

Cold Silicon — Status Update

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ZOOM/CERN



TUM Uhrenturm

Current Status at Silicon Target Location

Initial installation removed

Tests during Pilot Run cancelled. Installations removed to prepare construction at final position.

- Cooling system (PLC, Valve Box) moved to clean area for recabling and testing
- Top concrete blocks freed for movement:
 - “Mounting infrastructure” prepared on blocks
 - Optical bench and scaffolding removed
- Cable tray removed and cables stored at rack
- All cable equipment ready + stored underneath platform
- CAEN APV low-voltage power supply rented and installed from e-pool (new: SY4527 + A1518A modules)
- HV + ADC LV installed



Performed Tests — Vacuum Gauges

Operation under vacuum

Vacuum constantly monitored by cooling system.

- 13 vacuum gauges available
- 9 ready for installation — 5 in operation:
 → Additional 5 spare vacuum cells
- One additional “spare” cell connected to each station in case of failure



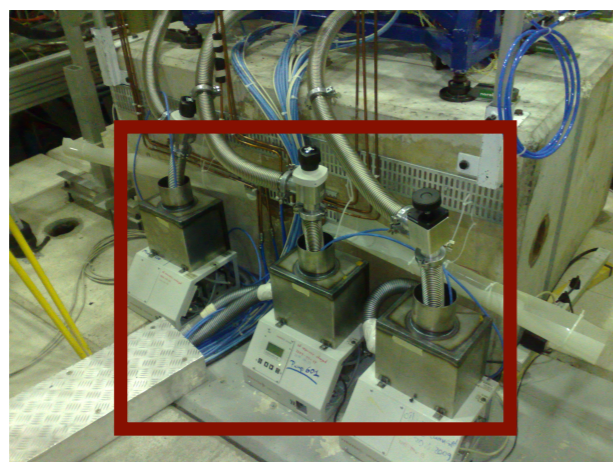
| ID | Cell | Test |
|----|------|---|
| 1 | 1 | OK |
| 2 | 2 | OK |
| 3 | 3 | OK |
| 4 | 4 | OK |
| 5 | 5 | probably broken; installed at ValveBox for cabel testing EP-DT group |
| 6 | X | Initial pressure wrong 2E2 → adjustment to environmental pressure 1E3; OK |
| 7 | 7 | OK |
| 8 | 8 | OK |
| 9 | 9 | OK |
| 10 | 10 | Measured pressure too high at max. rotation 2E-2 @ 1.5kHz pump |
| 11 | X | Electric broken |
| 12 | X | Can be used as music instrument – rattle |
| 13 | 13 | OK |

Performed Tests — Vacuum Turbo-Pumps

Operation under vacuum

Turbo molekular vacuum pumps will be in 24/7 operation.

- 9 vacuum pumps refurbished and tested:
 - Replacement of oil reservoirs
 - Replacement of o-rings and diaphragms
 - All pumps about 10^{-7} mBar
- 5x will be in operation — 4+1 as spare
- Magnetic shielding required for those close to target magnet (max. 3.8 mT) — Stefano in contact with Workshops



| ID | Type | DCU | Maintenance | Test result (mBar) |
|----|---------------|-----|----------------------|--------------------|
| 1 | HiCube 80 Eco | Yes | 4.14.2021 | 9,00E-07 |
| 2 | TSH 071 E | Yes | 4.14.2021 | 5,05E-07 |
| 3 | TSH 071 E | No | Maintenance required | |
| 4 | HiCube 80 Eco | Yes | 4.14.2021 | 1,43E-06 |
| 5 | TSH 071 E | No | 4.14.2021 | 1,00E-06 |
| 6 | TSH 071 E | Yes | 4.14.2021 | 4,28E-06 |
| 7 | TSH 071 E | Yes | 4.14.2021 | 4,00E-06 |
| 8 | TSH 071 E | No | 4.14.2021 | 8,86E-06 |
| 9 | TSH 071 E | Yes | 4.14.2021 | 1,92E-06 |
| 10 | TSH 071 E | No | 4.14.2021 | 8,87E-7 |

