Bending and assembly of the L0 and L1 layers

SVT Bari team
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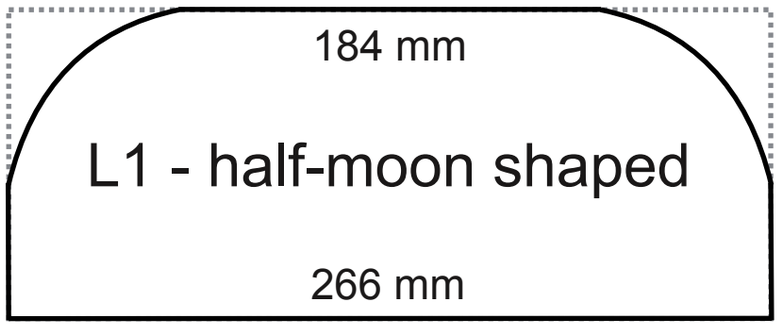
Recent progresses

1. SVT-L1 half-layer attempt n. 1
2. SVT-half-layers summary table
3. Next steps
4. Prototyping campaign and material procurement

Recent progresses

SVT-L1 half-layer attempt n. 1



Half-Layer	sensor size (mm^2)	# sensors
0	78.3 x 266	2
1	58.7 x 266	2

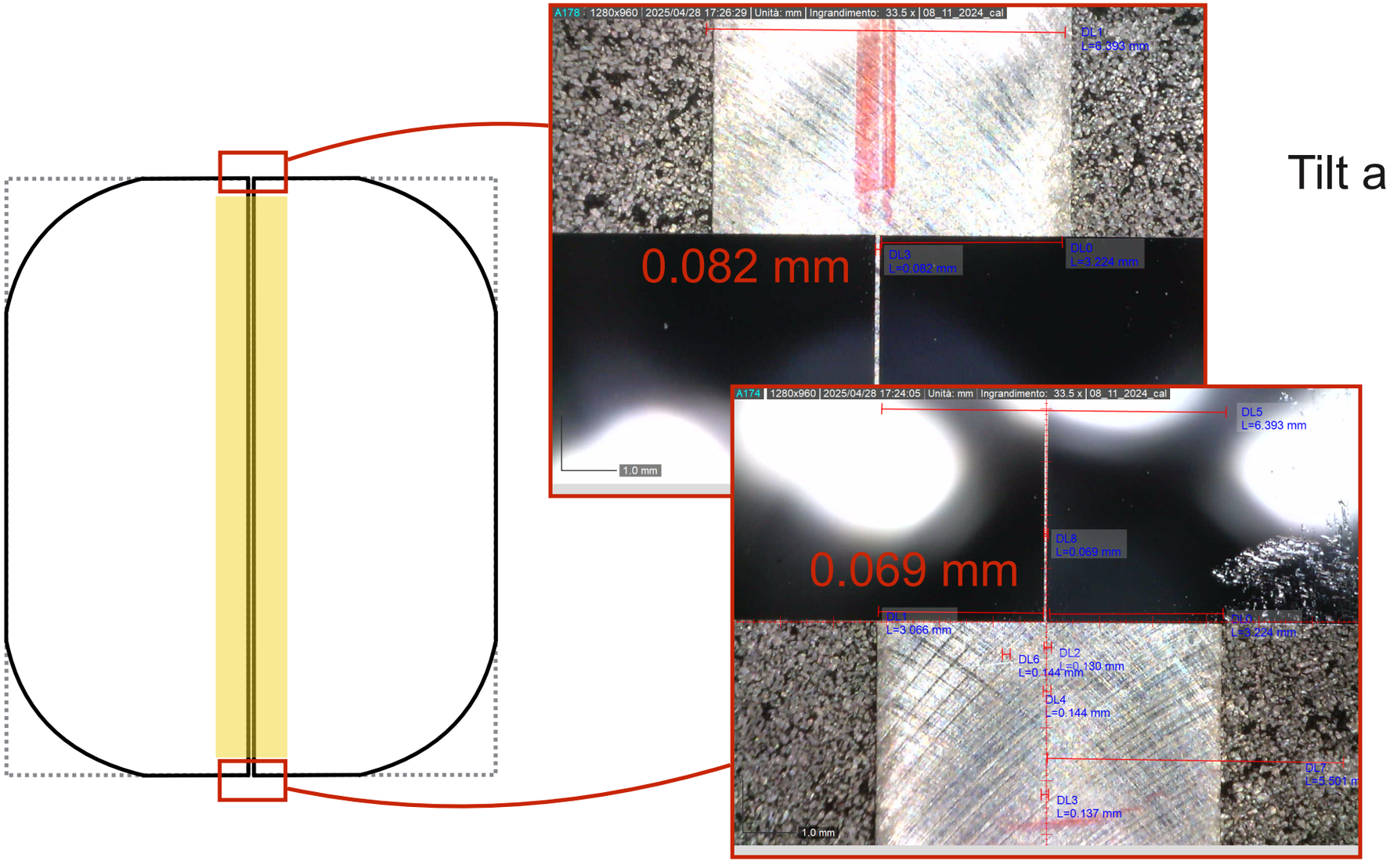
- April 28 - Two sensors alignment and connection with tape [OK!]
- April 29 - Bending of L1 silicon piece couple [OK!]
- May 6 - Gluing of support structures [Silicon breakage!]

Recent progresses

SVT-L1 half-layer attempt n. 1

April 28 - Two sensors alignment and connection with tape

Procedure done by hand using a plane equipped with two independent vacuum regions.

