A Drift Chamber Tracker for SAND –

Mechanical Design

DUNE-Italia Collaboration Meeting, Ferrara
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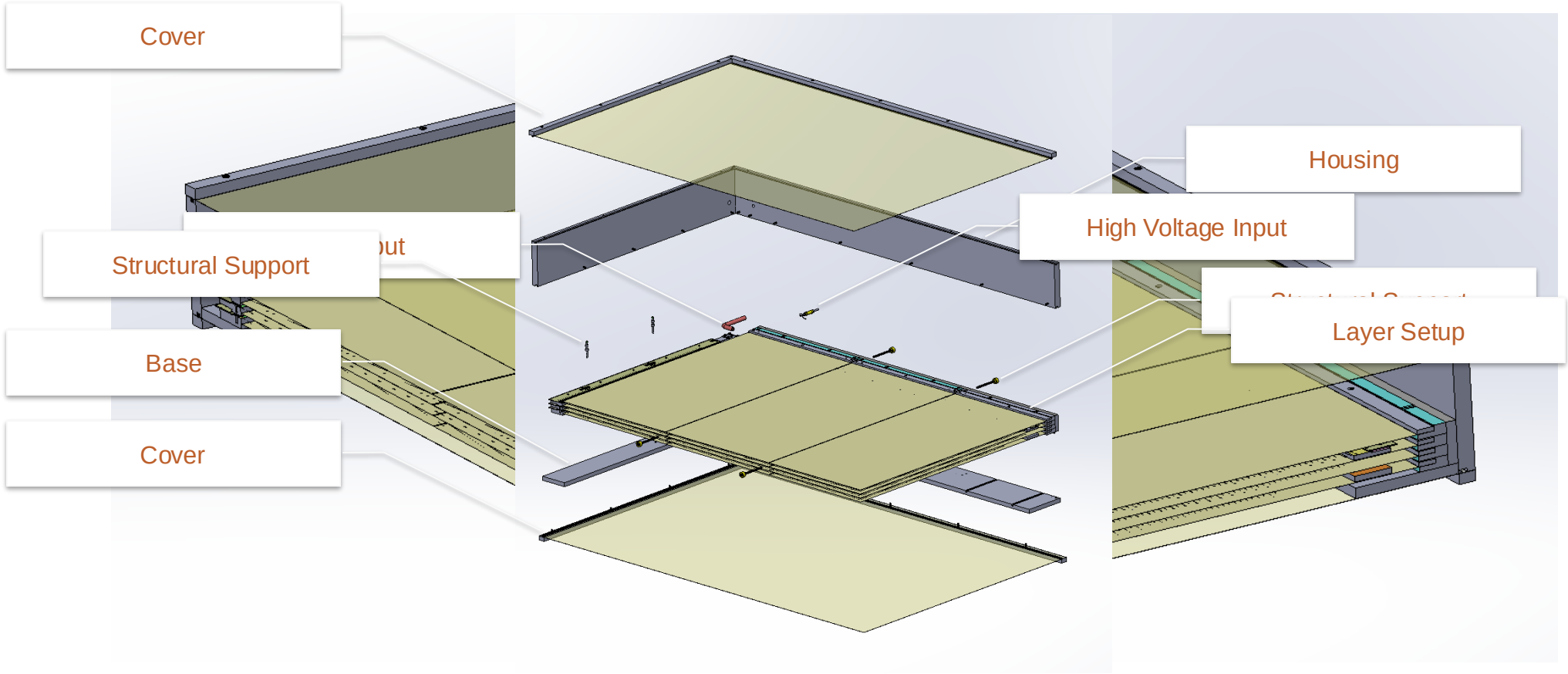
Cross-section of the complete Drift Chamber



