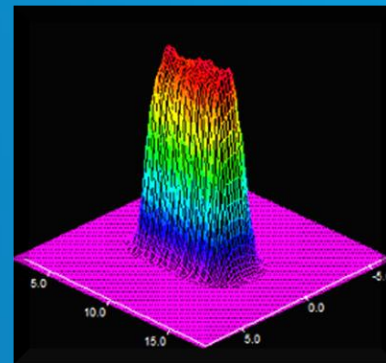
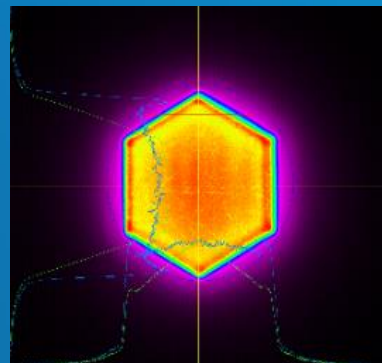
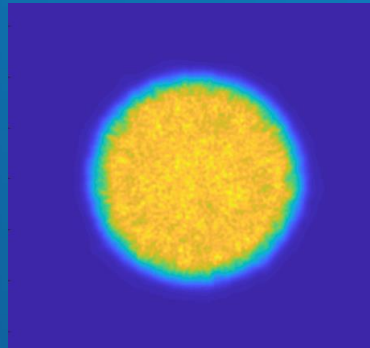
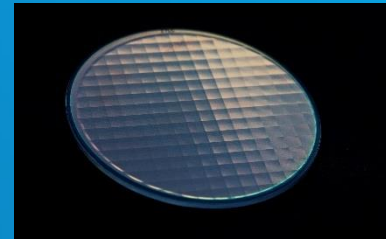




PowerPhotonic

Improving laser material processing with freeform beam shaping

Roy McBride, Managing Director, PowerPhotonic Ltd



Roy McBride, PowerPhotonic Ltd

EPIC Online Technology Meeting on Next Steps Fast Growing Freeform Optics Applications, 17th Mar 2021



PowerPhotonic

Company overview

Summary

- Freeform design and manufacture of precision fused silica micro-optics
- 35 staff
- Class 1000 cleanroom fabrication
- Shipping freeform micro-optics since 2006

Technology Leadership

- Proprietary patented laser direct-write process
- One process from prototype to volume
- 24/7 lights-out automated production
- Class-leading performance





Applications of laser beamshaping

PowerPhotonic

Industrial

- Macro-processing: cutting, welding, cladding and additive manufacturing
- Micro-processing: micro-ablation, marking, drilling
- Wafer & glass processing: cutting, annealing, laser lift-off

Imaging

- Laser projection display
- Advanced microscopy

Defence

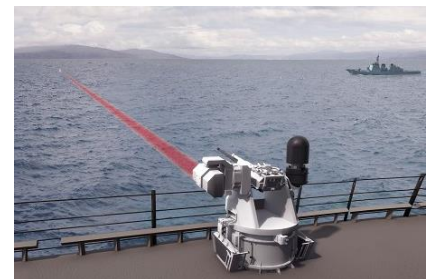
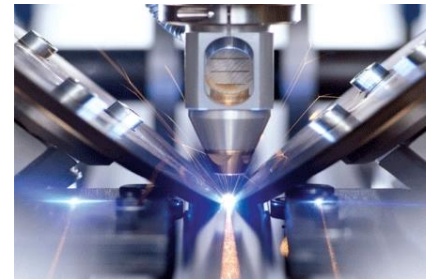
- Target illumination
- LDEW

Scientific

- High energy pump sources
- Optical tweezers

Medical

- Skin treatment
- Tattoo removal

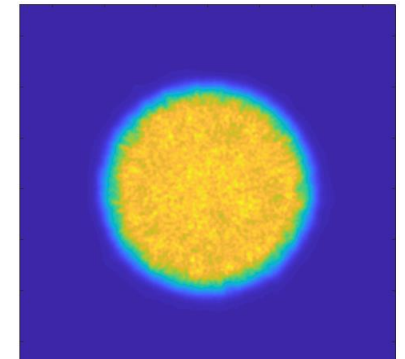
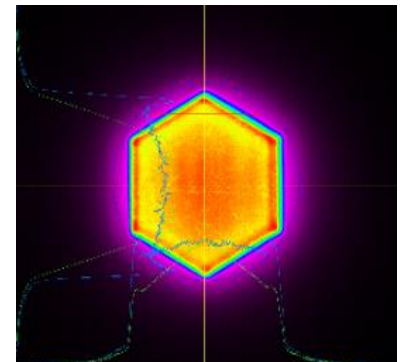
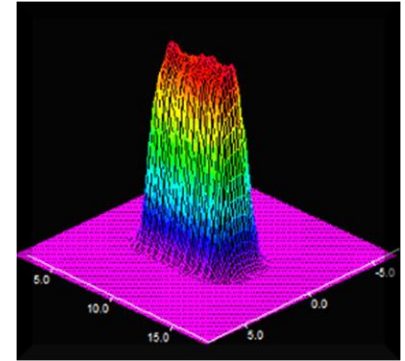




