4 - 31 Measurement of Spatial and Temporal Resolution for the Ultrafast New-type Pyrometer

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Temperature is one of the key thermodynamic parameters of HED matter. As a popular technique, the pyrometer of narrow-band filters together with photodiodes (namely multi-channel pyrometer) has been applied. However, the pyrometer can only measure one-position temperature in single shot [1,2]. Actually, it is very important to know temperature evolution of multiple positions in single shot, especially for the target induced by heavy ion beam, where a large volume of HED matter can be generated. Consequently, a fast new-type pyrometer has been designed.

The newly-designed pyrometer based on imaging spectrometer could measure the range of brightness temperature of the target surface from 1 500 to 20 000 K in visible and near-infrared parts of spectrum, with about 400 μm spatial and 500 ps temporal resolution. It is emphasized that the pyrometer can simultaneously measure the multi-position temperatures from the target surface in single shot. The design scheme and detailed description on the pyrometer has been reported in Ref. [3].

Fig. 1 shows the measurement of spatial and temporal resolution for the newly-designed pyrometer. HED matter was produced by 167AMeV carbon ions impacting on the CsI(Tl) crystal. The fluorescence emission spectrum and the variations between the fluorescence intensity of each emission component and incident energy from the crystal are shown in Ref. [4]. In Fig. 1, the light of three positions at the direction of ion beam is focused point-to-point onto the input fiber array with 1 mm core diameter by an achromatic lens. The output light of fiber array is measured by Si photo-detectors. The output signal from the oscilloscopes is shown in Fig. 1(b). The typical parameters of the CsI(Tl) crystal are obtained by analyzing the recorded signal of the oscilloscopes. Here the optical power of peak value from three-position is 0.09, 0.19 and 0.49 mW, respectively, the value increases with the increasing of the range. The rising time is about 700 ns, which is the same as the extract time of ion beam. It means that the newly-designed pyrometer has very good temporal and spatial resolution. It fulfills the multi-position simultaneously measurement in single-shot. It is very suitable for temperature measurement of a big volume HED matter induced by ion beam.

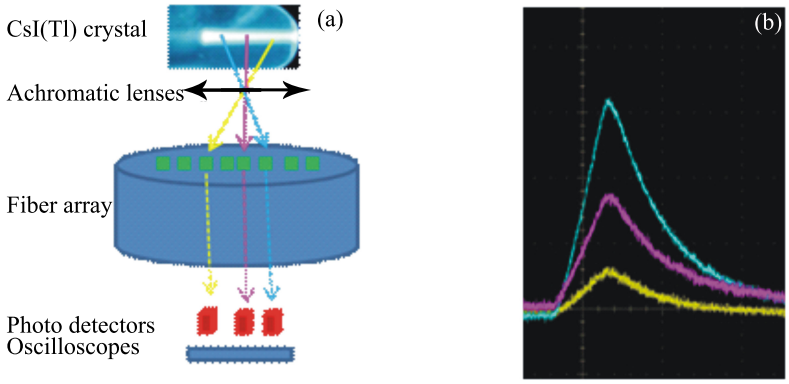

Fig. 1 (color online) The temperature measurement of HED matter produced by the high-energy carbon ions impacting on the CsI(Tl) crystal using the newly-designed pyrometer. (a) Experiment setup. (b) Measurement results.

References

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