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# OEC Integration

## 19. Half-ring installation & test

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# Introduction

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The Half-ring installation is done by a Half-ring installation tool meant to:

- impose a well defined installation sequence
- avoid Half-ring direct handling
- Half-ring rigidly fixed at any time
- Half-ring positioning by manual adjusting stages
- Eventually, the same mechanical tool can be used to hold electrical test box and welding tool

NB: The Half-ring installation tool will evolve accordingly to the integration but a full working prototype is ready in Frascati

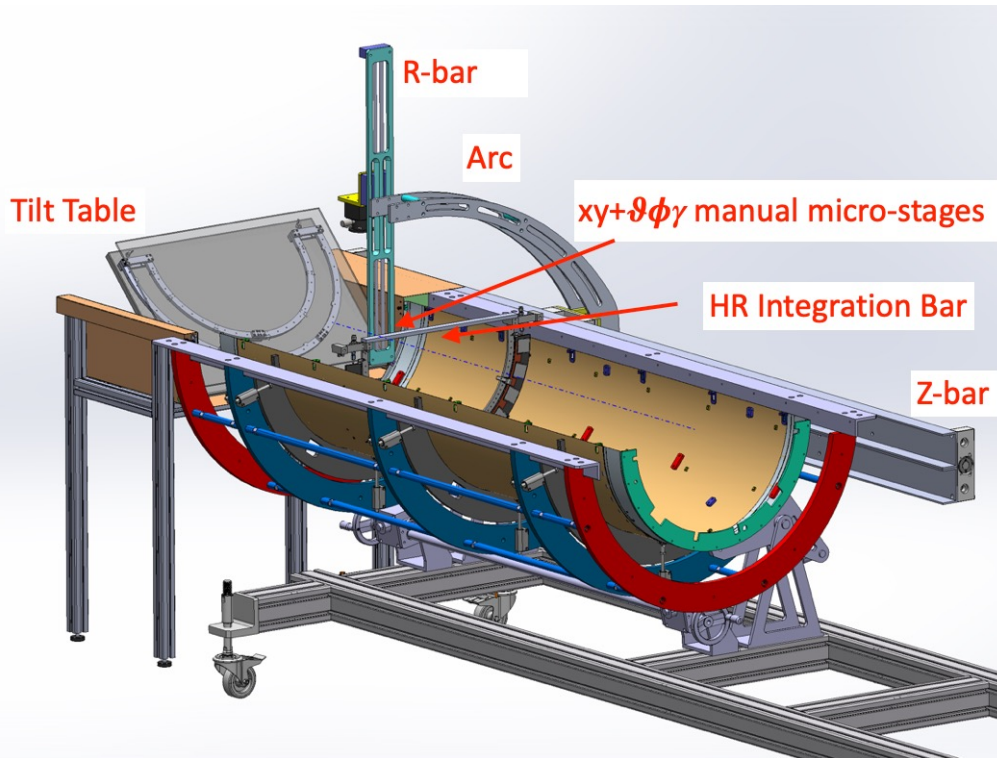
# Main steps

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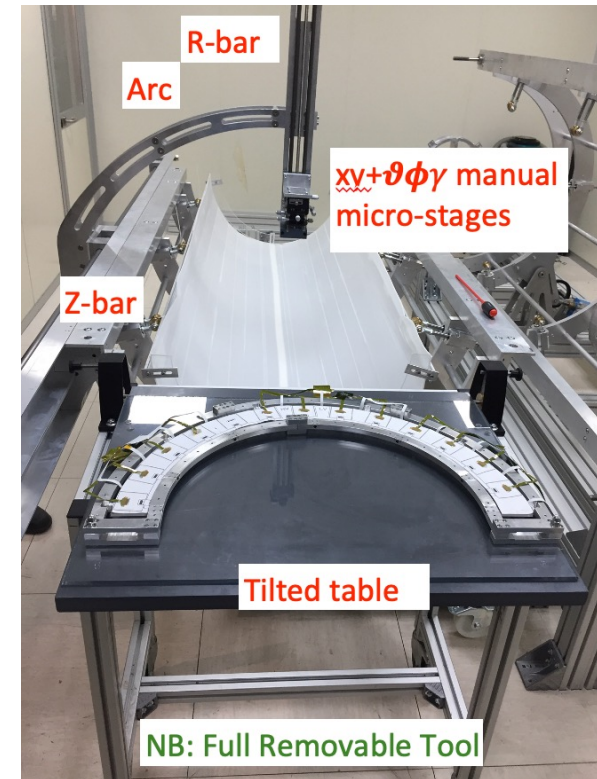
1. After reception test the Half-ring is manually removed from the test box with its support structure and fixed on the tilted table in horizontal position.
2. On the tilted table in horizontal position the Half-ring is set free from the Half-ring support structure.
3. On the tilted table in vertical position the Half-ring is hooked to the R-bar by the handling frame inner arcs.
4. The Half-ring is moved to the nominal z position by the Z-bar. Eventually passing above the previous installed Half-rings.
5. The Half-ring is moved to the default r position by the R-bar
6. The Half-ring is moved to the final position by acting on the  $XY+\vartheta\phi\gamma$  micro-stages
7. The Half-ring is mechanically fixed on the Half-shell
8. The data PPO supports are removed and the data PPO's connected to the Twinax-cables
9. The Serial Power's, High-Voltages and MOPS are connected
10. Half-ring electrical connectivity in low power mode before welding
11. Half-ring CO2 Inlet and outlet pipe connections by welding
12. Pressurized welding test
13. Half-ring electrical connectivity in low power

