

# GRAN SASSO

## SUMMMER INSTITUTE

### 2014 HANDS-ON EXPERIMENTAL UNDERGROUND PHYSICS AT LNGS

Hands-on activity:

The students will carry out the experimental activity in the frame of the LUCIFER project. The activity foresees the assembly and operation of bolometric detectors. In the specific, the students will directly put hands on the detector, designing and constructing a scintillating bolometer. The detector will be installed in a dilution refrigerator and operated at  $\sim 10$  mK. Finally, the students will analyze some preliminary data from the running set-up.

Students:

Mateusz Kaczmarecki

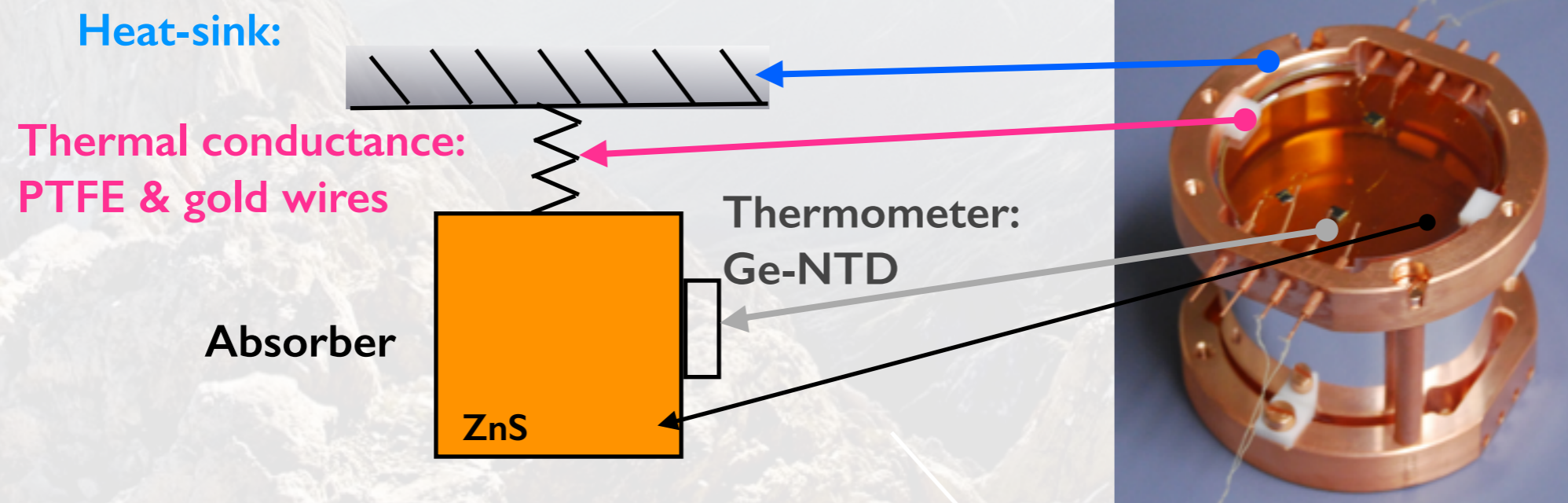
Miquel Nebot-Guinot

Advisor:

Dr. Luca Pattavina

## 1. Introduction

- LUCIFER searches  $0\nu\beta\beta$  using Se and Mo bolometers as detector/emitter among other rare events using an new technique.
- Combining bolometric technique with bolometric light detection make it ideal instrument for measuring  $0\nu\beta\beta$ . Very high resolution and great capabilities for background discrimination are main qualities of this kind of detector.
- Small scale of the device and crystal customization possibility make it very universal and allows wider spectrum of applications in future experiments.
- For our studies we assembled ZnSe based bolometer, but for characteristic measurements we used ZnMoO<sub>4</sub> based device due to lack of time required for cooling the cryostat.



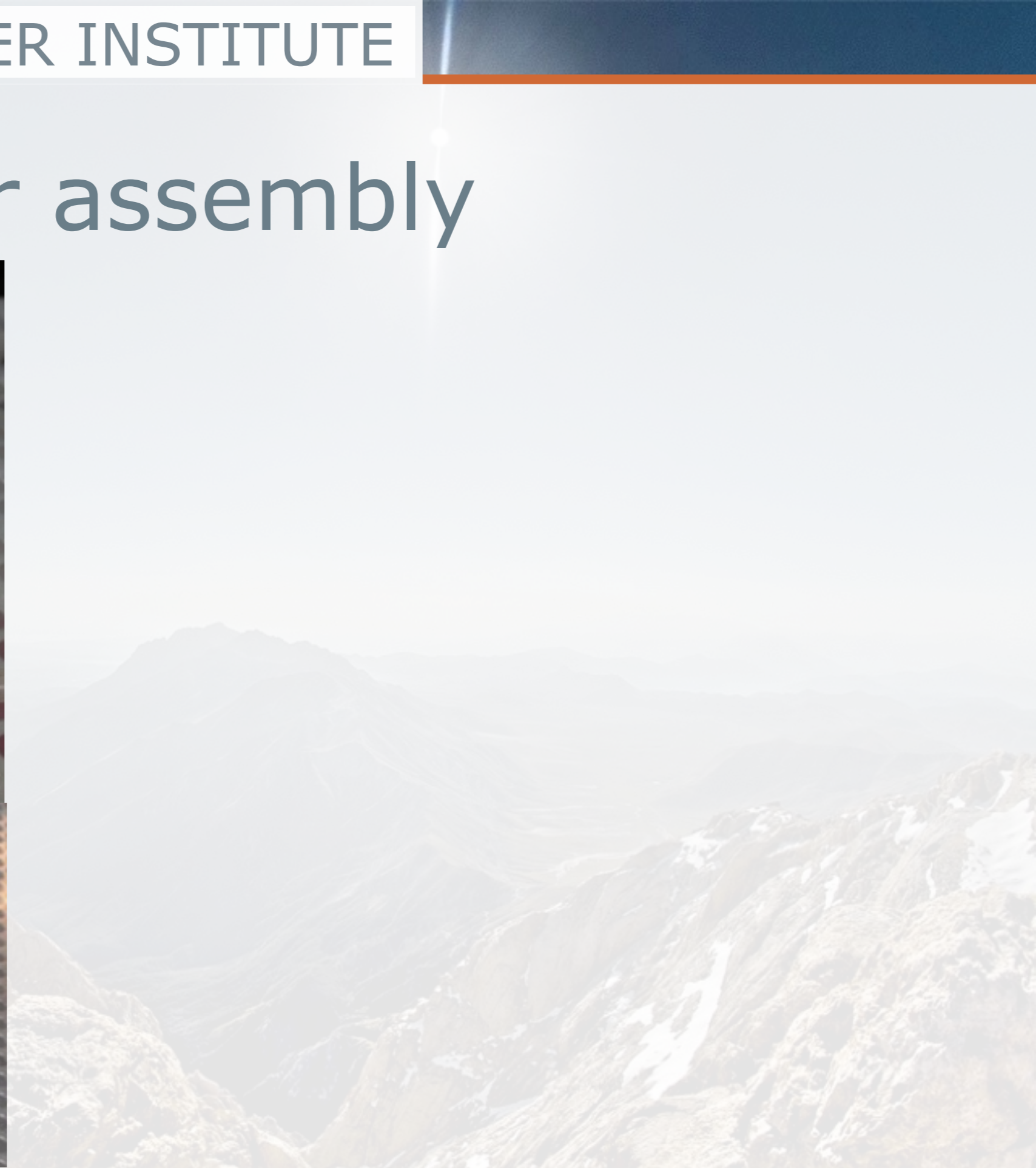
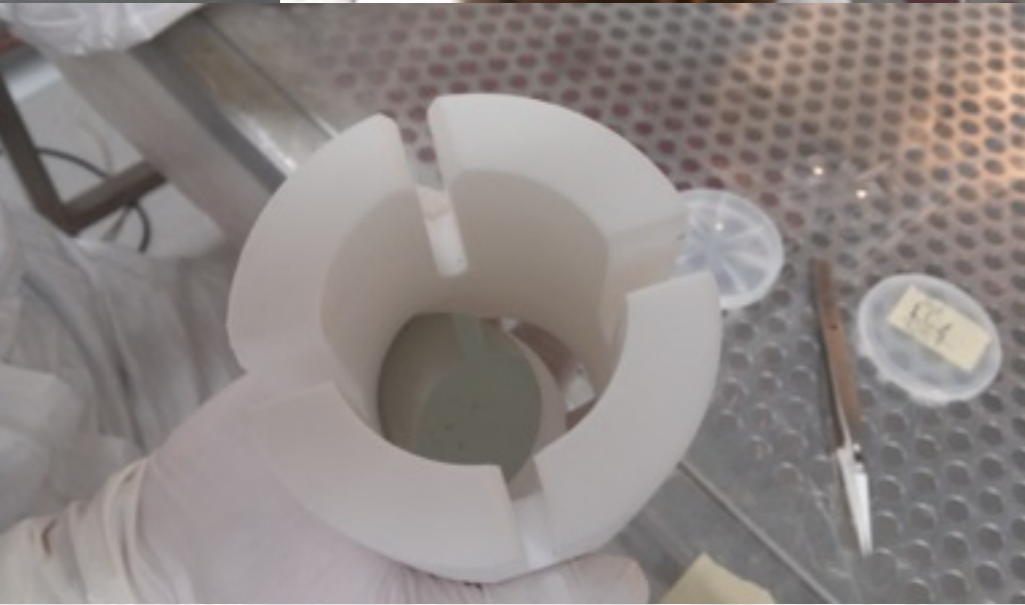
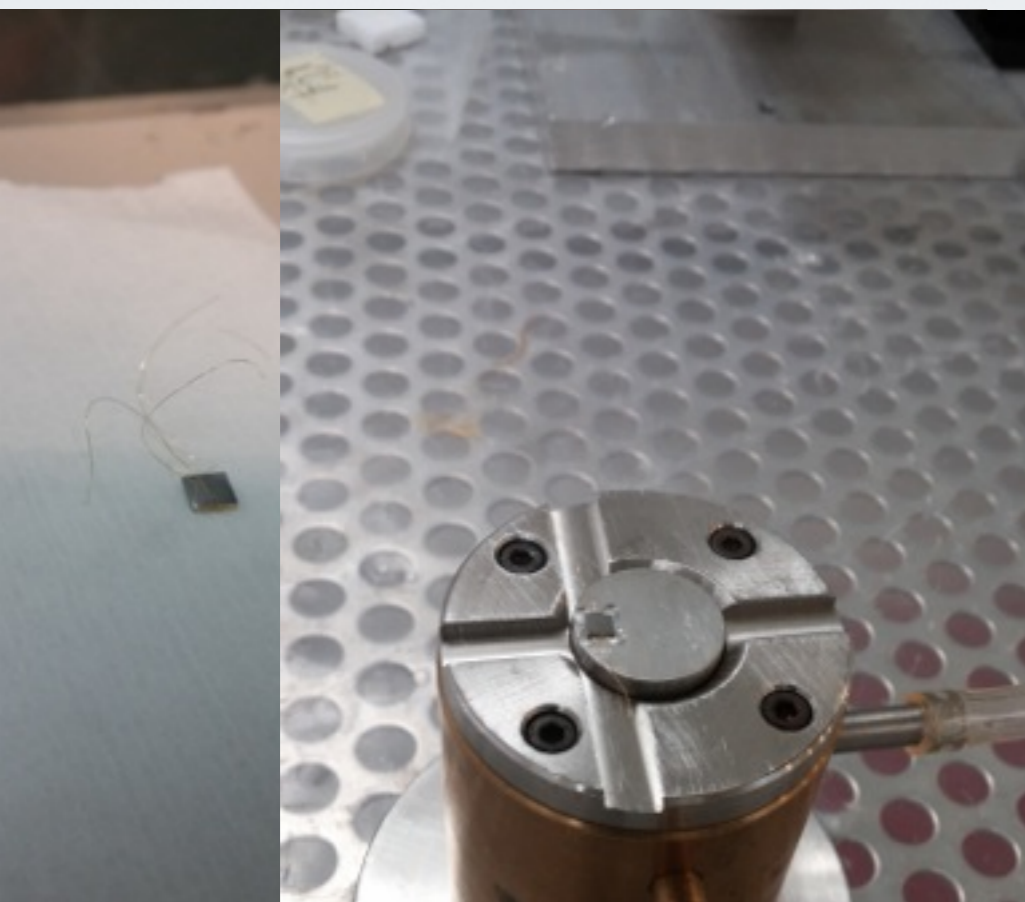
## 2. Detector assembly



