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H4 TEST - HERD

Measurement of setup of HERD experiment

Measurement of October 09th, 2023



The EDMS document **2977475**, containing this report can be found at the following address:

<https://edms.cern.ch/document/2977475/1>

1 GENERAL INTRODUCTION

On the demand of Nicola MORI, measurements of the HERD experimental setup in H4 test beam area took place on October 09th, 2023. The aim of the measurement has been to measure the relative position of the detectors and the position of the individual detectors with respect to the nominal beam line.

The following detectors have been part of the setup and have been measured:

- Trigger detector (4 points)
- European SCD detector (4 points)
- IHEP SCD detector (2 points)
- IHEP PSD detector (2 points)
- European PSD detector (2 points)
- Mini fit (EPFL) (8 points)
- Support Table (upstream) (4 points)
- Support Table (downstream) (4 points)
- Calorimeter (4 points)

2 COORDINATE SYSTEM

The coordinate system of the H4TEST experimental zone is defined as follows:

- **Origin:** Beam exit point of QNL479
- **X axis:** Nominal beam line passing through magnets QNL476 and QNL479, positive in the beam direction.
- **Y axis:** perpendicular to X axis in horizontal plane, positive from Salève side toward the Jura side.
- **Z axis:** vertical, perpendicular to the XY plane, positive to the top.

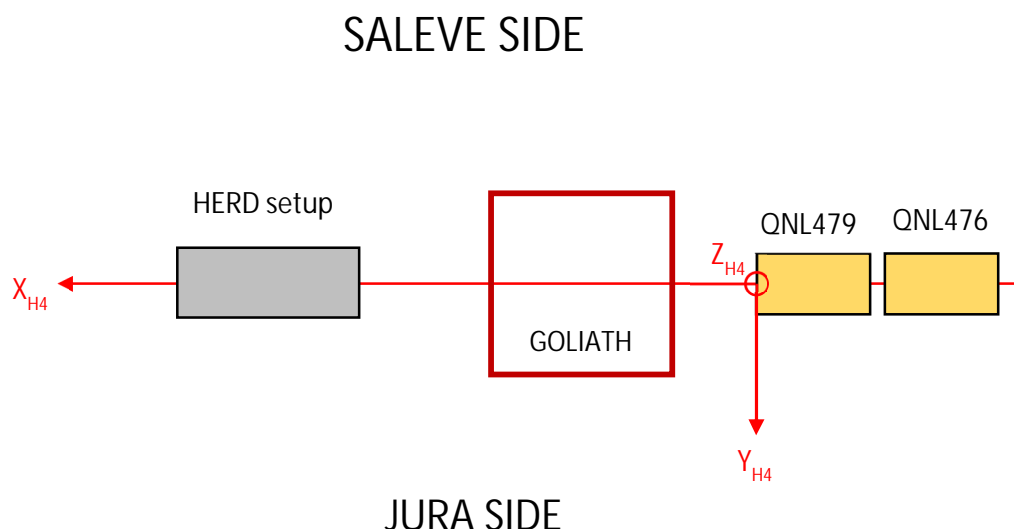


Figure 1 : Top view of the coordinate system

3 DISTRIBUTION OF THE MEASURED POINTS

The point distribution has been chosen that the points *detector_01* has positive Y-coordinates and is on the upstream end of the item if more than two points have been measured.

