Utilising Modern Metrology Techniques to Improve Efficiency for the AGATA Experimental Installation

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What is AGATA?

AGATA (Advanced Gamma Tracking Array) is a European research project with the aim of developing and building a 4π gamma-ray spectrometer of the next generation.
History of Alignment for AGATA

Metrology Arm

Laser Tracker

Laser tracker dedicated tooling

Now

Future

Laser tracker and 3D scanning
Flange Alignment and Survey Results

Projection on the target plane of the focusing point of each flange

Results from 2008 for 15 flanges

Results from 2022 for 30 flanges

All points below 0.4mm

Average error converging on the target point was 0.492mm (excluding split flanges)

Agreed tolerance for 2022 installation was all points below 0.4mm this was not achievable with extra 15 flanges
Why Change?

- Improved positioning of detectors
- Reduced risk of crashing detectors on installation (30 detectors @ £500k each)
- Live position monitoring when detector is installed
- Reduced installation times due to single point measurements
- Reduced cost due to time savings
- Repeatable point position measurements
- Honeycomb alignment tolerance was not achievable
Detector Alignment and Survey

- New ideas that take advantage of latest laser tracking technology
- Develop tooling that exploits new methods
- Generate detailed survey models of the full array

Survey tool design and development

Cap style tool
Kinematic style tool
End (Dewar) tool
Survey Tooling Test

- Tooling mounted/unmounted 100+ times
- Multiple data points recorded
- Provided information on repeatability
- Average error 0.022mm
- Inc. tracker error ~0.050mm accuracy
- Tooling errors removed by updating survey model with measured points not CAD points
Detector Positions in SA

- Dewar tool points
- AGATA Zero point
- Cap style tool points
Capable of surveying detectors to ~0.1mm (incorporating manufacturing errors)
Detectors Tracked into Position

<table>
<thead>
<tr>
<th>X</th>
<th>-0.0213</th>
</tr>
</thead>
<tbody>
<tr>
<td>Y</td>
<td>0.1044</td>
</tr>
<tr>
<td>Z</td>
<td>-0.2224</td>
</tr>
<tr>
<td>d</td>
<td>0.2467</td>
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</tbody>
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AGATA-D02::AGATA-D02-CS-0
Units: (mm)
Results

3 Detectors aligned to within ~0.1mm
How Can We Improve?

- Individually fiducialise each detector using laser tracker?
- 3D scan each detector nose and reference to fiducials. This would add an extra quality control step in the process and improve their position relative to the AGATA nominal zero position.

Contact surface map generated after detectors had been set to validate new tooling and confirm detector’s final location.
Questions