LIGHT CONVERSION

TOPAS-white

High Energy Non - Collinear OPA

FEATURES

- Pulse Duration less than 10 fs possible
- High Energy (> 80 microjoule) Visible Output
- Wavelength Tuning Computer Controlled
- Tuning Range 250-375, 425 -750, 850-1000 nm
- Pulse duration and Bandwidth control
- Compact and stable design
- High Output Stability

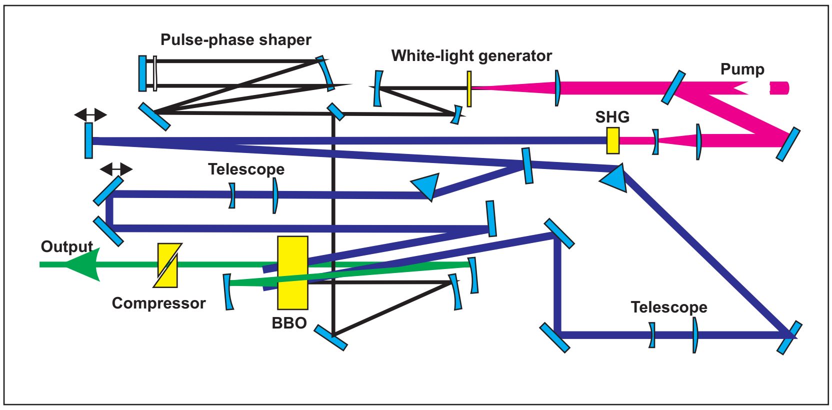
Basics of Operation

A Non collinear pumping scheme of an OPA is used when the collinear approach for the OPA reaches its limits in respect to broad spectral bandwidth and / or extremely short pulses (< 20 fs). The basic principle of operation of NOPA relies on parametric amplification of chirped signal produced by supercontinuum generation in a transparent medium possessing third order nonlinearity. The non-collinear geometry is used due to broad amplification bandwidth in the visible spectral range.

Design and Performance

Main problem in the "classical" NOPA approach is associated with non-collinear geometry and the limited applicable pump energy. Typical signal pulse energy is a few microjoules. In the TOPAS-white developed by Light Conversion, the output energy is enhanced by using a pump pulse with appropriate front tilt. The tilt of pump pulse is achieved by combination of a dispersive optic and a telescope.

Another problem of the "classical" NOPA approach is a complex issue of dispersion matching over broad wavelength range, which is necessary for generation of near- transform limited sub-30 fs pulses. This problem is usually solved either by optimizing pulse compressor for limited wavelength range, or by use of complex adaptive systems that also introduce significant loss for the output pulse. The TOPAS-white offers significant improvement regarding above problems. The device is a two-stage non-collinear parametric amplifier of white light continuum. The way of operation is as follows (see schematic).



Optical Layout of Topas-White

A small fraction of the incoming 800 nm pulse is used to produce white light continuum in a sapphire plate. The white light beam is collimated using chromatic aberration free, low astigmatism collimator. Then the pulse is sent into a double pass negative dispersion pulse phase shaper consisting of a diffraction grating, a spherical mirror, a folding mirror and a phase mask. Dispersion of this pulse shaper is calculated in order to achieve an adapted chirp of the seed pulse such that: first, the desired bandwidth fits under the pump pulse; secondly, the amplified signal pulse is compressed to the transform limit using material dispersion of fused silica or other material. In addition, the pulse shaper allows controlling the pulse spectrum: by placing a mask in front of the folding mirror one can clip off unwanted spectral components such as residual 800 nm, or narrow the bandwidth.
After passing the stretcher the seed pulse is fed into the preamplifier stage. The maximum bandwidth than can be amplified is from 500 nm to 750 nm. In the power-amplifier stage, the signal beam is overlapped within the same non-linear crystal with the main pump beam. After the power-amplifier stage, the beam is collimated using a mirror telescope and passes adjustable compressor made of two AR coated fused silica wedges. TOPAS-white tuning range can be extended into UV by using optional signal second harmonic generator.

