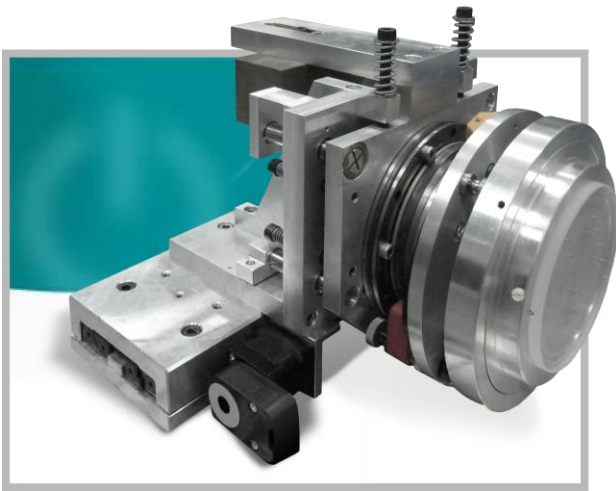


SL-ST-1000 Laser-Plasma Solid Target

High-precision high-velocity positioner



- **Ultrahigh positioning precision < 2 μm PTV**
- **Lifetime of 3 millions consecutive shots**
- **Rotation velocity superior to 720 $^\circ/\text{s}$**
- **Ultrahigh precision motion stages**
- **Fully motorized and easy to align**

The SL-ST-1000 system, originally developed at Laboratoire d'Optique Appliquée, is a motorized mechanical assembly conceived for the interaction of a high-intensity laser with a solid target at very high repetition rate, up to several kHz. This system can be used for plasma mirror contrast cleaning and high energy particle or radiation generation, such as sub-femtosecond XUV pulses, electron or proton beam acceleration.

➤ Design and hardware

The SL-ST-1000 is designed to quickly refresh a solid surface at laser focus while ensuring perfectly reproducible shot-to-shot interaction by high-precision positioning of the surface. To this end, an optically polished disc is mounted onto a computer-controlled rotating/translating target holder and vertically placed at laser beam focus. During operation, the target holder is rotated over a full period, drawing a circle of impacts, after which it is translated, drawing a second circle concentric to the

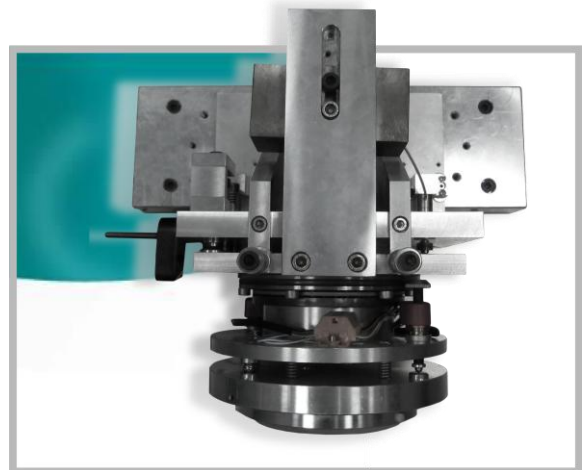
Examples of applications

- **Attosecond plasma science**
- **Particle acceleration**
- **Plasma mirror contrast cleaning**

previous one. This geometry allows more than 3 millions consecutive shots per target face (for 100 μm spacing between each laser impacts). Laser focal scan is also provided through an additional longitudinal translation.

The system comprises mainly:

- A large diameter solid target (BK7 solid disk of 200 mm diameter and $\lambda/20$ flatness over the full surface).
- A high repetition rate target holder, made of:
 - A set of two actuators allowing nanometric alignment of the target surface with respect to the rotation axis. This mechanism reduces the residual mechanical wobble to less than 2 μm Peak-to-Valley (see Fig. 1)
 - A high torque rotary motor for target rotation greater than 720 $^\circ/\text{s}$
 - A transverse motorized translation stage (rectitude less than 2 μm), for full scan of the target surface.
 - A longitudinal motorized translation stage (resolution 0.5 μm) for scan of laser focus.



➤ Performances

The SL-ST-1000 is designed to offer perfectly reproducible laser-solid interaction conditions, even for the tightest focusing. With its set of pico-actuators, the rotating target surface is precisely and easily aligned with the rotation axis (a position sensor with sub-micron precision can be used -not provided in this offer, but for better precision, see option). As a consequence, target surface residual motion is limited to 2 μm Peak-to-Valley and maintains the surface of



interaction within the Rayleigh length of the incoming laser beam (see Fig. 1).

The SL-ST-1000 is also capable at working at high rotation and translation velocity. It notably allows to be used together with high repetition rate laser system, even with very tight focusing conditions. It is

➤ Technical data

Performances

Residual motion after alignment	< 2 µm (< 200 nm with active stabilization in option)
Number of consecutive shots (per target face)	> 3 millions (for 100 µm spot spacing)

Miscellaneous

Dimensions (X x Y x Z)	350 x 250 x 340 mm x mm x mm
Mass	7,9 kg

Translation X

Motor type	Stepper motor
Range	200 mm
Encoder	yes
Minimal incremental motion	0.1 µm
Rectitude	2 µm
Maximum velocity	15 mm/s

Translation Z

Motor type	Stepper motor
Range	30 mm
Encoder	yes
Minimal incremental motion	0.1 µm
Rectitude	2 µm
Maximum velocity	5 mm/s

Rotation

Motor type	Torque motor
Range	>360°
Encoder	yes
Resolution	1°
Intrinsic wobble	< 10 µrad
Maximum velocity	720 °/s

Wobble correction

Motor type	Picomotor actuators
Range	12,5 mm
Encoder	no
Resolution	30 nm
Maximum velocity	0,5 mm/s

of course designed to work in vacuum conditions (10^{-6} mbar). Finally, the large area of the target surface (200 mm diameter) allows long time running experiment (more than 3 millions shots for 100 µm impact spacing) before changing the target.

Scientific publications

- A. Borot et al, **Nature Physics**, 8, 416 (2012)
- J. Wheeler et al, **Nature Photonics**, 6, 829 (2012)
- M. Veltcheva et al, **Phys. Rev. Lett.**, 108, 075004 (2012)
- A. Borot et al, **Optics Letters**, 36, 1461 (2011)