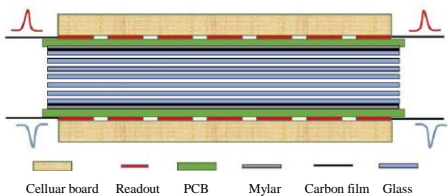
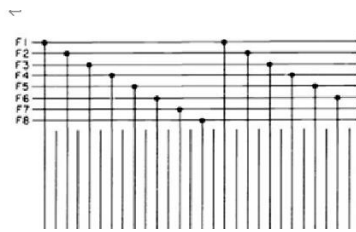


MRPC has a significant advantage in the application of muongraphy which means more convenient **large area production and lower production costs**. To compress the scale of electronics ,the readout has been multiplexed which **influenced the signal integrity**.

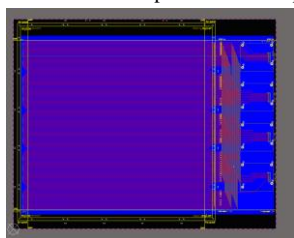


The MRPC detector used in this paper is a single chamber with six gaps. System used the fine-fine multiplexing readout method through a specific coding method.

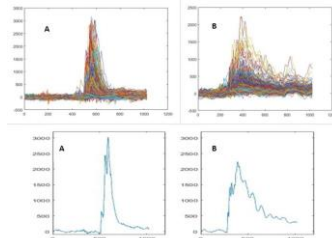
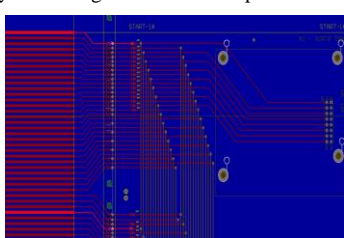


The principle of multiplexing

The structure of multiplexing is shown in figure . In this paper , five readout was multiplexed with via hole. The PCB was designed to 3 layers . And the readout stripes will be led from top layer to the mid layer through via . **The structure of via and multiplex strip constitute a waveguide** together, which differs from non-multiplex readout strips. Obviously this change will affect the process of signal transmission.



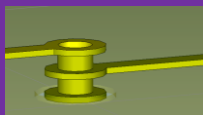
The structure of multiplexed readout



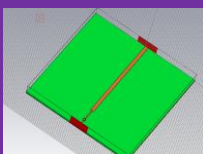
The signal between and after multiplexing

The difference of signal between and after multiplexing was shown. It can be seen that after multiplexing, the signal amplitude decreases with the width increases, and the signal's back edge is superposed by multiple pulse signals which is messy and **is not conducive to amplitude discrimination**. It is necessary to further explore the transmission process of the energy of the signal in the strip.

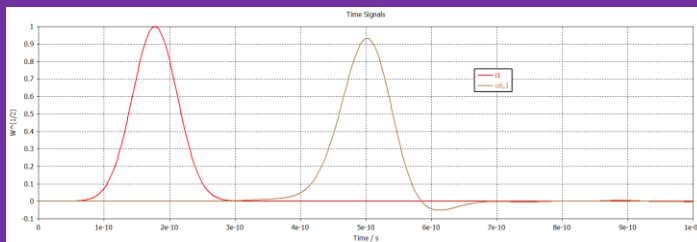
This paper has simulated the process of EM wave transmission in the readout strips waveguide by using CST MS. The via structure was built firstly.



Via hole structure

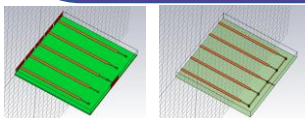


CST model for via signal analysis



Signal comparison before and after through the via.(i1 for before and o6,1 for after)

Giving a signal excited with port1 and monitoring the signal with port6,we can see that after passing through the via structure, the **amplitude of the signal appeared decreasing and distortion**.



The CST model of 5 readout multiplexing was shown .By setting the waveguide port and monitor , the signal waveform , S parameters and wave transmission process can be calculated. For MRPC , the dominate frequency is about **500MHz** , the maximum frequency can reach GHz , so the **range of simulated frequency is 0-10GHz**.

In the process of signal transmission , the energy of signal won't transfer to the electronics integrally , **a part of them will transfer to the neighbouring readout which has multiplexed each other** . This is the main reason for the decreasing of the signal amplitude . The S-para of port2 and port6 was shown.

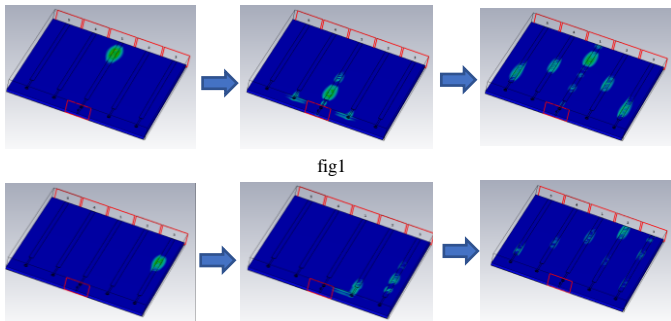
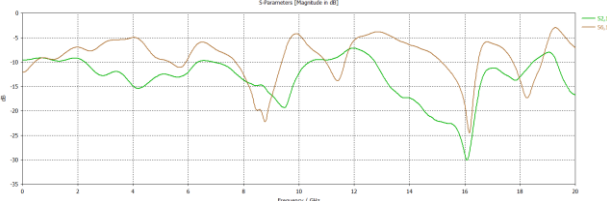


fig2

The signal transmission process of multiplexed readout the signal source is from the middle strip for fig.1 and the far right for fig.2



S-para of port6(connected to electronics ) and port2(other readout)