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CFEL-bldg. 99, seminar room IV (O1.111)

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Graphene saturable absorbers for femtosecond pulse generation with ultrabroad bandwidths

I will report on:

1) mode locking experiments with Cr:LiSAF laser using graphene as a saturable absorber and 2) pulse generation experiments with 2.3 μ m Tm:YLF laser using passive Q-switching and Kerr-lens mode locking techniques.

In the first part, a monolayer graphene was used as a saturable absorber to generate femtosecond pulses from a diode-pumped and compact Cr:LiSAF laser. At a pump power of 270 mW, the laser produced nearly transform-limited 68 fs pulses with an average power of 11.5 mW at 850 nm. The repetition rate was around 132 MHz, corresponding to a pulse energy and peak power of 86 pJ and 1.26 kW, respectively. Once mode locking was initiated with the graphene saturable absorber, stable, uninterrupted femtosecond pulse generation could be sustained for hours. We then carefully optimize the group delay dispersion in the Cr:LiSAF resonator to shorten the pulse width. We generated 19-fs pulses with a low-threshold, diode-pumped graphene mode-locked Cr:LiSAF laser near 850 nm. To the best of our knowledge, these represent the shortest pulses generated to date with a graphene mode-locked laser.

In the second part, we first used a Cr:ZnSe medium as a saturable absorber to obtain pulsed operation from a Tm:YLF laser operating near 2.3 μ m. The Tm:YLF laser was end-pumped with a continuous-wave Ti:sapphire laser at 780 nm. At all pump power levels above lasing threshold, passively Q-switched operation of the Tm:YLF laser could be obtained at 2309 nm with pulse durations and repetition frequencies in the ranges of 1.2–1.4 μ s and 0.3–2.1 kHz, respectively. This represents direct pulse generation from a Tm:YLF laser operating near 2.3 μ m for the first time. We then used Tm:YLF laser to generate femtosecond-long pulses using the technique of Kerr-lens mode locking. We introduced an undoped ZnSe substrate to provide enhanced nonlinear phase modulation during KLM operation. With 880 mW of pump power, we generated 514-fs pulses at a pulse repetition rate of 41.5 MHz with an average power of 14.4 mW.