Computer Controlled Tuning

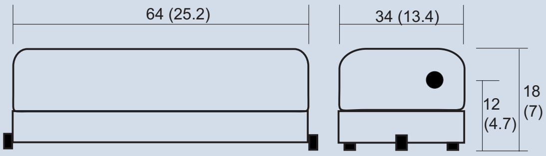
TOPAS-white is equipped with computer controllable stepping motor stages, which allow automatic tuning of the output wavelength. During wavelength tuning, the computer controls crystal angle, the two delays, compressor setting, and the optional second harmonic crystal angle. Standard WinTOPAS software is used to drive TOPAS-white. The program is written in C++ and supports interfacing with master routine in LabView.

Standard TOPAS-white Configurations

Modification	Tuning ranges (nm)*	
TOPAS-white	500-750, 850-1000	(Signal)
TOPAS-white-SH	250-375, 425-500	(SH of Signal)
	500-750, 850-1000	(Signal)

SH-Second Harmonic
*Wavelength ranges are for 800 nm pump wavelength. The ranges will shift for a different pump wavelength.

TOPAS-white and TOPAS-white-SH DIMENSIONS in cm (inches)



LIGHT CONVERSION LTD

Sauletekio av. 10
LT-10223 Vilnius
Lithuania
Tel.+370 (5) 2491830
Fax.+370 (5) 2698723
E-mail: lc@lightcon.com

http://www.lightcon.com

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PERFOMANCE SPECIFICATIONS

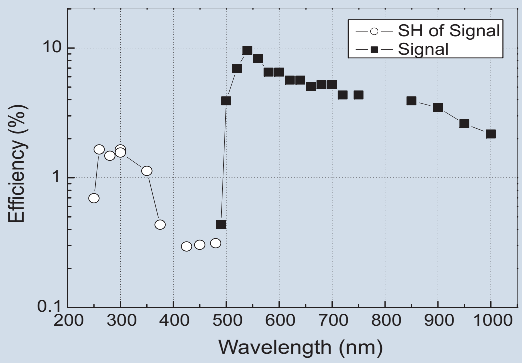
PUMP REQUIREMENTS

Input wavelength	770 - 820 nm
Pulse energy	0.2- 1.0 mJ
Pulse duration (FWHM)	80 - 150 fs
Spectral input bandwidth	≤ 180 cm^{-1}
Energy instability	≤ 1.0% rms
Instability of pulse duration	≤ 2% rms
Input spatial profile	Gaussian
Intensity modulation	≤ 15%
No hot spots	

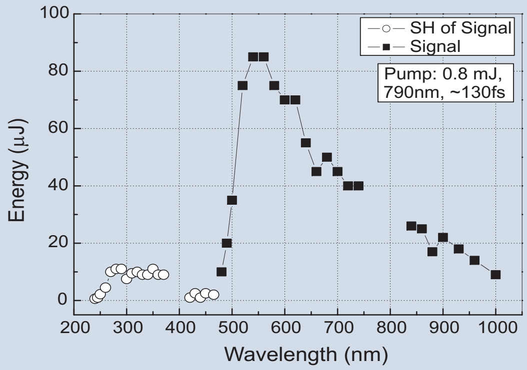
SIGNAL OUTPUT (with 800 nm, 0.5 mJ pump)

Tuning range	500 - 750 nm 850 - 1000 nm
Pulse energy	≥ 30 μJ @ 550 nm ≥ 20 μJ @ 700 nm
Pulse duration, assuming Gaussian profile	≤ 25 fs @ 530 - 720 nm ≤ 70 fs @ 500 - 530 nm ≤ 70 fs @ 720 - 750 nm ≤ 70 fs @ 850 - 1000 nm
Energy instability	≤ 1.5% rms - 5% rms (depending on the wavelength and the input stability)
Instability of pulse duration	≤ 3% rms

TYPICAL TOPAS-WHITE OUTPUT EFFICIENCY
(efficiency= output energy/ input pump energy @800nm)



OUTPUT ENERGY FROM TOPAS-WHITE
Pumped by 0.8 mJ @ 790 nm



OUTPUT FROM SECOND-HARMONIC GENERATOR (with 800 nm, 0.5 mJ pump)