# Half-ring installation tool

CAD design



Prototype in Frascati

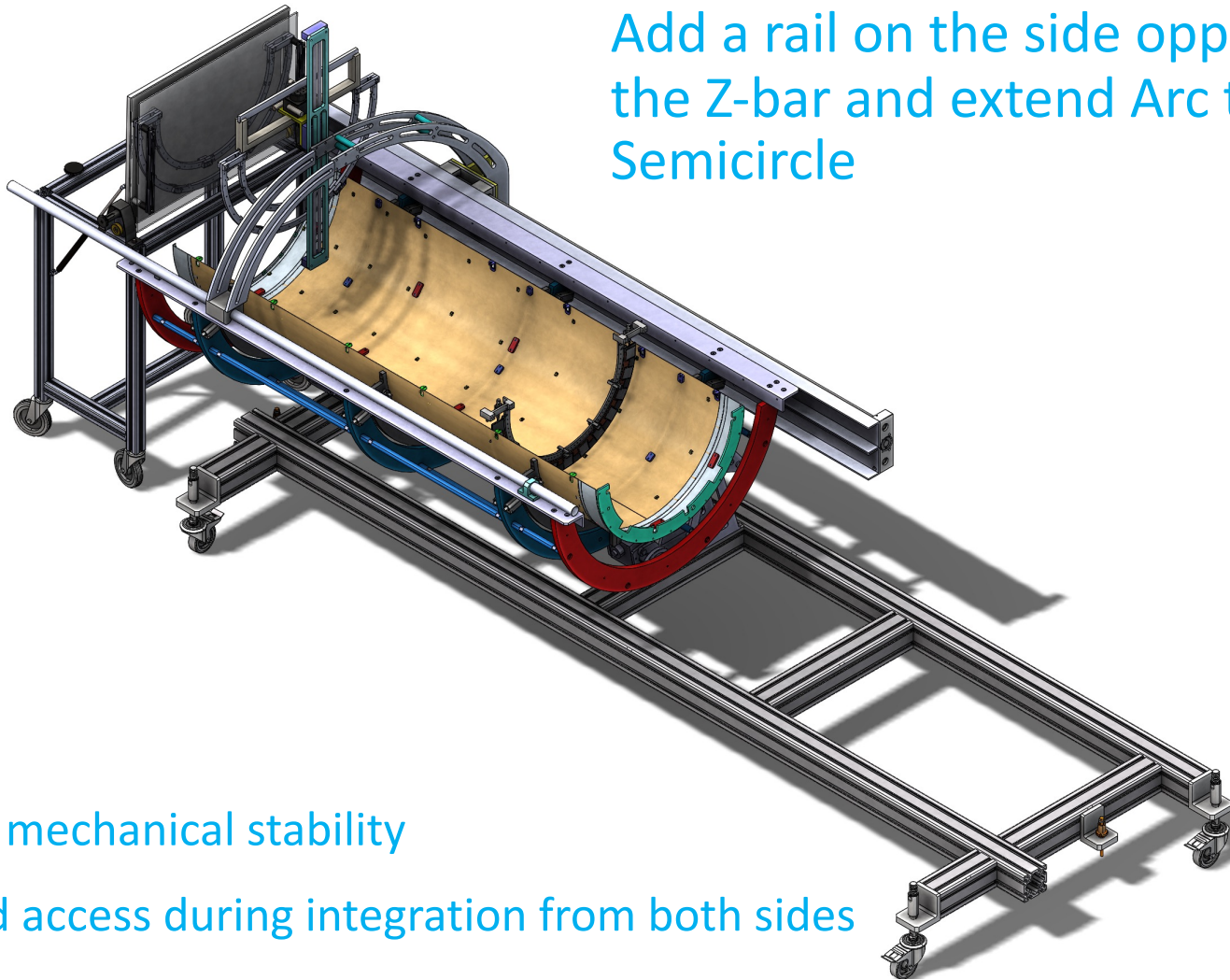


The Half-ring installation tool parts are described in red:  
Tilted table, Z-bar, Arc, R-bar, micro-stages and I-bar.

# Improvement under evaluation

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Add a rail on the side opposite to the Z-bar and extend Arc to a Semicircle



