The installation and application of multi-wire profile monitor for PBW in CSNS*

Ming Meng, Anxin Wang, Zhihong Xu, Ruiyang Qiu, Fang Li, Taoguang Xu, Tao Yang, Peng Li, Lei Zeng, Dongguan Neutron Science Center, Dongguan 523803, China
Institute of High Energy Physics, Chinese Academy of Sciences (CAS)， Beijing, China,

IBIC MALMÖ, SWEDEN International Beam Instrumentation Conference 8-12 SEPTEMBER 2019
TUPP025
(Tuesday)

Abstract

To monitor the size and position of 1.6 Gev proton beam in front of proton beam window(PBW) of China spallation neutron source (CSNS), one multi-wire profile monitor (MWPM) is designed and installed with PBW. It can bear the heat caused by beam and generate signal to electronic in local station. We can monitor the situation of beam and protect PBW using MWPM.

Introduction

In the CSNS, proton is accelerated to 1.6 Gev after drawn form Rapid Cycling Synchrotron(RCS), then transported to target which is behind PBW by Ring to Target Beam Transport(RTBT). The target in CSNS is flat package made of tungsten and covered by tantalum, to protect target and PBW, we need to monitor the position and shape of beam, to make sure the offset of beam center and convergence situation is safe. One MWPM is designed and installed to achieve this.

DESIGN OF MWPM

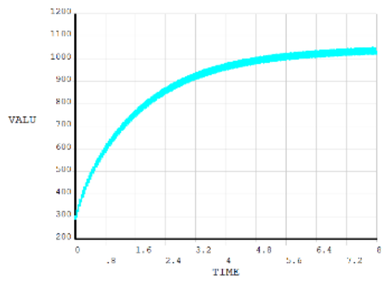
The main beam parameter of CSNS is shown in table below, there are two stage of CSNS with different beam power 100 kW and 500 kW, while at the beginning for engineering acceptance the power is 20 kW, so the scheme should cover all low and high range

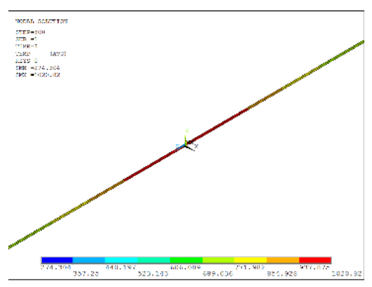
Phase	I	II
Beam power on target [kW]	100	500
Beam energy on target [GeV]	1.6	1.6
Ave. beam current [uA]	62.5	315
Pulse repetition rate [Hz]	25	25
Protons per pulse [10^{13}]	1.56	7.8

As for calculate temperature of tungsten wire, we consider highest beam power and beam current as below

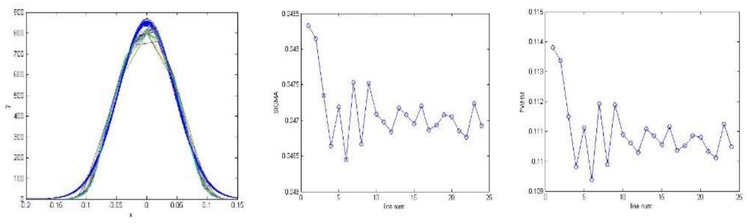
	MWPM
3 time sigma	L*W=84 * 21mm
current	15.6A
Pulse time	80ns
power	1.6Gev
Repetition frequency	25Hz

At last we get the maximum temperature of wire as 1020 K in next fig, according to the temperature 2000 K tungsten need to generate visible spectrum, it is not suitable for VMOS method, if we consider 20 kW beam power, the temperature would be even much lower.

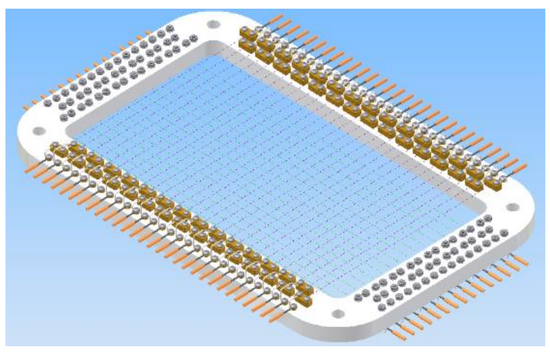




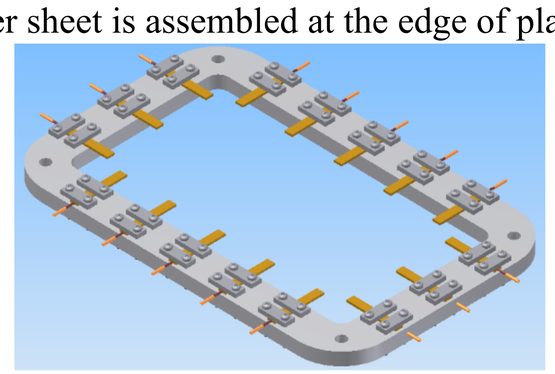
We also rebuild beam size with different wire number on simulated data , according to result, the wire number which act with beam should over 13 then precision is better than 1%. But in mechanical structure, we bore a hole on ceramic plate and install device to hold wire, under this limitation, the range between wire can only be 7 mm,