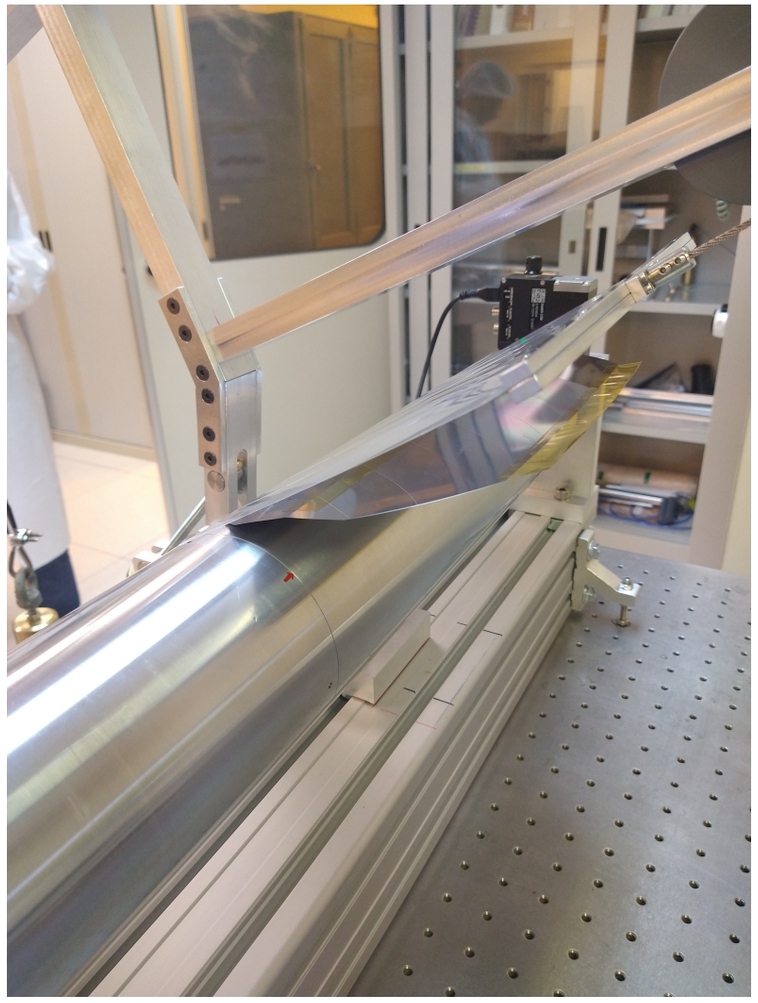


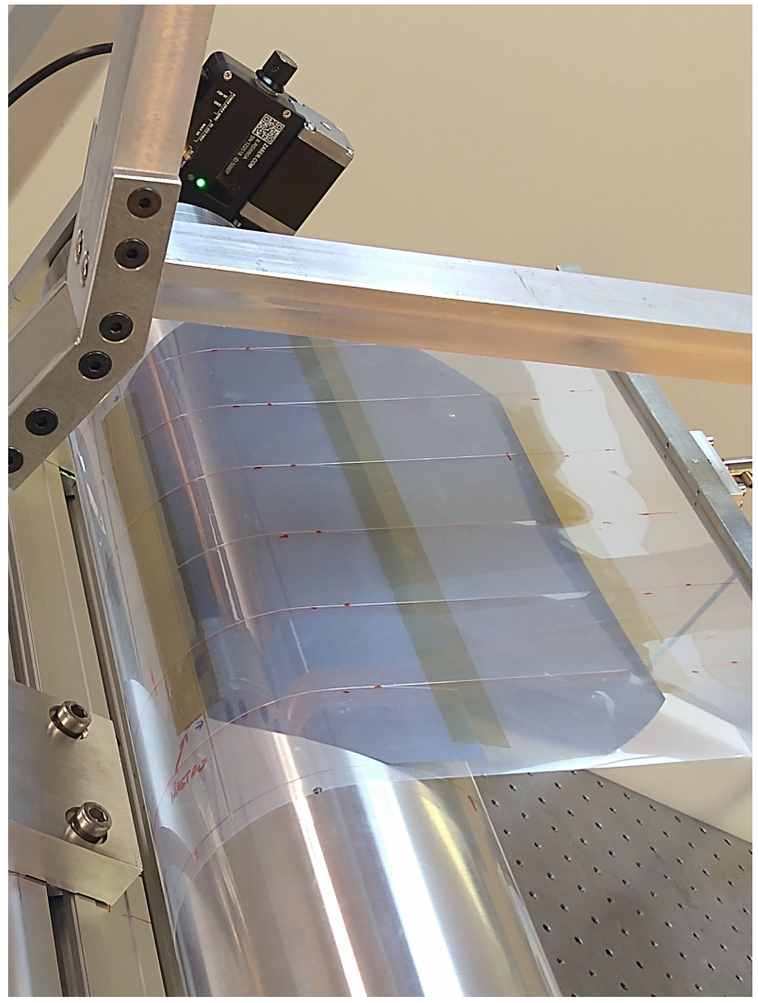
Tilt angle: ~0.0028°

Recent progresses

SVT-L1 half-layer attempt n. 1

April 29 - Bending of L1 silicon piece couple





Recent progresses

SVT-L1 half-layer attempt n. 1

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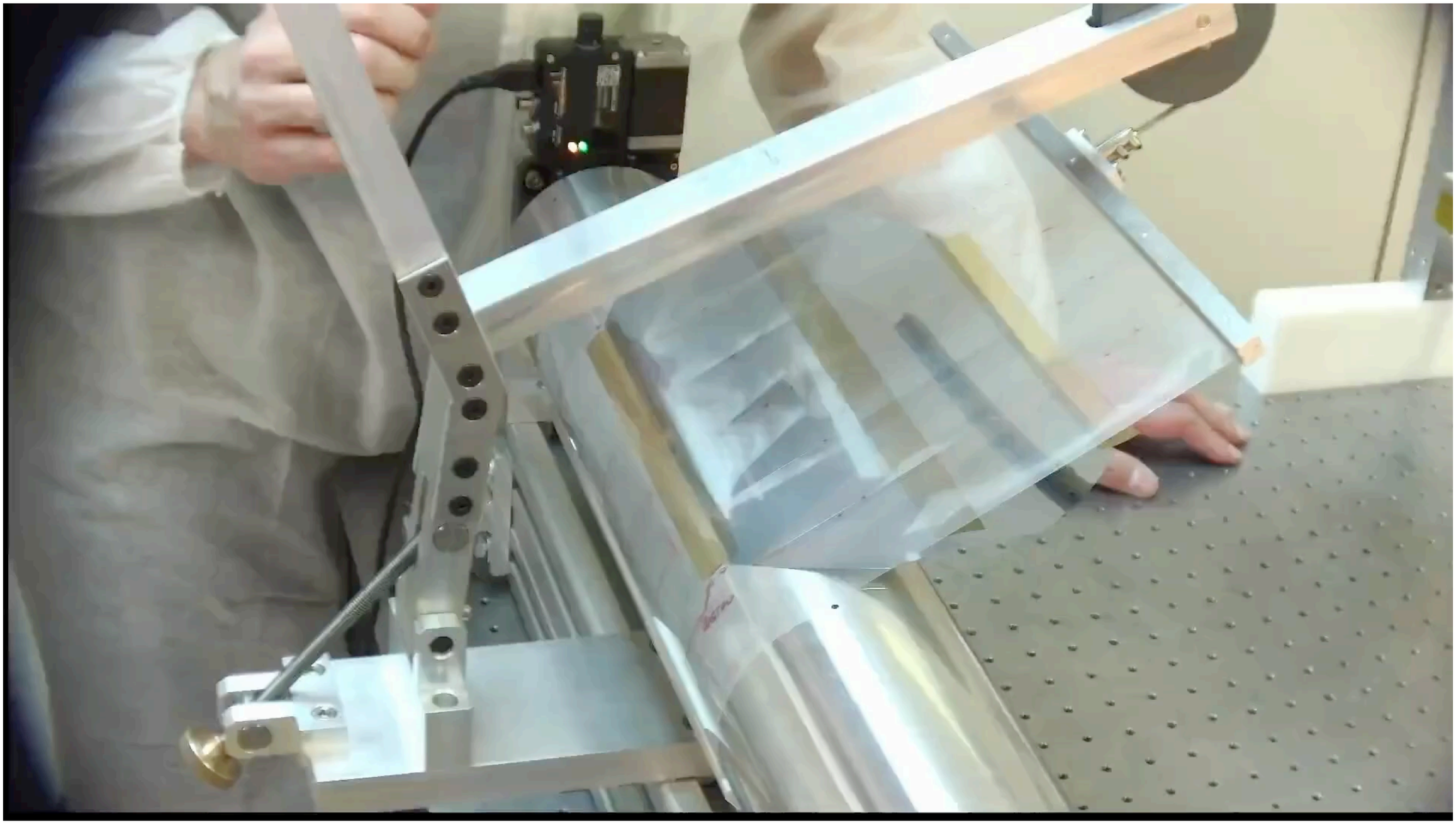

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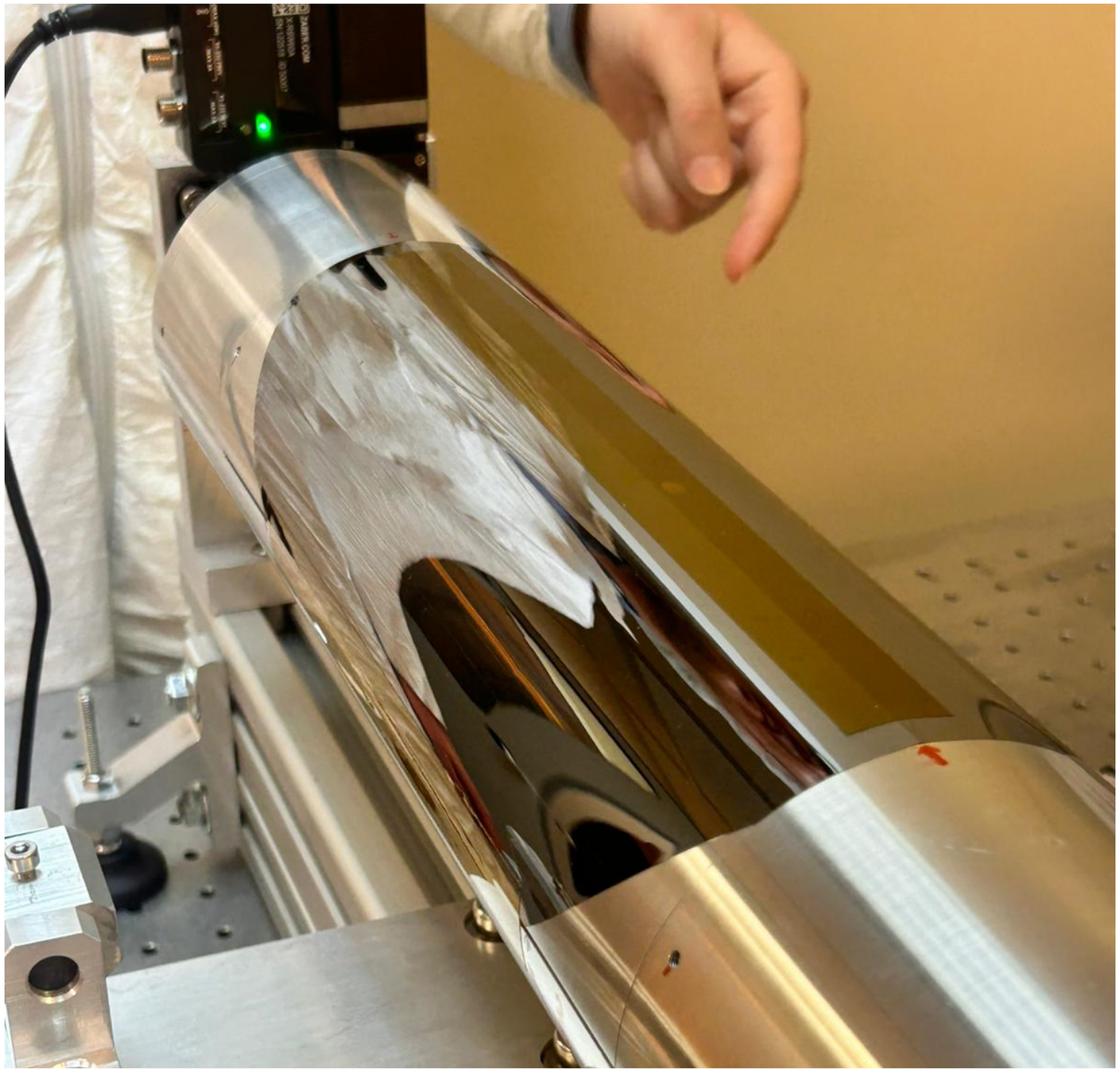
Recent progresses

