



PowerPhotonic
Freeform Optical Solutions

Freeform Optics for Beam Combination: Delivering More Power on Target



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Overview of PowerPhotonic

Locations: Dalgety Bay, UK / Sahuarita, AZ, USA

Capabilities: Design and manufacture of freeform optics and precision optomechanical modules for laser beam **shaping**, beam **combination**, homogenization and correction

Automated Manufacturing: From prototype to high-volume production with consistent quality and cost efficiency

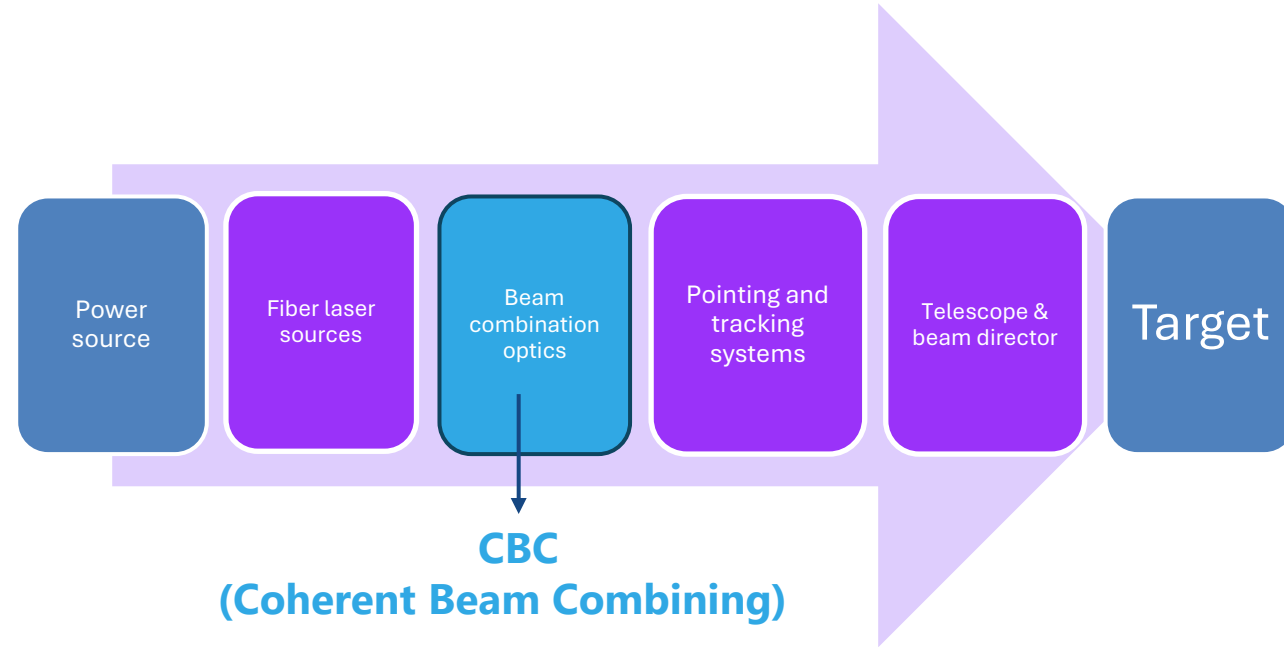
High Power Capability: High LIDT and low scatter maximize optical performance for multi-kW and multi-J beams

Defense Capability: Supplying freeform optics for high-power beam shaping and beam combination into defense applications for >15 years





