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Radiation study of the target station for the EMuS baseline scheme

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The Experimental Muon Source (EMuS) is a proposed facility at China Spallation Neutron Source (CSNS). EMuS, which is an additional platform to CSNS, aims to provide muon beams for different applications such as neutrino physics, muSR, etc. The baseline design uses up to 25kW proton beam. The target station of EMuS is consist of a long carbon target in conical shape, a superconducting capture solenoids system that produce adiabatic magnetic field and shields inside the solenoids to protect them from radiation. The target is situated in the superconducting solenoids and second particles are collected forwardly. As a result, high radiation is produced in the target station. In this presentation, we will present the radiation study for the baseline scheme. We firstly report the study for the 5kW proton beam.

- The most radiation vulnerable material is the epoxy which is used as the insulator and the material to bond the cables. It can tolerate a maximum of 7MGy dose before it experiences a 10% degradation in its shear modulus. We optimize the tungsten shield position, thickness and materials. Results show that after the optimization, the peak doses on all the cables satisfy this 7MGy limit for a 10 year operation.
- Another radiative effect we should consider is the neutron fluence on the superconducting solenoids. The electrical conductivity of the stabilizer of the solenoids degrade in high-flux neutron environment, which can lead to instability of the superconducting system. Our calculation shows that the aluminum stabilized cable can stand for a 5-month continuous run after it needs to be warmed up to room temperature to get the full recovery.
- We have also performed the thermal analysis for superconducting solenoids considering the helium cooling and the aluminum 1100 thermal bridge. Results show the superconducting solenoid system can safely run for 5 months.

Our simulation show a reliable target design for the 5kW proton beam regarding the radiation. Studies for the 25 kW beam are also started.

- As the radiation level is much higher for the 25 kW beam, we update the design. The layout of the superconducting solenoids should be changed, and more shields need to be equipped. Our early study show a hybrid-shield-design can satisfy the requirement for the dose on the solenoids.

More studies will be carried out in the future for the 25 kW proton beam case.

Working Group

WG3 : Accelerator Physics

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