

# 3D Display of Events on a Stack of CCDs and OSCURA MCMs Copper Box Redesign

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## What is OSCURA?

- OSCURA aims to construct a 10 kg experiment using ultralow readout noise silicon Charged-Coupled Devices (skipper-CCDs) to probe electron recoils from sub-GeV dark matter.

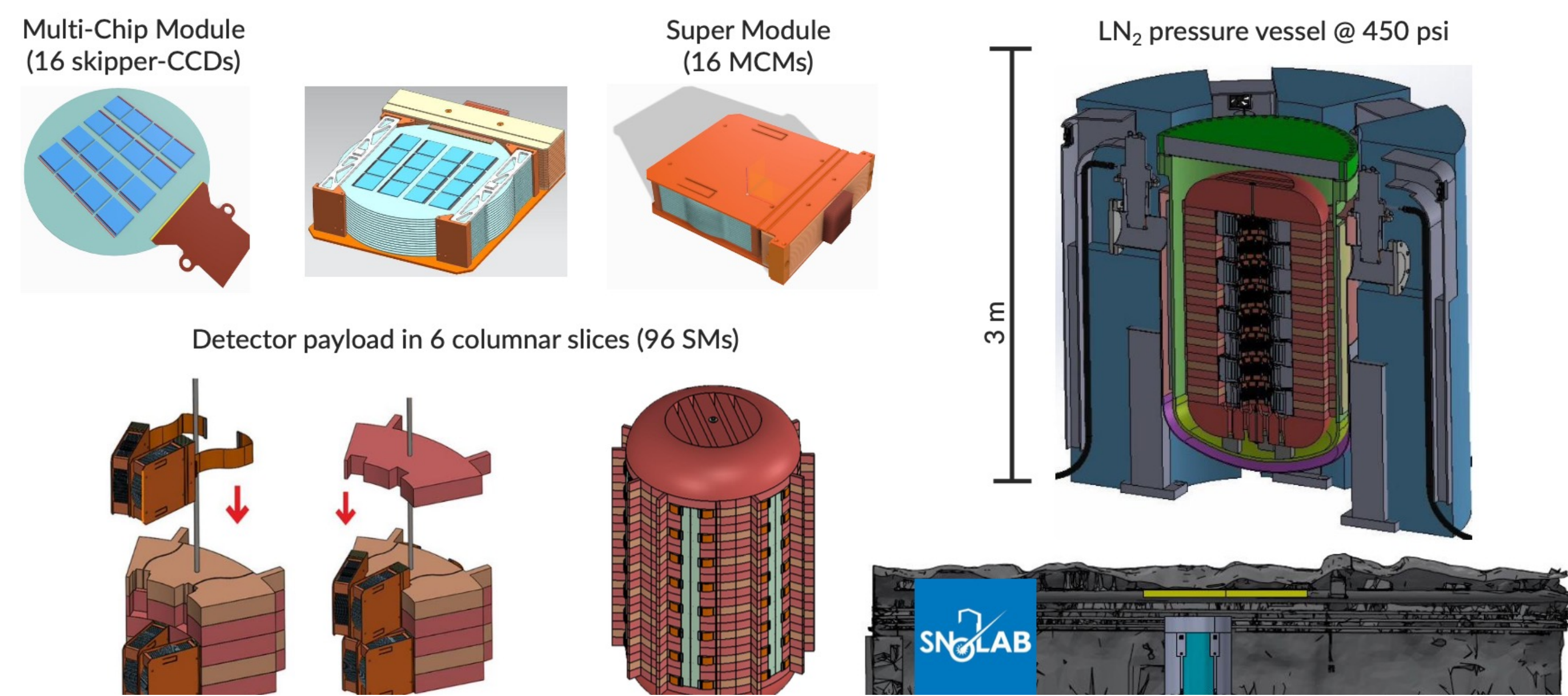


Fig. (1.1) Future OSCURA 10Kg Skipper-CCD Experiment

## CCDs (Charge-Coupled Devices)

- CCDs are advanced semiconductor devices used in imaging, including Dark Matter research.
- They convert particle interactions into electrical charge.
- Charge is read out sequentially pixel by pixel, converting analog signals into digital data as high-quality digital images.

