Newsletter 2

HORIZON-CL4-2023-TWIN-TRANSITION-01-02.

Co-funded by the European Union

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union. Neither the European Union nor the granting authority can be held responsible for them.

Co-funded by
the European Union

FLASH

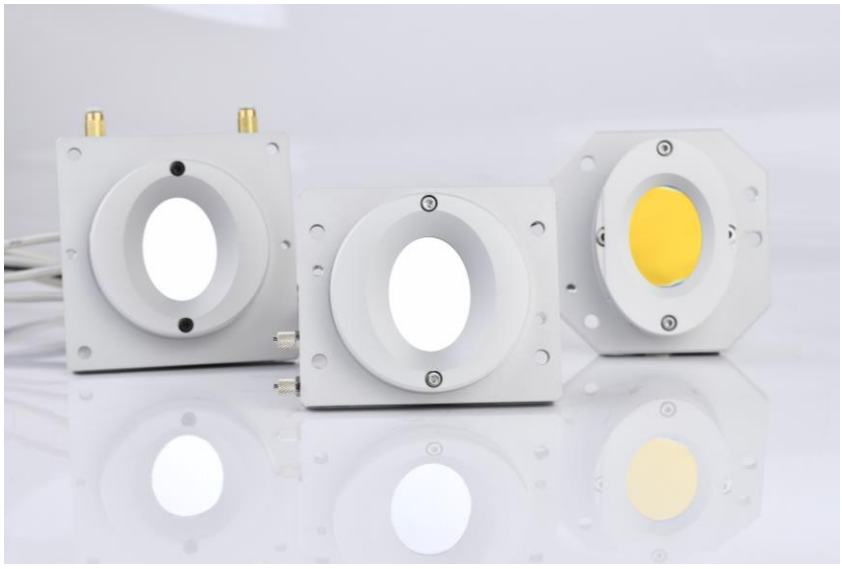
Flexible Laser-Based Manufacturing

DYNAMIC BEAM SHAPING

The new dimension in laser machining

In the fast-evolving field of high-power laser applications, precision and adaptability are paramount. This is taken into account by the integrative concept of the FLASH machine.

ROBUST AO introduced a breakthrough in Dynamic Beam Shaping (DBS) with Zwobbel® technology, designed to revolutionize laser cutting and processing. By enabling rapid, dynamic adjustments to the laser beam's energy distribution, Zwobbel® provides unmatched control over the laser's interaction with the material, making it ideal for high-quality manufacturing tasks.



Cutting-Edge Innovation with Deformable Zwobbel® Mirrors

Our Zwobbel® units integrate deformable mirrors that allow for precise control over the focal position of the laser beam along its propagation path. This dynamic focusing capability supports laser powers up to 12kW and covers a range of wavelengths. By deforming a dielectric coated glass mirror, the wavelength ranges (high power near-infrared and two ns green lasers) of the FLASH machine system are accessible.

Through kHz-level oscillation frequencies, Zwobbel® enables both caustic and longitudinal energy distribution shaping. This means the focal energy can transition from a standard spot to an elongated, sword-like shape along the beam path—offering new versatility for complex machining needs (Figure 2). In the project frame, our team is actively testing prototypes that push the power handling of these mirrors up to 20kW, ensuring robustness for demanding industrial applications. This implies the development of concepts followed by the experimental setup and test of mirror. First samples are now under evaluation.

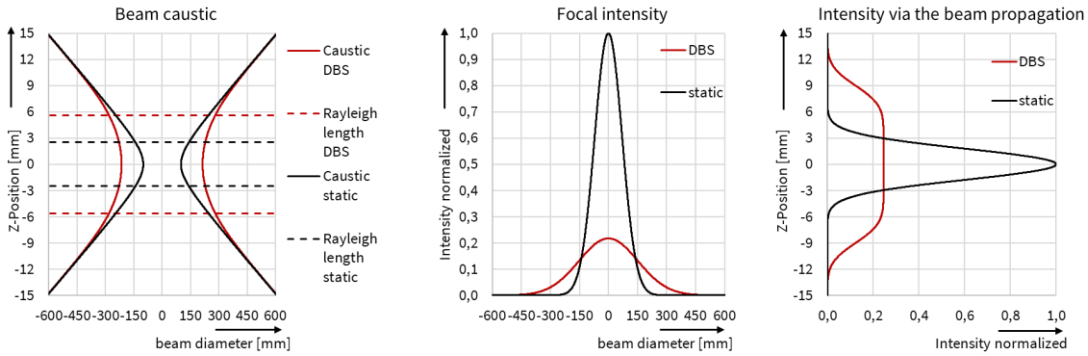


Figure 1 - Comparison of for a static beam focussing and dynamic beam shaping (DBS) by Zwobbel technology. (a) beam caustic can be changed so that the focal spot and Rayleigh length increases. (b) The focal intensity decreases in the centerand increases at the rim. (c) Higher intensity can be achieved with greater longitudinal distance to the focal spot (laser sword).

Pioneering Collaboration for Integrated Laser Solutions

As part of our project, we have developed critical optical, mechanical, and IT interfaces with our consortium partners to ensure seamless integration. One key collaboration is with Cailabs, which is developing a 3D beam shaping unit for the FLASH machine. Together, we aim to create an advanced setup that combines spatial and dynamic beam shaping. Recent tests have shown excellent stability in focal spot consistency during Zwobbel focusing—a crucial factor for achieving reliability in real-world applications. We are currently preparing a mirror for integration with the Cailabs system.

Innovative Monitoring for Quality Assurance

To maximize operational efficiency, the project also explores the impact of Zwobbel® oscillations on in-line monitoring systems. We are partnering with AIMEN to assess acoustic sensor technology's potential in monitoring Zwobbel-assisted production consistency and quality. This evaluation is pioneering in its use of acoustic and optical monitoring methods alongside fast digital communication protocols, such as SL2-100, to keep up with Zwobbel's high oscillation dynamics.

With Zwobbel® Dynamic Beam Shaping, we are poised to redefine the capabilities of high-power laser technology, bringing unprecedented speed, precision, and adaptability to modern manufacturing.

Expanding the Potential of Laser Technology with Zwobbel®: Dynamic Beam Shaping in Action

In the fast-evolving field of high-power laser applications, precision and adaptability are paramount. ROBUST AO introduced a breakthrough in **Dynamic Beam Shaping (DBS)** with Zwobbel® technology, designed to revolutionize laser cutting and processing. By enabling rapid, dynamic adjustments to the laser beam's energy distribution, Zwobbel® provides unmatched control over the laser's interaction with the material, making it ideal for high-precision manufacturing tasks.

Cutting-Edge Innovation with Deformable Zwobbel® Mirrors

Our Zwobbel® units integrate **deformable mirrors** that allow for precise control over the focal position of the laser beam along its propagation path. This dynamic focusing capability supports laser powers up to 12kW and covers a range of wavelengths, including high-power near-infrared and nanosecond green lasers, broadening the flexibility and utility of the **FLASH machine system**.

Through kHz-level oscillation frequencies, Zwobbel® enables both caustic and longitudinal energy distribution shaping. This means the focal energy can transition from a standard spot to an elongated, sword-like shape along the beam path—offering new versatility for complex cutting needs. Currently, our team is actively testing prototypes that push the power handling of these mirrors up to 20kW, ensuring robustness for demanding industrial applications.