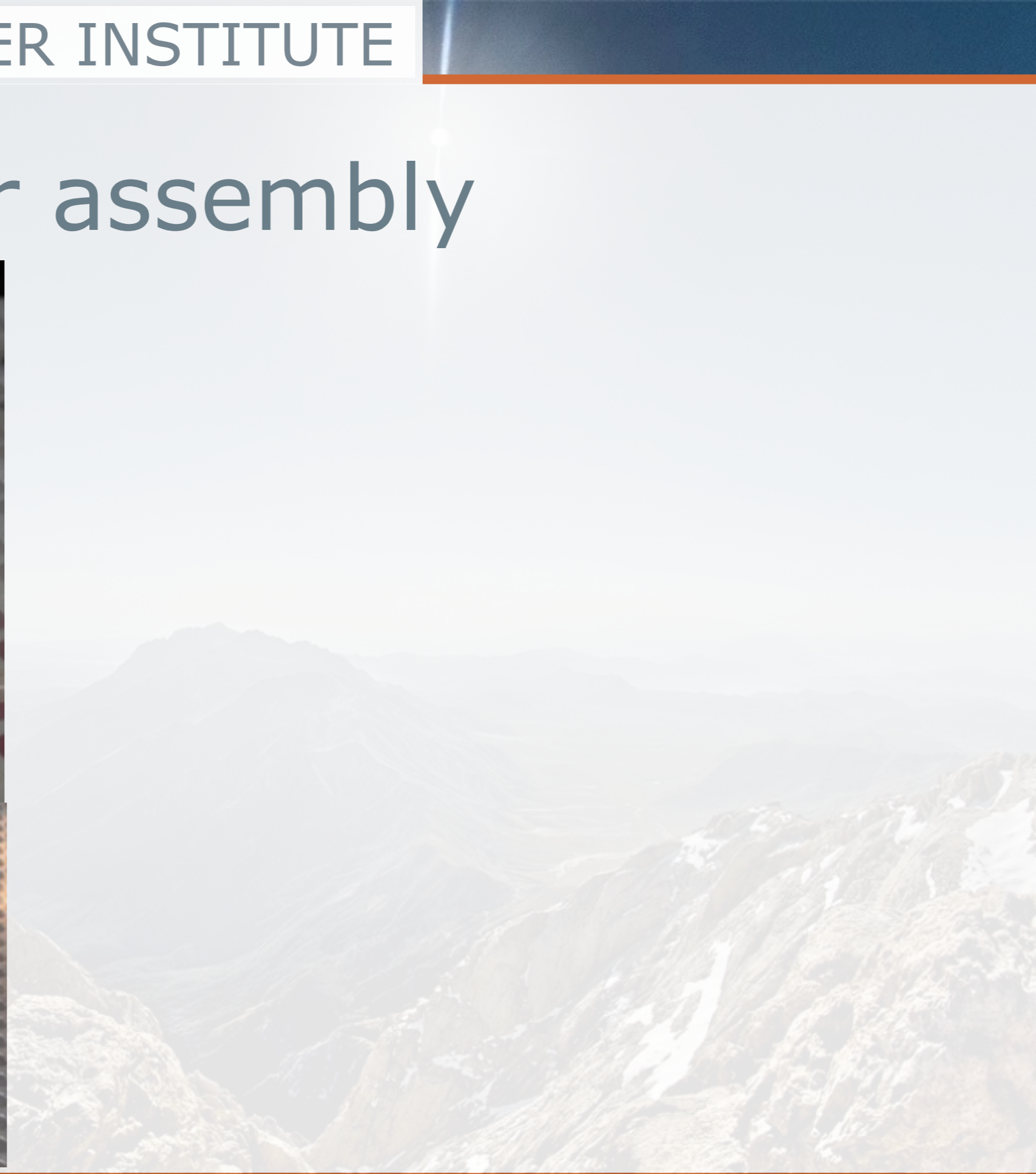
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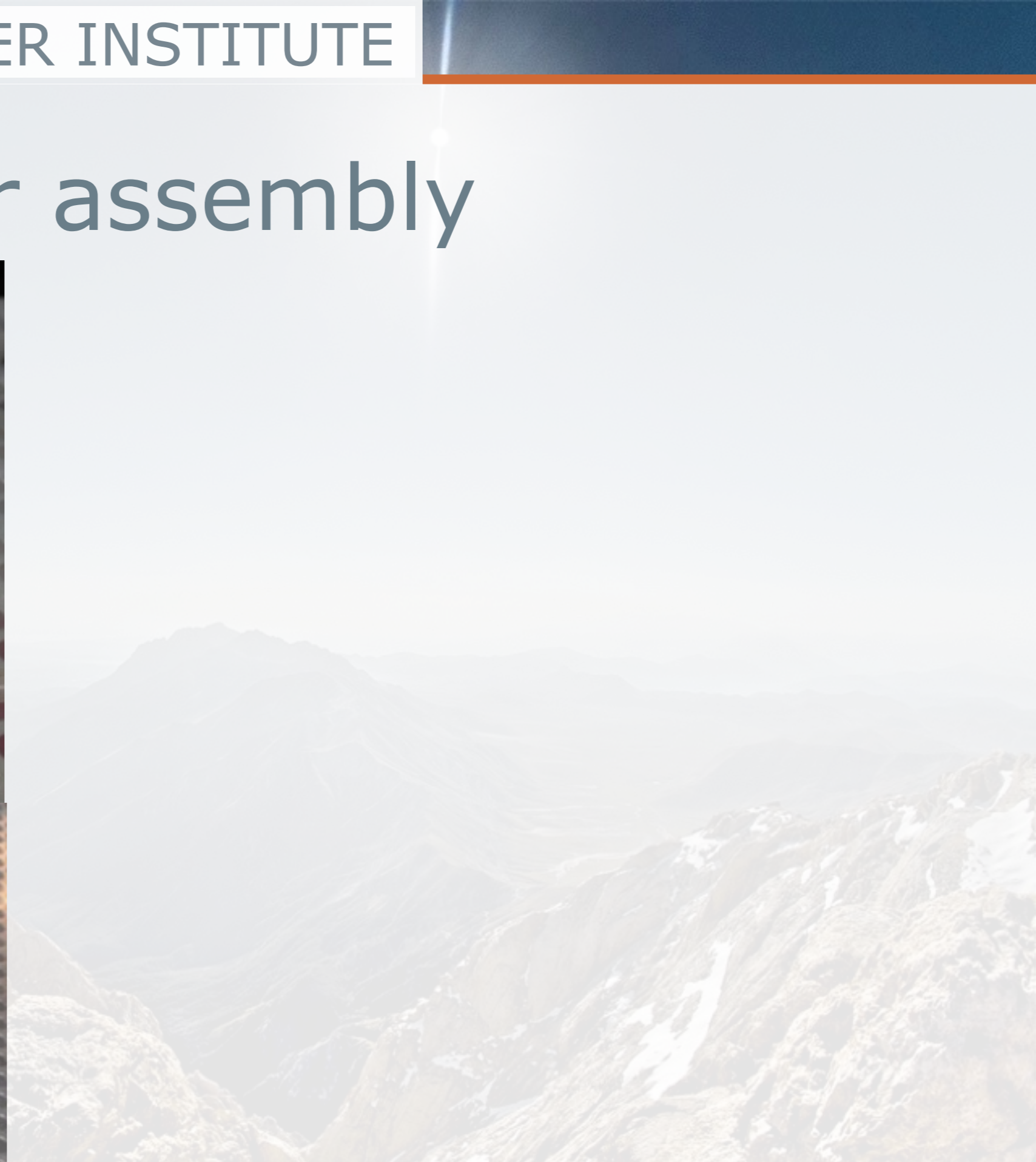
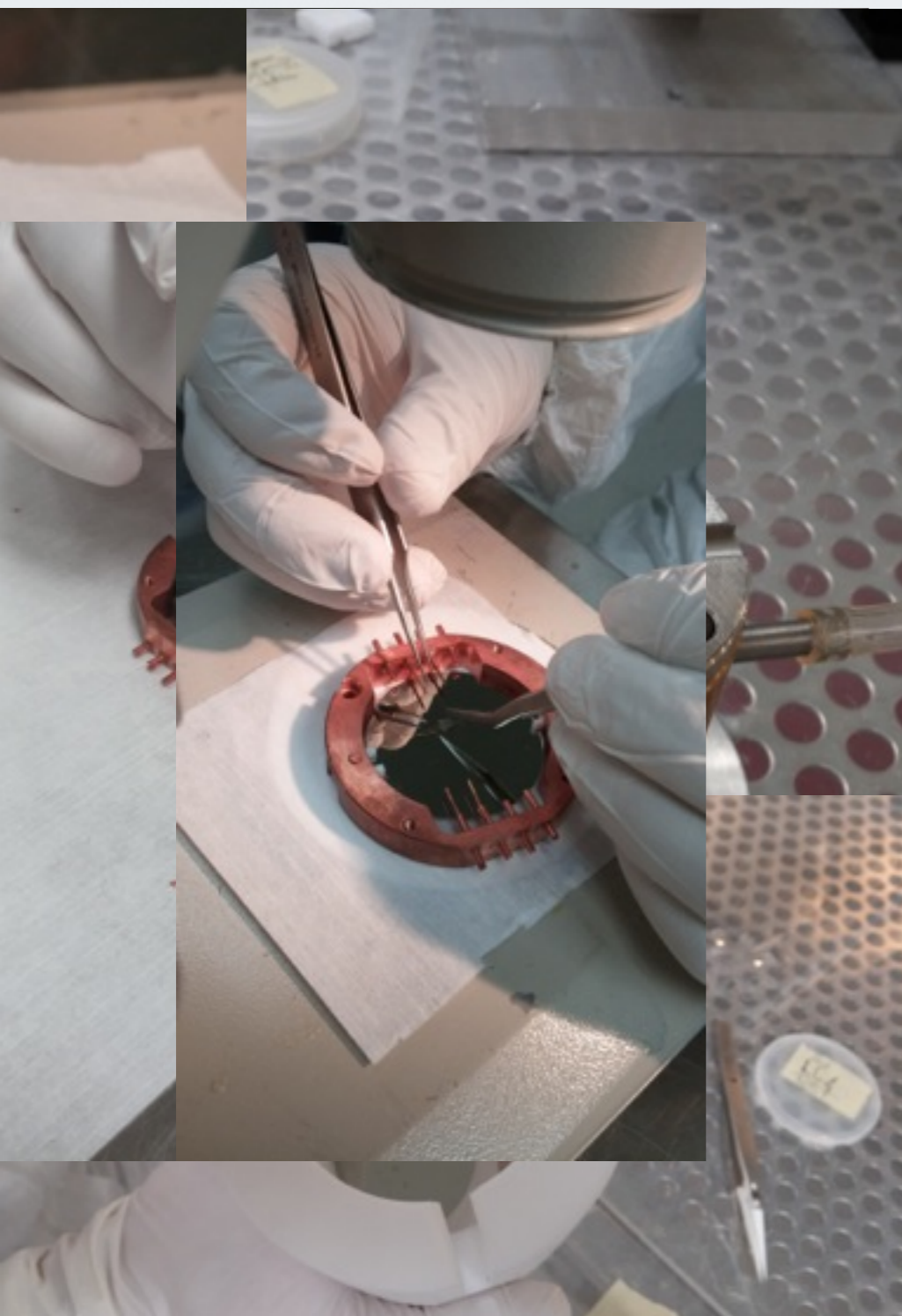
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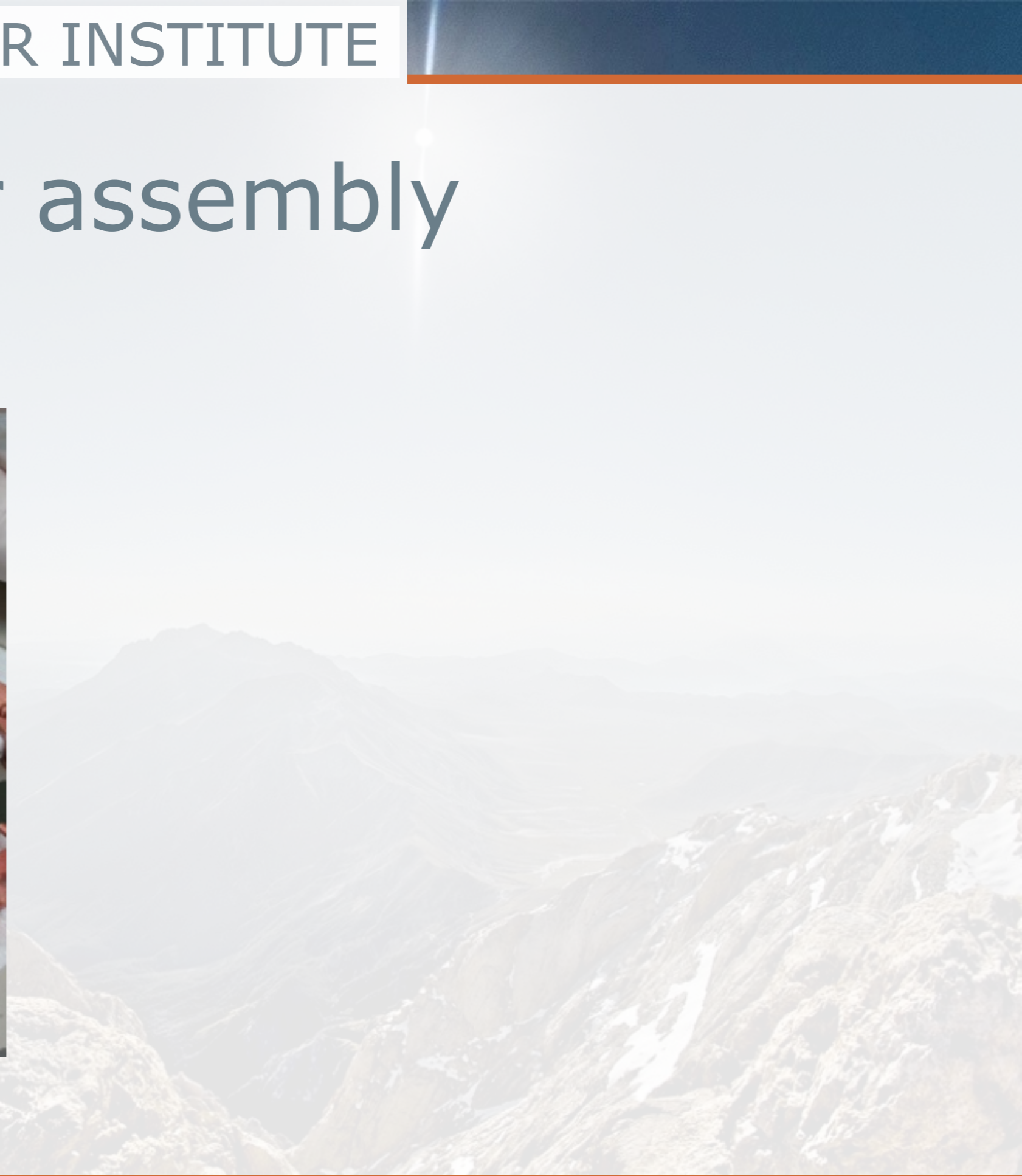
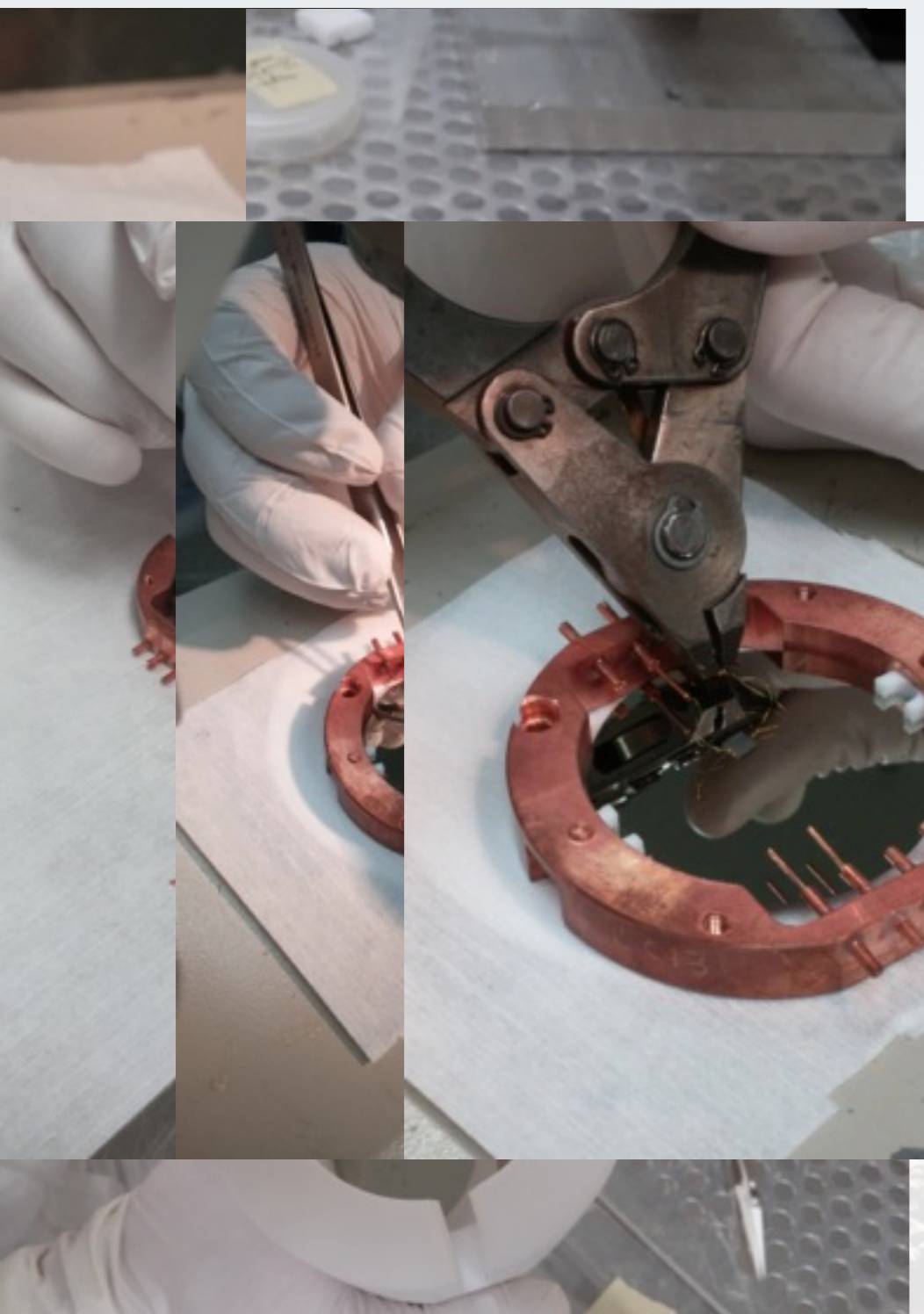
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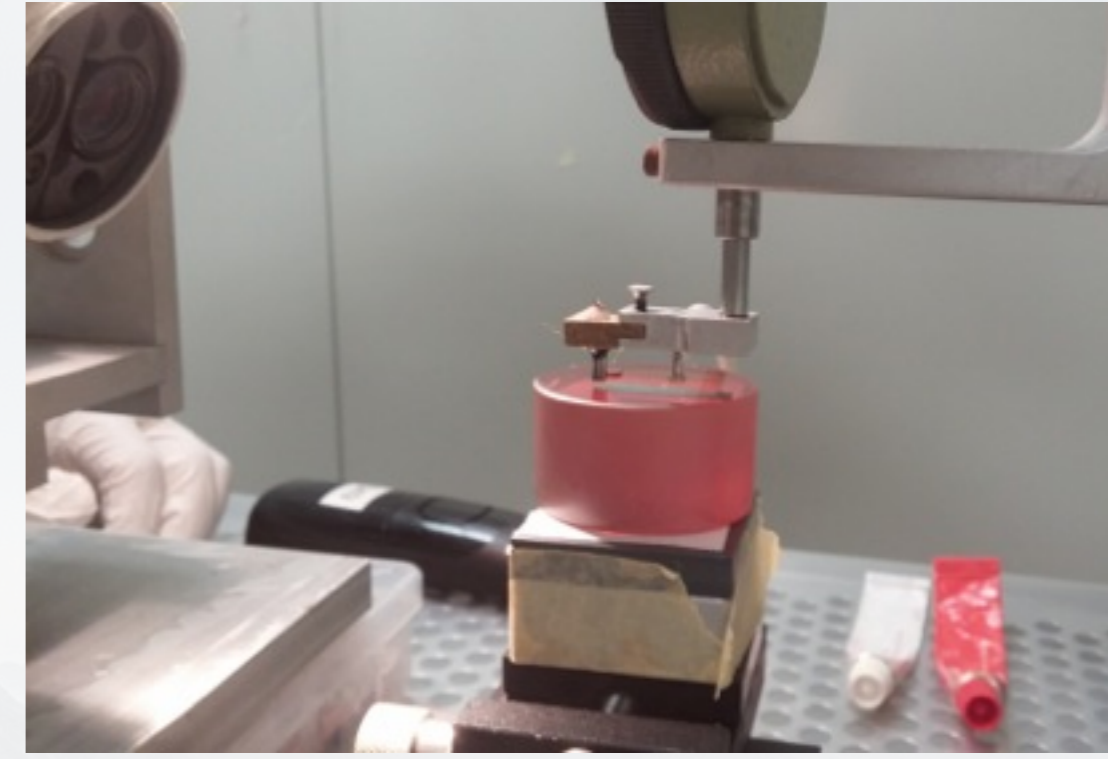




