HiRadMat Beam Time Request Form

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<th>Designation</th>
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<td>Experiment Name</td>
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Date | 12.10.2014

General

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<th>Responsible/primary contact</th>
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<td>Name</td>
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<th>Participating institutes</th>
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<th>Number of team members</th>
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<th>Interested in Transnational Access</th>
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HRM Beam Time Request – SextSC - Addendum

Measurement of the damage limit of superconducting cable due to impact of high intensity proton beam at ambient temperature

A pre-experiment at room temperature with cable samples will allow to verify the main mechanisms leading to damage of superconducting magnets and will be a very useful input to optimize the following experiment at liquid helium temperature. The main goal of the experiment is to measure the insulation degradation due to beam heating and to measure the degradation of the critical current due to temperature gradient in a superconducting strand.
In the experiment, 6 to 8 cable stacks with LHC type superconducting cables will be tested with SPS proton beam at room temperature in a container with Argon atmosphere. The beam will be shot once on each pair of cables. The impacting beam intensity will be increased in steps. The cable stacks will be removed after the irradiation, and post mortem analyses will be done on the insulation and on the superconducting strands. The degradation of insulation will be measured with high voltage. The degradation of the critical current of the superconducting strand will be measured.

It is also foreseen to insert behind the samples one stainless steel plates (~ 5 mm thickness) in order to verify the structural integrity of stainless steel after the irradiation. The plates will be analyses with microscope after irradiation. The result of the analysis will be used as input for the next experiment with a stainless steel cryostat.

**Measurement methods**

*During irradiation*
- Diamond particle detectors to monitor the particle showers outside of the container and for beam alignment
- Temperature: PT100 temperature sensors to monitor the cable temperatures.

**Experimental Setup**

Container with 6 to 8 stainless steel moulds containing cable stacks under pressure and two stainless steel plates in front and behind the moulds.

- The dimension of the moulds containing the cable stacks are expected to be 60 x 85 x 100 mm³ (width x height x length)
- The dimension of the container are expected to be 350 x 100 x 500 mm³ (width x height x length). The container will be air tight and made of Al. It will be filled with Argon.
- The dimension of the stainless steel plate are expected to be 5 x 300 x 80 mm (thickness x length x height)
  The total weight < 100 kg.
Target:
- Al container
- Superconducting cables
- Stainless steel mould and plate

Support:
- It is proposed to re-use the table of HRMT-12 LPROT experiment.

Beam Parameters
- Pulse intensity (range): $5 \times 10^9 - 2.3 \times 10^{12}$
- Intensity bunch: $5 \times 10^9 - 1.5 \times 10^{11}$
- Spot size: Round beams sigma 1-2 mm
- Number of pulse: ~ 12 to 18 shots
- Integral intensity: ~$2.4 \times 10^{13}$

Safety and radiation protection aspects
- Activation of container, cable samples, mould and measurement equipment: to be studied in FLUKA
- The intensity will be chosen such to rule out melting of the samples and of the container.

Schedule
Experimental Timeline:
- Shot every ~ 5 minutes (time to displace the target into the beam trajectories): $18 \times 5 \text{ min} = 1.5 \text{ h}$
- Installation of target in tunnel: 1.5 days
- Test of setup: 1 day
- Removal of target from HiRadMat: 1 day

Earliest date: 08.2016
Latest date: 10.2016