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Requirements for high performance

- **Free choice of input beam**
 - Source beam shape and profile
 - Source spatial coherence
- **Precise control of output beam**
 - Precise control of beam shape and profile
 - Defined by application, not laser source
- **High efficiency**
 - Low scatter & absorption loss
- **High power and fluence handling**
 - Multi-kW CW
 - Multi-joule ns, ps, fs

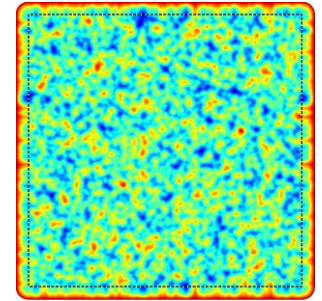
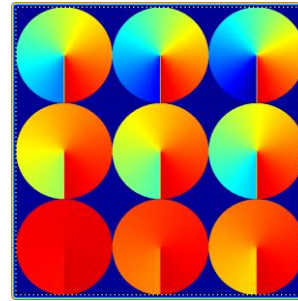
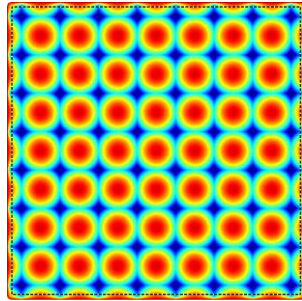
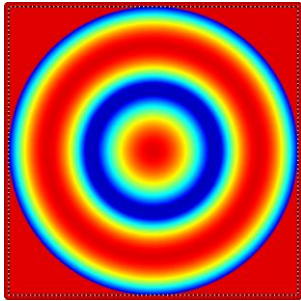




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Freeform, direct-write optical fabrication

Free choice of surface profile

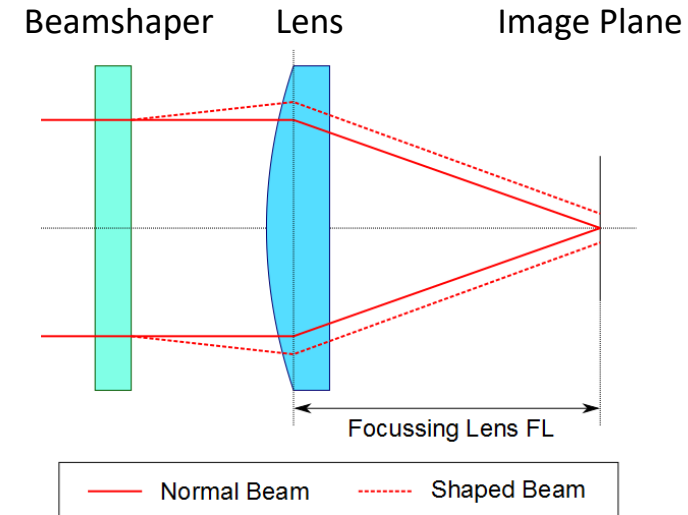




Laser beamshaping: optical configuration

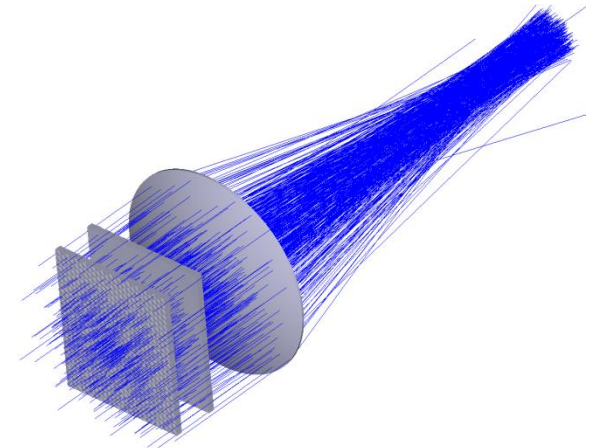
Typical system

- Beamshaper generates far-field (angular distribution)
- Lens images far-field profile onto near-field at process plane