Pro: Increase mechanical stability

Con: Reduced access during integration from both sides

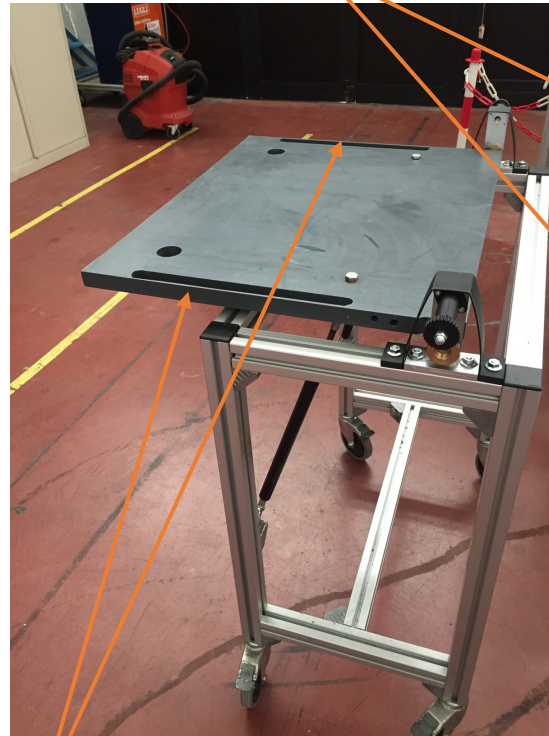
# Tilted table

CAD design

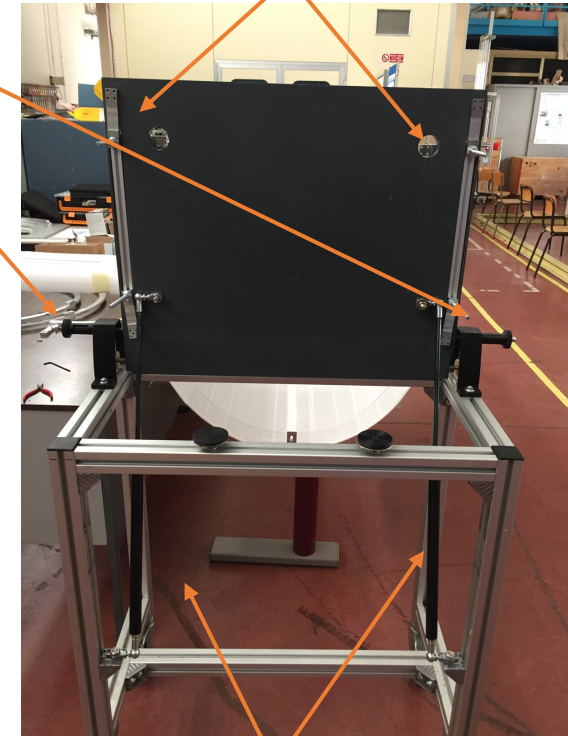


Prototype in Lecce

Springs for vertical stop



Opening for unscrew  
Handling-frame inner arcs



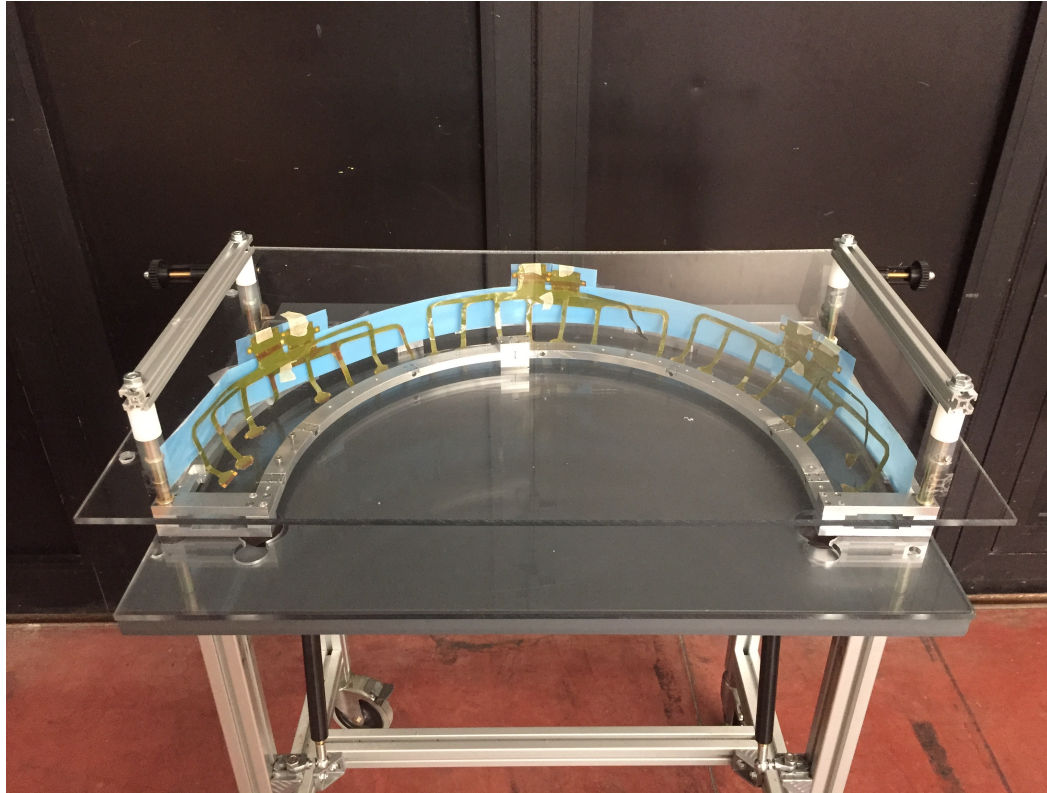
Opening for Half-ring box  
lower handlers

