Vacuum tests for TRISTAN Monispec

Martin Descher, Lars Ullmer, Joachim Wolf
Outgassing test chamber
Mode 1: Pressure increase measurement

- Flush with N2
- Gas inlet and gas throughput valves closed
- Bakeout 100°C
- Cool down and keep stable temperature
- Close main valve and record pressure increase with hot cathode and RGA
Mode 2: Gas throughput measurement

- Flush with N2
- Gas inlet and gas throughput valves closed
- Bakeout 90-100°C
- Cool down and keep stable temperature
- Close main valve and pump via throughput side with known conductance.
Measurement procedure

- 1 week per measurement → sufficient bakeout → repeatability
- Apply 2 methods:
  - Pressure increase measurement
  - Throughput measurement (Data for this at a later time)
- 2 such measurements per probe:
  - Empty measurement → chamber outgassing
  - Probe measurement → chamber + probe

<table>
<thead>
<tr>
<th>Time</th>
<th>Thursday</th>
<th>Friday</th>
<th>Saturday</th>
<th>Sunday</th>
<th>Monday</th>
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<tbody>
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</table>
Probe bunching

- Holding structure
  - Flange with feedthroughs
  - Cooling pipes with copper pieces and swageloks

- Kapton flex cables

- Other Electronics
  - Detector wafer + Cesic + Glue + C-shape flex
  - 2 ASIC boards (mostly unequipped / no SMD parts)
  - Vacuum side feedthrough connectors (Airborne)
  - Flex connectors

- Other parts that were sent to us:
  Hopefully replace for vacuum compatible alternative
  - GFK-Brackets → e.g. stainless steel
  - copper block → OFHC copper)
# Vacuum lab schedule: Past and future

<table>
<thead>
<tr>
<th>May</th>
<th>June</th>
<th>July</th>
<th>August</th>
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</thead>
<tbody>
<tr>
<td>1-30</td>
<td>Gather and clean parts</td>
<td>Short empty meas.</td>
<td>Holding structure reassembly and leak test</td>
</tr>
<tr>
<td>31</td>
<td>chamber assembly, commissioning, holding structure cleaning</td>
<td>Hot bakeout</td>
<td>empty measurement</td>
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<tr>
<td>1-30</td>
<td>Part cleaning, chamber assembly, commissioning, holding structure cleaning</td>
<td>empty test measurement</td>
<td>HS dissassembly</td>
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<tr>
<td>31</td>
<td>Aperture calibration</td>
<td>Holding structure cleaning</td>
<td>Pressure gauge calibration</td>
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<tr>
<td>1-30</td>
<td>chamber assembly</td>
<td>Electronics cleaning</td>
<td>Empty measurement</td>
</tr>
<tr>
<td>1-30</td>
<td>Assemble vacuum baking chamber</td>
<td>Aperture calibration</td>
<td>Empty measurement</td>
</tr>
</tbody>
</table>
Holding structure leak test

- Leak test in outgassing chamber
  - Procedure:
    - Holding structure inserted
    - He leak tester on chamber
    - Spray He from outside
  - Results:
    - Flange and feedthroughs leak tight
    - Leak somewhere along cooling pipe

- Sniffer probe leak test
  - Procedure:
    - Holding structure in air
    - He overpressure in pipe (~3 bar)
    - He sniffer probe from outside
  - Results:
    - Some VCR connections leaky → tried tightening
    - Weldings maybe leak tight, but not completely ruled out

- Continuing:
  - Holding structure disassembled and cleaned
  - Reassemble with new seals → test again
Kapton flex

- 4 kapton flex cables by Polimi, (120 cm² total)
  - Measured separately from other electronics
    (extrapolation to more cables)

- Pressure increase measurements:
  - \( q_{\text{empty}} = 1.7 \cdot 10^{-8} \text{ mbar} \cdot \text{l/s} \)
  - \( q_{\text{probe}} = 1.3 \cdot 10^{-8} \text{ mbar} \cdot \text{l/s} \)
  - compatible with background → upper limit ~ \( 10^{-8} \text{ mbar} \cdot \text{l/s} \)

- Throughput measurements:
  - Also ~ \( 10^{-8} \text{ mbar} \cdot \text{l/s} \) range
  - Reevaluation with new aperture calibration pending

- Lowest pressure after bakeout:
  - Empty: \( 2.1 \cdot 10^{-9} \text{ mbar} \)
  - Probe: \( 1.8 \cdot 10^{-9} \text{ mbar} \)

- Total outgassing of Kapton flex negligible

Measurement and analysis by Lars Ullmer
Kapton flex: Residual gas analysis

- RGA spectra of empty and probe measurement also compatible

Measurement and analysis by Lars Ullmer
Electronics (preliminary results) (Measurement from yesterday)

- Probe:
  - Detector wafer + Cesic + Glue + C-shape flex
  - 2 ASIC boards (mostly unequipped / no SMD parts)
  - Vacuum side feedthrough connectors (Airborne)
  - Flex connectors

- Pressure increase measurements:
  - $q_{empty} = 2.6 \cdot 10^{-8} \text{ mbar} \cdot \text{l/s}$
  - $q_{probe} = 1.4 \cdot 10^{-7} \text{ mbar} \cdot \text{l/s}$
  - $\Rightarrow q_{electronics} = 1.14 \cdot 10^{-7} \text{ mbar} \cdot \text{l/s}$

- Lowest pressure after beakout:
  - Empty: $1.4 \cdot 10^{-9} \text{ mbar}$
  - Probe: $1.2 \cdot 10^{-8} \text{ mbar}$

Measurement and analysis by Lars Ullmer
Electronics: Residual gas analysis

residual gas spectrum average over interval [200,300]s (combined from 2 measurements)

Measurement and analysis by Lars Ullmer
Summary

- Measurement of Kapton flex done
  - Sensitivity limit of chamber reached
  - Outgassing small, upper limit $\sim 10^{-8}$ mbar $\cdot$ l/s $\Rightarrow q \sim 10^{-10}$ mbar $\cdot$ l/(s $\cdot$ cm$^2$)
  - RGA spectrum shows no difference to empty measurement

- Measurement of Electronics done
  - Analysis still preliminary
  - Outgassing $q_{electronics} = 1.14 \cdot 10^{-7}$ mbar $\cdot$ l/s
  - Some differences in RGA, but no long hydrocarbons

- Throughput measurements
  - Data in need of pressure gauge cross calibration
  - Will be performed after all measurements are done

- Testing of holding structure ongoing
Backup


**Kapton Flex: Pressure increase measurement**

**Empty measurement**

\[ q_{\text{empty}} = 1.7 \cdot 10^{-8} \text{ mbar} \cdot \text{l/s} \]

**Probe measurement**

\[ q_{\text{probe}} = 1.3 \cdot 10^{-8} \text{ mbar} \cdot \text{l/s} \]

**Analysis/Plots by Lars**
Electronics: Pressure increase measurement

Empty measurement

Probe measurement

\[ q_{\text{empty}} = 2.6 \cdot 10^{-8} \text{ mbar} \cdot \text{l/s} \]

\[ q_{\text{probe}} = 1.4 \cdot 10^{-7} \text{ mbar} \cdot \text{l/s} \]
Cleaning Procedures

- **Kapton Flex:**
  - Cleaned with ethanol and vacuum baked

- **Electronics**
  - **Wafer + Cesic + C-shape flex:**
    - Acetone → Ethanol → Pure water
  - **Other parts:**
    - Electronics dish washer at IPE
    - Pure water
  - **Air bakeout 4h 90°C**