SourceLAB
Laser Plasma Technologies

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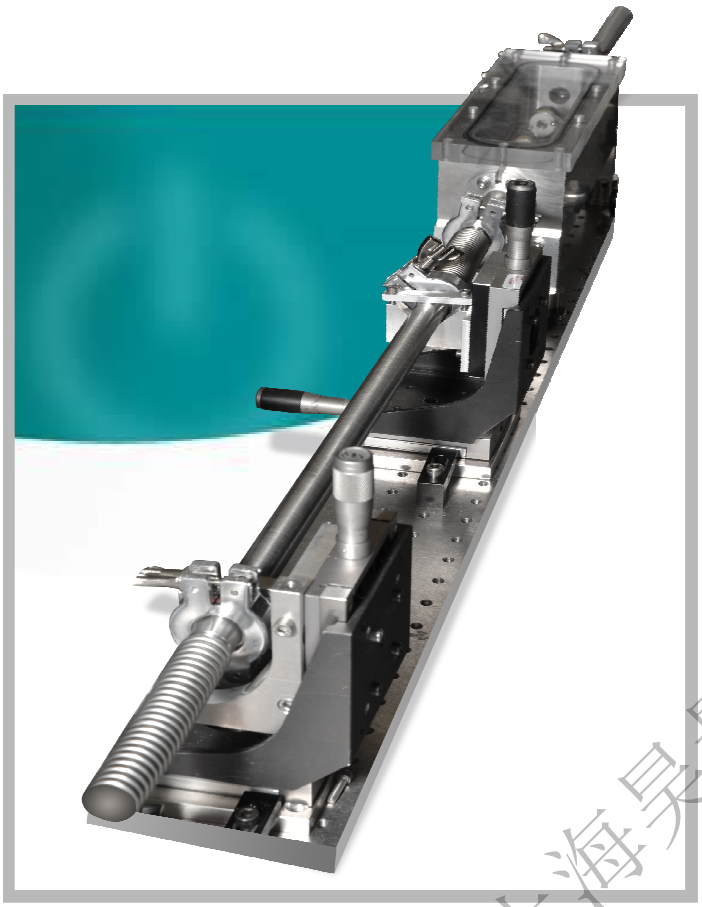
SL-XPW-1000

Energy-scalable high-efficiency laser temporal contrast filter



- **High-efficiency single-crystal set-up**
- **Excellent spatial profile thanks to hollow-core fibre filtering**
- **Contrast enhancement ratio of 10^3 or more (limited by polarizers)**
- **Spectral quality enhancement and broadening leading to shorter pulses**
- **Carrier-to-envelope-phase (CEP) compatible**
- **Easy-to-align and robust**

Examples of applications

- **fs-pulse contrast enhancement (> three orders)**
- **fs-pulse post-compression (> two-fold)**
- **Generation of high-contrast few-cycle pulses**

Scientific publications

- A. Ricci et al, **Rev. Sci. Instr.** 84, 043106 (2013)
- A. Ricci et al, **Appl. Sciences** 3, 314-316 (2013)
- A. Ricci et al, **Opt. Exp.** 21, 9711-9721 (2013)
- A. Jullien et al, **Appl. Phys. B** 102, 769 (2010)

The SL-XPW-1000 system, originally developed at Laboratoire d'Optique Appliquée, is a ready-to-use temporal filter for contrast enhancement of above-mJ ultra-short pulses. This system can also be used for post-compression of femtosecond pulses by a factor of 2 or more, potentially leading to few-cycle pulses. It is based on cross-polarized wave generation (XPW).

Design and hardware

The SL-XPW-1000 is a passive system adapted to UV to IR wavelength, short pulse duration and high repetition rate. Incident laser pulses should be linearly polarized and adequately compressed to duration of 1.1 times their Fourier-transform limit (FTL) or better. A Strehl ratio (SR) of 0.9 or better is required to ensure optimal transmission. The set-up is installed under vacuum. Input pulses are coupled into a hollow-core fibre that serves as a spatial filter and waveguide. An XPW crystal is placed after the fibre to serve the purpose of nonlinear conversion into the orthogonal polarization state. Only the most intense part of the pulse is converted, leading to contrast enhancement. Additionally, XPW pulses exhibit a broader Gaussian-like spectrum, corresponding to shorter compressed pulse durations (more than two-fold compression). After exiting the vacuum set-up, the XPW wave is discriminated by a polarizer.