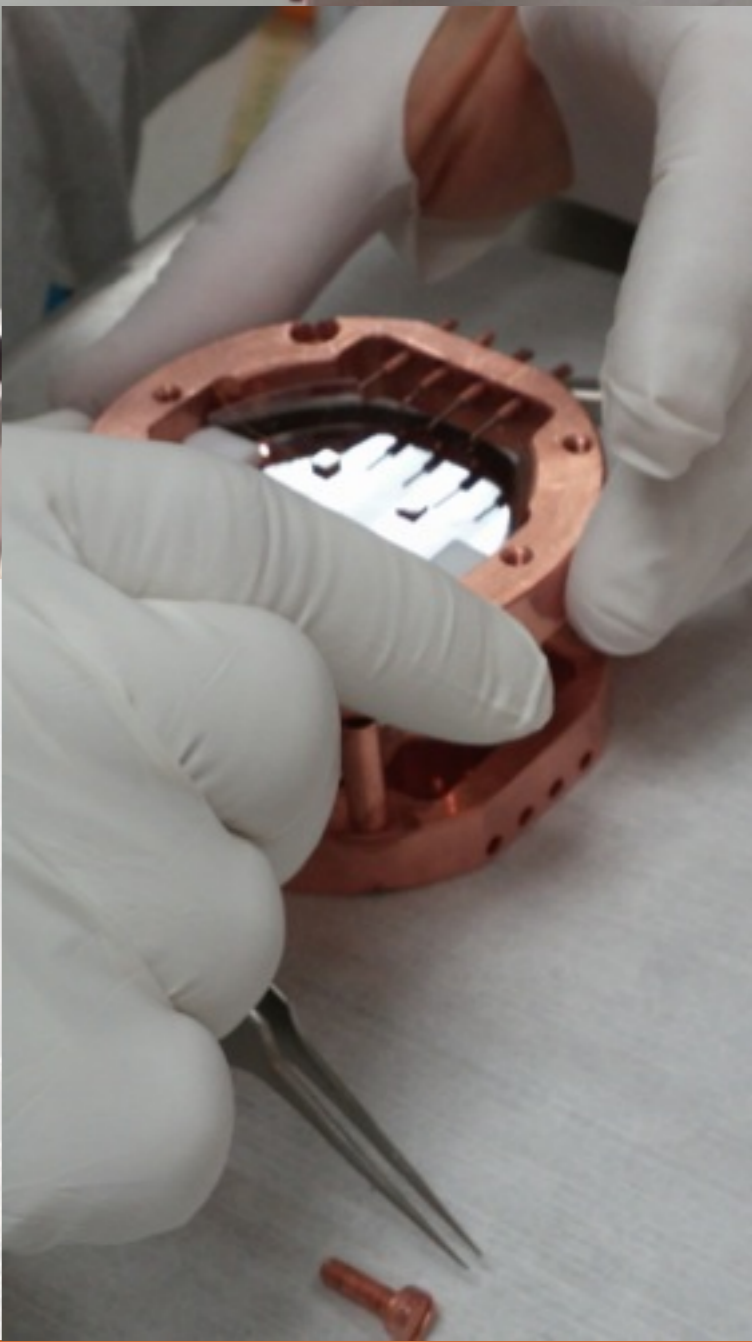
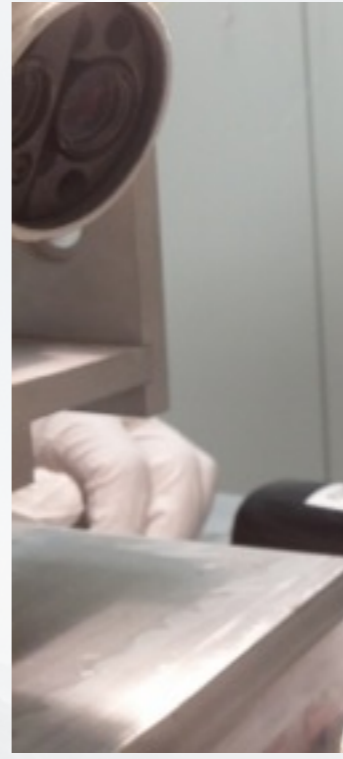
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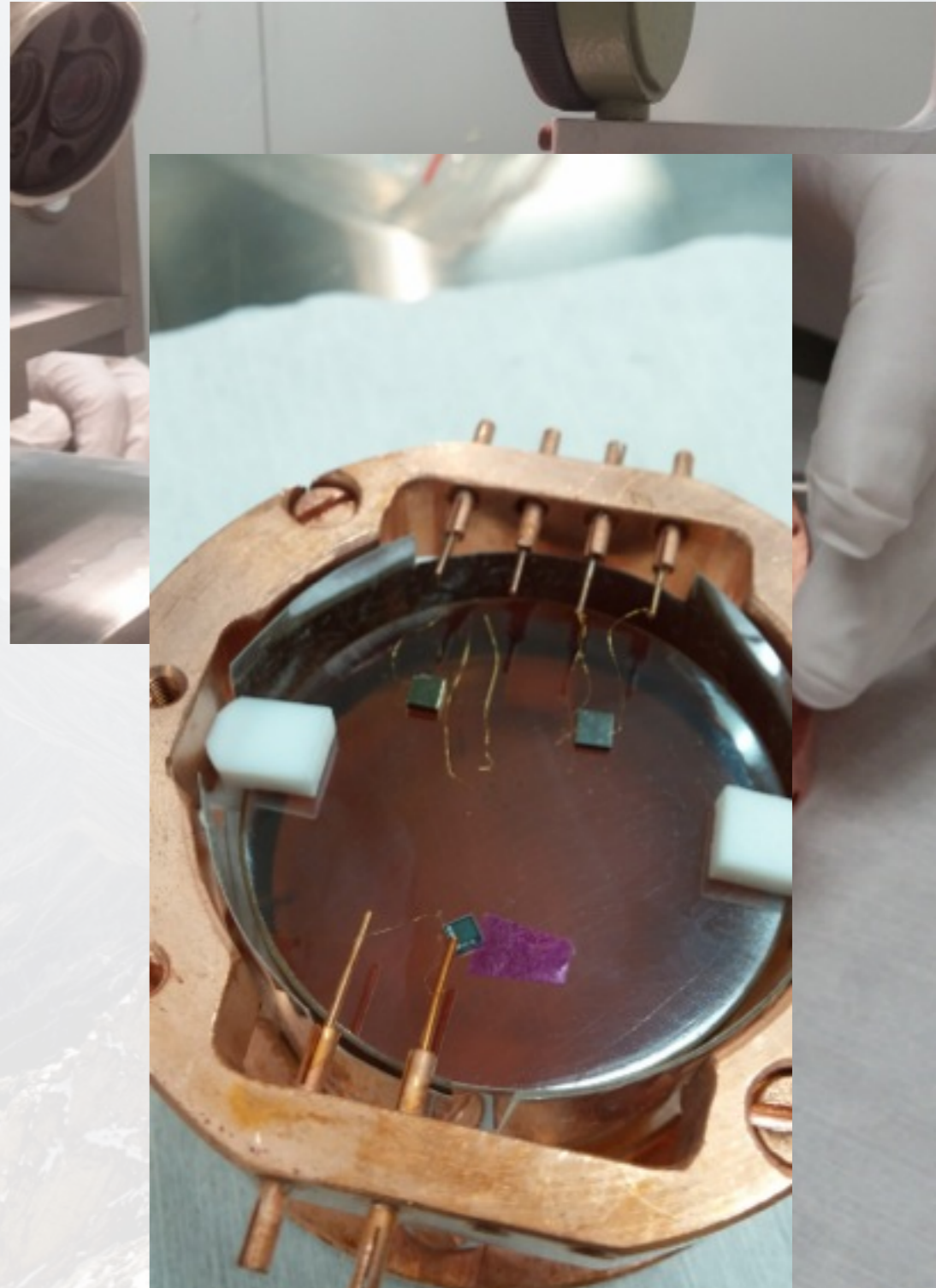
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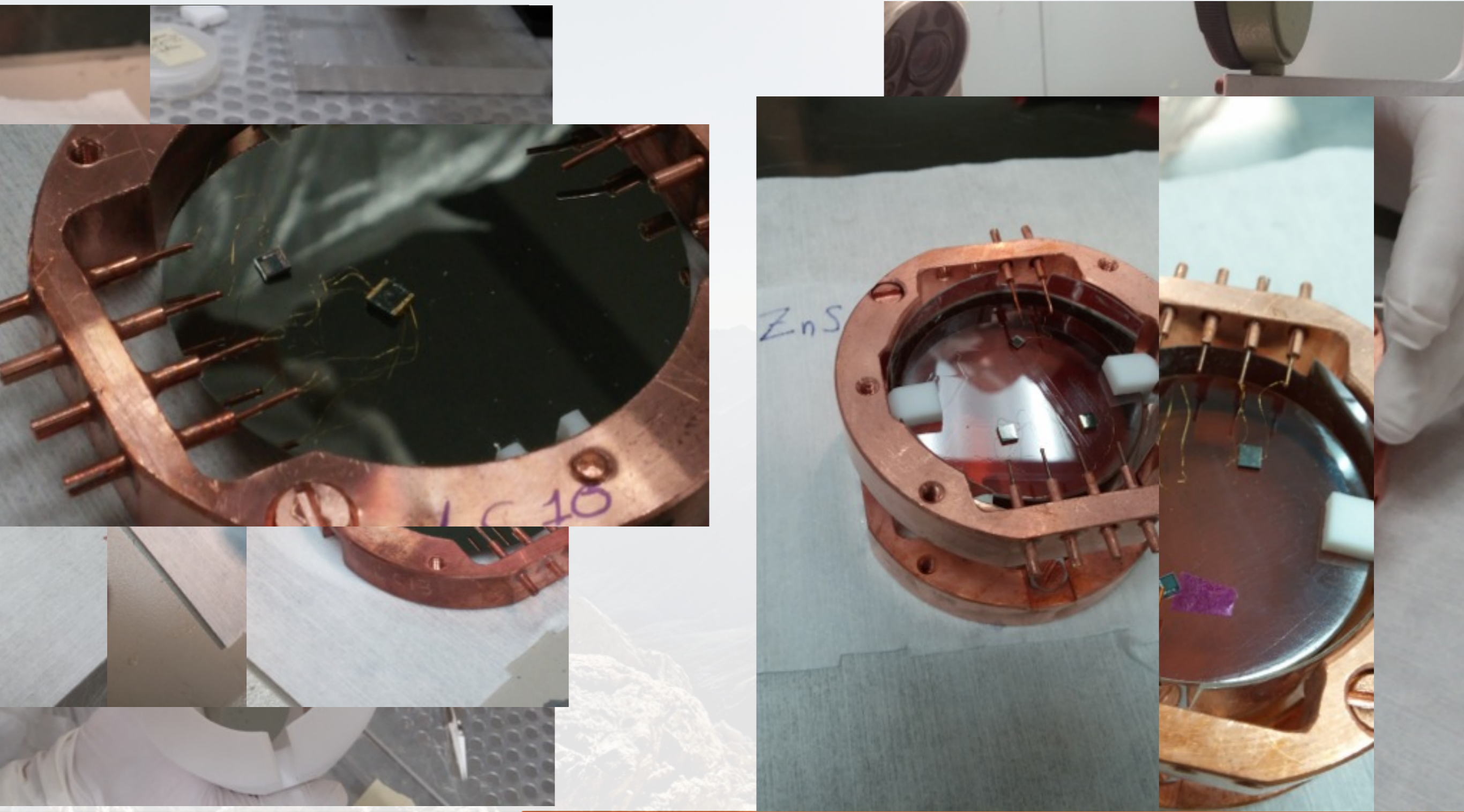
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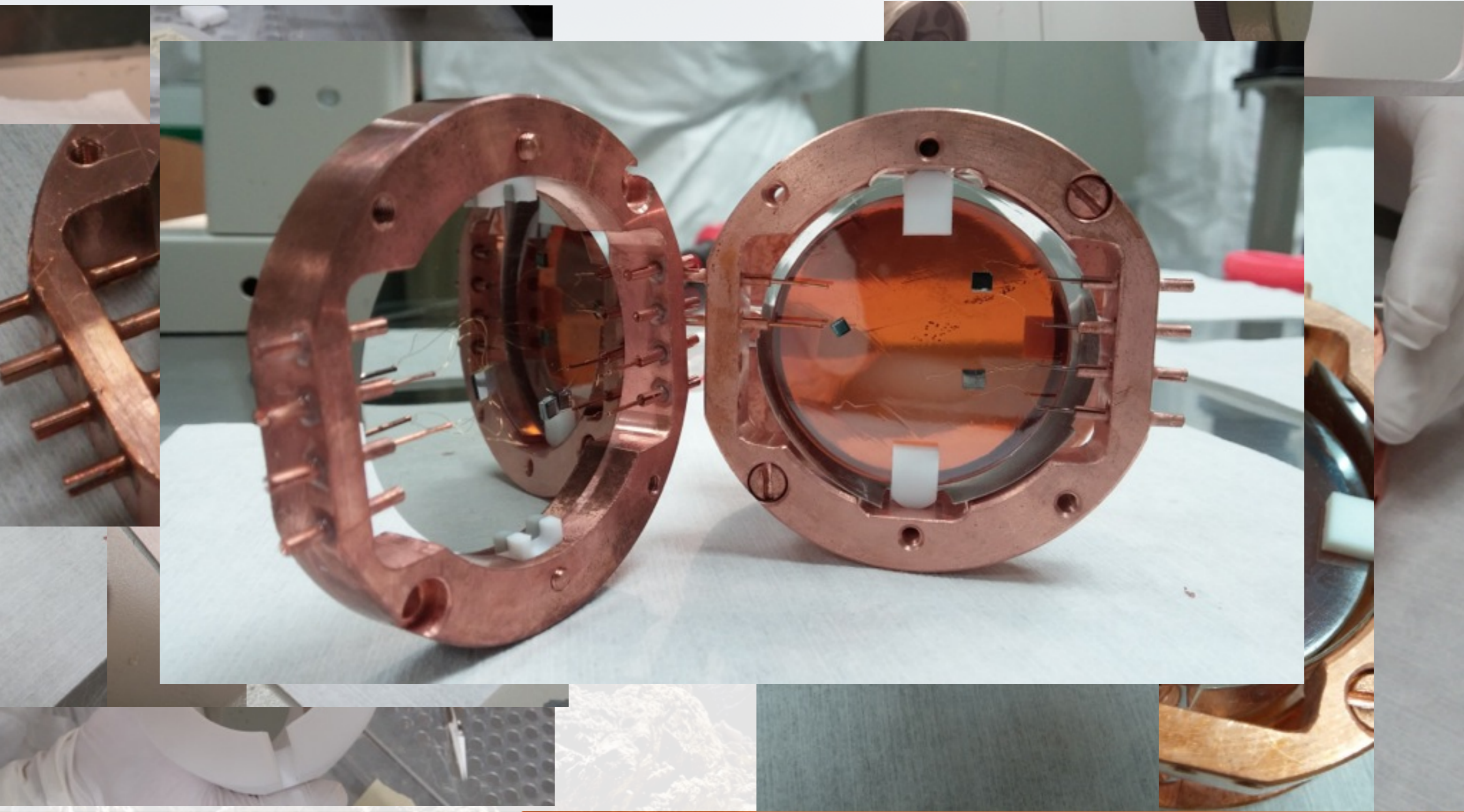
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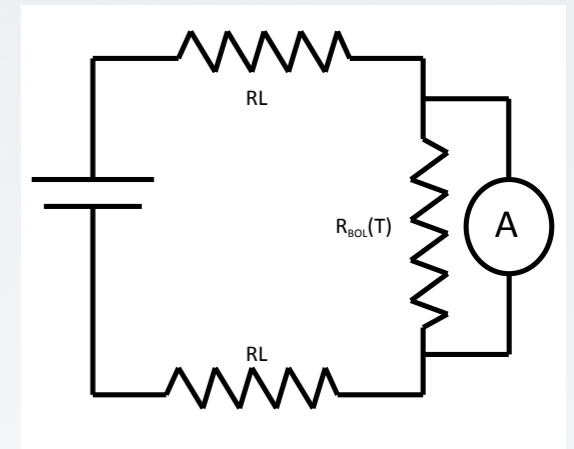


