Laser Ignited Multi-Cylinder engine

Objective of this experimental setup:

This Experimental setup is being developed with aim of demonstrating laser ignition system for multi-cylinder engine equipped with gaseous fuel such as H2, CNG and their mixture.

About Experimental Setup:

This experimental setup is under development. In this experimental setup initially, a two-cylinder CI engine was modified to run on SI mode. The test engine selected for modification was Mahindra & Mahindra. / Supro 0.909 L. Other specifications of the engine are given in the table.

Table 1: Technical specifications of the test engine

Engine Parameters	Specifications
Manufacture/Model	Mahindra & Mahindra./ Supro 0.909 L
Engine Type	Four strokes, naturally aspirated diesel engine
Fuel Injection system	Port Fuel Injection
Number of cylinders	2
Bore × Stroke	83 mm × 84 mm
Connecting rod length	140 mm
Engine displacement	909 cc
Compression ratio	-
Rated torque	55 Nm @ 2200 rpm
Rated power	19.2 kW (26 BHP) @3600 rpm
Valvetrain type	Double overhead camshaft (DOHC)
Cooling system	Water-cooled
Injector	Gaseous Injector

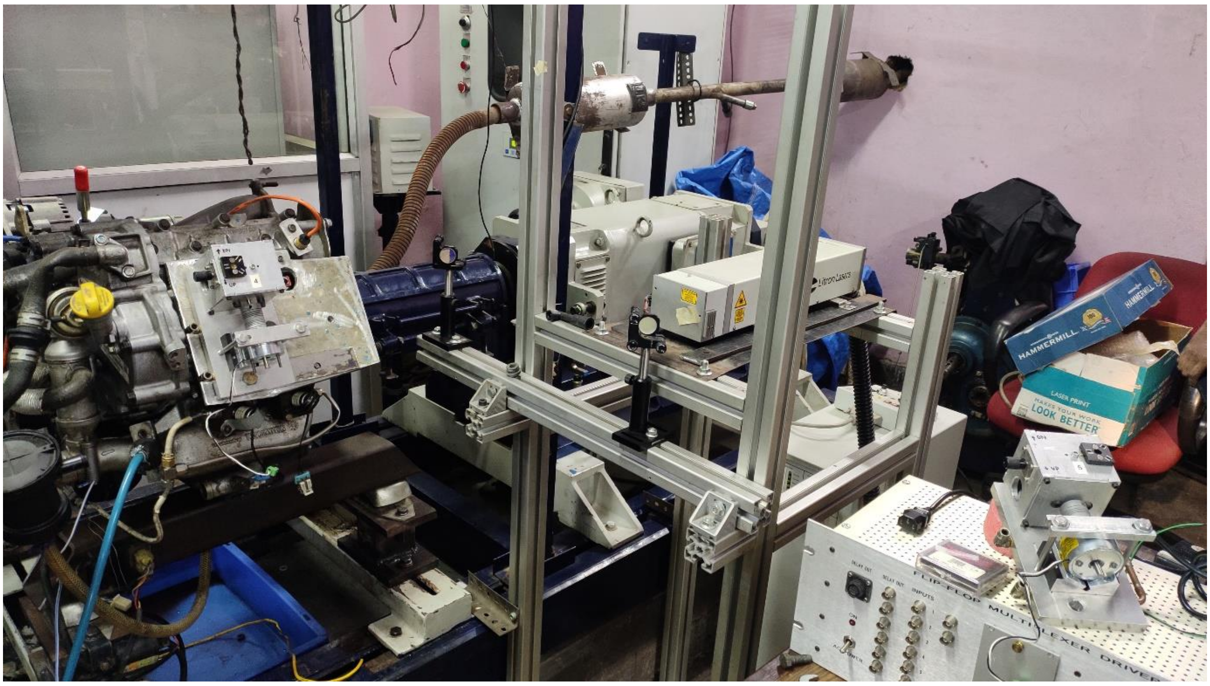

Figure 1: Experimental setup of Laser ignited multi Cylinder engine

Short laser pulses of several nanoseconds of duration, delivered by a Q-switched laser, are focused by a proper lens system inside the combustible mixture. If the peak intensity in the focal region overcomes certain threshold intensity, breakdown occur leading to formation of a plasma spark whose size depends on the numerical aperture (NA) of the focused beam. If the energy content of the spark is high enough, the mixture becomes ignited. In the laser ignition case, breakdown voltage decreases with increasing in cylinder pressure, contrary to conventional spark plug.

