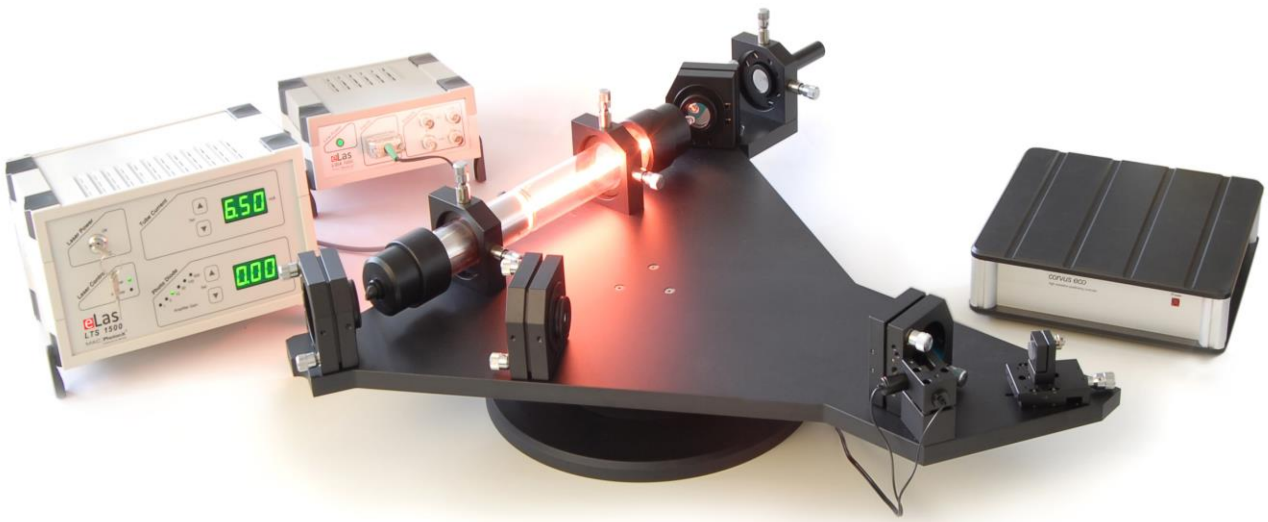
Laser Gyroscope (CA-1310)

