OSE Dissertation Defense by Mr. Mostafa Peysokhan on Optimization and characterization of the doped optical fibers for radiation balanced fiber laser and amplifier

Date: Wednesday, January 20, 2020
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Committee members:
Dr. Arash Mafi, Physics and Astronomy (Committee Chair)
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Abstract: Due to the reliability, compactness, low maintenance costs, superior performance, and versatility of fiber lasers and amplifiers, they are commonly employed in scientific and directed energy applications. Among all kinds of fiber lasers and amplifiers, high-power, Yb-dopped fiber lasers, and amplifiers have been extensively researched to achieve higher output powers. One of the major hindrances to achieving higher powers with adequate stability and efficiency in high power performance is heat generated in the fiber lasers and amplifiers' core.

The Radiation Balanced Laser (RBL) is a viable technique for heat mitigation has been proposed by S. Bowman in 1995. RBL technique is based on solid-state laser cooling as a self-cooling mechanism to mitigate the generated heat in lasers and amplifiers. Here in this study, we will investigate three critical issues for building a radiation-balanced fiber laser or amplifier: (i) the accountability of ZBLAN glass as a platform for executing the idea of RBL, (ii) the possibility of laser cooling of silica, which is a necessary condition for RBL, and (iii) investigation of an analytical solution for radiation balanced fiber laser.

A necessary condition for a radiation-balanced laser or amplifier is that the gain medium should be amenable to laser cooling. We introduce a new technique for extracting laser cooling related parameters of doped optical fibers. Furthermore, we implement our technique to characterize Yb-doped ZBLAN fiber, and also we investigate the feasibility of radiation balancing in Yb-doped ZBLAN fibers. We also characterized Yb-doped silica, which is the most common fiber leaser material. In this study, we accomplished, to the best of our knowledge, the lowest achieved laser-cooled temperature in silica glass, which is more than 6 K temperature drop. In this research, we introduce an analytical solution for a radiation balanced fiber laser.