Layer Setup

Effective Measurement Area: 1200 x 800 mm

4 Mylar Layers

Distance between alternating layers: 6 mm

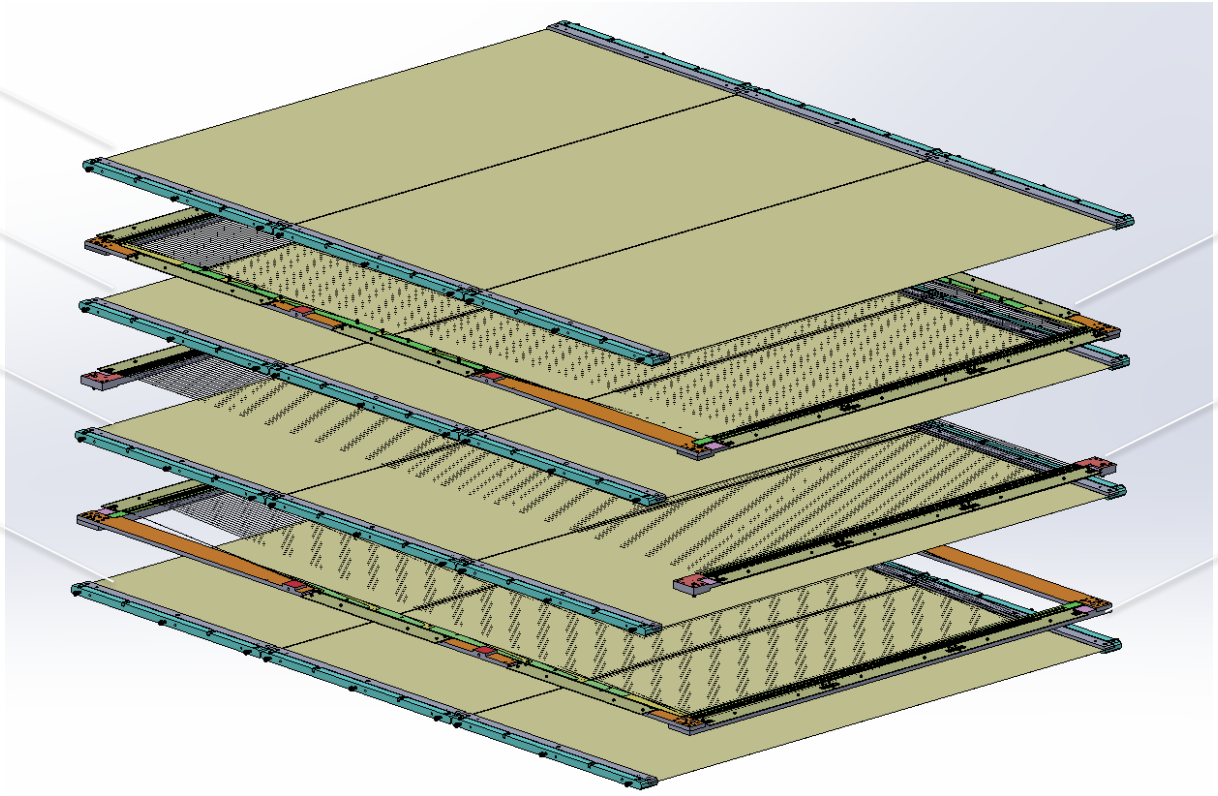
3 Wire Layers

Mylar Layer

Mylar Layer

Mylar Layer

Mylar Layer



-5° Wire Layer

0° Wire Layer

5° Wire Layer

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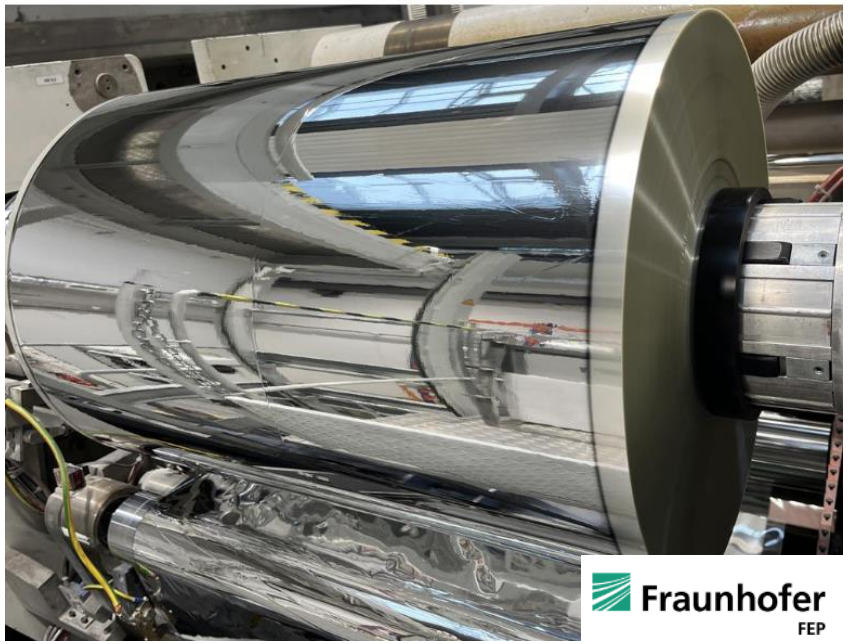
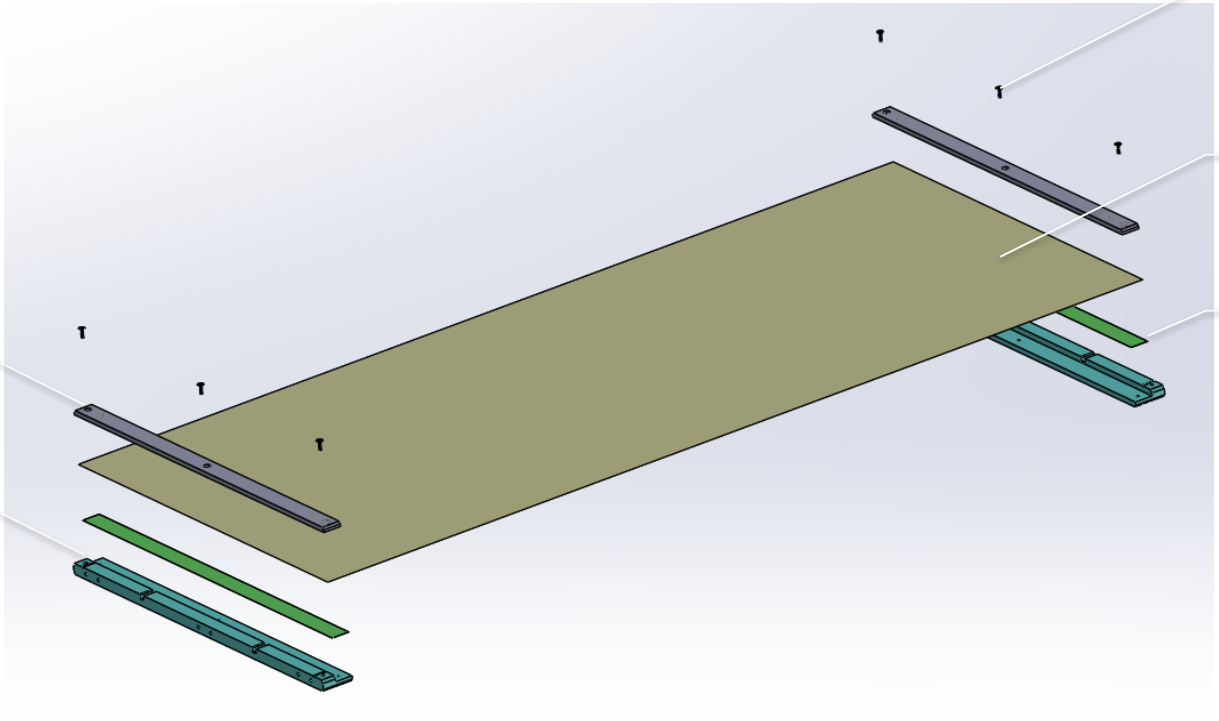
MYLAR LAYER

Mylar Layer – Foil

- The Mylar films provided by Fraunhofer are 19 µm thick PET films, coated on both sides with an approximately 70 nm thick layer of aluminum.
- Since the roll is about 0.4 meters wide, three films are required to cover the measurement area.

