*Technology Offer*

# Ultra-Fast Electro-Optical Beam Shaping for Super-Resolution Microscopy

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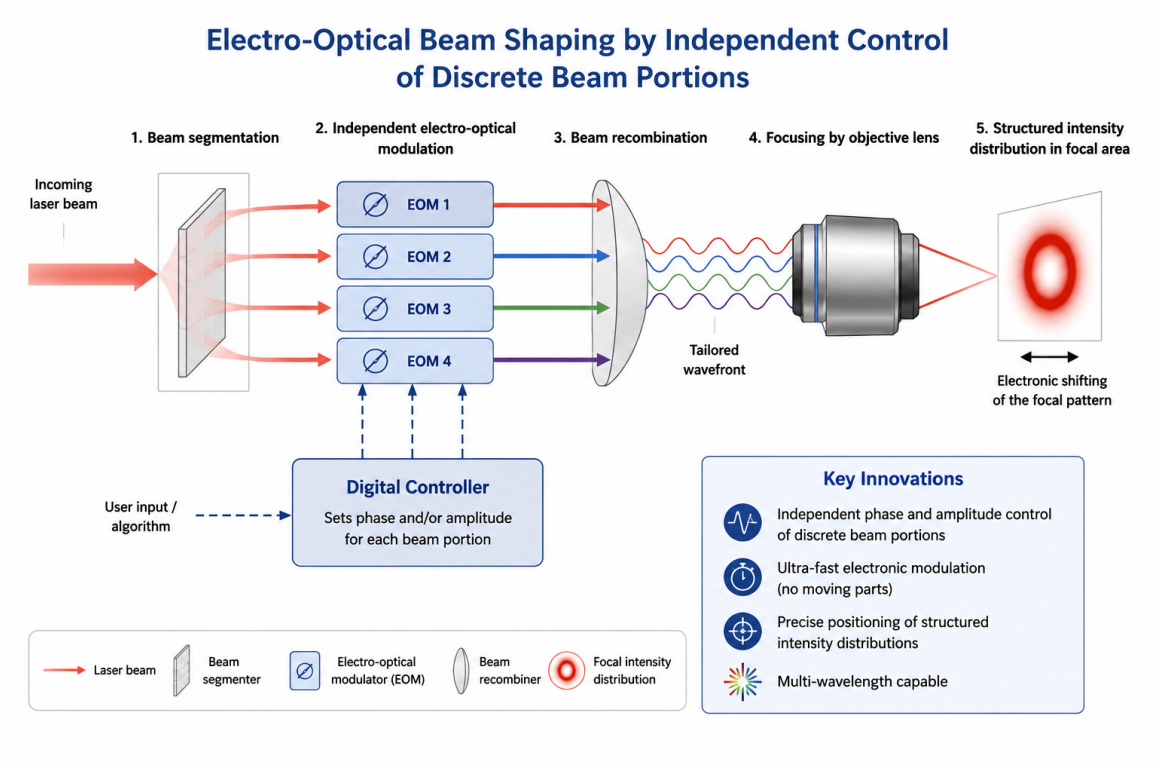
The patented electro-optical beam shaping technology generates and dynamically shifts structured focal light distributions without mechanical beam scanning. The technology uses independently controlled electro-optical modulators acting on discrete beam portions to achieve ultra-fast, diffraction-limited beam shaping with nanometer precision. The technology enables significantly higher switching speeds than spatial light modulators or mechanical scanners and is particularly suitable for STED, MINFLUX, RESOLFT and other advanced fluorescence microscopy techniques.




## Background

Modern fluorescence microscopy increasingly relies on engineered light distributions such as optical donuts or focal intensity minima to overcome the diffraction limit. Applications including STED and MINFLUX microscopy require rapid, precise positioning of these light distributions while maintaining excellent optical quality.

Current beam-shaping solutions face important limitations. Mechanical scanners suffer from inertia and limited speed, while spatial light modulators cannot provide sufficiently fast dynamic modulation. Acousto-optic systems often compromise wavelength flexibility or optical performance.

## Technology

The patented invention introduces a fundamentally different approach. A coherent laser beam is divided into multiple discrete beam portions, each independently controlled by a dedicated electro-optical modulator. After individual phase and/or amplitude modulation,

the beam portions are recombined within the objective pupil where they interfere to generate user-defined focal intensity distributions.

Unlike conventional systems, every beam segment is individually addressable, allowing extremely rapid electronic modulation without moving components. The architecture supports free-space optical implementations as well as compact fiber-based systems with integrated electro-optical modulators. Multiple optical implementations can be implemented, including birefringent beam splitters, Wollaston prisms, fiber-optic beam splitters and monolithic optical assemblies for robust industrial integration. The invention further enables rapid adaptation to different laser wavelengths through electronically stored calibration parameters and can compensate optical aberrations by dynamic phase control.

## Advantages

- Fully electronic beam shaping without moving mechanical components
- Independent phase and amplitude control of individual beam segments
- Microsecond-scale switching capability
- Sub-Nanometer positioning precision
- Dynamic generation of structured focal intensity distributions
- Multi-wavelength compatibility

## Potential Applications

- STED microscopy
- MINFLUX microscopy
- RESOLFT microscopy
- Confocal laser scanning microscopy
- Single-molecule localization microscopy
- Laser beam shaping

## Patent Information

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