Gas compressed springs

# Tilted table with Half-ring

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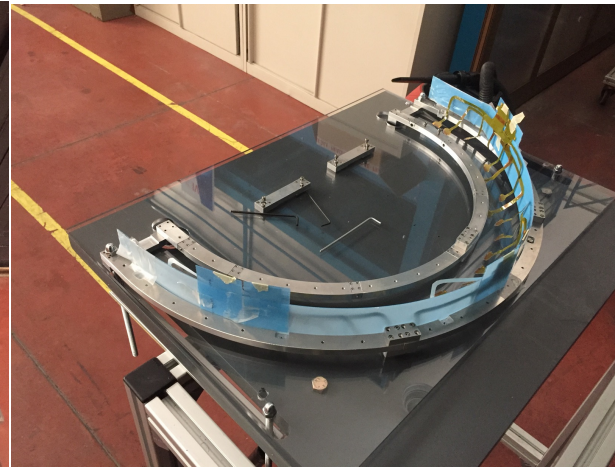
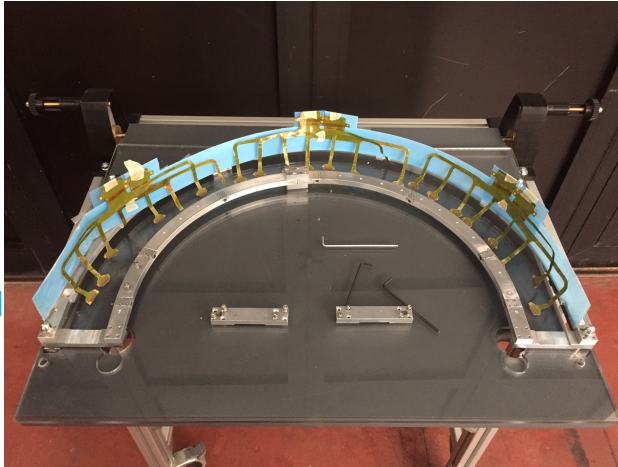
Prototype in Lecce



The tilted table is designed to hold and prepare the Half-ring for a safe and systematic installation. The Half-ring (not present) lays on the handling frame and protected by the support structure with the data PPO's held vertically by the data PPO supports.

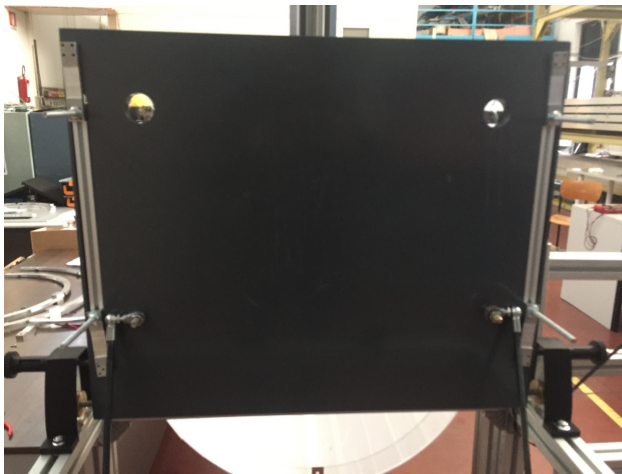
# Half-ring preparation steps (I)

- Remove upper handlers, perplex plate and end pieces
- Fix the lower handlers to the tilted table.

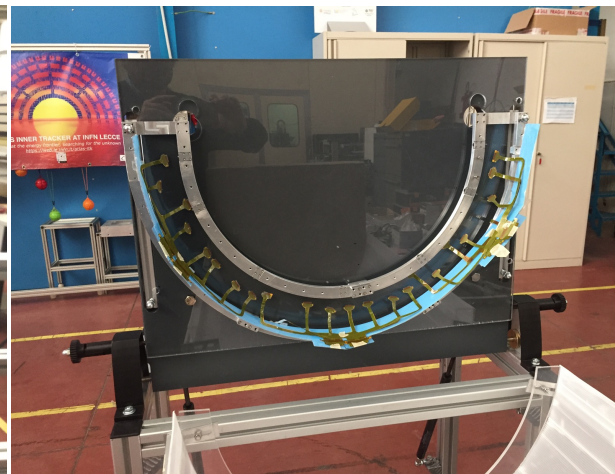


- Mounting lugs clamps on outer arc loosen, rotated by 90 deg. and tightened again to free Half-ring from outer arc.

