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LASOS® He-Ne laser series

Gas laser production in the course of time - LASOS is facing the present challenge

During the last few years diode lasers have replaced the Helium-Neon laser in many mass applications (e.g., barcode scanner, marking, adjusting, aligning). The global reduction in Helium-Neon laser sales means a great challenge for the few remaining manufacturers. Whereas, on the one hand, niche products require a resourceful mind to ensure the continuity of raw material supplies, on the other hand, many applications in high-precision measuring applications in interferometers and spectrometers, are inconceivable without the properties of the Helium-Neon laser which solid state laser hardly achieve. The requirements on mode and frequency stability as well as resistance to magnetic fields which He-Ne lasers must meet are growing constantly. Declining output, on the one hand, and growing demands on the quality in shrinking volumes on the other hand, define new framework conditions and tasks today.

The He-Ne laser has ceased to be a volume product; it has become a selected component with high application potential to meet specific high customer demands.

LASOS is facing up to this challenge and has invested in flexible, modern and highly specialized gas laser production (Fig. 1). Absolute focus on the customer is the principle by which LASOS is guided. Customers are highly appreciative when their specific requirements are met, the products are of the high quality they expect and they get good value for their money. This company can rely on an efficient and experienced team of development specialists. The extent of in-house manufacturing in Jena, Germany, supports direct access to most different production technologies.

Fig.: 1: Modern helium-neon laser production at the new facility in Jena, Germany

The specifications required by the customer are already in focus when the laser is still at the design stage, e.g., by the systematic selection of individual components and gas mixtures. LASOS cooperates with component suppliers who share the enthusiasm for continuous development and improvement processes. In addition to the permanent optimization of all materials used and technologies applied in laser production, new workplaces for selection have been established allowing economical selection according to custom defined criteria also for small production batches. The Helium-Neon lasers are selected for output, beam position, absence of side lines, polarization switching, split frequencies and other parameters under defined magnetic field impacts. In addition to the customized range, we supply a large number of standard types that can also be used as genuine substitutes for lasers from other well-known manufacturers.

A very recent example of this competence is the development of a new He-Ne tube for Physikalisch-Technische Bundesanstalt (PTB) in Braunschweig:

PTB Braunschweig opts for new helium neon laser tube from LASOS

The times at which a meter was defined as a material measure ("standard meter") have long passed; today a meter is defined as the distance light travels in a defined fraction of time (viz. 1/299 792 458) seconds. This can only be defined by high-precision measuring equipment. The PTB uses lasers of the LASOS He-Ne laser series for it. The “workhorse" of the PTB for realizing the meter is an iodine stabilized Helium-Neon laser that serves as realization of this unit of length according to a recommendation of the International Committee for Weights and Measures (CIPM) (Fig. 2). This secures an outstanding position for the Helium-Neon laser in the

calibration chain from the National Metrological Institute, the accredited calibration laboratories to the users in industry and research.

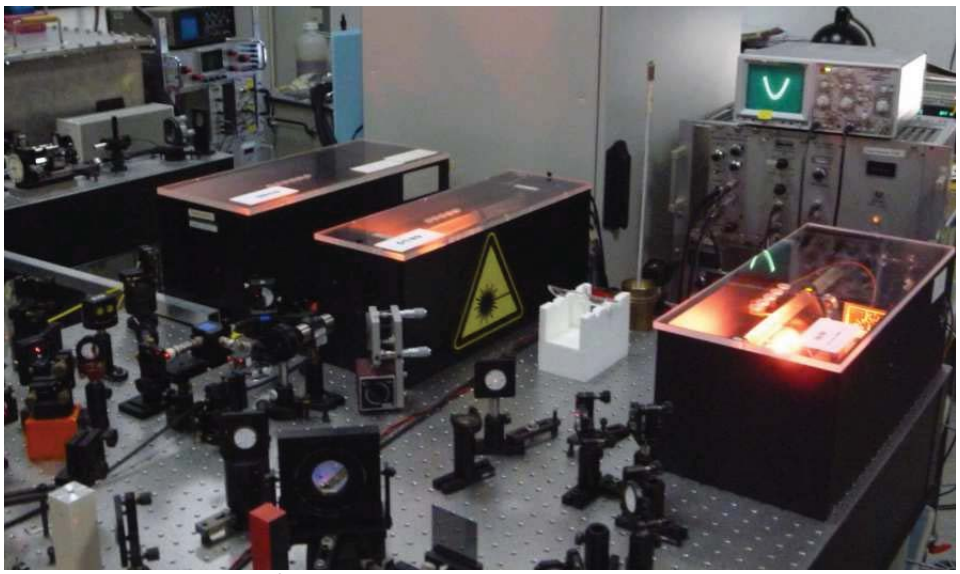

Fig. 2: PTB measuring station for laser wavelength calibration by three iodine stabilized Helium-Neon lasers.

