

# MOG Laser Vibrometer

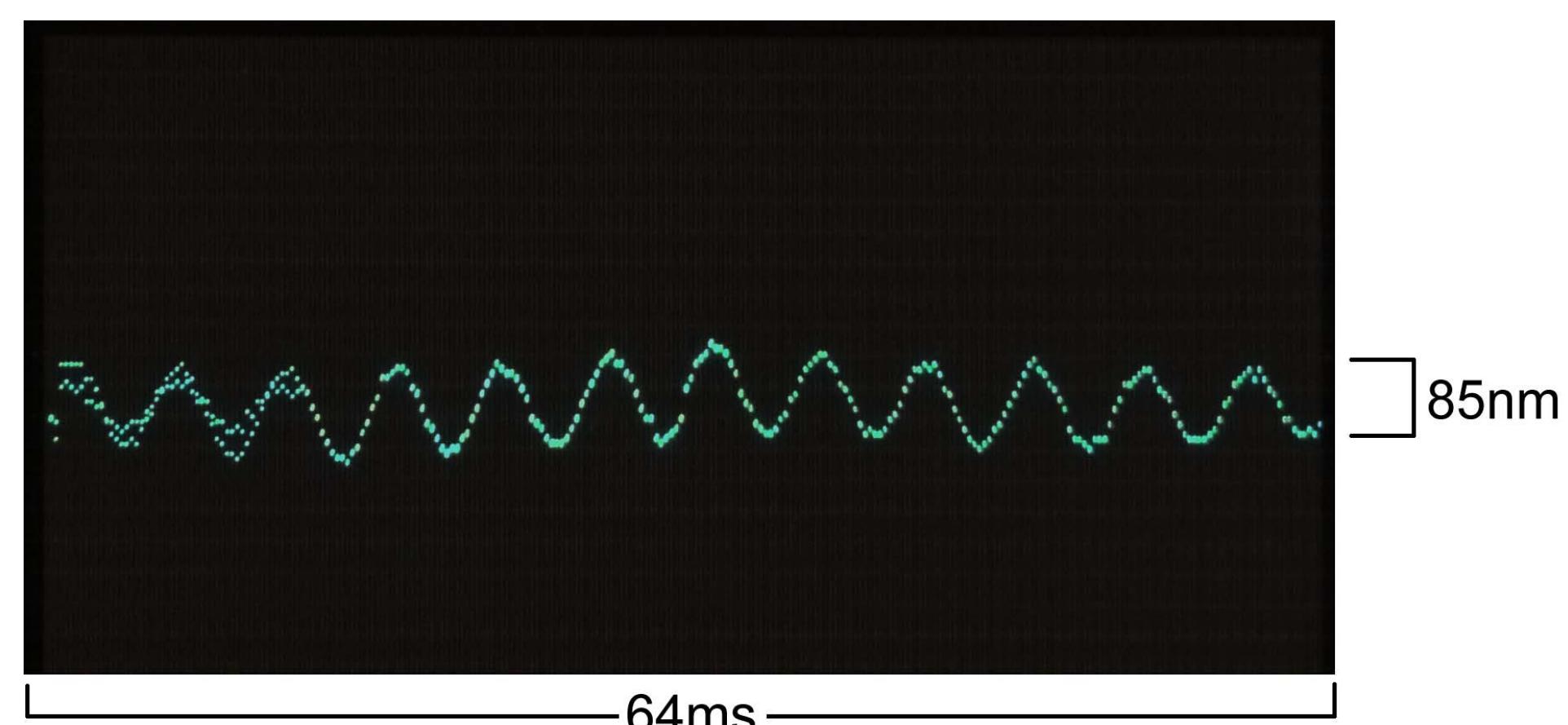
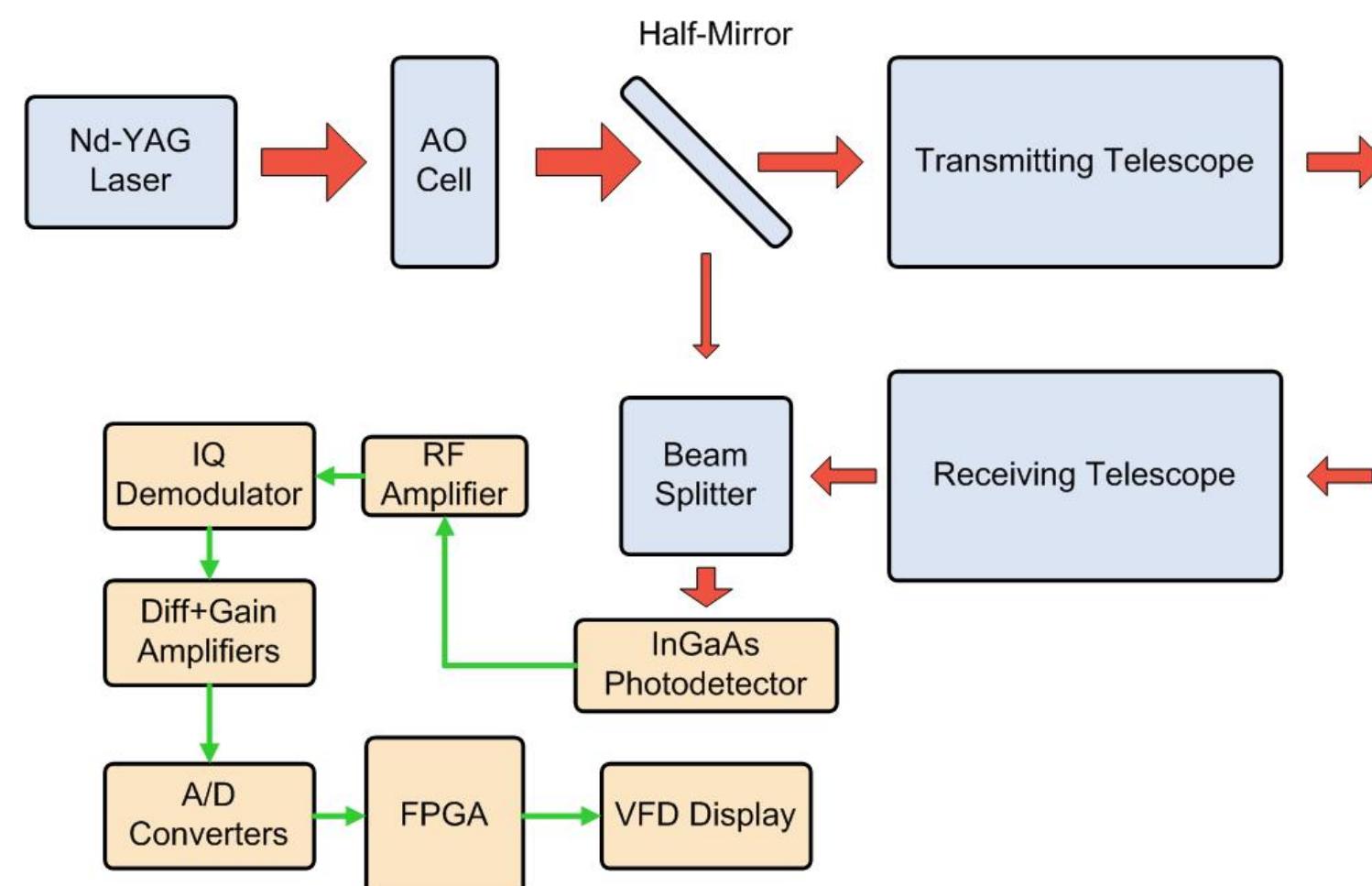