Tilted table rotated vertically



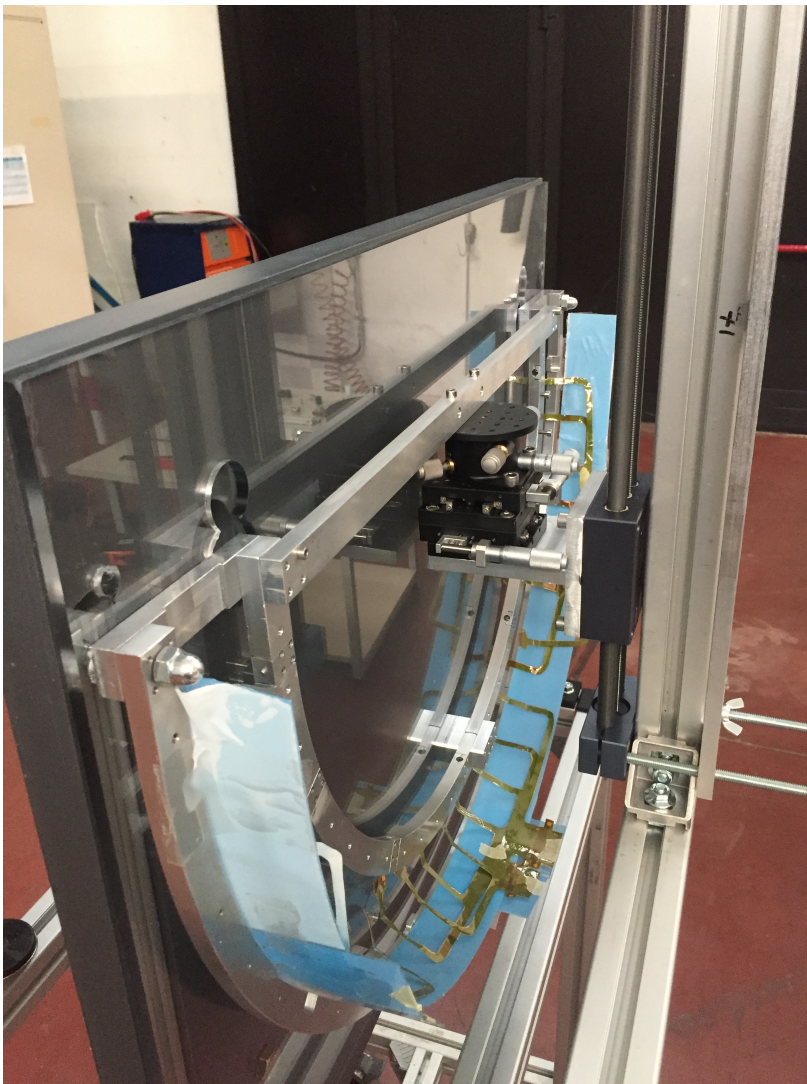
Back view



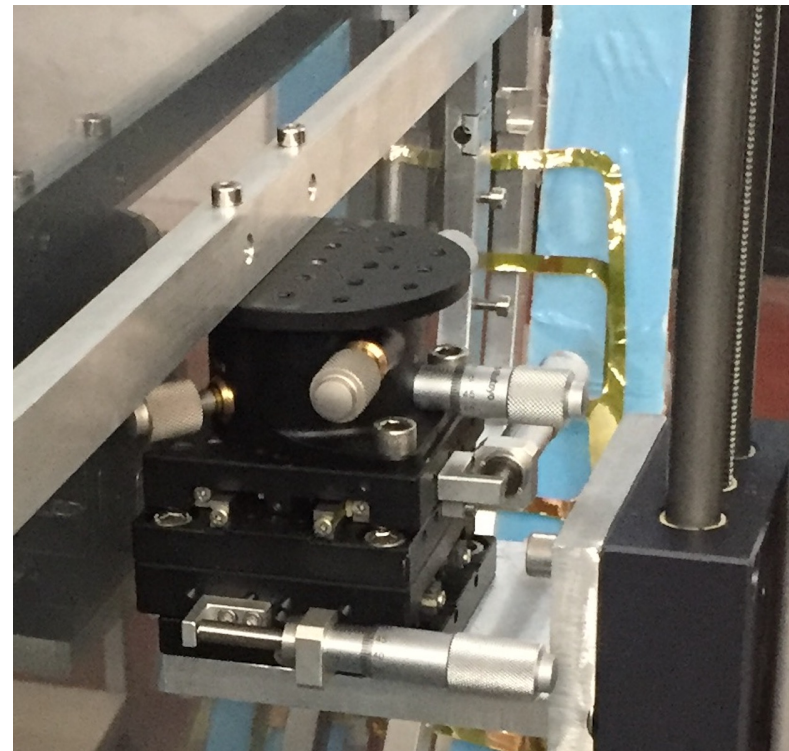
Front view



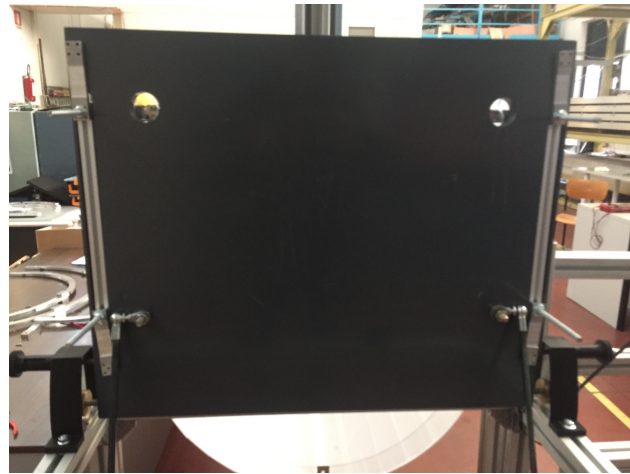
## Half-ring preparation steps (II)



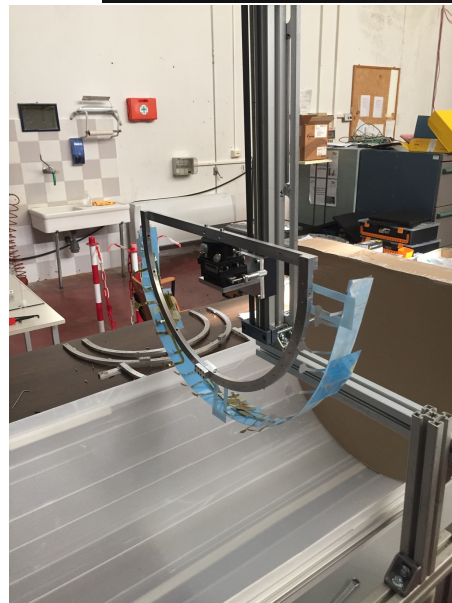
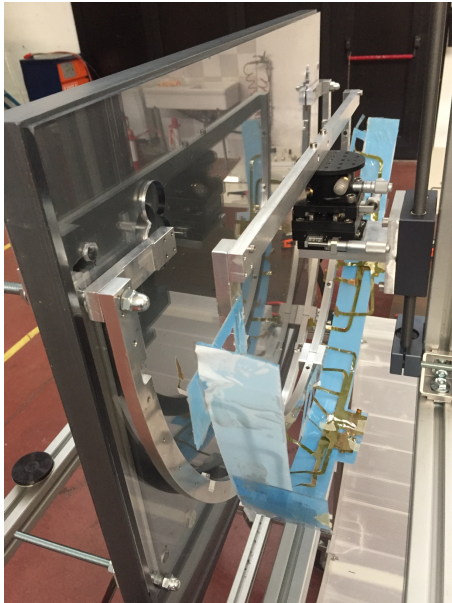
Screw the Integration Bar to the Handling Frame inner arcs using the threaded holes left free when top End Pieces were removed. Now the HR is tight to the Integration Bars through the inner arcs.