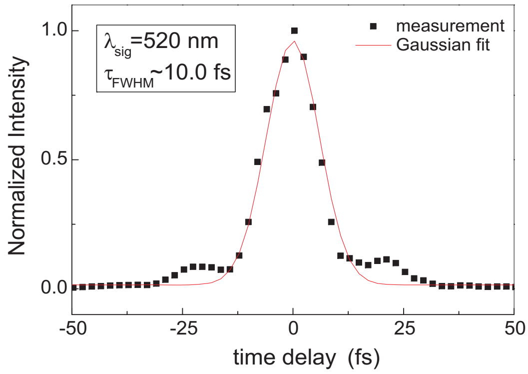
Tuning range	250 - 375 nm 425 - 500 nm
Pulse energy	≥ 4 μJ @ 275 nm ≥ 2.5 μJ @ 350 nm ≥ 1.0 μJ @ 450 nm
Pulse duration, assuming Gaussian profile	≤ 40 fs @ 325 nm ≤ 75 fs @ 450 nm
Energy instability	≤ 2.5% rms - 6% rms (depending on the wavelength and the input stability)

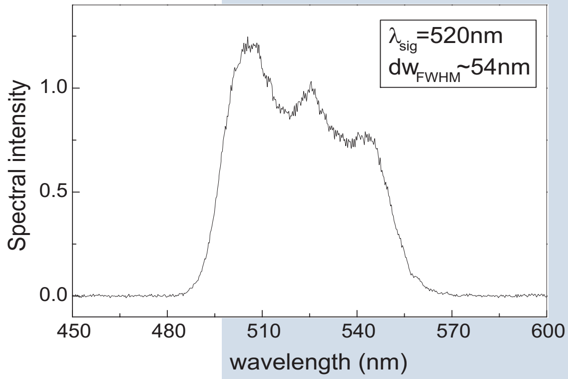
Note: output energies scale linearly with the pump energy in the pump energy range of 0.2 - 1 mJ

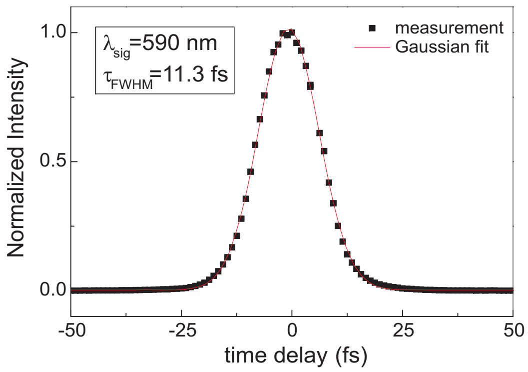
PERFOMANCE DATA
Signal Autocorrelations and Spectra

