

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

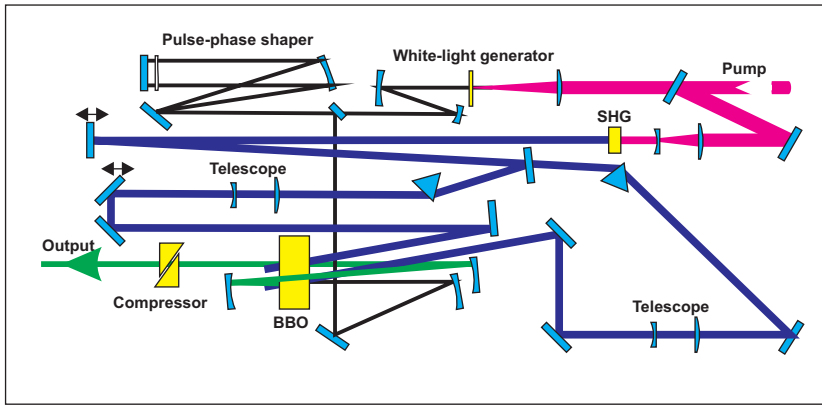
Basics of Operation

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

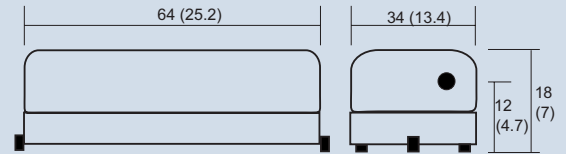
Modification	Tuning ranges (nm)*	
TOPAS-white	500-750, 850-1000	(Signal)
TOPAS-white-SH	250-375, 425-500	(SH of Signal)
	500-750, 850-1000	(Signal)

SH-Second Harmonic

*Wavelength ranges are for 800 nm pump wavelength. The ranges will shift for a different pump wavelength.

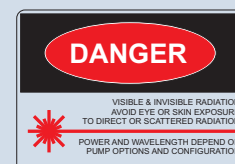
TOPAS-white

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>

PERFORMANCE SPECIFICATIONS

PUMP REQUIREMENTS

Input wavelength	770 - 830 nm
Pulse energy	0.2- 1.0 mJ
Pulse duration (FWHM)	80 - 150 fs
Spectral input bandwidth	$\leq 180 \text{ cm}^{-1}$
Time bandwidth product	<1.3 times transform limit
Energy instability	$\leq 1\%$ RMS
Instability of pulse duration	$\leq 1\%$ pulse-to-pulse
Pulse front tilt	<10% of pulsewidth
Pulse contrast	<5 % of output energy in background
Spatial mode quality	$M^2 < 1.2$
Beam spatial profile	Gaussian- Hyper Gaussian
Intensity modulation	$\leq 15\%$
No hot spots	
Beam divergence	<1.2x(diffraction limit)
Beam pointing instability	<0.1x(diffraction limit)
Beam height	135-185mm from optical table
Beam size, $1/e^2$	<7 mm (optional external telescope can be ordered for the beam size 7- 28mm)

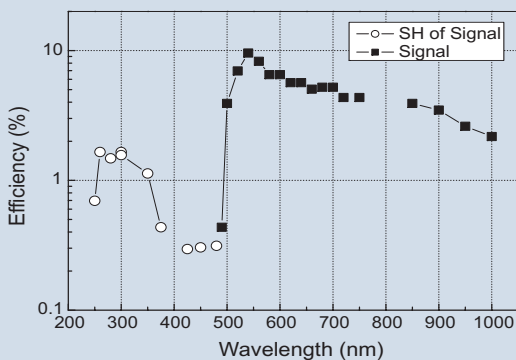
SIGNAL OUTPUT (with 800 nm, 0.5 mJ pump)

Tuning range	500 - 750 nm 850 - 1000 nm
Pulse energy	$\geq 30 \mu\text{J}$ @ 550 nm $\geq 16 \mu\text{J}$ @ 700 nm
Pulse duration, assuming Gaussian profile	$\leq 25 \text{ fs}$ @ 530 - 700 nm $\leq 70 \text{ fs}$ @ 500 - 530 nm $\leq 70 \text{ fs}$ @ 700 - 750 nm $\leq 70 \text{ fs}$ @ 850 - 1000 nm
Pulse bandwidth	<1.8 times transform limit
Energy instability	< 9 % rms @ 500-530 nm < 2.5 % rms @ 530-700 nm < 5 % rms @ 700-750, 850-1000 nm

