

Operation manual for the crystal array sub- system  
of HERD full- functional prototype at CERN Beam Test  
2021 (V0.1)

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## 1 Introduction

### 1.1 Introduction of the crystal array sub- system

Crystal array contains 525 LYSO cubes, WLSFs, PDs ,WLSF connectors, CRFP frames, lead plate, Al box and so on.

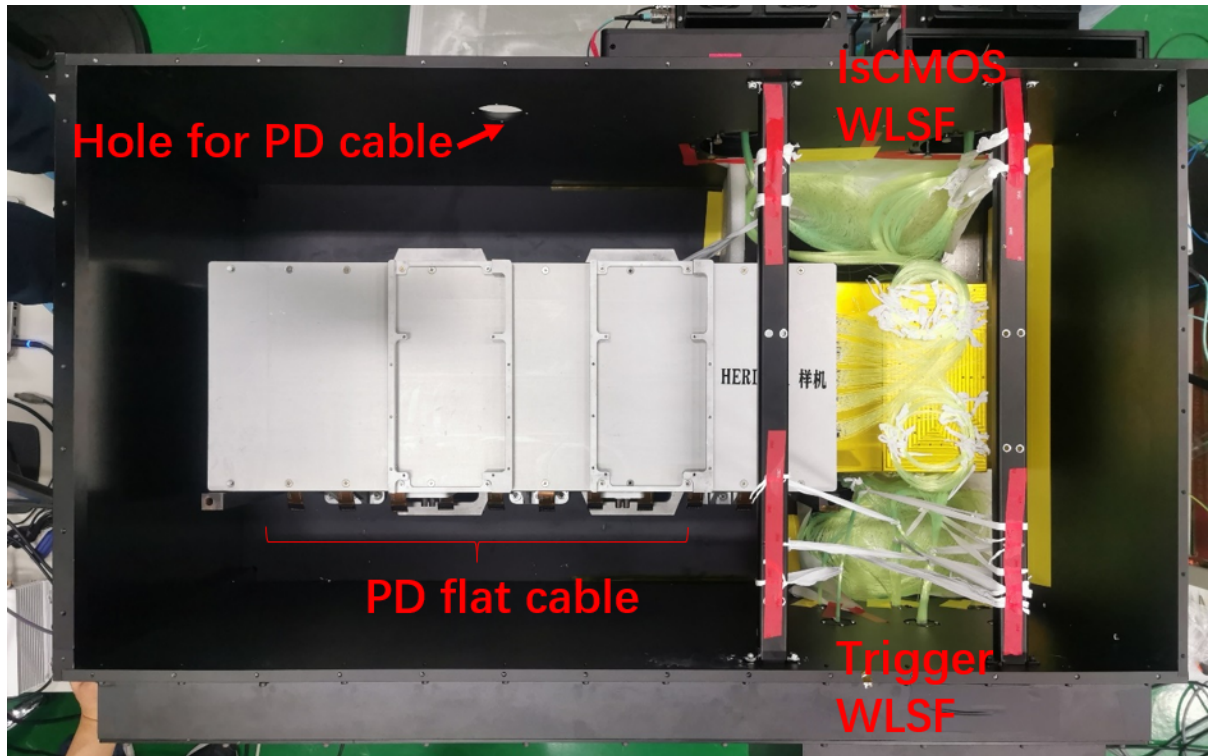


Figure 11 Illustration of crystal array sub- system removed lead plate

Table 11 Device list of crystal array sub- system

No.	Device name	number	Function
1.	LYSO with WLSF readout	462	Energy deposition and WLSF readout
2.	LYSO with WLSF and PD readout	63	Energy deposition and WLSF &PD readout
3.	IsCMOS WLSF connector	2	Transfer light from WLSF to IsCMOS
4.	Trigger WLSF connector	6	Transfer light from WLSF to trigger PMT
5.	CRFP frame	7	Support LYSO ,WLSF, PD and accessories
6.	lead plate	2	LYSO spontaneous radioactive shielding

7.	Al box	1	Support crystal array and light shielding
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## 1.2 Purposes of BT for crystal array sub- system

Particle energy deposition and scintillation light transformation from LYSO to IsCMOS, trigger and PD system.

## 2 Hardware

### 2.1 Unpacking

All components needed to be moved are labeled with tags, the details are listed in the following table.