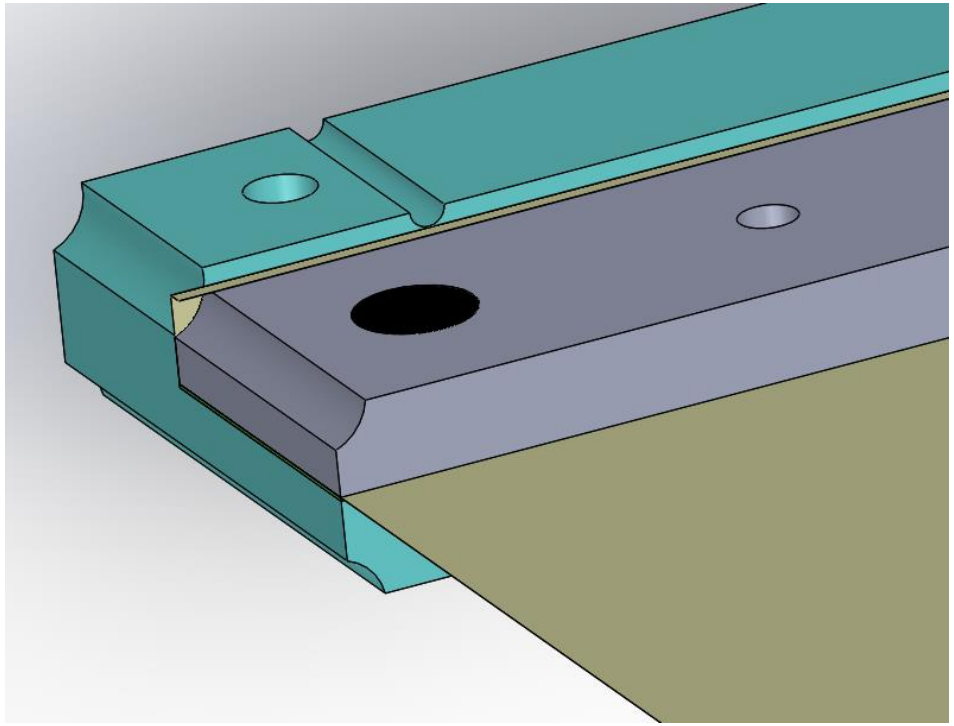


Mylar Layer - Setup



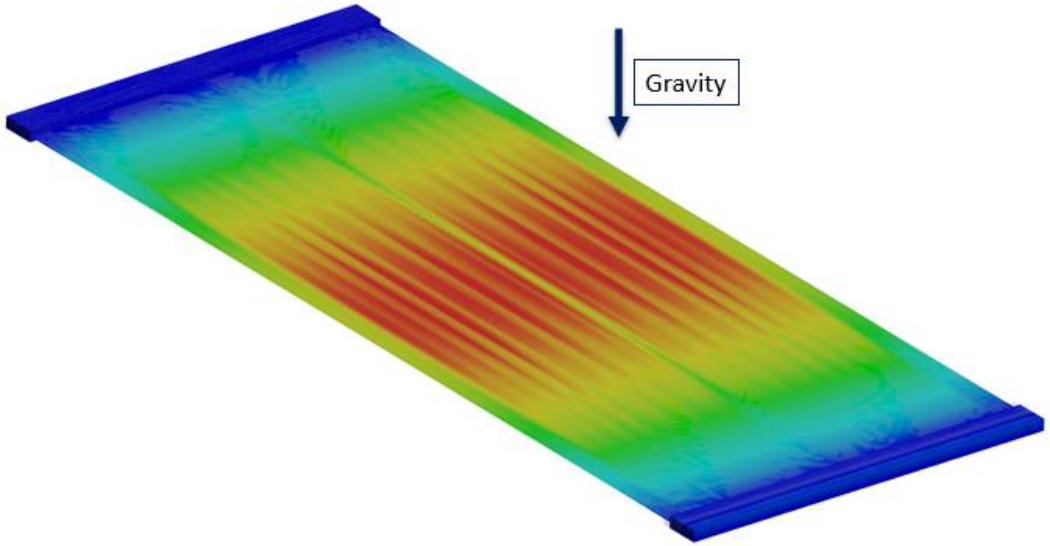
Mylar Layer – Foil

- The foil is attached to the lower plate of the clamping device using double-sided tape.
- Next, an aluminum alloy plate is screwed in place, through which high voltage is applied.
- To apply voltage to both sides of the film, the Mylar is folded over and adhered to the aluminum alloy plate.



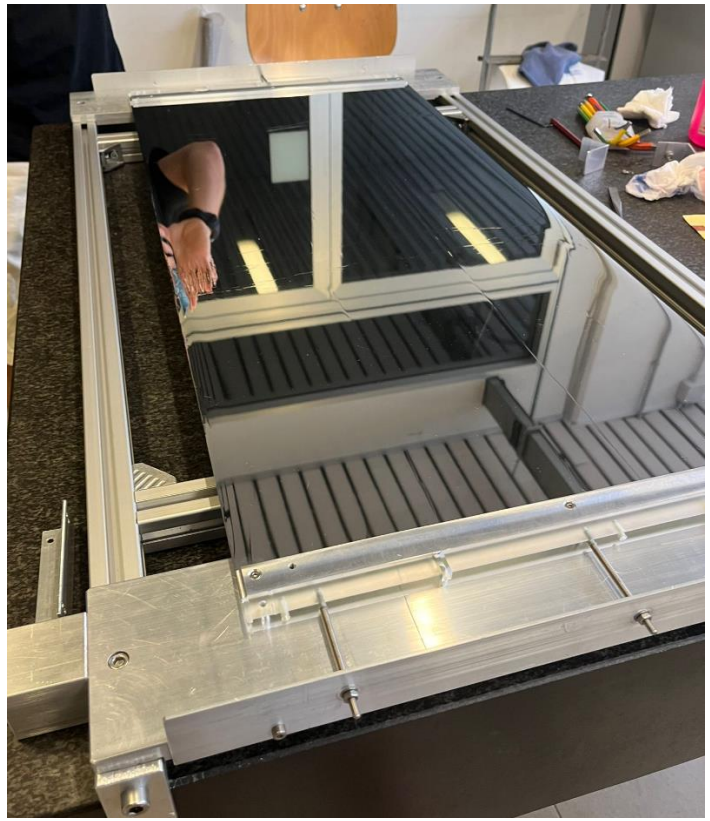
Mylar Layer – Pre-tensioning in horizontal setup

- To achieve a plane foil, it must be pre-tensioned.
- In the horizontal setup gravitational forces cause bulging at the free edges and in the center.
- By stretching these bulges are reduced a few µm in depth .
- However, if the Mylar is over-tensioned, the material begins to wrinkle.



Mylar Layer – Horizontal Pretension Test

- In a test setup, the assembly process was evaluated.
- Additionally, the pretension distance required for foil to achieve flatness was determined.
- The results indicated that a pre-tensioning distance of approximately 2 mm was ideal.