# Half-ring preparation steps (III)



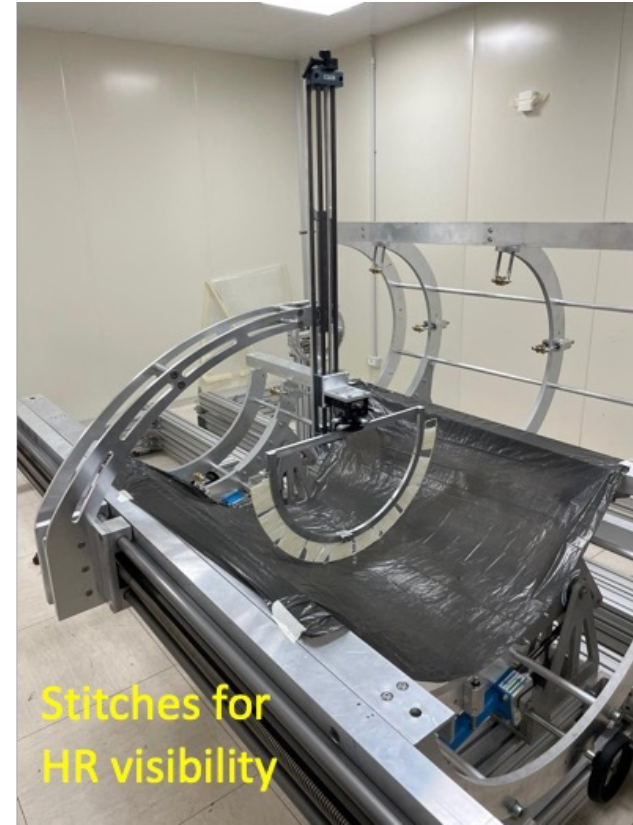
From behind Unscrew the Bottom End Pieces from the Handling Frame Inner Arcs



- From behind Unscrew the Bottom End Pieces from the handling frame inner arc
- Now the HR is mechanically free from the Outer Arc and from the End Pieces
- The data PPO's support stay fixed on the handling frame inner arc
- Move the Integration Arc toward Z