Table 2 1 All components need to be moved in crystal array

Label	Name	Weight/kg	Function
Cry- 1	Top plate of box	28	Light shield
Cry- 2	Large lead plate	28	LYSO ' s gamma shield
Cry- 3	Incident Al plate	-	Light shield
Cry- 4	Incident lead plate	10	LYSO ' s gamma shield
Cry- 5	Parts for PD	-	PD installation

The procedure of unpacking crystal array are as follows:

1. Remove all screws on the top plate of Al box, the number of screws is about 45 pieces.

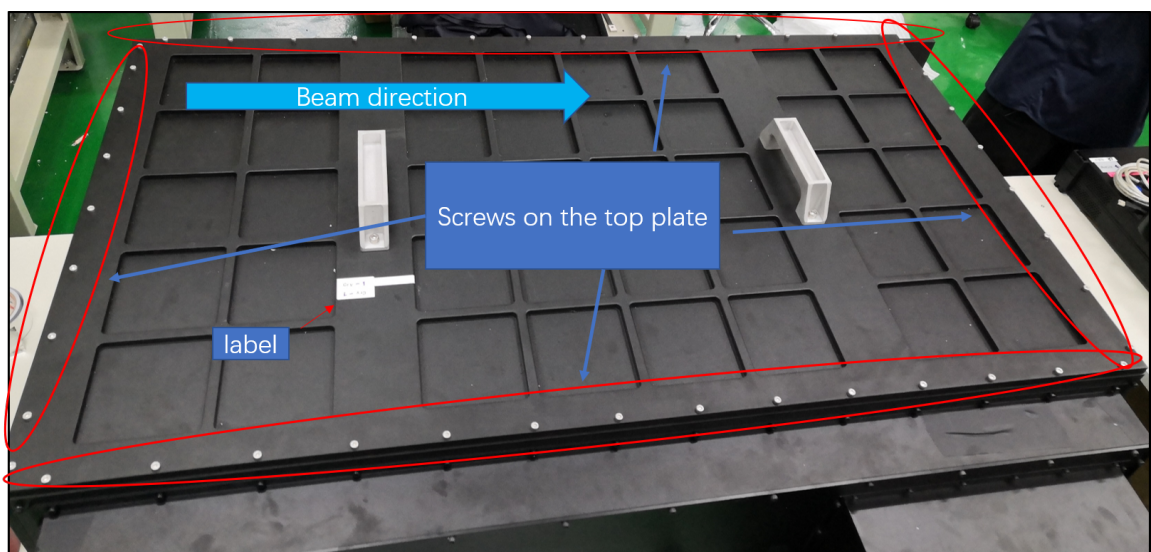


Figure 2 1Top of view of Al box

2. Remove the top plate. It is highly recommended that 4 people lift it together

and avoid impact on box.

3. After finishing the last procedure, you will see the following figure. Take off Cry- 5 which bundled around front handle.



Figure 2 2 lead plate over crystal array

4. Remove four pieces of blue tape that cover four retaining screws, then remove four retaining screws. Each screw covered with two different sizes of gaskets, and will be used for packing.
5. Move the lead plate toward the incident side panel, 2 cm gap is commended.
6. Remove the lead plate. The lead plate should be lifted at a specific angle with horizontal plane, because the lead plate length is longer than the exit length above crystal array. At the operational level, the height of front handle must be higher than the rear handle. It is highly recommended that 4 people lift it together and avoid impact on box.
7. Install PD electronics and protect WLSF from touch.
8. After finishing PD electronics cable connection, cover the hole with four install screw holes by opaque material.

9. Cover the top plate of box and mount screws. The top plate is not symmetrical. In the correct installation, the incident side panel is nearer the tag cry- 1 than rear side panel. Please refer to Figure 2 1

## **2.2 On- site transportation and connection**

### **2.3 Packing**

1. Remove all screws on the top plate of Al box, the number of screws is about 45 pieces. Please refer to Figure 2 1.
2. Remove the top plate. It is highly recommended that 4 people lift it together and avoid impact on box.
3. Uninstall PD electronics boards and protect WLSF from touch.
4. Check the lead plate at proper shape. Put lead plate over crystal array. The lead plate should be lifted at a specific angle with horizontal plane, because the lead plate length is longer than the exit length above crystal array. At the operational level, the height of front handle must be higher than the rear handle.
5. Adjust the lead plate position, and make sure the red cross position mark is on correct position. Please refer to Figure 2 2. Install four screws containing two sizes of gaskets, then fix them with tapes.
6. Remove half of screws evenly on the incident side panel, then install incident lead plate with the half of screws. please refer to the direction in the following figure.