3.1 Trigger detector

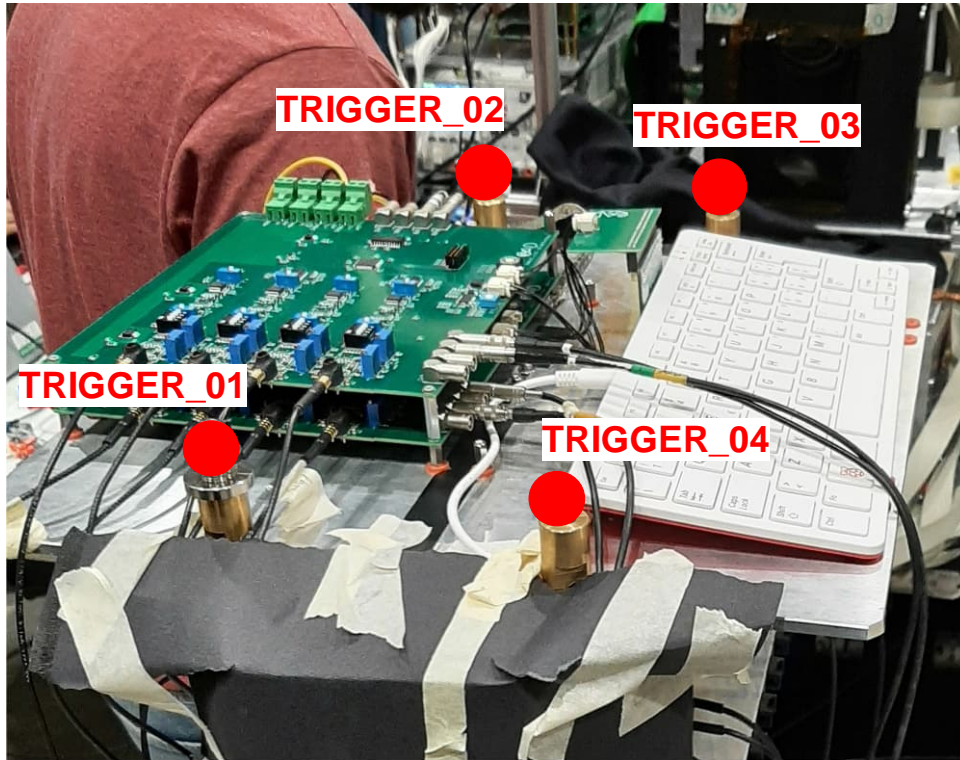


Figure 2: Distribution of points and point names on the Trigger detector

3.2 European SCD detector

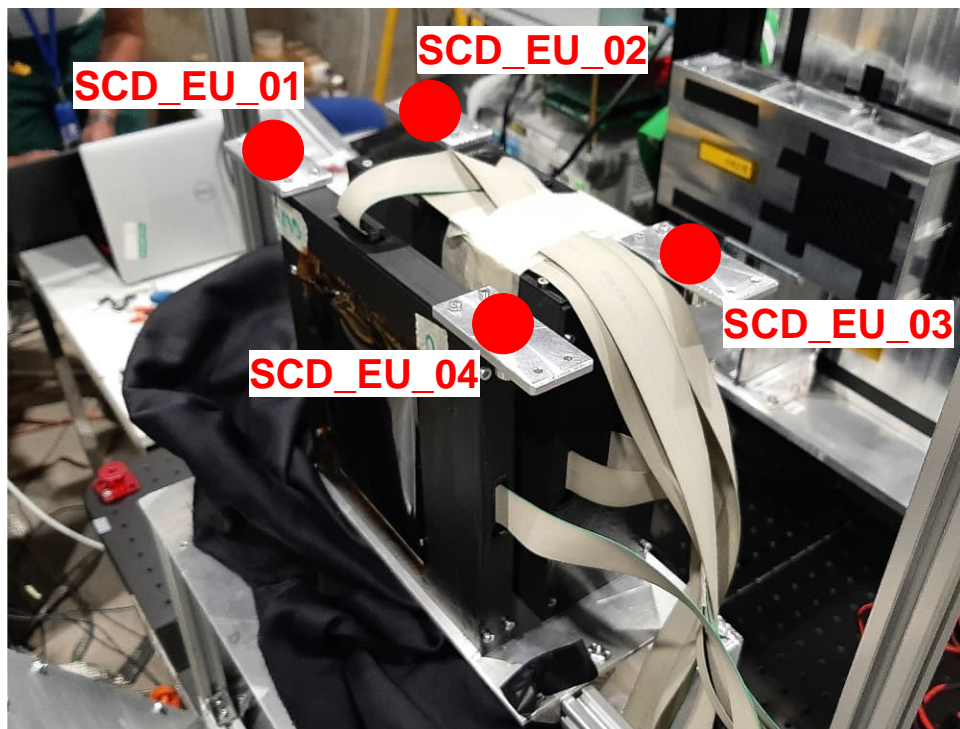


Figure 3: Distribution of points and point names on the European SCD

