Lab project M2 PPN

Monday & Tuesday from Oct 2025 to March 2026

Title of the project: Applications of intermodal modulational instability in a normally dispersive graded-index few-mode fiber

Supervisor(s): Guy Millot and Bertrand Kibler
Laboratory / Department / Team: ICB/Photonics/SAFIR
Collaborations: Karol Tarnowski, Wrocław Univ. Science and Technology, Poland

Summary:

Intermodal modulational instability (IM-MI) is a nonlinear process that occurs in multimode optical fibers, where Kerr-induced interactions between different spatial modes lead to the exponential growth of perturbations, resulting in the generation of new spectral components and complex spatiotemporal dynamics. Unlike classical scalar modulational instability, which is limited to single-mode fibers and typically requires anomalous dispersion, IM-MI can occur even in the normal dispersion regime due to intermodal coupling.

In this work, we propose to investigate IM-MI in a few-mode graded-index fiber pumped by picosecond laser sources at 532 nm and 1064 nm. By combining experimental characterization with theoretical modeling, this study aims to provide a deep understanding of the underlying mechanisms and dynamic behaviors of intermodal instabilities. Such a comprehensive investigation will also enable exploration of potential applications, including the generation of optical domain walls and the development of novel techniques for measuring the power distribution among different fiber modes.

Type of project (theory / experiment): Experiment and theory

Required skills: Multimode optical fibers, dispersive effects, four-wave mixing