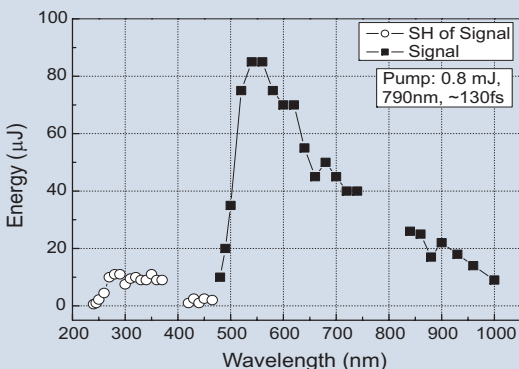
OUTPUT FROM SECOND-HARMONIC GENERATOR (with 800 nm, 0.5 mJ pump)

Tuning range	250 - 375 nm 425 - 500 nm
Pulse energy	$\geq 5 \mu\text{J}$ @ 275 nm $\geq 3 \mu\text{J}$ @ 350 nm $\geq 1.5 \mu\text{J}$ @ 450 nm
Pulse duration, assuming Gaussian profile	$\leq 40 \text{ fs}$ @ 325 nm $\leq 75 \text{ fs}$ @ 450 nm
Pulse bandwidth	<1.8 times transform limit
Energy instability	< 12 % rms @ 250-265 nm < 2.5 % rms @ 265-350 nm < 5 % rms @ 350-375, 425-500 nm

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

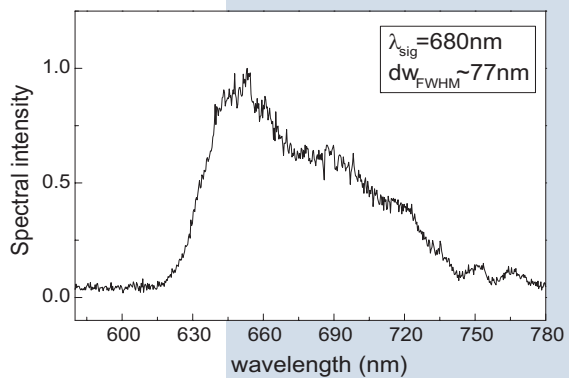
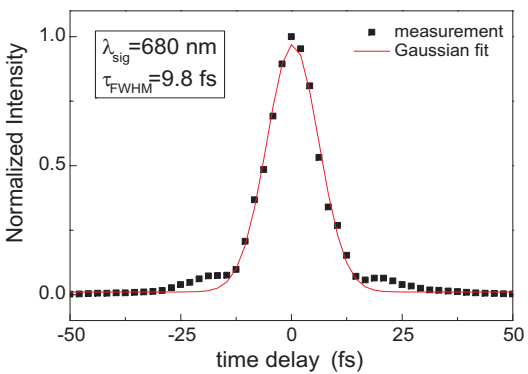
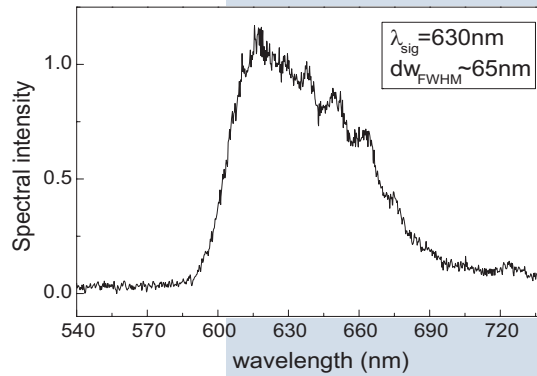
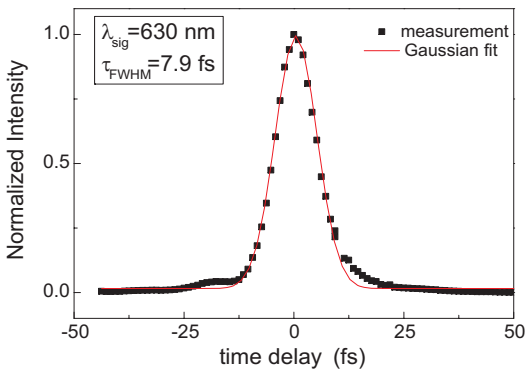
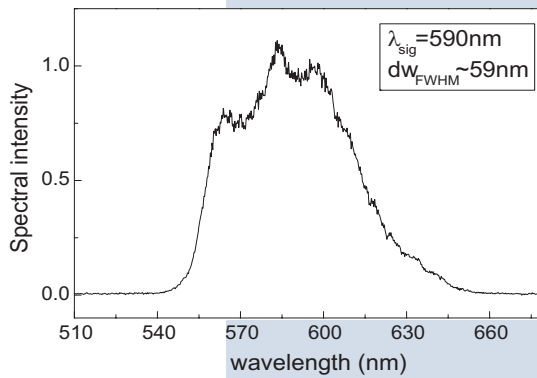
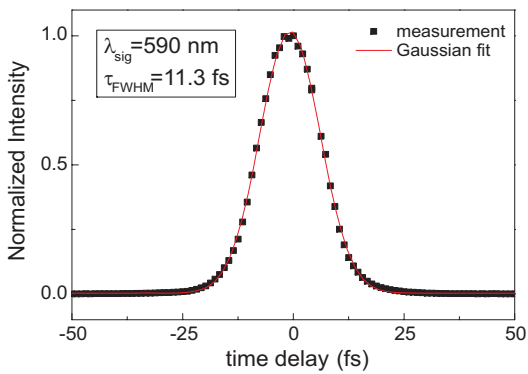
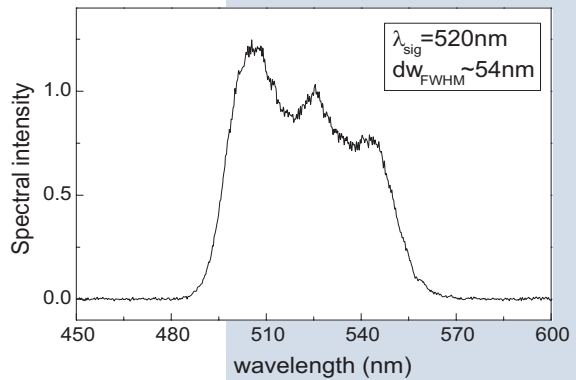
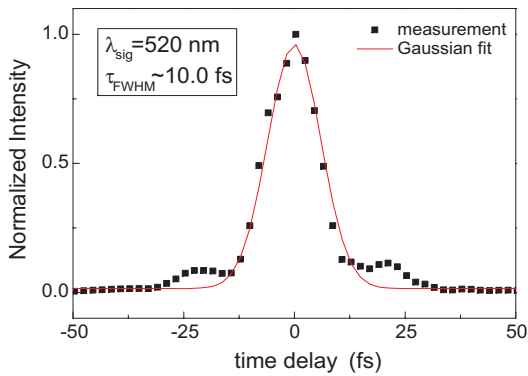


