FORTHCOMING PAPERS

On the High-Voltage Regime of the Discharge in Hollow-Cathode-Tube

J. Mizeraczyk, M. Neiger (F. R. Germany)

A comparison of the operating characteristics of the high-voltage regime of the discharge in a hollow-cathode tube, the hollow-cathode discharge (HCD) and the discharge to a plane cathode are presented. The disappearance of the hollow-cathode effect and the transition to a high-voltage discharge after inserting several anode rods into the cathode cylinder is exhibited. The similarity between the operating characteristics of such a high-voltage discharge and of a plane cathode discharge is shown. The loss of ions at the anode rods, as well at insulators or floating conductors is believed to be the reason behind the increase of the operating voltage and the disappearance of HCD characteristics. Practical means of increasing the operating voltage are mentioned.

Prospects for Vapor-Phase Dye Lasers

Yu. Yu. Stoilov (USSR)

This review covers the field of vapor-phase dye lasers (VPDL) with special emphasis on prospects of gas lasers with optical pumping. Some peculiarities of the gaseous active medium and a possibility to control its density near the critical point are discussed. High specific laser energies (~ 0.3 J/cm^{-3}), low thresholds, and high efficiencies (20 — 40%) made it possible to construct a powerful tunable VPDL.

Investigation of Stimulated Brillouin Scattering Under Well-Defined Interaction Conditions. II. Experimental Results and Interpretations

B. Gellert, B. Kronast (F. R. Germany)

The spatial and temporal development of the SBS ion wave was investigated extensively by ruby-laser light scattering techniques using a picosecond streak-camera for recording. The measurements performed for various levels of peak backscattering provide the ion wave energy density as a function of space, time and backscatter level, i. e. peak power density of CO_2 laser radiation focussed into an underdense and homogeneous target plasma of large extent. In an attempt to understand the various experimental aspects, numerical solutions of respective theories were compared with observations. Whilst for backscatter levels below 5% the three-wave description of Forslund et al. [11] does suffice, it took an extensive review of nonlinear mechanisms to pin down harmonic production of the ion wave according to Karttunen and Salomaa [23] as the process govering SBS behaviour above 5% up to the Manley-Rowe limit. The corresponding system of four-wave equations is capable to explain reasonably well all the aspects observed; in particular, it shows, how it comes about that the dangerous Manley-Rowe limit is reached already at moderate power densities below 10^{13}W/cm^2 such as in [1]. From this description, it is also evident that — by contrast to many other aspects of laser fusion — this is an effect which becomes the more serious the *shorter* the laser wavelength is.

Infrared Multiphoton Dissociation of Unsubstituted Metal Carbonyls at 5μm

Mei-Kuen Au, P. A. Hackett, M. Humphries, P. John (Canada)

A frequency-doubled carbon dioxide laser of modest output energy (1 mJ) has been used to study, for the first time, the infrared multiphoton absorption by, and dissociation of, the unsubstituted carbonyls of vanadium, chromium, iron, nickel, molybdenum, and tungsten. The multiphoton absorption cross-sections measured for $Ni(CO)_4$, $Fe(CO)_5$, $Cr(CO)_6$, $Mo(CO)_6$, and $V(CO)_6$ are high ($\sigma \sim 2\times10^{-17}$) and ensure facile multiphoton dissociation. In focussed beams a pressure independent reaction yield proportional to the 1.5 power of the beam energy is observed for $Fe(CO)_5$, $Cr(CO)_6$, and $Mo(CO)_6$ implying threshold fluences of only 32, 25, and 26 mJ cm^{-2}, respectively. The stoichiometry of the reaction, observed by a pressure measurement technique, is consistent with production of metal atoms and carbon monoxide as final products for $Ni(CO)_4$, $Fe(CO)_5$, $Cr(CO)_6$, and $Mo(CO)_6$. This extensive decarbonylation along the ground state surface is consistent with recent studies of the photochemistry of these molecules from excited electronic states.

