# SEMINAR: An Eigenmode Expansion Framework for Bi-Directional Multimode Nonlinear Mixing Processes

SALVADOR POVEDA HOSPITAL

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10:30 to 11:30

Seminar Room

The design of photonic devices increasingly relies on accurate numerical simulations to simulate light propagation and optimize device performance. Among the available techniques, the Eigenmode Expansion (EME) method has become a powerful tool for modeling complex optical structures due to its computational efficiency and its ability to describe mode coupling in arbitrary waveguide geometries. However, most existing EME implementations are restricted to linear optical phenomena, limiting their application to many emerging technologies based on nonlinear optics.

In this talk, I will present an extension of the Eigenmode Expansion framework that incorporates nonlinear frequency-mixing processes. The proposed approach describes second-order processes, including difference-frequency generation (DFG), sum-frequency generation (SFG), and spontaneous parametric down-conversion (SPDC), as well as third-order processes such as four-wave mixing (FWM) and spontaneous four-wave mixing (SFWM). The formulation naturally supports multimode propagation, bidirectional fields, and arbitrary photonic structures by combining nonlinear propagation matrices with conventional linear scattering matrices.

**Hosted by:** Prof. Dr. Valerio Pruneri