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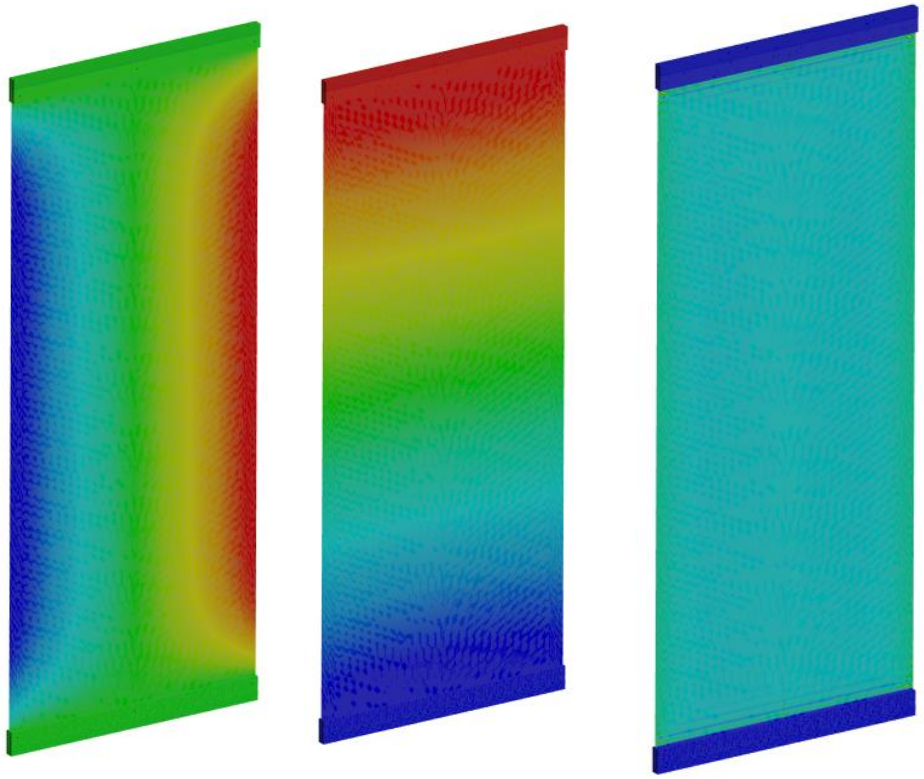
Mylar Layer – Pre-tensioning in vertical setup

- When the clamping device is positioned vertically, no bulging occurs in the material, and it. remains flat
- Based on this observation, it will be tested whether the pre-tensioning of the Mylar can be achieved solely through gravitational force.
- Until then, the prototype should be constructed so that the Mylar is tensioned to a fixed distance.



Mylar Layer – Vertical CreepTest

- Since the film is now under constant tension, it will experience creep over time. Creep refers to the permanent deformation of a material.
- A creep test will be conducted in the near future.
- The clamping device with the film will be hung vertically, and its deformation will be measured at regular intervals.

WIRE LAYER

Wires

- Ø 100 µm Field Wire (FW) of a Copper Beryllium Alloy
- Ø 20 µm Sens Wire (SW) of gold-plated Tungsten

Images are for guidance only and might not represent the final product.

Copper/Beryllium Alloy Spooled Wire (Cu98/Be 2)

Copper/Beryllium Alloy Spooled Wire (Cu98/Be 2) is a metal alloy product offered by Goodfellow within their extensive range of over 224 variations. This wire combines the high strength and hardness of beryllium with the high electrical and thermal conductivity of copper. Copper/Beryllium wire is valued for its ability to resist fatigue and its non-magnetic properties. Common applications include springs, electrical contacts, and precision instruments where its resilience, conductivity, and non-magnetism are critical performance factors. With over 224 variations, Goodfellow's Copper/Beryllium wire products cover a wide range of diameters and tempers to suit diverse design needs.

Formula: Cu98/Be 2
Product Shape: Spooled
Diameter: 0.1mm
Length: 2000m
Temper: Hard
UOM Code: 465-040-87

LUMA METALL
Fine wire products

Luma Gold Plated Tungsten Wire

For some applications tungsten wire has to be plated to meet special requirements. This may be for instance to protect the wire from corrosion, to solder it to other metals or to reduce the secondary emission of electrons.

Example of applications

Antennas · Medical · Technical research · Bonding
Printing · Connectors · Fuses

Properties of bare Tungsten wire

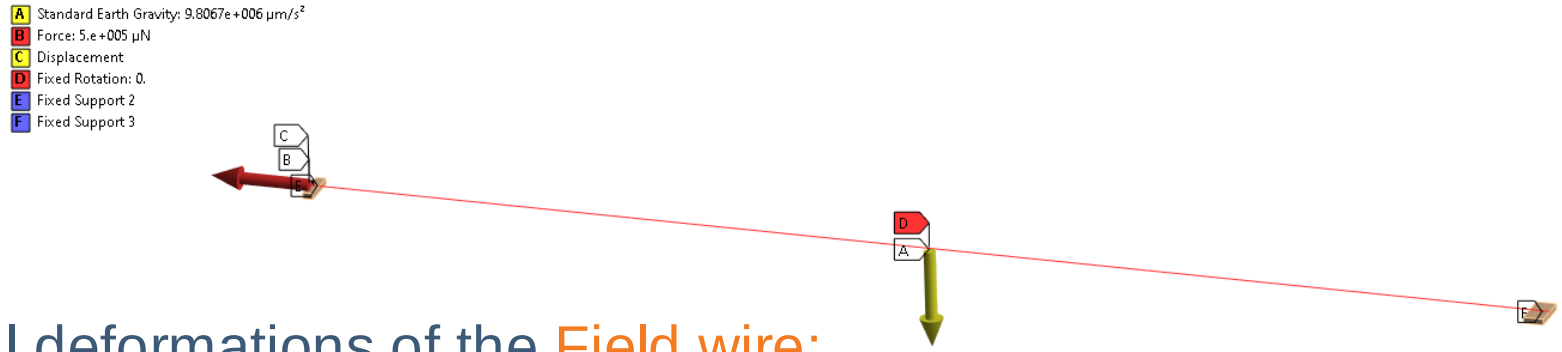
Purity	99.95% W
Melting point	3410 °C
Density	19.3 g/cm³
Specific electrical resistance at 20 °C	0.055 Ohm x mm²/m
Modulus of elasticity at 20 °C	410 kN/mm²

Wire qualities	Description
82/60	Treatment before plating Etched Type of strike Gold
82/65	Treatment before plating Etched Type of strike Gold This quality is processed to meet demands for medical use.
82/66	Treatment before plating Ultra polished Type of strike Gold
82/67	Treatment before plating Ultra polished Type of strike Nickel

