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Towards high spatial resolution temperature sensing in an optical fiber amplifier

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Today, extremely powerful lasers are required in more and more areas of science and industry. The youngest and fastest growing class amongst high power lasers are fiber lasers. Since 2011, the exponential rise in output power has slowed down [1] by reaching the threshold for transverse mode instabilities (TMI) [2], which until today is a fundamental limit for the maximal achievable output power of fiber lasers. Researchers have developed extensive theory about the origin of these mode instabilities and were able to shift the instability threshold towards higher powers [1]. However, to our knowledge, a direct experimental proof of TMI originating from thermal gratings forming inside the amplifiers has not been achieved yet. A promising method to achieve the necessary millimeter resolution on a timescale of milliseconds [3] is Brillouin Optical Correlation Domain Analysis (BOCDA) [4]: By properly modulating the frequency of counterpropagating pump and signal beams, the effective Brillouin gain region in an optical fiber can be narrowed down to few millimeters. Since the frequency of Brillouin amplification is highly temperature dependent, the temperature profile can be inferred by shifting the gain region through the fiber. We will present this method in detail together with first temperature measurements performed in single mode fibers.

References

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