Q 1: Laser development and applications I

Time: Monday 10:30–12:30 Location: DO26 207

Q 1.1 Mon 10:30 DO26 207

Continuous Wave turquois laser in Pr^{3+}:BaY_2F_8 — •Kore Hasse[1], Philip Werner Metz[1], Daniela Parisi[2], Nils-Owe Hansen[1], Christian Kränkel[1,3], Mauro Tonelli[2], and Günter Huber[1,3] — [1]Institut für Laser-Physik, Universität Hamburg — [2]NEST-Istituto Nanoscience-CNR and Dipartimento di Fisica, Università di Pisa — [3]The Hamburg Centre for Ultrafast Imaging, Universität Hamburg

Pr^{3+}-doped crystals are known for efficient lasing on several transitions from the green to the dark red spectral range. Here we report on the first crystalline continuous wave solid state Pr^{3+}-doped laser emitting in the blue, based on Pr^{3+}:BaY_2F_8. While the higher Stokes efficiency should improve the laser efficiency, the short upper state lifetime of the Pr^{3+}-ion below 50 μs makes it challenging to generate the high excitation densities needed for such a three-level laser. The main advantage of Pr^{3+}:BaY_2F_8 in this respect is the presence of a comparably intense emission line at 495 nm terminating into an energetically high lying Stark level of the $^3H_4$ ground state, which only requires inversion levels as low as 5 % to obtain gain.

Lasing was obtained under InGaN laser diode pumping at 445 nm and pumping with a frequency doubled optically pumped semiconductor laser at 479.6 nm. In the latter case 172 mW of output power at 495 nm with a slope efficiency of 24 % were achieved. Further improvement can be expected from a better resonator geometry, more suitable mirror coatings and an optimized length and doping concentration of the active material.

Q 1.2 Mon 10:45 DO26 207

Fabry-Pérot etalon walk-off loss in ring cavities — •Ulrich Eismann — Université Pierre et Marie Curie - Paris VI, 4 place Jussieu, 75252 Paris, France — Present address: LNE-SYRTE - Observatoire de Paris, CNRS, UPMC, 61 Avenue de l'Observatoire, 75014 Paris, France.

Single-frequency lasers have found widespread applications in science and technology. Many current designs require intracavity Fabry-Pérot etalons as frequency-selective elements.

I present both analytic and numeric calculations of the walk-off loss, inevitable when installing an etalon in a laser cavity. I treat the case of a single pass of a gaussian beam through the etalon, which corresponds to the practically important situation of a ring laser operating on its fundamental mode. I furthermore compare to former results obtained for a linear resonator geometry, and draw important conclusions considering single-frequency laser designs.

Q 1.3 Mon 11:00 DO26 207

CW Hochleistungsscheibenlaser mit guter Strahlqualität — •Daniel Kolbe und Jochen Speiser — Deutsches Zentrum für Luft- und Raumfahrt e.V., Stuttgart

Das Scheibenlaserkonzept erlaubt die Realisierung von Laserquellen mit hoher Leistung bei gleichzeitiger hoher Brillanz. Thermische Linseneffekte und bei hohen Pumpintensitäten auftretende Aberrationen werden durch die hocheffektive longitudinale Wärmeabfuhr minimiert. Jedoch bleibt die Leistungsskalierung auf über 1 kW bei Grundmodenbetrieb immer noch herausfordernd. Hier präsentieren wir einen Scheibenlaser im Kilowatt-Regime mit hoher Strahlqualität ($M^2 < 2.5$). Das gezielte Anpassen des Grundmodenradius an den Pumpfleck unterdrückt höhere transversale Resonatormoden und ermöglicht einen Betrieb nahe Grundmode. Modeninstabilitäten aufgrund von Phasenstörungen, die durch Luftturbulenzen bei hohen Pumpleistungen auftreten, werden durch Evakuierung des Resonators reduziert.

Q 1.4 Mon 11:15 DO26 207

Fiber Amplifier for trapping ultra-cold mercury - a non-cryogenic approach — •Holger John and Thomas Walther — Technische Universität Darmstadt, Institut für Angewandte Physik, Laser- und Quantenoptik, Schlossgartenstraße 7, 64289 Darmstadt

Laser-cooled mercury constitutes an interesting starting point for various experiments, in particular in light of the existence of bosonic and fermionic isotopes. On the one hand the fermionic isotopes could be used to develop a new time standard based on a optical lattice clock employing the $^1S_0$ - $^3P_0$ transition. Another interesting venue is the formation of ultra cold Hg-dimers employing photo-association and achieving vibrational cooling by employing a special scheme.

The requirements for trapping neutral mercury are given by the cooling transition at 253.7 nm with a linewidth of 1.27 MHz. In the past a twice frequency doubled Yb:disc laser has been used for trapping ^{202}Hg and ^{199}Hg. Due to the little gain at 1014.9 nm of Yb at room temperature stable long time operation of the thin disk laser is hardly possible.

By cooling a Yb-doped fiber to a temperature of 223 K first measurements have shown a slope-efficiency of more than 30 % and a beam and polariation stability of more than 95 % without any influence by the cooling system.

Our goal is to set up an efficient Yb doped fiber amplified ECDL for substituting the thin-disc laser. We will report on the status of the experiments.

