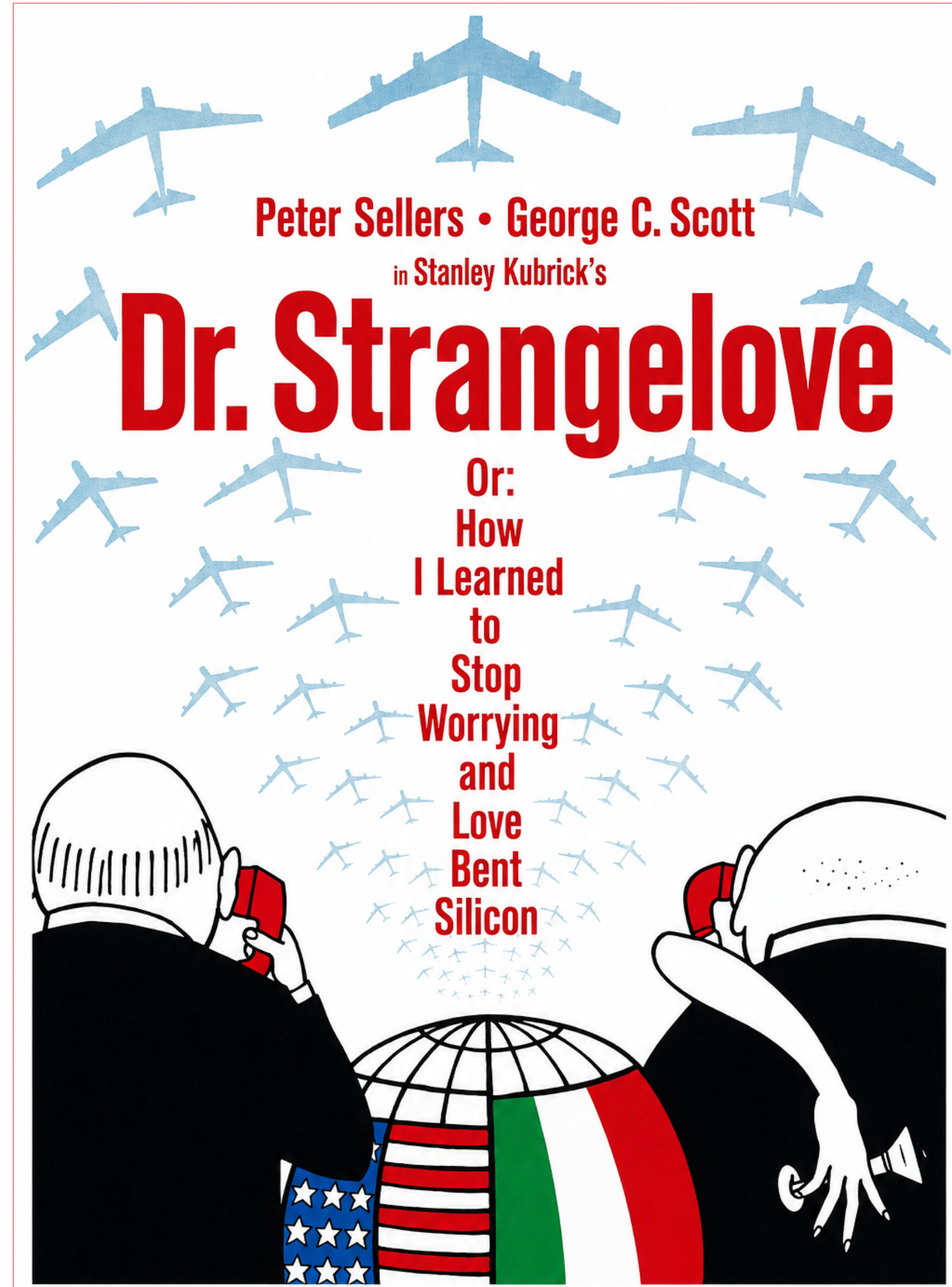
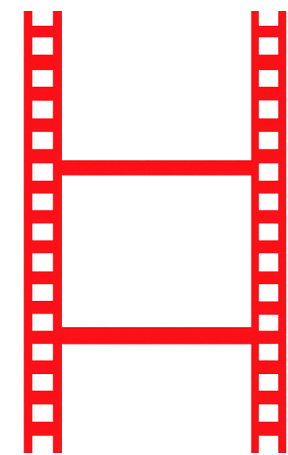


How
I Learned
to
Stop
Worrying
and
Love
Bent
Silicon



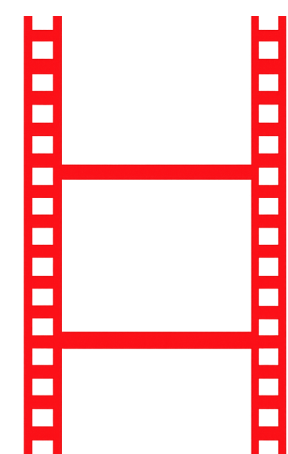
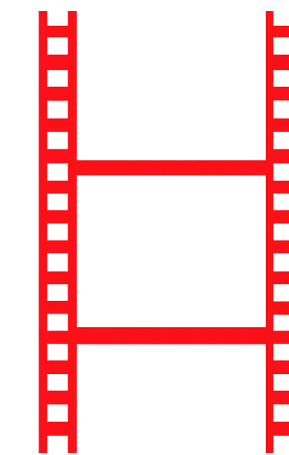
Domenico Colella
University and INFN Bari





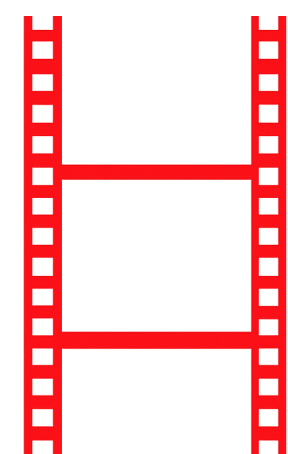
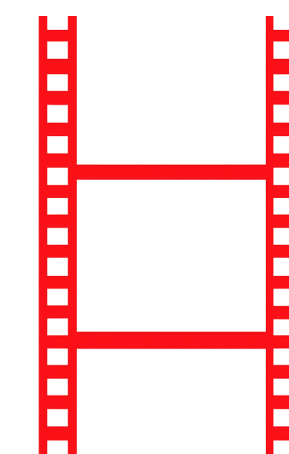
ACT I

Learning how to operate and build a vertex detector



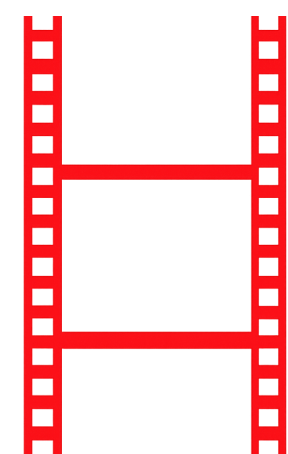
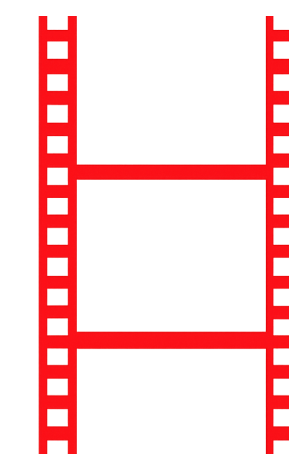
ACT II

First steps toward a new way of building vertex detectors



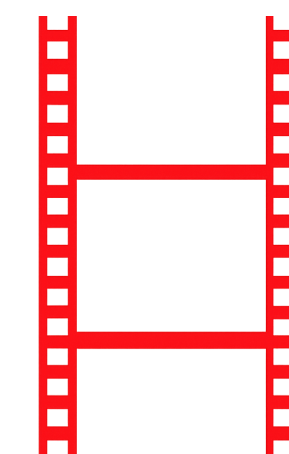
ACT III

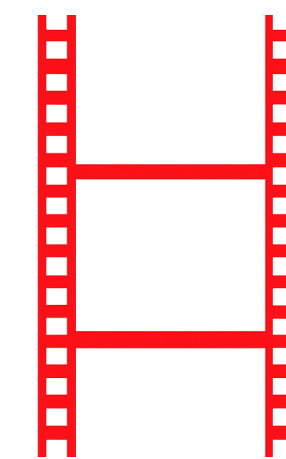
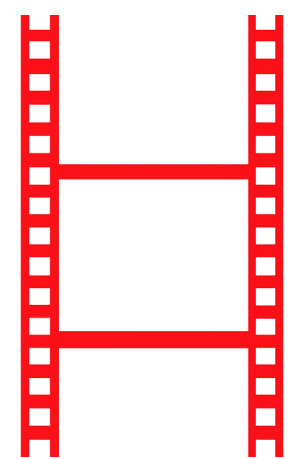
Designing and building the SVT Inner Barrel



Epilogue

To the future and beyond

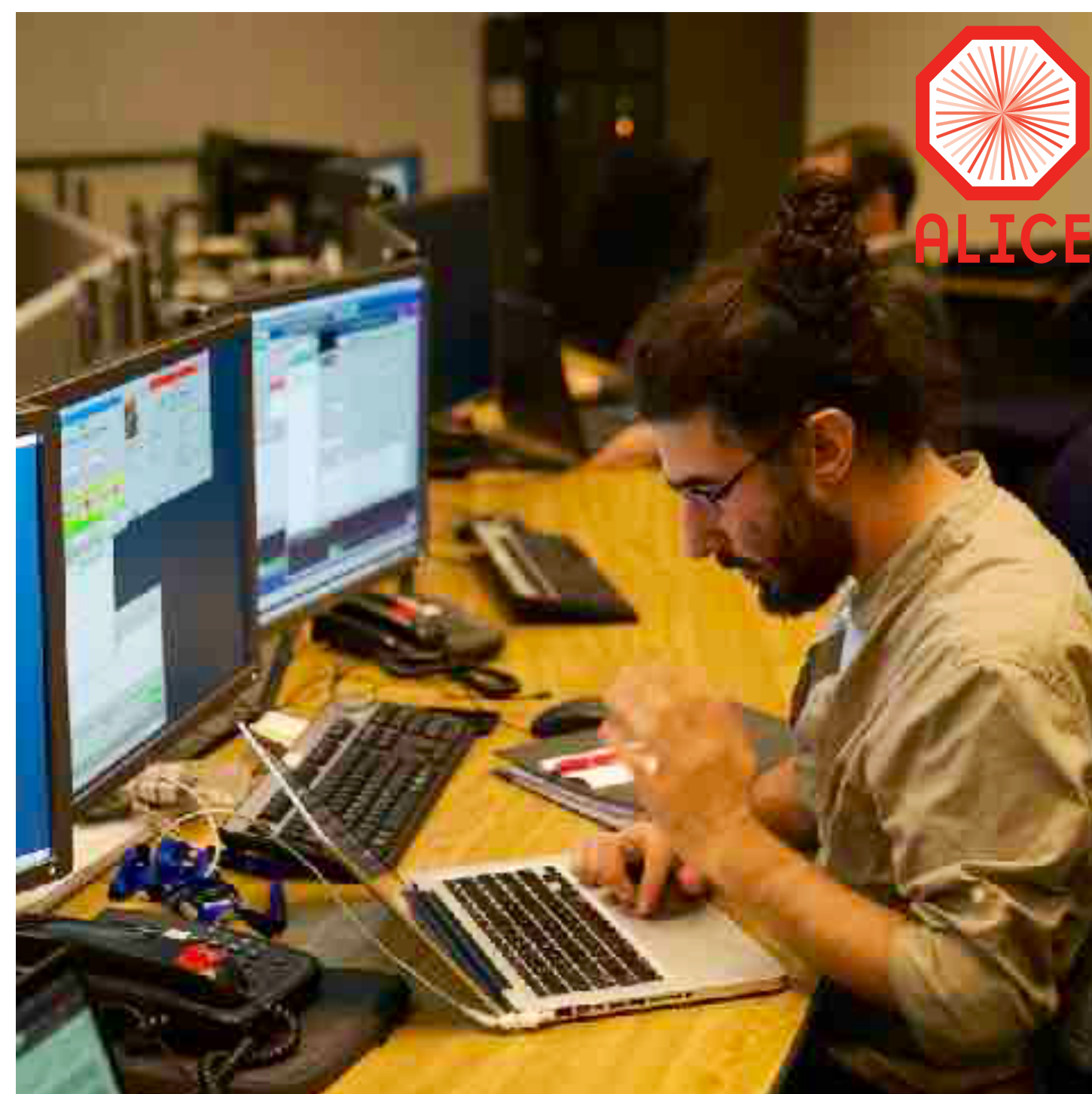




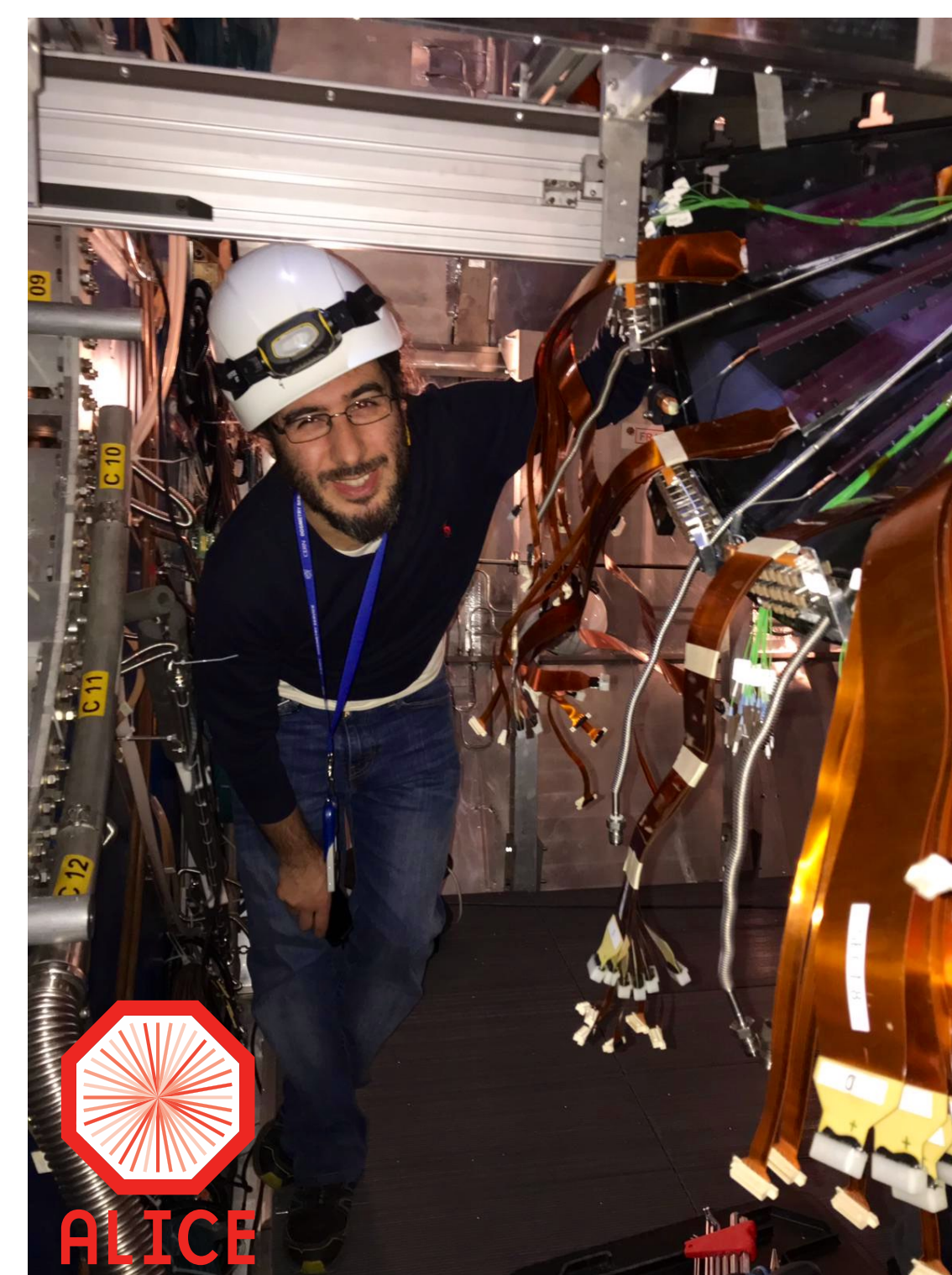
ACT I

Learning how to operate and build a vertex detector

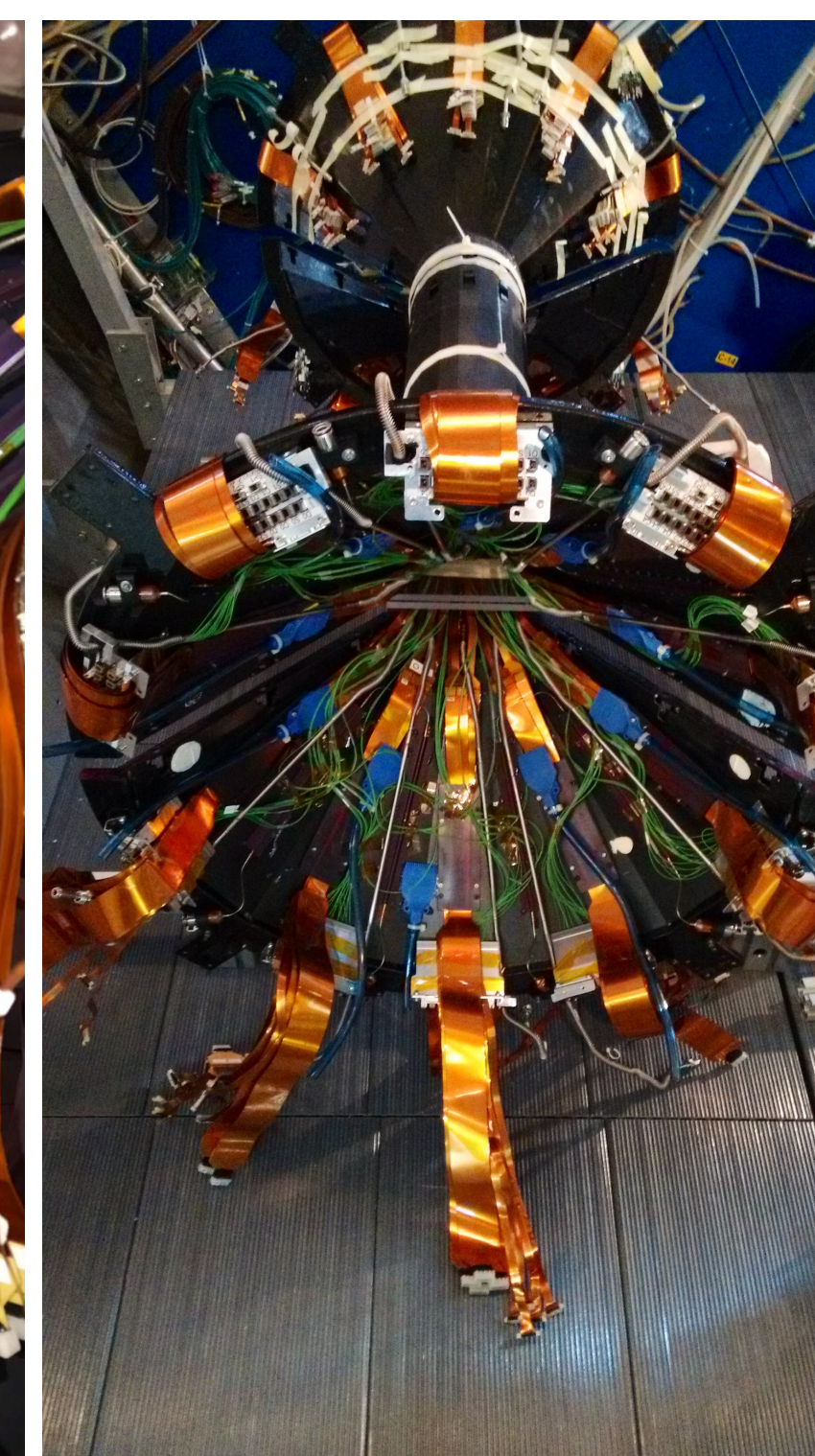
Scene 1

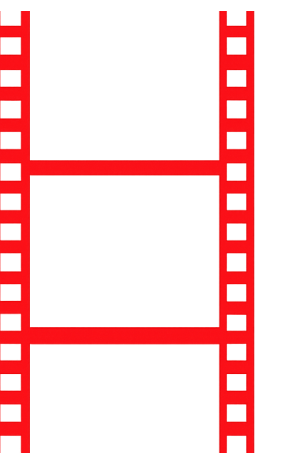
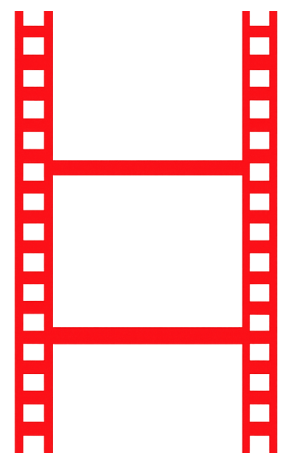


Young me spending hours in ALICE control room taking care of the noisy pixels of the Silicon Pixel Detector (SPD) innermost layers of the ITS



