The **French-German Research Institute of Saint-Louis (ISL)** situated in the border triangle of Germany, France and Switzerland is an internationally renowned research institute belonging to a global industrial and economic network.
The spectrum of our core activities comprises a variety of topics: aerodynamics, energetic and advanced materials, lasers and electromagnetic technologies, protection, security and situational awareness. Our activities are related to both basic and applied research.

ISL is offering a **PhD Position**

Research field: Directed Photonics and Applications

Numerical and experimental study of 2 µm light propagation in a high power continuous wave monolithic Tm, Ho or Tm-Ho doped fiber laser source

Context

Fiber lasers emitting at wavelengths around 2 µm in continuous wave (CW) regime are promising sources of laser radiation for both civil (surgery, spectroscopy) and military applications as eye-safe lidar systems, laser weapons or optical countermeasures. For several years, ISL has been working particularly on the development of infrared laser sources dedicated to optical countermeasures, which the aim is to protect an airborne or ground platform against a missile attack. An innovative solution is to jam, dazzle or damage infrared seekers of guided weapons thanks to a Direct Infrared Counter-Measures (DIRCM) system using an infrared laser source.

Optimizing the size, weight and power of DIRCM lasers to meet military requirements is a major concern. The need of a compact and robust laser source leads us towards all-fiber solutions. In 2018, ISL started a new 2-µm monolithic fiber laser development activity. We demonstrated recently that CW Tm^{3+},Ho^{3+}-codoped fiber lasers are a promising solution for countermeasures by delivering a high output power (almost 200 W) with a very good beam quality ($M^2 < 1.1$). [*C. Louot et al. in Laser Congress 2020 (ASSL, LAC), paper JTh2A.11*].

A complete understanding of the physical phenomena in the fiber laser is essential to go towards higher power laser sources with a good beam quality. This work will be carried out in collaboration with ICube institute, a joint research unit including CNRS and University of Strasbourg.

Goals and program

The goal of this thesis is to study and simulate the high power propagation in rare-earth ions (Tm^{3+}, Ho^{3+} or Tm^{3+}-Ho^{3+}) doped optical fibers used in 2-µm laser sources developed at ISL, in order to develop a system with a higher efficiency while maintaining a good beam quality. To achieve this objective, the work of the thesis will be organized on two main axes, one theoretical and one experimental:

- The development of numerical tools to model the laser propagation in active fibers. High power effects occurring with the power scaling of the fiber laser (photo-darkening, nonlinear effects, thermal effects) will also be investigated.
- The development of a high power, Tm^{3+}-doped or Tm^{3+},Ho^{3+}-codoped, fiber laser source emitting at 2 µm in CW regime, and pumped by several 793-nm diodes. The aim of this fiber laser source is to increase the 2 µm power from an all-fiber source in which all components are fibered and fusion-spliced to each other, with a high efficiency and a very good beam quality.

Candidate profile and embedding

The PhD candidate shall be able to work independently as well as in a multidisciplinary environment collaborating with scientists, engineers, and other PhD students working in the field of photonics and lasers. Desired qualities and knowledge:

- Motivated, diligent and committed in realizing her/his duties;
- Knowledge on physics, optics and lasers and experimental capability (mainly in optical fibers);
- Knowledge in FDTD (Finite-Difference Time-Domain) modeling, in particular with COMSOL Multiphysics and/or LUMERICAL;
- Good English level, basic knowledge of the French and/or German language is not essential, but would be considered as an asset.

Localization

The PhD will be carried out at ISL. Some periods at ICube institute (in Cronenbourg, Alsace) are to be planned. The University of Strasbourg will deliver the PhD degree at the end of the thesis

French-German Research Institute of Saint-Louis (ISL)

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