3.3 IHEP SCD detector

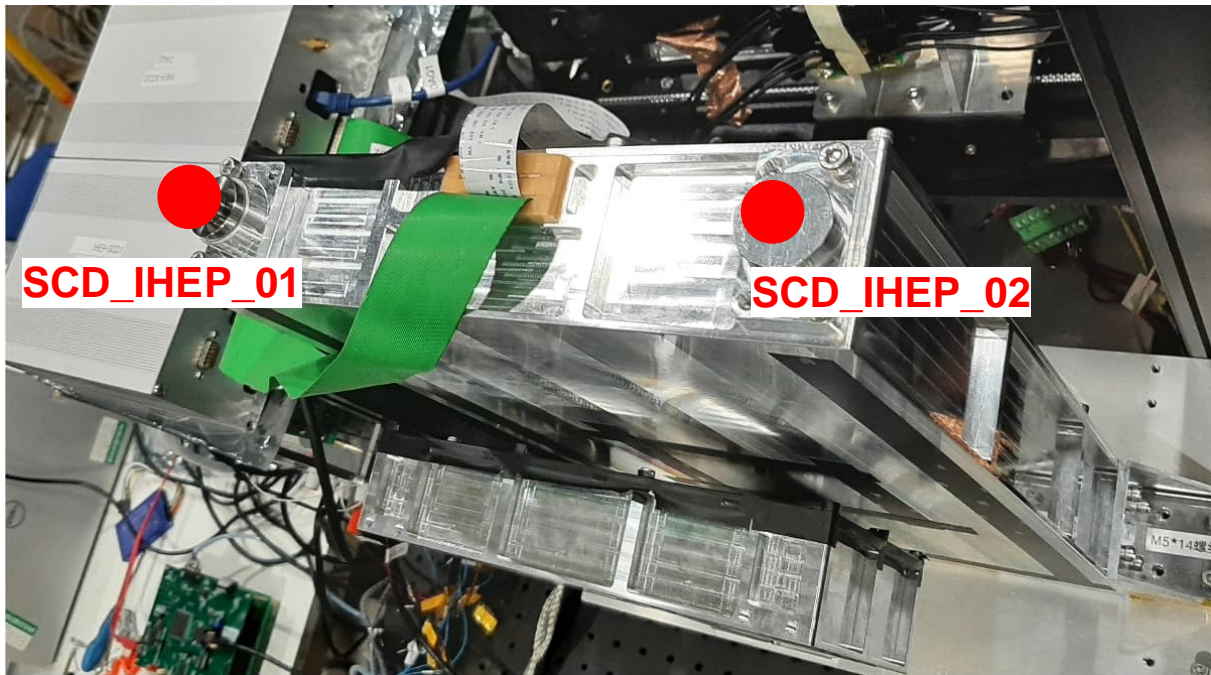


Figure 4: Distribution of points and point names on the IHEP SCD

3.4 IHEP PSD detector and European PSD detector

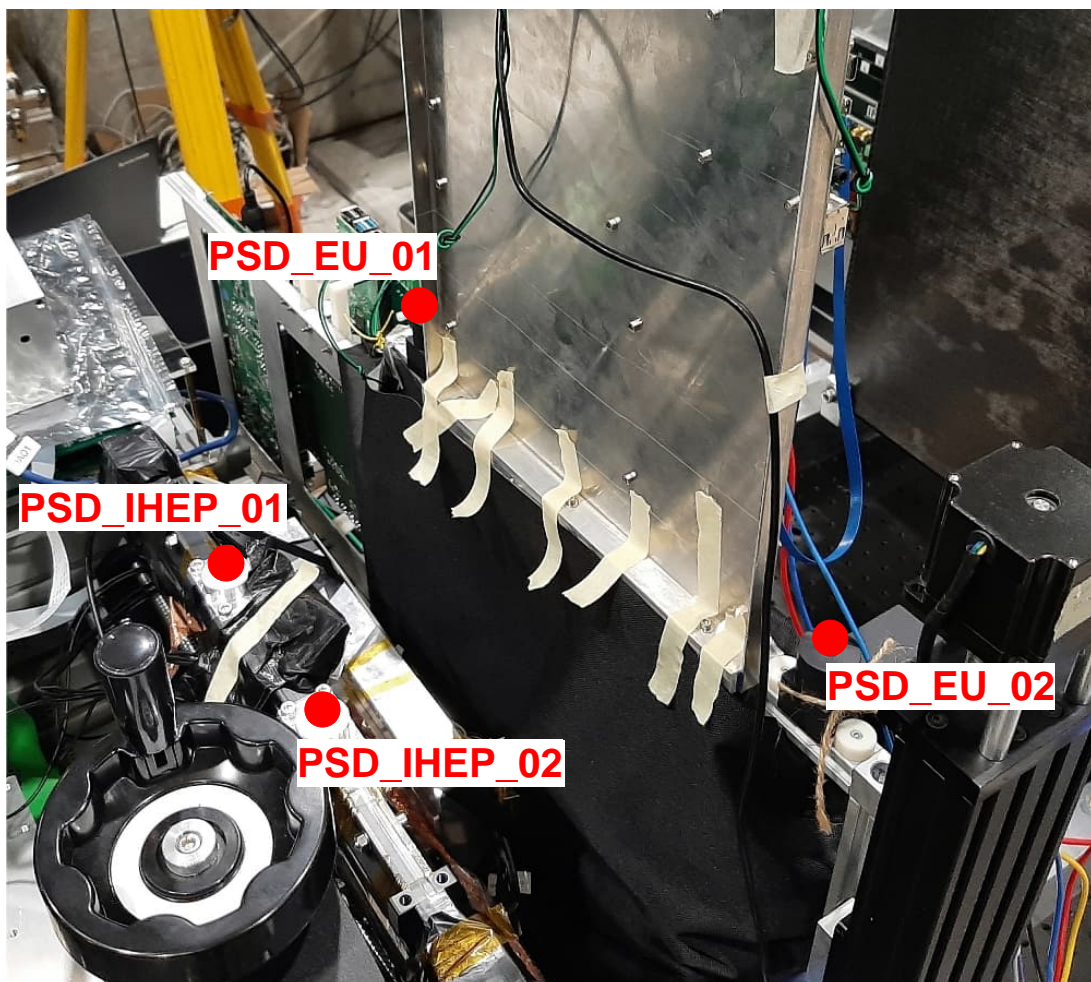


Figure 5: Distribution of points and point names on the PSD detectors