Up to the last breath at the end of LHC Run2



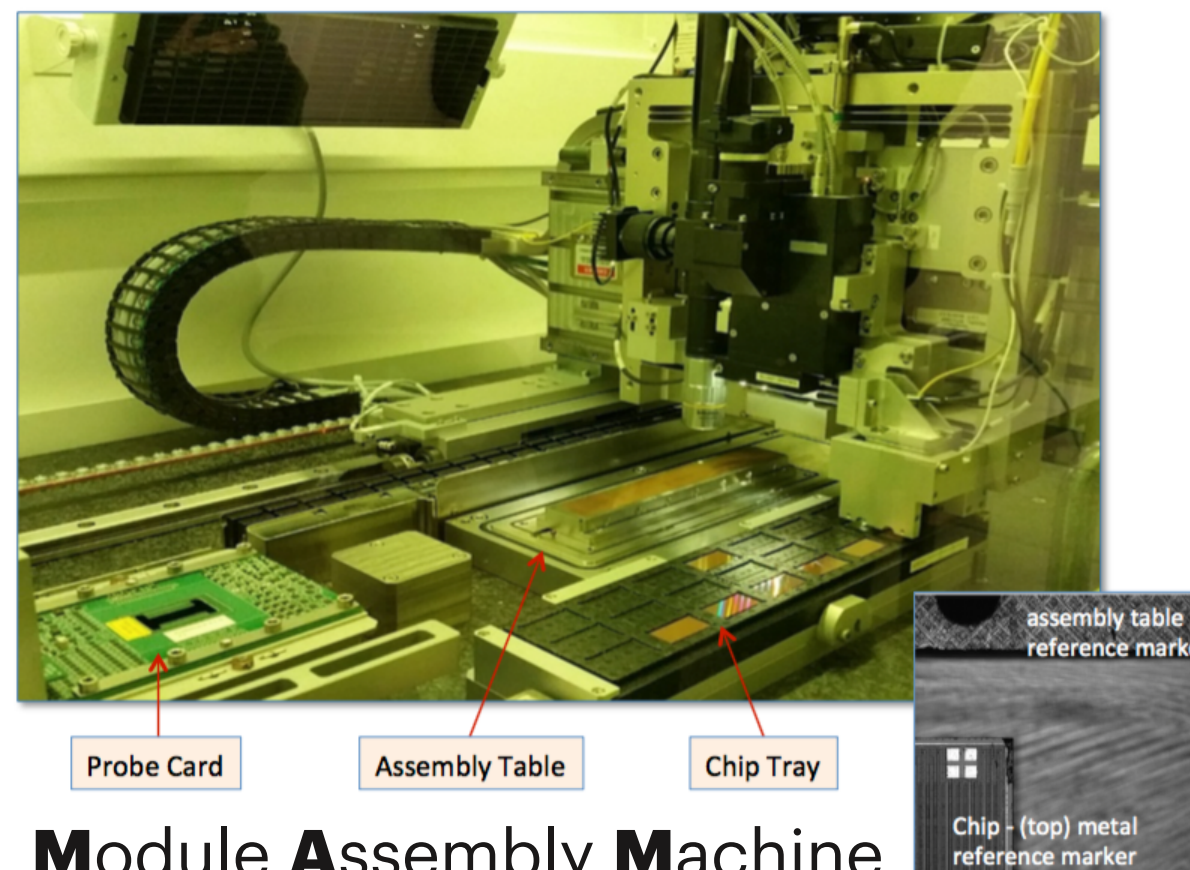
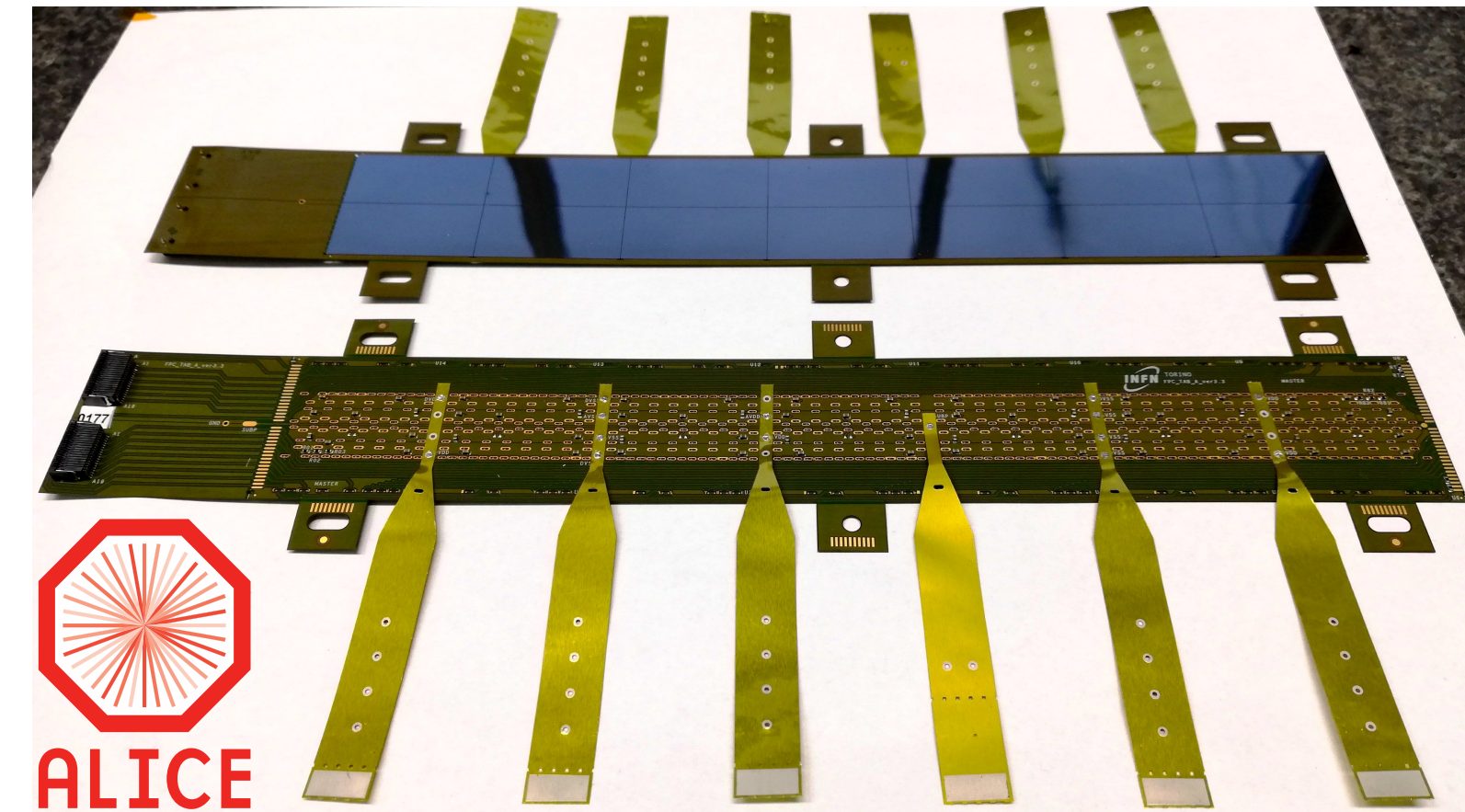


ACT I

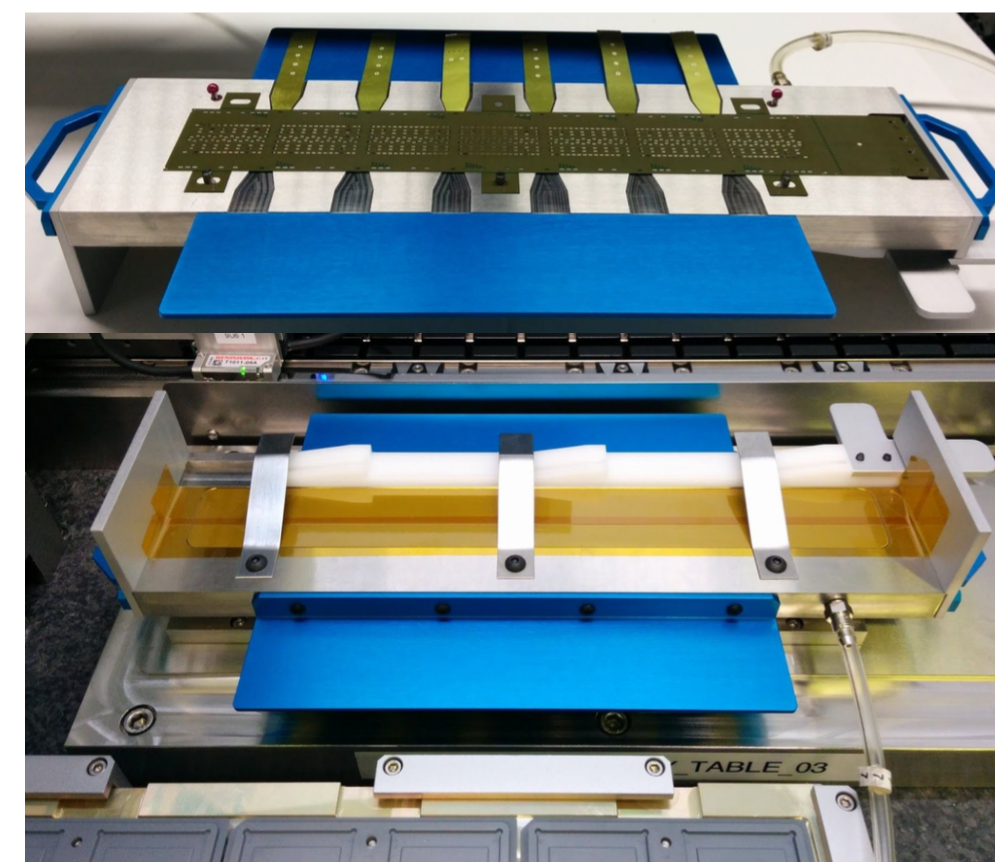
Learning how to operate and build a vertex detector

Scene 2

Coordinating the effort for the constructions of the Hybrid Integrated Circuit (HIC), modules of the ALICE ITS2 outer barrel staves

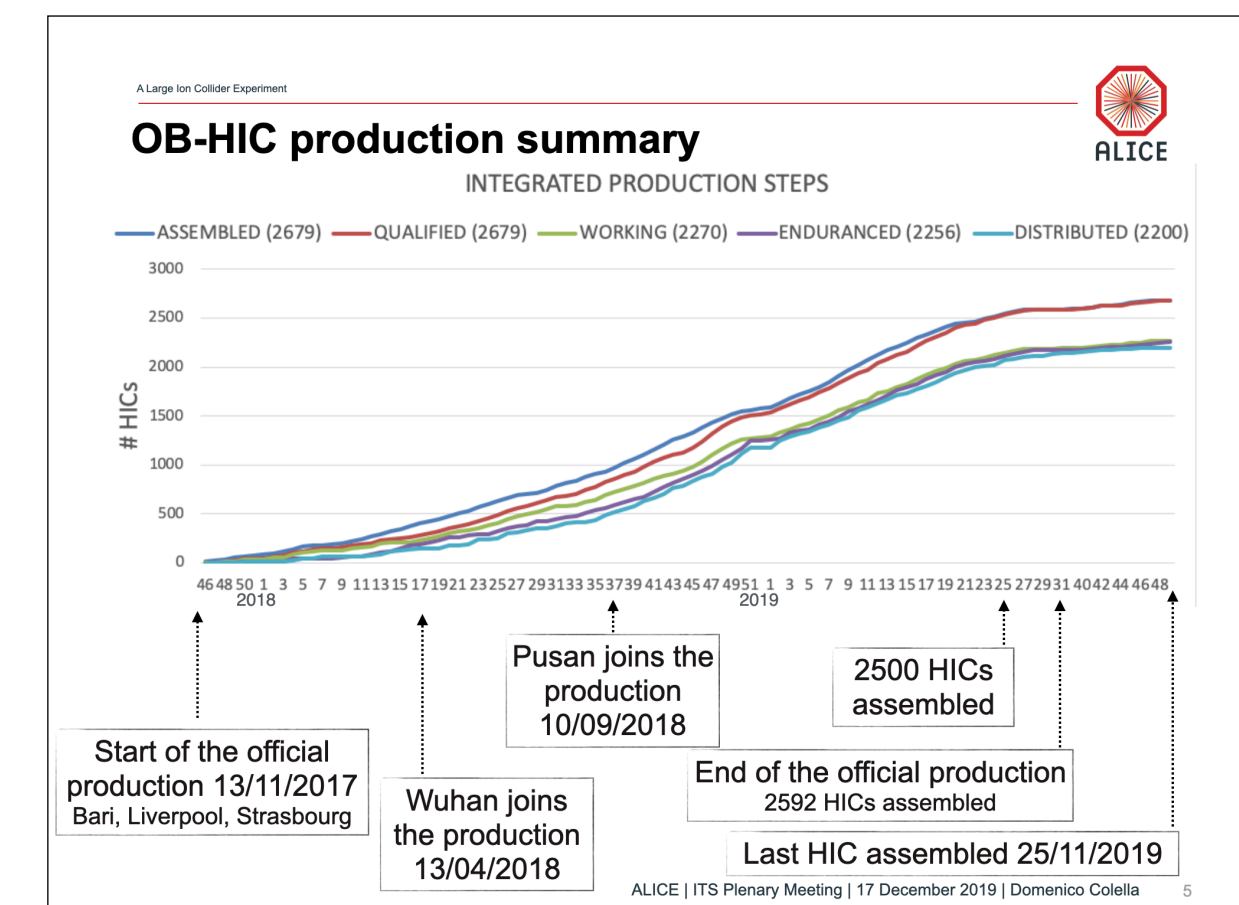
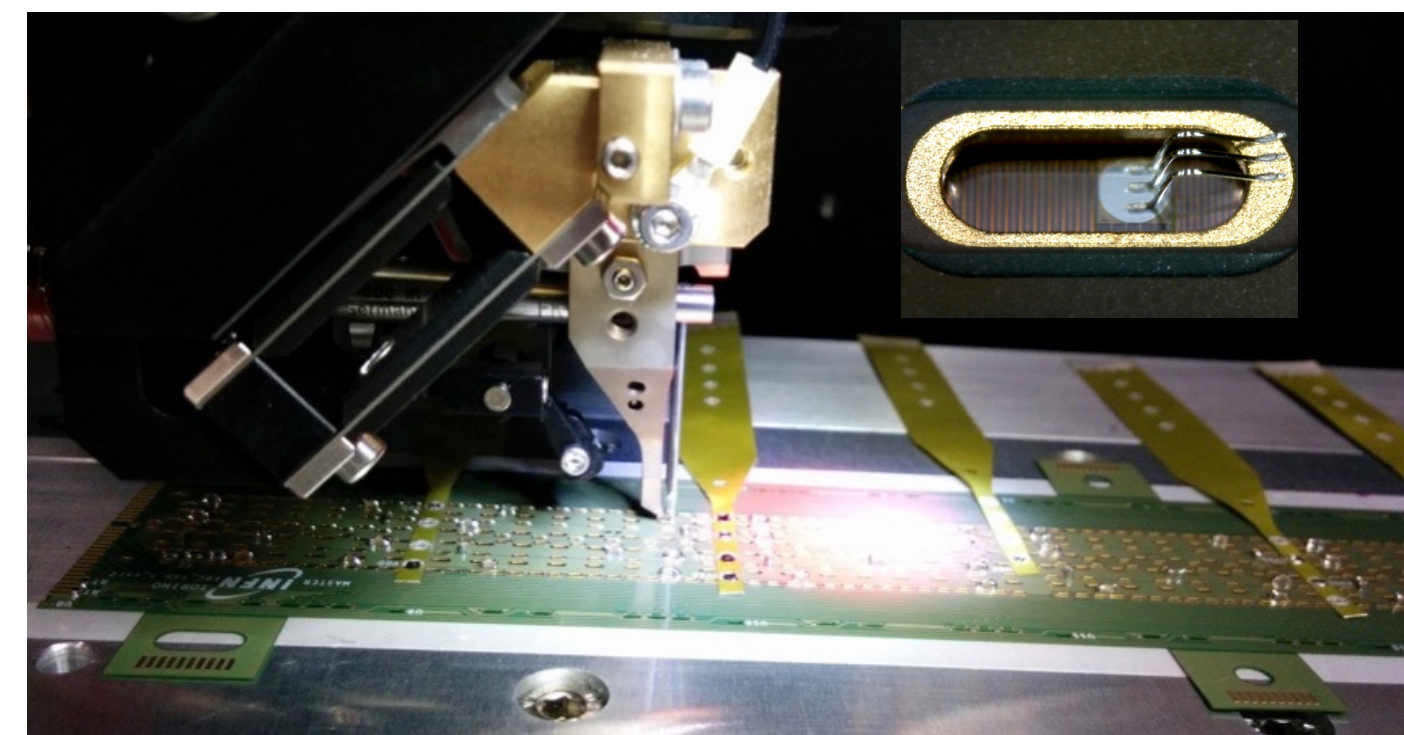


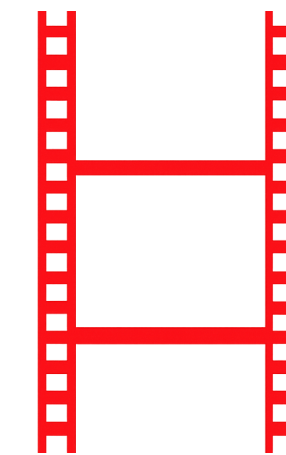
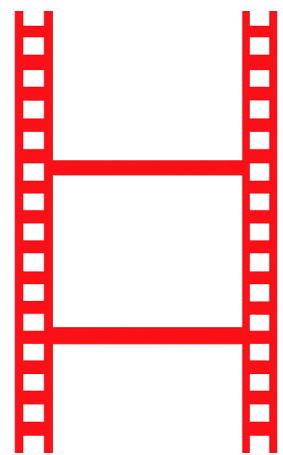
Module Assembly Machine
» 5 μ m precision chip placement
» Automatic chip inspection



FPC gluing to chips

Wire-bonding





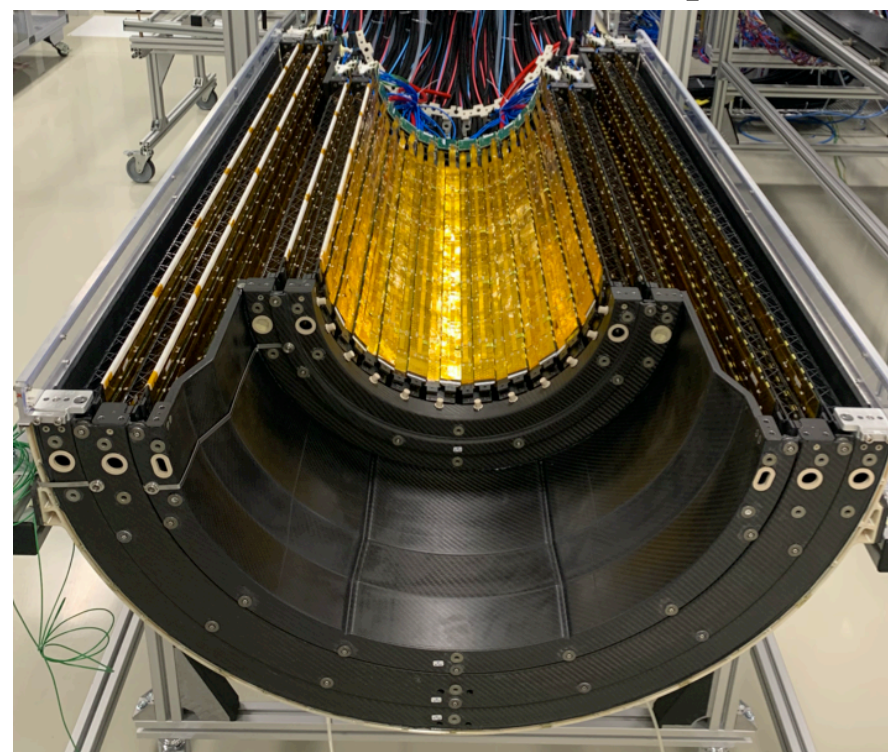
ACT I

Learning how to operate and build a vertex detector

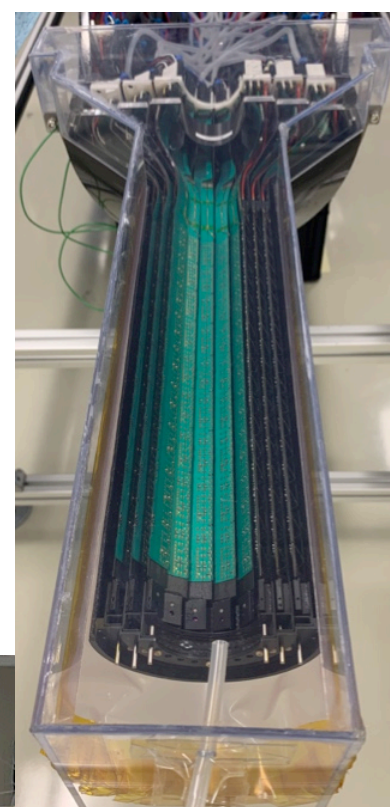
Scene 3

Guiding the ALICE ITS2 commissioning phase, up to the installation, as the System Run Coordinator.