OUTPUT ENERGY FROM TOPAS-WHITE
Pumped by 0.8 mJ @ 790 nm



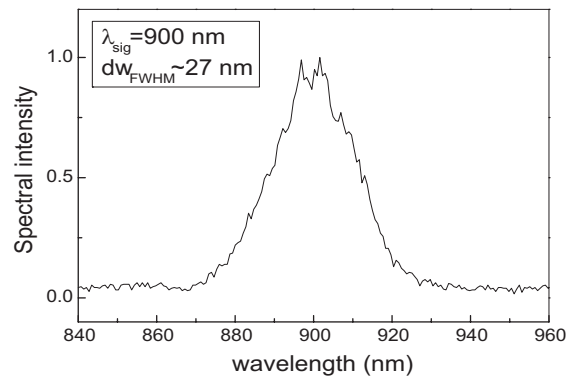
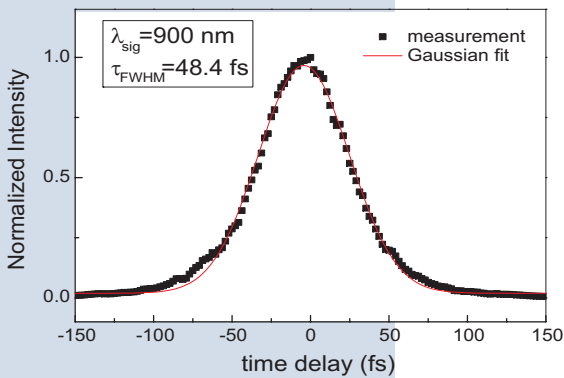
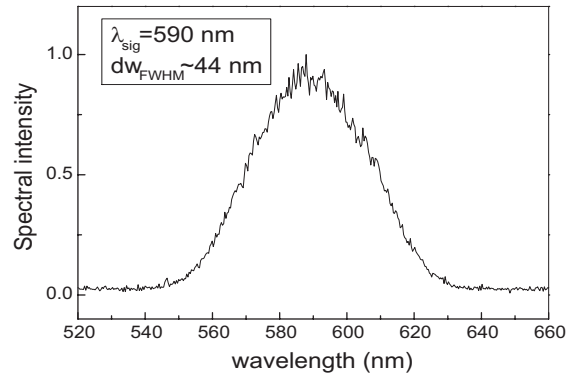
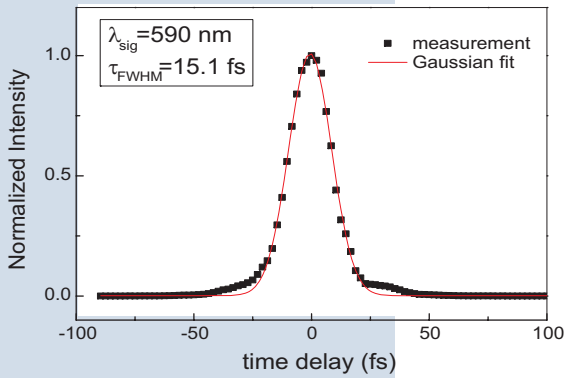
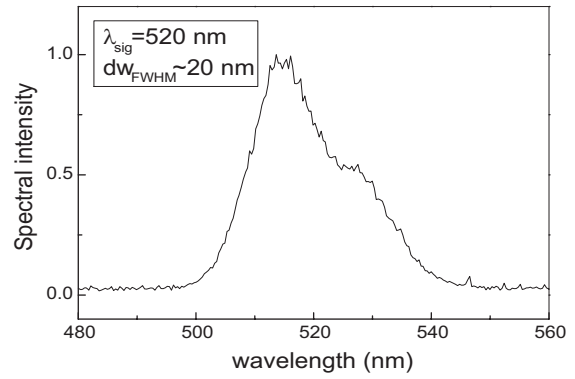
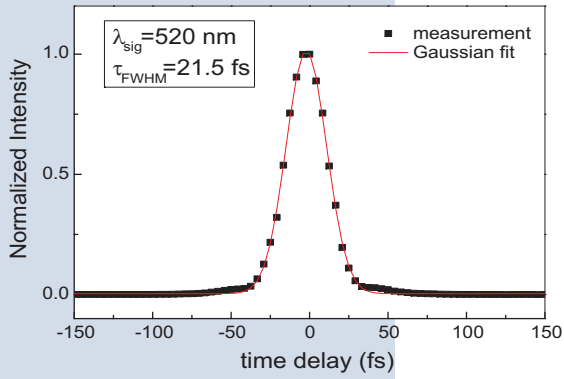
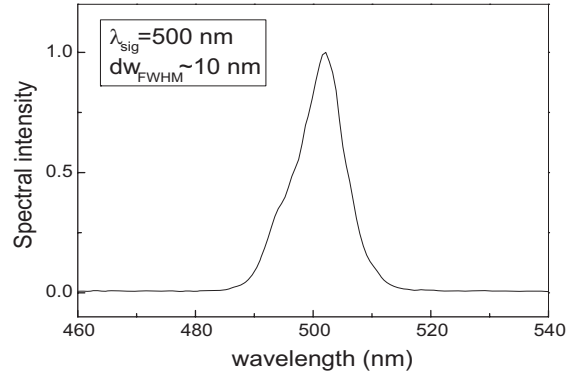
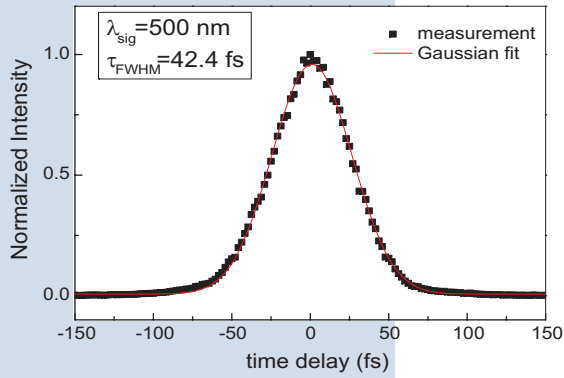
Note: output energies scale linearly with the pump energy in the pump energy range of 0.3 - 1 mJ