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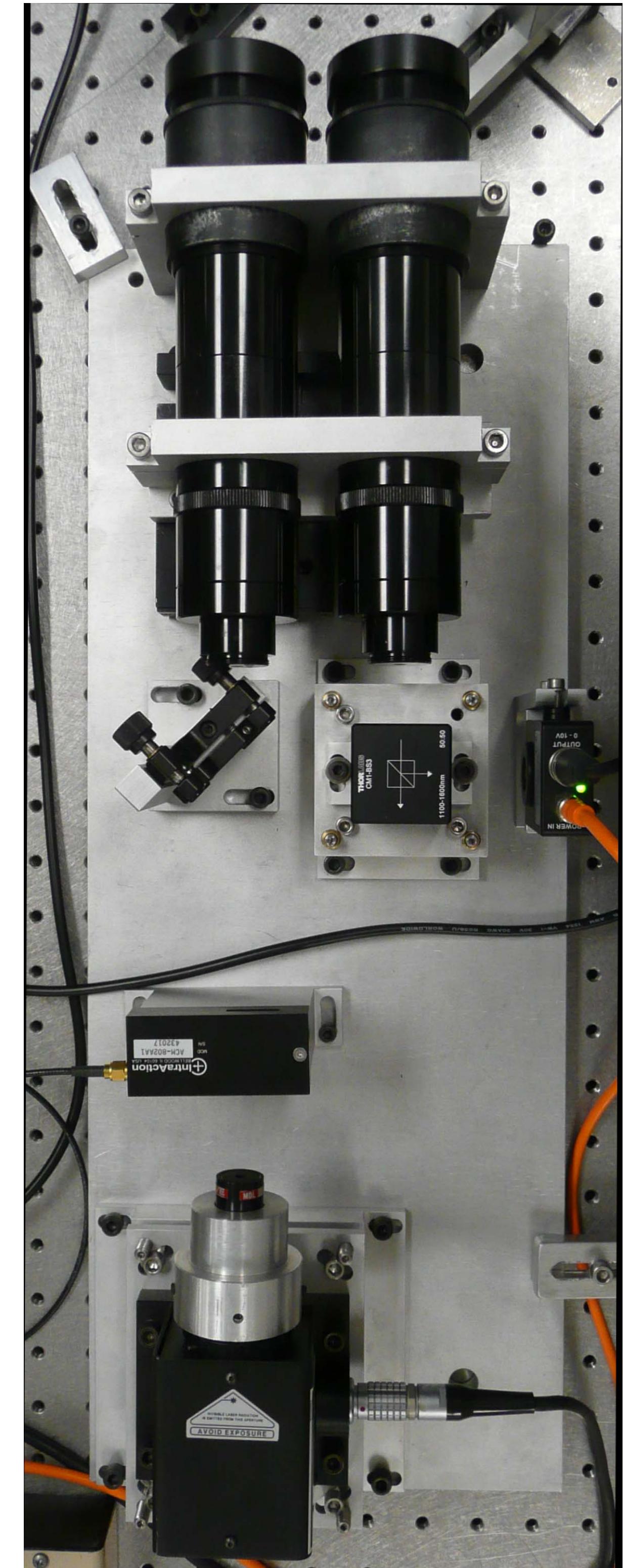
## Technical Summary