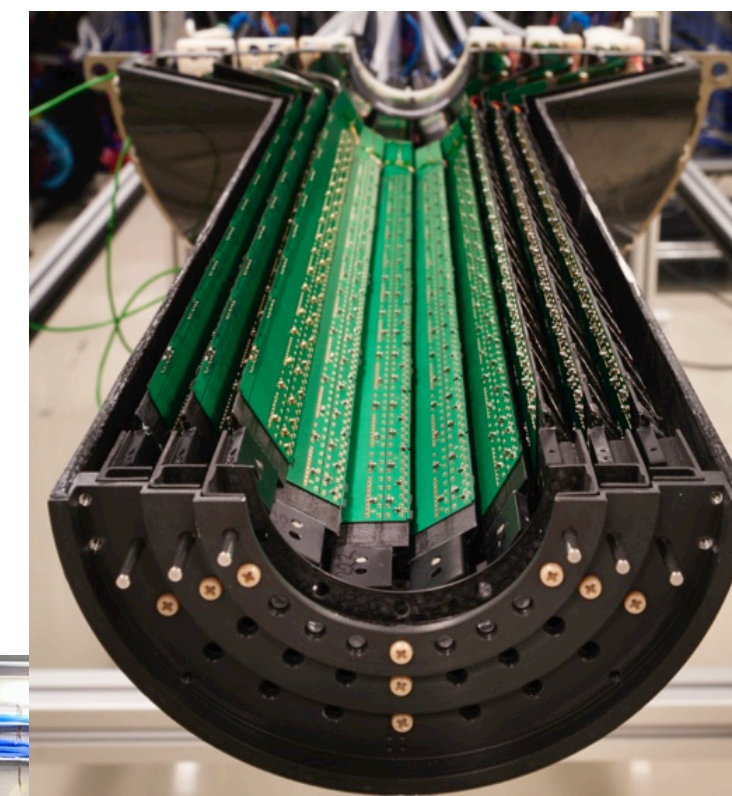
Outer Barrel Top



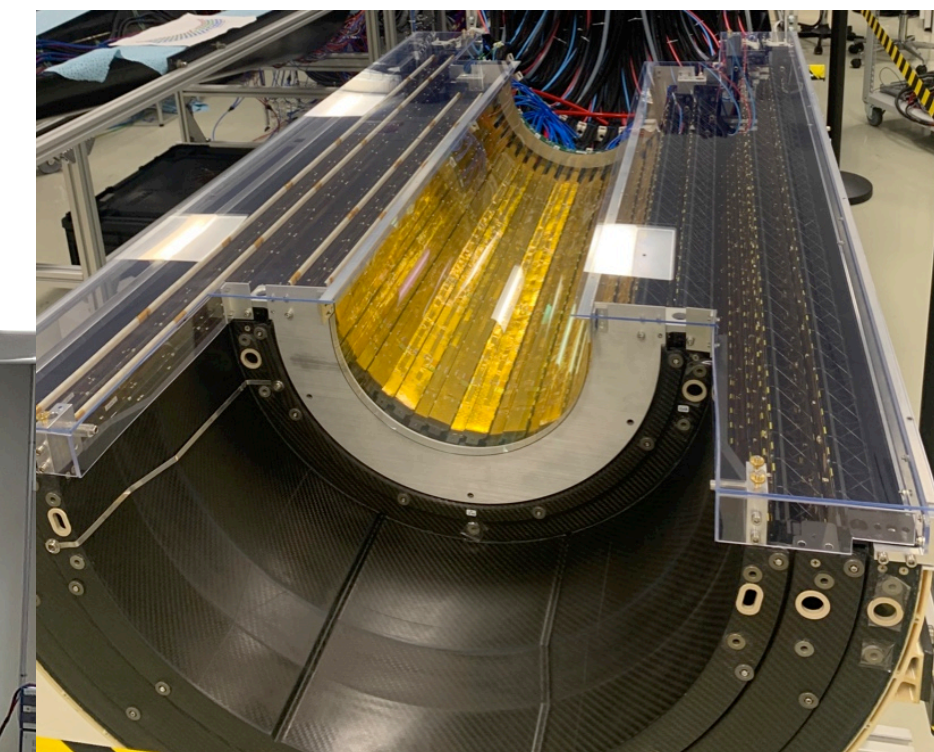
Inner Barrel Top

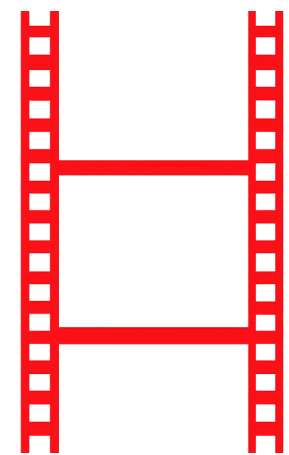


Inner Barrel Bottom



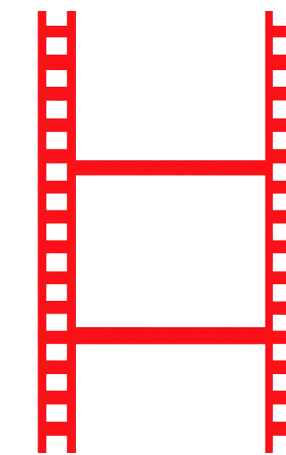
Outer Barrel Bottom



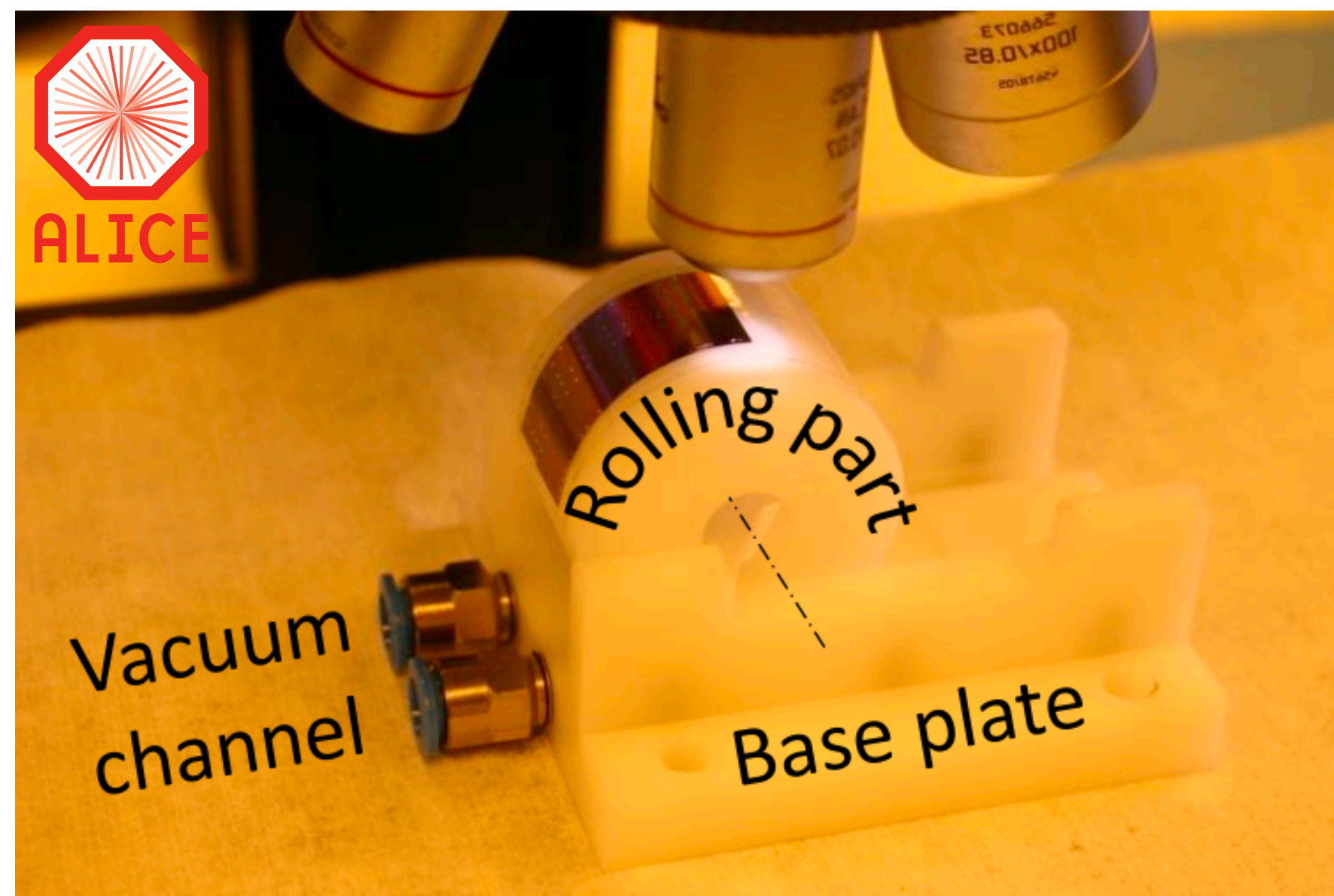
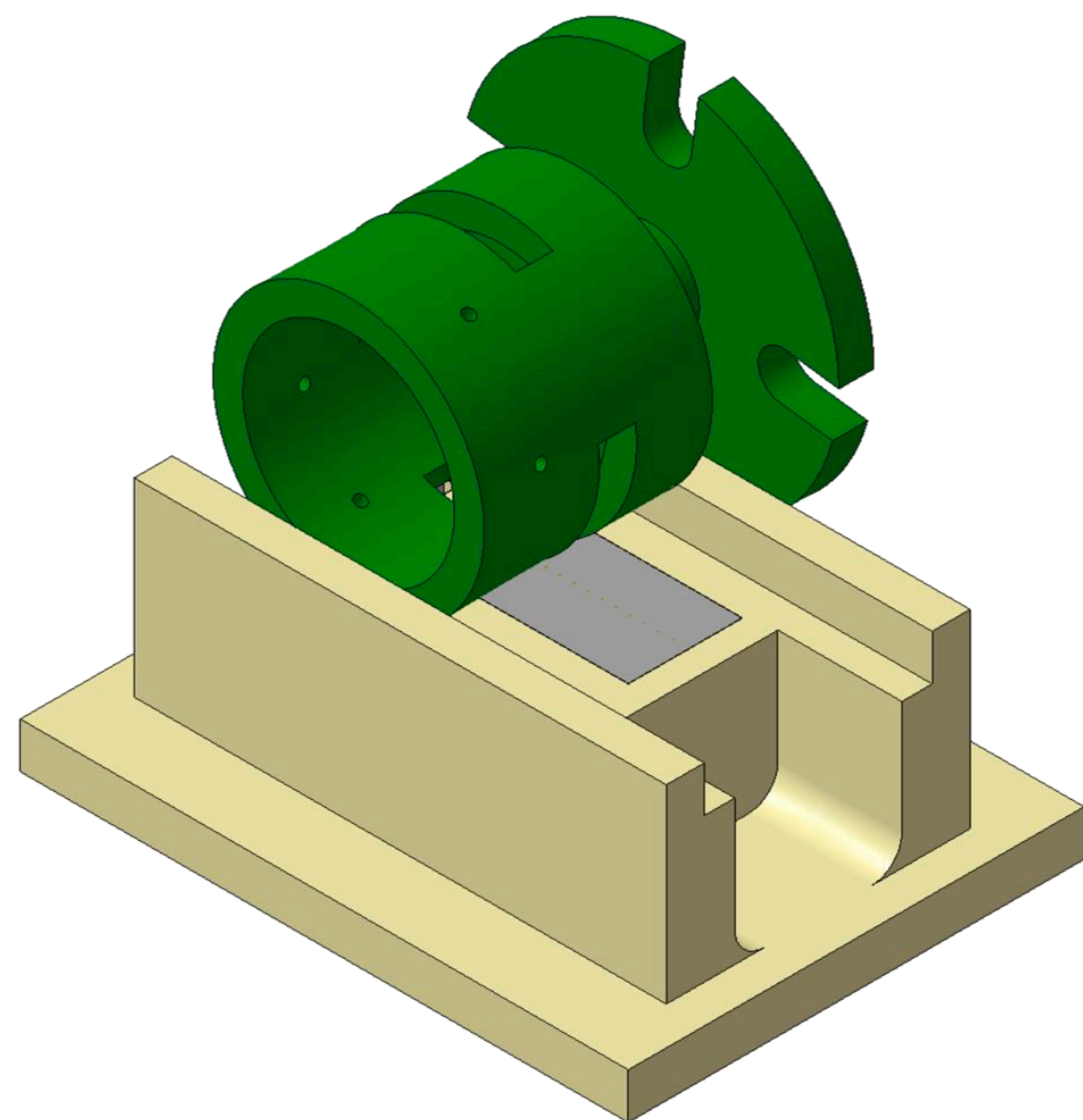


ACT II

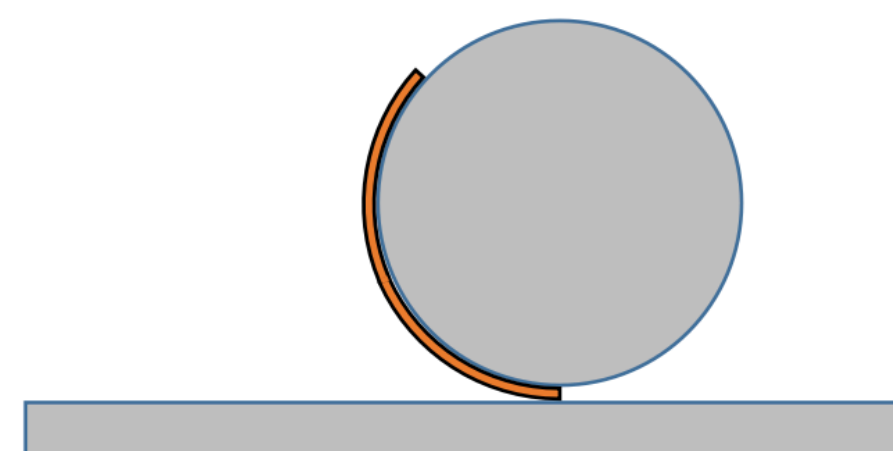
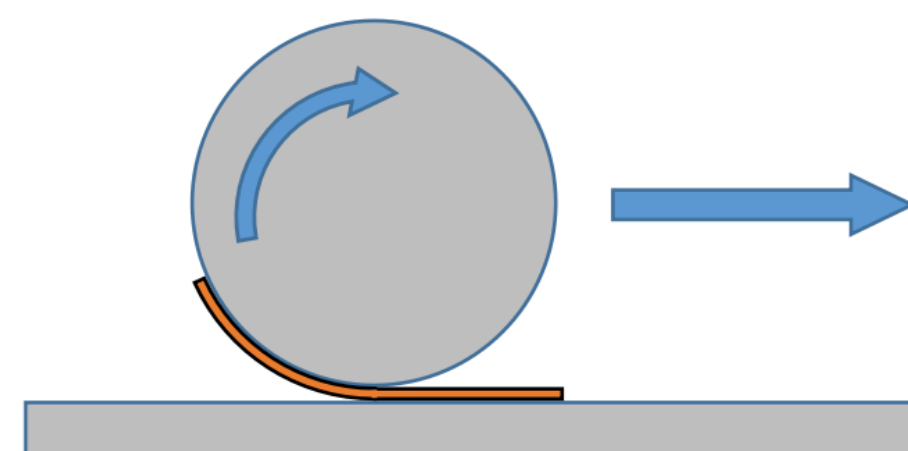
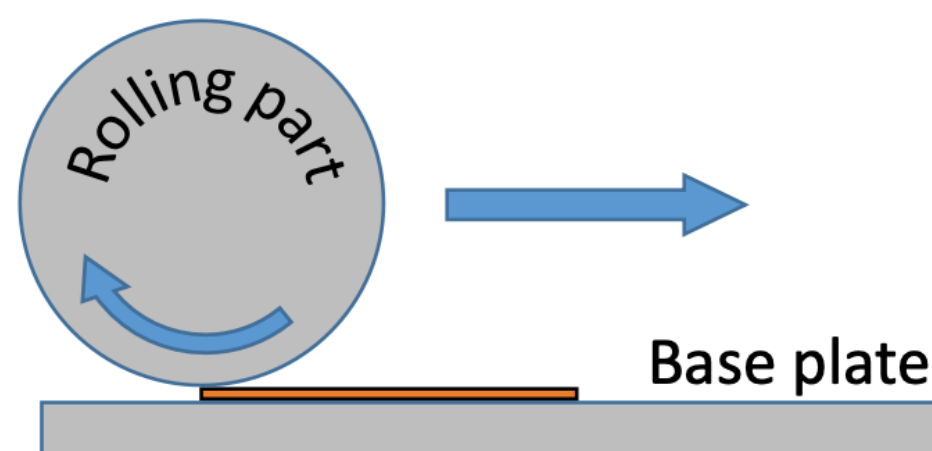
First steps toward a new way of building vertex detectors

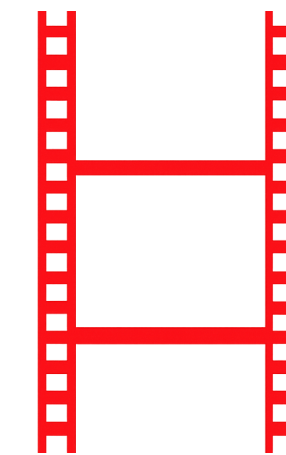
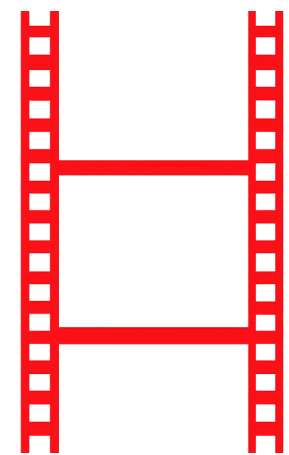


Scene 1



Back in 2020
very first idea for
bending small sizes
sensors in Bari within
the ALICE ITS3 project

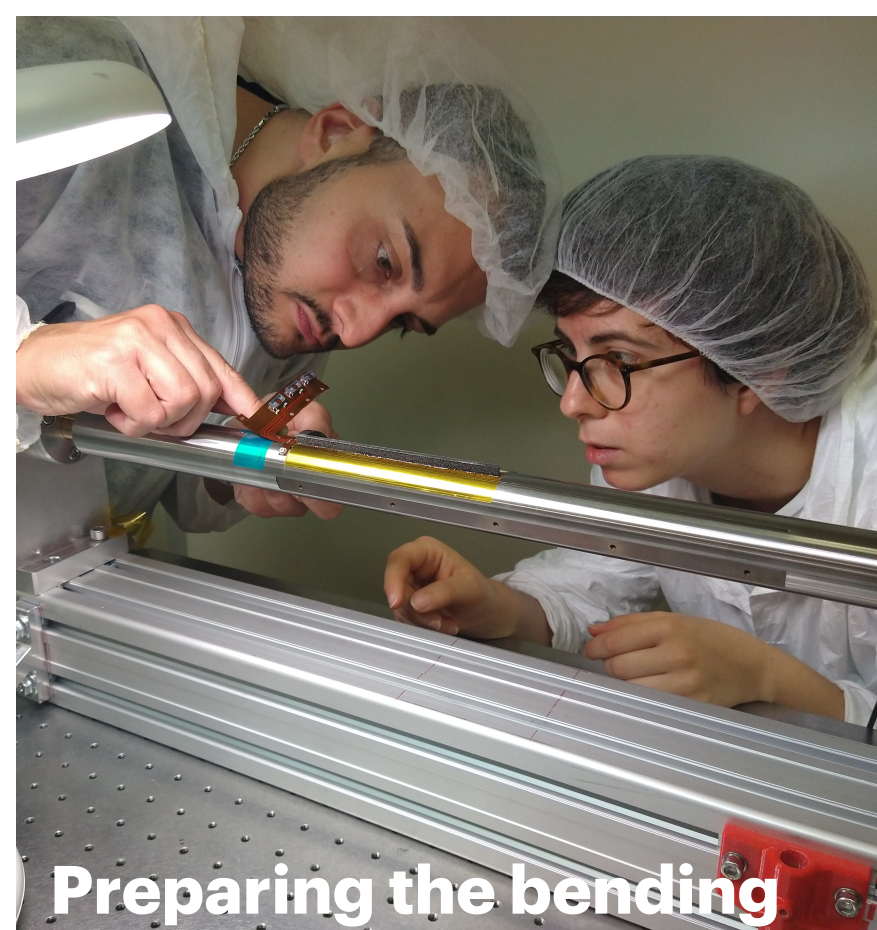
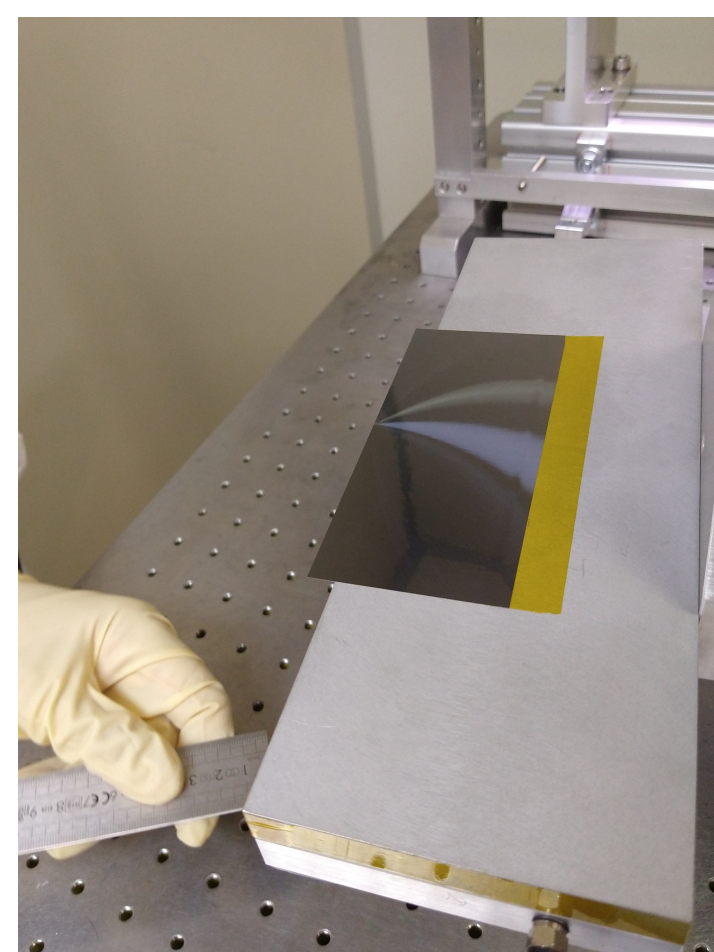
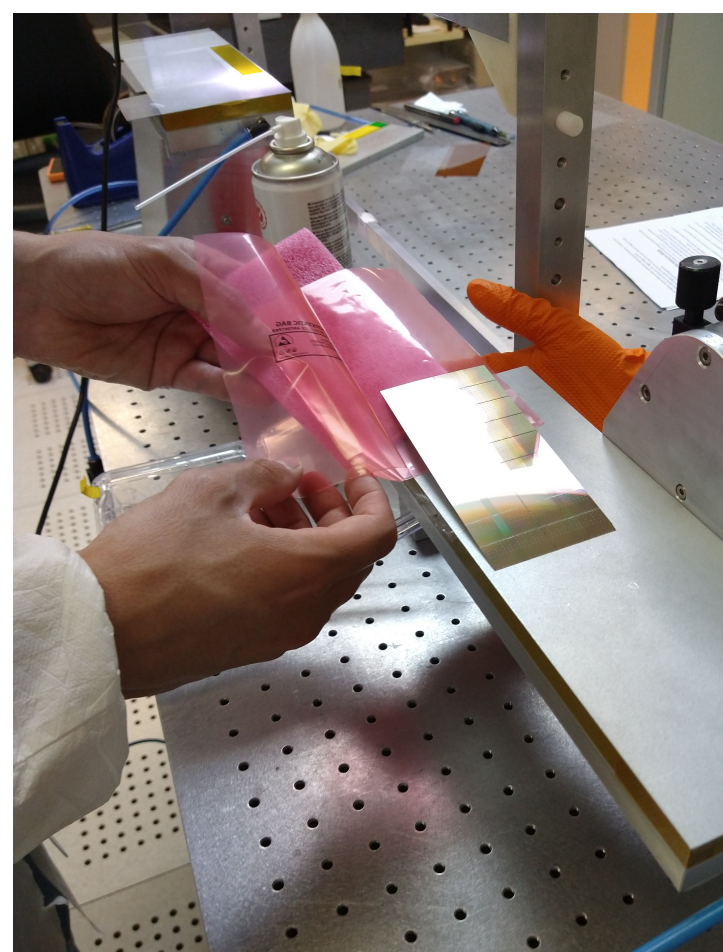