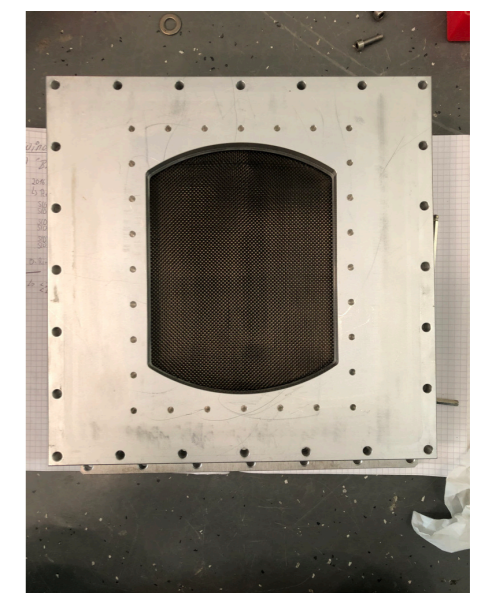
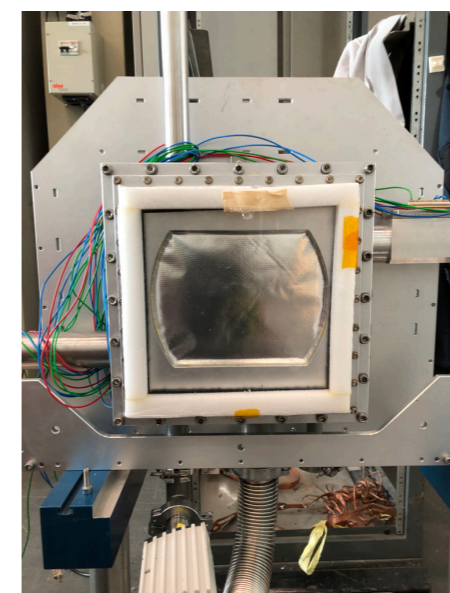
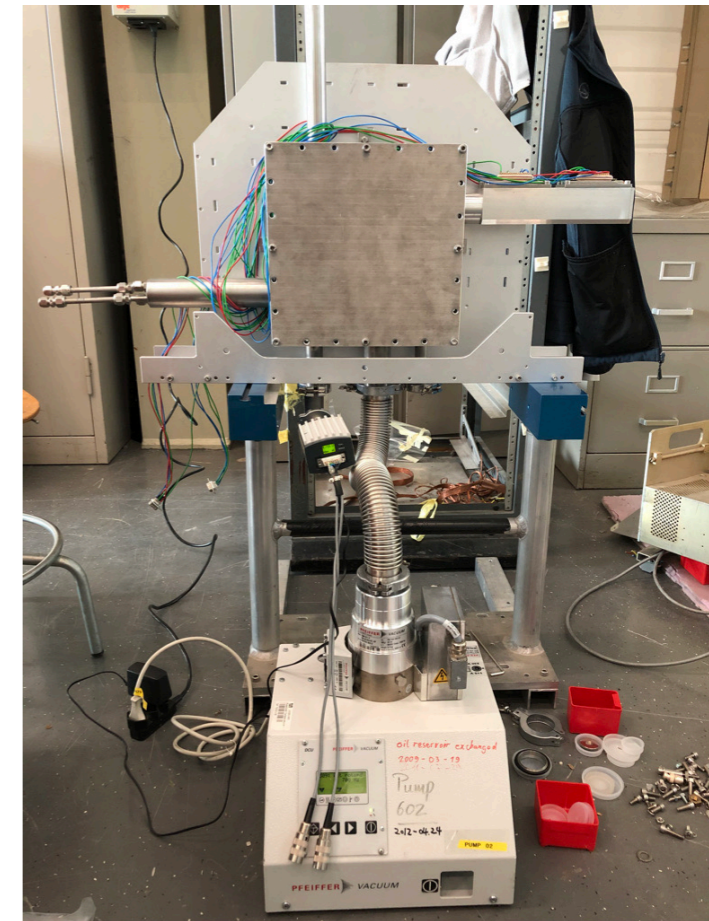
Performed Tests — Station Window

Test cryostat used for single-window test

Each set of windows per station was tested for vacuum tightness.