# Half-ring installation on the integration tool in Frascati

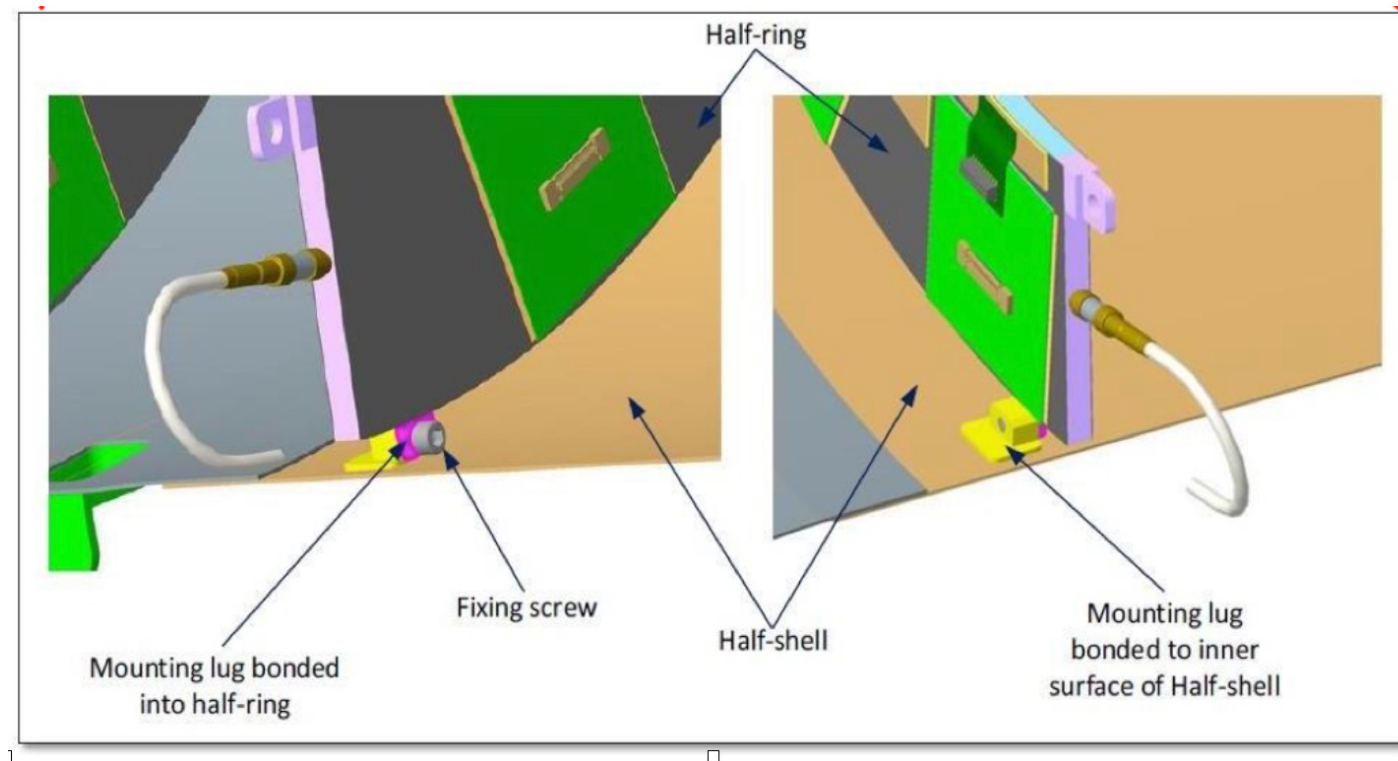
NB: data PPO's support not present



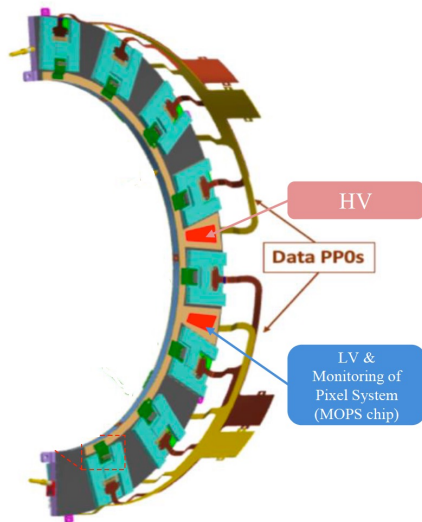
- When the HR is separated from the support frame raise the HR.
- Move the HR along Z to pass above the previous installed HR and reach the final z position.
- Lower the Arc and adjust the HR as needed in order to match the HS fixation lugs.

# Half-ring mechanical fixing

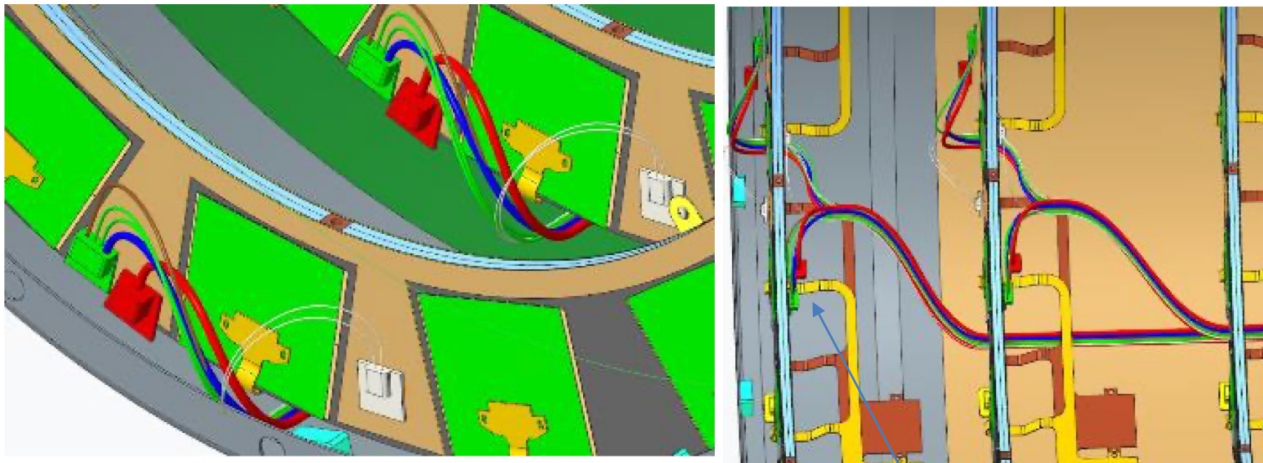
- Fix the screws to the mounting lugs bonded to half-ring and Half-shell.
- Remove data PPO's support
- Remove captive screws from Half-ring
- Raise the R-bar



# Serial Power, HV and MOPS connections



The PP0 flex in the half shell is secured to the carbon support ring and the data cables (Firefly) are connected.



The SP, HV and MOPS cable connectors are connected to the EoS cards.

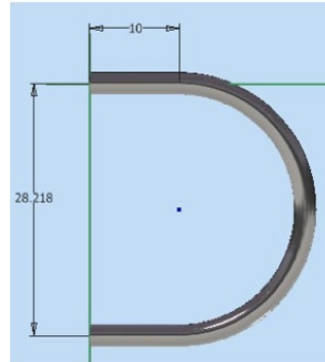
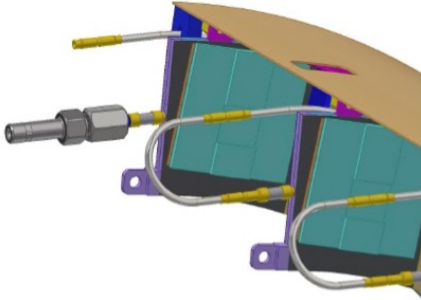
# Half-ring tests before cooling pipe welding

- After insertion and mounting on the half-shell, the half ring is electrically connected to its services.
- HR connectivity test with low power mode before welding