3.5 MiniFit (EPFL)

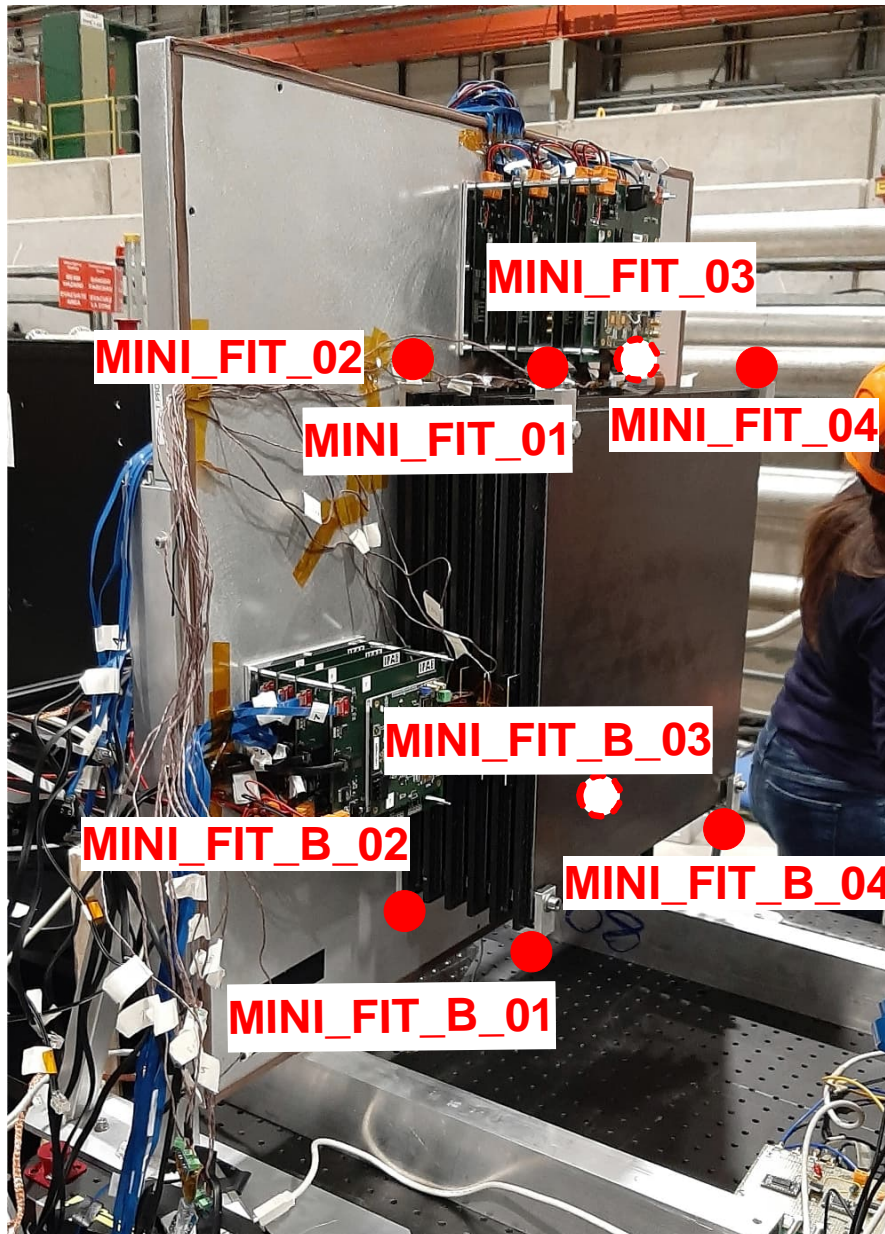


Figure 6: Distribution of point and points names on the Mini Fit detector

3.6 Support table (upstream)

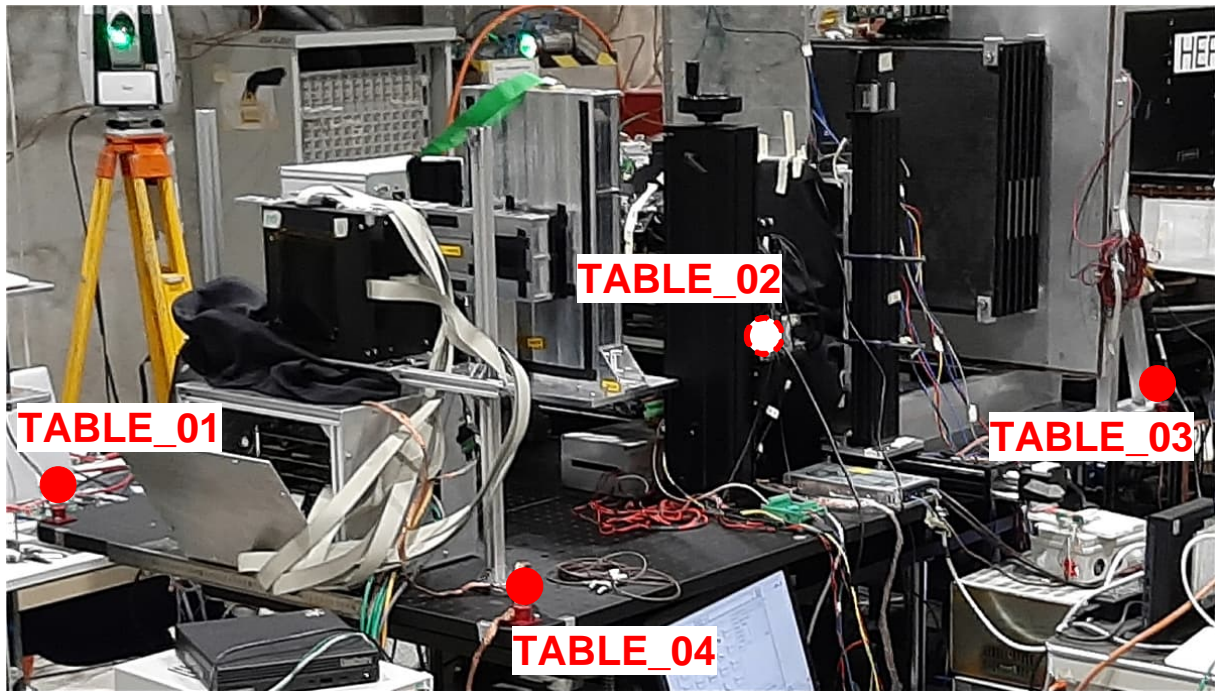