SVT-L1 half-layer attempt n. 1

April 29 - Bending of L1 silicon piece couple

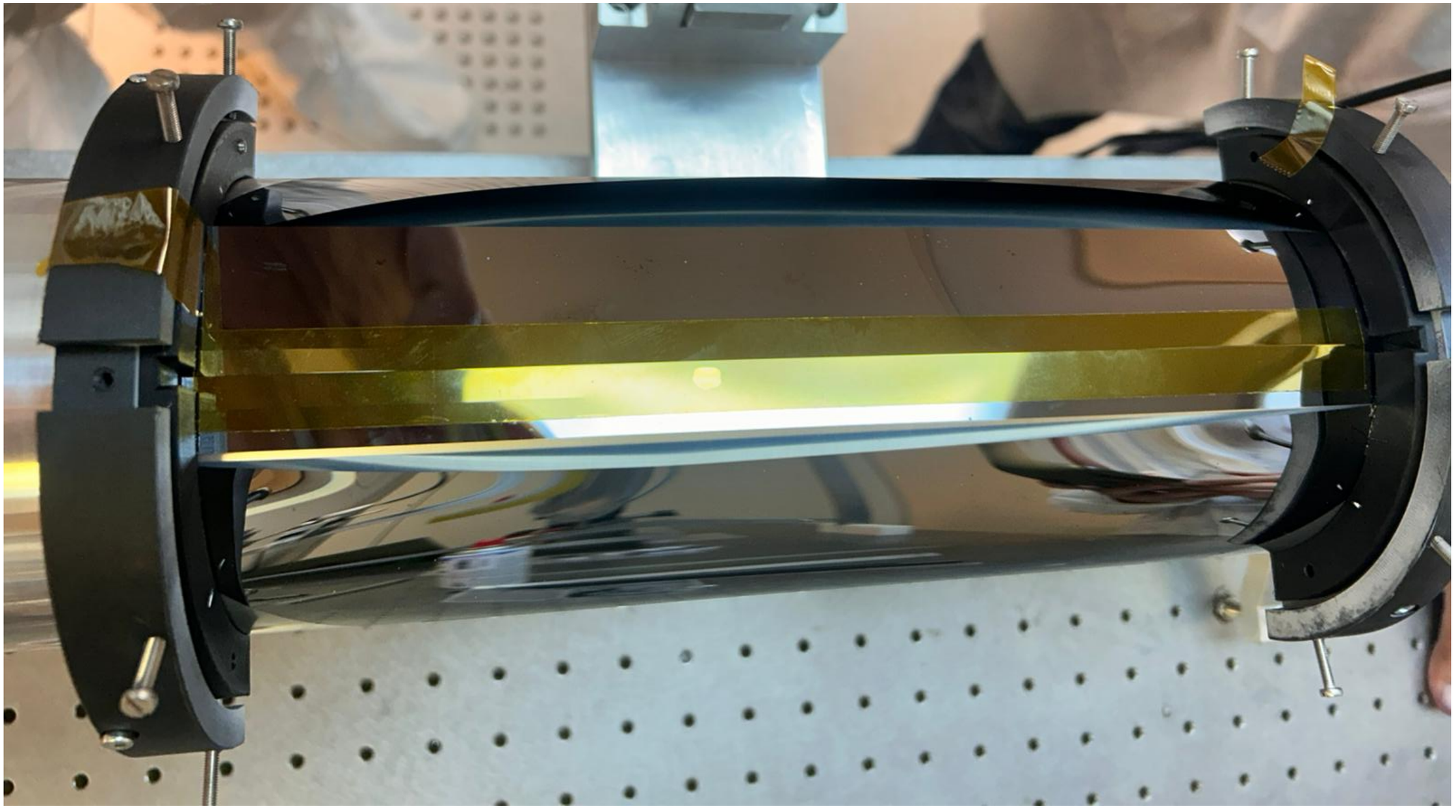


Recent progresses

SVT-L1 half-layer attempt n. 1

May 6 - Gluing of support structures

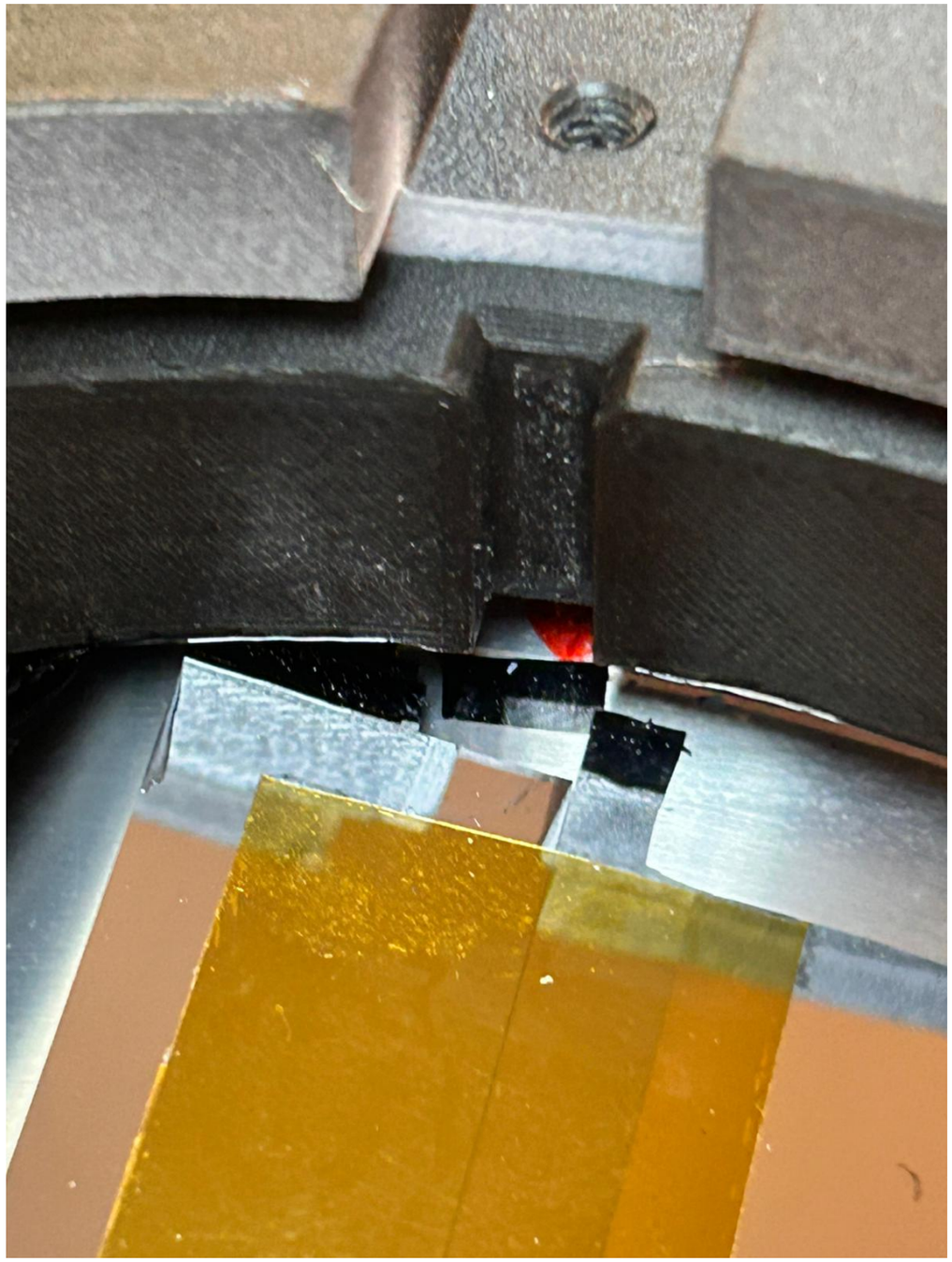
Silicon breakage during the placement of the half-ring holders with the half-ring