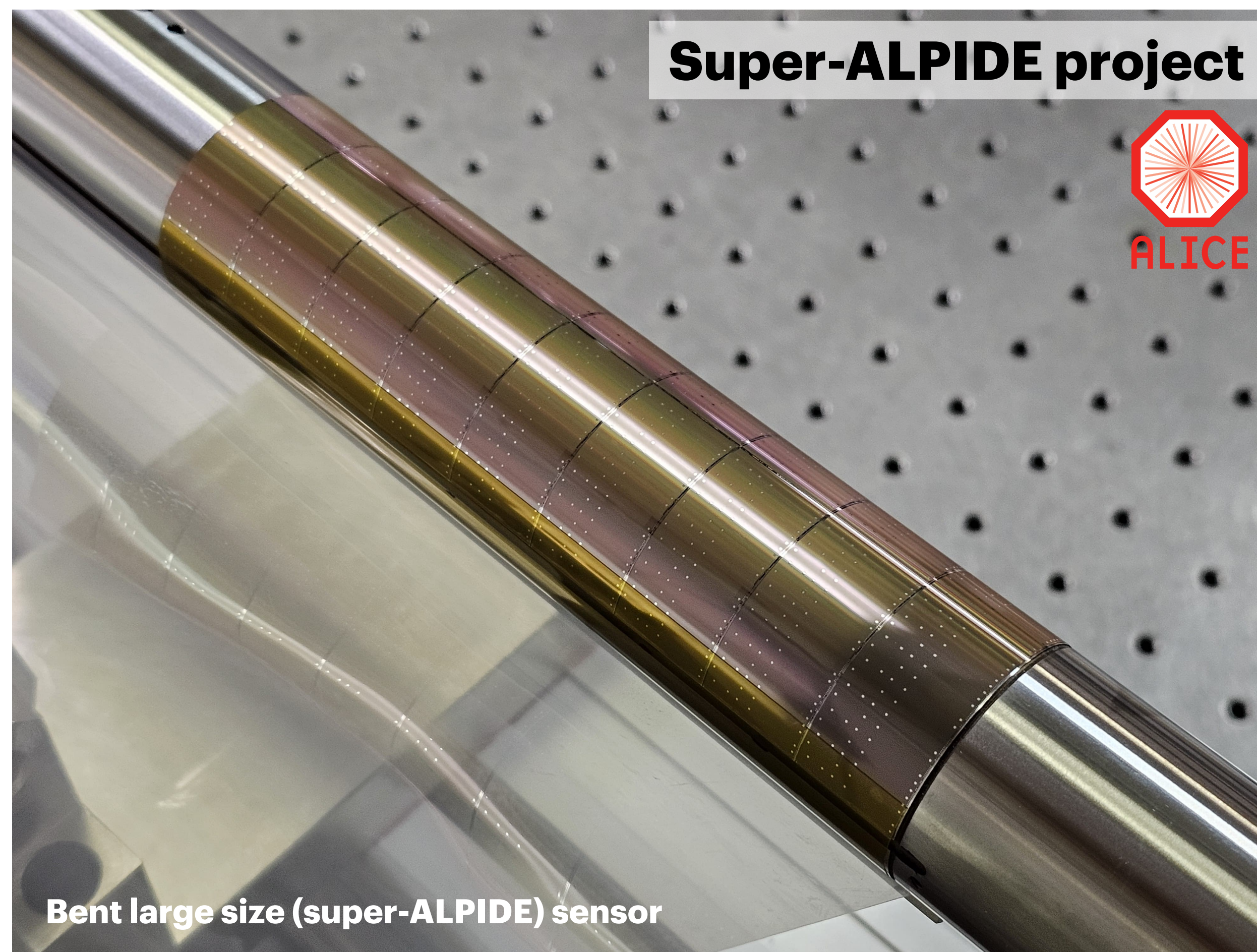
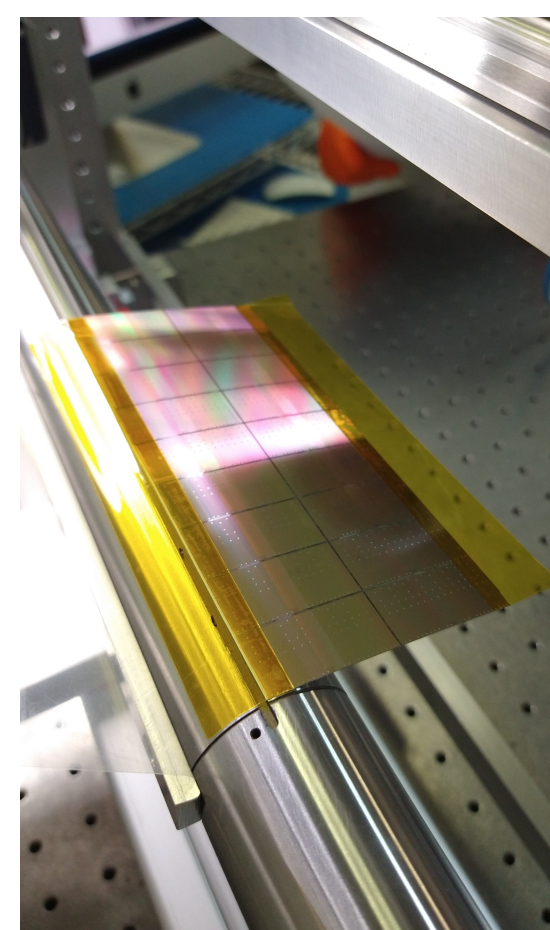
ACT II

First steps toward a new way of building vertex detectors

Scene 2



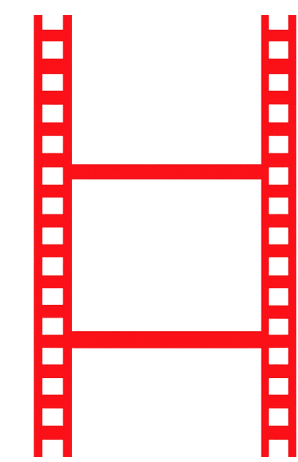
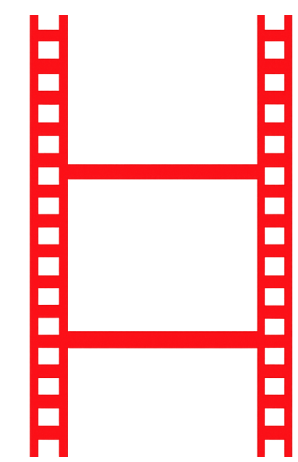
Preparing the bending



Super-ALPIDE project



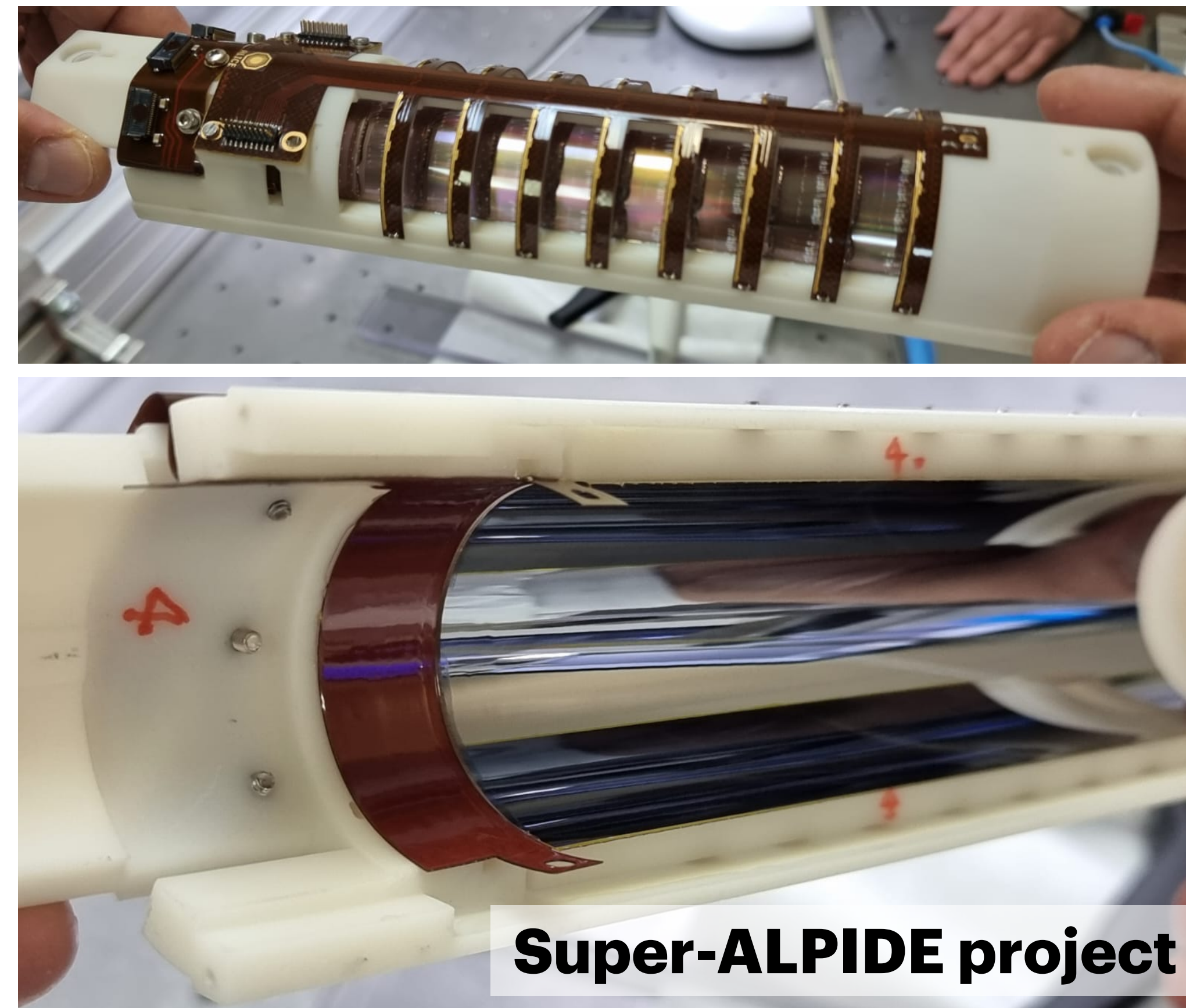
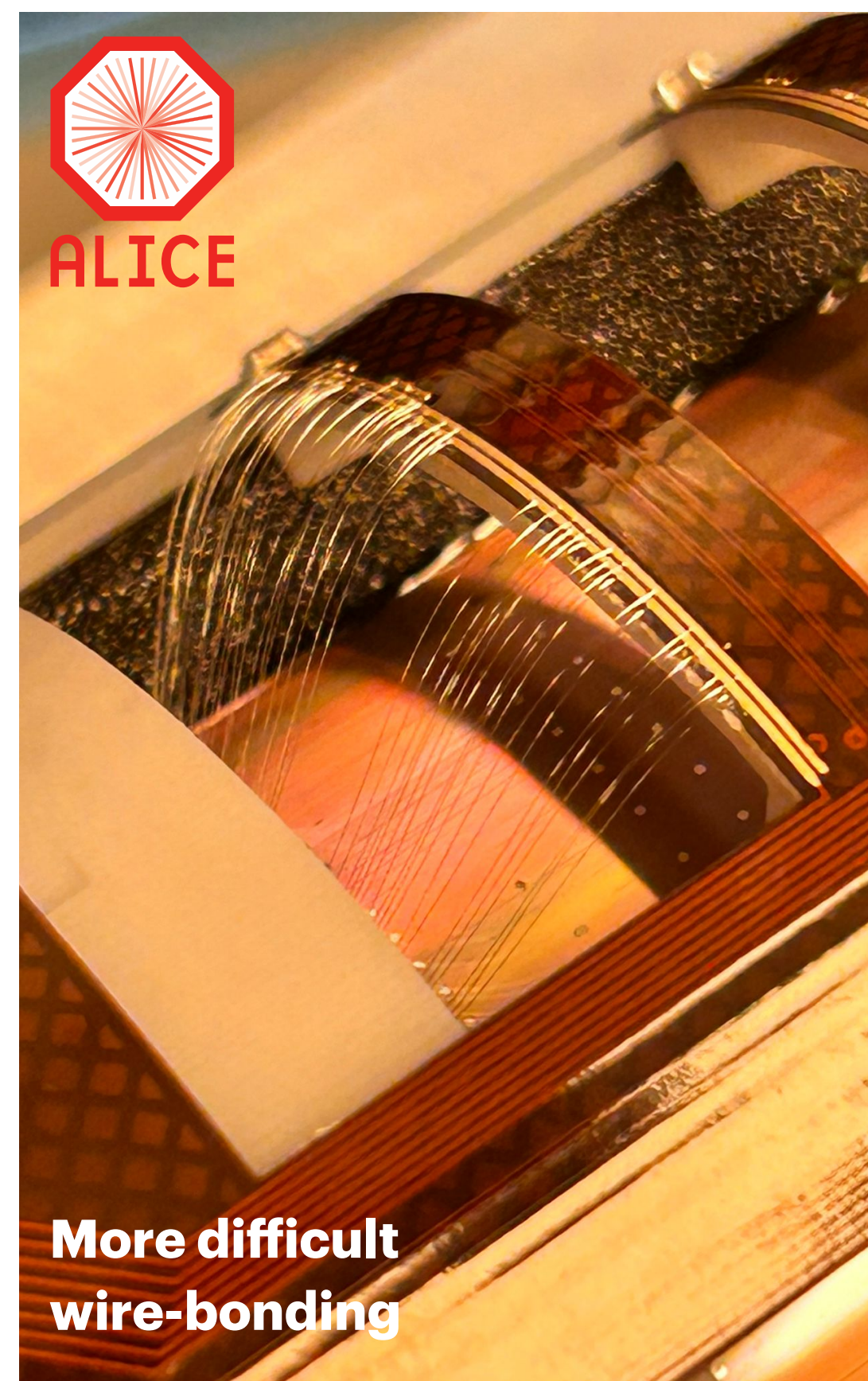
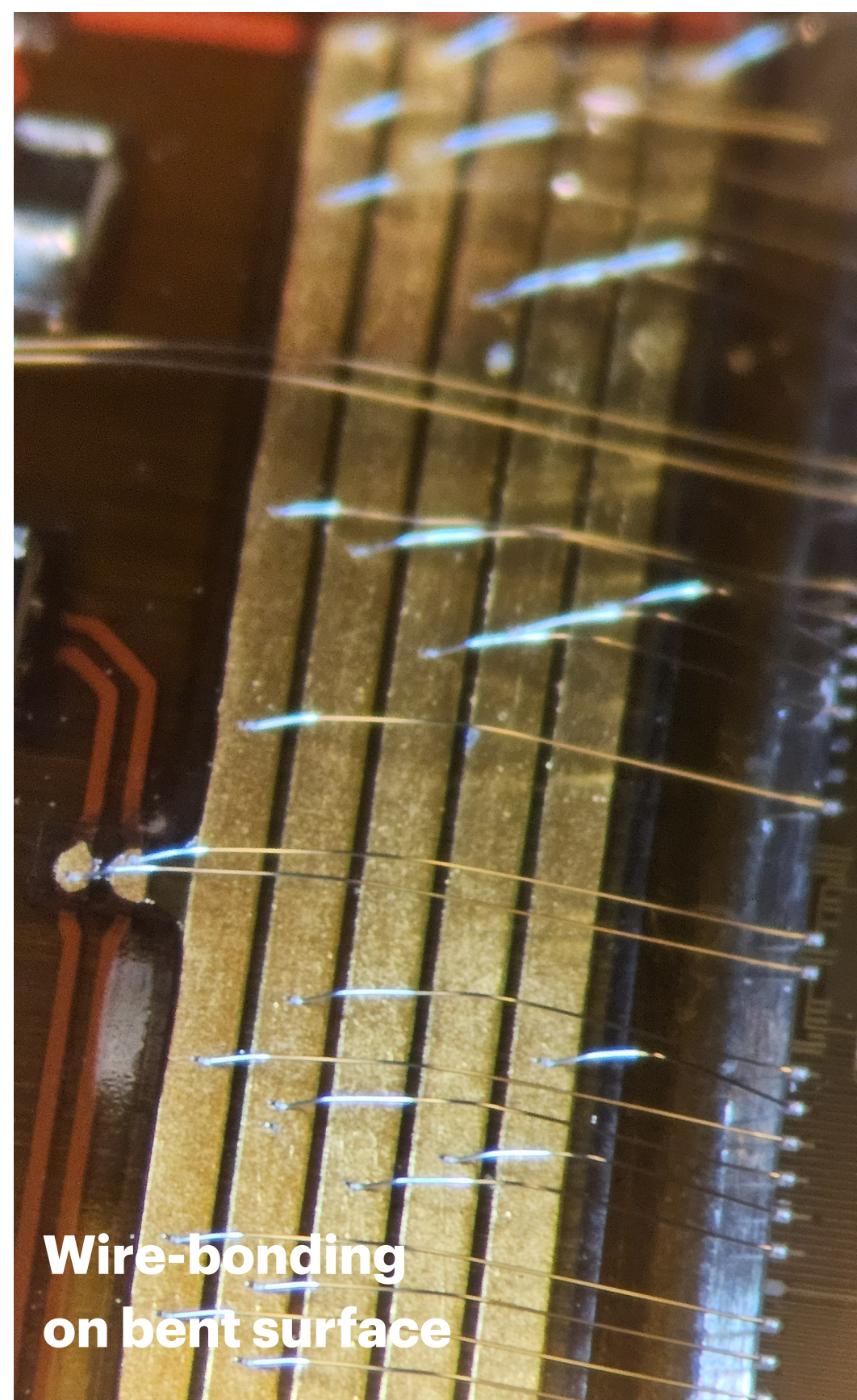
Bent large size (super-ALPIDE) sensor



ACT II

First steps toward a new way of building vertex detectors

Scene 2



ACT II

First steps toward a new way of building vertex detectors

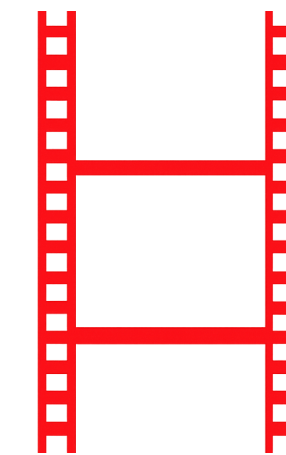
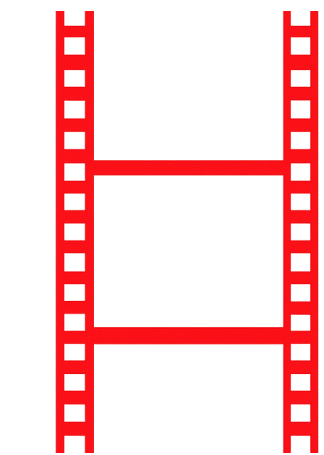
Scene 3



ITS3 Bread Board Model 6

Prototype integrating heaters to reproduce power dissipated by sensors to study the air-cooling effectiveness.

