The Design And Use of Faraday Cage In Linac Temporary Line of CSNS*

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IBIC 2018 Shanghai China

MOPA12 (Monday)

Abstract

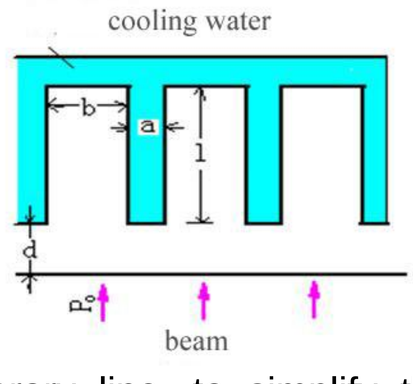
In the end of linac temporary line in csns, we need a faraday cage to absorb the beam. in the experiment it will be mounted and used twice. according to the beam energy and current of csns, we choose water-cooled pipe structure with tilted panel after simulation with ansys. the main principle of the faraday cage is to simplify the structure and reduce the radiation activation of it, to do this, we also do the simulation of radiation. to make sure the faraday cage is safe in beam experiment, we alos plug in a pt100 Platinum resistance to monitor the temperature. after faraday cage is built and mounted on the line, it works well and sustain the beam bombardment. discussed in this paper.

Introduction

China spallation neutron source (CSNS) is the first spallation neutron source in developing countries. In linac, there are a 50 kev H- iron source, a 3 Mev Radio Frequency Quadrupole(RFQ), and a 80 Mev Drift Tube Linac(DTL). In the first stage of beam experiment, when the H- come to the end of Medium Energy Beam Transport(MEBT) with 3 Mev energy and the end of DTL1 with energy 26.7 Mev, we need a temporary line with some beam measuring equipment like BPM, wire scanner to check the parameter of beam is right. And at the end of temporary line, we need to design a faraday cage to absorb the beam safely.

Machine design

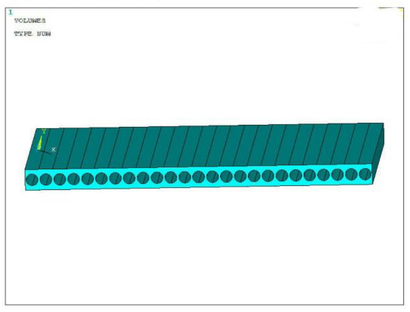
In the foundation project before, we use “V” type beam stop, it is built with Oxygen free copper covered with aluminum using water cooling, and contain vacuum structure, the angle between the center line and surface is 8° . we use quadrate tunnel structure to improve cooling efficiency.

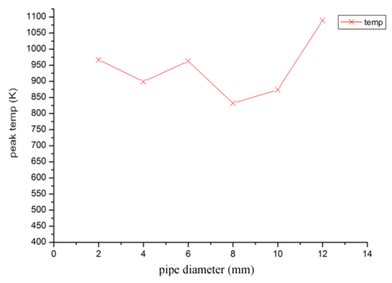


In the csns temporary line, to simplify the design and machining, we decide to use just one tilted board and set the welds of water cooling pipe out of the vacuum structure. The faraday cage should be able to absorb beam as follow

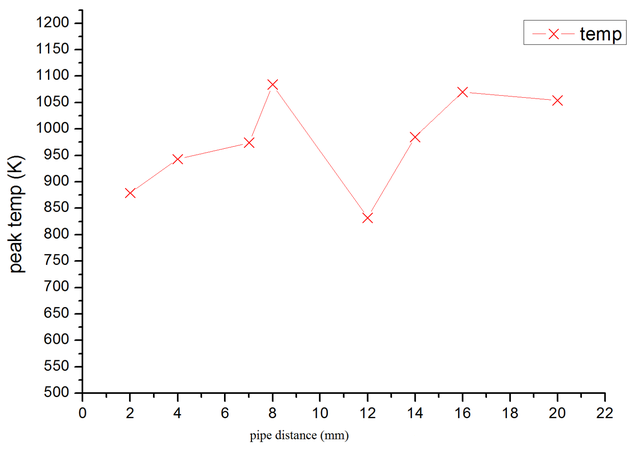
energy	26.7 MeV	3 MeV
Peak current	15 mA	15 mA
Beam frequency	5 Hz	5 Hz
width	500 μs	500 μs

we build model and set the cooling water pipe to different size, while the interval between pipe is fixed to 4mm, set up a slope between faraday cage and central axis to 10° ,and the beam size to 2.5 mm, from this we can check that 8 mm size of cooling pipe is most suitable.

