STELLAR TEAM NOBLE MISSION

# Directed Energy Direct Diode

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# Research Areas for High Power Single Mode Direct Diode Lasers (HPSMDDLs) for Military High Energy Laser Applications

1. Demonstrate scalability of Coherent Beam Combining (CBC) of HPSMDDLs without significant degradation.
2. Determine ways to drastically reduce, or totally eliminate SMILE from multiple emitter Direct Diode Laser bars/arrays.
3. Research thermomechanical mechanisms driving the catastrophic optical damage (COD) in HPSMDDLs.
4. Research improvements to HPSMDDL design and manufacturing processes to reduce unit to unit wavelength variability, thus simplifying the control system and improving the power efficiency.
5. Research passive phase locking mechanism for combining multiple laser diode emitters.
6. Develop an independent, repeatable test capability of various types of research modules (emitters and combiners) to quantify optical module performances at the laser system level.
7. Improve the purity and uniformity of the material layers used to construct a semiconductor laser device to reduce or eliminate hot spots that cause damage or failure of HPSMDDLs.
8. Improve the overall conversion and operating efficiency, beam quality and lifetime performance of HPSMDDLs by reducing the waste heat loss at very high operating temperatures with very little or no cooling.

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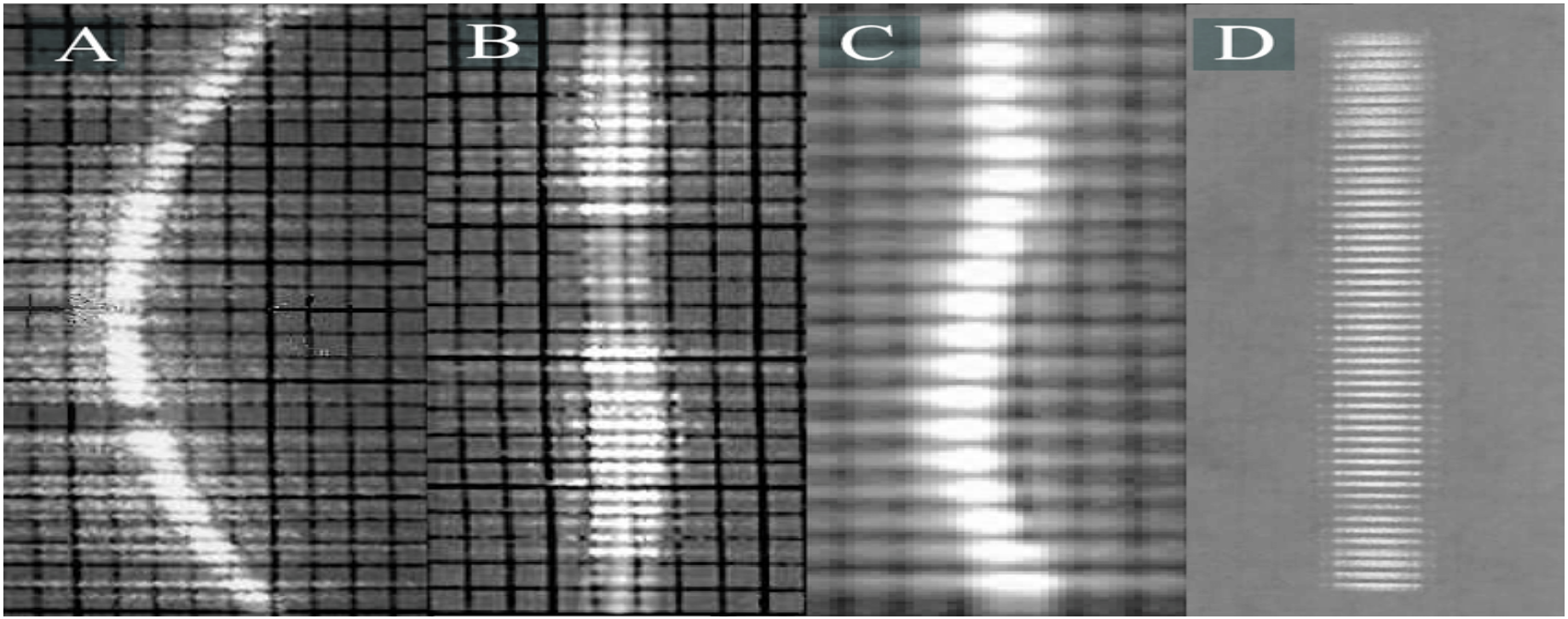
# 2: Determine ways to drastically reduce, or totally eliminate, the SMILE profile from a multiple emitter Direct Diode Laser bars/arrays




Images of SMILE in laser bars. Image D is a 49-element Nuvonyx laser with < 1µm SMILE - the most desired SMILE profile.

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# 3: Research thermomechanical mechanisms driving the catastrophic optical damage (COD) in HPSMDDLs

The catastrophic optical damage (COD) of laser diodes consists of the sudden drop off of the optical power. COD is generally associated with a thermal runaway mechanism in which the active zone of the laser is molten in a positive feedback process. The full sequence of the degradation begins when a weak zone of the laser is incubated and the temperature is locally increased. When a critical temperature is reached, the thermal runaway process takes place. However, the meaning of the critical temperature, has not been unambiguously established and needs further investigation. Selection of hardier materials can help mitigate or reduce COD.

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