The Helium-Neon laser tube LGR 7660 BF01 developed for the PTB now gives reliable service in the newly set up ultra-precision interferometers of PTB. The LASOS team succeeded in implementing the required optical and mechanical specifications in a product within short time.

PTB Braunschweig: "The design of that laser dates from the 1970's and its reliability and stability have been optimized to this date. The PTB lasers contain an iodine cell of 10 cm length and a special Helium-Neon tube with Brewster windows approximately 25 cm long. The laser cavity is 37 cm long; the zerodur rods maintain the distance between the mirrors (Fig. 3). Applying in-house specifications, LASOS manufactured Helium-Neon tubes suitable for that kind of laser which ensure that the lasers can operate with minimum uncertainty also in future. "

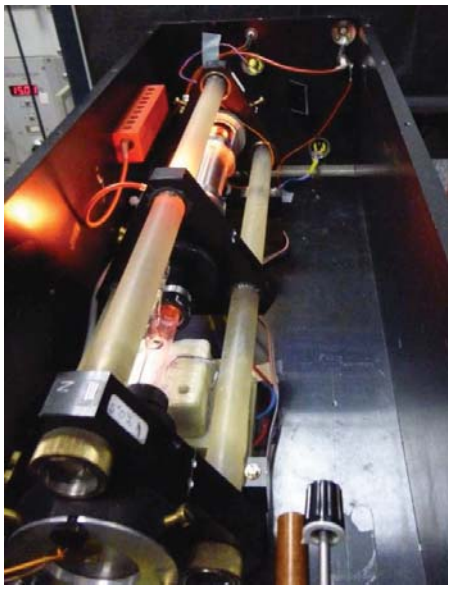

Fig. 3: Iodine stabilized lasers at PTB. The cavity mirror mounts are kept apart by three zerodur rods. The iodine cell is seen in the foreground, the LASOS laser tube at the rear.

The glossary contains more information on the above requirements on Helium-Neon lasers.

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Glossary of terms

Side lines

The strongest and most frequently used laser lines of the He-Ne laser are in the visible wavelength range at 543, 594 and 633 nm. In addition to these, there is a large number of weaker laser lines, e.g., at 609nm or 640nm. These so called side lines are a great disadvantage in the application of these lasers in spectroscopy and interferometry.

LASOS uses mirrors with optimized coating to suppress these subordinate lines. The amplification of the nuisance wavelengths is suppressed completely by a defined increase of their transmission. At the same time the reflectivity of the main lines is not affected so that the output of the He-Ne lasers is not impaired.

Polarization changes

In an Helium-Neon laser, resonant amplification of different frequencies (modes) occurs, depending on the length of the cavity. This means that several laser modes contribute simultaneously to the emitted light, the distance between these modes being $< 10^{-3}$ nm. Neighboring modes are polarized vertically to each other so that there are two different polarizations at a time in each non-polarized laser.

This is used for stabilizing the length of the cavity and thereby increasing the coherence length of the laser and therefore the measuring range. As a rule, short cavities which amplify 2 or 3 modes are used for that. The neighboring modes are separated by a beam splitter and a control signal obtained from the ratio of their outputs. As both polarization directions are equal, sudden changes of the polarization of the different modes are possible, which is particularly negative for the control. The polarization changes can occur spontaneously or are triggered by external factors, particularly the presence of a magnetic field.

A special manufacturing method LASOS applies ensures that these polarization changes are minimized. This enables LASOS to offer lasers without polarization changes, even in magnetic fields up to 3 Gauss.

Split frequencies

When a strong magnetic field (>0.1 T) is present, the different laser modes are split into two frequencies in close neighborhood with each other. The frequency difference is referred to as split frequency. Advantage is taken of this phenomenon for obtaining extremely high frequency stability of the laser and improving the measuring accuracy of interferometric measurements and in the semiconductor industry, respectively.
The split frequency is controlled by the combination of magnetic field strength and the quality of the cavity. LASOS has been successful in developing tubes with specific split frequencies for defined magnetic fields.