

Advances in ultrashort pulse lasers: systems and technologies

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Overview of our group

Prof. Ursula Keller group
ETH Zurich

Ultrafast lasers sub-group (this talk)

- ~10 PhD students
- 4 Postdocs
- 1 Technician
- 1 Senior research scientist

Attosecond science sub-group



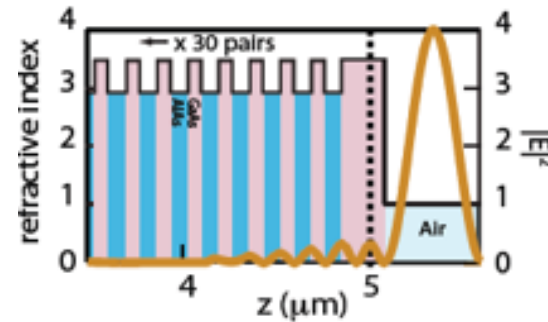
- Frontiers in ultrafast lasers
 - Wavelength, power, repetition rate, low noise
- High intensity lasers
 - Pump-probe measurements
- Compact lasers
 - Sensing and metrology



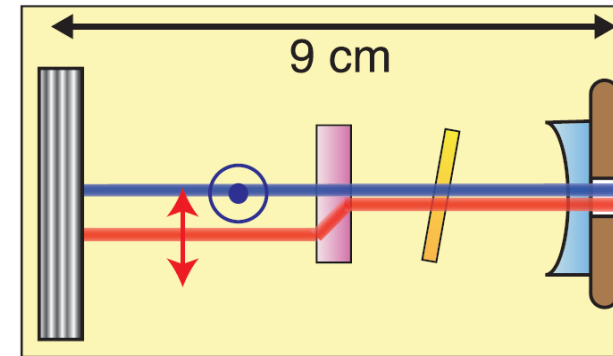
Semiconductor devices

Saturable absorbers
Laser gain

→ Mode-locked laser development



Advanced laser cavities

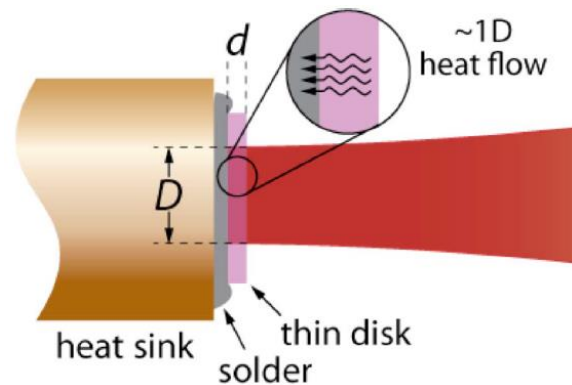


Gigahertz
frequency
comb
generation

S. M. Link et al, Science 356, 1164 (2017)

A. S. Mayer, et al, Nat. Commun. 8, 1673 (2017)

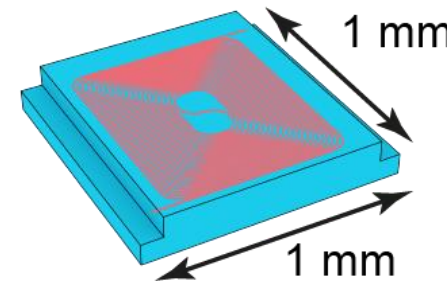
Lasers at high average power



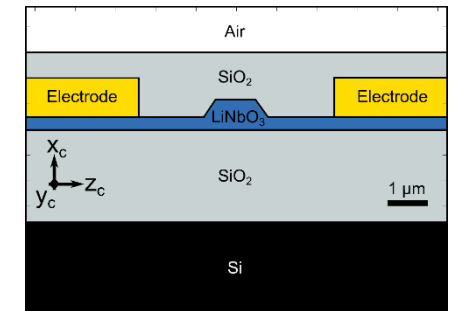
Up to 430 W
average power

F. Saltarelli, et al, Opt. Express. 27, 31465 (2019)

Nanophotonics devices



Silicon nitride



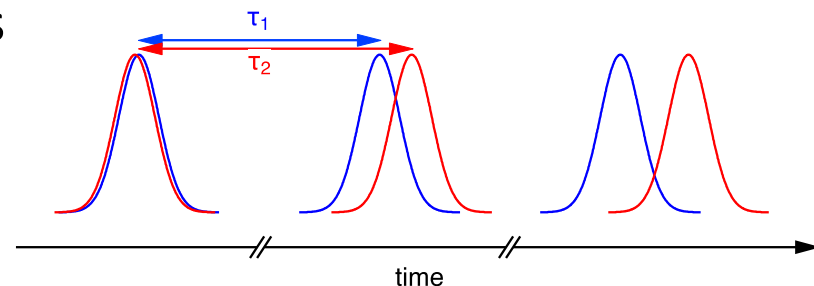
Lithium niobate

Highly flexible laser systems

- Wavelength (NIR, mid-IR, also some UV)
- Femtosecond pulses
- High repetition rates
- High powers

Delay-swept comb lasers

Spectroscopy, $>10^3$ times faster than FTIR
 No moving parts

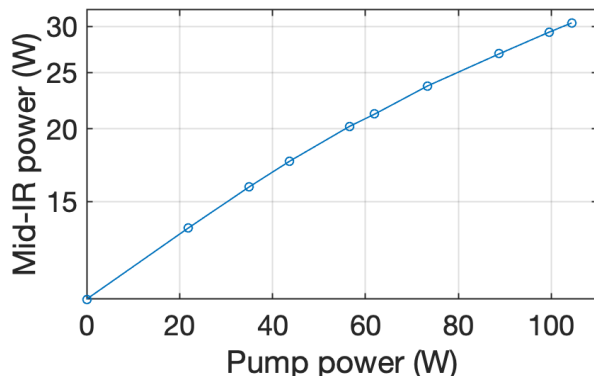


work: demonstrated in fs solid-state laser
 B. Willenberg, et al, submitted to CLEO

Looking for applications,
 requirements, collaborations!

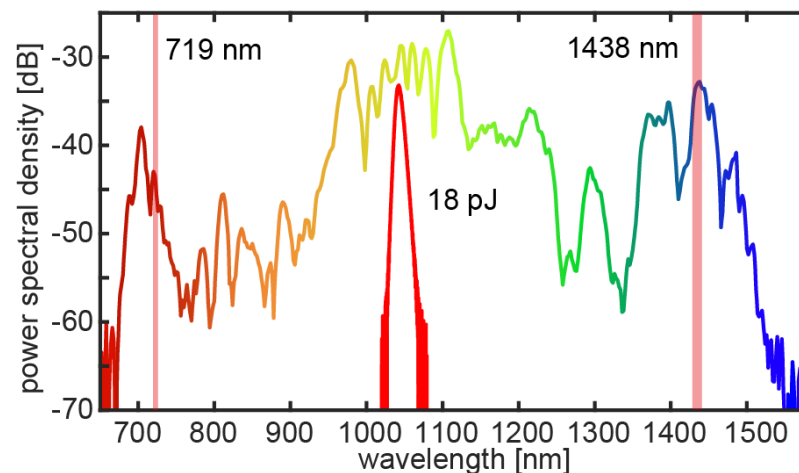
Mid-infrared systems

- Up to 30 W average power mid-IR
 - Can access absorption peak
- Medical applications?



J. Pupeikis et al,
 arXiv:1910.03236 (2019)

Broadband sources, supercontinuum



Picojoule
 pulse
 energies

L. M. Krüger et al,
 submitted to CLEO



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