- 3 stations — windows up- and downstream:
 → Replacement of o-rings
- 1x spare window
- All windows $< 5 \times 10^{-4}$ mbar — good result

| Type | Result 2016 | Result 2021 |
|-----------------|-------------|-------------|
| "Blind Window" | 2,20E-04 | 2,40E-04 |
| SI01 Upstream | 4,90E-04 | 4,40E-04 |
| SI01 Downstream | 4,40E-04 | 3,83E-04 |
| SI02 Upstream | 8,40E-04 | 3,76E-04 |
| SI02 Downstream | 8,70E-04 | 1,24E-04 |
| SI03 Upstream | 8,20E-04 | 3,46E-04 |
| SI03 Downstream | 3,70E-04 | 4,12E-04 |
| Spare Window | | 1,84E-04 |



Performed Tests — Full Station

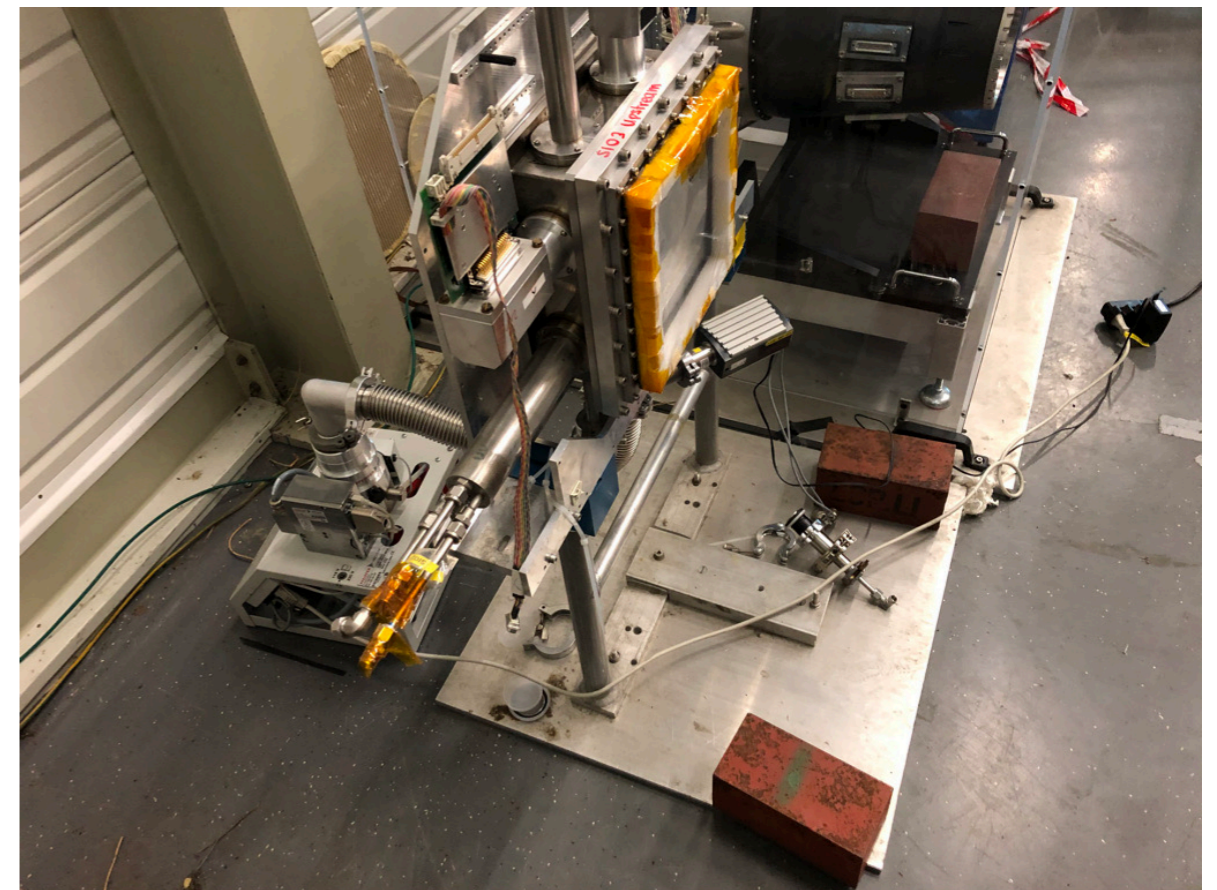
Full station tested for vacuum tightness

Each station tested to check for possible vacuum leaks.