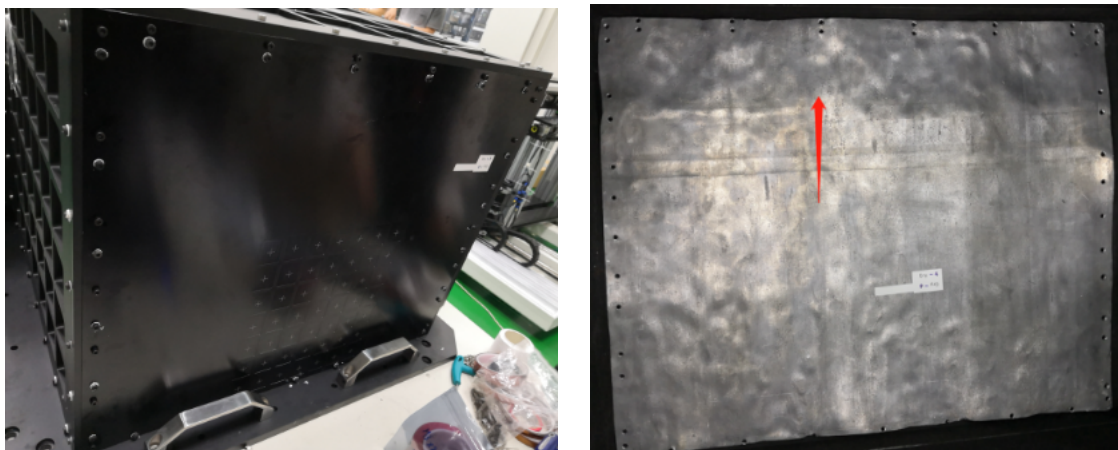


Figure 2 3 incident side Al panel and lead panel

7. Cover the top plate of box and mount screws. The top plate is not symmetrical. In the correct installation, the incident side panel is nearer the tag cry- 1 than rear side panel. Please refer to Figure 2 1.
8. Cover the hole for PD cable pass through with tape.

## 2.4 Preparation before radioactivity detection

After crystal array packing, the radioactivity level near the box is about 1.5- 2 times as public background. Transport box is needed to install before CERN radioactivity detection. Please call for CERN radioactivity detection after transport box installation!

The following is the picture of transport box. Two marks labeled on the box help us to install transport box in right position. No screws are required only on the side that printed project name(“HERD”) with Chinese and English, as right picture shows in following figure.

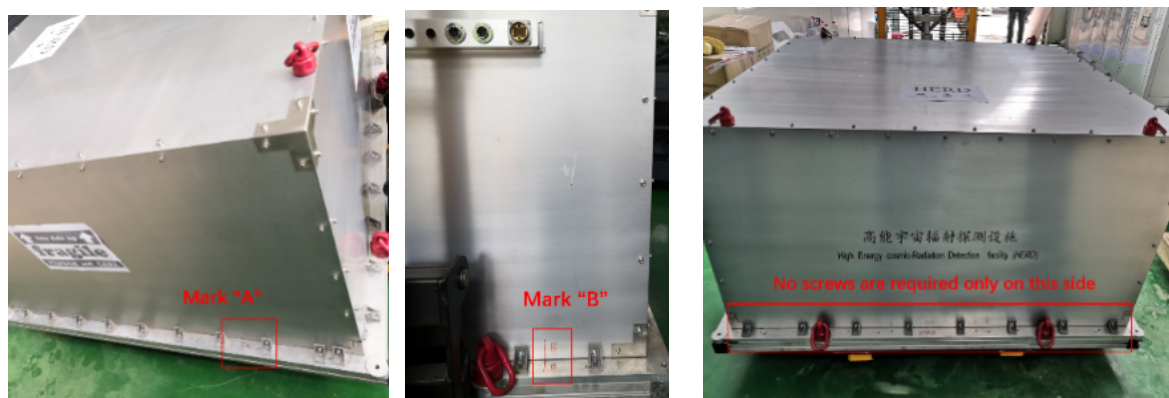


Figure 2 4 transport box of CALO prototype

### **3 Control software**

#### **3.1 Introduction**

#### **3.2 Normal operations**

##### **3.2.1 Pre- test outside the beam area before beam test**

##### **3.2.2 Particle run**

##### **3.2.3 Calibration run**

##### **3.2.4 Test outside the beam area after beam test**

#### **3.3 Abnormal operations**

Operations in case of errors.

##### **3.3.1.1 Sub title 4**

### **4 Conclusion**