4 - 14 A Beam Pulse Position and Time Structure Monitor for Fast Extraction Mode of HIRFL-CSR

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In the fast extraction mode of HIRFL-CSR, about 10^8 ions accumulated in the main ring CSRm will be kicked out within about hundreds of nanoseconds and then bombard on a target. In many cases, the ion beam pulse passes through a titanium window and then bombard a target in the atmosphere. In order to record the experimental parameters more accurately, we need to monitor the pulse position, intensity and time structure without blocking the beam.

We have developed a beam pulse monitoring device that can work in the atmosphere and in a strong background magnetic field. As schematically shown in Fig. 1(a), the device is composed of 8 sensor boards. Each sensor board contains a pair of identical coils, see Fig. 1(b). When the beam pulse passes near the board, the induced magnetic field (on the order of 10^{-8} T) generates a pair of voltage pulse signals with equal size but opposite direction in the two coils. The signal amplitude is proportional to the time of rising edge or falling edge of the beam pulse, which is on the order of microvolts. The pair of signals are differentially amplified by our home-made amplifiers, which can significantly suppress environmental interference and improve signal-to-noise ratio, and finally recorded by an oscilloscope, as shown in Fig. 1(c). By comparing the relative amplitudes given by the 8 sensor board, the spatial position of the beam can be judged. Through the duration of these signals, the time structure of the beam can be roughly determined.

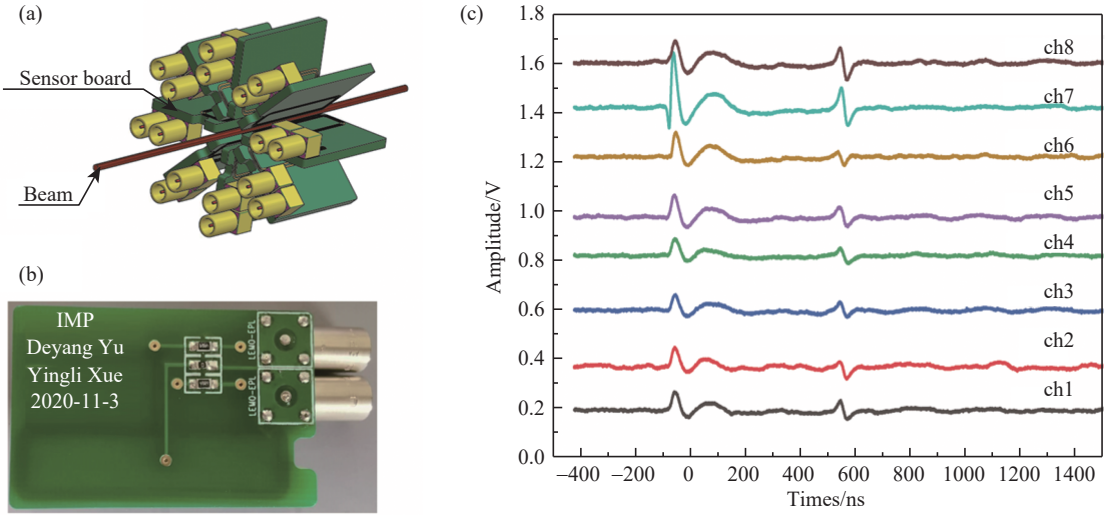

Fig. 1 (color online) (a) Schematic drawing of the beam pulse monitoring device, (b) Photo of a sensor board, (c) The signals recored by an oscilloscope, which are from the 8 sensor boards and amplified by our home-made amplifiers. The relative amplitudes of the 8 signals are related to the beam spatial position, while the duration of the signals is corresponding to the beam time structure.

The equipment has been applied in experiments. In the future, we will further develop this method, such as directly obtaining the time structure of the beam by integrating the signal.