Design starts with beam properties

- Source spatial coherence drives beam shaper type
- Input and output beam profiles drive detailed design

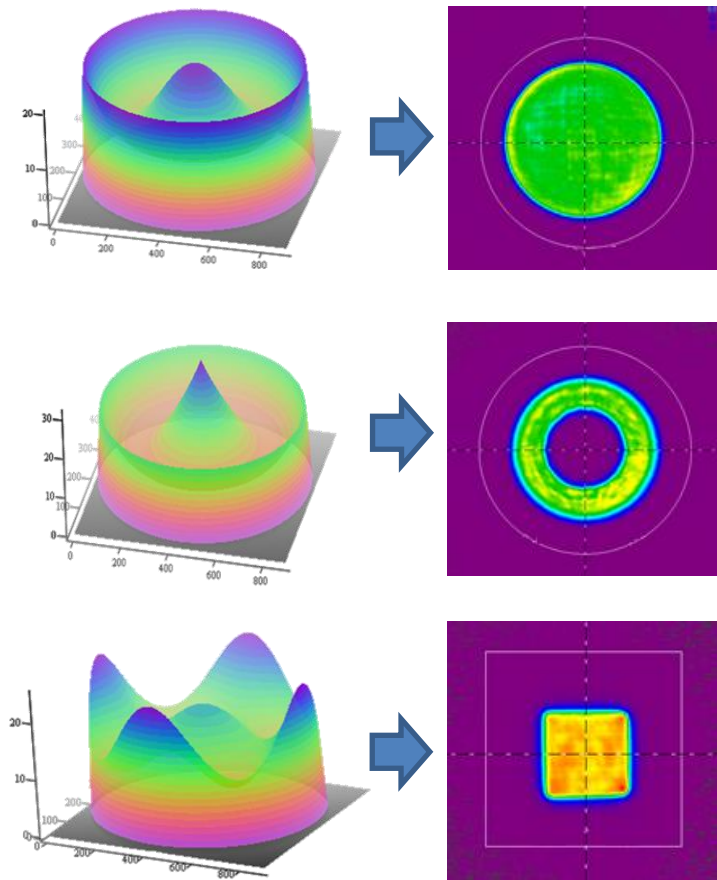




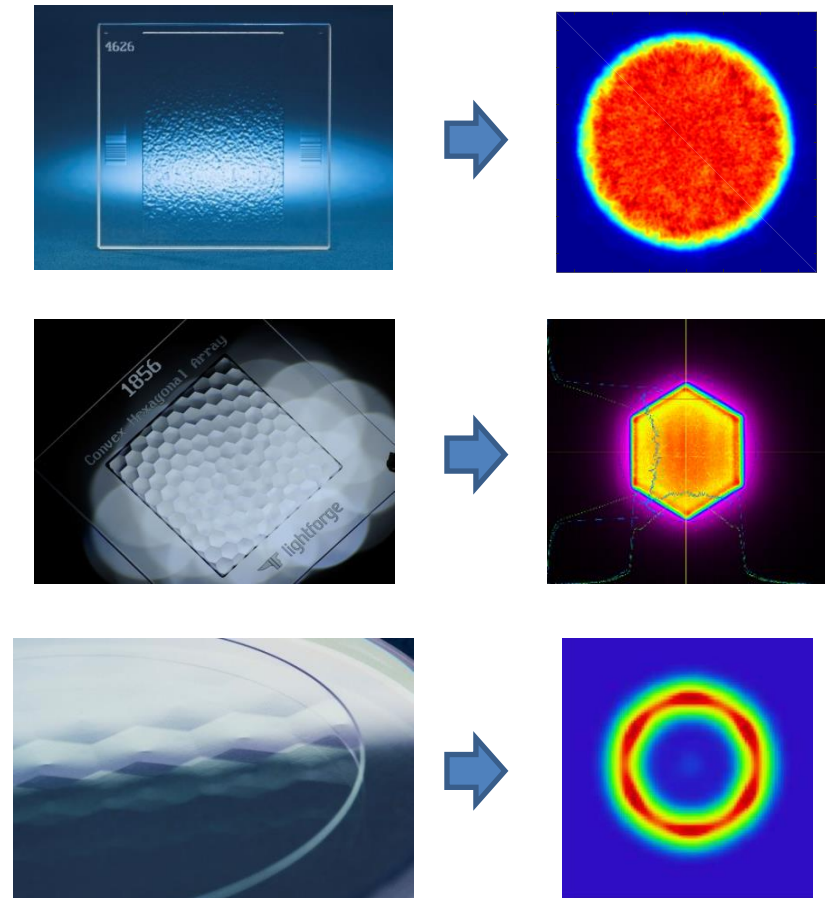
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Singlemode and multimode beamshaping