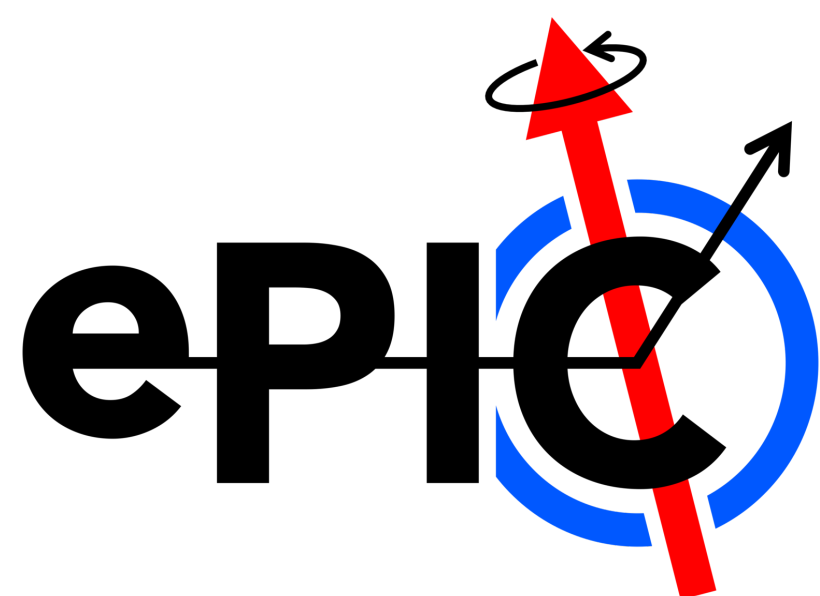




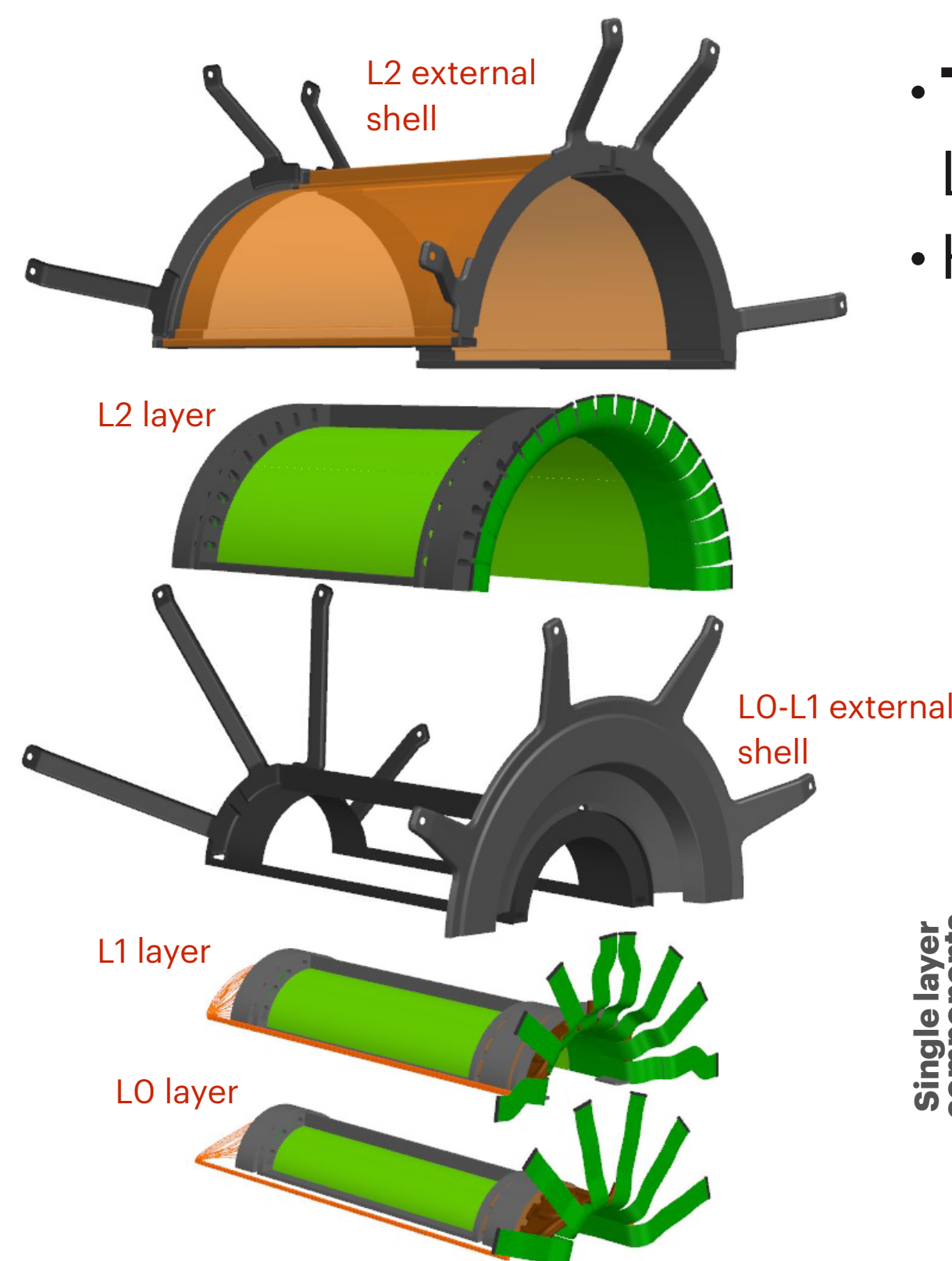
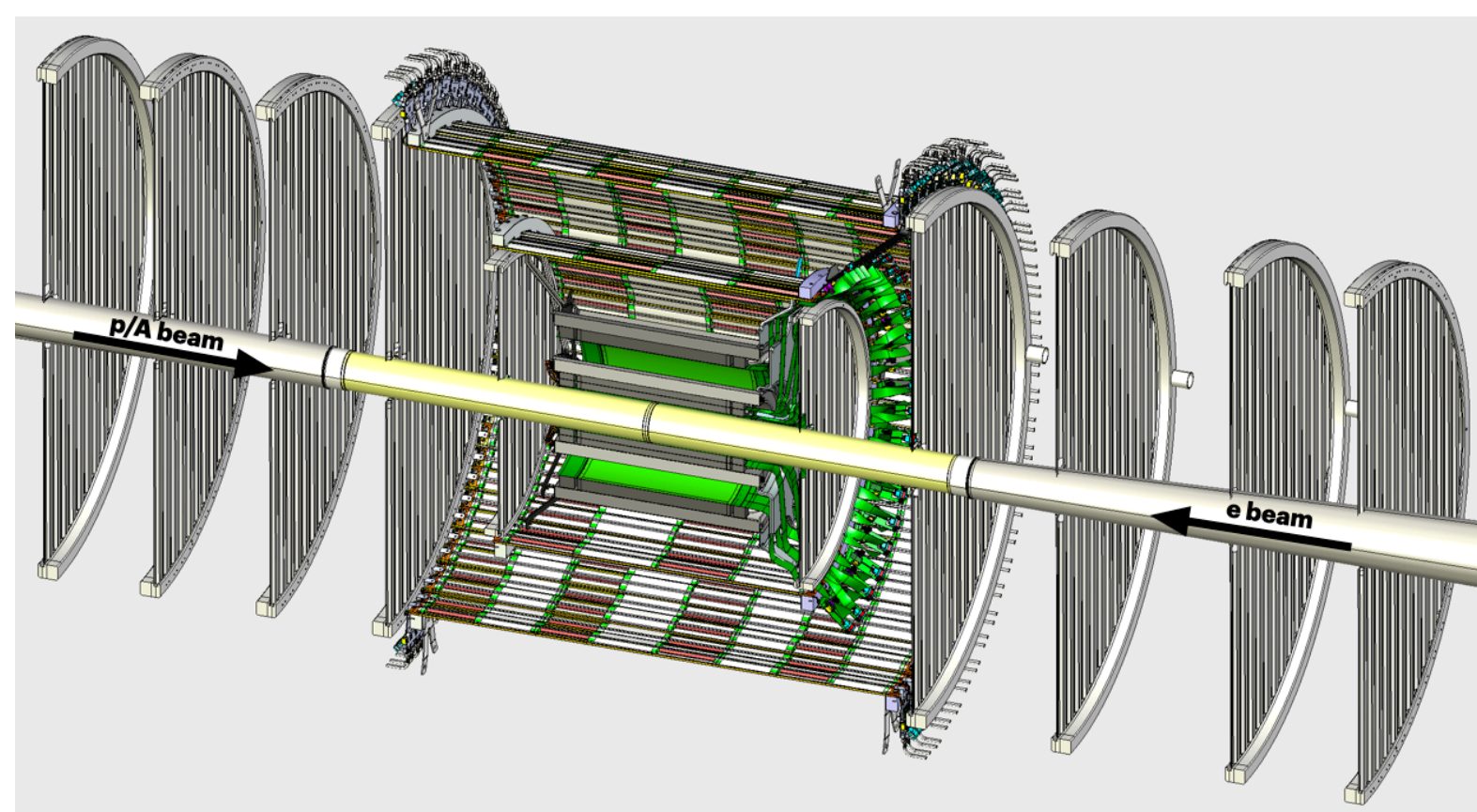
ACT III

Designing and building the SVT Inner Barrel

Prologue

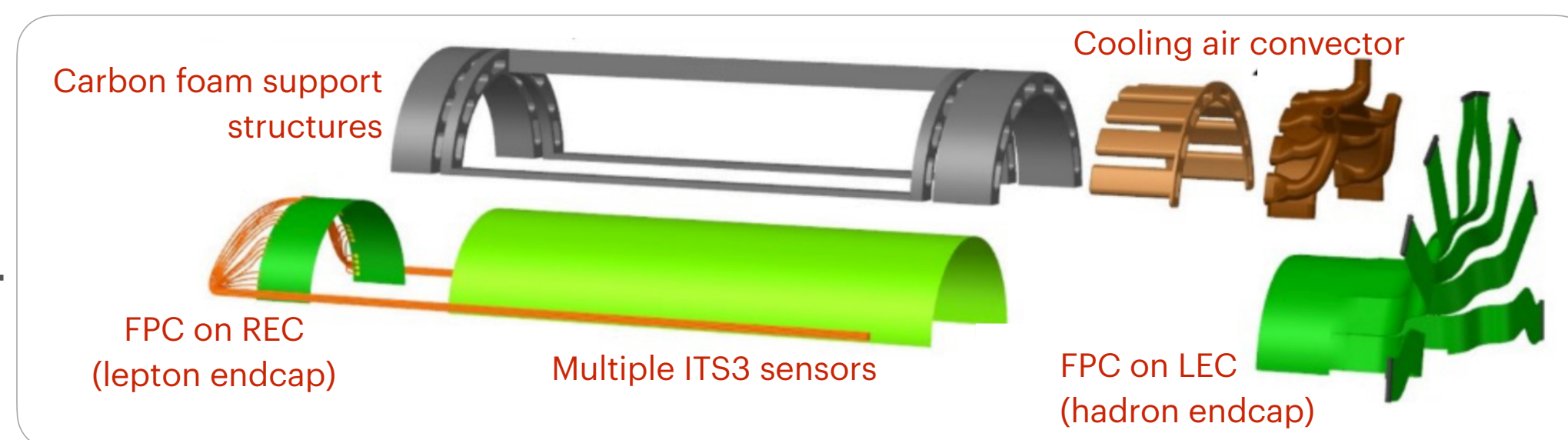


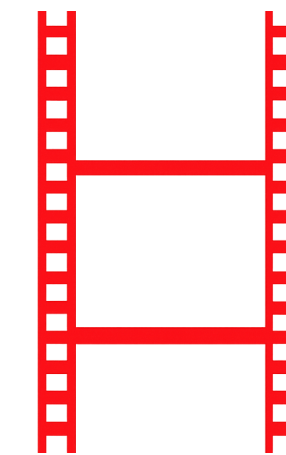
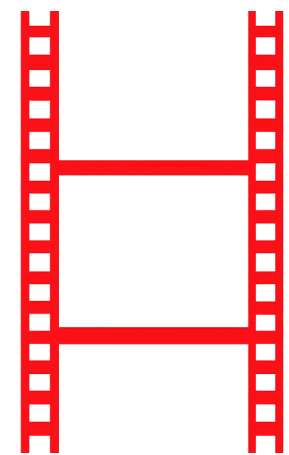
**Silicon
Vertex
Tracker**
Inner Barrel



- **Three layers** (radius):
L0 (~38 mm), L1 (~50 mm) and L2 (~125 mm)
- Half-layer sensitive area length ~270 mm and width:
 - for **L0**: 6 segments over **2 ITS3 L0 sensors** (~120 mm)
 - for **L1**: 8 segments over **2 ITS3 L1 sensors** (~157 mm)
 - for **L2**: 20 segments over **4 ITS3 L2 sensors** (~393 mm)

Single layer
components



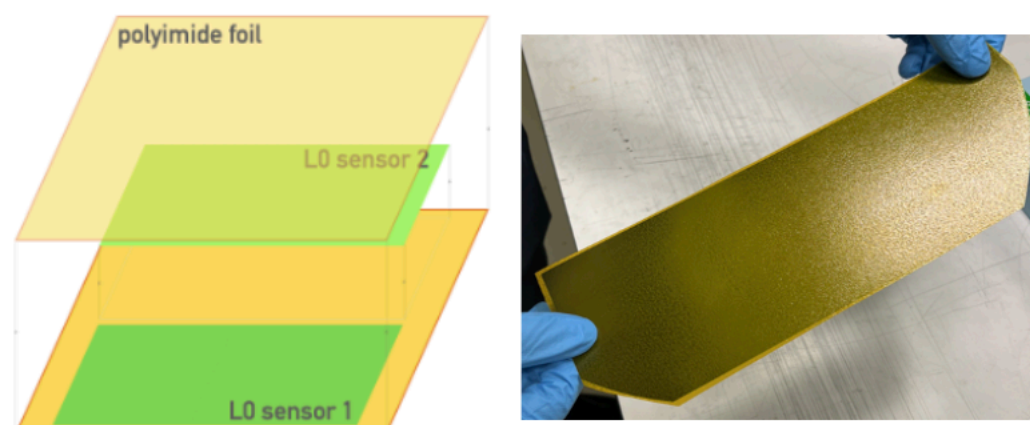


ACT III

Designing and building the SVT Inner Barrel

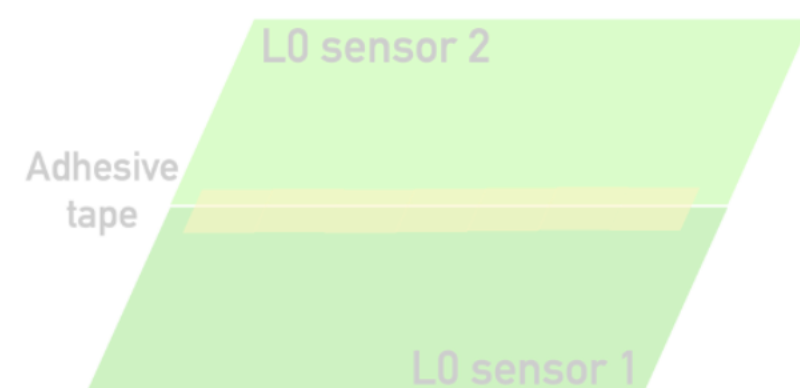
Scene 1

Embedding strategy

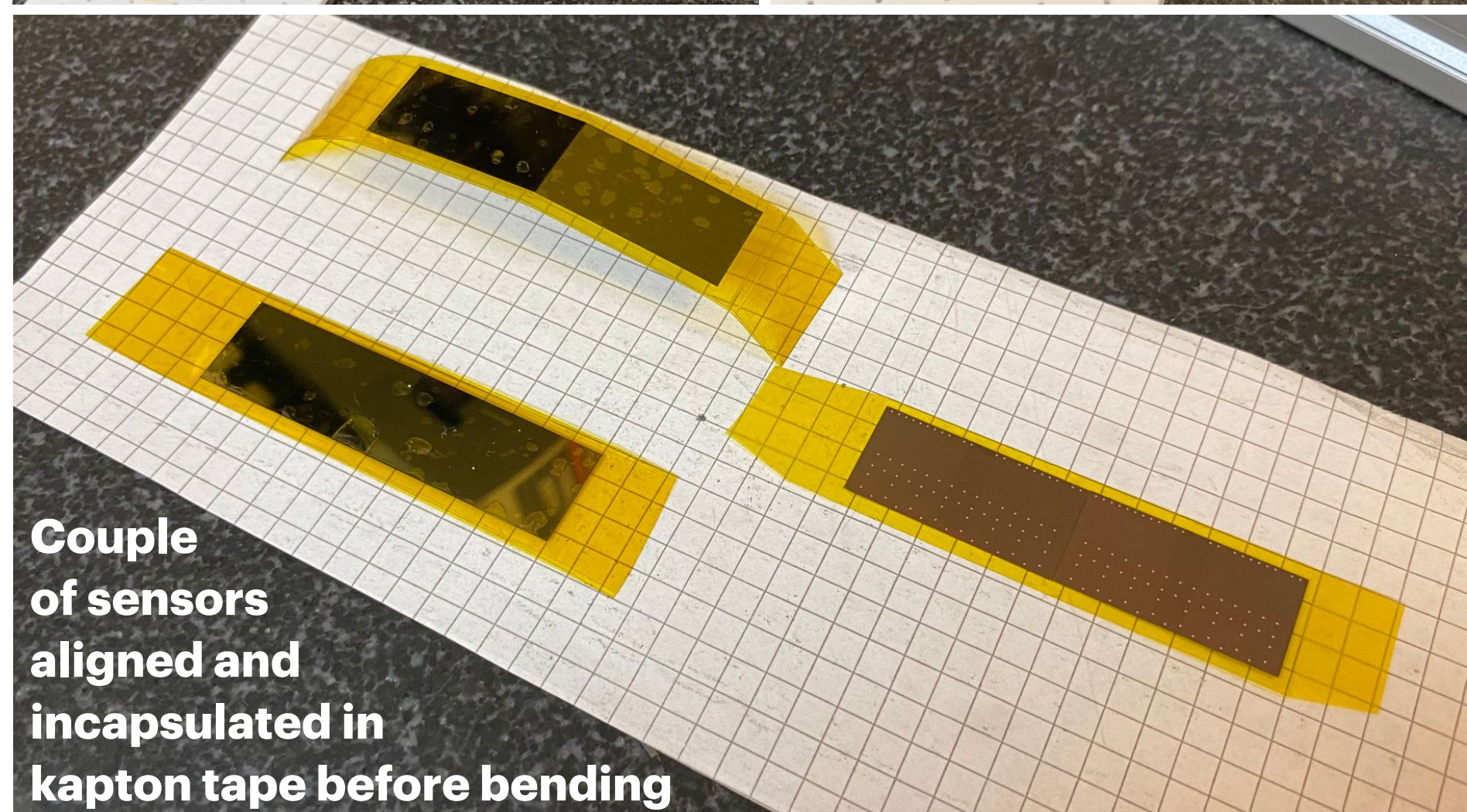
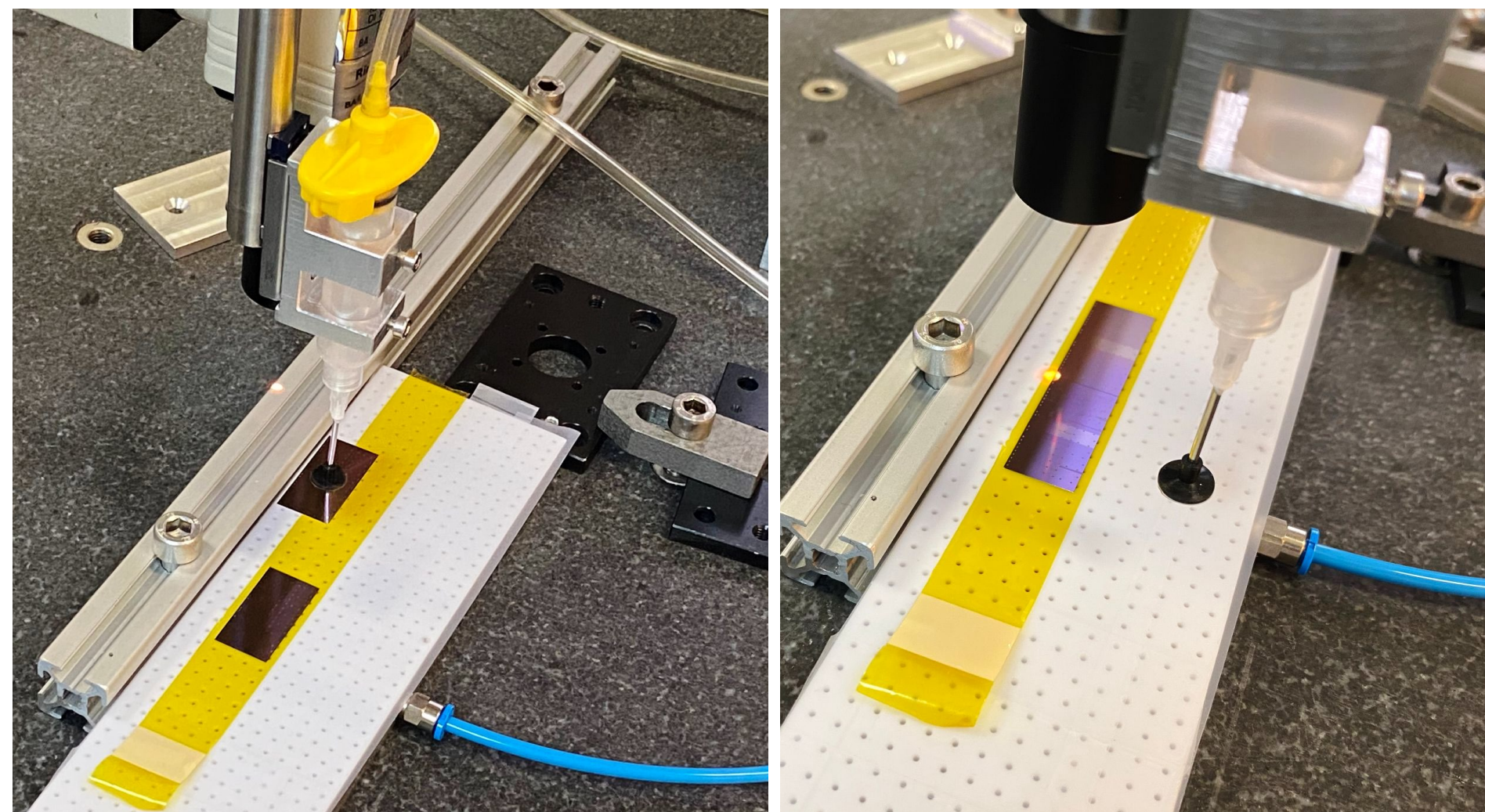