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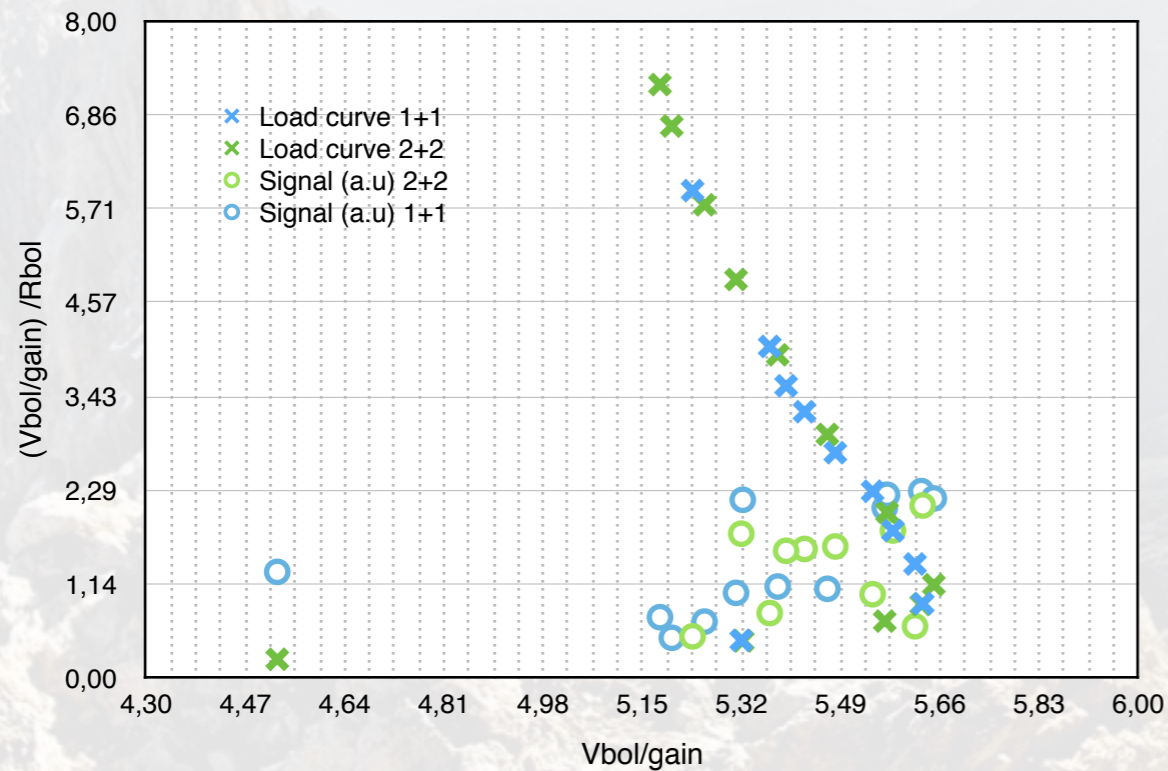