Ignition system- An electronic ignition system will install to ignite the hydrogen-air/CNG-air/HCNG-air mixtures. This type of ignition system consists of magnetic pick-up sensor, ignition module, ignition coil and spark plug. Magnetic pick-up sensor will install on the camshaft. It will give TTL signal in one cycle. This signal will serve as an input signal for ignition module. After receiving the input signal, ignition module will give output to the ignition coil i.e, primary current to the ignition coil and sparking can take place. We can put the delay in terms of crank angle in the ignition module so that engine can map in terms of spark angle and to get MBT.

Multiplexing Unit: The pulsed output of Nd:YAG laser is distributed to individual cylinders for focusing and creating sparks. A mechanical multiplexing system was developed to distribute laser pulses to different synchronized with engine rotation. The Multiplexer driver is shown in Figure 2.

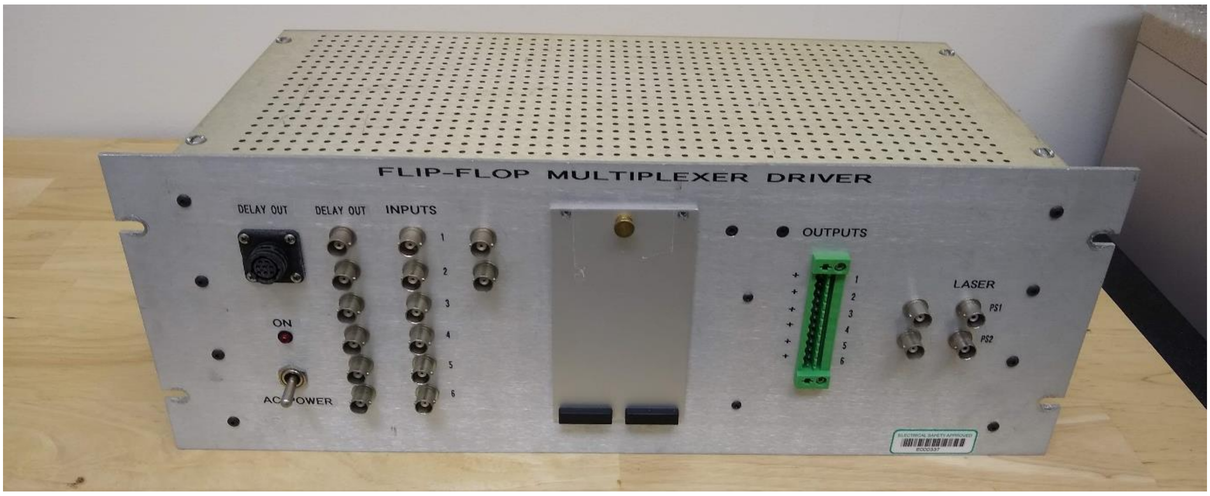

Fig 2. Flip Flop Multiplexer driver

Laser Unit: A flash lamp pumped Q-switched Nd: YAG laser (Litron, Nano L-200-30) (figure 3) was used for ignition of CNG-air mixture, delivering pulse energy up to 200 mJ with a pulse duration of 6-9 ns at FWHM at the fundamental wavelength. The beam diameter was 5 mm. Maximum internal repetition rate of the laser was 30 Hz. Laser could be controlled via a remote control box, which allows control of all system parameters, such as laser start and stop, pump on and off, pulse repetition rate, output energy and shutter position. Standard TTL controls give access to Q-switch, lamp synchronization and triggering.

Fig 3. Nd: YAG Laser

Flame trap - A flame trap will design for safety purpose. In case there is backfire, flame will travel to hydrogen cylinder and it will trap in flame trap.

Online Mixing System: For testing different mixture of H2 and CNG, a dynamic mixing system developed. It ensures the proper mixing on demand during experiment.