Typical LDEW Architecture



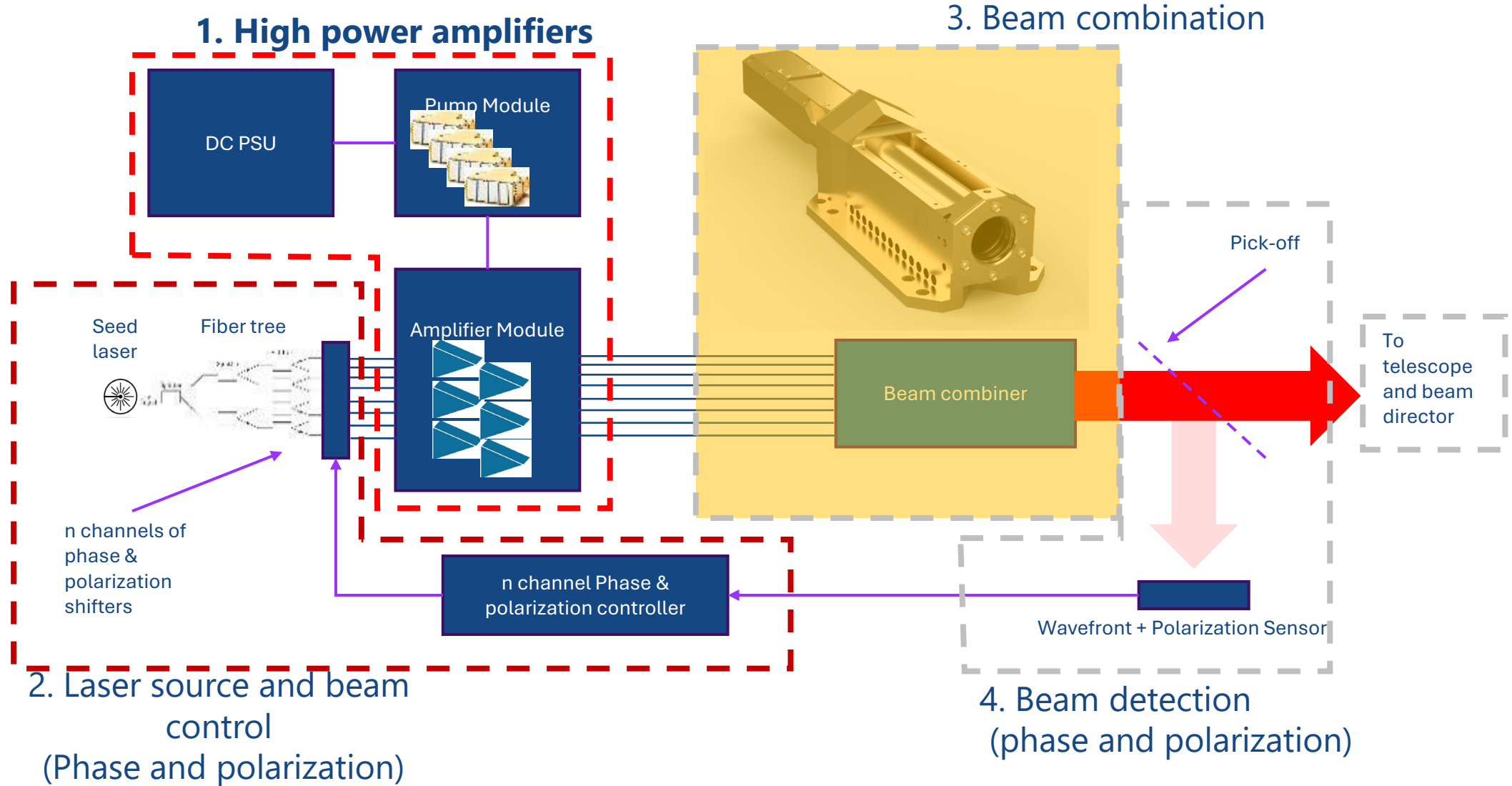
CBC (Coherent Beam Combining)

- High Power
- 50 – 300+ kW
- 'Unlimited' power scaling
- Atmospheric compensation through per-channel phase control