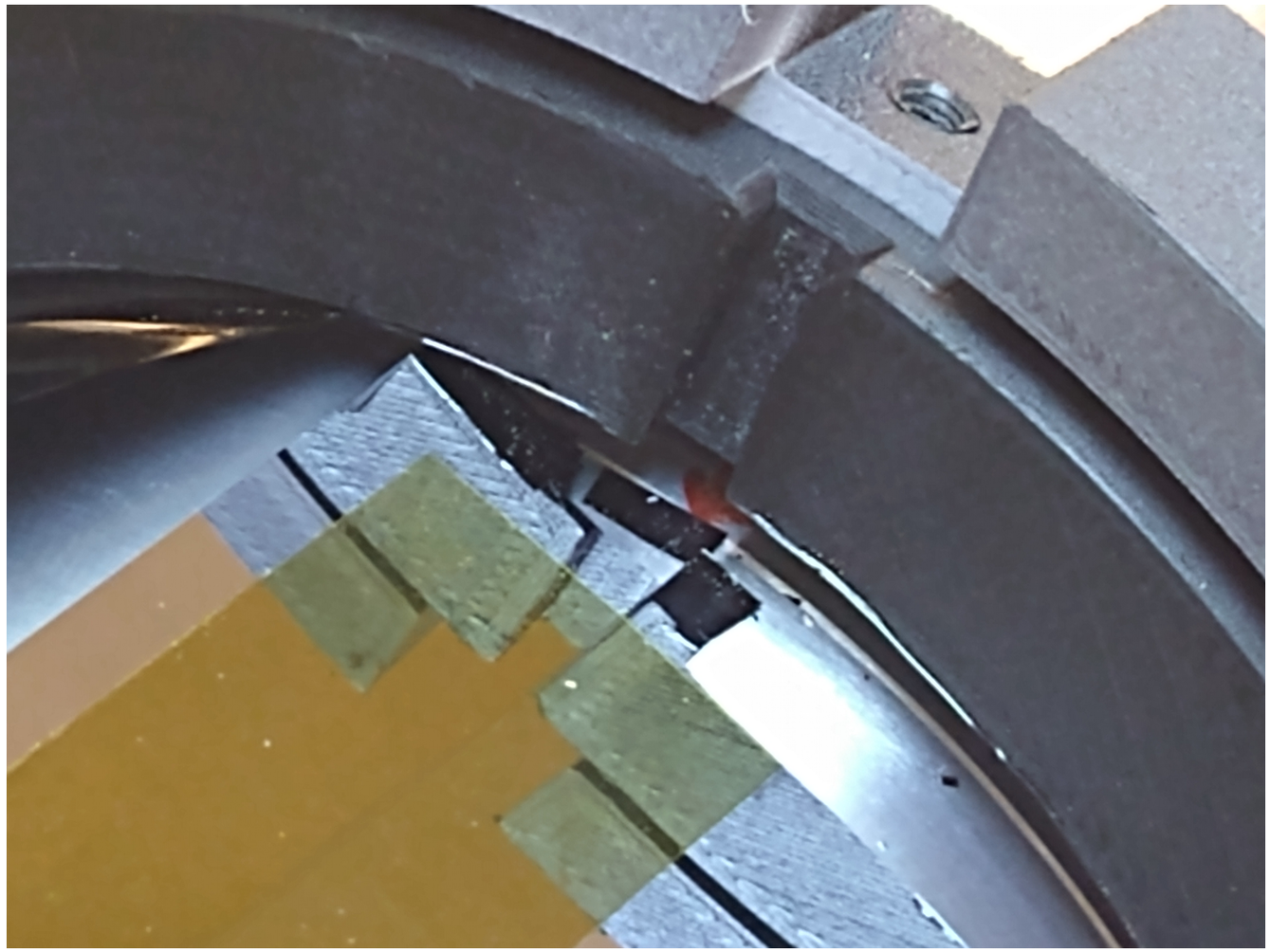


Recent progresses

SVT-L1 half-layer attempt n. 1

May 6 - Gluing of support structures





Recent progresses

SVT-L1 half-layer attempt n. 1

May 6 - Gluing of support structures

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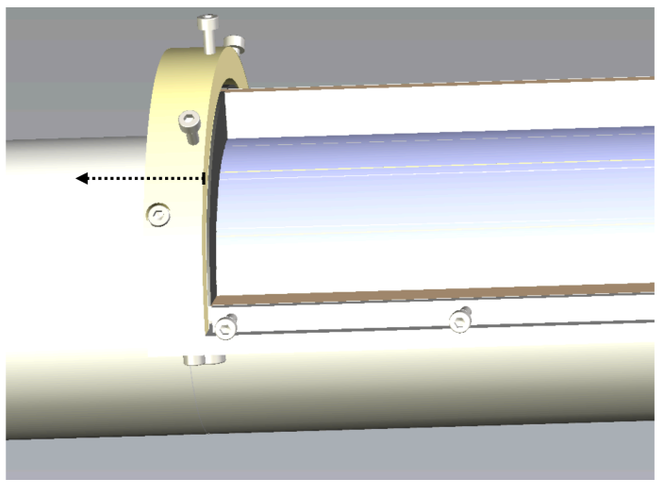
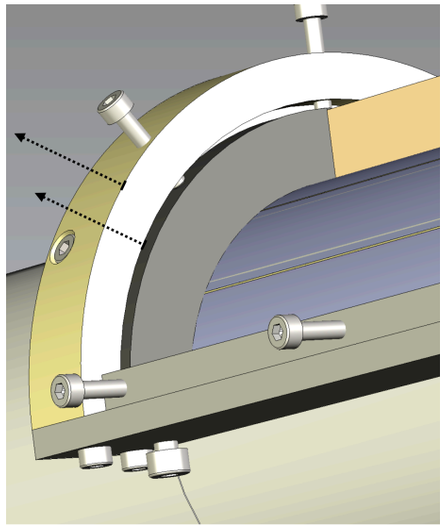
Recent progresses

SVT-L1 half-layer attempt n. 1

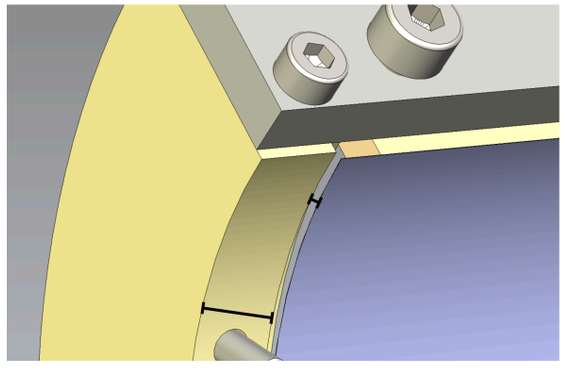
May 6 - Gluing of support structures



Increase the width of the holder → To facilitate the alignment during the placement



Increase the radii (internal and external) of the holder → To make easier the placement of the holder with the half-ring in position (to be later pushed toward the sensor)



Increase the distance between the edge of the tool and the edge of the silicon → To make safer the full procedure

Recent progresses

Further modification to the tools and procedures

- Few small features to be added to the handling and gluing tools
  - Better vacuum on movable tower → DONE, to be mounted
  - Better longerons handling during gluing → UNDER DESIGN
  - Sensor pitch measurement improvement and automatization
    → DECIDED TO IMPROVE PRESENT TOOLING/PROCEDURE IN ORDER TO MAKE MORE REPRODUCIBLE THE RESULTS; IDEAS TO BE VERIFIED AND MODIFICATION TO BE IMPLEMENTED

Recent progresses

SVT half-layers attempts summary

#	Layer	Conditions	Dates	Success	Notes
1	L0	2 half-moon shaped L0 3D printed longerons and half-rings mandrel produced on our workshop	25/11/2024 - 26/11/2024	**NO**	Breakage of the second silicon piece during the bending
2	L0	2 half-moon shaped L0 3D printed half-rings and plexiglass longerons mandrel produced on our workshop	13/01/2025 - 31/01/2025	**YES**	
3	L0	2 half-moon shaped L0 3D printed half-rings and plexiglass longerons mandrel produced on our workshop	24/03/2025 - 28/03/2025	**NO**	One silicon piece already broken from the transport box
4	L0	2 half-moon shaped L0 3D printed half-rings and plexiglass longerons mandrel produced on our workshop	03/04/2025 - 10/04/2025	**YES**	
5	L1	2 half-moon shaped L1 3D printed half-rings and plexiglass longerons mandrel produced on our workshop	28/04/2025 - 06/05/2025	**NO**	Both silicon pieces broke during the half-ring holder placement

Recent progresses

Next steps

- Modification to the half-ring gluing tool after the breakage of the L1 silicon pieces couple
- [TBD] An L0 or an L1 half-layer (Note: only 2 half-moon shaped L1 silicon pieces available…)
- (If previous step successful) SVT-L0L1 half-barrel

Prototyping campaign vs Material procurement

	Prototype	Components	Goal
MAR 2025	IBL01_P1 (half-layer)	• 2 naked silicon L1 sensors • L1 local support structure (3-D printed) • outer support shell (machined in PEEK)	• finalize half-layer assembly procedure
	IBL01_P2 (half-barrel)	• IBL01_P1 + • 2 naked silicon L0 sensors • L0 local support structure (3-D printed)	• finalize half-barrel assembly procedure
JUL 2025	IBL01_P3 (half-layer)	• 2 naked silicon L1 sensors • L1 local support structure (carbon foam) • outer support shell (carbon fiber, to be defined)	• thermal chamber test
	IBL01_P4 (half-barrel)	• IBL01_P3 + • 2 naked silicon L0 sensors • L0 local support structure (carbon foam)	• thermal chamber test
OCT 2025	IBL01_P5 (half-barrel)	• 2+2 silicon L0+L1 **sensors with heaters from CERN** • L0+L1 local support structures (carbon foam) • outer support shell (carbon fiber, to be defined) • **air distribution inlet et outlet** (to be designed) • PT1000 sensors (to be glued on heater surface)	• wind tunnel test

They require dummy silicon sensors from DISCO;
to validate 2-sensor connection and bending, to design local support structure, external shell etc

→ L0/L1 Silicon pieces
SS 3D printed
Outer shell ??

In addition to DISCO dummies, they require:
- carbon foam local support (procurement and machining TBD)
- carbon fiber outer support shell TBD (if yes, needs for design&simulation, procurement and machining)

→ L0/L1 Silicon pieces
SS carbon foam
Outer shell carbon fibre

IBL01_P5 requires:
- ~~dummy silicon sensors with heaters~~
- air-cooling mechanism verification
- Possible preliminary FPC (mechanical) prototype to check volumes, transport etc)
- transport issues to wind tunnel facility

→ L0/L1 heaters
SS carbon foam
Outer shell carbon fibre

Prototype	Components	Goal	Date
IBL012_P6/7	• 2+2+4 ER2 pad wafer L0+L1+L2 sensors (x 2 HB?) • L0+L1+L2 local support structures • gloabal support mechanics (advanced design) • FPCs (advanced design) • air distribution inlet & outlet (advanced design)	• first complete IB HB prototype w/o sensors • including test of wirebonding to FPCs • final test on HB support mechanics • possibly built 2 complete HBs (to allow HB mechanical support matching test)	2026/07
IBL012_P8	• 2+2+4 ER2 wafer L0+L1+L2 sensors • L0+L1+L2 local support structures • mechanics, FPCs, cooling (~final/advanced design)	• complete IB HB prototype w/ sensors • qualification model w/ bent sensors for cooling + powering/DAQ/DCS finalisation	2026/10

→ L0/L1 pad sensors
SS carbon foam
Outer shell carbon fibre

→ L0/L1 ER2 sensors
SS carbon foam
Outer shell carbon fibre

Prototyping campaign vs Material procurement

Silicon sensors/pieces:

Silicon pieces	4 L0 - 4 L1	AVAILABLE No spares
Heaters	2 L0 - 2 L1	Production completed: 4 L0 - 4 L1 Available in Bari
Pad sensors	[2 L0 - 2 L1 - (4 L2)] x 2	If two half-barrels (16 pad sensors = 16 wafers) → no spares
ER2 sensors	2 L0 - 2 L1 - (4 L2)	Only one half-barrel No spares