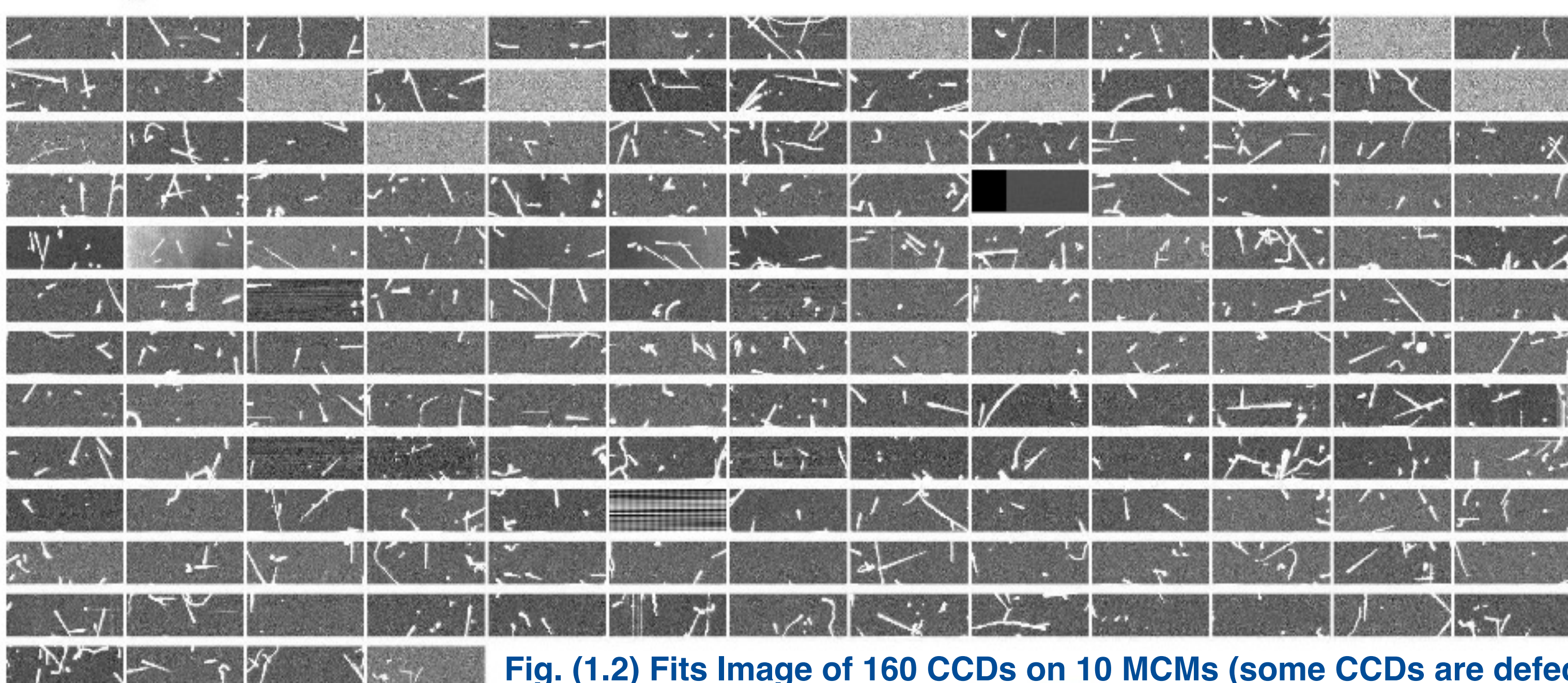


Fig. (1.2) Fits Image of 160 CCDs on 10 MCMs (some CCDs are defective)

## Implementing 3D Display of Events

OSCURA testing setup consists of 10 MCMs and 160 CCDs (Fig. 1.5) where two steps were needed to display events in 3D:

- Images were processed using "skipper2root" tool and developed a new algorithm to display events in 3D, using accurate CCD dimensions.
- A new algorithm was implemented on the data using CERN root, resulting in the display of multiple events in the OSCURA testing setup, including muons, electrons, and photons.

