AGATA Week November 2007

Acceptance test of the AGATA Ge detectors

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Overview

• Summary of detector deliveries
• Test results
• Microphonics
• Status of the asymmetric detectors
• Summary
<table>
<thead>
<tr>
<th>detector</th>
<th>delivery</th>
<th>owner</th>
<th>status CAT</th>
</tr>
</thead>
<tbody>
<tr>
<td>A001</td>
<td>11/05</td>
<td>GANIL</td>
<td>rejected – hole trapping</td>
</tr>
<tr>
<td>B001</td>
<td>11/05</td>
<td>Padova</td>
<td>rejected – segments with poor resolution</td>
</tr>
<tr>
<td>C001</td>
<td>12/05</td>
<td>Padova</td>
<td>accepted</td>
</tr>
<tr>
<td>A002</td>
<td>04/06</td>
<td>Munich</td>
<td>rejected – leakage currents</td>
</tr>
<tr>
<td>A001</td>
<td>06/06</td>
<td>GANIL</td>
<td>accepted</td>
</tr>
<tr>
<td>C002</td>
<td>07/06</td>
<td>GANIL</td>
<td>accepted</td>
</tr>
<tr>
<td>B002</td>
<td>08/06</td>
<td>GANIL</td>
<td>accepted</td>
</tr>
<tr>
<td>A003</td>
<td>11/06</td>
<td>Liverpool</td>
<td>rejected – leakage currents</td>
</tr>
<tr>
<td>C003</td>
<td>03/07</td>
<td>Liverpool</td>
<td>CAT done - open</td>
</tr>
<tr>
<td>B003</td>
<td>06/07</td>
<td>Liverpool</td>
<td>CAT done - open</td>
</tr>
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<td>A002</td>
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<td>Munich</td>
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</tr>
<tr>
<td>C004</td>
<td>09/07</td>
<td>Ankara</td>
<td>CAT done - open</td>
</tr>
<tr>
<td>A004</td>
<td>09/07</td>
<td>Ankara</td>
<td>test ongoing</td>
</tr>
<tr>
<td>A003</td>
<td>10/07</td>
<td>Liverpool</td>
<td>delivered to Cologne</td>
</tr>
<tr>
<td>B004</td>
<td>Expected 07</td>
<td>Ankara</td>
<td></td>
</tr>
</tbody>
</table>
Experimental setup & test cryostats

- Digital acquisition system (XIA)
- Analog acquisition system

**Cologne**

**Munich**

**Liverpool**

**Munich test cryostat:** FWHM 2.21 keV @ 1.3 MeV

Can be delivered soon

**Liverpool test cryostat:** test of cryostat ongoing
Test results C003

Specifications:

Core

Guaranteed
- at 1.3MeV: ≤ 2.35keV
- at 122keV: ≤ 1.35keV

Segments

Guaranteed
- at 1.3MeV: ≤ 2.30keV, mean ≤ 2.10keV
- at 60keV: ≤ 1.30keV, mean ≤ 1.20keV

Crosstalk ≤ 1‰

Microphonics on core signal
Result within specification

Not reproducible energy resolution on C1

Crosstalk on segment C1

CAT done - result open
Test results B003

Microphonics on core signal
Result within specification

Crosstalk within specification

CAT done – open due to microphonics
B001, A002 & C004 suffer from severe microphonics problem - these detectors do not pass CAT

Mechanical vibrations cause low frequency oscillations around 1 kHz of core signal

Spontaneous oscillation:
Amplitude: up to 50 mV  Frequency: 1 kHz

Triggered oscillation:
Amplitude: up to 4 V  Frequency: 1 kHz

Example:
B001 main amp core signal

Triggered oscillation
1 kHz frequency
1.5 V amplitude
Decay time > secs

Example for detector without microphonics:
12 mV noise band + energy signals
Microphonics may be caused by mechanical properties of detector and cryostat assembly.

- only core signal is affected!

Microphonics may be caused by
- Cryostat
- Ge detector

Search within cryostat:
- reassembly of test cryostat
- modification of cold core 
  pre-amp boards
  mechanical layout of pcb 
  coupling capacitor, FET, resistors 
  wiring from pcb to capsule
- electric shielding
- high voltage cabling
- mounting of end cap
Microphonics

Search within cryostat:
- reassembly of test cryostat
- modification of cold core
  - pre-amp boards
    - mechanical layout of pcb
    - coupling capacitor, FET, resistors
    - wiring from pcb to capsule
- electric shielding
- high voltage cabling
- high voltage cabling
- mechanical HV contact
- mounting of end cap

- Each test at LN temperature requires more than one week due to pumping, cooling, warming.

- Source of microphonics not located!
Cross check with symmetric AGATA detector S002

Reason for microphonics of detectors B001, A002 could not be located in Cologne test cryostat and Munich test cryostat.

Cross check with tested and accepted symmetric AGATA detector S002
- electrical contact - only one soldering point for HV was opened
- identical mechanical contact

Results with S002 in Munich test cryostat:
- earlier test results were readily reproduced!!
- no microphonics observed
- core energy resolution of 2.21 keV at 1.3 MeV

Results with S002 in Cologne test cryostat:
- again earlier test results were readily reproduced!!
- no microphonics observed
- core energy resolution of 2.23 keV at 1.3 MeV

Microphonics is caused by detector capsule not by test cryostat
Comparison of S002 with asymmetric detectors

<table>
<thead>
<tr>
<th></th>
<th>Cologne test cryostat</th>
<th>Munich Liverpool test cryostats</th>
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<tbody>
<tr>
<td><strong>A002</strong></td>
<td>Microphonics CAT failed</td>
<td>Microphonics CAT failed</td>
</tr>
<tr>
<td><strong>B001</strong></td>
<td>Microphonics CAT failed</td>
<td>Microphonics CAT failed</td>
</tr>
<tr>
<td><strong>S002</strong></td>
<td>No microphonics $\Delta E = 2.23$ keV</td>
<td>No microphonics $\Delta E = 2.21$ keV</td>
</tr>
</tbody>
</table>

First results for C004: suffers from microphonics in Cologne test cryostat
C004 without vs. with glued core contact

Exchange with Canberra (September 07):
- core feed-through in the capsule was modified by supplier
- provisional repair of outside part of feed-through

Gluing done for A004 by Canberra and C004 by IKP
C004 with glued core contact

Strong microphonics without glued core contact (Amplitude > 1 V). HV could not be fully applied → CAT failed

After gluing core feed-through no microphonics with glued core contact:

FWHM on core signal with glued core contact on capsule: 2.21 keV @ 1.3 MeV
A004 with glued core contact

Energy resolution:
FWHM on core signal: 2.24 keV @ 1.3 MeV
1.24 keV @ 122 keV

Source of microphonics located in detector capsule
Sequence of acceptance test was stopped after C003 & B003.

Microphonics problem: C003 & B003 - microphonics within specs, B001, A002 & C004 - severe microphonics - detectors do not pass CAT.

Microphonics is located within capsule - not in the cryostat.

Tedious investigation of cryostat without result.

First results of detectors with glued core feed-throughs are promising.

Outlook: B001 & A002 need repair (glued contact).

Do all asymmetric detectors need glued core contact?

Acceptance tests are delayed, glued detectors have to be tested again.