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SNS
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Optimum Design of Faraday Cup Structure for Beam Adjustment of CSNS

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ABSTRACT

Faraday cup was used to absorb and stop the beam during the two phases of beam commissioning, such as the front end (FE) system and the temporary line after the drift tube linac (DTL) at the Chinese Spallation Neutron Source (CSNS). According to the beam physical parameters, graphite was selected to stop the beam directly and oxygen-free copper, which is just behind the graphite, as the thermal conductive material. Through the analysis and comparison of the target type and cooling efficiency, the single slant target was determined. The inclination angle of the target surface to the beam was set to 10°, meanwhile a new waterfall type water-cooling structure with parallel tunnels was designed to improve the cooling efficiency. The finite element software ANSYS was used for thermal analysis of the model, by which the diameter and space of water cooling tunnel was optimized. Structure analysis and stress deformation were checked to ensure the reliability of the manufacturing. With the Faraday cup discussed in this paper, the beam commissioning went well.

INTRODUCTION

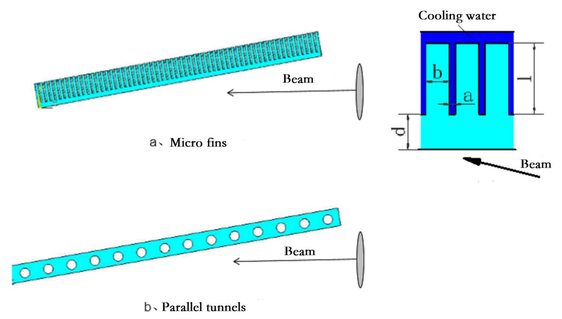
Design principles：

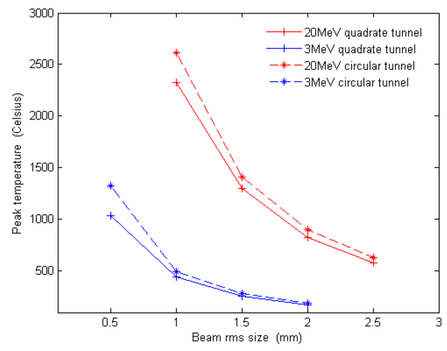
1、There is no limit to the device length；

2、Welding joints are outside the vacuum；

3、Optimizing the structures and processes；

4、Reducing the activation.





MATERIAL

1、According to the number of neutrons producing、activated product half-life and associated γ ray energy，graphite is selected to stop and absorb the beam.

2、 Copper is chosed as cooling and vacuum sealing material.

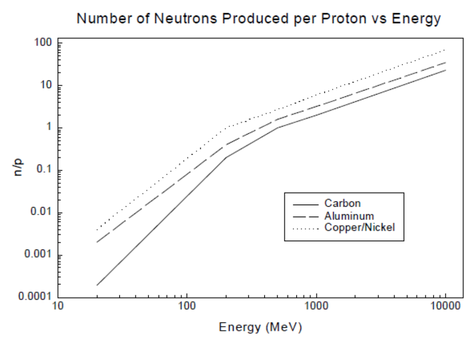
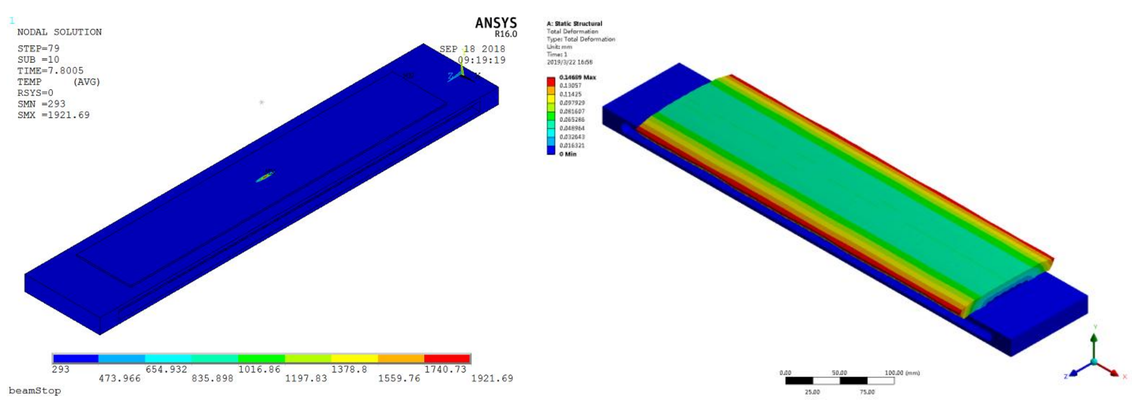


Table 1: Neutron Activation Products from Beamstop Materials

Isotope	Half-life	γ Energy (MeV)
C-12	------	------
Ni-65	2.52 h	1.46
Cu-64	12.8 h	1.34
Cr-51	27.7 d	0.321
Fe-59	44.51 d	1.099, 1.291
Na-24	14.96 h	1.37, 2.75