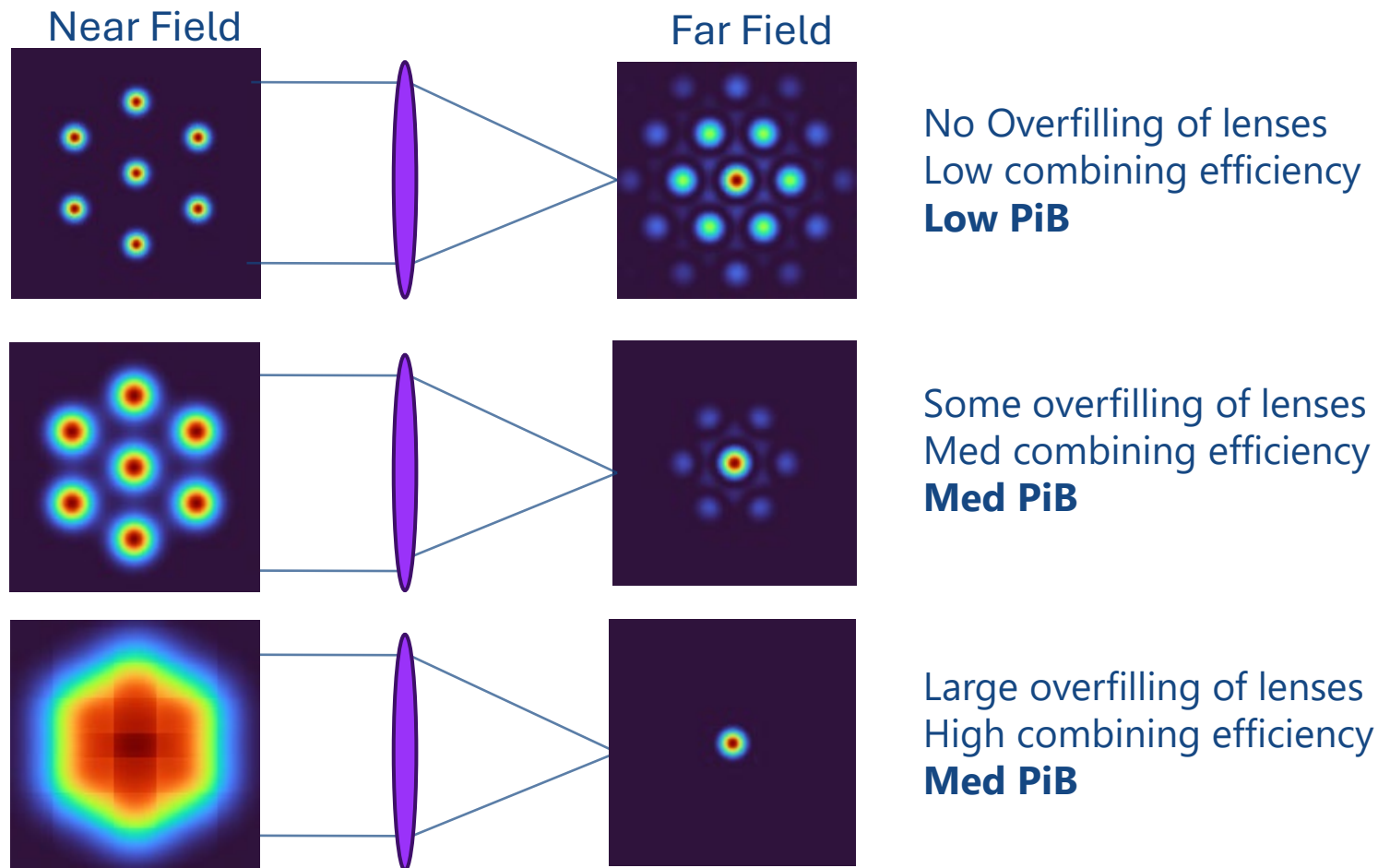


Coherent Beam Combining blocks



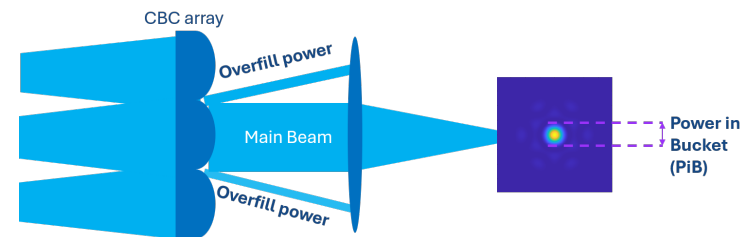


Coherent combination by array collimation



One SM fiber laser delivers 2-3kW

Array collimation of mutually-coherent gaussian beams allows scaling of both power and brightness, increasing useful power on target = Power in Bucket (PiB)