The system comprises:

- An autonomous vacuum set-up made of tubing, windows, crystal chamber, vacuum pump;
- A hollow-core fibre and its holder inserted in the vacuum set-up;
- Four translation stages for fibre alignment;
- A mounted XPW crystal;
- One output broadband polarizer;
- One input polarizer is optional.

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Performances

The SL-XPW-1000 is designed to act as a passive filter. Therefore, performances in terms of stability (energy, spectrum, CEP) will directly reflect laser quality. However, as the XPW process is driven in the saturation regime, fluctuations are kept to low level after the filter (see Fig. 1). Under the following conditions on the input pulses:

1) $\Delta t < 1.1\ \Delta t_{FTL}$,
2) $SR > 0.9$,

We guarantee 15% energy transmission at least along with two-fold spectral broadening (see Fig. 2), leading to filtered pulses potentially twice as short, and contrast enhancement of 10^3 at least.

Performances at a glance

- Input pulse in the range 0.4 mJ to 5 mJ*
- Energy transmission > 15 %*
- Repetition rate ranging from Hz to multi-kHz
- Wavelength range : UV to IR
- Pulse duration in the range 5 fs to > 100 fs (at 800 nm)
- Two-fold pulse compression

* More on request. Contact us for custom designs.

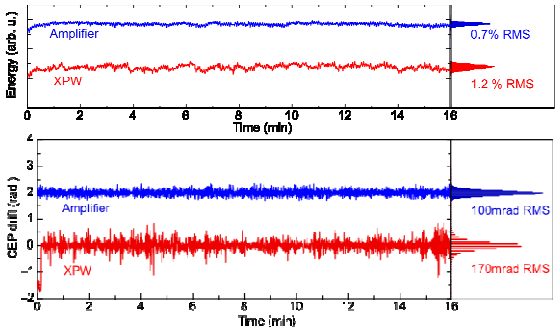

Fig.1: Energy (top) and CEP (bottom) stabilities before and after the XPW filter (ref: A. Ricci *et al.*, Appl. Sci. 2013)

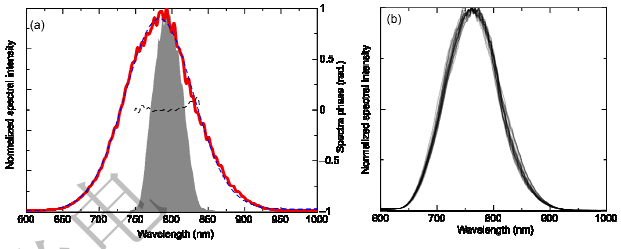

Fig. 2: (left) Spectral broadening due to XPW (red curve) compared to input laser spectrum (grey shaded area) and input spectral phase (dotted line); (right) Measurement of the XPW spectra integrated over hours (ref: A. Ricci *et al.*, Appl. Sci. 2013)

Technical data

Performances	
Contrast enhancement	10^3 or higher
Energy transmission	15 % or more
Maximum input energy – Contact us if your applications require more	5 mJ or ore
Strehl ratio	0.9
Miscellaneous	
Dimensions (L x W x H) – Custom designs available on request	200 x 25 x 20 (cm x cm x cm)
Mass	Approx. 4 kg (ex. vacuum pump)
Micrometric translation stages	
Range	25.4 mm
High-quality, high-straightness single-mode hollow-core fibre	
Length	40 – 50 cm
Inner diameter	Wavelength dependent
XPW crystal	
[011]-cristallographic orientation, high-quality polishing, BaF_2 crystal	
Thickness	2 – 3 mm
AR-coated FS vacuum windows	
Thickness	500 µm
Dry vacuum pump	
Pumping speed	6 m^3/h
Ultimate vacuum	< 10^{-1} mbar

All specifications are subject to change without notice.