Support structures:

3D printed	Mixing printed and manufactured in very first exercises
Carbon fibre/foam	Material for components - Half-ring on LEC: Allcomp K9 (standard density, 200-260 kg/m^3) - Longerons and half-ring on REC: Carbon RVC Duocel (density 45 kg/m^3, PPI 100) - Carbon fleece: wet-laid non woven carbon fibre veil(8 g/cm^2) - Outer shell: carbon fibre → Type of carbon fibre to be defined (Padova) Foam procurement - Allcomp K9 → Not easy to procure from Europe, ask colleagues in USA - Carbon RVC Duocel → Company in USA, but possible purchasing from Europe Foam shaping - Collecting procedure details from CERN colleagues - Genova INFN → First contact, under exploration - Berkley (Nikki) or U.K. (George) → Expressed availability - Local workshop → To be found and require material for attempts Carbon fibre production - Producer to be identified (Padova)

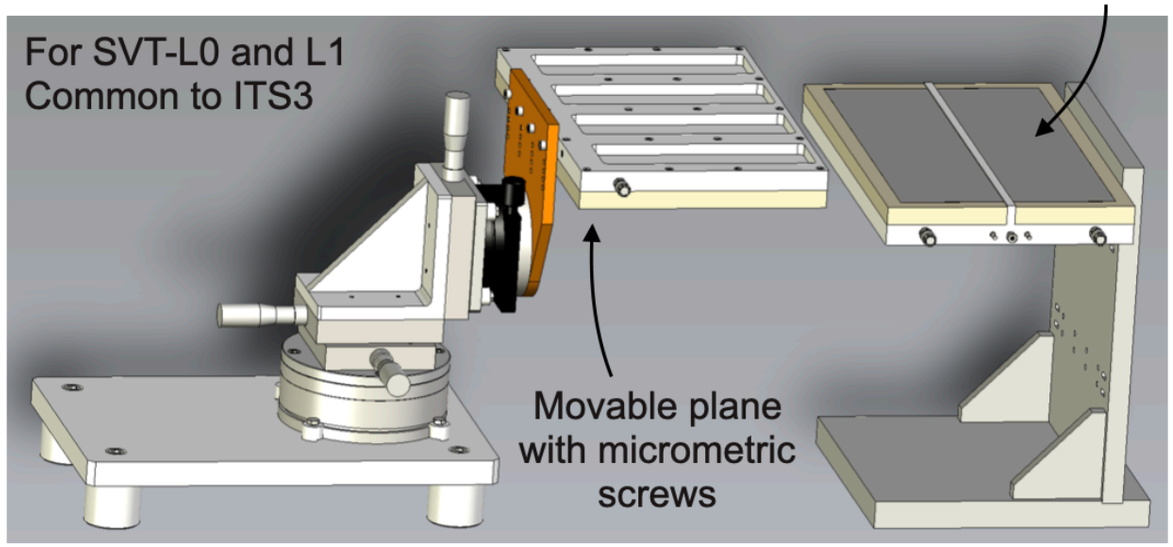
BACKUP

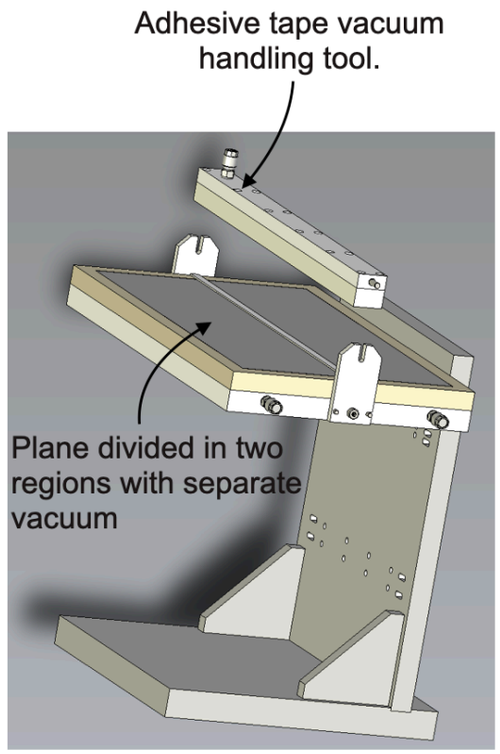
Recent progresses

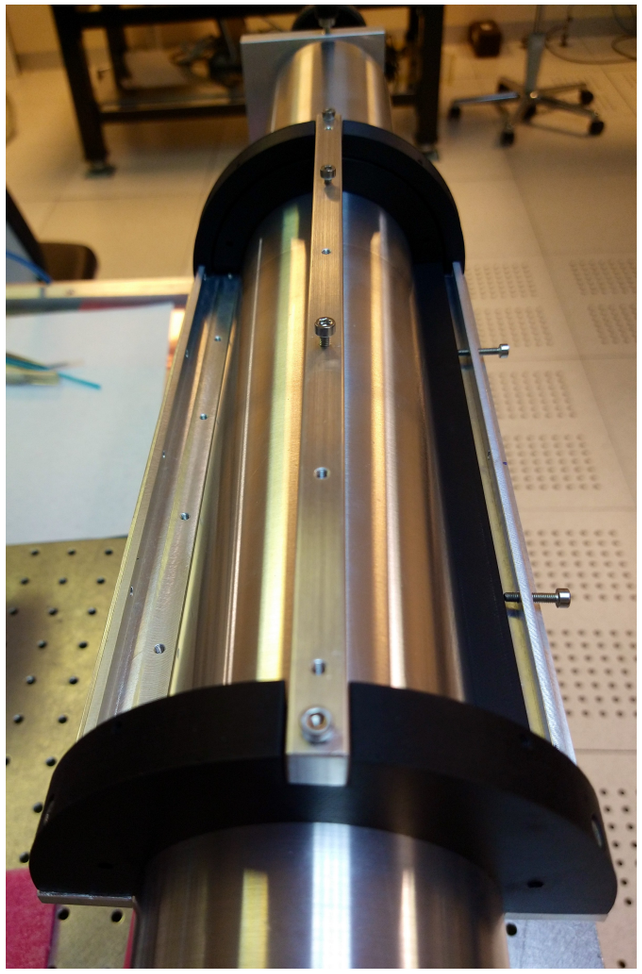
SVT-L0 half-layer attempts summary

Recent progresses

New sensor handling tools and support structure gluing tools





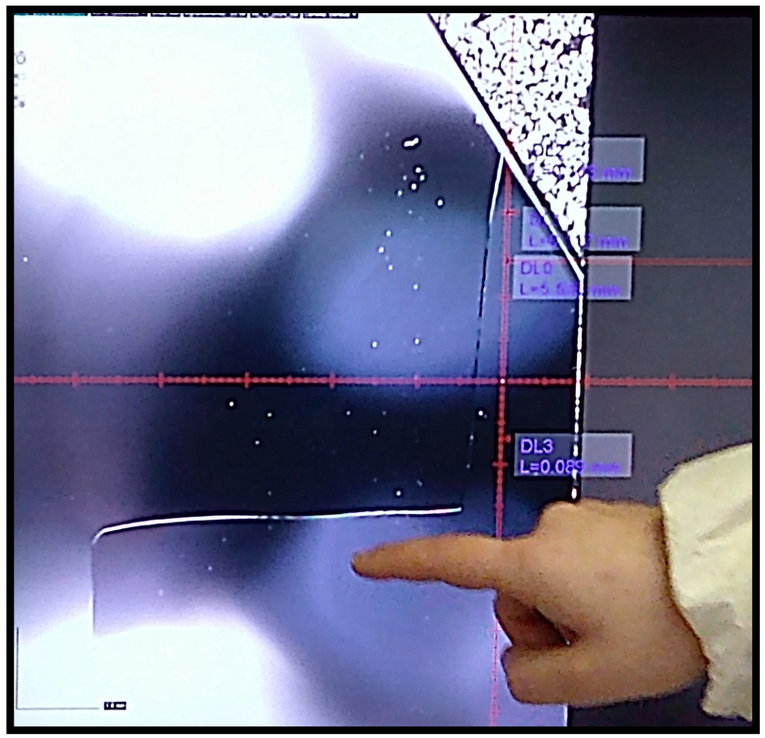


Required to:

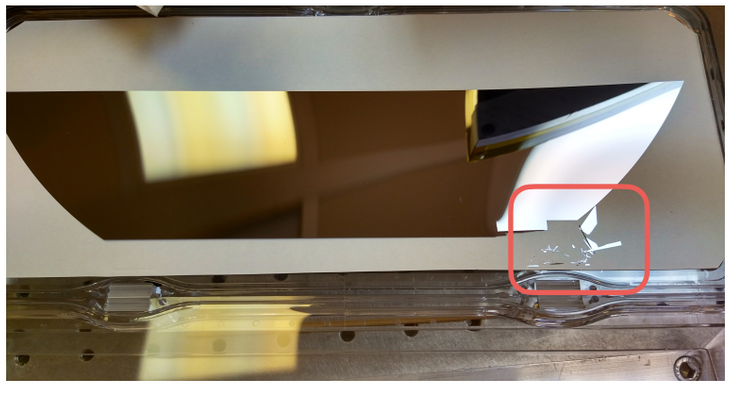
- Precisely align and join the two sensors
- Handle the joint sensors during the bending procedure to approach the mandrel
- New tool for support structures gluing