Examples of wire dimensions with coat thickness as per Luma standard

Wire Dimension (microns)	Wire Dimension (mils)	Au coat thickness (microns)	Au coat by weight %
25	0.984	0.25 +/- 0.07	3.0 - 5.0
50	1.97	0.5 +/- 0.1	3.0 - 5.0
75	2.95	0.5 +/- 0.1	2.2 - 3.2
100	3.94	0.5 +/- 0.1	1.6 - 2.4
150	5.91	0.5 +/- 0.1	1.0 - 1.6

Wires – Pre-tensioning in Horizontal Setup

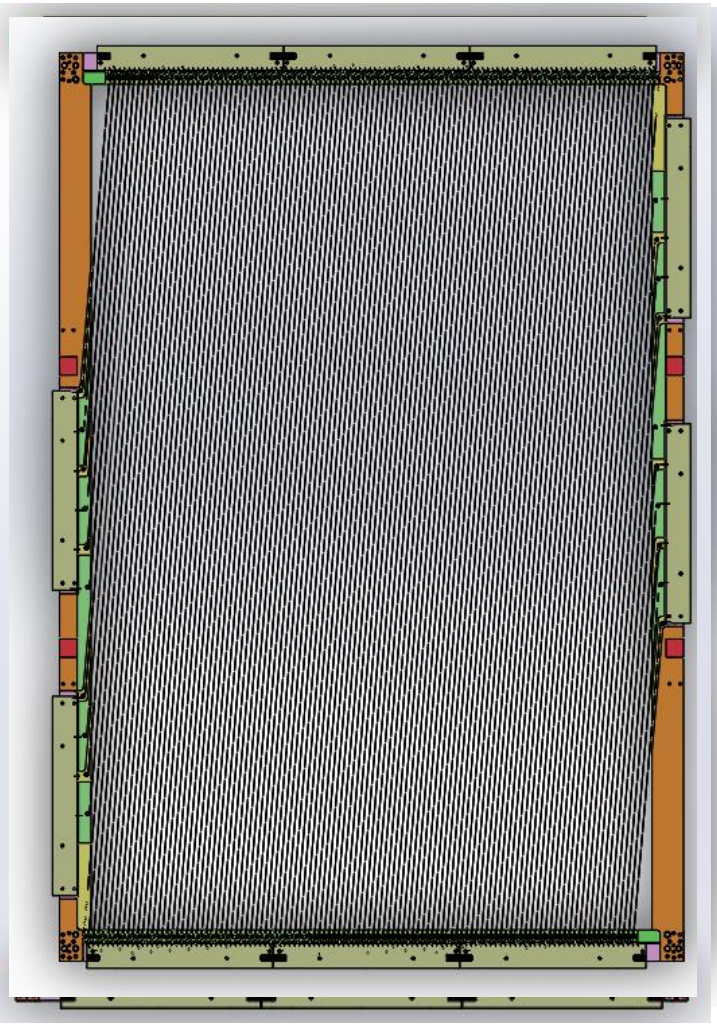


- Vertical deformations of the Field wire:
  - 160-180 µm @ 150g
  - 100-110 µm @ 320 g
- Vertical deformations of the Sens wire:
  - 86-88 µm @ 50g
  - 61-63 µm @ 70g

- In a future analysis:
  - necessary pre-tension for the sensor wire to achieve the same deformation as the field wire under vertical loading.

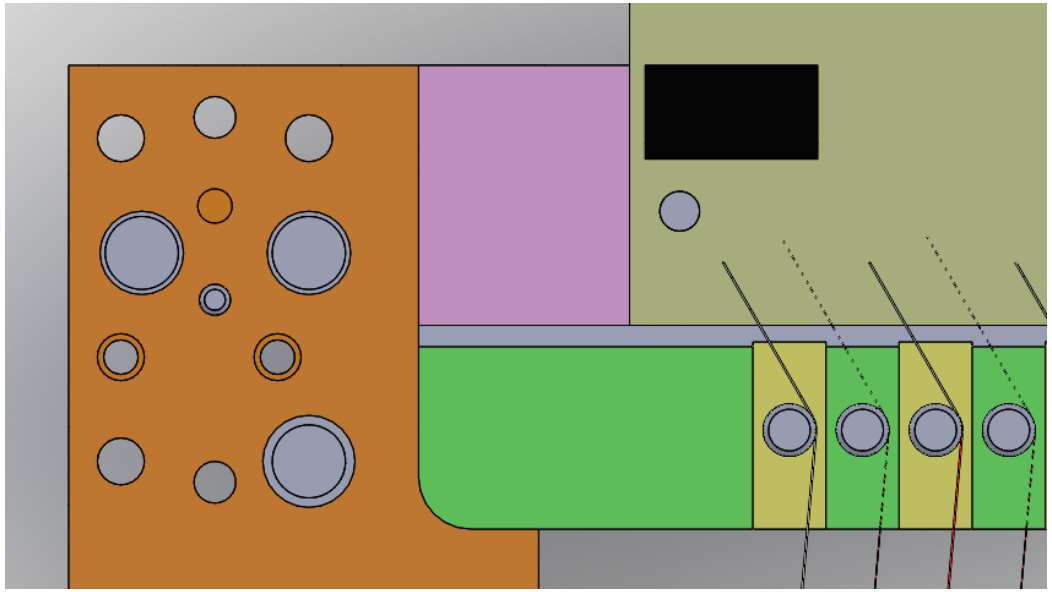
Wire Layers

- The horizontal distance between the wires is 7 mm.
- Each layer contains 113 wires (57 FW, 56 SW),
- There are four different types of PCBs, with two of them being mirrored.