Figure 7: Distribution of points and point names on the support table (upstream)

3.7 Calorimeter and Support table (downstream)

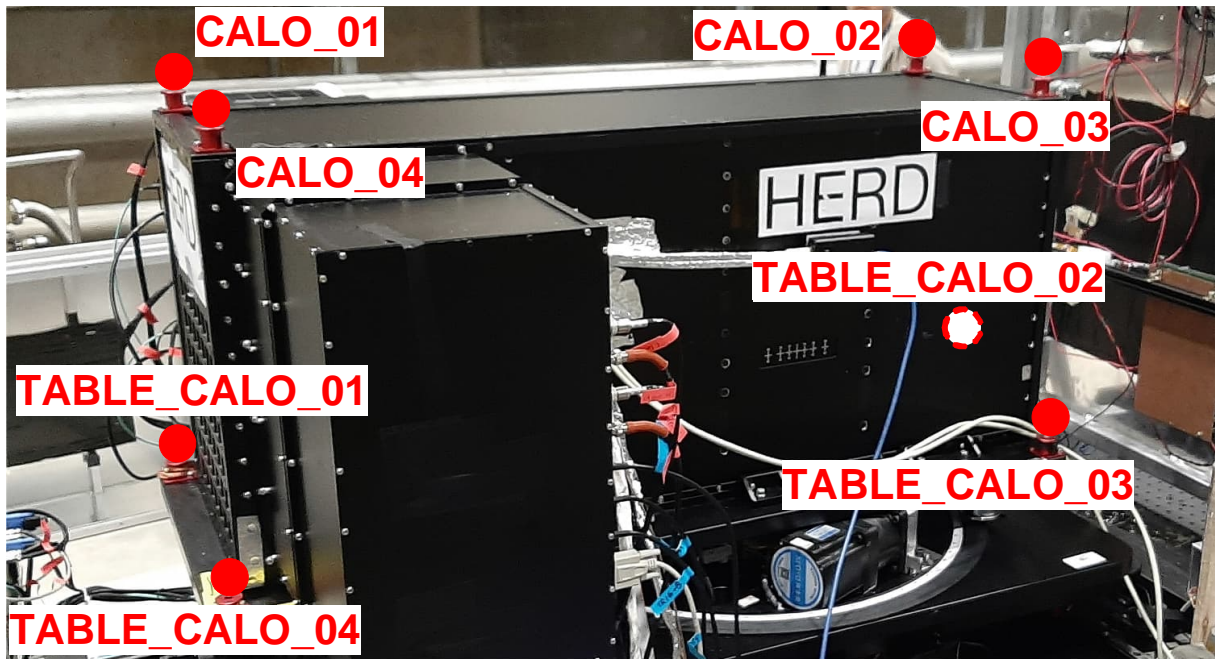


Figure 8: Distribution of point and points names on the Calorimeter and the calorimeter support table

4 SURVEY TARGET AND APPLIED ADAPTER

The measured points are situated on survey reference holes (8H7). The measured points of all items except the European PSD include a target offset of 20.0 mm in vertical direction - Z axis - with respect to the adapter contact surface as visible in Figure 9.