Recent progresses

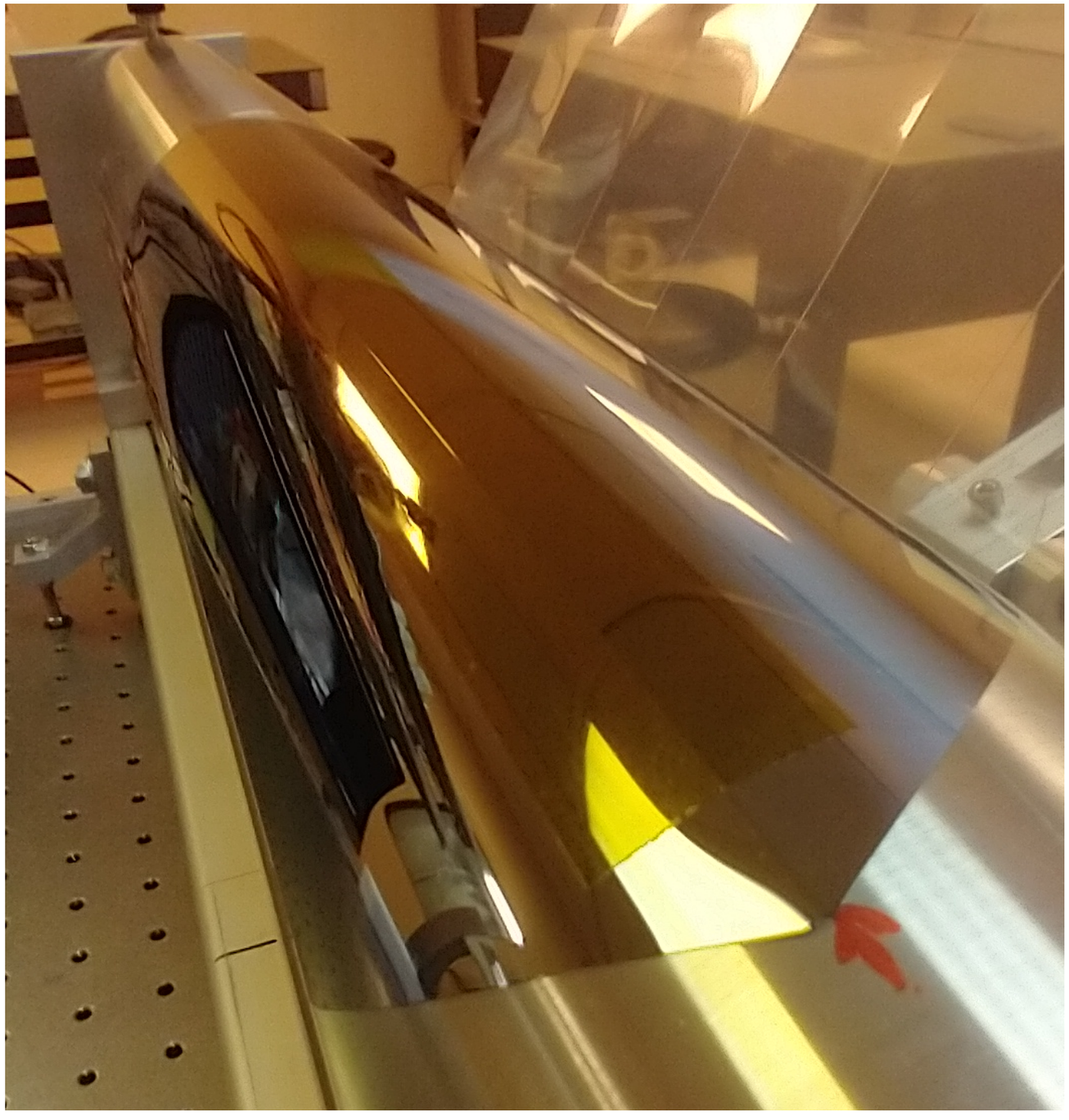
SVT-L0 half-layer attempt n. 3



Crack stopped during bending procedures using microscope (not easily visible by eye).

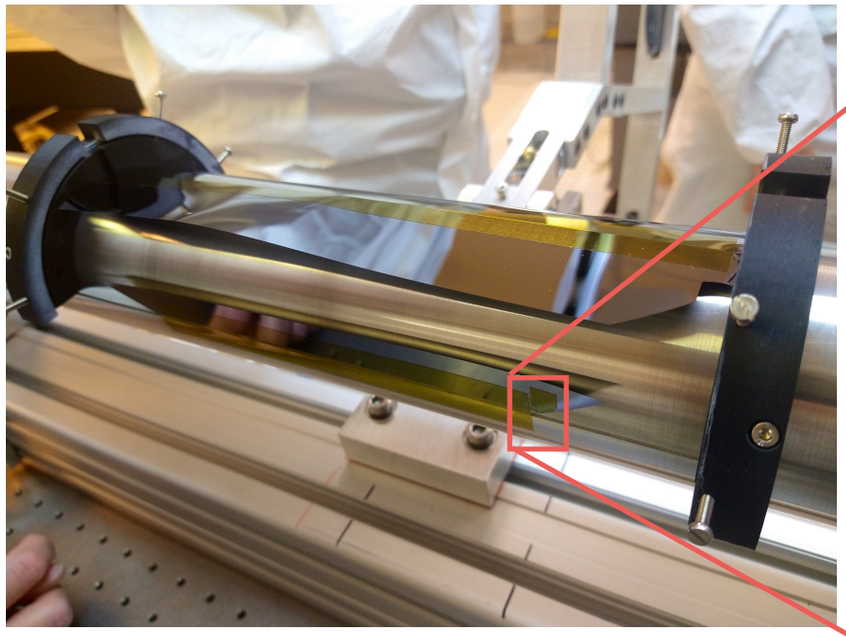


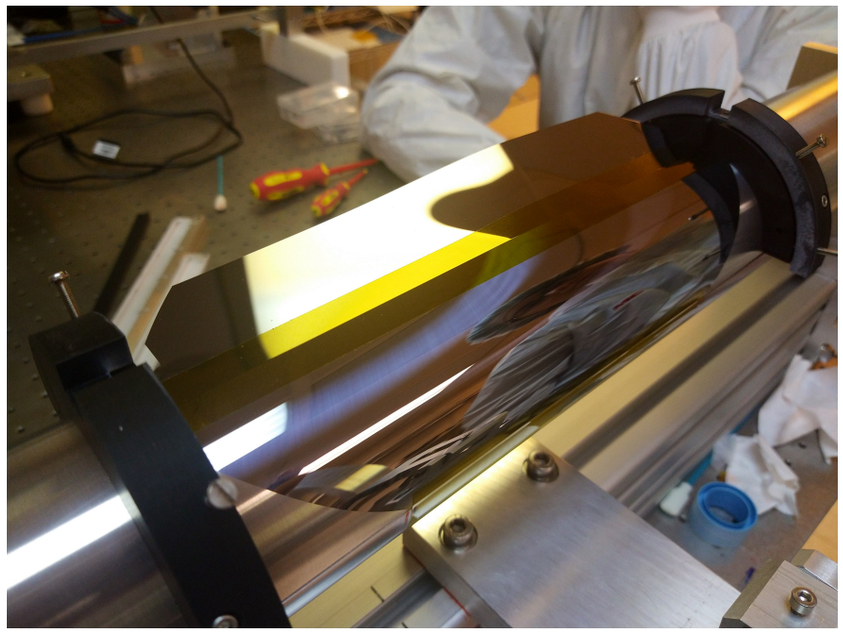
Broken silicon pipe found in the same box
- Don’t stack many silicons in the same box
- Visual inspection before each assembly