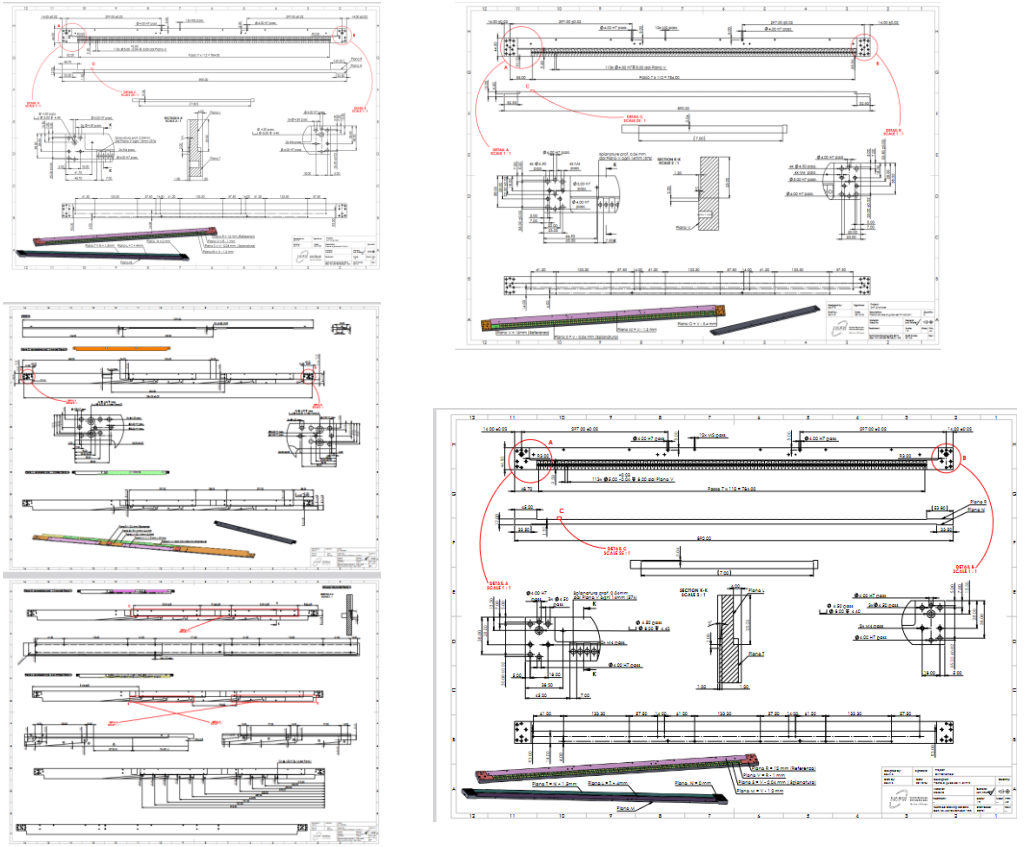
Wire Layers - Positioning

- Each wires is positioned using two cylindrical pins each.
- Each wire is soldered to the corresponding PCB.



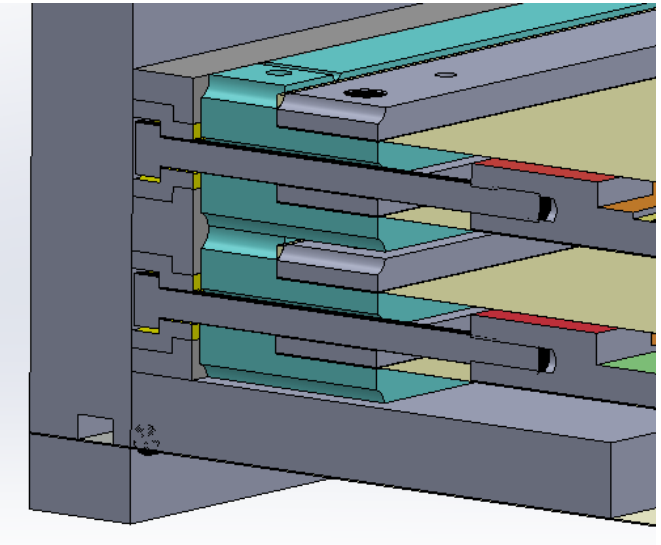
Wire Layers - Frame

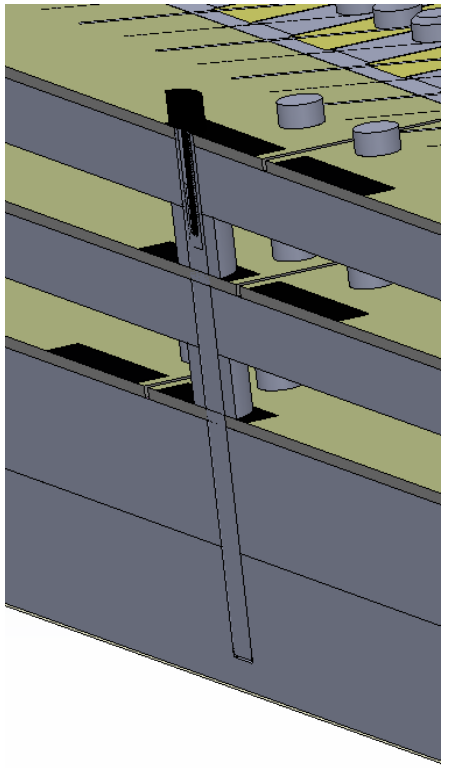
- The frame consists out of separate Stesalite plates that are screwed together.
- There are six different types of Stesalite plates, and a total of 10 plates.



