# The First Beam Experiment Result of the Protype of Wire Scanner for SHINE

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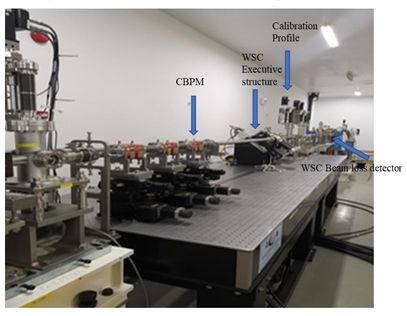
## Abstract

As a kind of quasi-non-destructive beam size monitoring, SHINE will employ dozens of wire scanners. The preliminary study is confronted with motion control difficulty. To reduce the ultrahigh coordinate about wire movement with beam loss data acquisition, a new method has been proposed in the SXFEL test platform. The strategy is utilizing the beam jitter, which is of the same magnitude with the beam size. Combine with the jitter of the beam position, we move tungsten wires in a few of different position to realize the measurement. This paper will present our experiment design as well as a furthermore plans about the prototyping design.

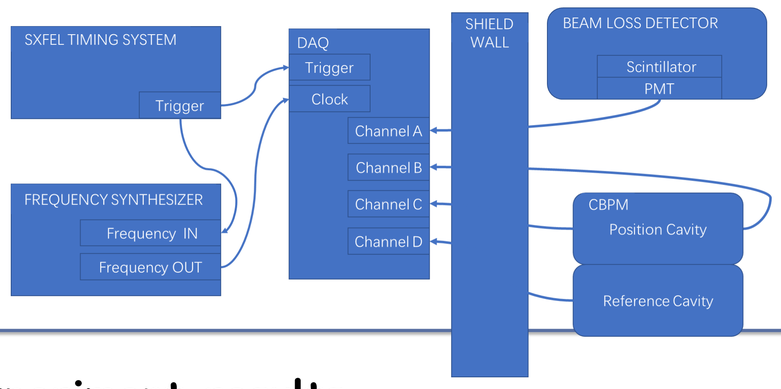

## Introduction

The initial setting is to use wire scanner to scan the beam transversal section at a uniform speed. Using the high repetition frequency of the SHINE, the position of the wire and the beam interaction can be obtained. Combining the beam loss detector data, we can calculate the beam size using Gaussian fit.
Since the SHINE device is still under construction, our wire scanner prototype is first installed in the SXFEL for testing. Unlike the hard X-ray free electron laser device with high repetition frequency(up to 1MHz), the current repetition frequency of the SXFEL is 2 Hz. After the first preliminary experiment, we learned that the beam size of the SXFEL is in the magnitude of several hundred microns, and the jitter of the beam position is about the order of magnitude. This will introduce a noticeable uncertainty of measurement. However, it provides a new idea for our test, we can take usage of the beam jitter. Using the CBPM we can calibrate the accuracy position. The DAQ using external clock with external trigger, which can guarantee the synchronization of the beam loss and the impact point.

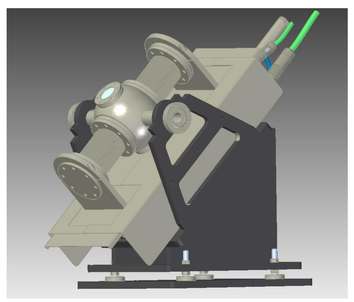
## System setup

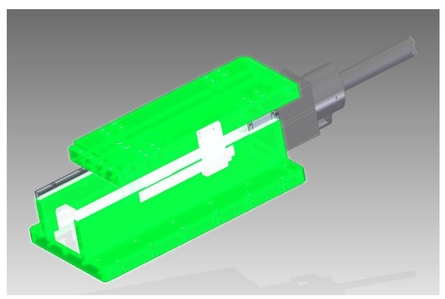



We introduce the timing signal from the timing system as the trigger signal of the data acquisition board. At the same time, we use the frequency synthesizer multiplication timing signal as the clock signal. The four channels of the data acquisition board are collected, two position signals of CBPM horizontal direction and vertical direction and CBPM reference cavity signal used for normalized charge.