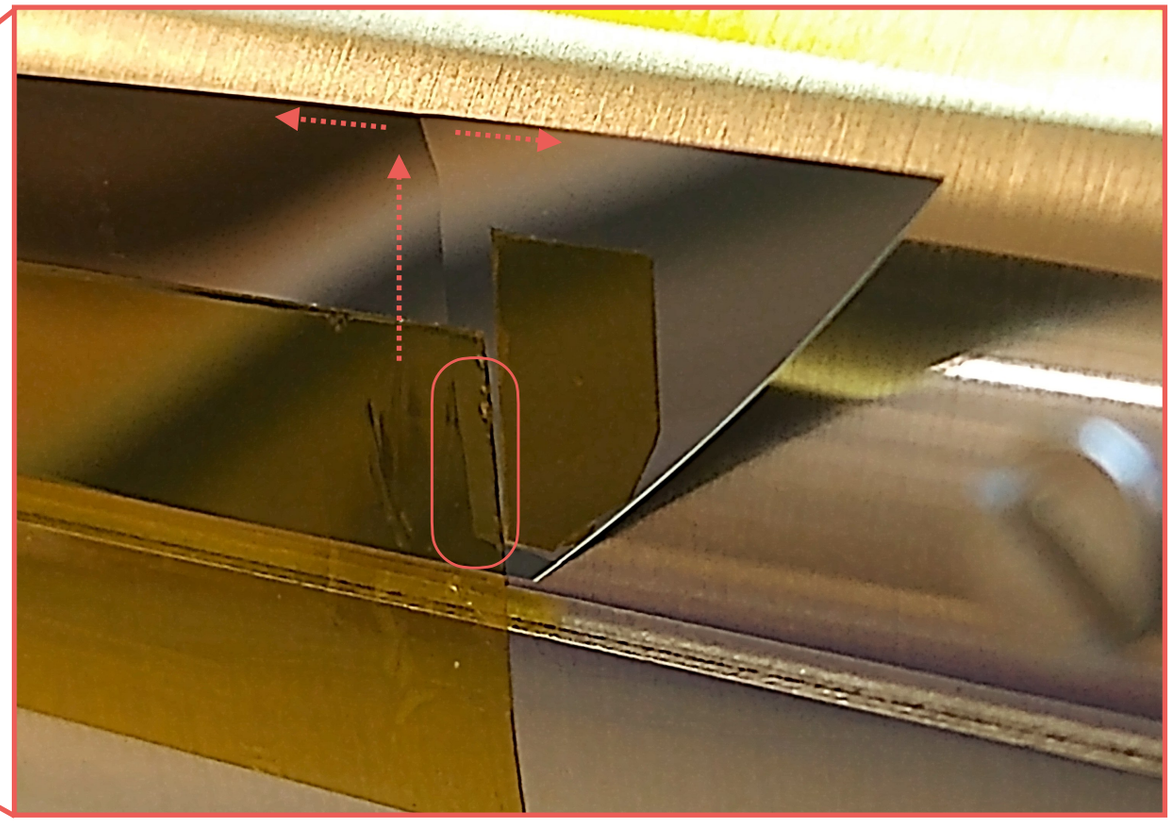


Recent progresses

SVT-L0 half-layer attempt n. 3



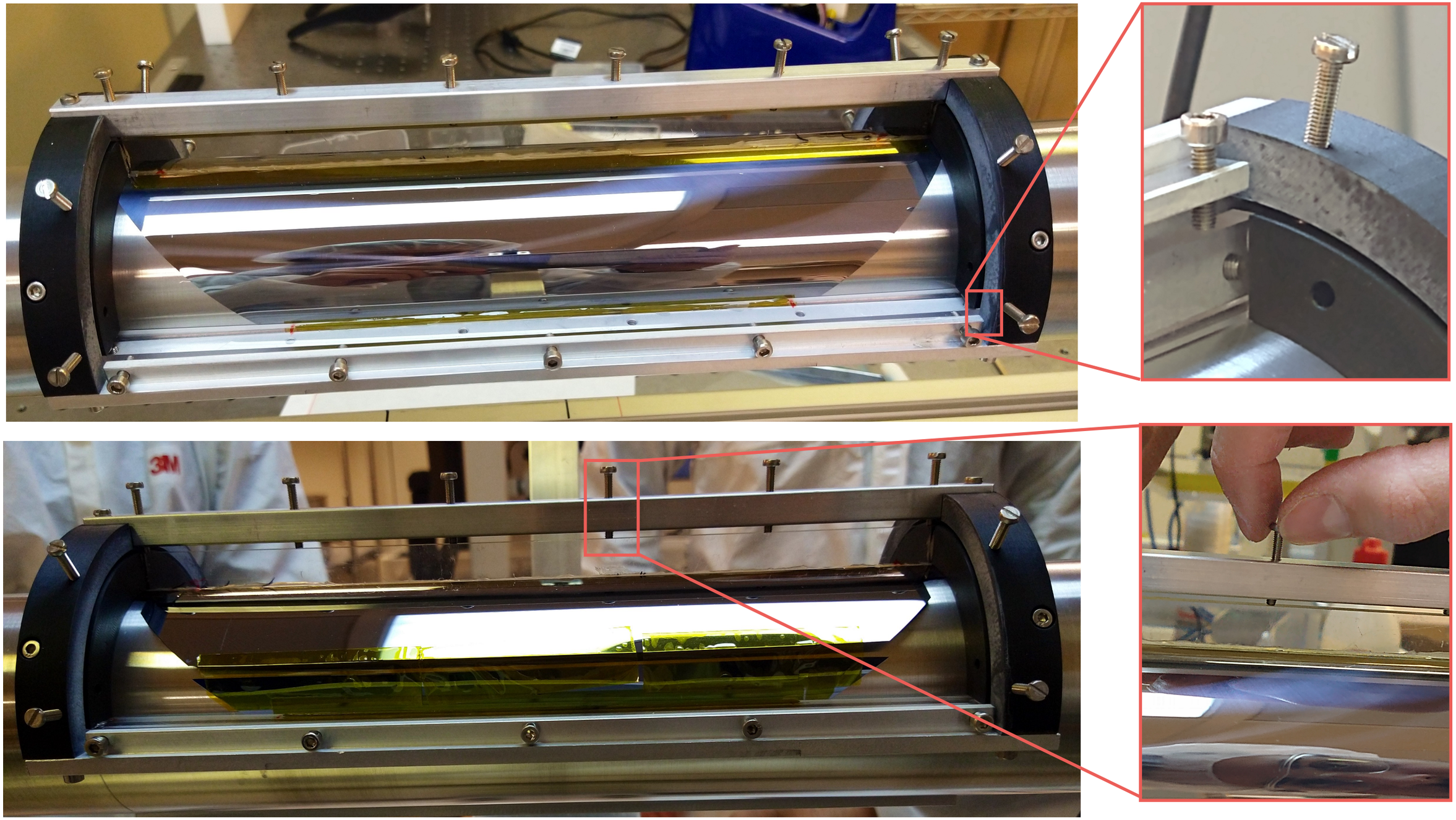




Fancy patchwork to finalize the exercise of verification of support structure gluing tools