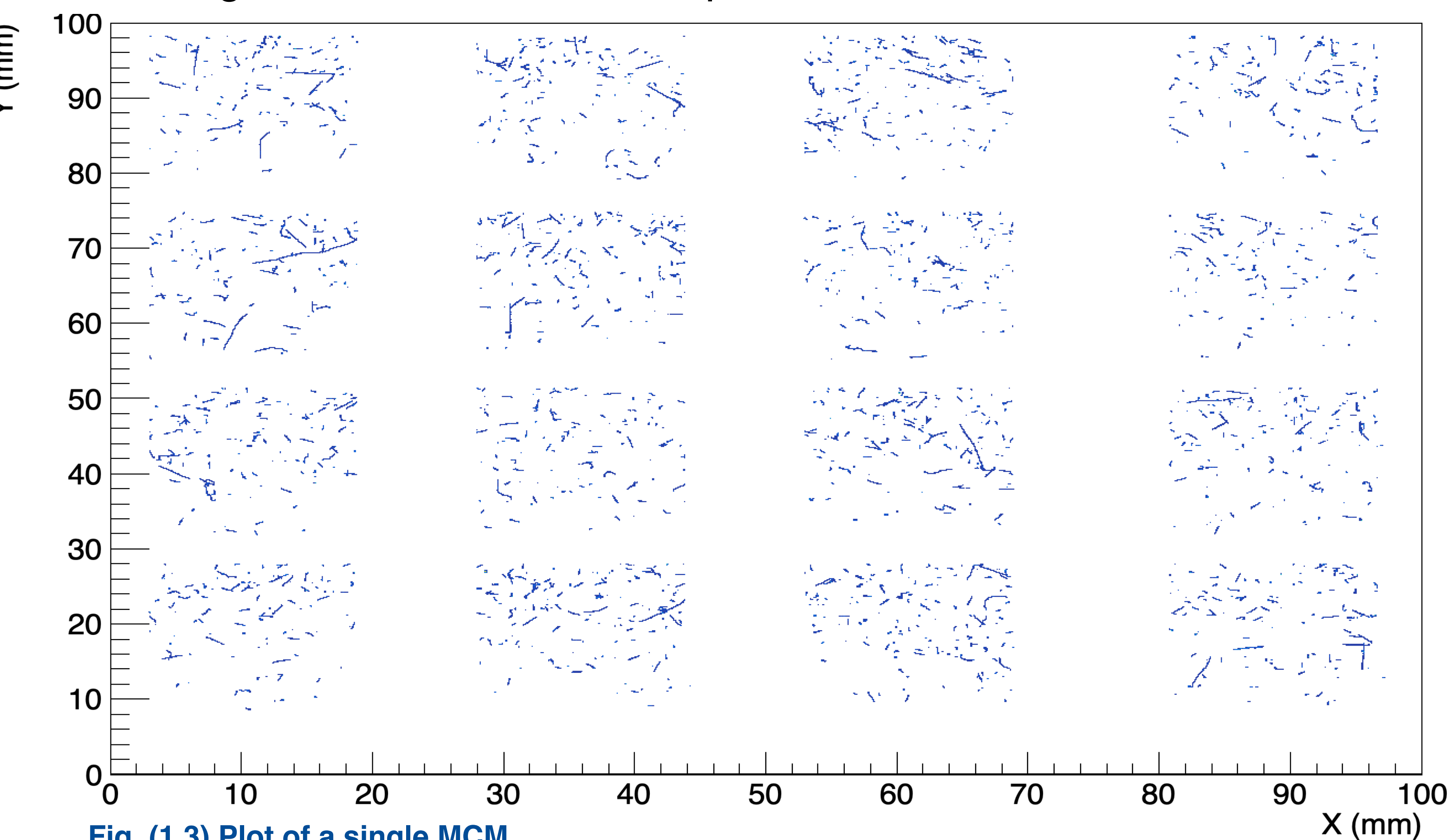


Fig. (1.3) Plot of a single MCM

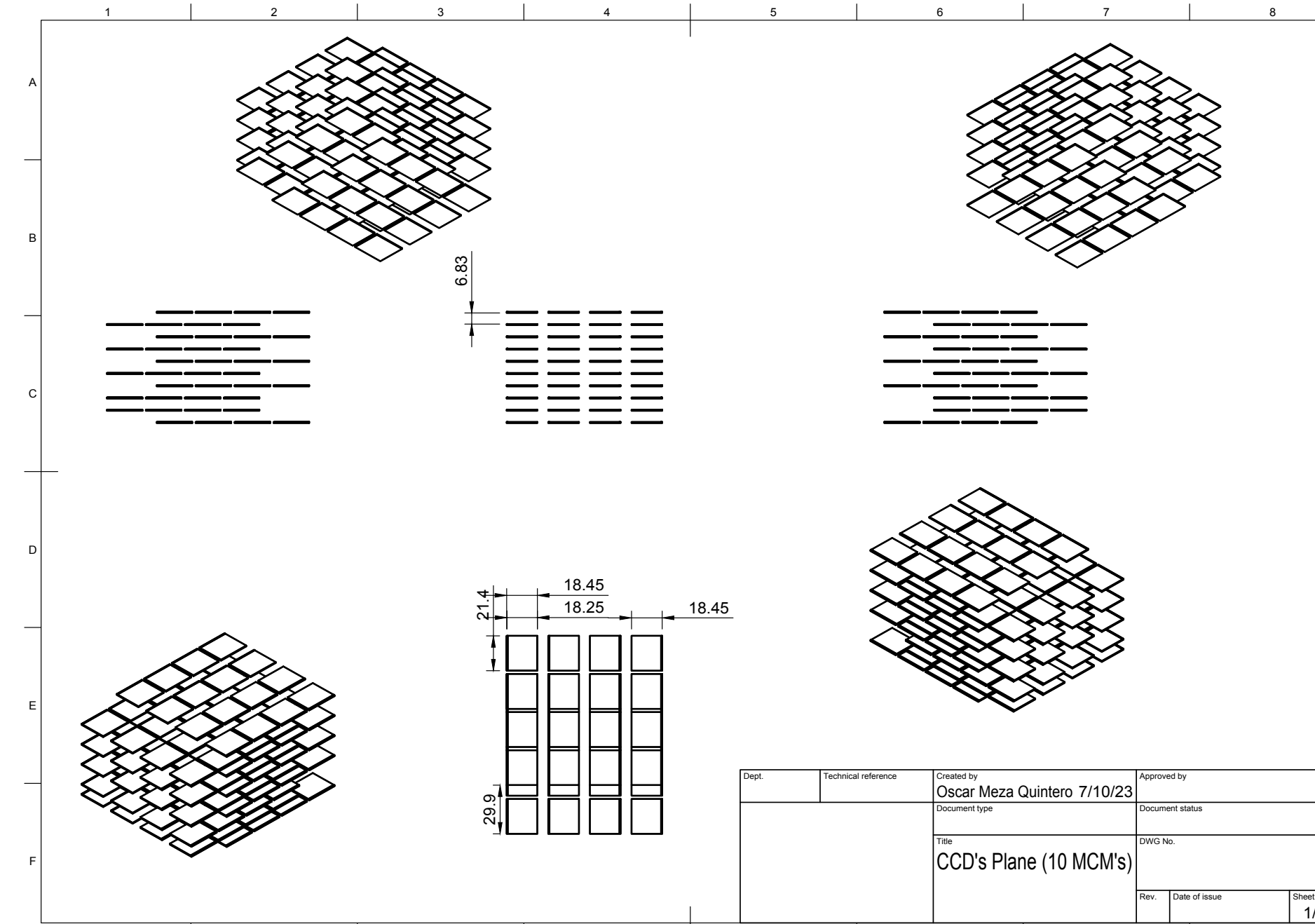


Fig. (1.4) Mapping of the CCDs inside the OSCURA testing setup

