6. Summary

Using four different commercially available single- and multi-longitudinal-mode pump lasers, we have stabilized the carrier-envelope frequency f_0 of a Ti:sapphire femtosecond oscillator by means of the f-to-$2f$ self-referencing technique. The residual phase noise of the stabilized femtosecond laser was measured with a second identical f-to-$2f$ interferometer outside the feedback loop. In order to analyze the influence of intensity fluctuations of the pump lasers on the stabilization, we also characterized the relative intensity noise of the pump lasers.

We found all pump lasers under test to be suitable for carrier-envelope frequency stabilization, irrespective of their single- or multi-mode operation. The best performance of the oscillator obtained with each pump laser corresponded to an integrated rms residual phase jitter of below 160 mrad, which is less than 1/40 of an optical cycle and amounts to an rms timing jitter of less than 70 as. We observed different repeatabilities in phase noise performance of the oscillator for different pump lasers, yet far from hampering stabilization.

The relative intensity noise of the pump lasers was measured and compared to the residual phase noise of the oscillator when pumped by the respective pump laser. While certain noise features of the pump sources can be seen to directly translate into phase noise of the oscillator, pumping the oscillator with the quietest source did not yield the lowest overall residual phase noise. None of the tested lasers showed intensity fluctuations strong enough to prevent stabilization of f_0.