TECHNOLOGY

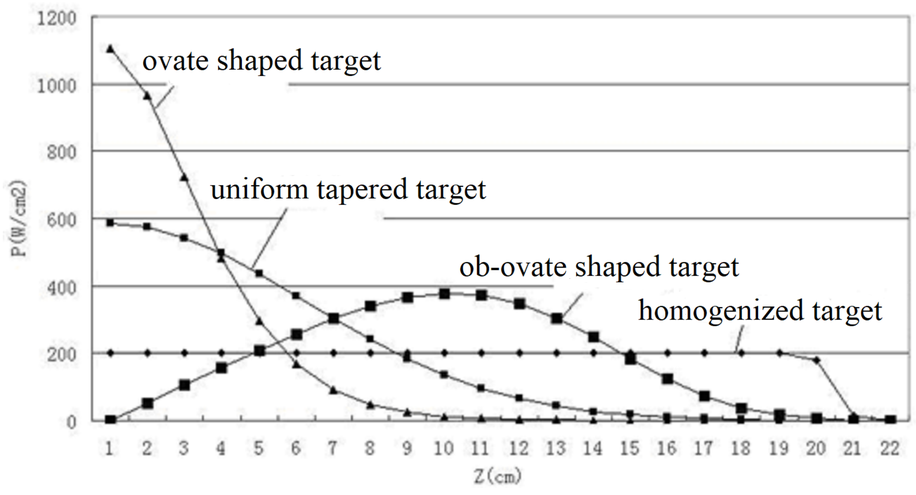
1、Brazing of graphite and copper：deformation and stress；

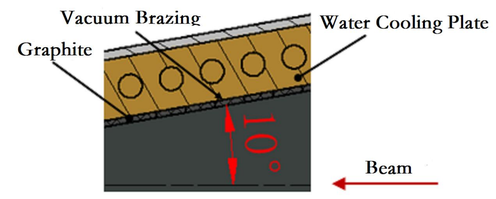
2、Radiation protection：graphite is useful；

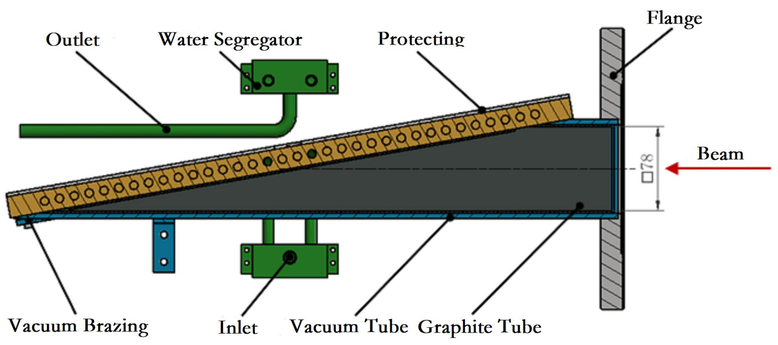
3、Structure analysis；

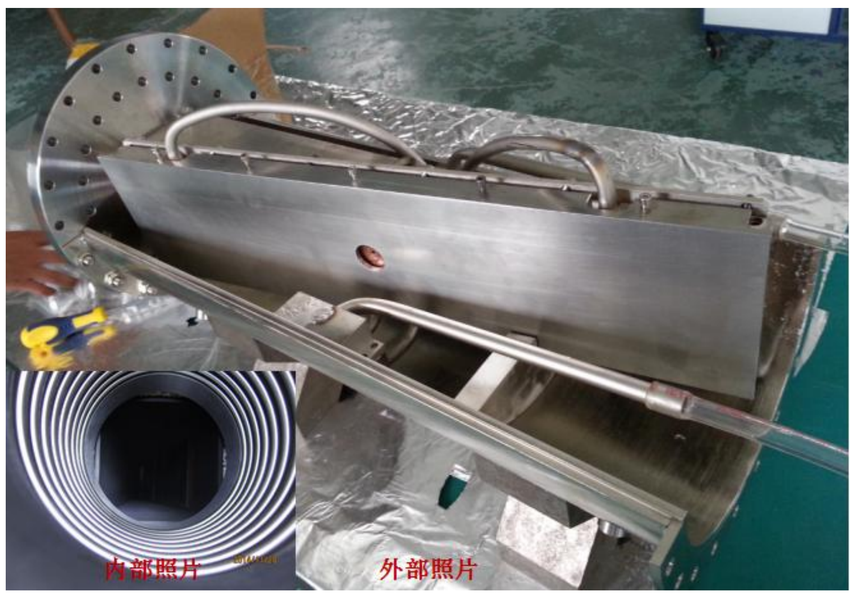
TARGET TYPE

Contrast： uniform tapered target, ovate shaped target, ob-ovate shaped target, plate target， etc.









STRUCTURE

Optimizing：

1、Micro fins or parallel tunnels?

2、The angle between beam and target surface is 10°；

3、The diameter of water cooling tunnels： 12mm；

4、 The interval of water tunnels：20mm。

The optimized results all satisfied the requirement.

CONCLUSION

Finally，a new type of faraday cup is designed and developed，and successfully applied in the two phases of beam commissioning of CSNS FE system and DTL temporary line.

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