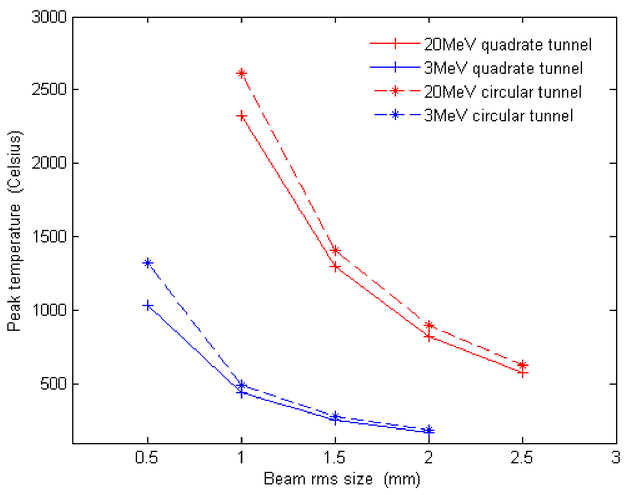




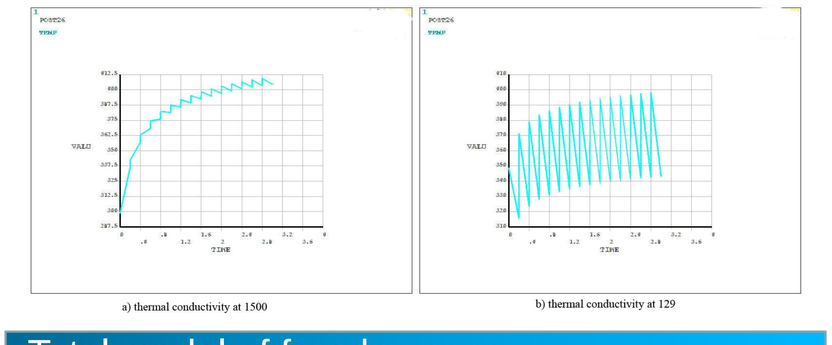
Calculation in different distance of pipe to choose 12 mm distance is best



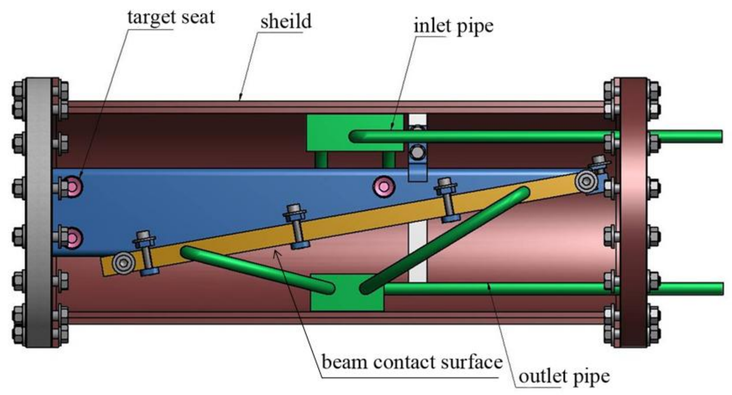
We change beam size and at last we set the size at 3 Mev should be bigger than 0.7 mm, while at 26.7 Mev the minimum size is 2 mm.



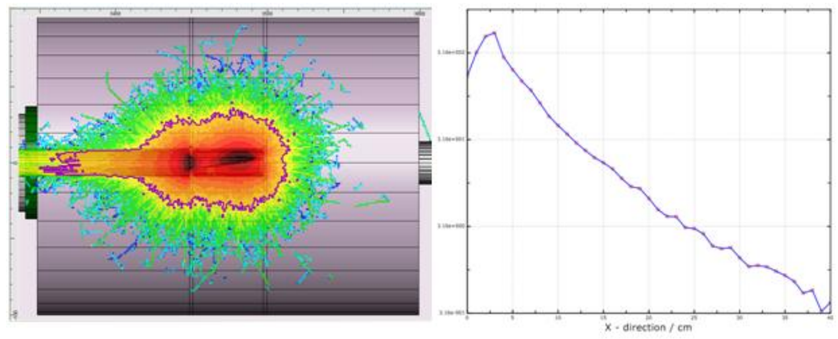
Because of the different activation energy of Cu and C in proton particle, and considering CSDA range, we plate one 2.5 mm layer of graphite on the copper board and compare different thermal conductivity



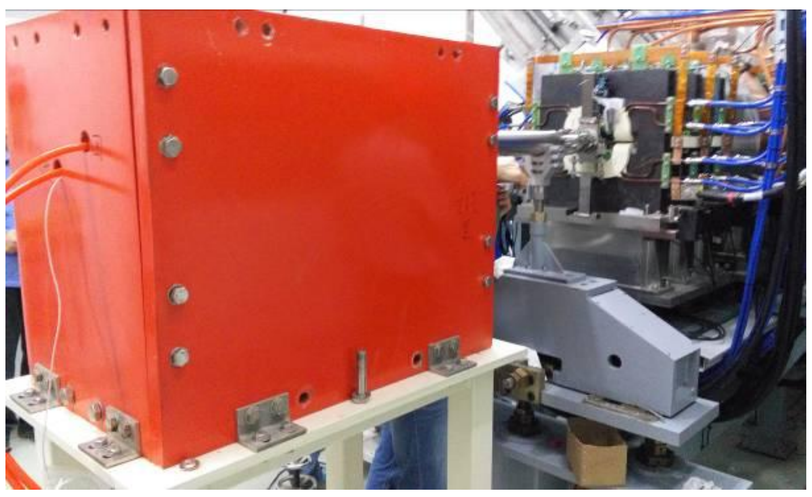
Total model of faraday cage



After calculation about Residual radiation dose, we use 5 cm thick lead plate as additional shielding facility



After machining and necessary test like vacuum and water pressure is done, the installation is finished



Conclusion

The faraday cage is designed to absorb beam of MEBT and first quarter of DTL in linac temporary line of CSNS, It should not be damaged at the energy of 26.7 Mev and current 15 mA, also the radioprotection should be considered. After all the beam experiment is done successfully, the faraday cage works well and residual radiation around it is safe, so we can conclude that this single sloping plate structure with cooling pipe meets the demands as expected.

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