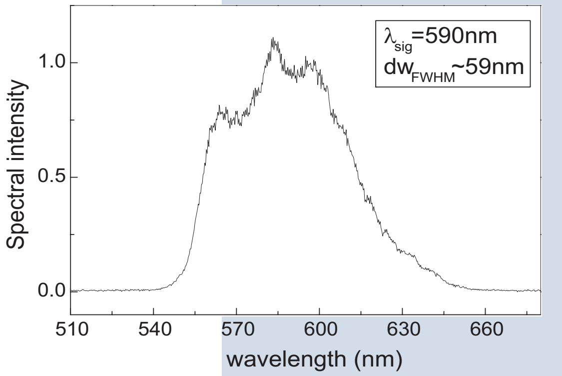
TOPAS-white

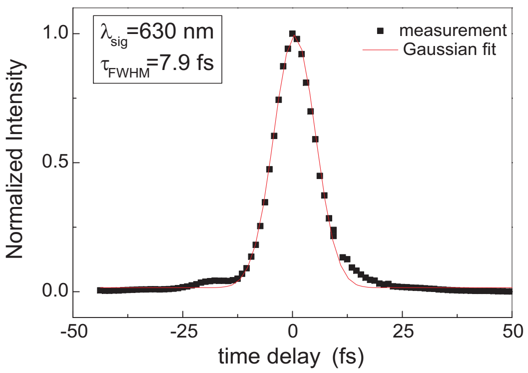
The shortest signal pulses

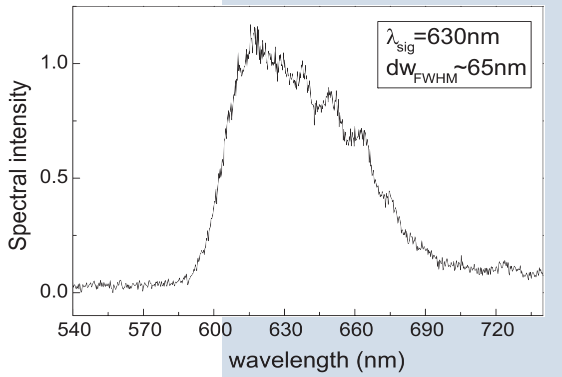


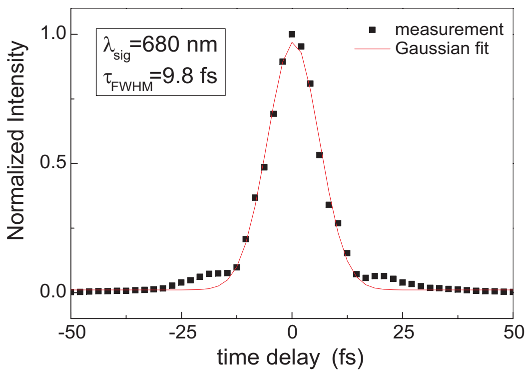


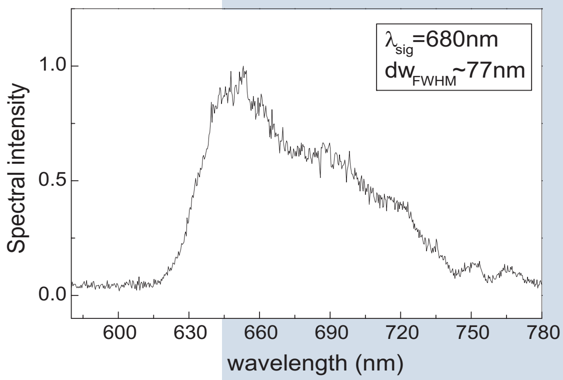












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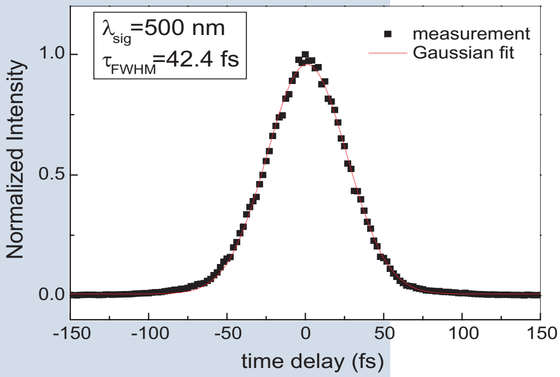
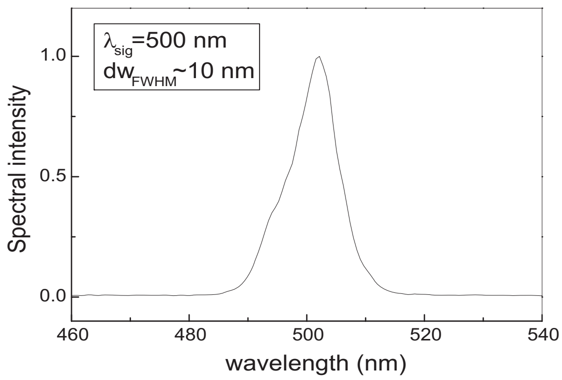
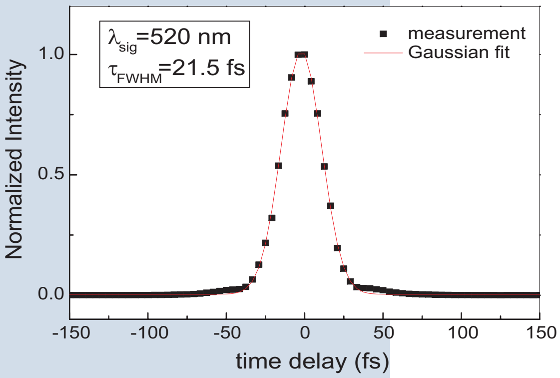
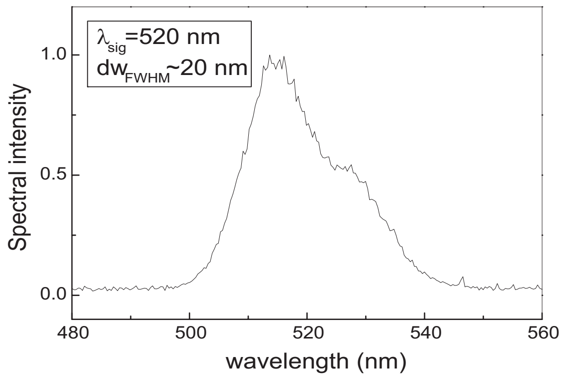
PERFOMANCE DATA
Signal Autocorrelations and Spectra