- 3 stations — each one tested after single-window test
- Values at 10^{-4} mBar level — consistent with single-window test

| <u>Station</u> | <u>Duration</u> | <u>Result</u> |
|----------------|-----------------|---------------|
| SI01 | about 1h | 8,87E-04 |
| SI02 | about 1h | 4,20E-04 |
| SI03 | about 1h | 8,20E-04 |

- Important: No test for cryo-leaks performed yet!
→ From experience: Vacuum can reduce by factor 10 (still fine) — but: $>10^{-2}$ mBar problematic

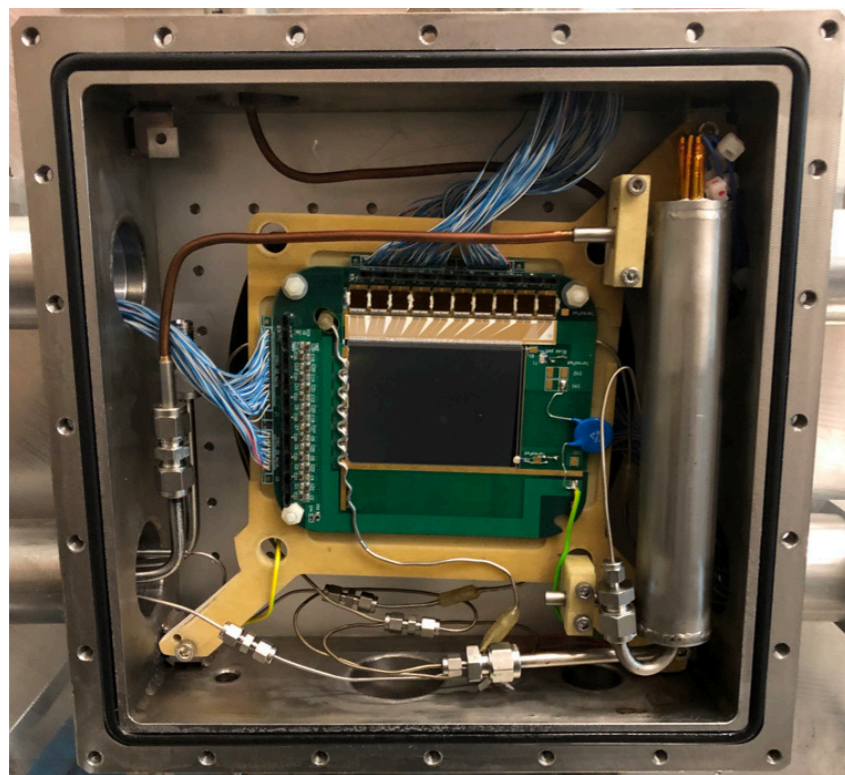


General Station Status

Overall status of stations

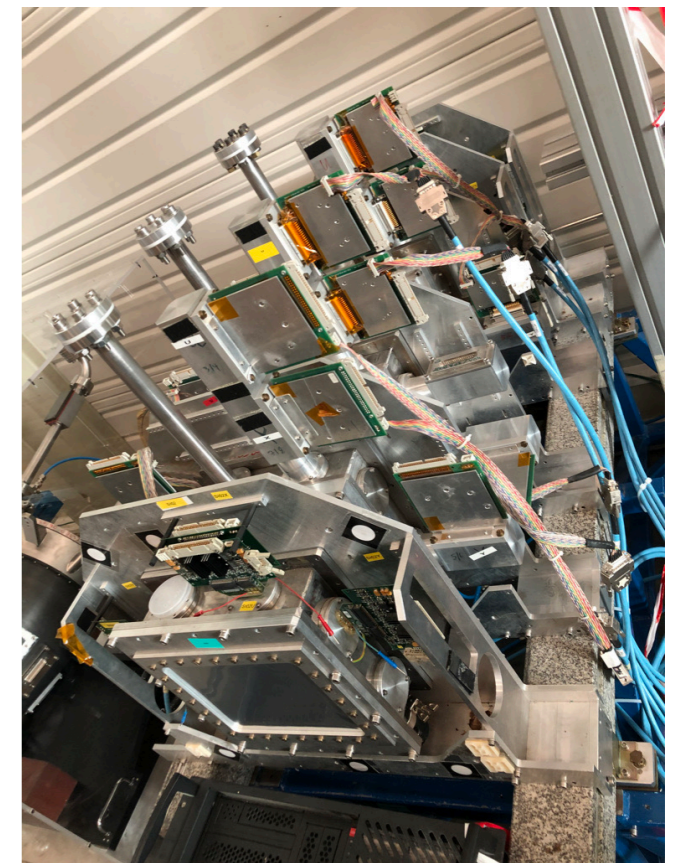
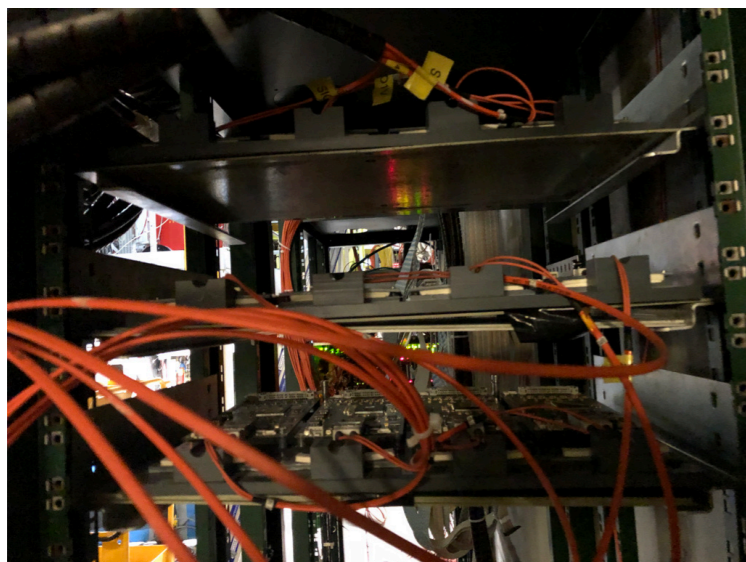
All stations look fine.

- Stations stored under N₂ in clean area
- Optical inspection of inner part looks fine
→ Check of glue connections and cooling capillaries
- Ready for installation and cooling tests



Front-End Status

- Repeater Cards:
 - 3 x 4 = 12 installed and working
 - 1x spare + many foreseen to be tested
- ADCs:
 - 3 x 4 = 12 ADCs tested during last years dry run — working
 - 8x spares to be tested (at least 4 should be fine — PRM Pilot Run)
- GeSiCa / TCS receivers:
 - 3x sets installed and tested during Dry Run
 - 1x set spare from PRM Pilot Run



Status of Cooling System

Recabling and testing ongoing

CERN EP-DT department work on cabling with new patch panels.

- New connections for flow meters and valves
- New electrical connections
 - Major connection simplification of system
 - Update of the schematics
- Work still ongoing:
 - Installation ongoing until mid May
 - Testing in clean area of sensors and valves end of May / beginning of June
 - Installation in target area mid June
 - Cryogenic tests to finalise upgrade
 - On-site personnel foreseen during first cryo-testing (EP-DT + Jean-Yves R. + Christian)



Summary and next Steps

- Silicon space in target area is prepared — ready to be relocated to the target area
 - Vacuum equipment maintained and tested — ready for installation
 - Station windows and complete station vacuum tested — ready for installation
 - Spare window tested and prepared — ready

 - Cooling system: Cabling work ongoing, sensor/valve tests foreseen to be finished end of May
→ Full test of sensors and valves in clean area until end of May / beginning of June
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- Finalisation of target platform mid June:
 - Start installation of Silicon Stations and Cooling System
 - Start cryogenic tests to finalise upgrade and installation of system

 - About 3 - 4 weeks of commissioning time until beam start (July 12th)
→ No major issues foreseen — time should be sufficient