

## L.2 : Development of S-20 optical streak cameras under Indo-Russian (ILTP) collaboration program

Streak camera is an important instrument for studying very fast (sub-nanosecond) events in a single-shot mode. The important features of a streak camera are: 1) high time resolution (of the order of few pico-seconds), 2) high sensitivity (near single photon) and 3) good dynamic range (typically 10-100). A streak camera is specially required in studies of laser plasma interaction due to very short time scales of the processes involved. Laser Plasma Division has developed two S-20 optical streak cameras in collaboration with General Physics Institute, Moscow. Due to the S-20 photocathode, it has a peak response in the green region of the visible spectrum. The optical components like streak tube, de-magnifier unit and image intensifier unit were procured from General Physics Institute. The optical imaging system, mechanical housings and mountings, as well as various electronic circuits were fabricated at RRCAT. The latter include high voltage (~15 kV/100  $\mu$ A) power supply with suitable divider network for biasing electrodes of various units like streak tube, de-magnifier unit and image intensifier unit; a high voltage and high speed ramp generator unit and an integrator for getting variable ramp speeds; and a trigger generator unit to generate various trigger signals. These circuits were developed using indigenous components. Optical output of the image intensifier was coupled to a CCD camera followed by a PC based frame grabber for capturing the images. These streak cameras are an improved version over those made earlier as de-magnifying intensifier units are used in them, making them more compact and of higher optical efficiency.

The specifications of these cameras are as follows:

- Photo-cathode Type: S-20 (Na-O-Sb-Cs)
- Spectral Sensitivity: 350-800 nm with peak at 500 nm
- Quantum Efficiency: 89%
- Useful phosphor window: 30 mm of phosphor screen
- Streak sweep time: 1.2 ns, 2.1 ns, 3.6 ns, 15 ns, 37 ns and 98 ns
- Temporal Resolution : ~ 7 ps
- Spatial Resolution : ~175  $\mu$ m

A photograph of one complete unit is shown in Fig.L.2.1.



Fig.L.2.1: Photograph of the S-20 optical streak camera

The dynamic testing of two units and their streak speed calibration was done using femto-second laser pulses from a Ti:sapphire laser system. The laser system provides 50 fs duration laser pulses at 790 nm at 10 Hz repetition rate. For this purpose, the laser beam was split into two beams using a BK-7 glass slab introduced just before the entrance to the input slit of the camera. Fig.L.2.2 shows the streaks observed for 50 fs laser pulses with a delay of ~ 100 ps on one streak camera with the fastest speed setting. It was found that the fastest streak speeds of two streak cameras are 2.49 cm/ns and 2.45 cm/ns respectively. The variation in the streak speed was found to be within 10 % of the average value. The temporal and spatial resolution for both the cameras was measured as ~7 ps and 175  $\mu$ m respectively. The streak camera is now being used for experimental investigation on laser driven intense shock propagation through different foils for equation of state and detection of optical signals to study dynamics of fast processes involved in laser-plasma interaction.

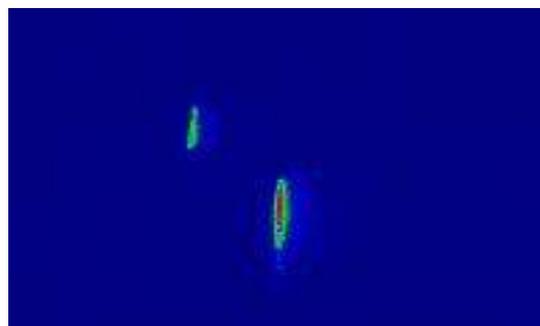


Fig.L.2.2 : Streak picture of a 50 fs laser pulse bifurcated through a glass slab

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