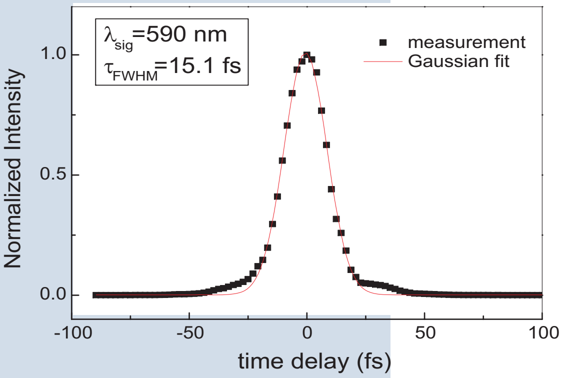
Typical signal pulse duration

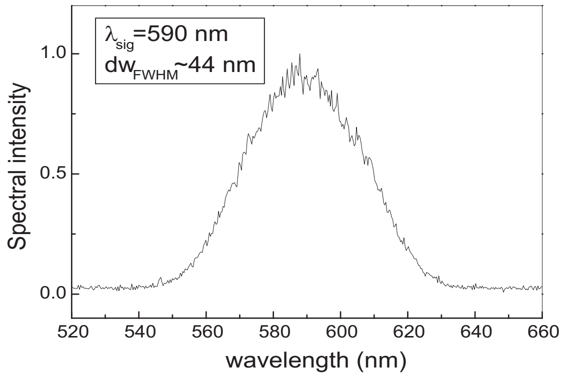


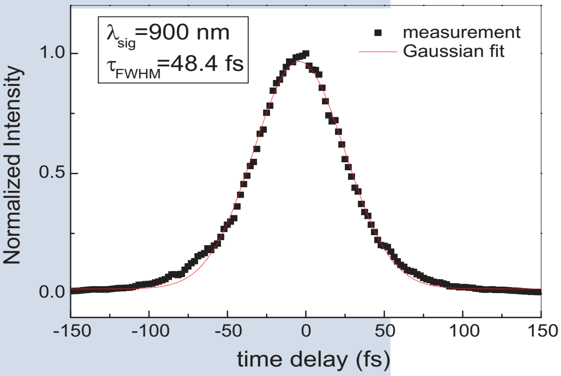


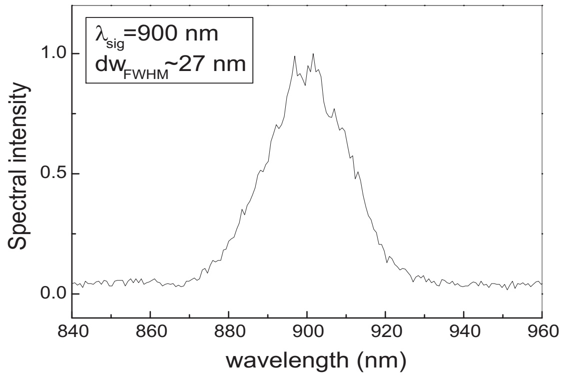












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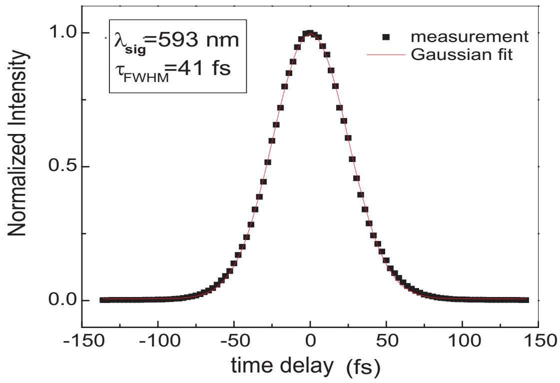
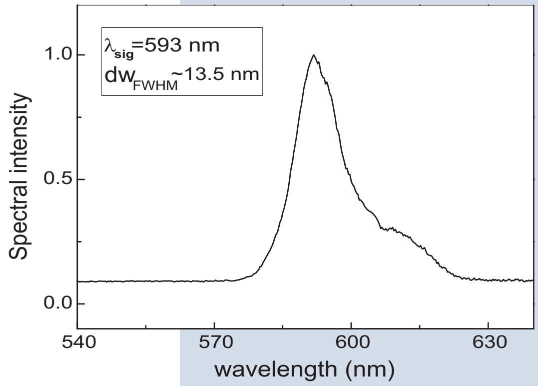
PERFOMANCE DATA

Narrow signal spectrum mode