# 3. Detector characterisation

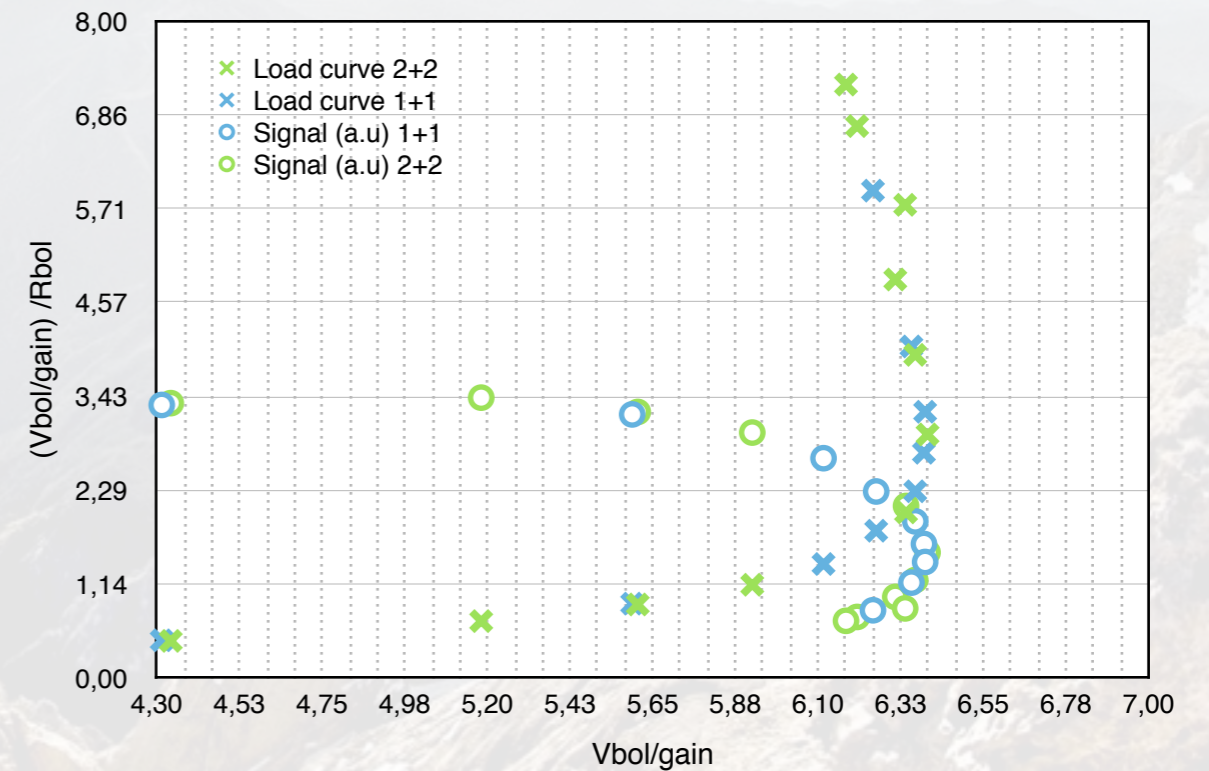
- Characterisation of the optimum working point of the heat detector ( $ZnMoO_4$ ) and the light detector (Ge) looking into the response to the different bias voltage of the thermistor



Ch12 GeLarge - Light detector

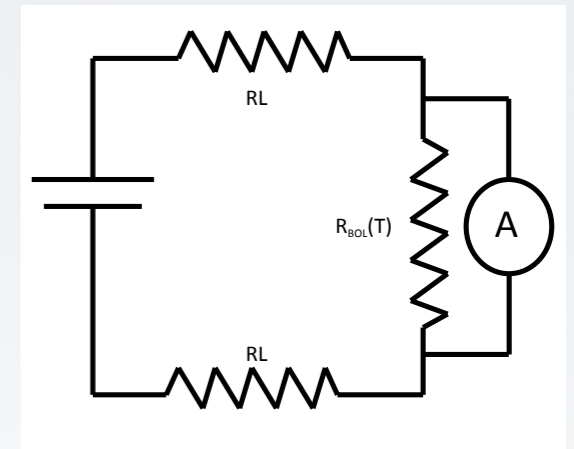


Ch21 Pompelmo - Heat detector

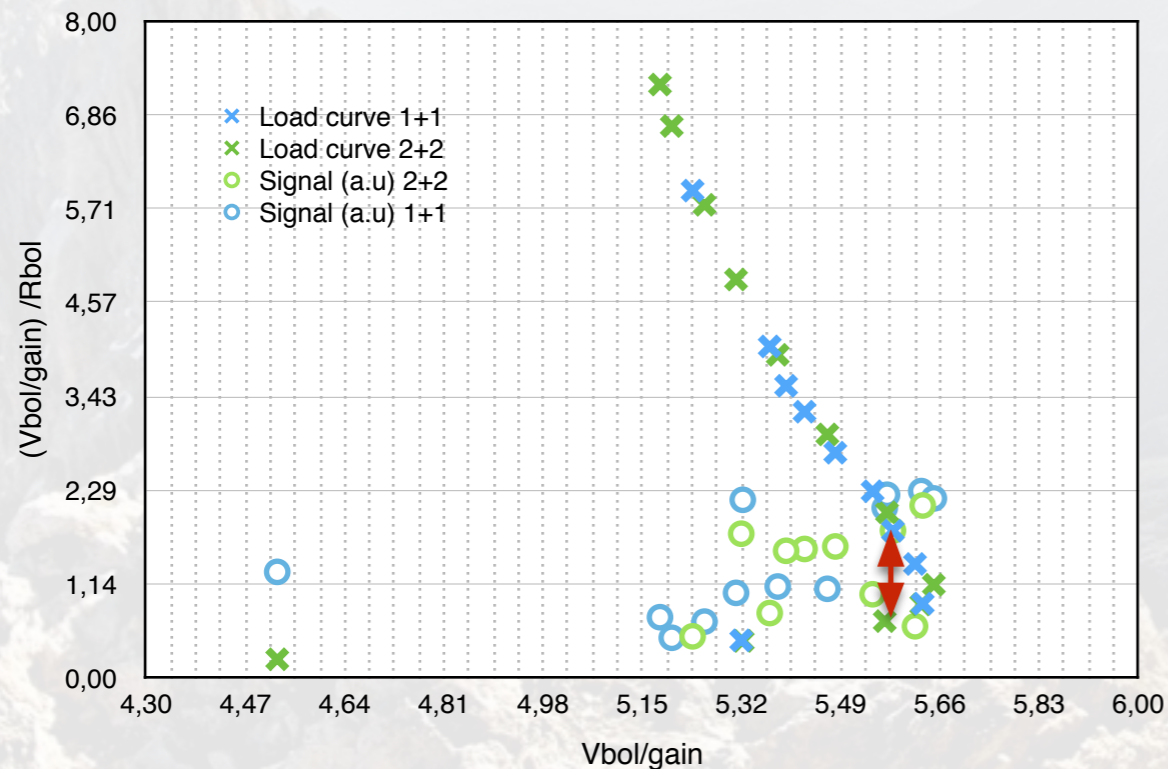


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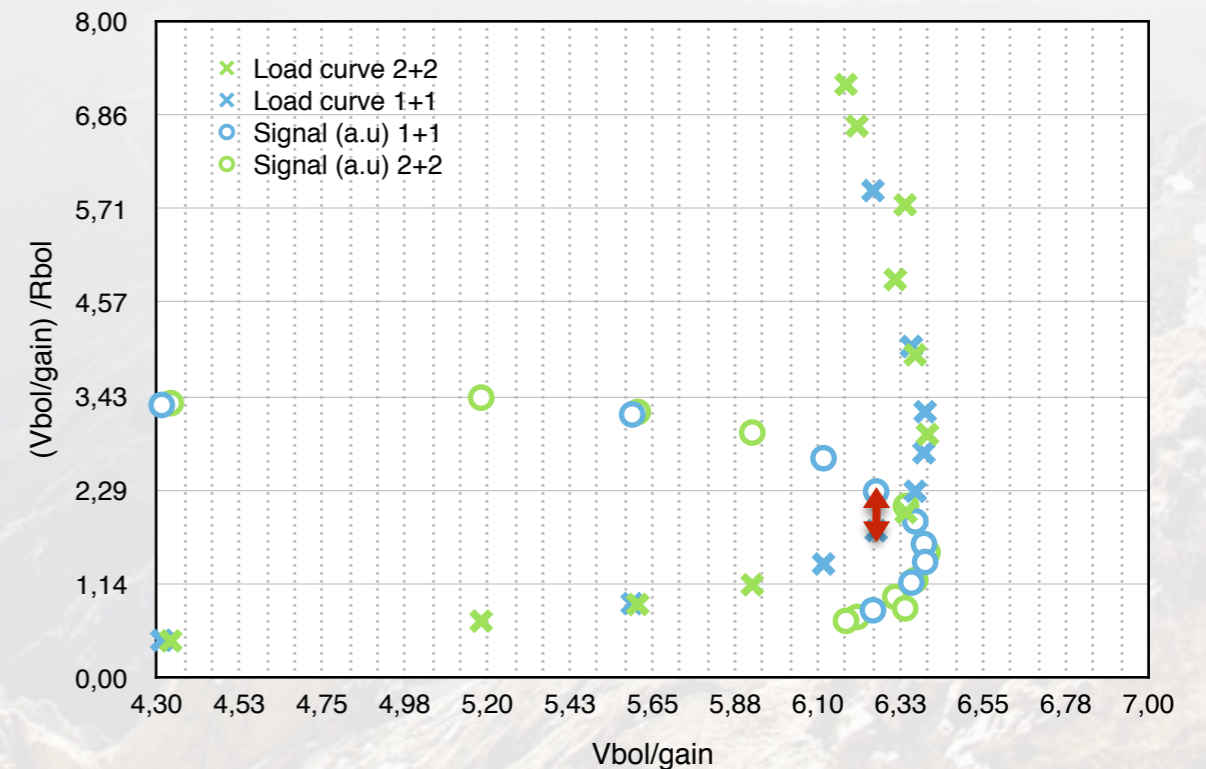
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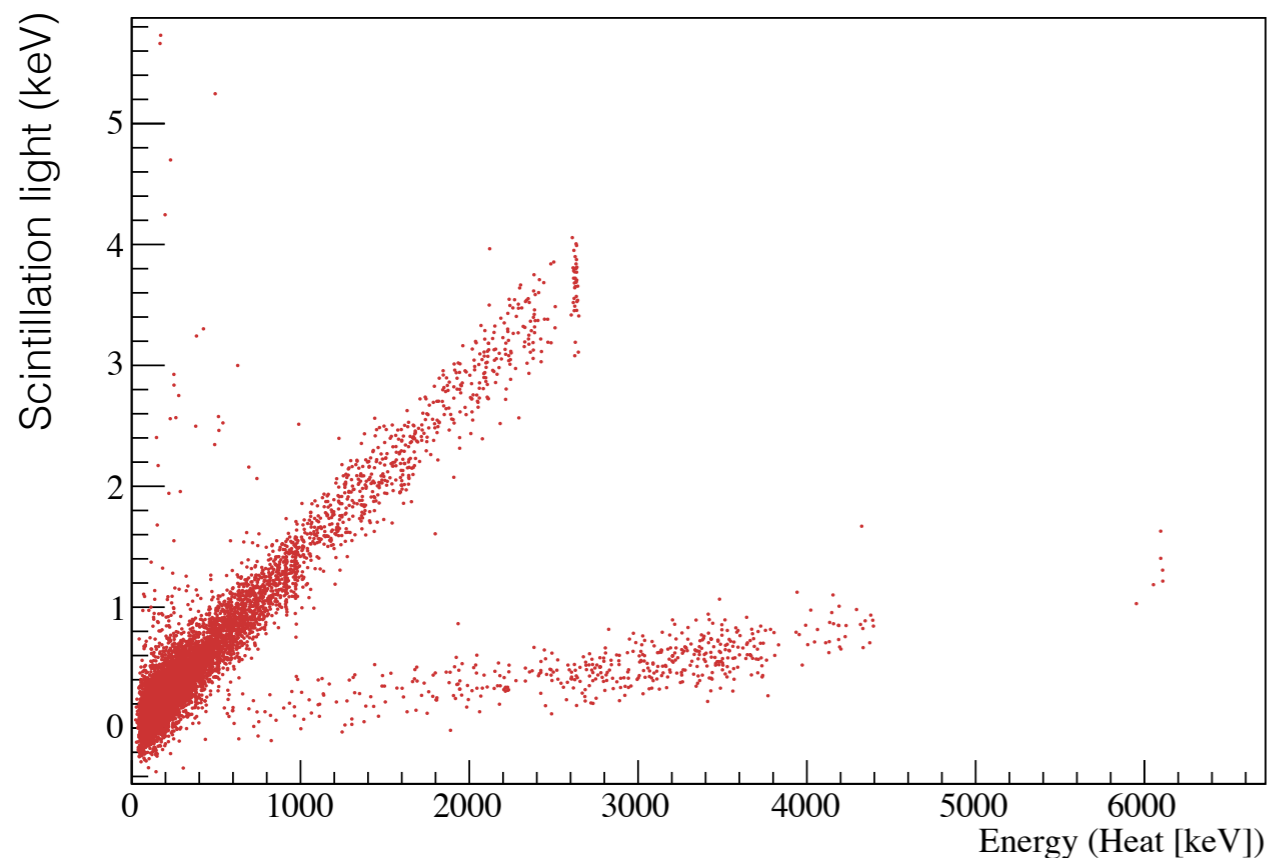
Ch21 Pompelmo - Heat detector