Half-ring testing enclosure mock-up

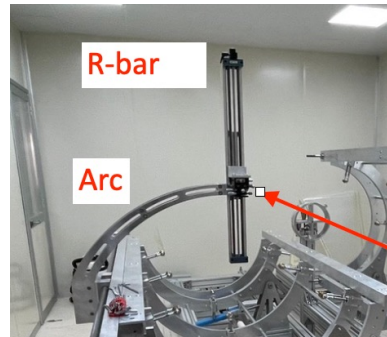
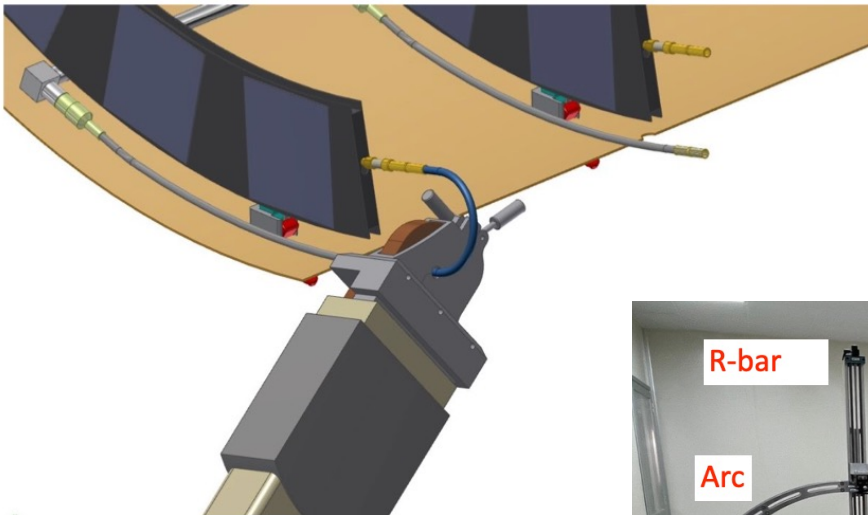
# CO2 connections and tests



The cooling U-bends can be welded.  
Now or after installation of all half-rings?

- Insertion of Half-ring and welding – 4-5 welds per HR
- Leak test
- Pressure test 162 bar
- Compressed Dry Air or freon (TBC)
- Leak test

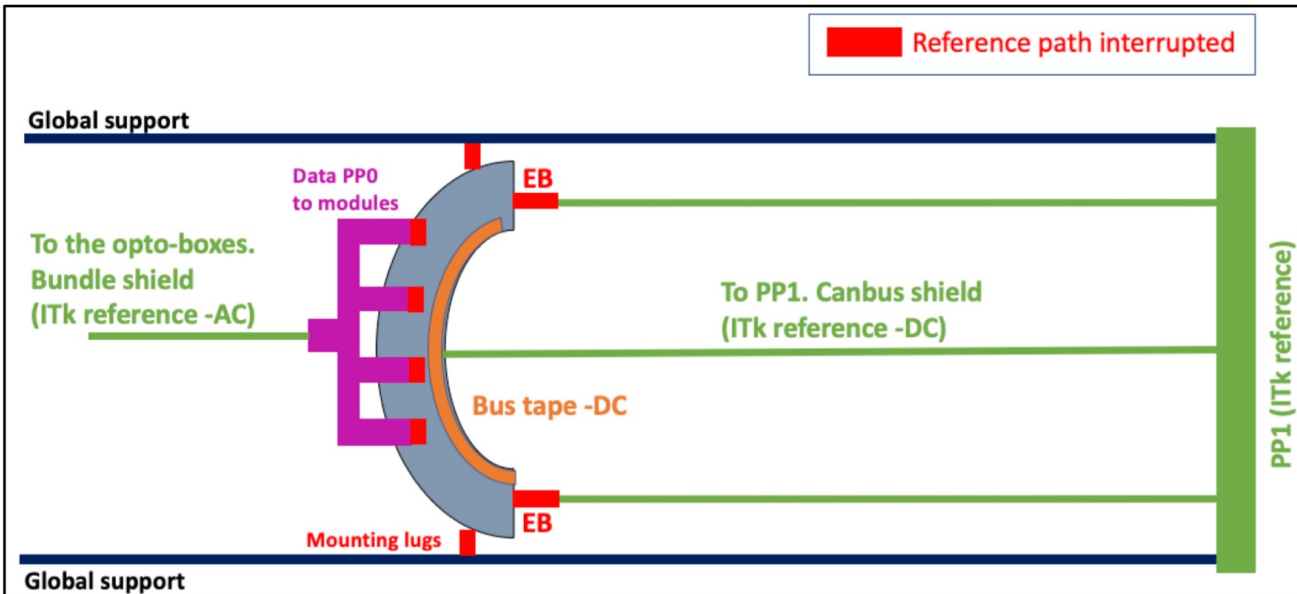
HR connectivity test after each welding  
with low power mode again



NB: Welding head  
could be kept in  
position by the R-  
bar or arc.

# Grounding test

The isolation resistance between a designated point on the half-ring to the Type-1 cooling manifolds and the half-cylinder will be recorded.  
Half-rings will be tested in low power mode.



Isolation resistance measured between GND pad on EOS card and Half Shell.



# Conclusions

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1. A Complete Half Ring installation sequence is designed.

1. The HR integration tool prototype is almost finalised but few variants still under evaluation.

2. Tilt table prototype finished.