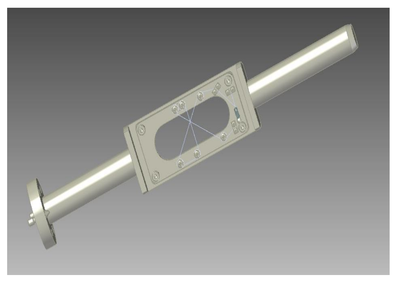

## Mechanical execution structure





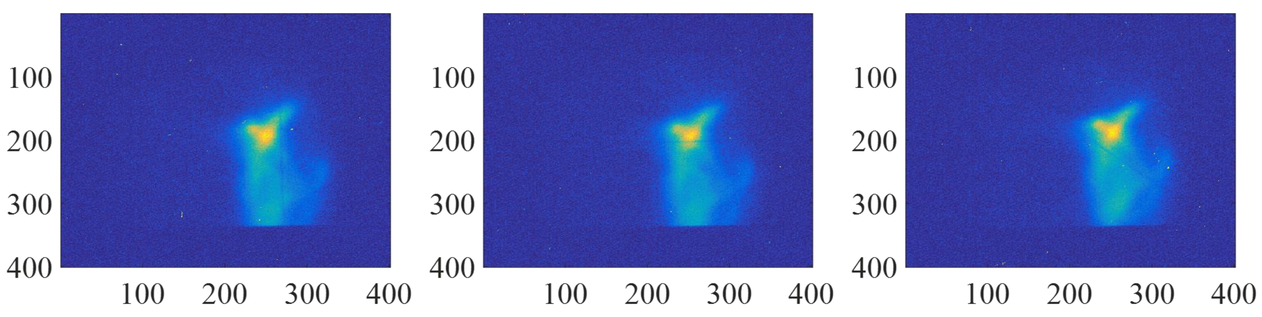
Motion Mode:

- Step by step test
- Fast scan
- User scan

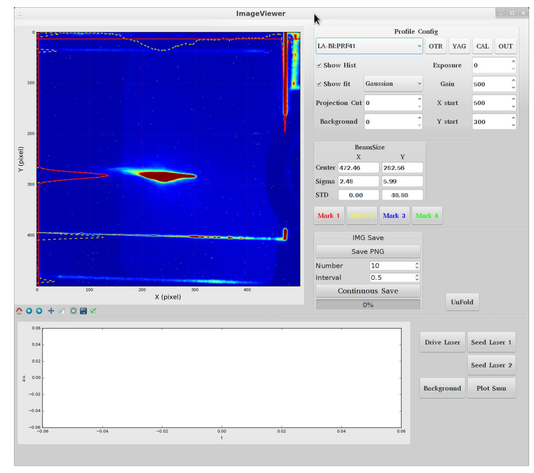


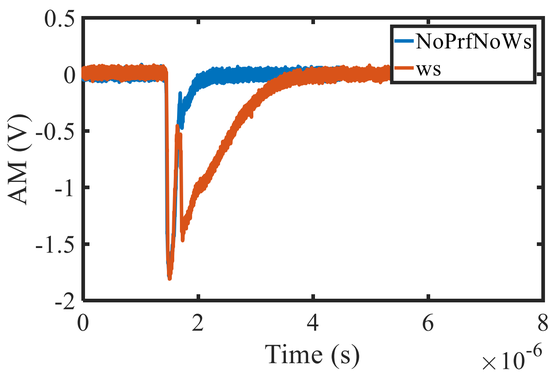
The beam loss detector

## Experiment results

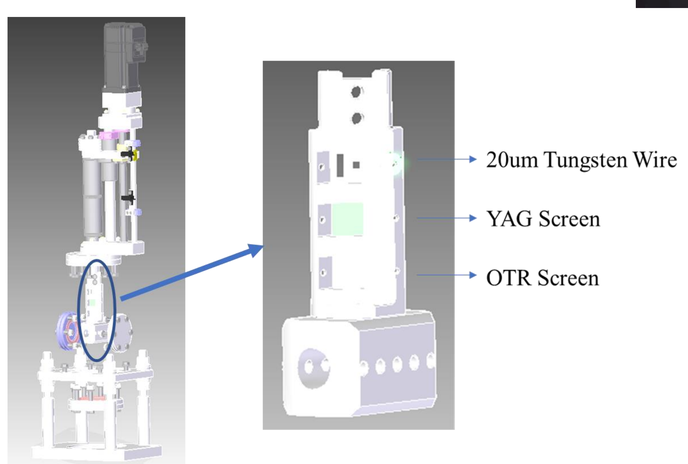


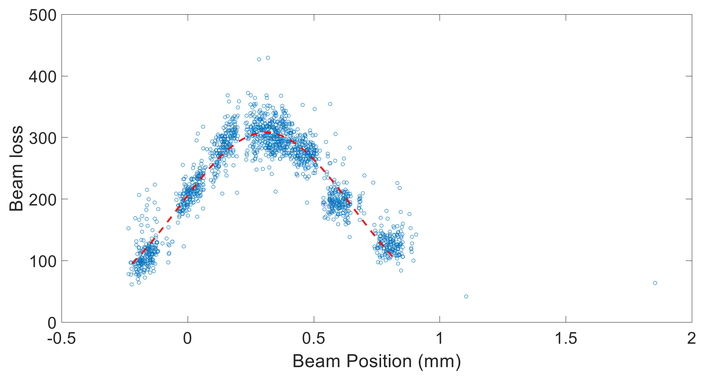

Beam interaction with the beam in three direction




Beam loss signals




Challenge：In view of the complexity of the noise background, our system resolution is deterioration.
Guess：It is suspected that the beam interact with the remaining air molecules in the vacuum tube.

Compare the test results with the profile, the beam size is bigger using the wire scanner, More supplementary experiments will be arranged later.

## Conclusion

Wire scanner system are keeping developed. In the next step, we will try to adjust the execution structure of the wire scanner and the position of the beam loss detector, the detector installation position and other methods to improve the beam loss signal reception efficiency and improve the system resolution. At the same time, to ensure that the mechanical execution structure can operate stably in the free electron laser device with high repetition frequency, we will conduct some destructive experiments to verify it in the later stage.



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