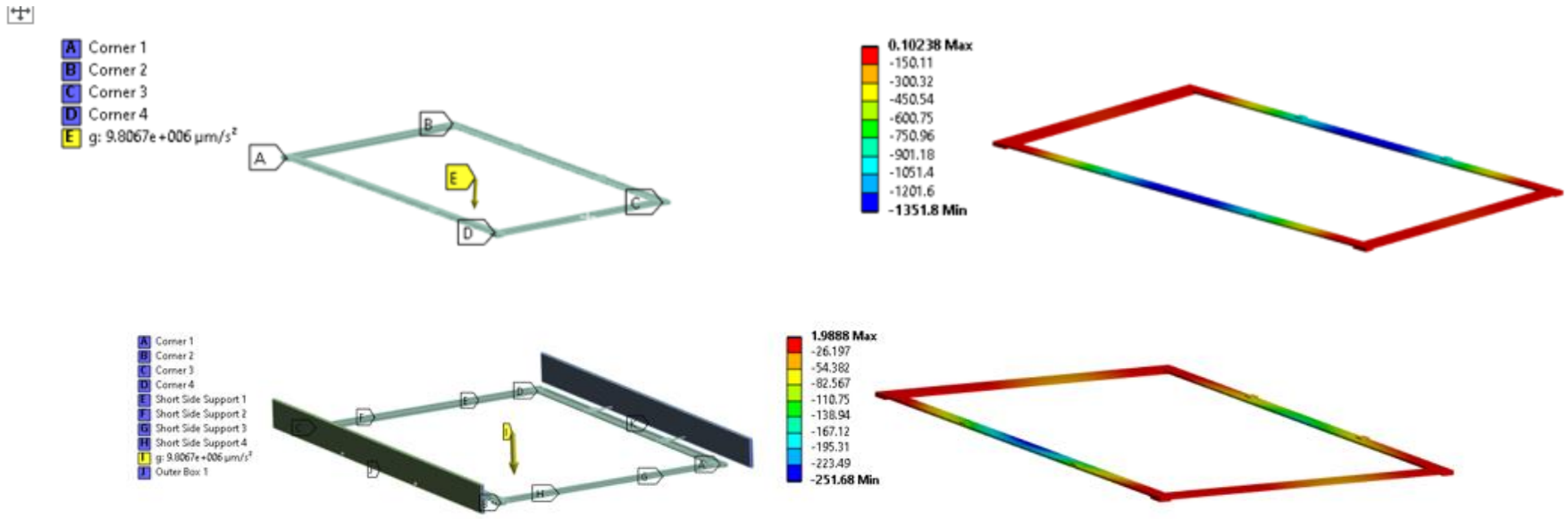
Wire Layers – Structural Support

- To prevent deformations structural supports are added.
- The longer plates will be held laterally.
- The shorter plates will be held vertically.





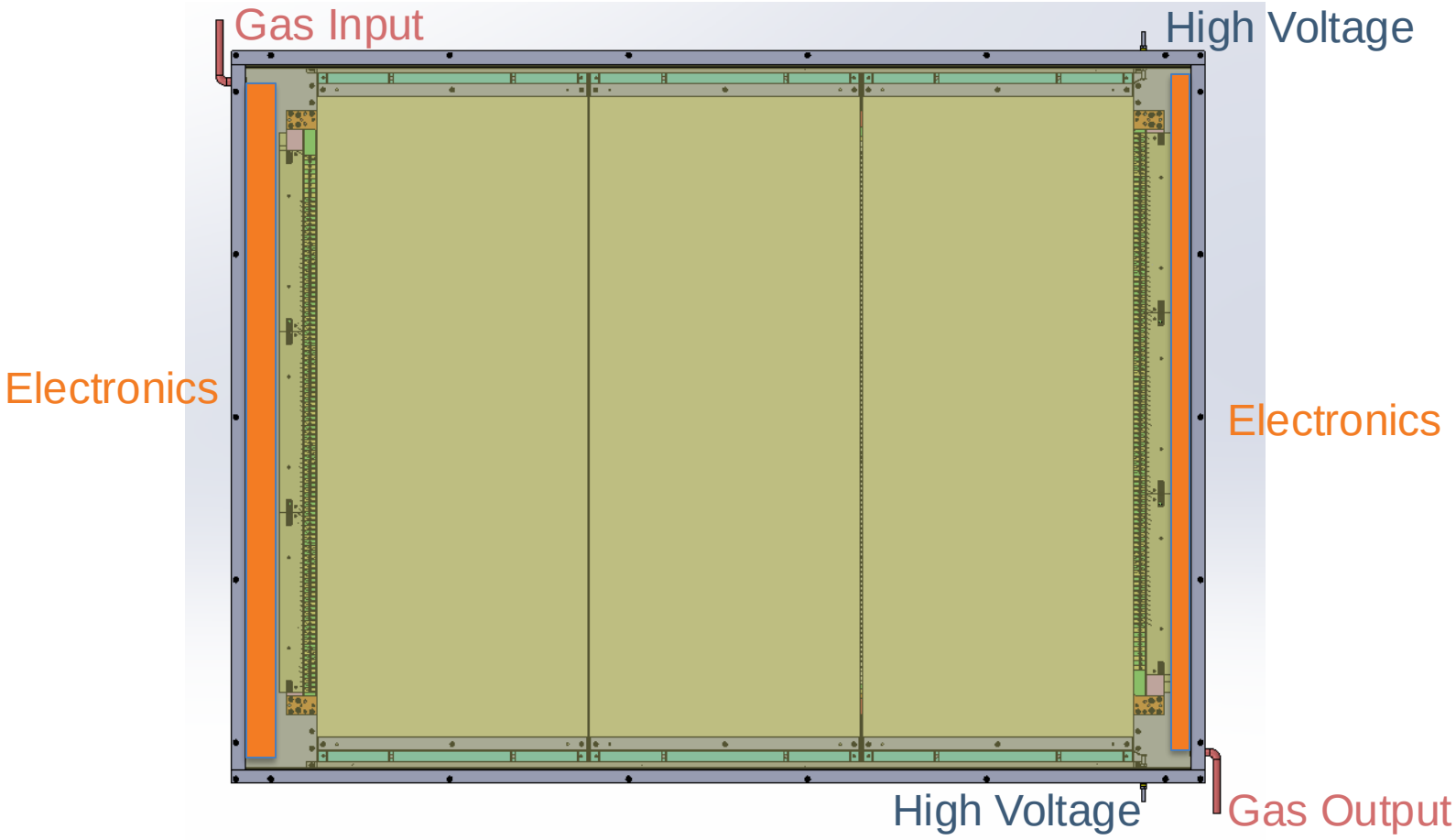
Wire Layers – Structural Support



- In the horizontal setup the vertical deformation could be reduced from 1.35 mm to 0.25 mm