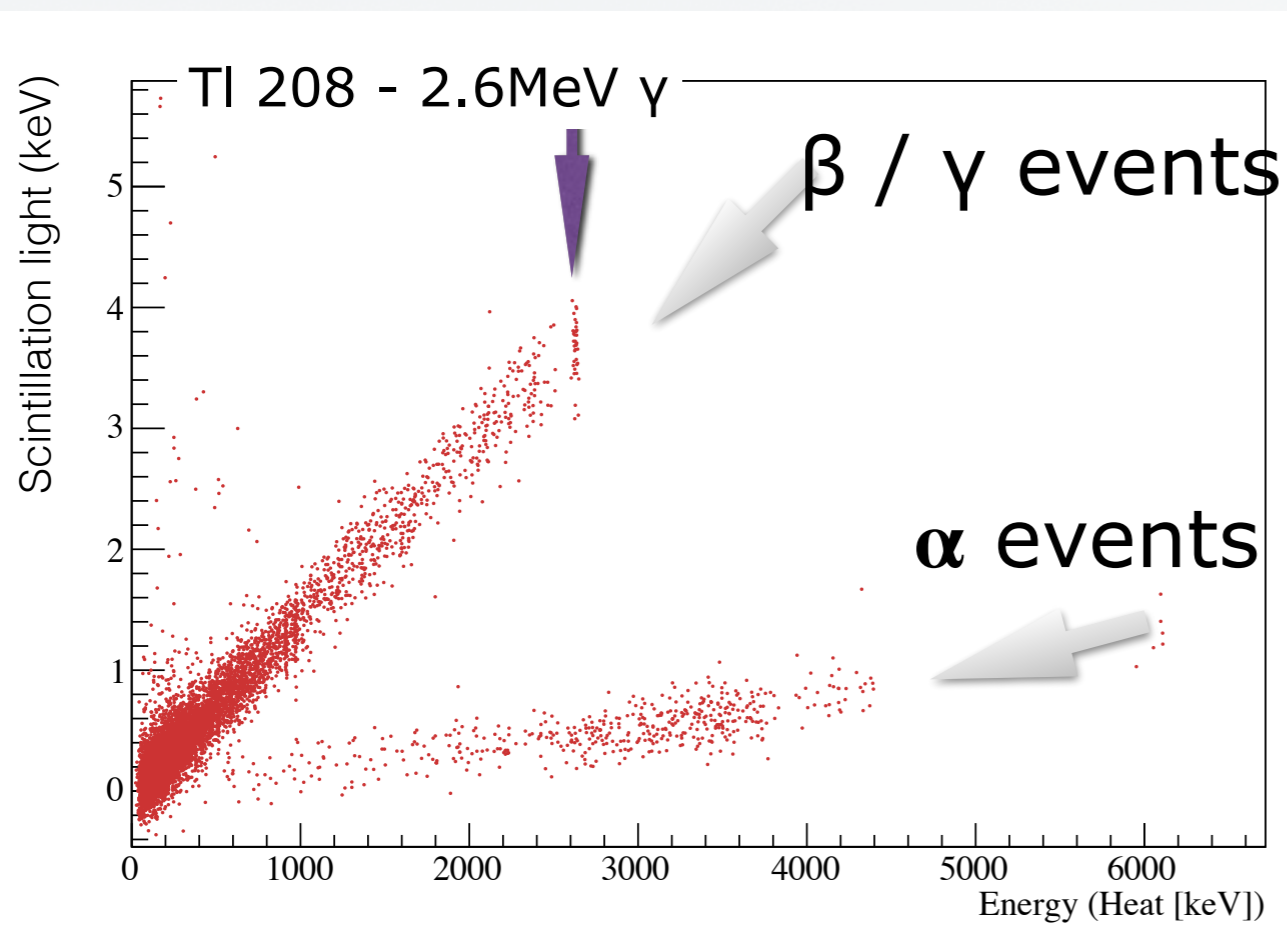
# 4. Particle discrimination

- Measuring the relation between scintillation light and the energy deposit by a particle into the detector one can identify the type.
- $\sim 11\text{mK}$   
Light detector config = GeLarge1 (RL 2+2,  $V_b=3597\text{ mV}$   $R_{bol}=6.2\text{ MOhm}$ )  
Heat detector config = Pompelomo2 (RL 1+1,  $V_b=3597\text{ mV}$   $R_{bol}=3.4\text{ MOhm}$ )  $I_{bol}=3.58\text{ nA}$   
Th228 calibration source