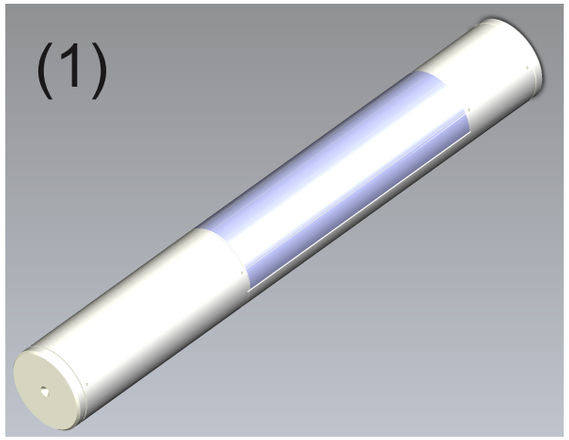
Recent progresses

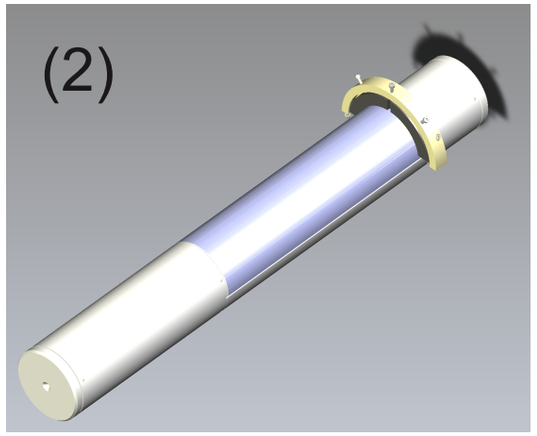
SVT-L0 half-layer attempt n. 3

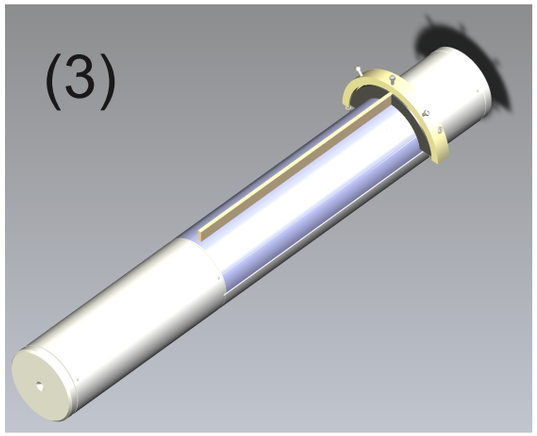


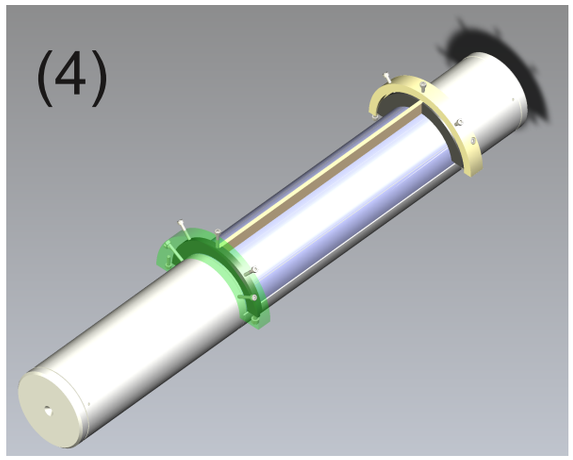
Recent progresses

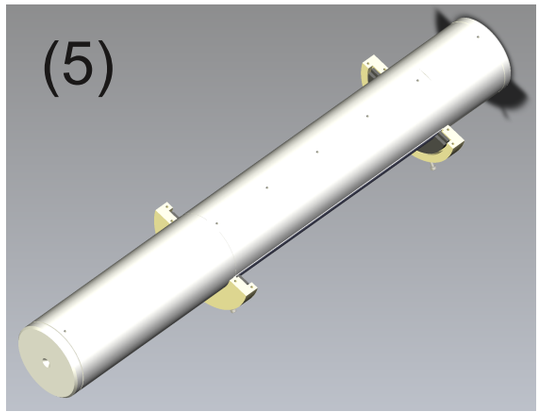
Support structures gluing tool

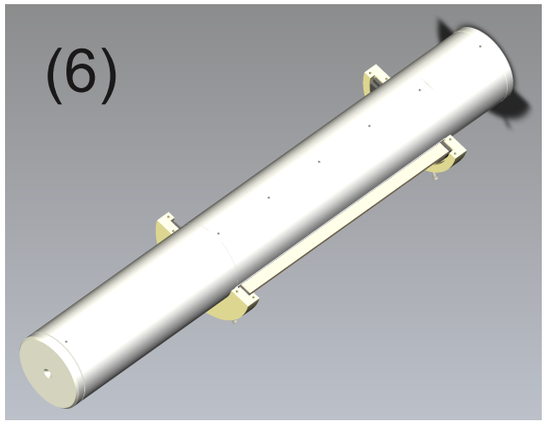


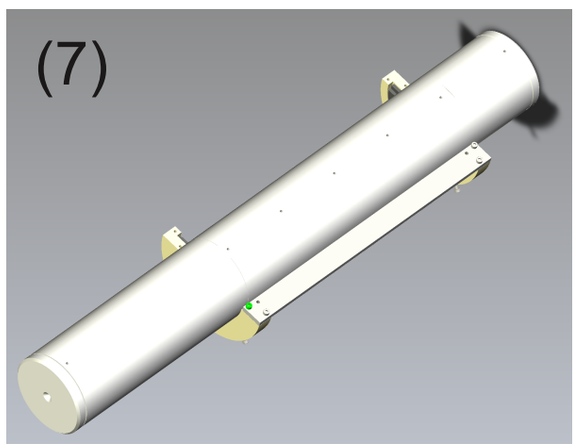


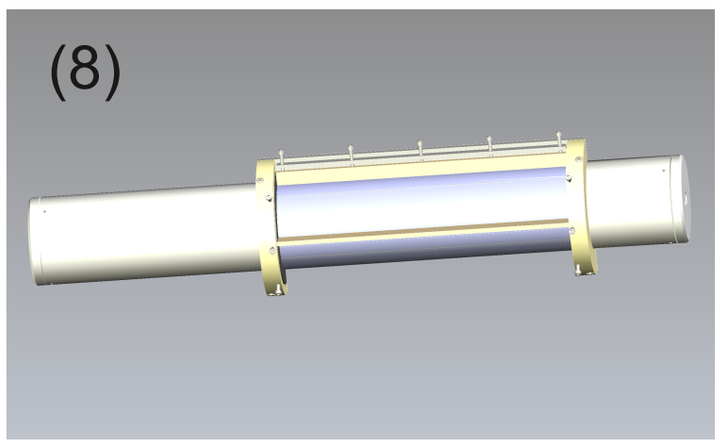


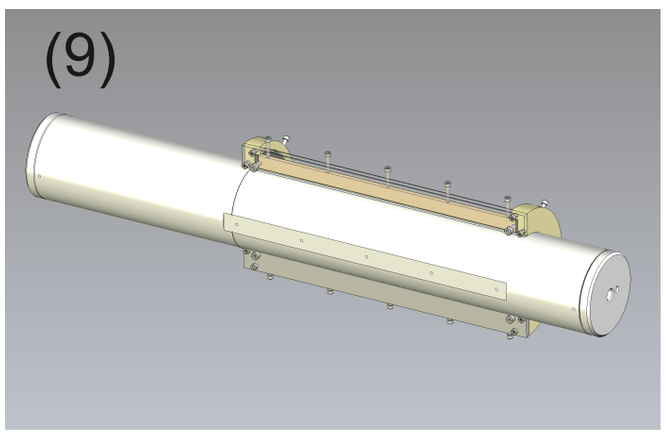








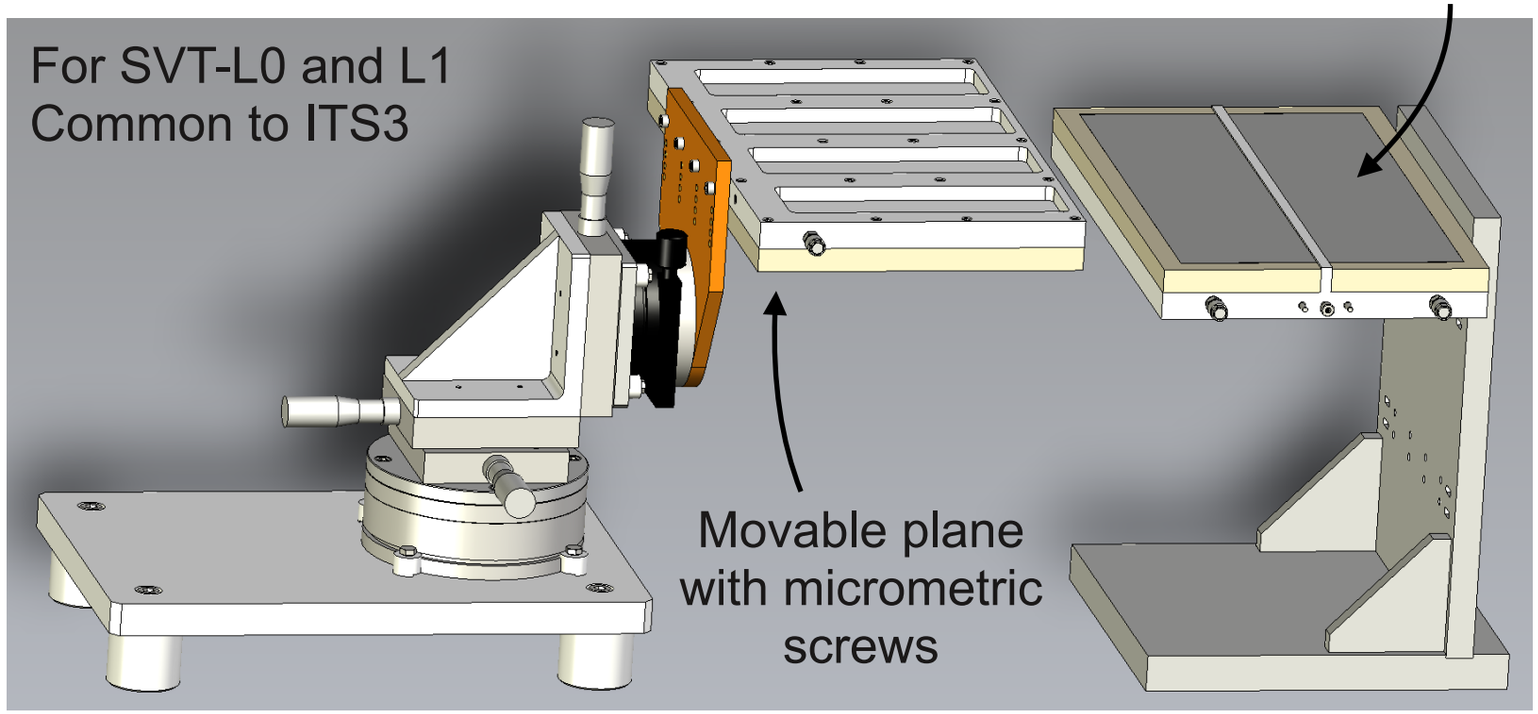


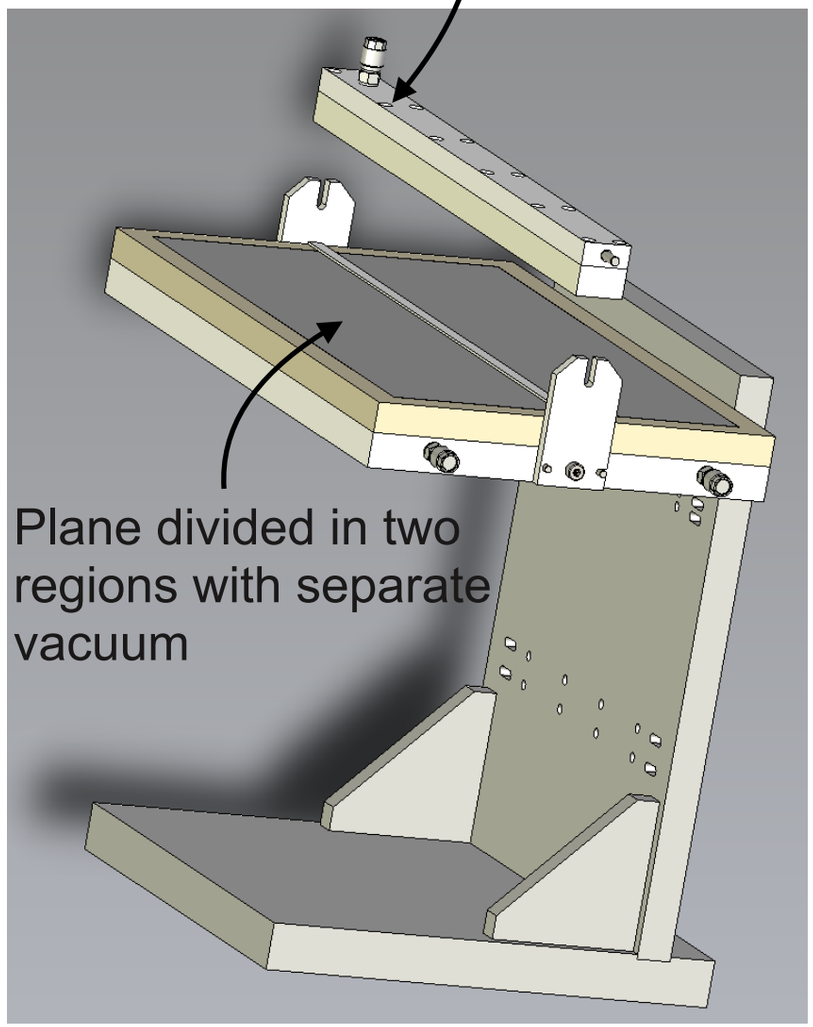


Tools under refinement after successful gluing.
Mainly improving pressing components for longerons to the sensors.

Recent progresses

Sensors alignment and handling tools





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