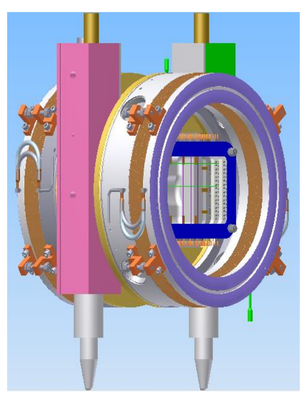
There are two ceramic plate for beam size measure-ment, one is 100 um wire and the other is 50 um. Each plate have two layers of wire, one is x direction with 29 wires, the other is y direction with 15 wires

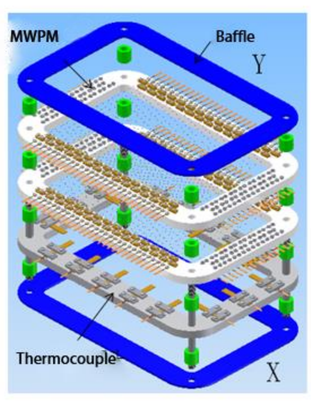


The third layer is for copper sheet and thermocouple, copper sheet is assembled at the edge of plate



Total model of MWPM in PBW

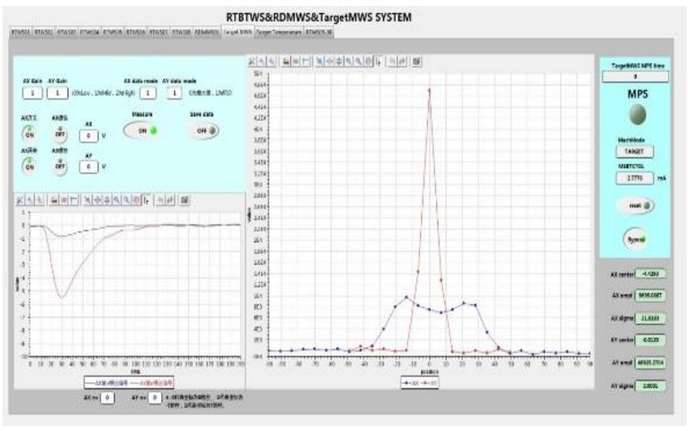




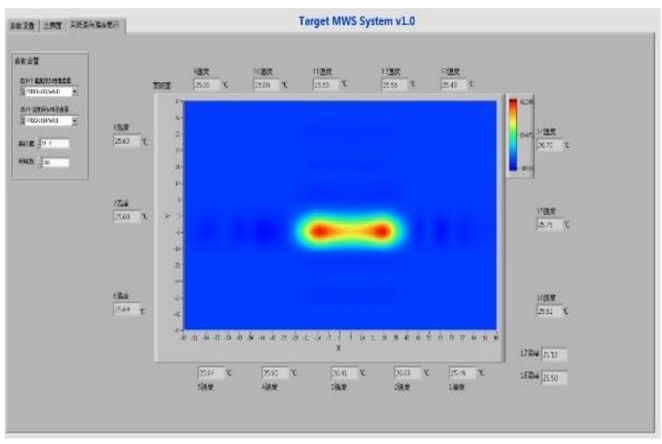
There are 5 hole left on the PBW, each is designed for 41 pins feedthrough, the thermocouple need 32 pins, 7 wires on the edge to single-ended while other 37 wires are double-ended, 4 pins of extra thermocouple for protect PBW

After all the wire and thermocouple is mounted and tested, the MWPM is installed to the PBW and connected to feedthrough on it.

In targeting experiment, MWPM system work well and give the profile of beam



After fitting of measurement data, we can get beam 2D distribution of X,Y plane as shown in fig.8, from the fitting result, the y sigma 2.8 mm is close to its theoretical value, while the x shape is nearly rectangle as wanted.



Conclusion

In this paper, we describe the design and simulation of MWPM, after machining and installed, it worked well in beam targeting experiment and give profile result for monitoring, it plays an important role in machine running. The resolution of y direction is not high as x direction because of space limitation, we need to find to improve it.

†mengming@ihep.ac.cn
China Spallation Neutron Source (CSNS), No. 1, Zhongziyuan Road, Dalang Town, Dongguan City, Guangdong Province, P.R. China