Laser concept of the mobile ATMONSYS-lidar and its application during CHEESEHEAD

Hannes Vogelmann, Johannes Speidel, and Matthias Perfahl

Discussion and further details via email <vogelmann@kit.edu>
Principle concept of the Laser design

- Transversely pumping allows for higher pumping power

- Orientation of crystal c-axis parallel to polarization of pump and IR

- Rod in rectangular cut (not Brewster)

- Rod can be much longer than in a longitudinal pumping setup

*Fluorescence inside a cylindrical rod pumped from one (left) or two sides*
The Ti:Sapphire rod is floated with water inside a pump chamber with two side windows (AR coated for 532nm).

The water is circulated through a small cooling device (100 W Colling power).
Transversely pumped Ti:Sapphire in its operating setup
Resonator design

Setup similar to Metzendorf et al., ILRC 2017, Bucharest
Electronic concept of seeding and resonator control

General concept:

- Resonator is tuned to the on wavelength from the seed laser
- The off wavelength is tuned to fit into the resonator

Technical implementation:

- The tuning mirror of the resonator is driven with a 200 Hz sine (Laser runs with 100 Hz).

- Via a sample and hold circuit fed into a PID control, an offset is added to the sine until resonance of the on wavelength is reached and kept stable.

- A second sample and hold circuit detects the resonance of the off wavelength. Via a second PID control this wavelength is electronically tuned (resonator length of seeding laser) and also kept stable with respect to the main resonator tuning for the on wavelength.
Electronic concept of seeding and resonator control
Timing and logical cycle of seeding an resonance

Details and explanation in personal discussion via email.
Achieved specifications

Pumping:  - 100Hz
          - 27W @ 532 nm

Output:   - 2.9 W @ 817 nm (approx. 2 W in stable operation)
          - Beam divergence < 2 mrad
          - Beam diameter 4mm
          - Spectral purity > 99%
            (estimated from absorption in humid air)
          - Pulse length about 50ns

Drawbacks in current the setup during the CHEESEHEAD campaign:

- very sensitive to temperature changes caused by the hysteresis
  of the air condition.
- very sensitive to vibrations from mechanical devices
  as cooling aggregates, ventilation.
Further Steps

- Better stabilization of the temperature of the laser setup.

- Mechanical decoupling from vibrations of cooling devices and other sources of noise.

- Characterizing the laser in more detail (e.g. precisely measuring $M^2$)
Thank you for attention!

Acknowledgments:

Bundesministerium für Wirtschaft within the ZIM Program for funding the development of the transversely pumped Ti:Sapphire laser used in this project.

Radiant Dyes Lasers & Accessories GmbH for developing the control electronics of the master oscillator and the motorized wavelength control of the seed lasers.

University of Hohenheim (V. Wulfmeyer, A. Behrendt, S. Metzendorf and F. Späth) for their technical support and sharing experiences from a development of a laser for the same purpose.