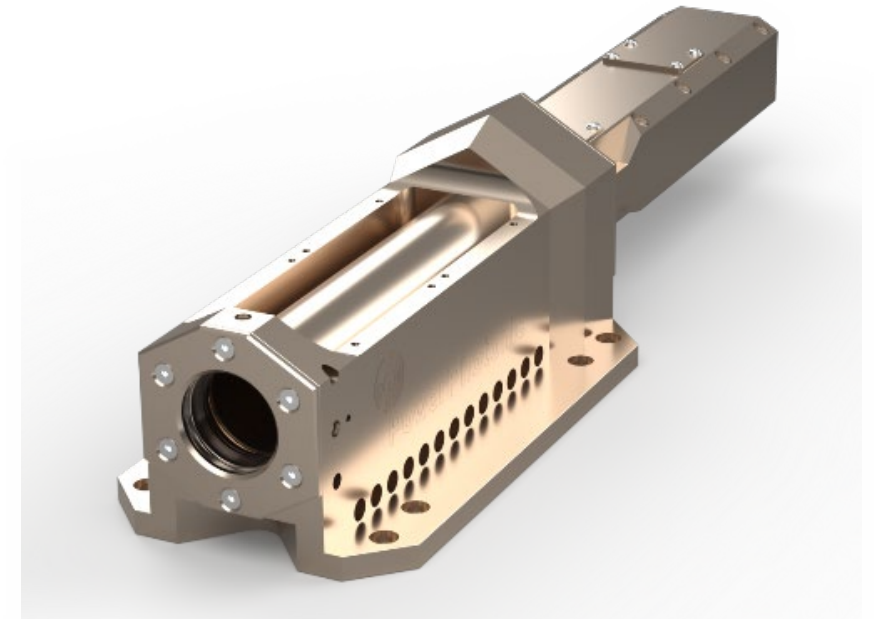
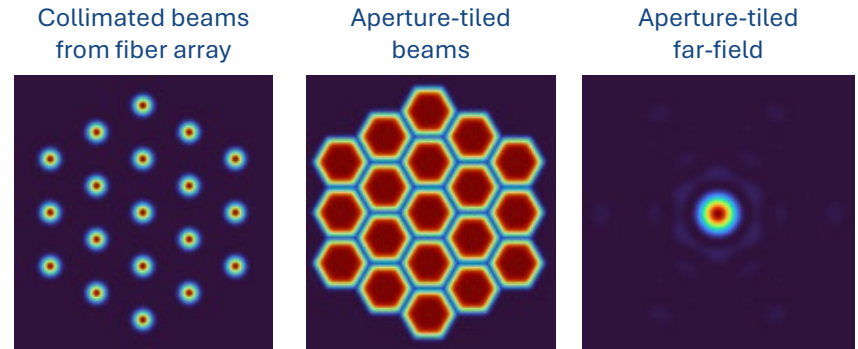
PiB is limited by the trade-off between diffraction efficiency and lens overfill:

- $PiB = \text{combining efficiency} * (1 - \text{Overfill power loss})$
- Theoretical PiB limit of 66%



Coherent combination by aperture tiling

- Freeform optics shape each beamlet to tile the aperture, reducing diffraction losses, increasing PiB from 66% to >80%
 - >20% more PIB from same laser source power
 - Overfill power reduced to 3% - less stray light
- Configured as compact, LMA fiber-coupled module
 - ~400mm x 150mm x 150mm
- Suitable for CW and pulsed operation

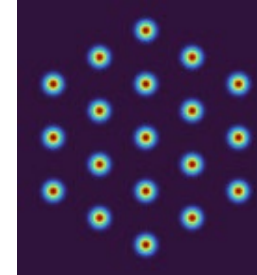




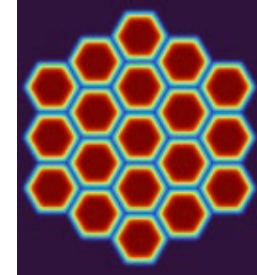
What can we do for each other?

- PowerPhotonic can provide:
 - Provide custom low-SWaP optical modules for higher-power applications including CBC, SBC
- Vendors can provide:
 - High power coatings and components for LDEW
 - Other high-power components & fabrication processes
 - High power test equipment
- Partners can provide
 - Citeable high power performance and effects trials and data, for CW and pulsed LDEW application
 - New applications for CBC
 - Satcom
 - Space debris removal
 - Power beaming

Collimated beams
from fiber array



Aperture-tiled
beams



Aperture-tiled
far-field

