

WHO

SYSCOM: NAVSEA

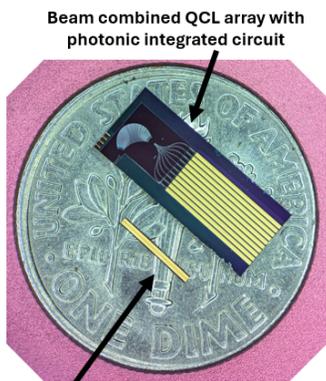
Sponsoring Program: PEO IWS, NRL, ONR, OPNAV N2/N6 and N96

Transition Target: Multiple Navy and DoD Programs

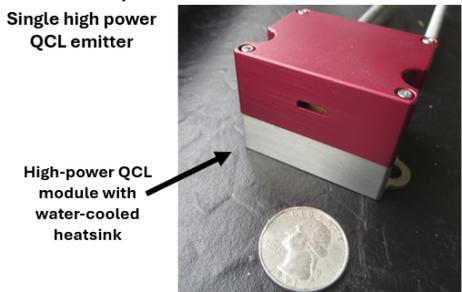
TPOC: (202) 404-7675

Other Transition Opportunities: Military, law enforcement, and civilian applications for infrared lasers, especially coupled to imaging systems, include: infrared countermeasures, target illumination, situational awareness (infrared scene illumination), industrial process control, remote sensing, obstacle avoidance, and selective etching, cutting, and marking of materials.

Notes: (Top) Picture showing two different types of infrared quantum cascade laser (QCL) chips developed at Pendar and placed on a US dime for size-comparison: (1) single high power QCL emitter developed for the present SBIR Program (2) Array of QCL emitters with an integrated photonic circuit (PIC) enabling beam combining in an extremely small footprint (NAVY STTR N19A-T005 in collaboration with Prof. Hu, MIT). (Bottom) Image of a packaged high power QCL source with its water-cooled heatsink.



Beam combined QCL array with photonic integrated circuit



Single high power QCL emitter

High-power QCL module with water-cooled heatsink

WHAT

Operational Need and Improvement: Laser systems have a wealth of military applications that include target designators, illuminators, secure communications and countermeasures. A great deal of effort has been invested in developing semiconductor laser across wide parts of the electro-magnetic spectrum but the critically important long-wave infrared (LWIR) band has received less attention.

LWIR laser sources with higher efficiency and power than current commercial offerings are needed to counter emerging threats in electronic warfare systems. Maintaining a low size, weight, and power (SWaP) envelope while improving affordability are also paramount concerns.

Specifications Required: Competing LWIR laser technologies include gas lasers and optical parameter oscillators (OPO) that cannot easily be tuned to emit over most of the spectral range of interest or are inefficient or have a large footprint and poor atmospheric transmission. Quantum Cascade Laser (QCL) technology is the most promising approach to achieve low-cost, high power in a system with appropriate SWaP for many military applications. However, current LWIR QCLs are low power and too expensive. Pendar Technology is addressing this capability gap by developing LWIR QCLs that have higher brightness and significantly better atmospheric transmission than current commercial offerings. This enables the efficient delivery of higher optical power on target. The implementation of innovative new concepts to improve device reliability and manufacturing yield paves the way to significant cost reduction.

Technology Developed: Pendar is developing an affordable, multi-Watts, highly efficient QCL technology for operation in the LWIR spectral band. Our laser design has in particular features to force the QCLs to emit light only at wavelengths with high atmospheric transmission, enabling efficient power delivery on target over long propagation distances. Unique fabrication processes including a novel treatment of the laser output facet to improve coating reliability are being implemented to increase production yield and reduce overall manufacturing costs.

Warfighter Value: Considerable capability improvement in the LWIR spectral band for applications that require EO/IR Sensors and lasers to counter emerging threats in electronic warfare systems.

WHEN

Contract Number: N68335-22-C-0009

Ending on: Nov 10, 2023

Milestone	Risk Level	Measure of Success	Ending TRL	Date
Demonstration of high-power, continuous wave, LWIR QCL without wavelength selection	N/A	Prototypes tested	5	2nd QTR FY23
Laser emission matched to transparent atmospheric windows	N/A	Prototypes tested	5	3rd QTR FY24
High power, continuous wave, LWIR QCLs with emission matched to transparent atmospheric windows	Medium	Delivery of high performance prototypes	5	3rd QTR FY26
Reliable and reproducible laser manufacturing process and packaging	Medium	Cost and production model established	4	3rd QTR FY26

HOW

Projected Business Model: Pendar's goal is to integrate and transition this technology into government and prime contractor systems. Pendar is actively pursuing opportunities to transition laser prototypes emerging from this and other SBIR/STTRs into next generation military systems. Additionally, advances made in this program will more broadly benefit the commercialization of Pendar's infrared laser-based platforms, including spectroscopic instrumentation.

Company Objectives: To address the different markets in need for affordable, compact mid-infrared sources, Pendar has developed several infrared platforms which all share and leverage our proprietary QCL designs, beam-combining solutions, and system innovations:

- Broadly tunable single-mode laser array as general spectroscopy tool.
- Compact, high performance IR spectrometers and sensors.
- Reliable high-power lasers and laser bars for infrared countermeasures, and other DoD applications.

Potential Commercial Applications: Pendar has developed several proprietary mid-infrared QCL platforms, which have unique features such as broadband spectral coverage, arrays with high optical power through power scaling, excellent beam-quality through rugged wavelength beam-combining, low laser noise, fast tuning speed, and low SWaP due to the monolithic nature of our laser source. These advantages enable many applications in IRCM, spectroscopy, medical device, pharma, laser processing, and scientific applications. The technology developed under this Program will help Pendar provide higher-power laser sources at reasonable cost across multiple military and commercial markets.