Announcing the Final Examination of Pedro N Figueiredo for the Degree of Doctor of Philosophy in Physics

Date: Friday, April 7, 2017
Time: 9:45 a.m.
Room: ENG 2 – 202A (Main Campus)
Dissertation title:
THE CONSEQUENCES OF A REDUCED SUPERLATTICE THICKNESS ON QUANTUM CASCADE LASER PERFORMANCE

Abstract:

Coherent infrared radiation sources are essential for the operability of a wide range of scientific, industrial, military and commercial systems. The importance of the mid-infrared spectral region cannot be understated. Numerous molecules have some vibrational band in this range, allowing for identification of species by means of absorption, emission or some other form of spectroscopy. As such, spectroscopy alone has numerous applications ranging from industrial process control to disease diagnosis utilizing breath analysis. However, despite the discovery of the LASER in the 60s, to this day the amount of coherent sources in this range is limited. It is for this reason that the quantum cascade laser has gained such momentum over the past 23 years.

Quantum Cascade LASERS (QCL) are semiconductor LASERS which are based on the principle of bandgap engineering. This incredible technique is a testament to the technological maturity of the semiconductor industry. It has been demonstrated that by having precise control of individual material composition (band gap control), thicknesses on the order of monolayers, and doping levels for each individual layer in a superlattice, we have unprecedented flexibility in designing a LASER or detector in the infrared. And although the technology has matured since it's discovery, there still remain fundamental limitations on device performance. In particular, active region overheating limits QCL performance in a high duty cycle mode of operation.

In this dissertation forum, along with general discussion on the background of the QCL, we propose a solution of where by limiting the growth of the superlattice to a fraction of typical devices, we allow for reduction of the average superlattice temperature under full operational conditions. The consequences of this reduction are explored in theory, experiment and system level applications.

Outline of Studies:
Major: Physics

Educational Career:
B. S. University of Central Florida, USA, 2011

Committee in Charge:
Dr. Arkadiy Lyakh (Chair)
Dr. Robert Peale (Vice Chair)
Dr. Richard Klemm
Dr. Sasan Fathpour (External Committee Member)

Approved for distribution by Dr. Arkadiy Lyakh, Committee Chair, on March, 31 2017.

The public is welcome to attend.