Q 1.5 Mon 11:30 DO26 207

Wavelength Tuning of Praseodymium Lasers in Different Fluoride Hosts — •Philip Werner Metz[1], Sebastian Müller[1], Fabian Reichert[1], Daniel-Timo Marzahl[1], Christian Kränkel[1,2], and Günter Huber[1,2] — [1]Institut für Laser-Physik, Universität Hamburg — [2]The Hamburg Centre for Ultrafast Imaging, Universität Hamburg

Trivalent Praseodymium provides a variety of highly efficient distinct laser transitions in the visible spectral range. The coupling of these electronic transitions to the phonons of the surrounding host lattice is comparably strong, leading to a broad phonon assisted background for these transitions. This makes such systems interesting for wavelength tunable lasers, though the exact emission properties strongly depend on the host material. In this contribution we report on different Pr^{3+}-doped fluoride crystals and their suitability for laser wavelength tuning. The widest tuning range was achieved using Pr^{3+}:KY_3F_{10} as the active material. Under quasi continuous wave excitation with an InGaN laser diode at 445 nm we were able to adress a total wavelength tuning range of 100 nm in different intervals between 520 nm and 740 nm. The largest continuous tuning range of almost 50 nm was obtained in the red spectral range around 710 nm.

Q 1.6 Mon 11:45 DO26 207

A multi-Watt-level, all-solid-state laser source for laser cooling of lithium — •Norman Kretzschmar[1], Franz Sievers[1], Ulrich Eismann[2], Frédéric Chevy[1], and Christophe Salomon[1] — [1]Laboratoire Kastler Brossel, CNRS UMR 8552, UPMC, Ecole Normale Supérieure, 24 rue Lhomond, 75231 Paris, France — [2]LNE-SYRTE, Observatoire de Paris, CNRS, UPMC, 61 avenue de l'Observatoire, 75014 Paris, France

Realizing degenerate quantum gases of lithium involves different laser cooling schemes which typically require near-resonant single-frequency light in the watt-level range. In this contribution we report on the development and optimization of an all-solid-state laser source emitting 3.2 W of narrowband 671 nm light in a near-diffraction-limited beam.

Our design is based on a diode-end-pumped Nd:YVO_4 ring laser operating at 1342 nm. We discuss the further mitigation of detrimental thermal lensing effects in the Nd:YVO_4 crystal which is the main prerequisite for power scaling of Nd-lasers at this wavelength.

The infrared light is subsequently frequency doubled to 671 nm: In this context we compare the high-power performances of an enhancement cavity using periodically poled Potassium Titanyl Phosphate (ppKTP) to a periodically poled $LiNbO_3$ (PPLN) waveguide module allowing a technologically simplified single pass wavelength conversion process.

We demonstrate the suitability of this spectrally narrow light source for cold atom experiments with lithium by employing it for D_1-sub-Doppler laser cooling of ^{6}Li atoms.

Q 1.7 Mon 12:00 DO26 207

Skalierung der Pulsenergie mit einem modularen Vierkristall-Yb:CALGO-Oszillator — •Moritz Emons[1], Jana Kampmann[1], Bernhard Kreipe[1] und Uwe Morgner[1,2] — [1]Institut für Quantenoptik, Leibniz Universität Hannover, Welfengarten 1, 30167 Hannover — [2]Laser Zentrum Hannover, Hollerithallee 8, 30419 Hannover

Wir präsentieren die Umsetzung eines neuartigen Oszillatorkonzepts zur Leistungsskalierung von Ultrakurzpulslasern. Das Konzepte basiert auf einem kompakten, direkt diodengepumpten Lasersystem auf der Basis von Yb:CALGO. Das Hintereinanderschalten mehrerer Module in "zero-q"-Konfiguration ermöglicht die einfache Skalierung, wodurch eine Reduzierung von thermischen Effekten sowie die Erhöhung des Umlaufkleinsignalgewinns ermöglicht werden. In Kombination mit Cavity-Dumping lässt sich eine besonders hohe Auskopplung bei einer Wiederholrate im 1-MHz-Bereich realisieren. Das System wird durch einen SESAM modengekoppelt und im positiven Dispersionsbereich betrieben, um Nichtlinearitäten zu reduzieren.

Q 1.8 Mon 12:15 DO26 207

GaSb-based SESAM mode-locked Tm:YAG ceramic laser — •Alexander Gluth[1], Valentin Petrov[1], Uwe Griebner[1], Günter Steinmeyer[1], Jonna Paajaste[2], and Mircea Guina[2] — [1]Max Born Institute for Nonlinear Optics and Short Pulse Spectroscopy Berlin — [2]ORC, Tampere University of Technology

There is a growing interest in developing ultrafast laser sources with direct emission at mid-infrared wavelengths. In particular, in the 2 um wavelength range where ultrashort pulse generation was already demonstrated using Tm- and Ho-doped gain media. However, so far only active mode-locking has been demonstrated based on the most approved solid-state laser host material: YAG. Acousto-optic modulation produced 35 ps long pulses at 2.01 um [1]. Ceramics were intensively studied leading to a high quality with higher rare earth doping levels with respect to single crystals. Here, we demonstrate passively mode-locked Tm:YAG ceramic lasers using near-surface GaInSb quantum-well SESAMs. This kind of SESAM allows fast carrier relaxation without introducing additional losses. The interband relaxation time was measured to be less than 2 ps. Passive mode-locking was achieved for 4at%- and 10at%-Tm-doped YAG ceramics in a standard X-cavity. Shortest pulses of 3 ps with a maximum average output power of 145 mW at 2012 nm center wavelength were measured. The RF spectrum at the 89 MHz fundamental beat note showed no spurious modulations and a noise floor that was 67 dB below the signal.

[1] J. F. Pinto, L. Esterowitz, and G. H. Rosenblatt, Opt. Lett. 17, 731 (1992).