Single mode / few mode: field mapper



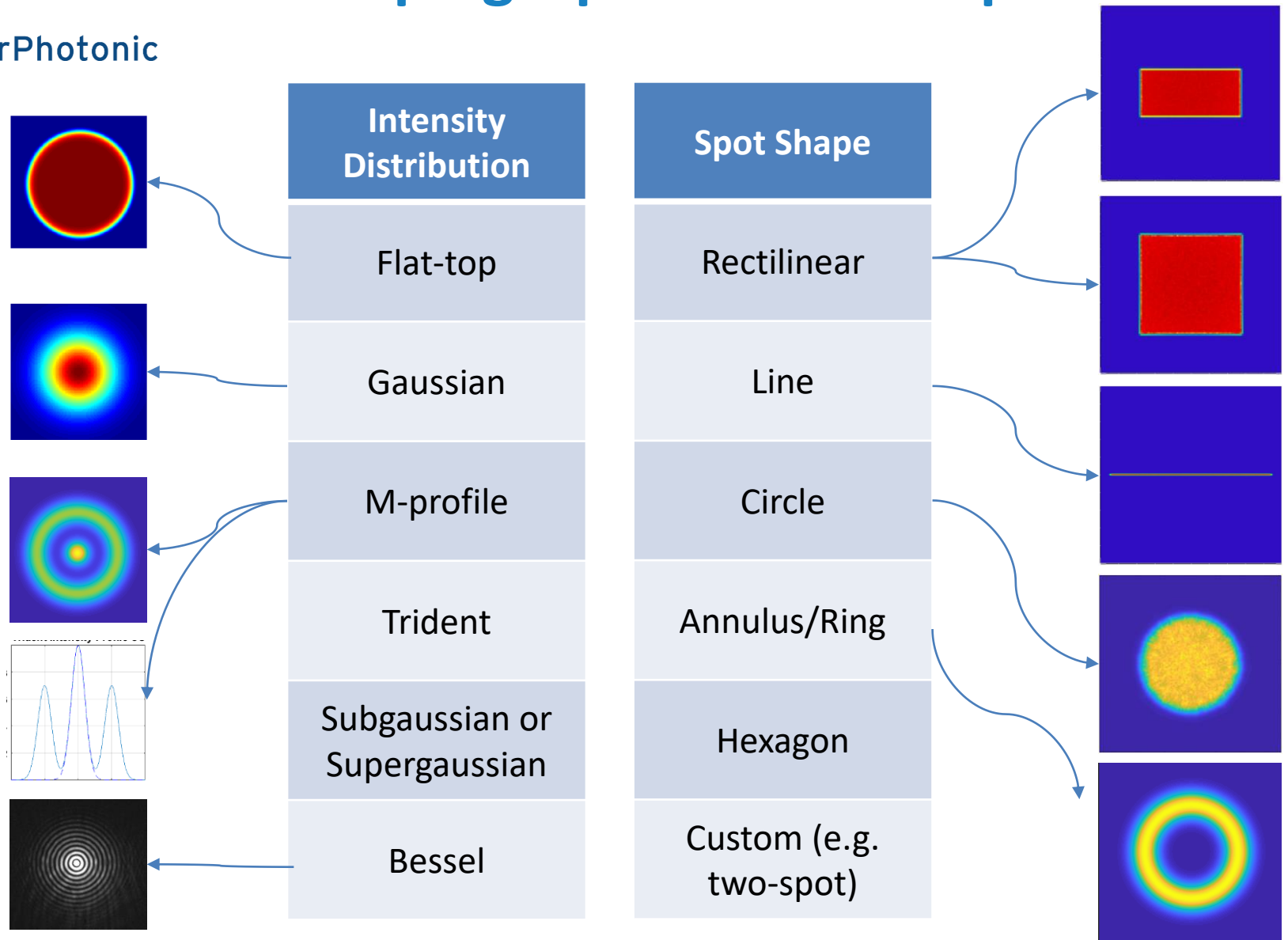
Multi-mode: homogeniser





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Beam Shaping Options & Examples