- R&D started within ITS3, but extended one required (thermal and pressure stress on the sensor during the gluing, air bubbles, access to the soldering pads)

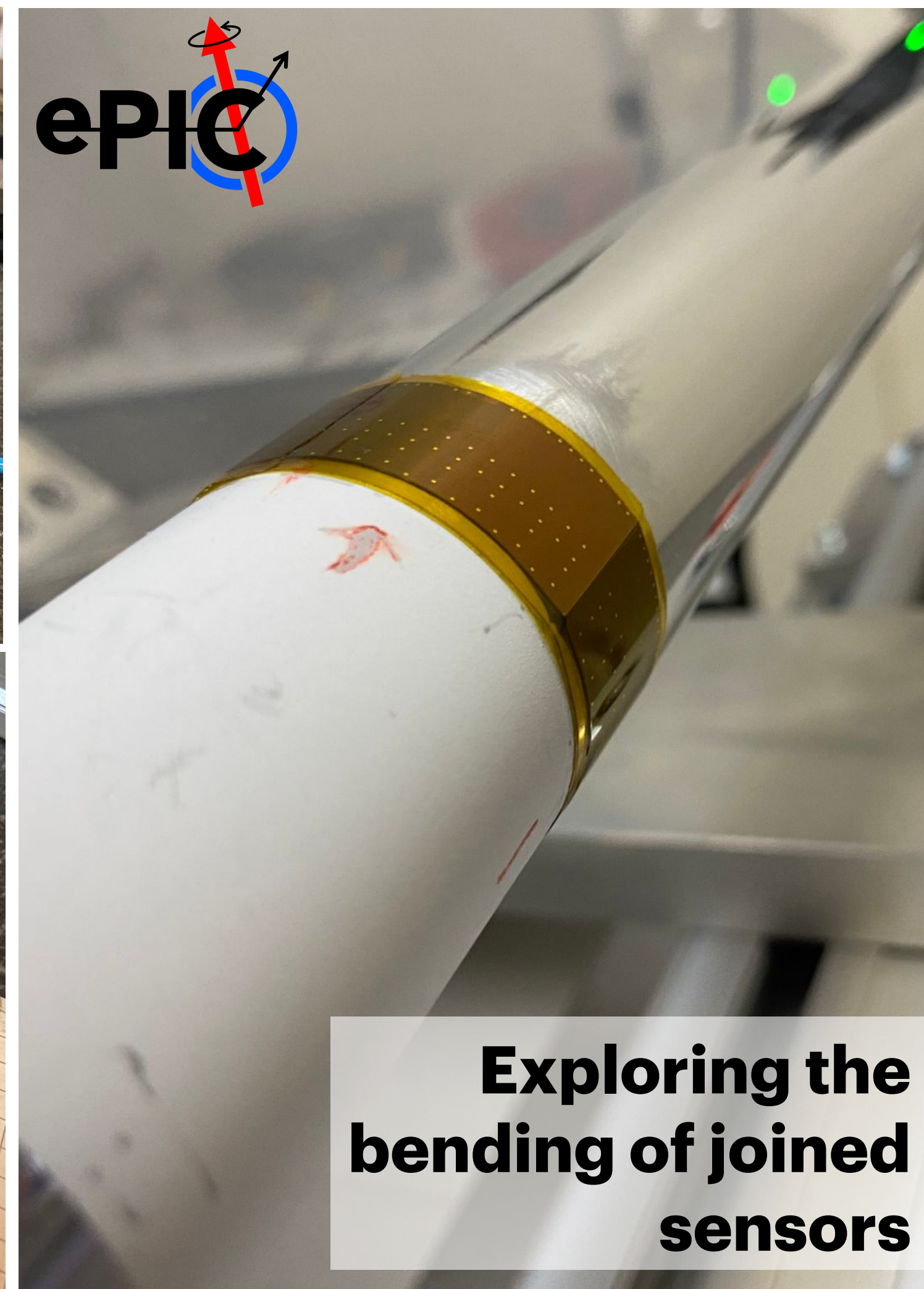
Bare+tape strategy



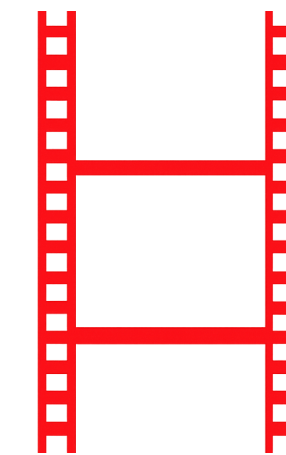
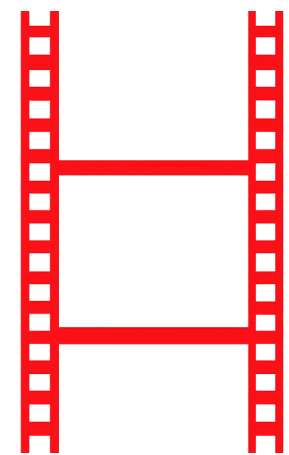
- Reduced amount of kapton
- Feasibility to be verified



Couple of sensors aligned and encapsulated in kapton tape before bending



Exploring the bending of joined sensors

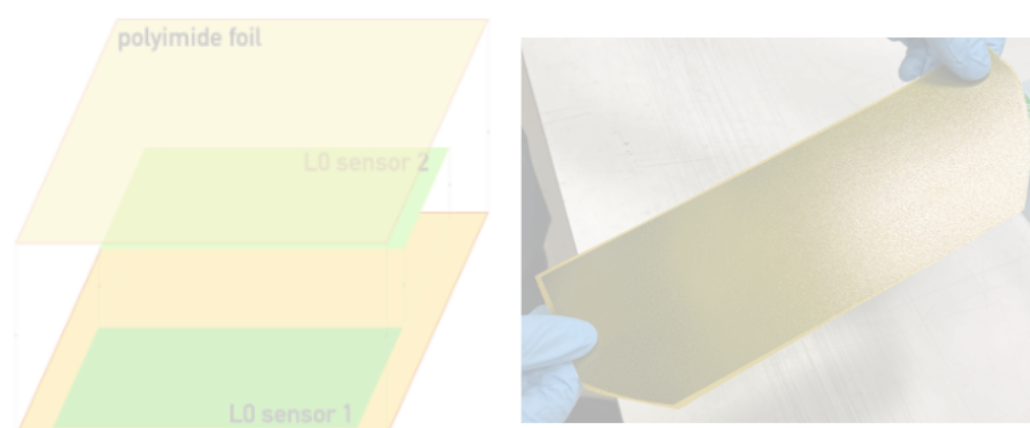


ACT III

Designing and building the SVT Inner Barrel

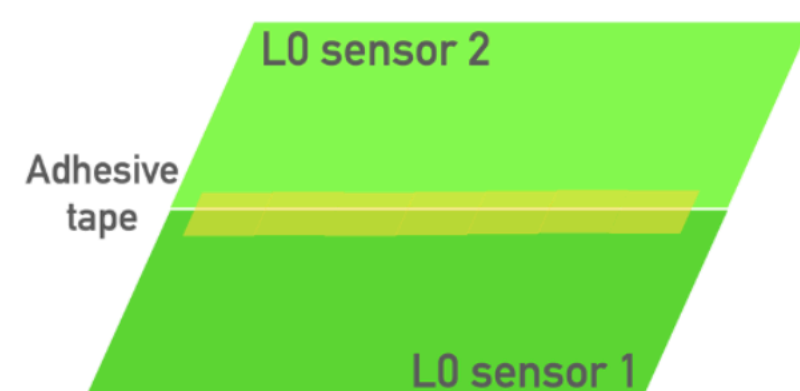
Scene 2

Embedding strategy

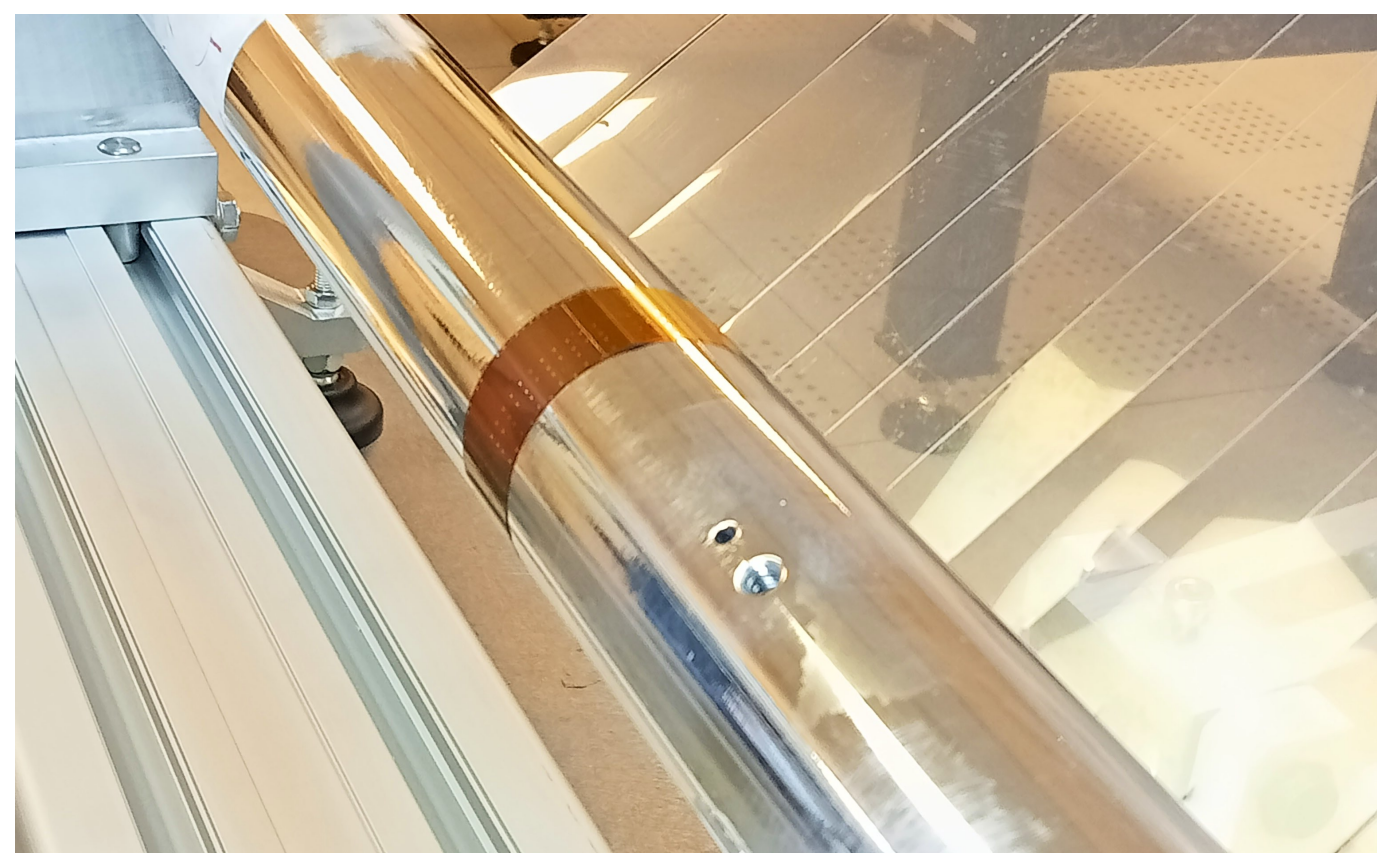
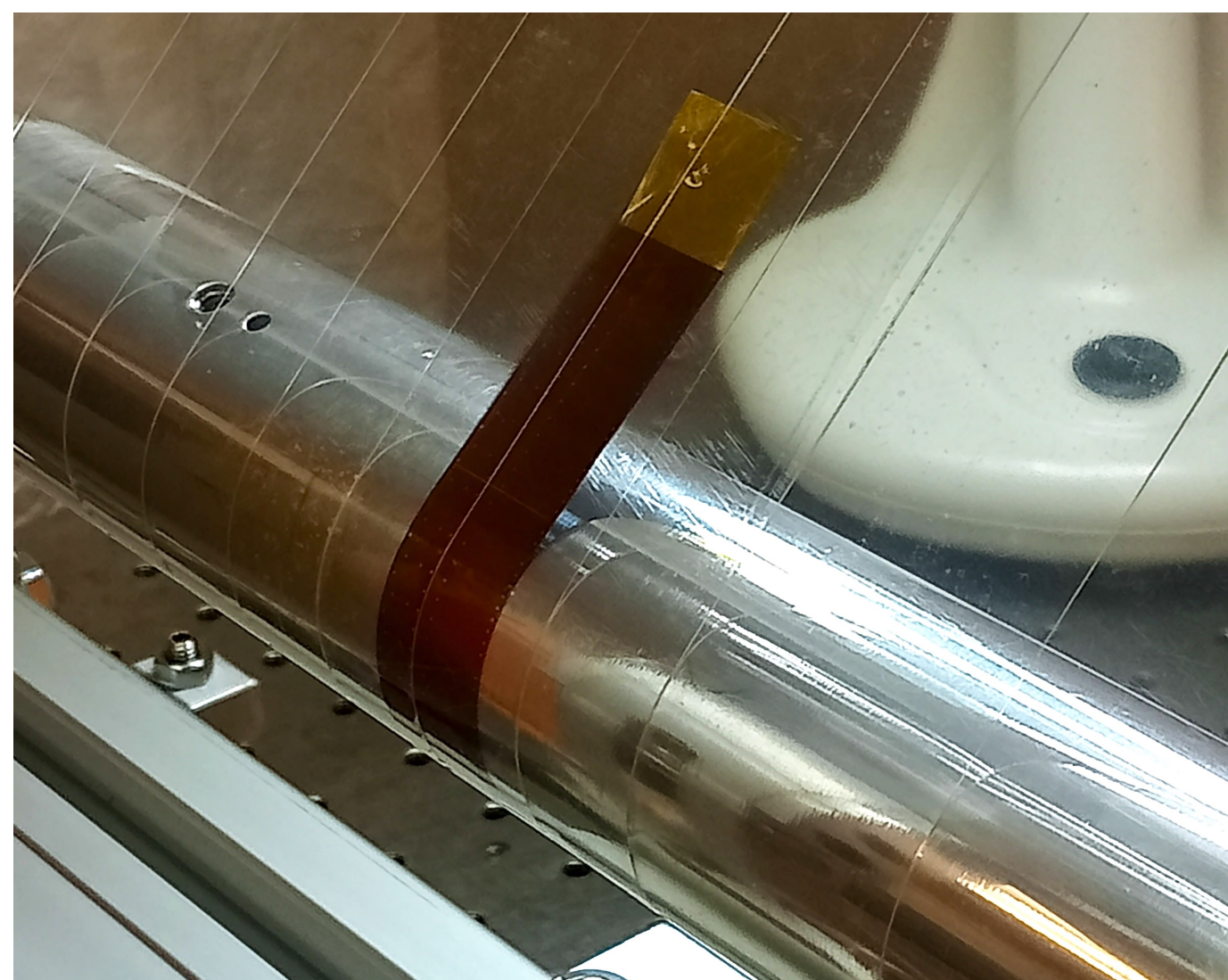


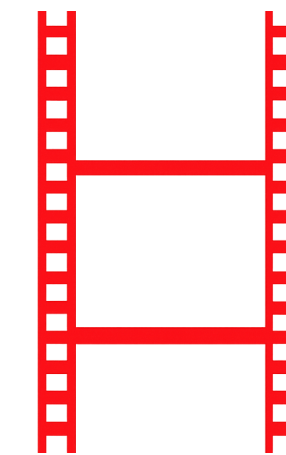
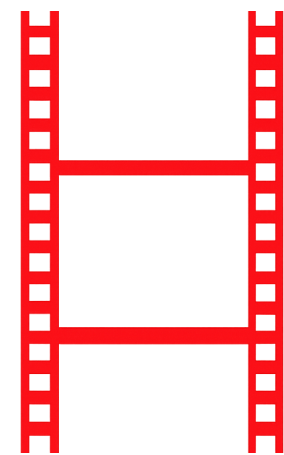
- R&D started within ITS3, but extended one required (thermal and pressure stress on the sensor during the gluing, air bubbles, access to the soldering pads)