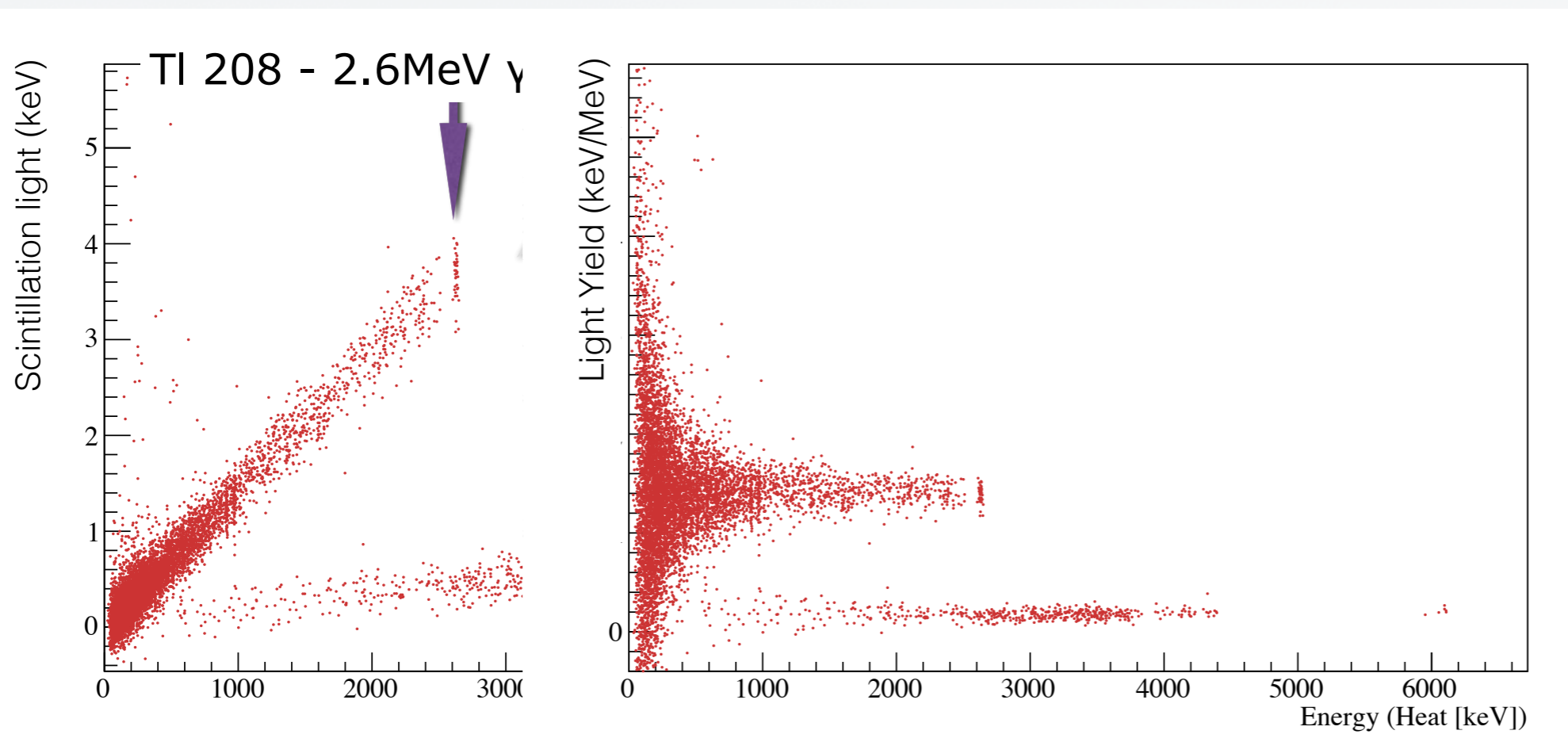
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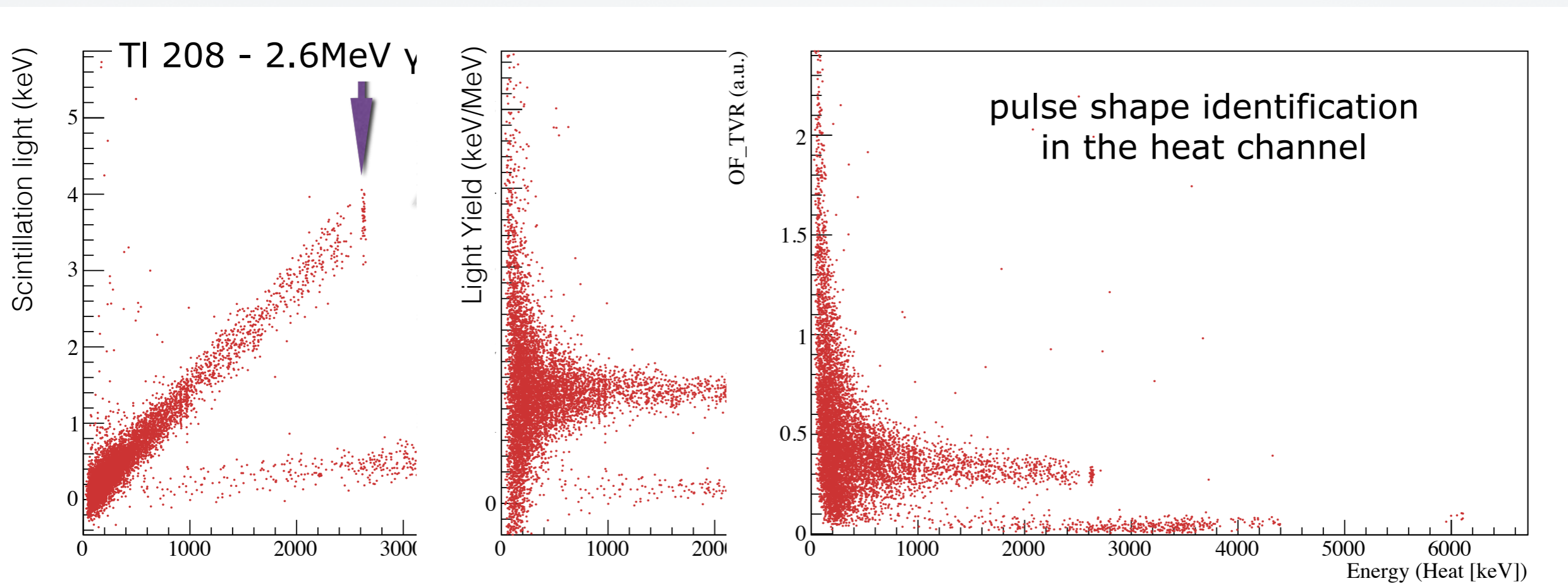
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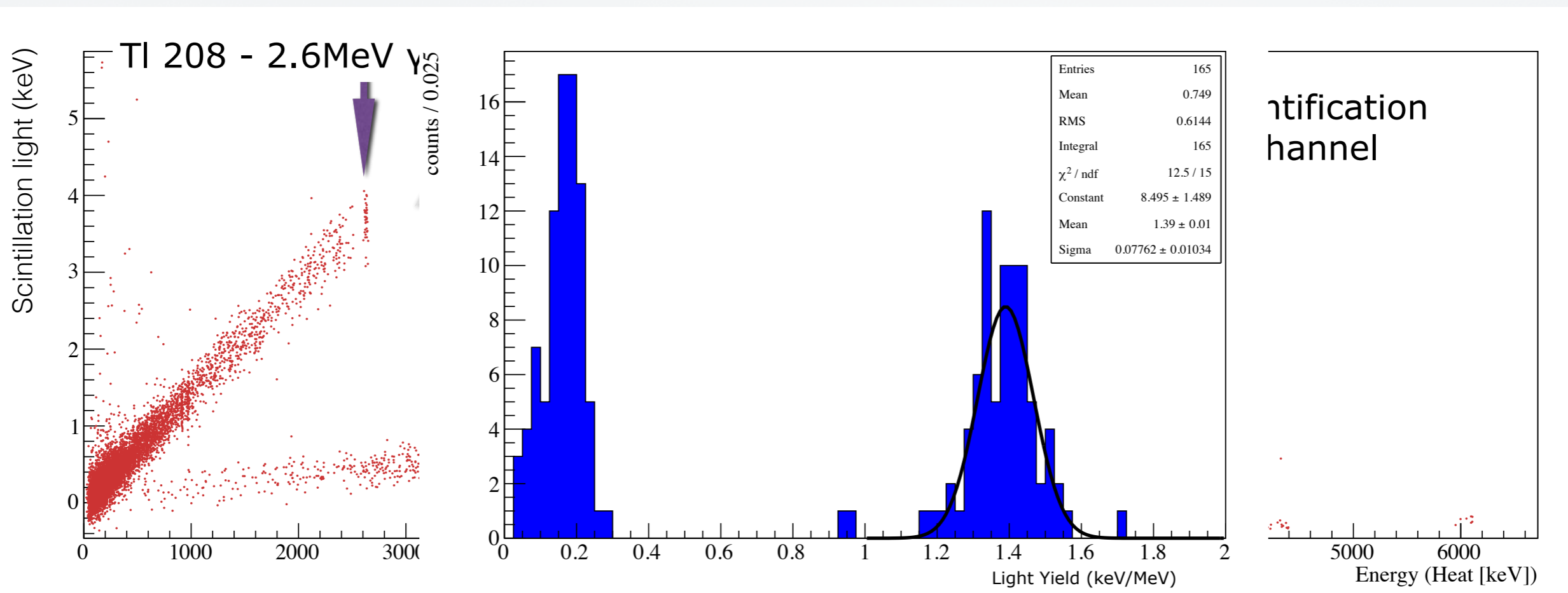
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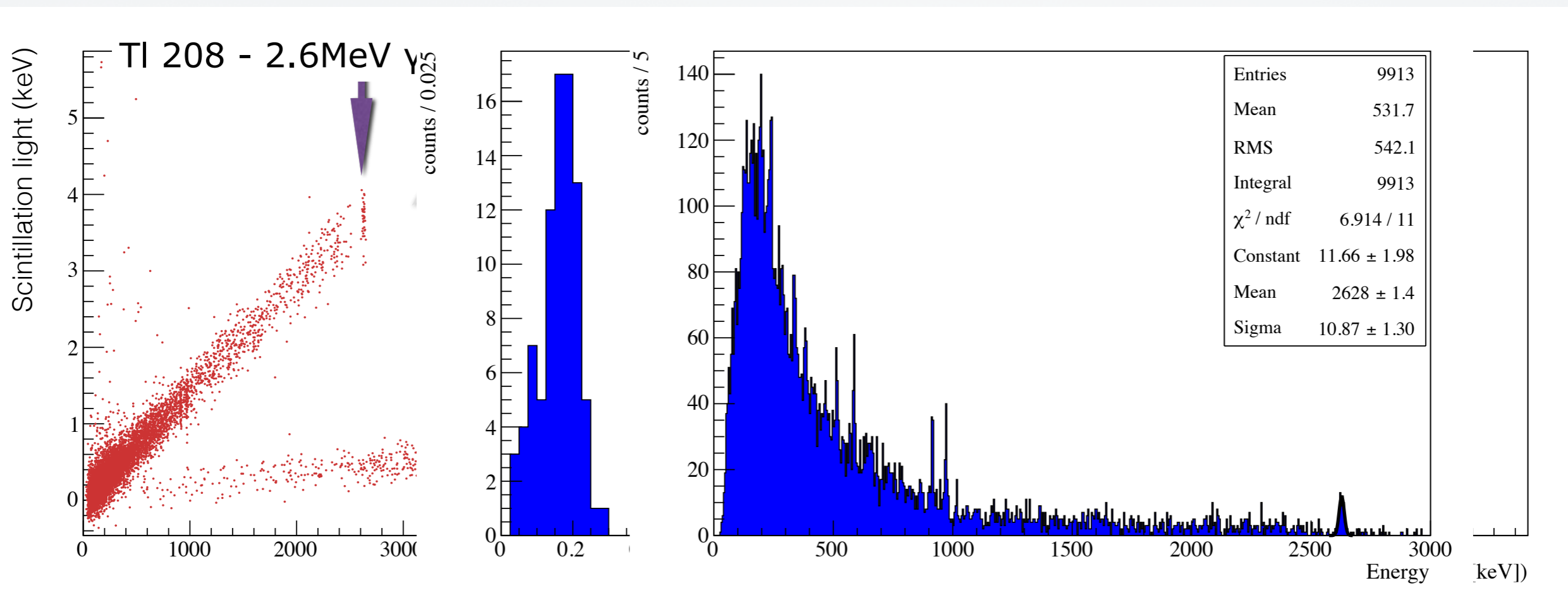
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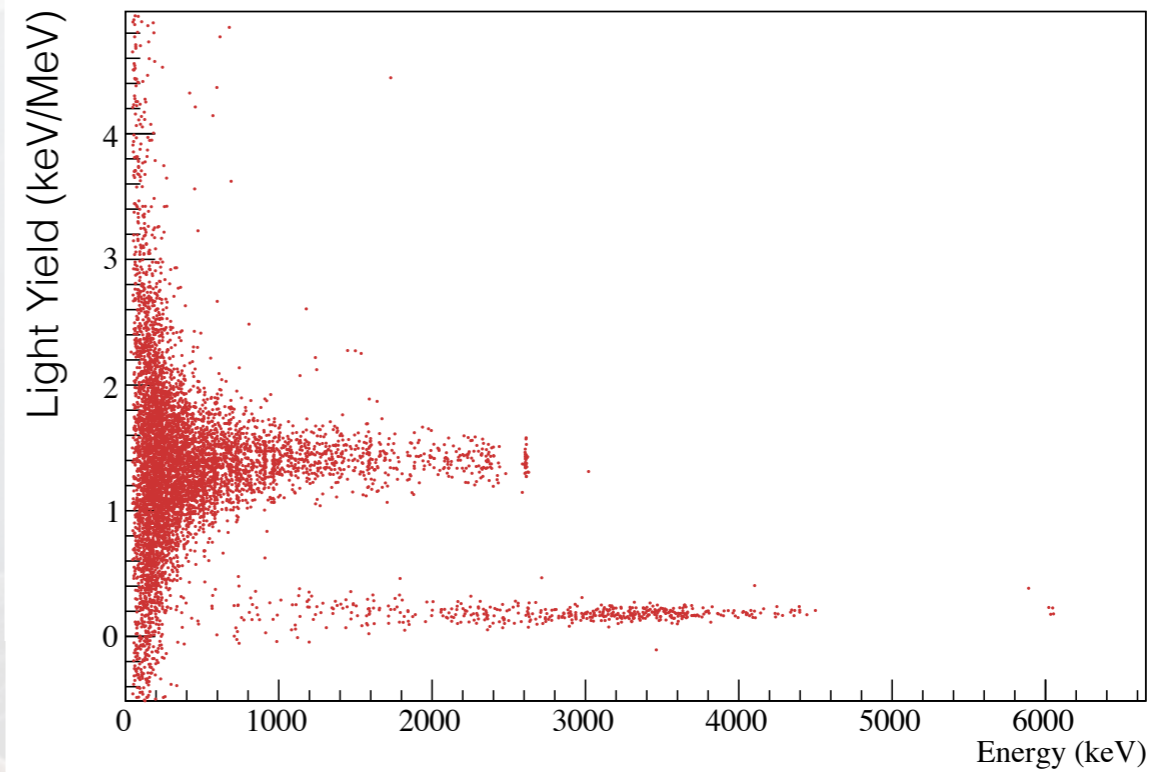
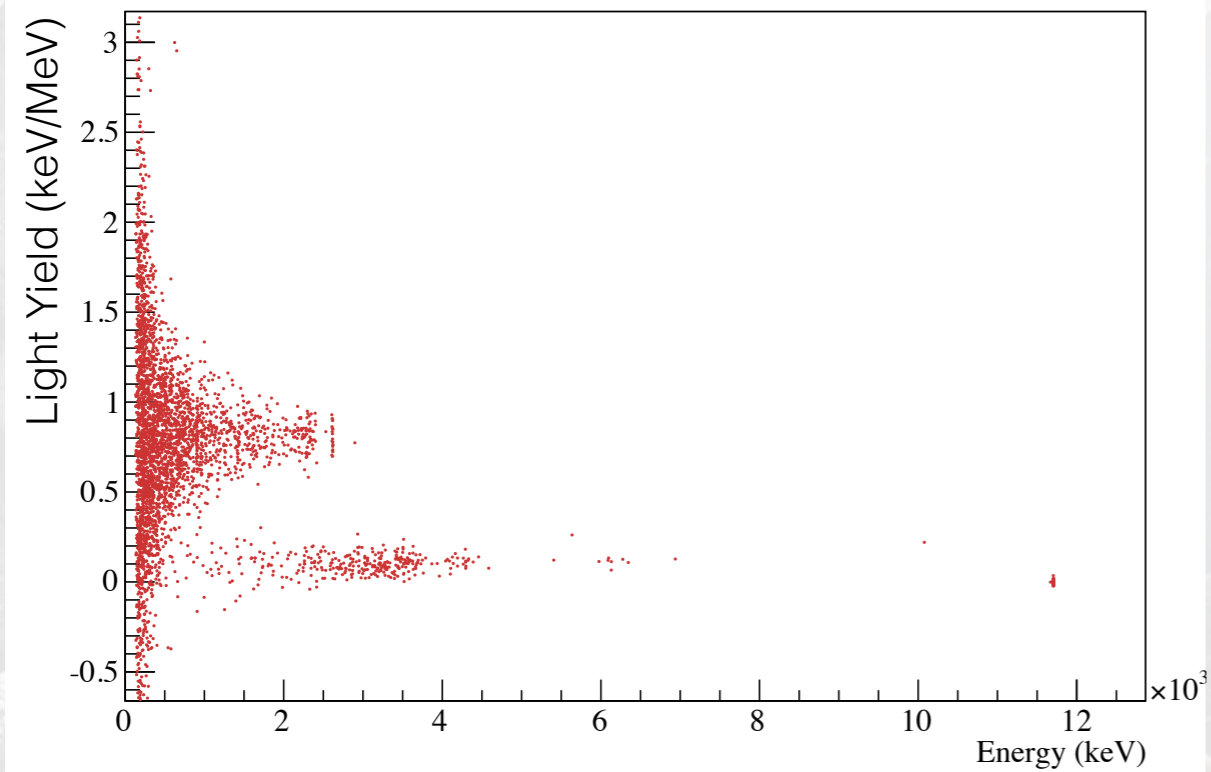