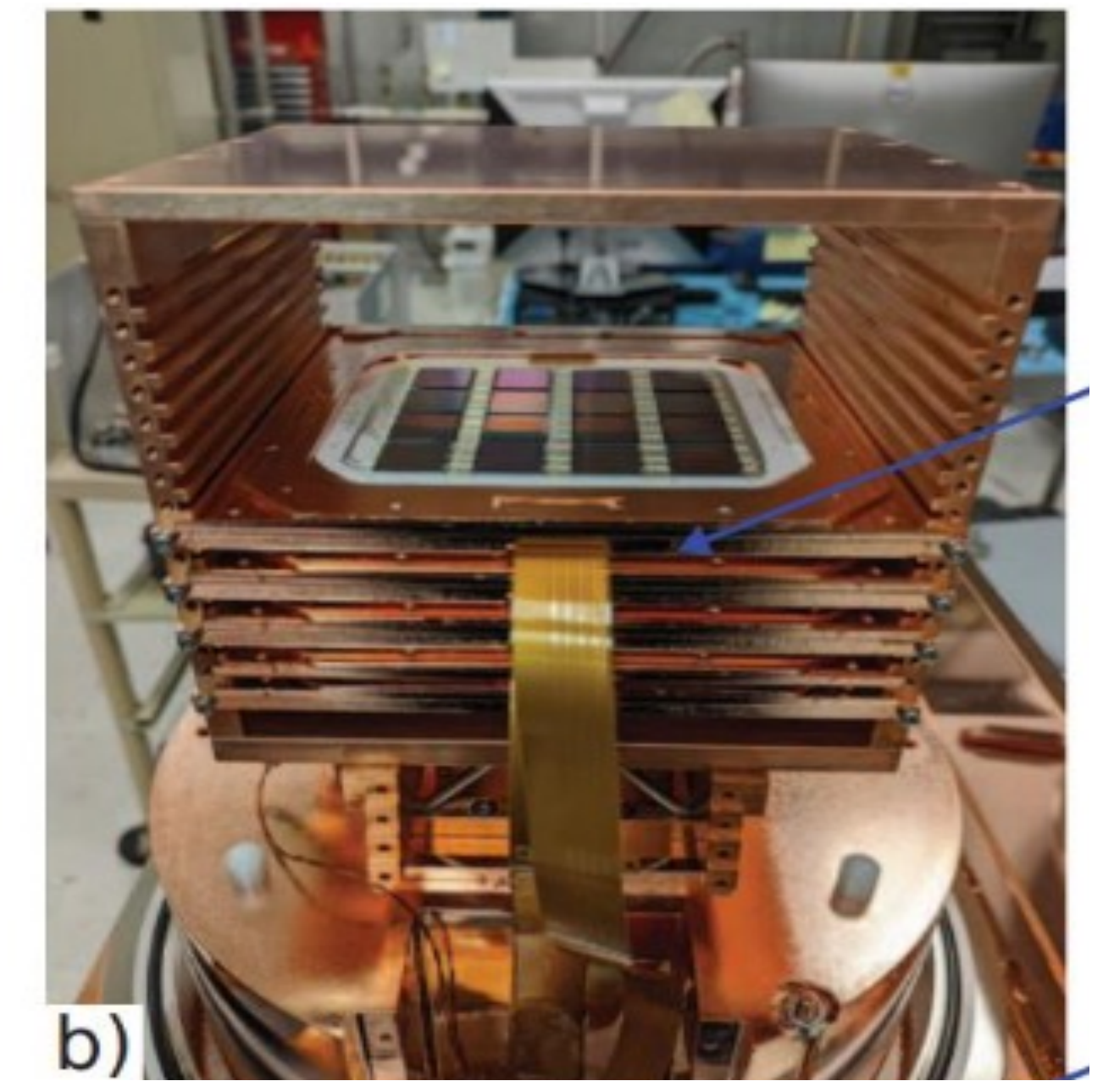


Fig. (1.5) Image of OSCURA testing Setup

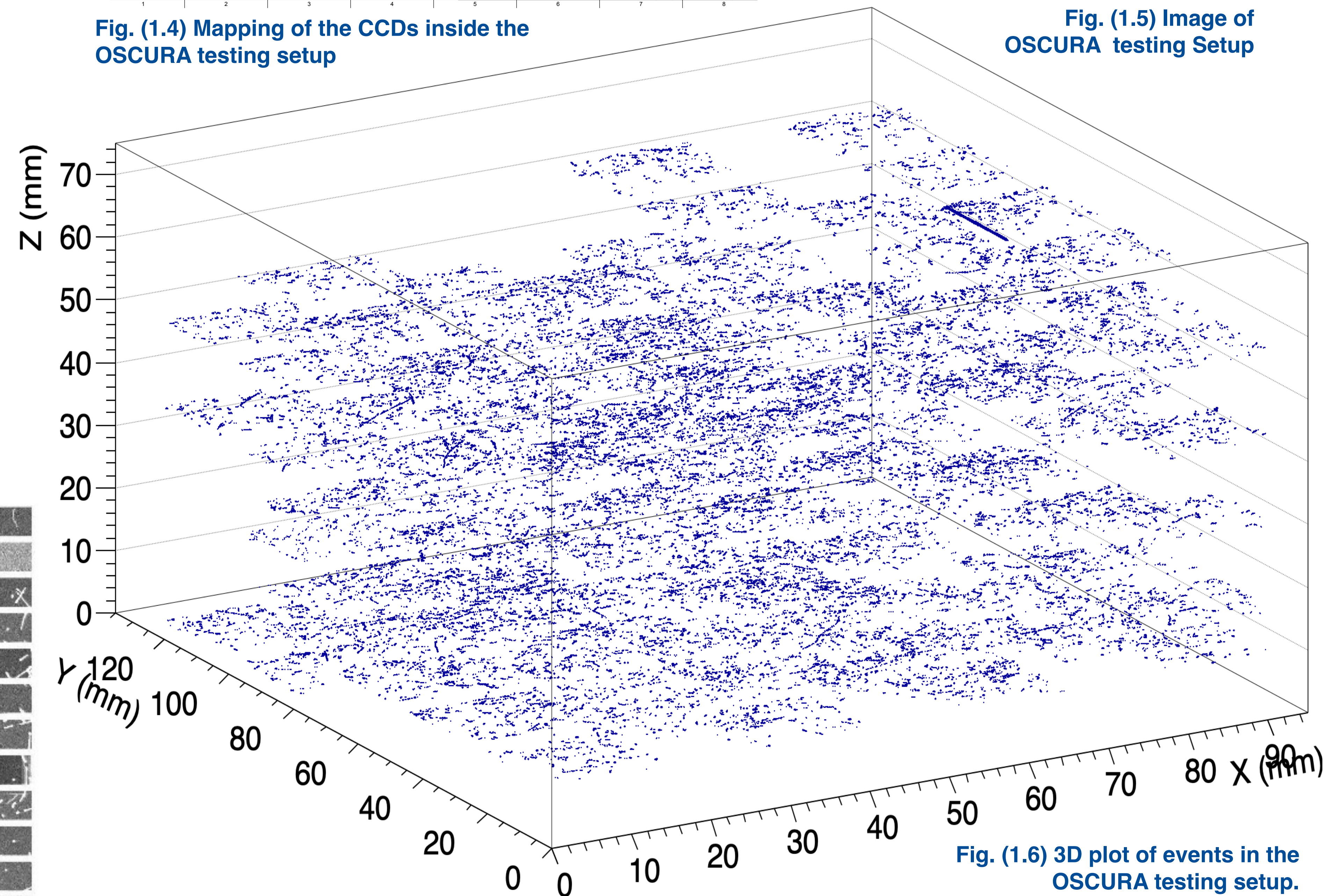


Fig. (1.6) 3D plot of events in the OSCURA testing setup.

## Copper Box Redesign

- The setup's copper box was originally in a horizontal orientation (Figure 1.4).
- A new design is needed reorienting vertically the MCMs planes for beam usage.
- The copper box was redesign using Fusion 360 CAD software, allowing it to accommodate up to 21 MCMs while meeting all dimensional requirements.