Continued on page A6

Applied Physics A 32, No. 4 (1983)

FORTHCOMING PAPERS (CONT'D)

Identification of the Origins of Photoionisation in CO_2 TEA Lasers

S. J. Scott, A. L. S. Smith (U. K.)

In sealed CO_2 spark preionised lasers the preionisation is largely due to photoionisation of NO and NO_2, in seeded TEA lasers it originates from the low ionsation potential additive used. Unseeded and flowing gas lasers can still be successfully preionised but the source of this preionisation has remained a mystery; previous attemps to isolate and identify low I. P. gaseous impurities have failed. We have now identified these, using a combination of cryogenic impurity concentration and mass spectroscopy and found them to be a complex mixture of hydrocarbons (C_2— C_7). Of these hydrocarbons, the alkenes are found to be predominantly responsible for the photoionisation and are present in concentrations of ~ 0.5 ppm. Deliberate addition of one of these alkenes, propene, to a uv preionised CO_2 TEA laser was found to enhance the lasers performance at high energy loadings.

CW and Pulsed FIR-CO_2 Hybrid Laser with Improved Efficiency and Amplitude Stability at Short FIR Wavelengths

Z. Šolajić, J. Heppner (F. R. Germany)

For the first time stable cw output of a FIR-CO_2 hybrid laser has been achieved at wavelengths shorter than 300 μm. Due to the saturable absorber characteristic of the FIR laser gas, cw or pulsed emission is observed on both, the CO_2 and the FIR laser output, depending on the operating conditions. Results are reported on different resonant lines in CH_3OH and the 67 μm Raman line in NH_3. The good efficiency of this laser is also demonstrated by the excitation of two new emission lines in CH_3OH, namely 49 and 56 μm, pumped by 9*R* (22) and 9*R* (24), respectively.

Locking the Laser Frequency to an Atomic Transition

W. Jitschin (F. R. Germany)

A simple method for stabilizing the laser frequency to an atomic transition is described. It makes use of the frequency shift caused by the Doppler effect. With this method the frequency of a dye laser be kept tuned to an atomic resonance line within 10% of the linewidth for periods of several hours.

Transverse Mode Dynamics in a Free-Electron Laser

P. Elleaume, D. A. G. Deacon (France)

We derive the most general equations of motion for the electrons and the electromagnetic field in a free-electron laser including the effects of diffraction and pulse propagation. The field evolution is expressed in terms of the amplitudes and phases of a complete set of transverse modes. The analytic solution is given in the small-signal regime, where the theory is shown to be in excellent agreement with a recent experiment at Orsay.

Effective and Simplified Hybrid TEA Laser Design and Operation

G. Scott, A. L. S. Smith (UK)

A compact hybrid TEA CO_2 laser has been developed which, when operated with the low pressure section well below oscillation threshold, demonstrates that little cw gain is necessary to ensure single longitudinal mode (SLM) output pulses with peak power, energy and pulse shape approaching those of normal multimode operation. This has allowed reliable. SLM operation to be obtained with a very short, wide bore rf-excited low-pressure section, making feasible simple single-mode, large-aperture TEA lasers with high peak powers and energies.

Self-Phase Locking in Lasers with Homogeneously Broadened Emission Lines

W. Brunner, R. Fischer, H. Paul (German Democratic Republic)

It is shown by numerical analysis based on Lamb's equations of motion, that standing wave lasers with purely homogeneously broadened emission lines exhibit regular multimode oscillations. Specifically, modes lying far from the line centre are quenched due to mode competition, and the amplitudes of the oscillating modes approach steady-state values. The stabilization of the amplitudes is normally accompanied, or followed, by an evolution of the phases towards a phase-locked regime, where the relative phases $\psi_n = 2\ \phi_n - \phi_{n+1} - \phi_{n-1}$. [$\phi_n$ phase in the n-th mode, defined by (6)] attain either the value 0 or $\pm\pi$. The build-up times for the relative phases are found to vary over a wide range.