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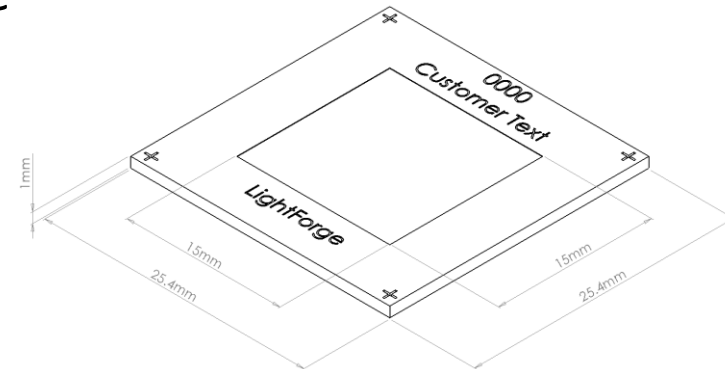
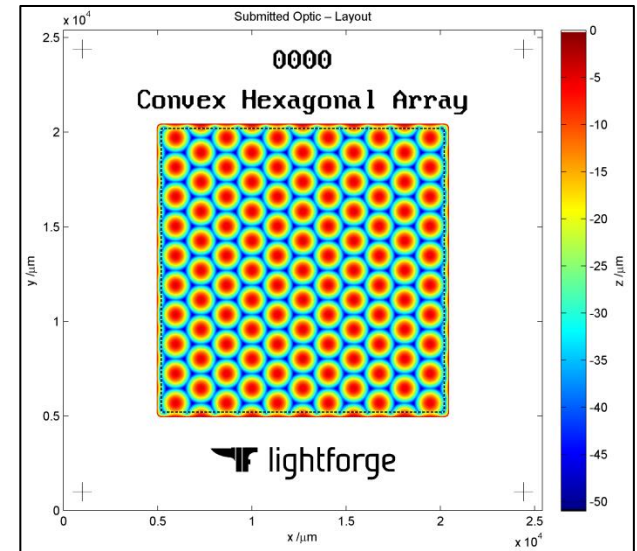
Rapid prototyping of freeform optics

Key Features

- Upload design to server
- WYSIWYG
- 2 week typical turnaround
- Fixed menu pricing (<\$3k per part)
- 15x15mm CA, fixed design rules
- AR coating and mounting option available
- From Zemax to LightForge in one simple step

Benefits

- Industry's lowest cost and fastest custom freeform fabrication service





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High volume freeform optics

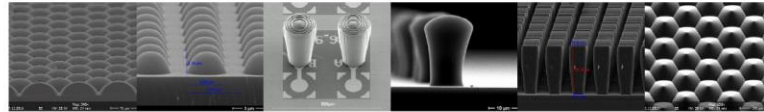
Partner in Phabulous pilot line

 www.Phabulous.eu

A new era for free-form micro-optics

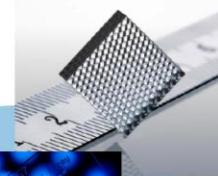
Free-form Micro-optics are micro-optical components:

- Designed with no symmetry constraints
- Enabled by innovative modelling
- Requiring ultra-precision machining



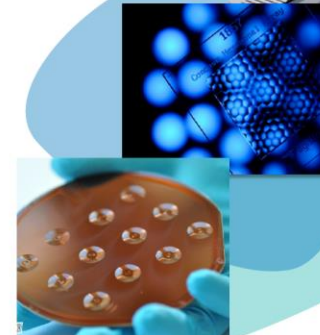
Innovative technology with various advantages

- New functionalities with aberration reduction
- Miniaturization & integration
- Low-weight & Large-area
- Flexibility & Conformability
- Low-cost mass manufacturing
- System simplification



Challenging technology

- Design
- Fabrication
 - Mastering
 - Up-scaling
 - Tooling
 - Replication
- Material
- Characterization
- Mass production
- Integration





Freeform beamshaping – working with you

PowerPhotonic

What can PowerPhotonic do for you?

- **Application-specific beamshapers tailored to**
 - Source properties
 - Process requirements
- **Used with broad range of lasers**
 - CW to fs
 - UV to NIR
- **High power handling, high efficiency**
 - mW to multi-kW CW
 - mJ to multi-J pulsed

How can you help PowerPhotonic?

- **Metrology solutions**
 - Surface metrology
 - Functional performance
- **Manufacturing processes**
 - Blockers on freeform surfaces
 - Module assembly
- **New applications**
 - Material processing requirements
 - Beam profile requirements
 - Systems/modules concepts

Ideas? Problems? Solutions? Ask now, or contact us later!