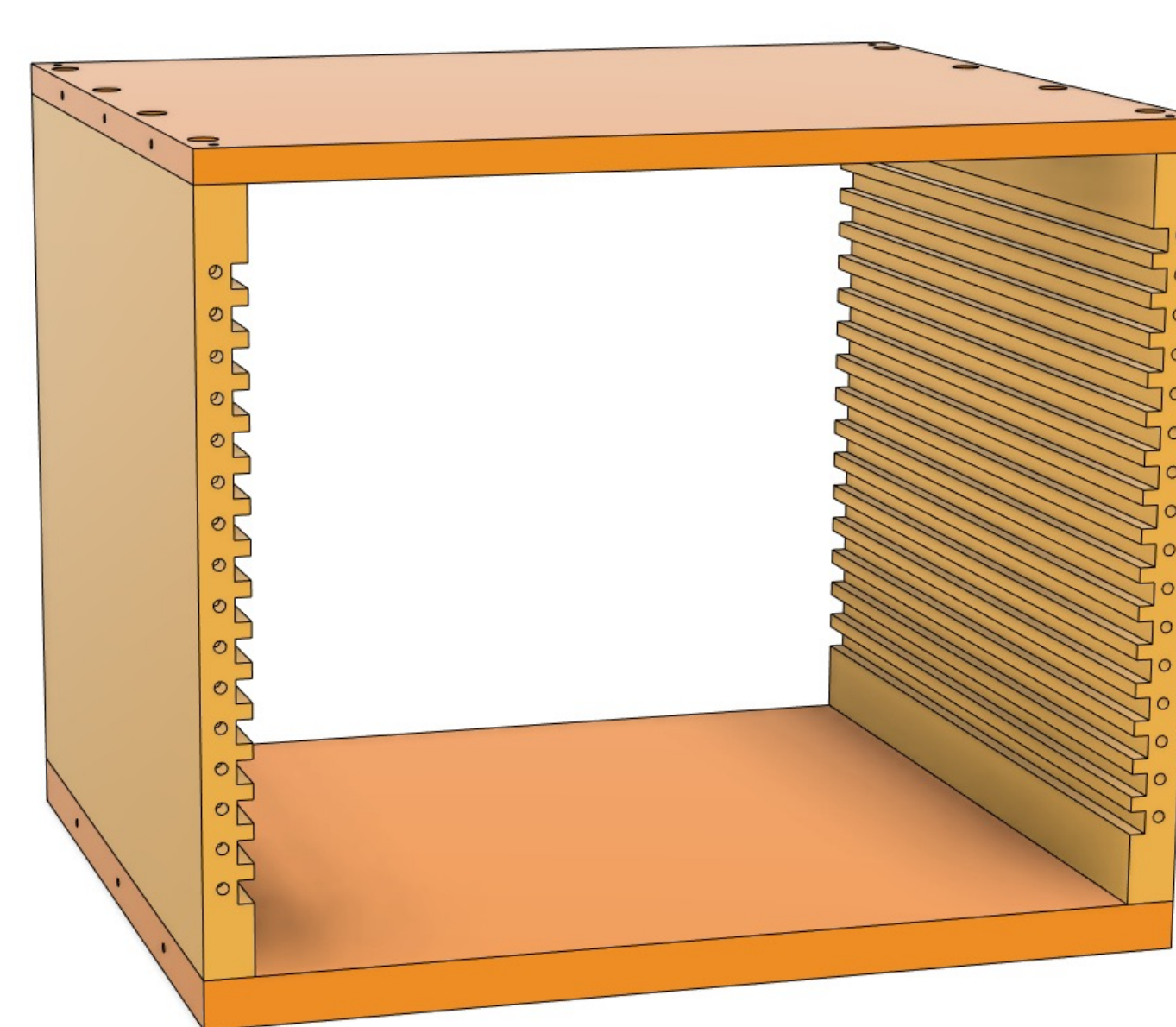


Fig. (1.7) Current copper box of the OSCURA testing setup.

