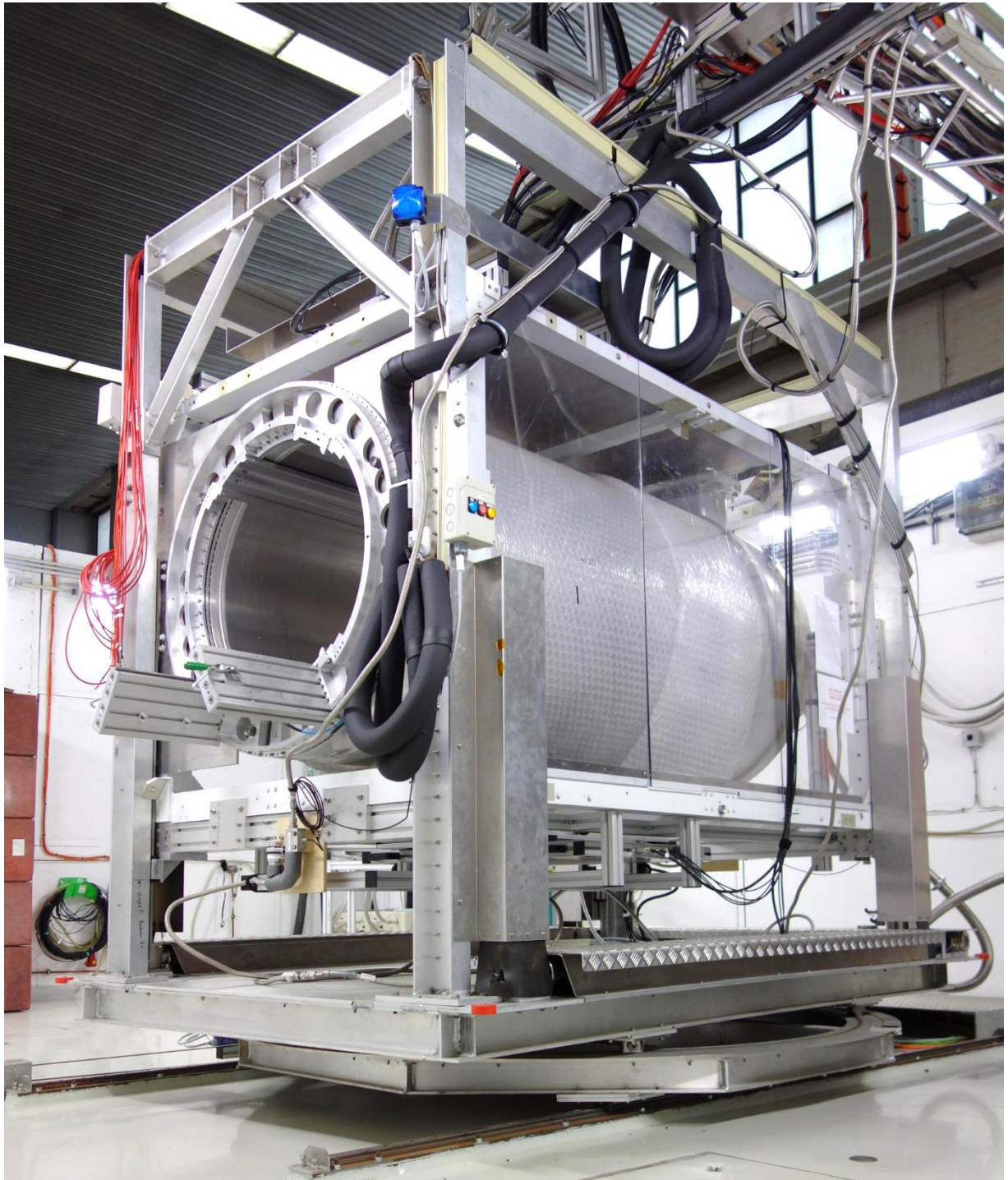
Floorplan DESY testbeam TB24/1

- In December we may have a rather low energy (~ 3 GeV)
- Rate depending on the applied collimator
- Maximum 5 – 6 kHz
- Beam height is 169.5 cm wrt the ground floor



Solenoid magnet in TB24/1

- Remotely movable vertically and sideward (X and Z)
- Super conducting
  - => no running power needed
  - But how much time does it take to cool it down?
- 1T magnetic field horizontally
- Radiation length magnet wall: 20%
- Inner diameter: 85 cm



Floorplan DESY testbeam TB24/1

- Leak tray with all services on wooden table
- DCS PC Levaard also on that table
- **Cable length between leak tray and testbox: ~ 8 m**
- We cannot lay our own cables between the hut and our area
  - Only possible when all beams are off
  - We have to use available cables/tubing