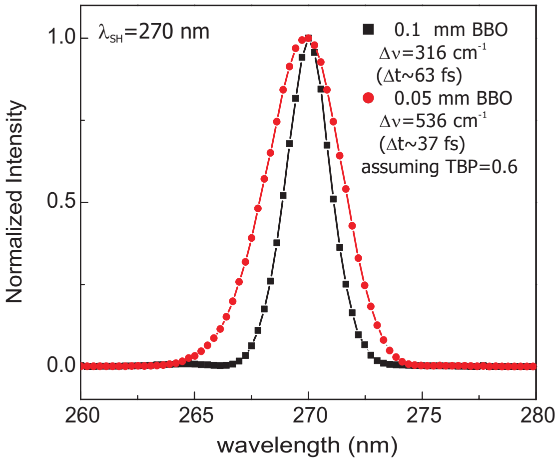
Autocorrelation

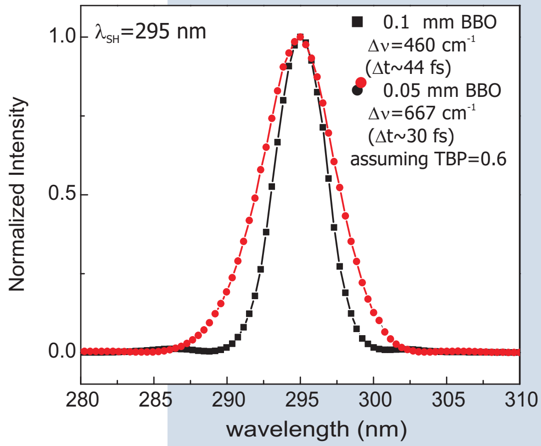


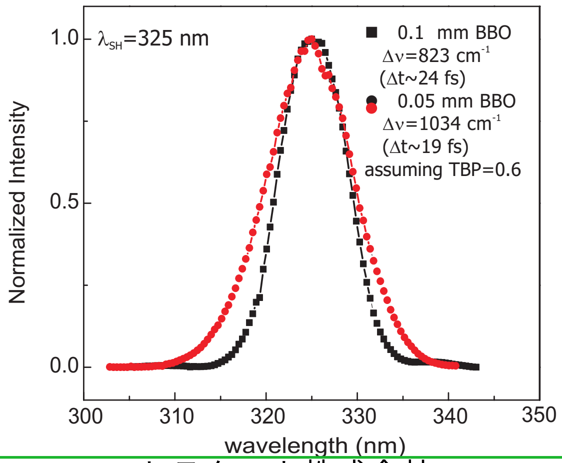
Spectrum



TOPAS-white-SHS spectra of second harmonic of signal







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Sauletekio av. 10
LT-10223 Vilnius
Lithuania
Tel.+370 (5) 2491830
Fax.+370 (5) 698723
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http://www.lightcon.com