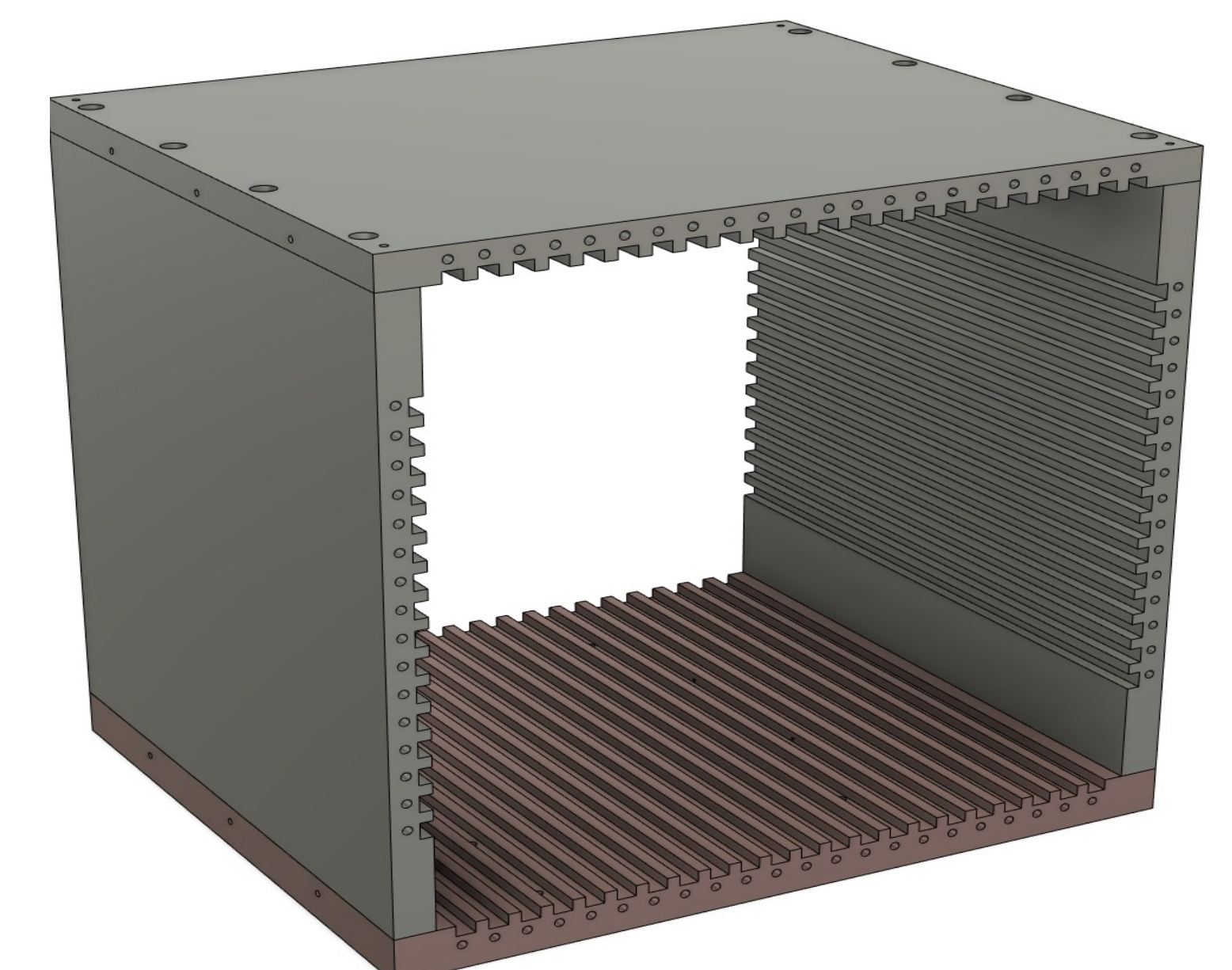


Fig. (1.8) Redesigned copper box

## Future Implementations beyond OSCURA

- The redesigned copper box can be used to develop a tracker with multiple sensor layers to search for millicharged particles (mCPs) in accelerator facilities.
- Display events in 3D (Figure 1.6) is the initial step towards developing advanced tools for analyzing 3D images, with the aim of improving particle tracking while reducing background events.

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