For the development of efficient superconducting cavities, field emission is an important parasitic phenomena to monitor. A diagnostic system composed of Geiger-Mueller (G-M) probes, NaI(Tl) scintillators are placed in the cryomodule test stand. Collected data is analysed and confronted to particle tracking simulation and electro magnetic shower code. With such systematic analysis we aim to identify the most probable field emission location and hence help to improve clean procedures during assembly and operation.

**INTRODUCTION**

In addition to the production of the 30 medium and high beta cryomodules of the European Spallation Source (ESS) LINAC, CEA perform the test at high RF power of two prototype cryomodules and of the three first cryomodules of each type assembled at CEA Saclay. We present the results and analysis concerning the third cryomodule (i.e. CM03) for the medium beta section performance with a particular attention to its field emission behavior. The four cavities installed in the cryomodule were manufactured and prepared by Zanam Research&Innovation under the supervision of INFN LASA. The string assembly were done at CEA Saclay by a subcontractor, while the power test was performed by CEA personnel.

**CAVITY PARAMETERS**

<table>
<thead>
<tr>
<th>Design parameters</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Geometrical beta</td>
<td>μ</td>
</tr>
<tr>
<td>Nominal gradient Eacc</td>
<td>[MV/m]</td>
</tr>
<tr>
<td>Q0 at nominal gradient</td>
<td>&gt;5×10⁶</td>
</tr>
<tr>
<td>G</td>
<td>[Ω]</td>
</tr>
<tr>
<td>R/Q</td>
<td>[Ω]</td>
</tr>
<tr>
<td>El</td>
<td>[MV/m]</td>
</tr>
<tr>
<td>Bq</td>
<td>[mT/MV/m]</td>
</tr>
<tr>
<td>Eopt</td>
<td>(nominal Em</td>
</tr>
<tr>
<td>0</td>
<td>[mT]</td>
</tr>
</tbody>
</table>

**SUMMARY**

We have implemented a set of tools in order to detect and analyse radiation produced by field-electron images impacting on cavity surface. A good agreement is observed between simulation and experimental results despite some simplified model has been used. It proves that our systematic approach consisting of detailed radiation mapping around the cryomodule and analysis by means of particle tracking code and Monte Carlo simulation can indeed help to have a better understanding of field emission phenomena during cryomodule tests and operation [10]. Furthermore, CEA Saclay is continuously improving the detection capability for both vertical and cryomodule test stand. In the future, more detectors (G-M and scintillators) will be added to gain a more detailed view of the radiation distribution around the cavities and hence a more precise location of field emission sources. More detailed model will be implemented in the GEANT4 simulation in order to capture characteristic features of the radiation pattern generated by field-emitted electrons.

**REFERENCES**


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**ABSTRACT**

Field Emission Studies During ESS Cryomodule Tests at CEA Saclay

**Cryomodule Test Stand Diagnostic**

**Data Analysis and Simulation**

**REFERENCES**