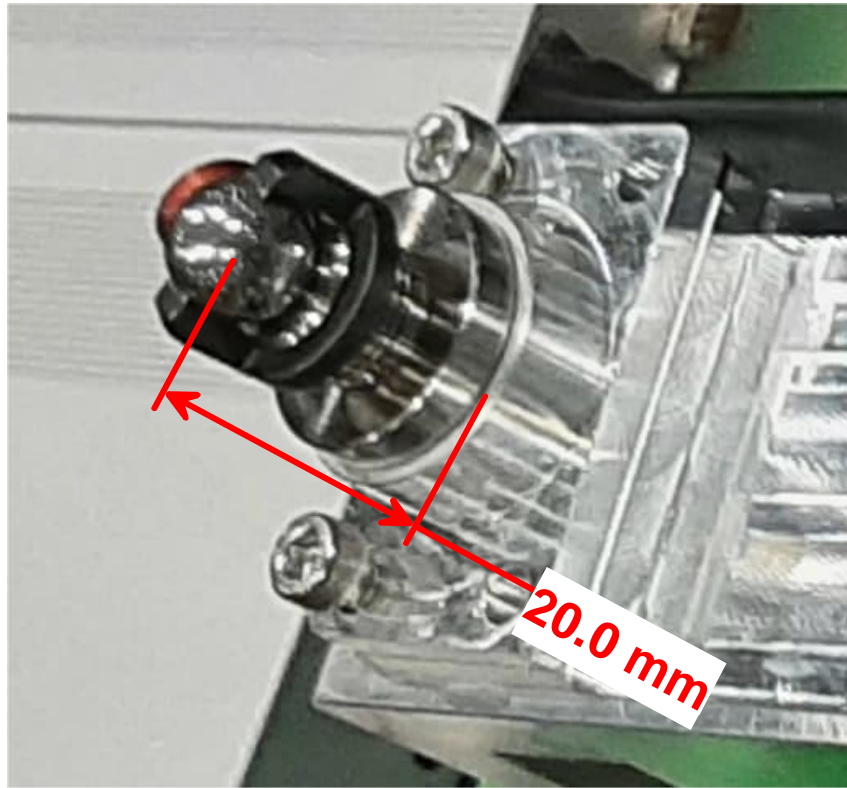


Figure 9: Target offset of 20.0 mm caused by the survey target and adapter

The European PSD the diameter of the reference holes has been too small and the pin of the target holder could not be inserted. Instead, the 0.5-inch spherical mounted retroreflector has been added directly on the 8 mm hole. This induces an offset of approximately 6 mm with respect to the contact surface.

5 RESULTS OF THE MEASUREMENT

In the table below, measured coordinates are given in the centre of the survey targets in the coordinate system as described in §2. Coordinates are given with precision **0.5 mm** at 1σ level.

The relative precision of the measurement of the HERD survey reference points can be expected to be at **0.15 mm** at 1σ level.

H4 Test beam area (Goliath)										
Measurement of HERD experiment (09.10.2023)										
	Measured coordinates			Correction for target offset			Corrected coordinates			Comment
Name	Xloc (m)	Yloc (m)	Zloc (m)	CorrX (m)	CorrY (m)	CorrZ (m)	Xloc (m)	Yloc (m)	Zloc (m)	
Trigger detector										
TRIGGER_01	21.7724	0.0608	0.1184	0.0000	0.0000	-0.0200	21.7724	0.0608	0.0984	Holes have a certain play
TRIGGER_02	22.1015	0.0722	0.1192	0.0000	0.0000	-0.0200	22.1015	0.0722	0.0992	Holes have a certain play
TRIGGER_03	22.1052	-0.0583	0.1183	0.0000	0.0000	-0.0200	22.1052	-0.0583	0.0983	Holes have a certain play
TRIGGER_04	21.7764	-0.0687	0.1181	0.0000	0.0000	-0.0200	21.7764	-0.0687	0.0981	Holes have a certain play
European SCD detector										
SCD_EU_01	22.6600	0.0818	0.1302	0.0000	0.0000	-0.0200	22.6600	0.0818	0.1102	
SCD_EU_02	22.7615	0.0814	0.1308	0.0000	0.0000	-0.0200	22.7615	0.0814	0.1108	
SCD_EU_03	22.7636	-0.1234	0.1298	0.0000	0.0000	-0.0200	22.7636	-0.1234	0.1098	
SCD_EU_04	22.6619	-0.1236	0.1302	0.0000	0.0000	-0.0200	22.6619	-0.1236	0.1102	
IHEP SCD detector										
SCD_IHEP_01	23.1516	0.1222	0.2734	0.0000	0.0000	-0.0200	23.1516	0.1222	0.2534	
SCD_IHEP_02	23.1534	-0.1035	0.2730	0.0000	0.0000	-0.0200	23.1534	-0.1035	0.2530	
IHEP PSD detector										
PSD_IHEP_01	23.3995	0.0580	0.0747	0.0000	0.0000	-0.0200	23.3995	0.0580	0.0547	
PSD_IHEP_02	23.3989	-0.0654	0.0748	0.0000	0.0000	-0.0200	23.3989	-0.0654	0.0548	
European PSD detector										
PSD_EU_01	23.5764	0.1174	0.1351	0.0000	0.0000	-0.0060	23.5764	0.1174	0.1291	0.5 inch prism directly, offset approximately -6 mm