Bare+tape strategy



- Reduced amount of kapton
- Feasibility to be verified

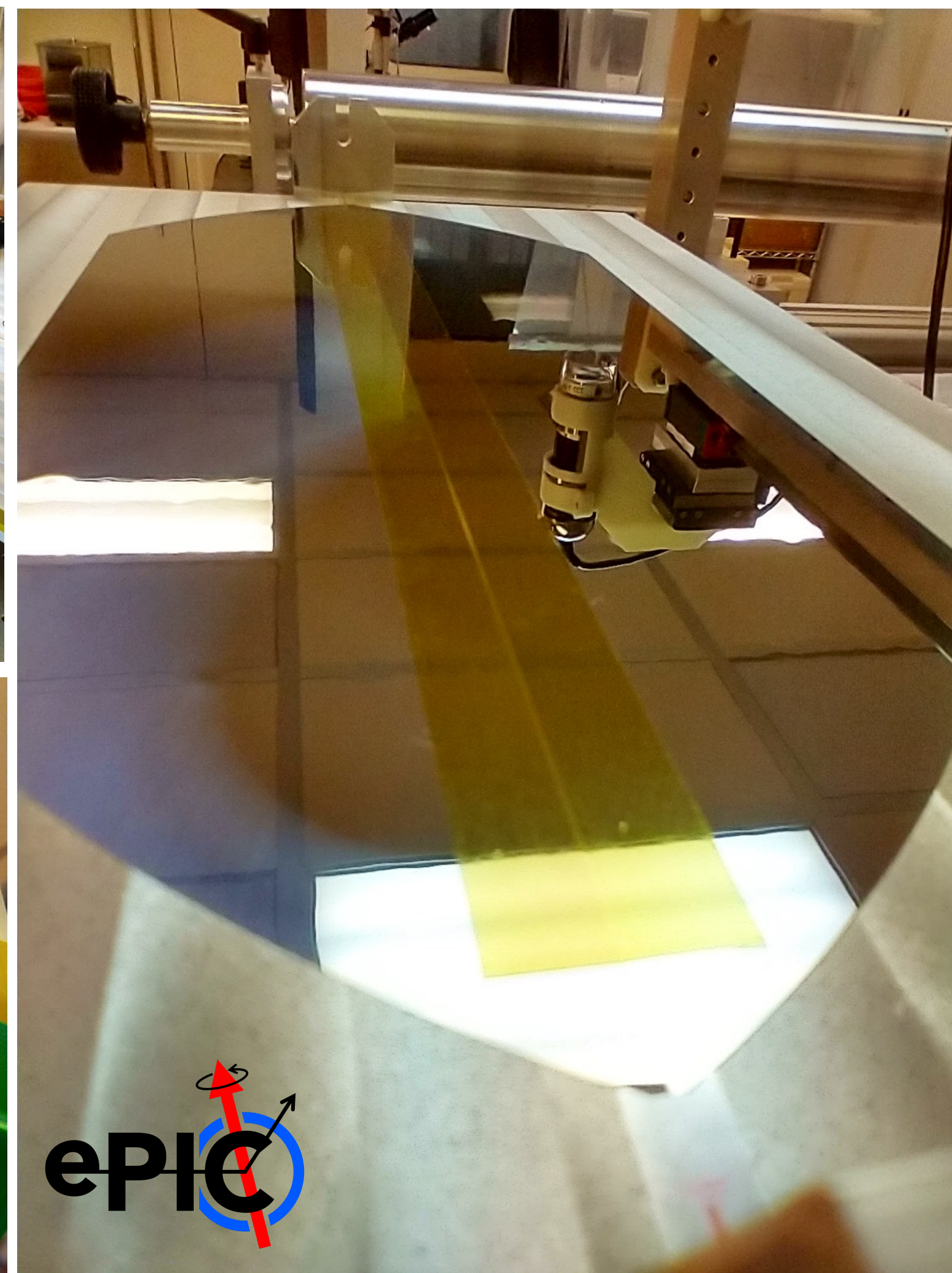
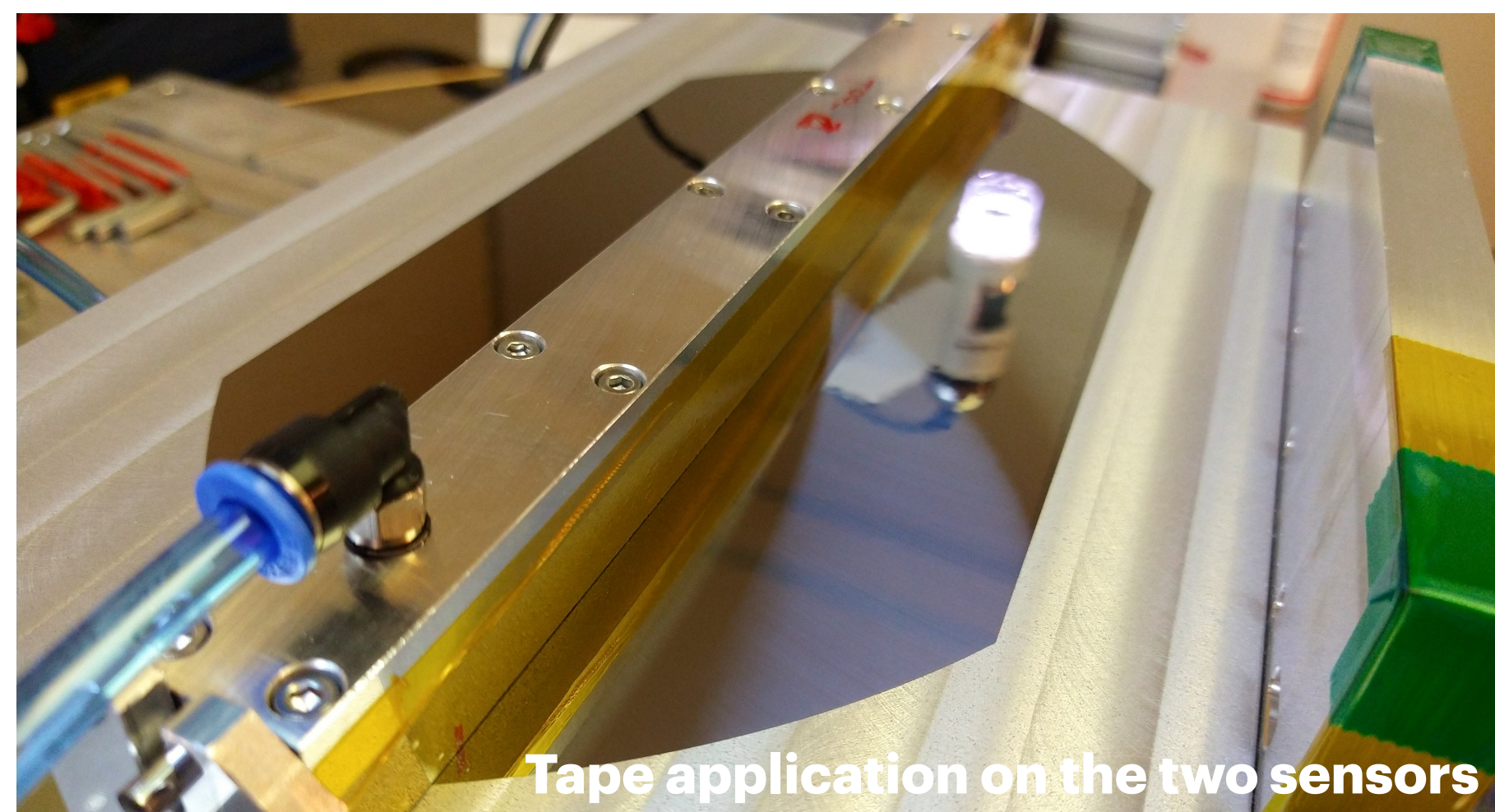
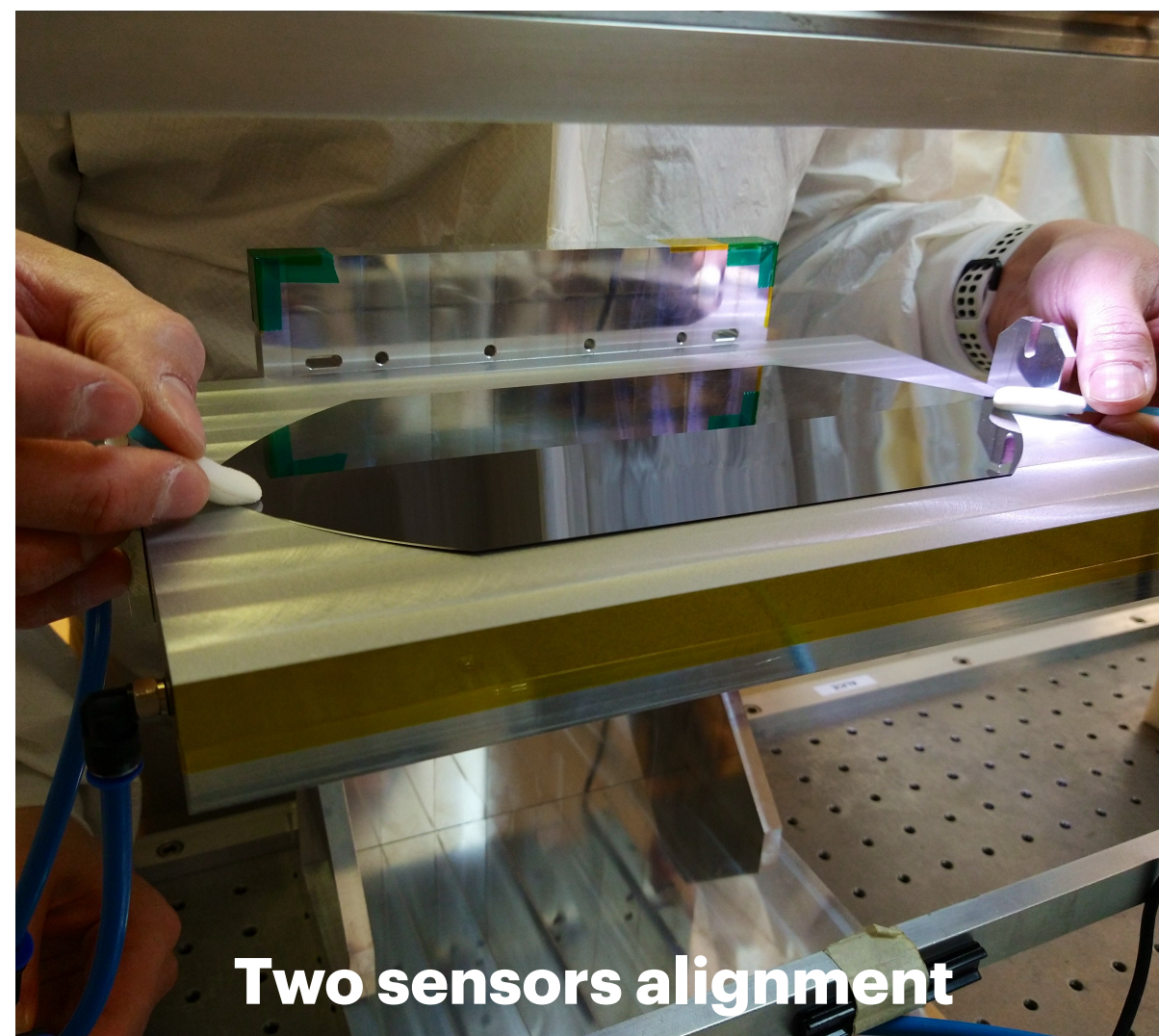


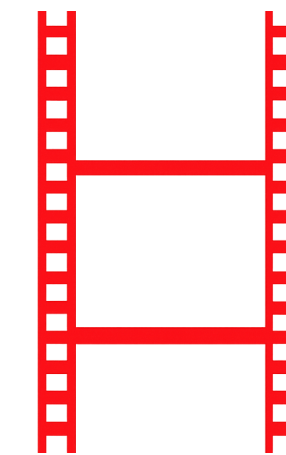
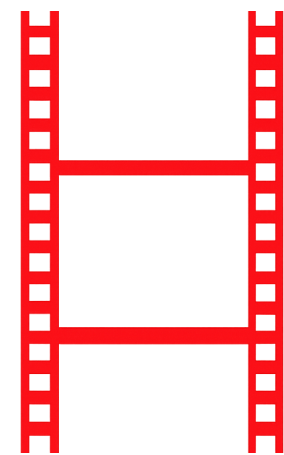


ACT III

Designing and building the SVT Inner Barrel

Scene 3

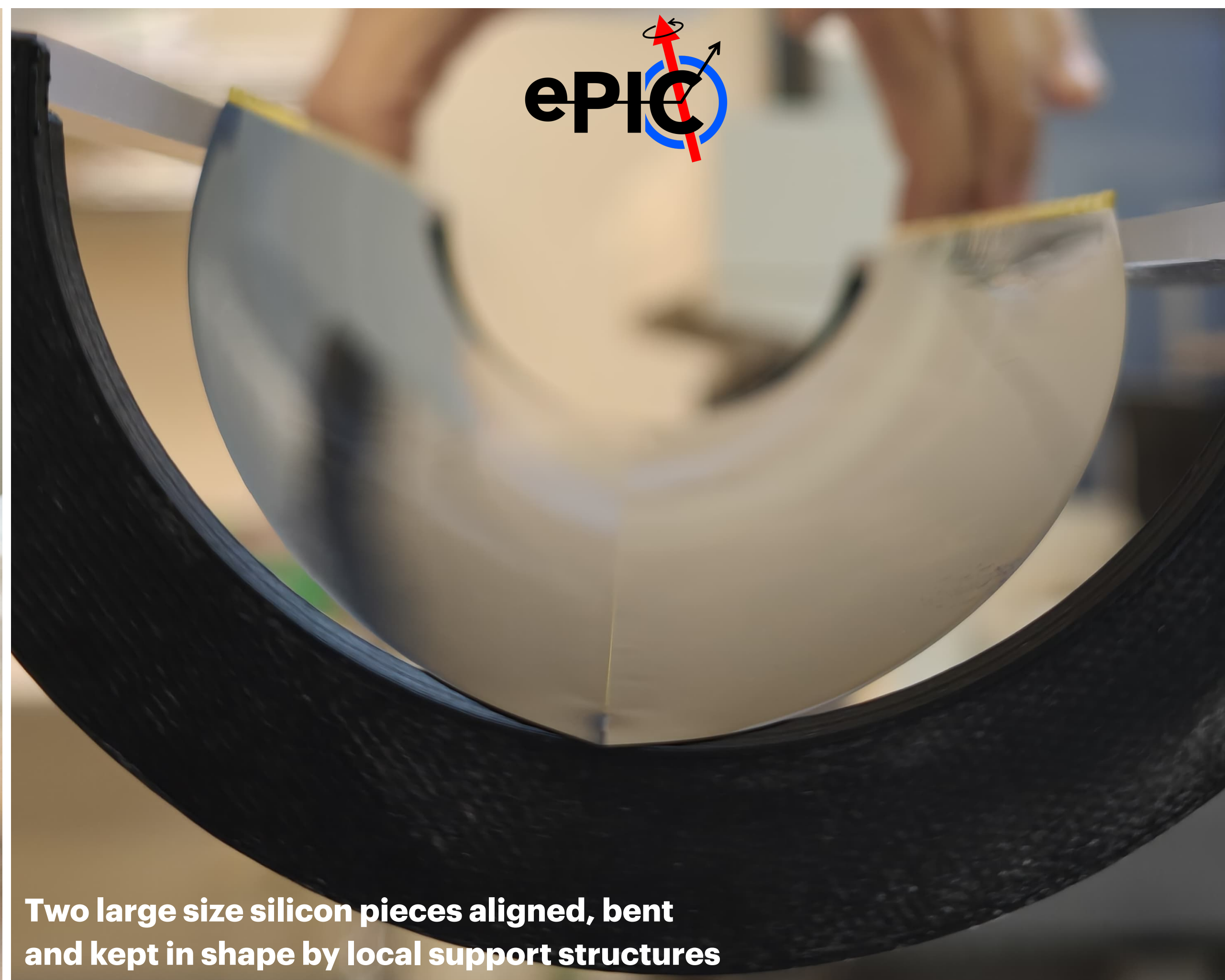




ACT III

Designing and building the SVT Inner Barrel

Scene 3



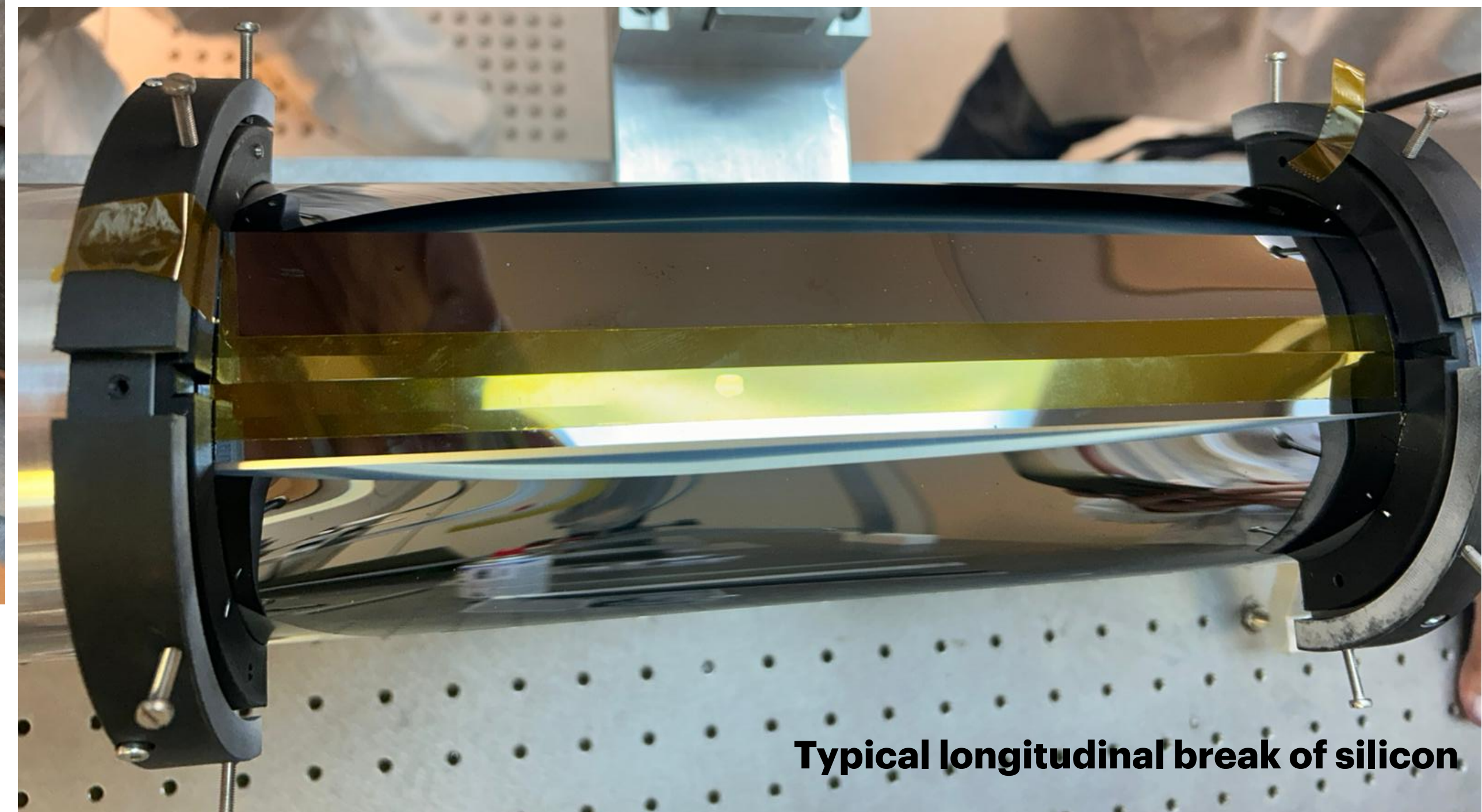
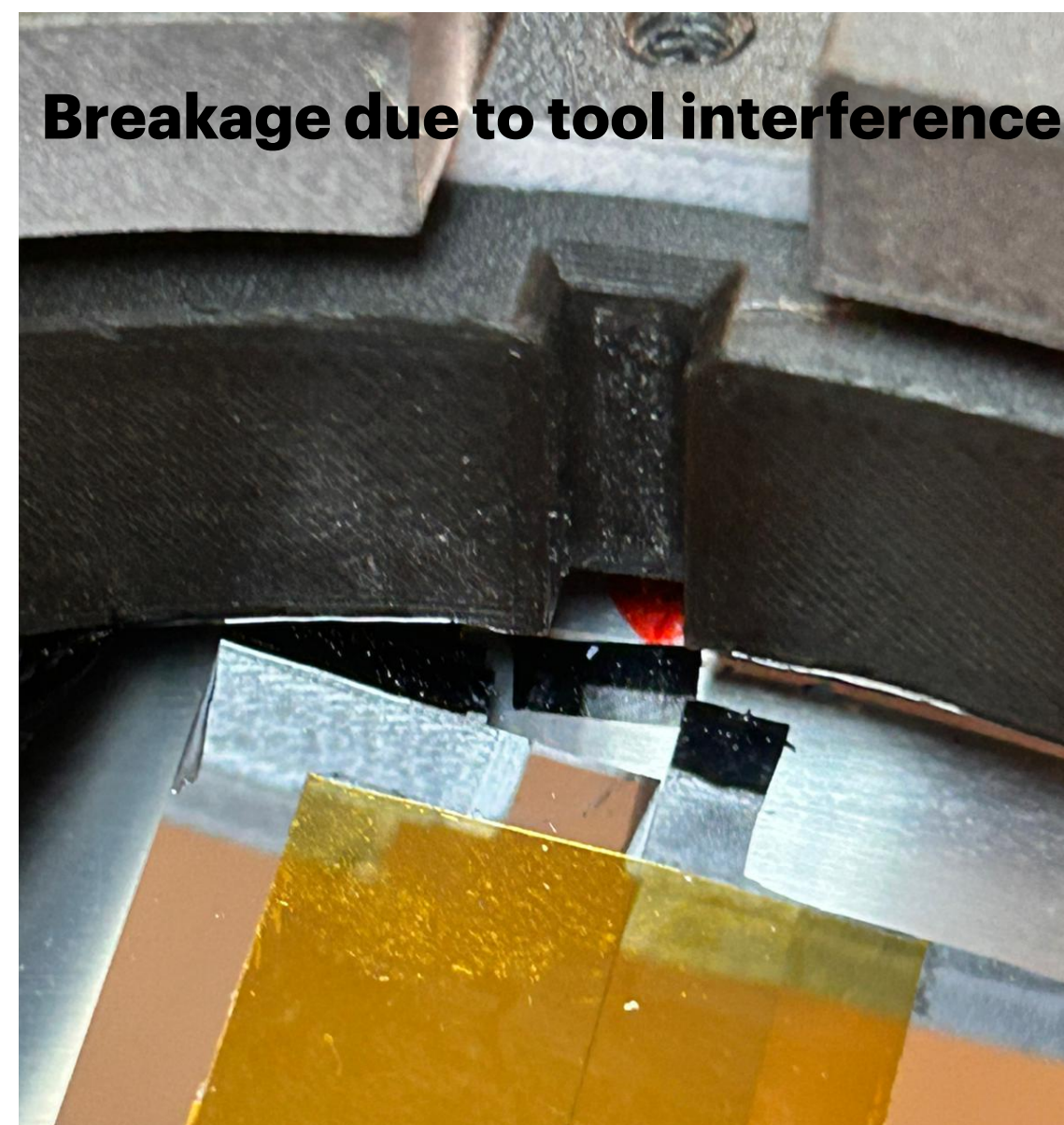
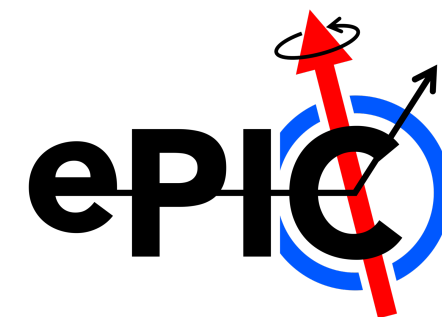
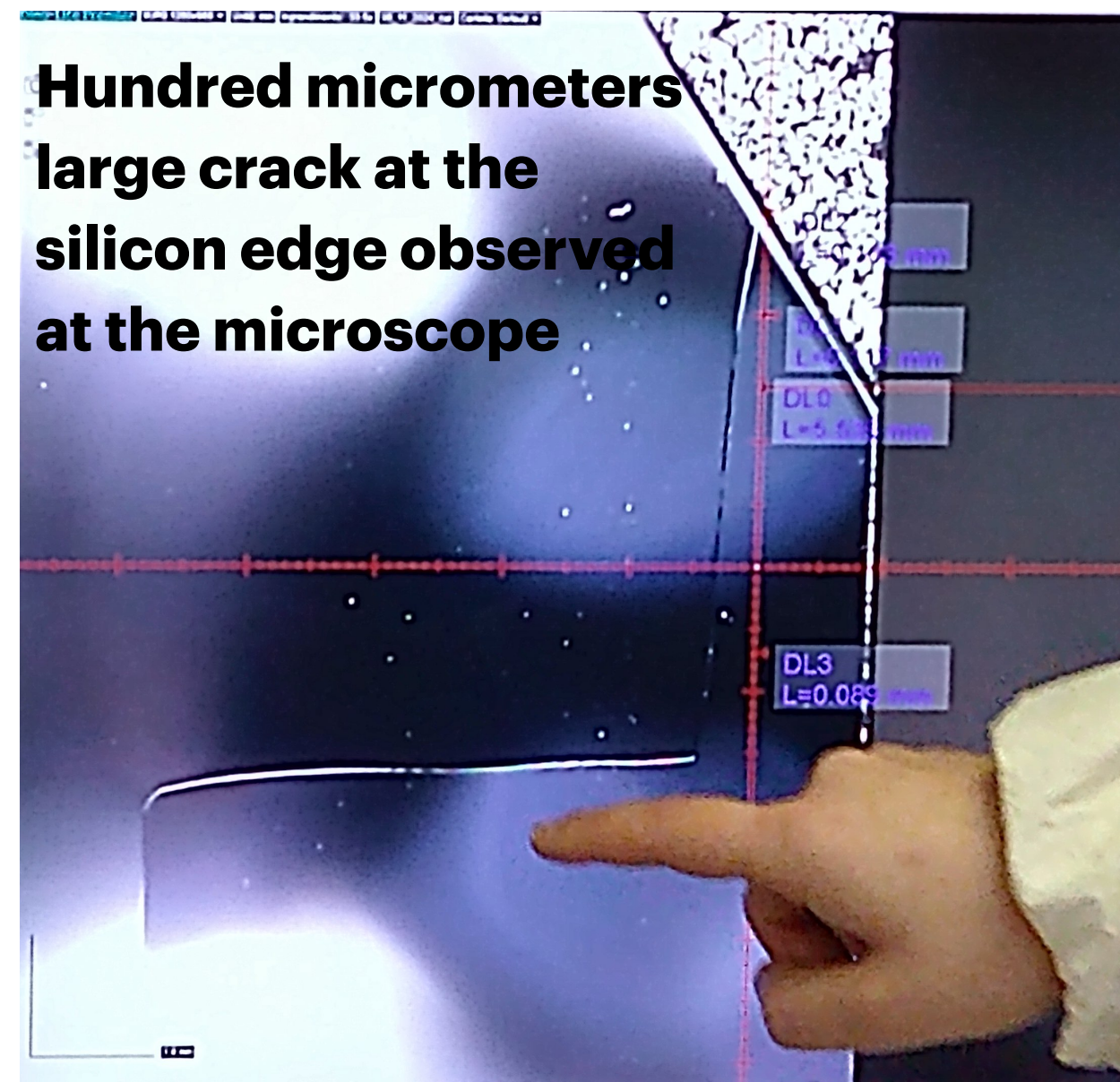
Two large size silicon pieces aligned, bent and kept in shape by local support structures

