LABORATORY FOR LIGHTWAVE METROLOGY

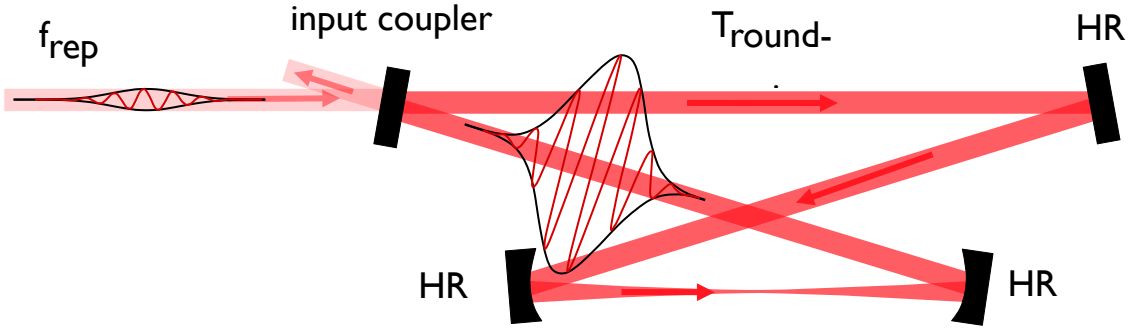
RPTU Rheinland-Pfälzische Technische Universität Kaiserslautern Landau

BSc/MSc Thesis at the Laboratory of Lightwave Metrology, Prof. Ioachim Pupeza

Femtosecond Laser Enhancement Cavities

Passive laser enhancement cavities allow light to be coherently accumulated over many round trips, producing an intracavity power substantially higher than the incident laser power. Of particular interest are high-power femtosecond enhancement cavities, which combine high repetition rates with intense ultrashort laser pulses. Such cavities provide promising platforms for high-field applications, including high-harmonic generation and the generation of high-energy photons. They may also contribute to the development of advanced laser technologies for fusion research, where the required conditions are conventionally achieved using large-scale, petawatt-class laser infrastructure. Achieving strong and stable enhancement requires careful cavity design, accurate spatial and temporal mode matching, low optical losses, and precise control of the resonance between the laser and the cavity.

Within this project, the student can contribute to the design, simulation, construction, and characterization of a laser enhancement cavity. Possible activities include modelling Gaussian-beam propagation and cavity stability, selecting and optimizing the cavity geometry, aligning the optical setup, and improving the coupling of the laser into the fundamental cavity mode. The student may also characterize the cavity by measuring its finesse, linewidth, free spectral range, coupling efficiency, and power-enhancement factor. Further work can include the development of a cavity-locking scheme, characterization of frequency and intensity noise, optimization of the feedback system, automation of cavity locking and data acquisition, or investigation of effects limiting operation at high intracavity power. The project can be carried out as either a BSc or an MSc thesis, with the scope and depth adjusted accordingly.



H. Carstens et al., "Megawatt-scale average-power ultrashort pulses in an enhancement cavity," Opt. Lett. 39, 2595-2598 (2014).

Contact: Martin Micica, martin.micica@rptu.de, lightwave.de