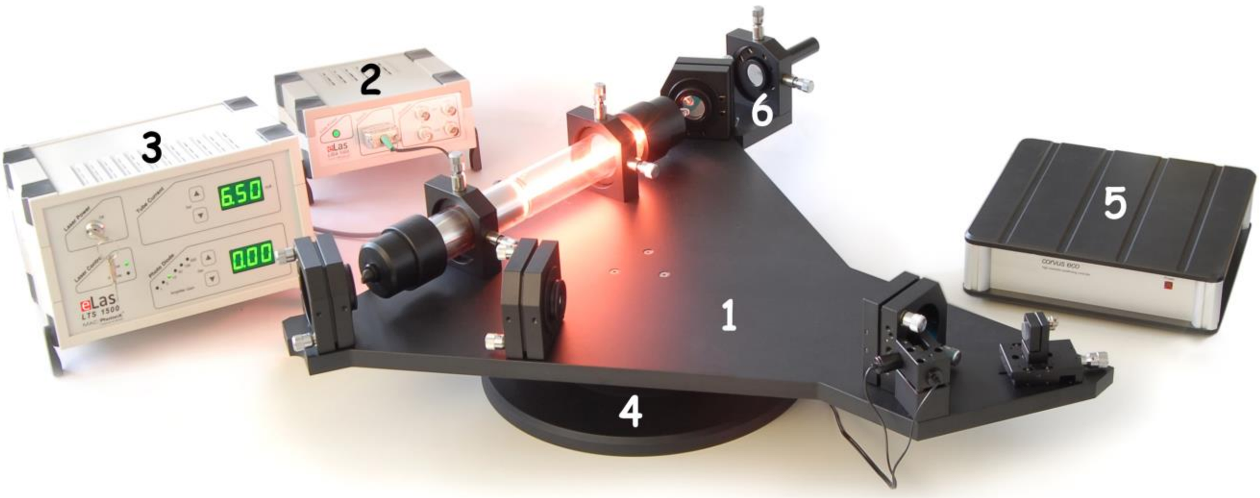


One of the most fascinating applications of lasers is the set-up of a laser gyroscope. This absolute measurement system is a very important tool in daily life: navigation in airplanes and ships, alignment of telescopes, survey of landscapes and high precision rotation measurements to name only a few.
The educational kit demonstrates to students the optical and mechanical components of a laser gyroscope as well as the practical work of alignment and measurement of such a system.
The gyroscope is an active laser gyroscope and contains a ring laser consisting of an open frame He-Ne tube and a triangular resonator. The whole ring laser is set up on a motorized rotational platform. The rotational velocity can be varied allowing to the dynamic range of the Gyroscope to be investigated. Counter-rotating modes of the ring laser are coupled out and are superimposed for demonstration and measurement of the Sagnac effect. The resulting interference is detected and electronically converted to a frequency proportional to the rotational velocity. The lock-in threshold is determined by variation of the rotation frequency. Single mode operation is achieved by an etalon mounted in the ring resonator.
For the experiments a 100 MHz oscilloscope is required and can be offered by eLas optionally.

Educational Objectives of Investigation

- HeNe Ring Laser
- Ring Laser Modes
- Interference
- Single Mode Etalon
- Sagnac Effect
- Mode Lock-in
- Measurement of Rotation
- Dynamic Range

Setup and Components



1	Ring laser setup with HeNe laser tube, resonator mirrors, single mode etalon and detection unit
2	Amplifier and comparator for the detector signals
3	HeNe power supply
4	Rotation stage
5	Controller for the rotation stage with Joy-Stick
6	Adjustment laser for the resonator alignment
7	Frequency counter (not shown)
8	Optics cleaning set (not shown)
9	User manual (not shown)

Ordering Information

For ordering the Laser Gyroscope kit (CA-1310)

use ordering number: 490091310

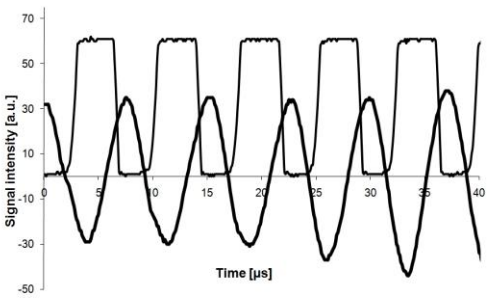
Measurements and Handling

Some of the possible measurements are presented in the following list:

- **Alignment of the ring laser system**

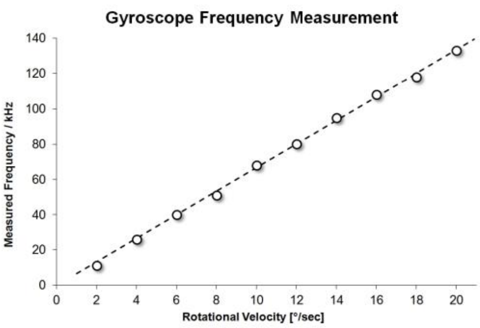
The Laser gyroscope consists of a ring laser which is formed by a He-Ne laser tube and three resonator mirrors. The gyroscope is mounted on a base plate, which can be rotated by a rotating turntable of high precision. The first task of the experiment is to adjust the ring laser and bring the laser to operation. Mode selection is achieved by a single mode etalon, inserted in the ring laser beam path.

- **Adjustment and detection of the output signals**



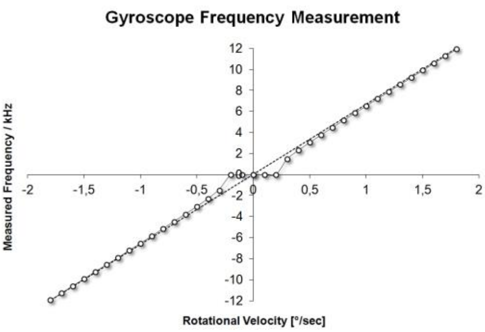
In a next step the two counter propagating signals of the ring laser are brought to interference. The interference signals are detected, amplified, forwarded to a comparator and then a TTL signal is generated. Finally, the beat frequency is measured with a frequency counter.

- **Determination of the scaling factor**



At the beginning of the measurements the scaling factor of the laser gyroscope has to be determined, which gives the relation between the measured signal frequency ν and rotational frequency ω of the gyroscope. For that the rotation table is driven with a series of increasing angular velocities. The slope of the resulting linear relation gives the desired scaling factor.

- **Lock-In threshold**



For this measurement one selects a range of small angular speeds and lowers the velocity stepwise. Again, the measured frequencies plotted in a graph as a function of the angular speed result in a straight line which, however, does not go through the origin, but drops at a certain point down to zero. The rotation velocity at which the interference signal disappears is the lock-in threshold.

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