ACT III

Designing and building the SVT Inner Barrel

Scene 4

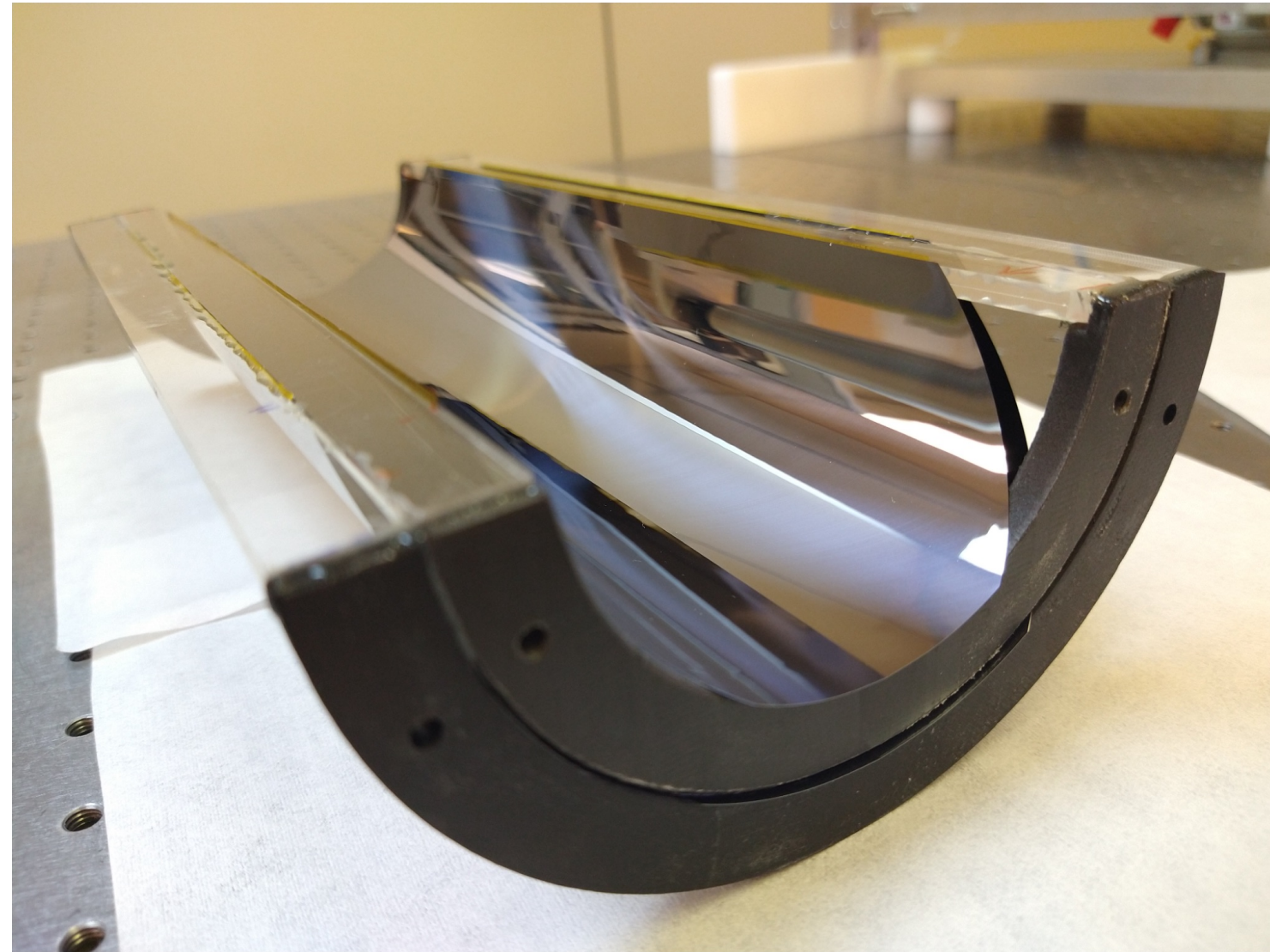
Learning how to break large size thin silicon while bending/handling



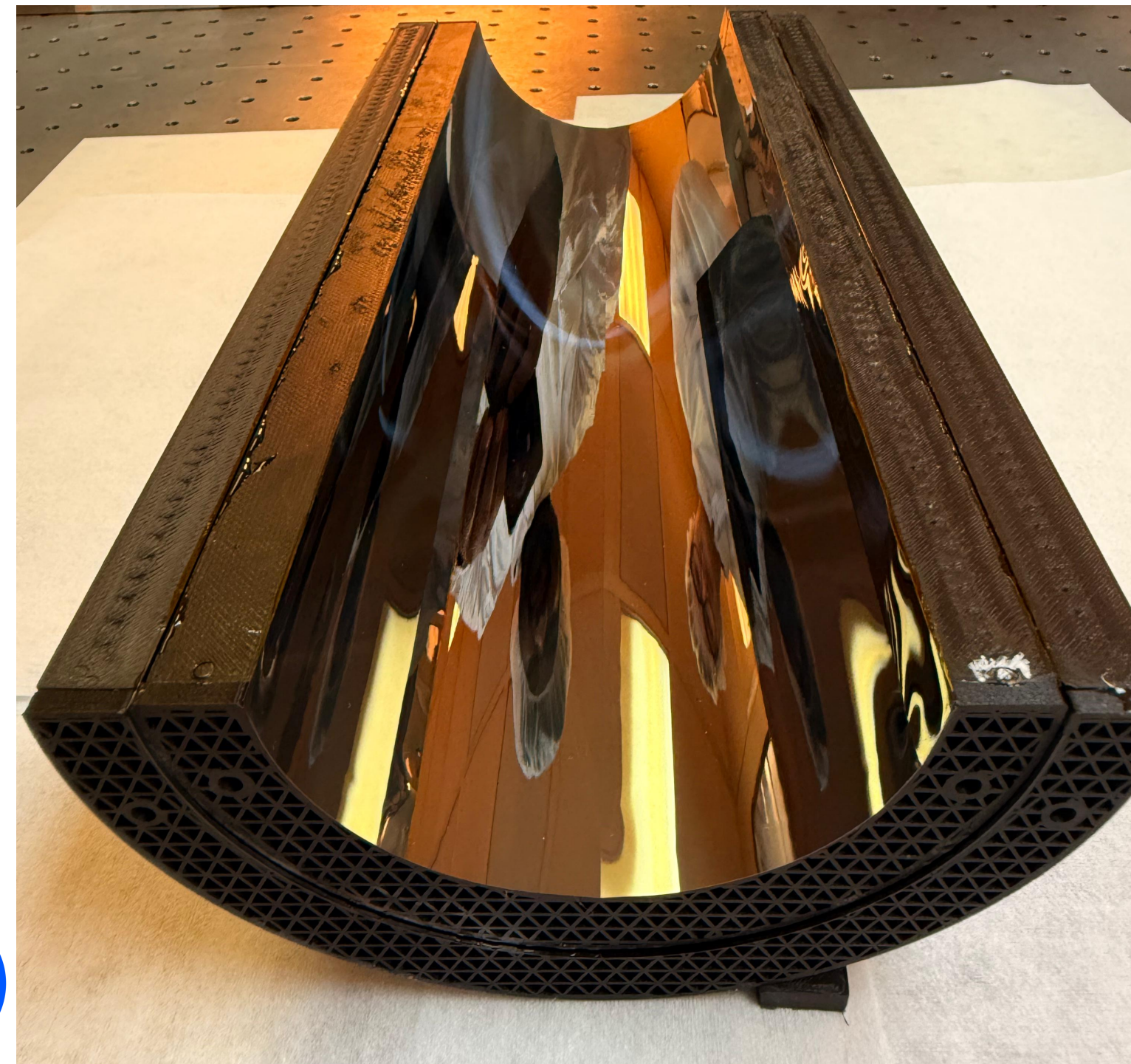
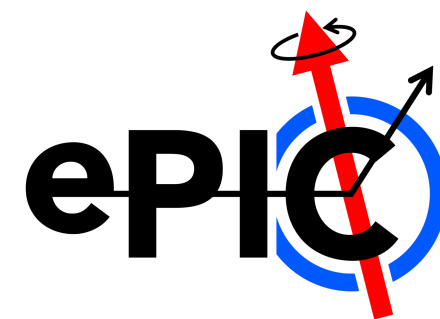
ACT III

Designing and building the SVT Inner Barrel

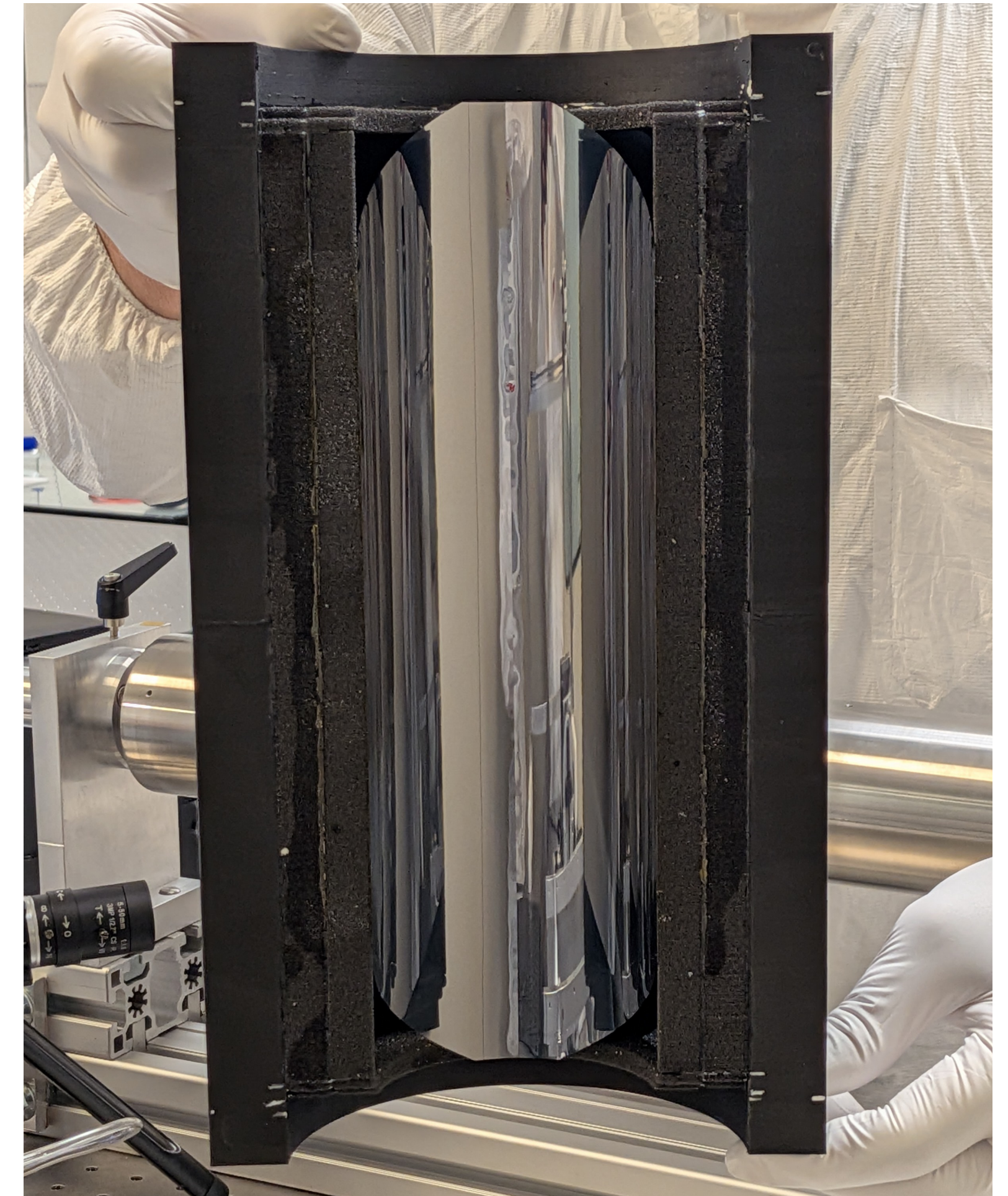
Scene 5



First bare prototype of SVT L0-L1 barrel



Second bare prototype of SVT L0-L1 barrel

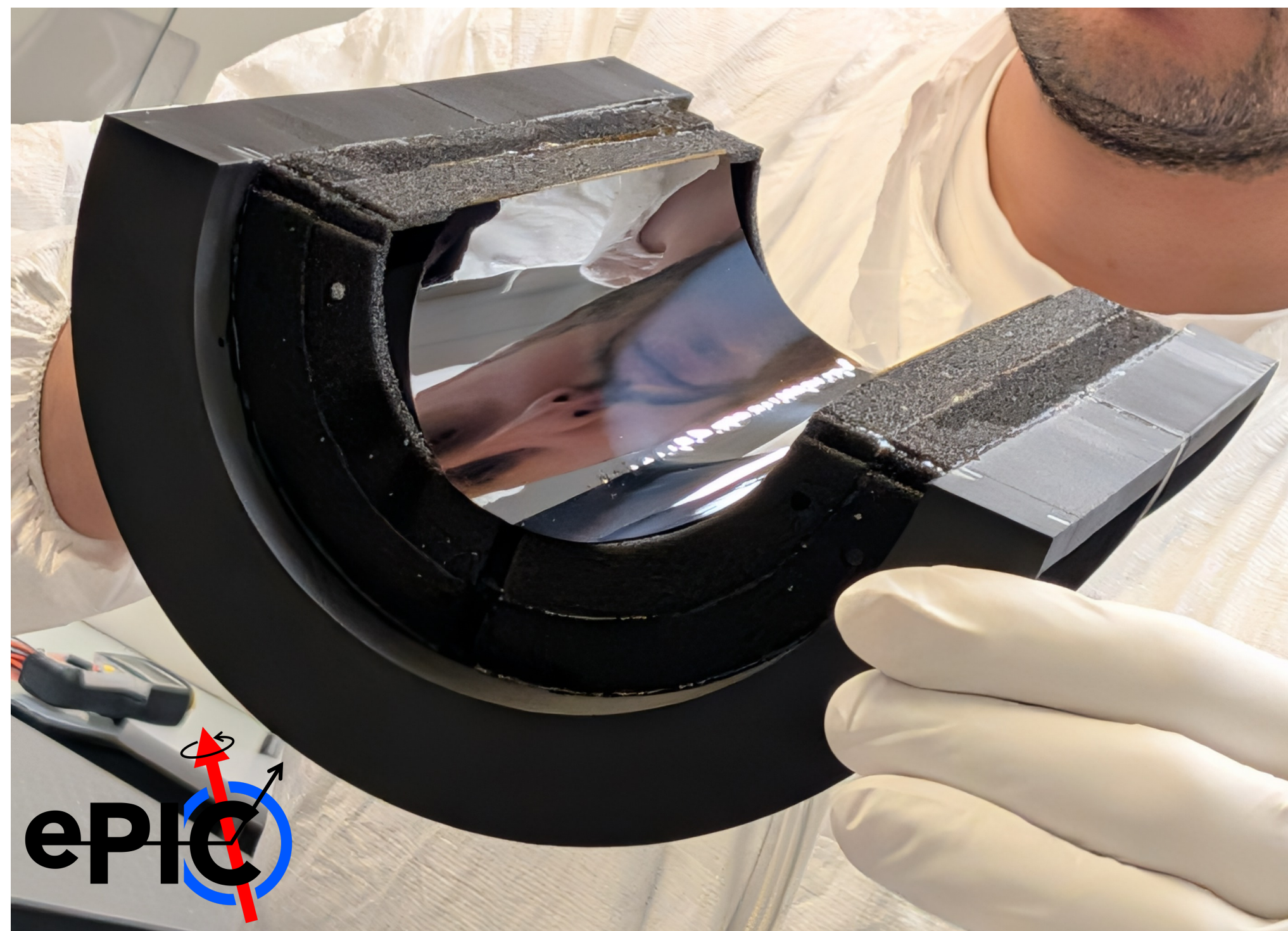


**Advanced prototype of SVT L0-L1 barrel
integrating external shell and local support
structures in carbon foam**

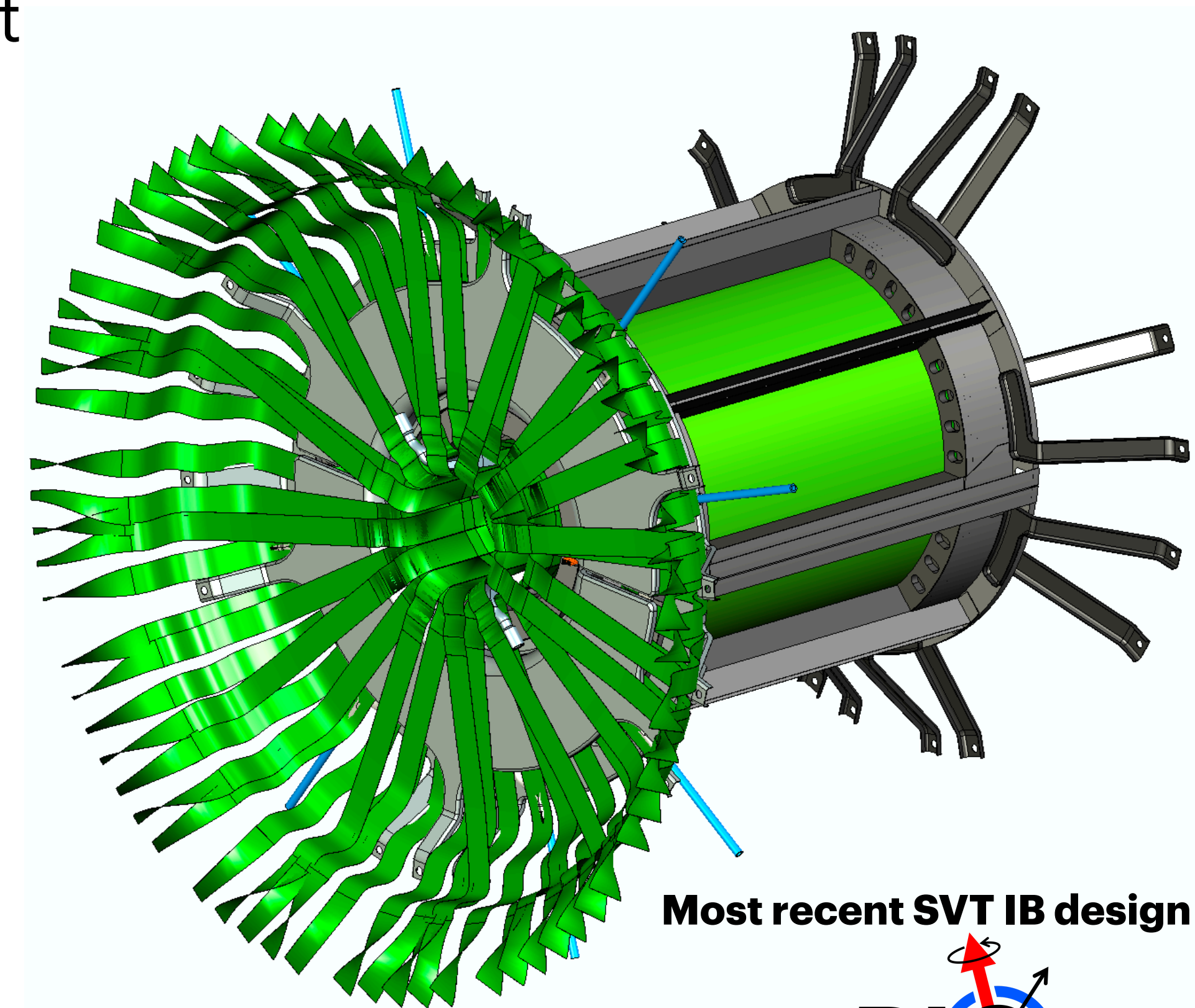
Epilogue

To the future and beyond

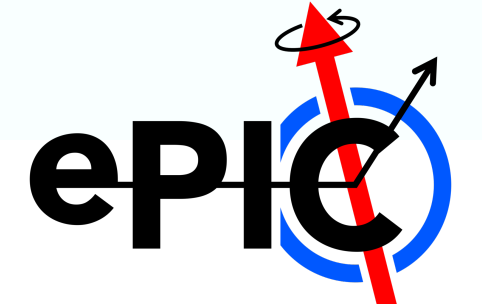
Moving from present developments to final detector will require lot of effort



Most recent SVT LO-L1 half-barrel prototype



Most recent SVT IB design



Epilogue

To the future and beyond

Like Captain Mandrake, we may not always control the outcome, but we can always choose **reason**, **collaboration**, and **persistence** in our job.



Thank you to the EICUG community for this honor.