Gas In- and Output, Electronics, and High Voltage

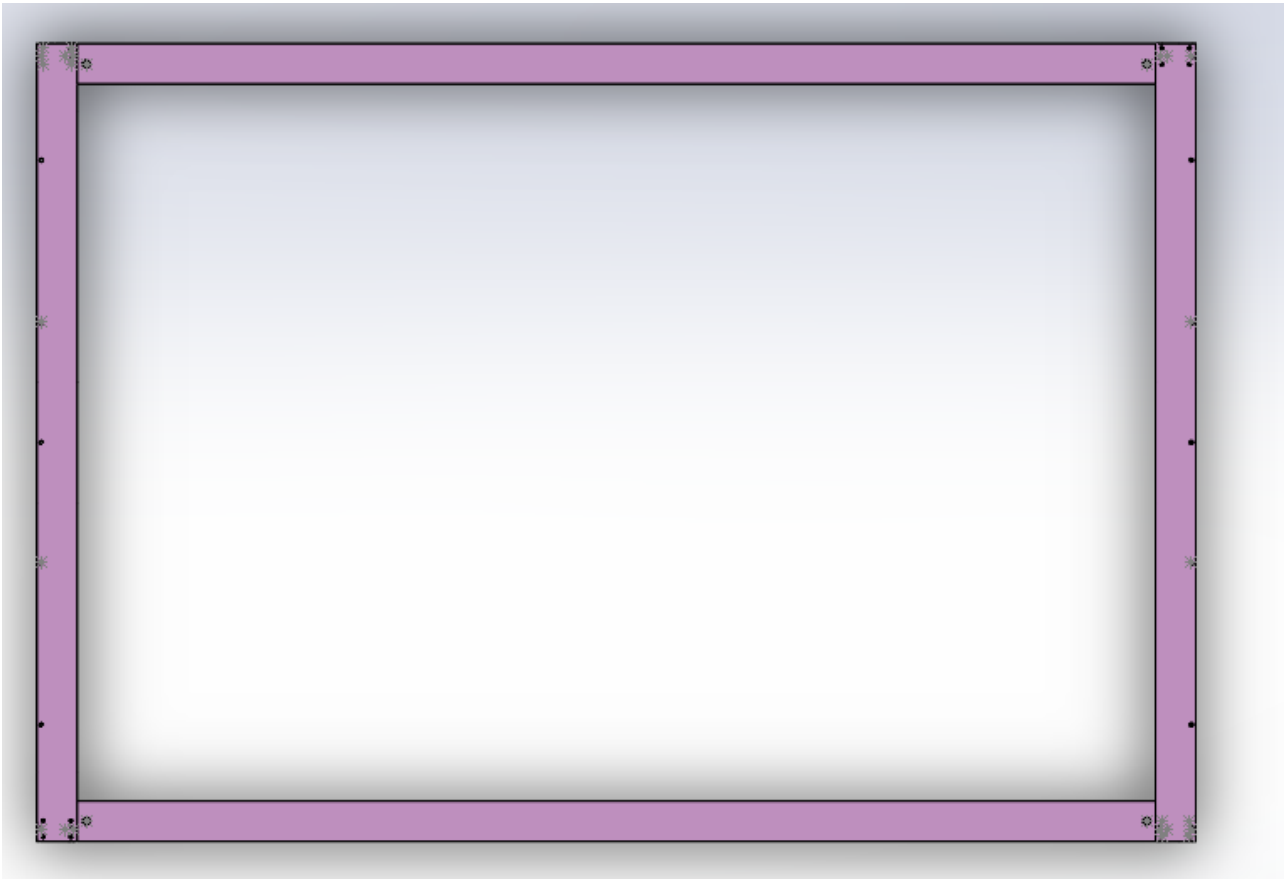
To be defined…



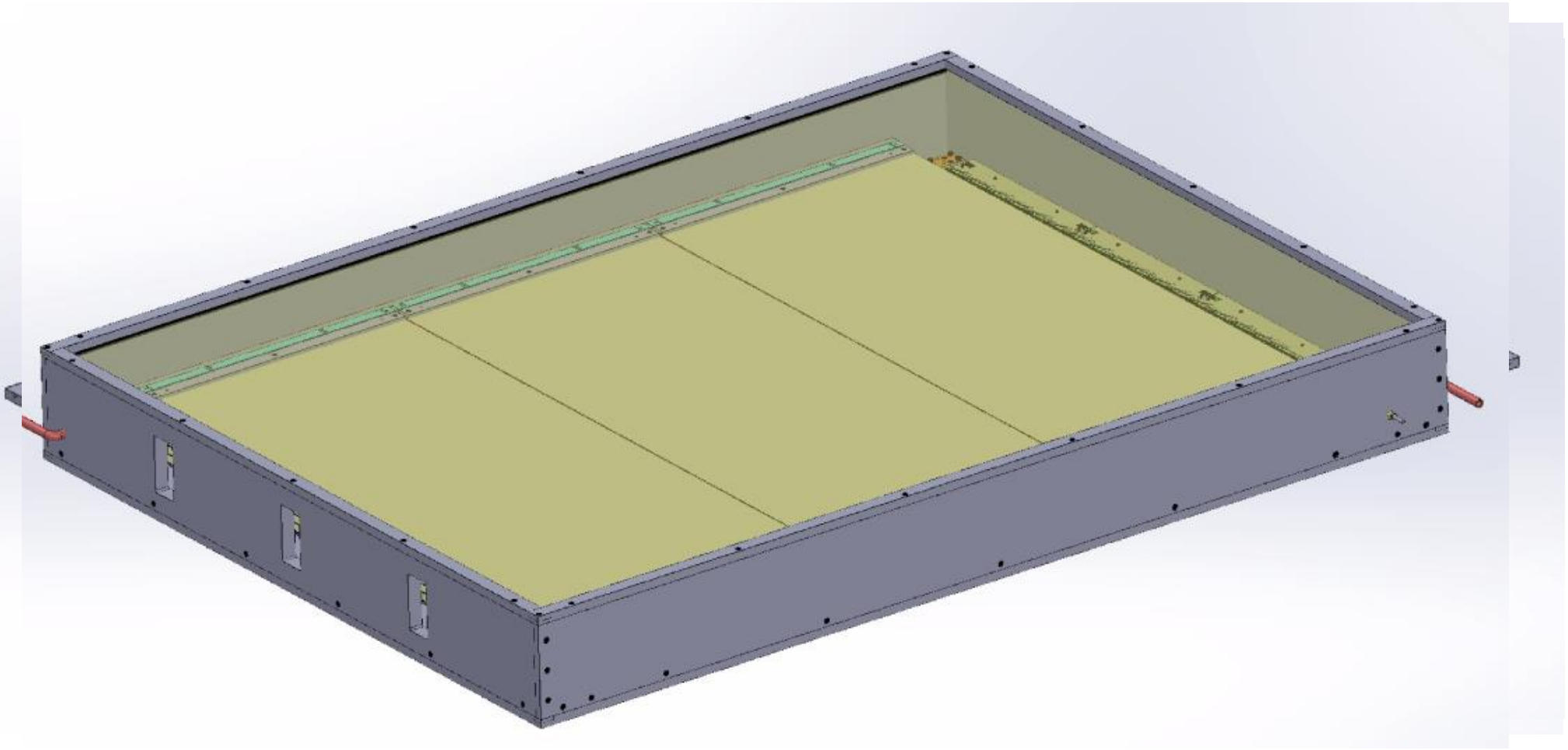
Mounting and Transport

Wire Layers – Mounting Frame

- The frame consists of separate Aluminum alloy plates that are screwed together.
- Here the Wire Layers will be mounted completely.



Mounting



Thank you for your attention!