A laser vibrometer uses an interferometer-like setup to detect the vibrations of distant objects using a laser beam.

- A 1.3 $\mu$ m Nd-YAG diode-pumped laser is frequency shifted with an acousto-optic modulator, giving the interferometer section a 80MHz reference beam. A portion of this beam is diverted to the photodiode , which acts as the local oscillator.
- The majority of the laser power is directed through a Galilean-style telescope, which focuses the laser on the distant target. The returning scattered laser light is collected by the receiving telescope. This light is optically mixed with the local oscillator at the beam splitter, and the resulting signal is measured by the InGaAs photoreceiver.
- The output of the photoreceiver is passed through a 30dB RF amplifier, and then into a quadrature demodulator. The resulting I and Q signals are fed into separate differential amplifiers with an addition gain stage, amplifying the weak received signal up to the input range of the dual 12bit, 600KS/s analog to digital converter chips.
- A Field Programmable Gate Array (FPGA) embedded controller running at 133MHz then calculates the inverse tangent of the two digitized input signals from the demodulator, giving the angle  $\Phi$ , which is a measure of the displacement of the target (its vibration) over time. A digital high pass filter removes the slow drift caused by the air and other background noise. The system is designed to detect vibrations with amplitudes less than one nm, at around 300ft away.
- A vacuum fluorescent display shows the target vibration in real-time, updating at 22 frames/sec.



Display showing Target Vibration



Vibrometer Optical Setup