On-chip PHotonics Erbium-doped Laser for LIdar Applications

PROJECT PRESENTATION

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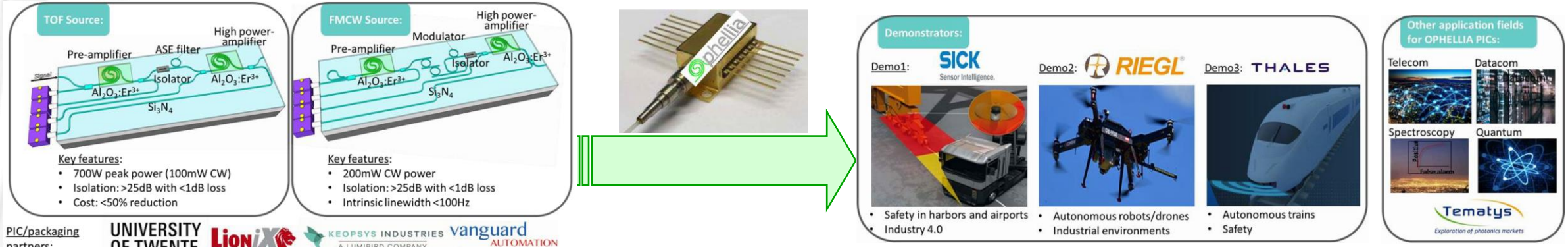
OBJECTIVES - On-chip PHotonics Erbium-doped Laser for LIdar Applications

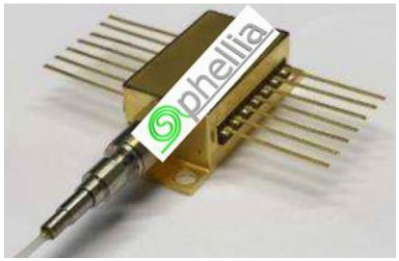
The objective of OPHELLIA is to develop novel materials and integration technology for the realization of innovative PIC[(a)] building blocks to develop PIC-based laser sources for emerging TOF[(b)] and FMCW[(c)] LiDAR[(d)] applications.

These LIDAR will be low cost and low size thanks to the high chip integration and tolerant packaging technology while, at the same time, exhibit the same or even higher performance than existing solutions.



[(a)]PIC: Photonic integrated circuit [(b)]TOF: Time of flight [(c)]FMCW: Frequency-modulated continuous-wave [(d)]LiDAR: Light detection and ranging

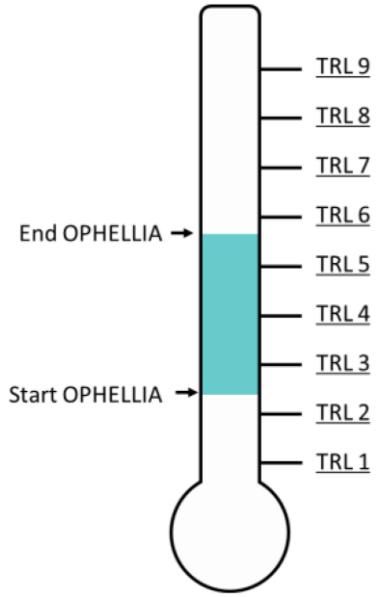
1. To develop advanced functional materials with enhanced performance
   - Both high gain per unit length erbium doped Al_2O_3 (for on-chip amplification), as well as materials with high magneto-optical response



2. To develop several key PIC building blocks that are not yet available, and that are critical for the realization of PIC based sources for LiDAR applications

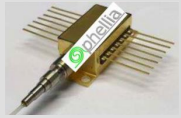
3. To develop automated-compatible assembly and packaging technologies allowing high chip density and high coupling efficiency

4. To design, fabricate and characterize
   - a high peak power pulsed source for eye safe chip-scale TOF LiDAR
   - a high-output power phase modulated ultra-narrow linewidth source suitable for highly advanced FMCW LiDAR

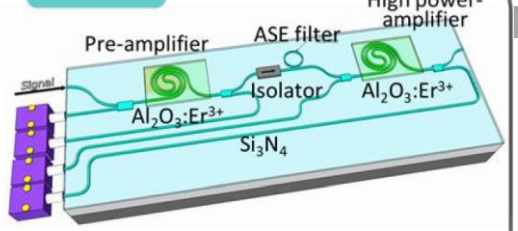


5. To validate the developed technology in three demonstrators for three different emerging LiDAR applications
   - TOF LiDAR system to be mounted on ground robots or small drones to monitor industrial or archeological environments (RIEGL)
   - TOF LiDAR system for safety in harbors and airports (SICK)
   - FMCW LiDAR system for autonomous trains (Thales)

EXPLOITATION AND DEMONSTRATIONS

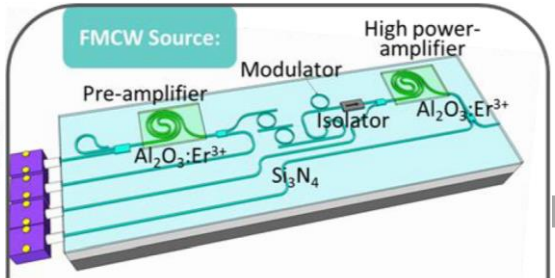


TOF Source:



Key features:
- 700W peak power (100mW CW)
- Isolation: >25dB with <1dB loss
- Cost: <50% reduction

FMCW Source:



Key features:
- 200mW CW power
- Isolation: >25dB with <1dB loss
- Intrinsic linewidth <100Hz

New material, PIC blocks, packaging…

Demo1: SICK Sensor Intelligence.

Safety in harbour and airport / Industry 4.0

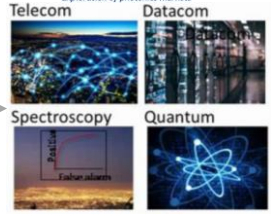
Demo2: RIEGL

Autonomous robots/Drones
Industrial applications

Demo3: THALES

Autonomous train / Traffic safety

Tematys
Exploration of photonics markets



Exploitation of the results in other potential applications

ABSTRACT

On-chip PHotonics Erbium-doped Laser for LIdar Applications

Miniaturized, yet highly sensitive and fast LiDAR systems serve market demands for their use on platforms ranging from robots, drones, and autonomous vehicles (cars, trains, boats, etc.) that are mostly used in complex environments. The widespread use of high performance LiDAR tools faces a need for cost and size reduction. A key component of a LiDAR system is the light source.
Very few laser light sources exist that provide sufficient performance to achieve the required distance range, distance resolution and velocity accuracy of the emerging applications identified in LiDAR roadmaps. The available sources, namely single mode or multimode laser diodes and fiber lasers, are either very costly, not sufficiently robust or not compact enough.
In OPHELLIA, we will investigate advanced materials and integration technologies directed to produce novel PIC building blocks, namely high gain, high output power (booster) amplifiers and on-chip isolators that are not yet available in a PIC format with the required performance.

The novel building blocks will be monolithically integrated onto the Si3N4 generic photonic platform to produce high performance laser sources with unprecedented high coherence and high power, which will have a profound impact on the performance of the systems. Advanced packaging will further contribute to a dramatic reduction of the overall cost.

To achieve this ambitious goal, OPHELLIA will leverage the expertise of its consortium members, ranging from materials, integration technologies and PIC design to packaging and LiDAR systems integration, which covers the full chain from innovation to the deployment of the technology in a relevant environment. The successful realization of OPHELLIA will not only represent a milestone towards the widespread utilization of LiDAR systems, but the developed building blocks will also have an enormous impact in other emerging application fields such as datacom/telecom, sensing/spectroscopy and quantum technology.