PSD_EU_02	23.5864	-0.2210	0.1455	0.0000	0.0000	-0.0060	23.5864	-0.2210	0.1395	0.5 inch prism directly, offset approximately -6 mm
Mini Fit EPFL										
MINI_FIT_01	24.0311	0.1722	0.3043	0.0000	0.0000	-0.0200	24.0311	0.1722	0.2843	
MINI_FIT_02	24.1702	0.1713	0.3048	0.0000	0.0000	-0.0200	24.1702	0.1713	0.2848	
MINI_FIT_03	24.1694	-0.2486	0.3063	0.0000	0.0000	-0.0200	24.1694	-0.2486	0.2863	
MINI_FIT_04	24.0302	-0.2479	0.3057	0.0000	0.0000	-0.0200	24.0302	-0.2479	0.2857	
MINI_FIT_B_01	24.0327	0.1692	-0.2184	0.0000	0.0000	0.0200	24.0327	0.1692	-0.1984	
MINI_FIT_B_02	24.1725	0.1696	-0.2179	0.0000	0.0000	0.0200	24.1725	0.1696	-0.1979	
MINI_FIT_B_03	24.1719	-0.2488	-0.2166	0.0000	0.0000	0.0200	24.1719	-0.2488	-0.1966	
MINI_FIT_B_04	24.0325	-0.2489	-0.2170	0.0000	0.0000	0.0200	24.0325	-0.2489	-0.1970	
Support table upstream										
TABLE_01	22.5980	0.4846	-0.3441	0.0000	0.0000	-0.0200	22.5980	0.4846	-0.3641	base structure
TABLE_02	24.3223	0.4821	-0.3452	0.0000	0.0000	-0.0200	24.3223	0.4821	-0.3652	base structure
TABLE_03	24.3206	-0.4432	-0.3447	0.0000	0.0000	-0.0200	24.3206	-0.4432	-0.3647	base structure
TABLE_04	22.5958	-0.4409	-0.3438	0.0000	0.0000	-0.0200	22.5958	-0.4409	-0.3638	base structure
Support table downstream (calorimeter)										
TABLE_CALO_01	24.5626	0.2015	-0.1169	0.0000	0.0000	-0.0200	24.5626	0.2015	-0.1369	base structure
TABLE_CALO_02	25.6267	0.1955	-0.1185	0.0000	0.0000	-0.0200	25.6267	0.1955	-0.1385	base structure
TABLE_CALO_03	25.6253	-0.2194	-0.1178	0.0000	0.0000	-0.0200	25.6253	-0.2194	-0.1378	base structure
TABLE_CALO_04	24.5601	-0.2125	-0.1158	0.0000	0.0000	-0.0200	24.5601	-0.2125	-0.1358	base structure
Calorimeter detector										
CALO_01	24.5695	0.1354	0.3537	0.0000	0.0000	-0.0200	24.5695	0.1354	0.3337	
CALO_02	25.5874	0.1313	0.3523	0.0000	0.0000	-0.0200	25.5874	0.1313	0.3323	
CALO_03	25.5859	-0.1506	0.3530	0.0000	0.0000	-0.0200	25.5859	-0.1506	0.3330	
CALO_04	24.5687	-0.1464	0.3545	0.0000	0.0000	-0.0200	24.5687	-0.1464	0.3345	