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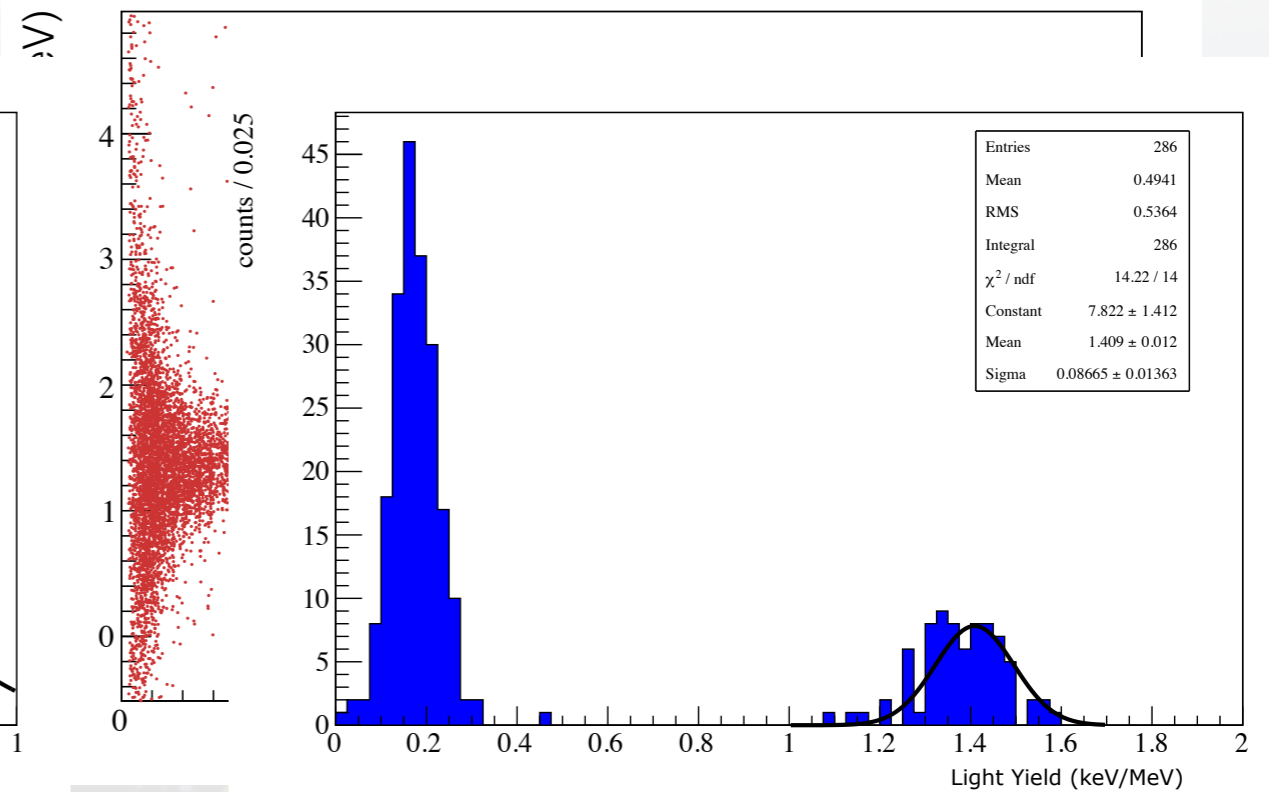
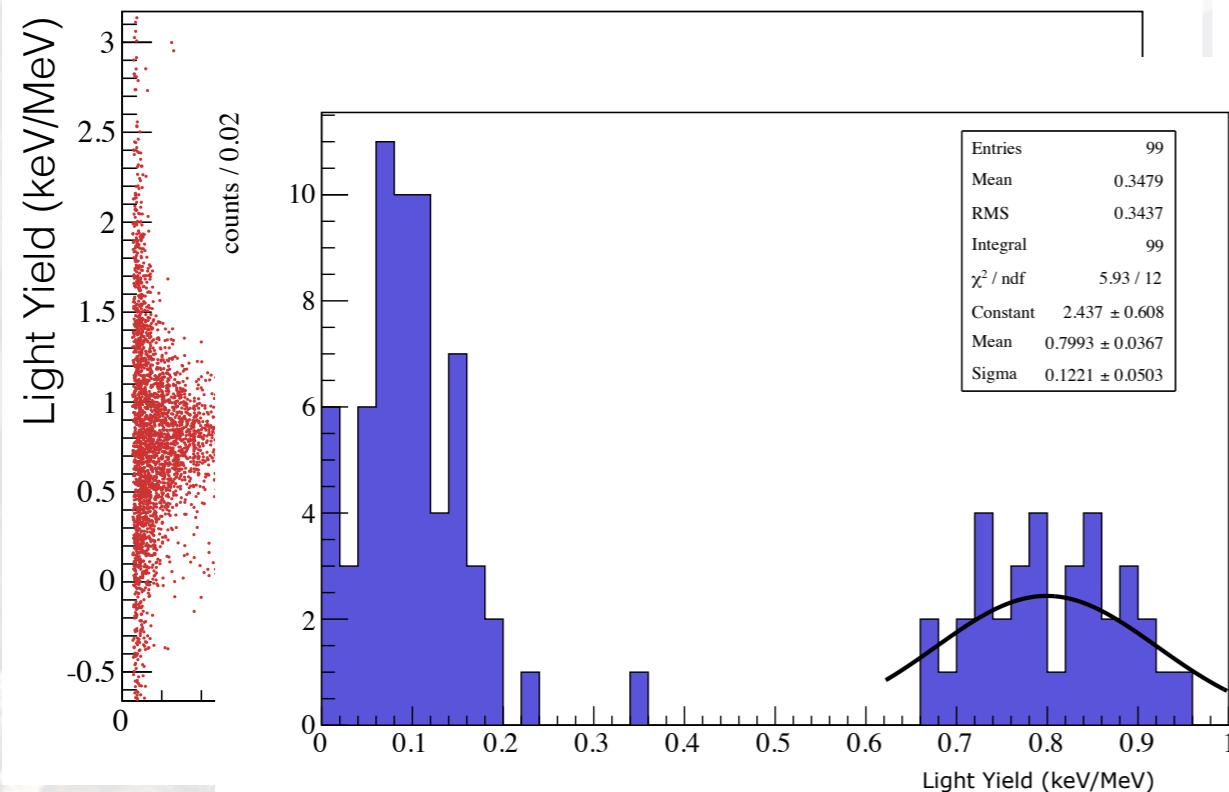




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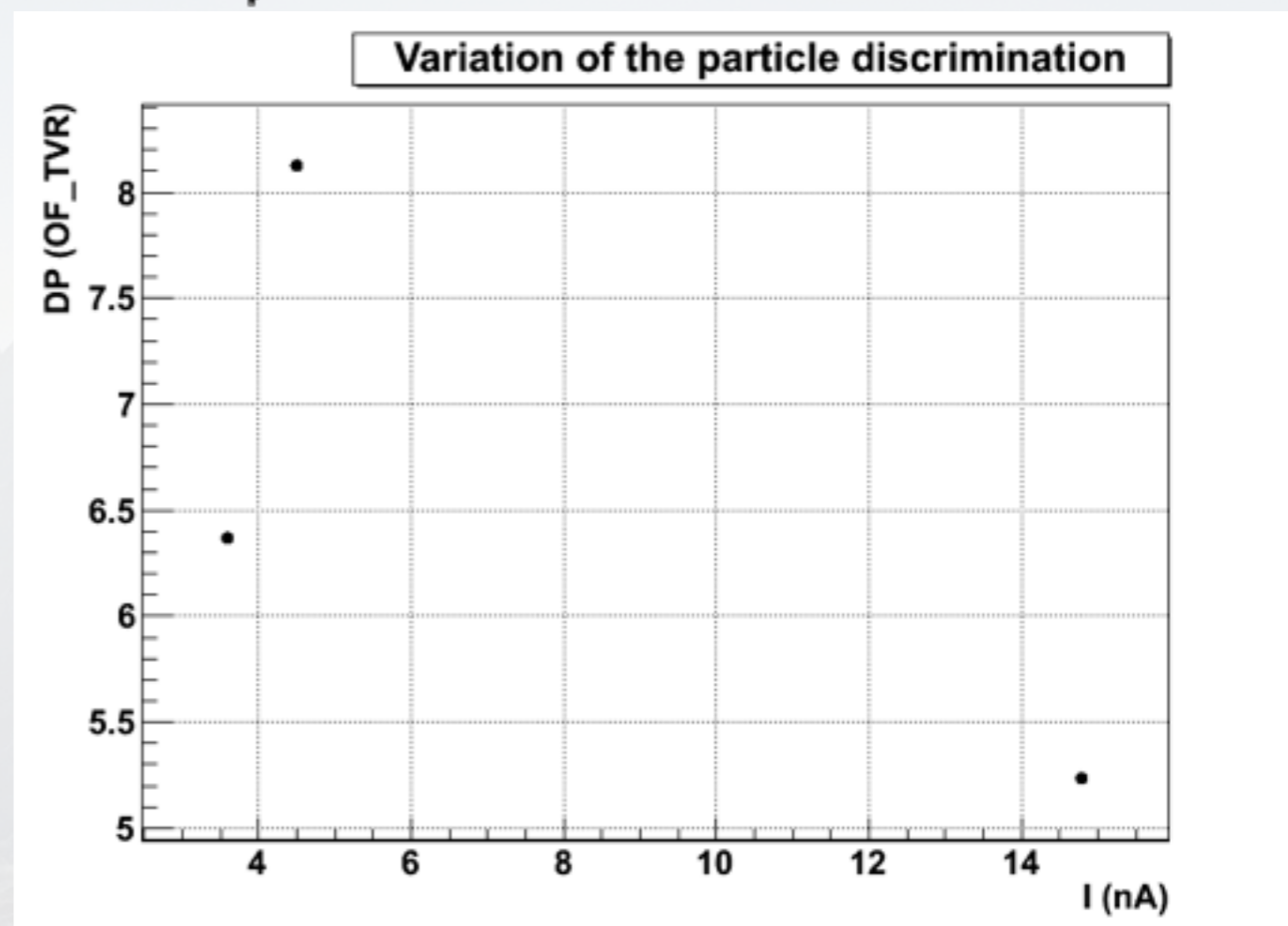
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# 4. Particle discrimination

- With the identification of the particles one can define the discrimination power.
- Comparing this feature in different running conditions one can find the best configuration of the detector in order to get the best background rejection affordable.
- Because of the lack of time the statistics are poor and we couldn't repeat one measurement that shows an unexpected behavior.
- In this sense more data and different working points would help to go further in this study.
- Nevertheless has been shown the capabilities of this kind of detector to discriminate backgrounds.

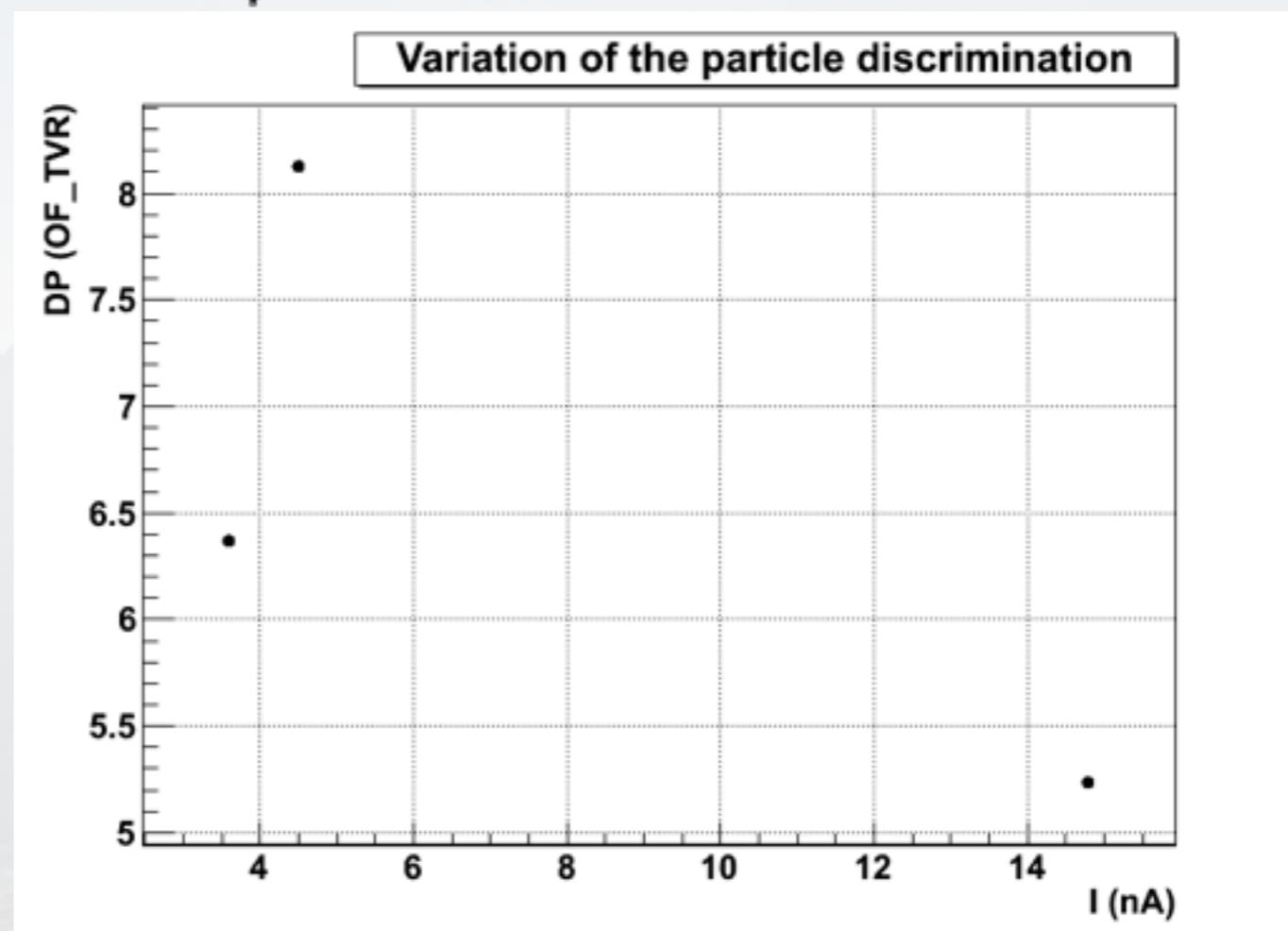
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We would like to greatly thank Dr. Luca Pattavina for the guidance and letting us take part in this new rare events detector technology.

Also we would like to thank the LNGS for this Summer Institute.