The shortest signal pulses



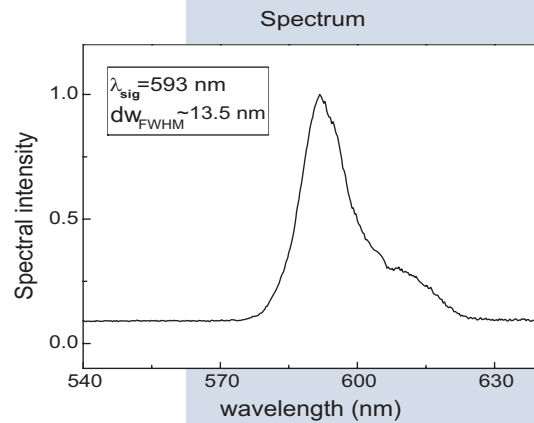
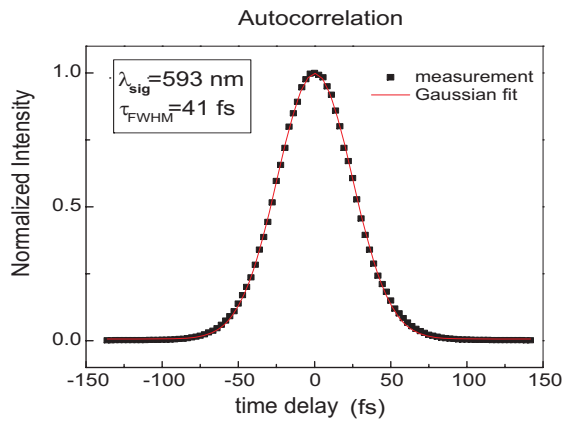
PERFORMANCE DATA
Signal Autocorrelations
and Spectra

Typical signal pulse duration

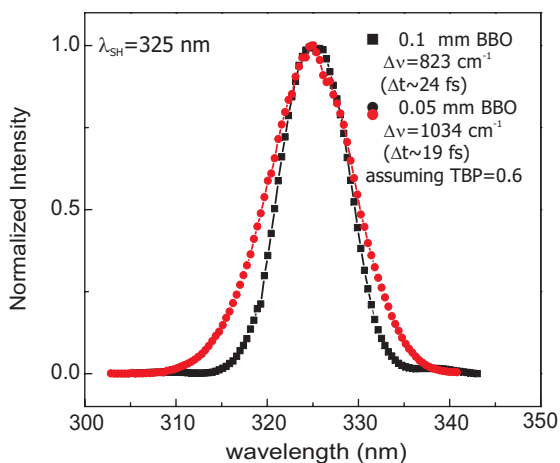
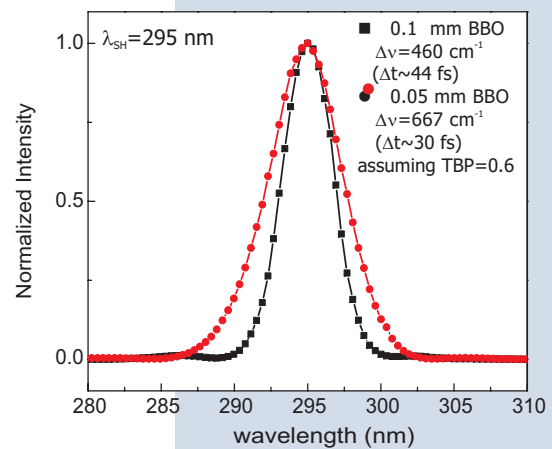
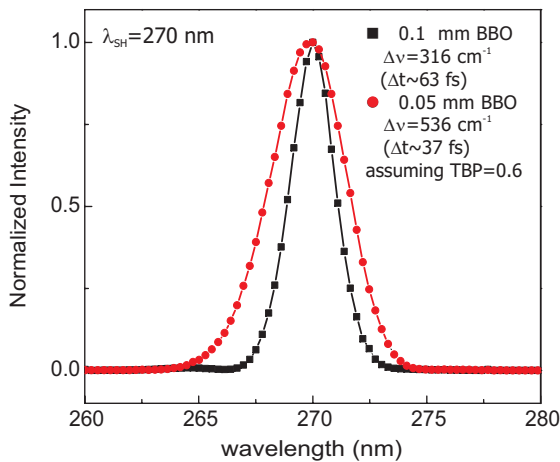


Narrow signal spectrum mode

PERFORMANCE DATA



TOPAS-white-SHS spectra of second harmonic of signal



LIGHT CONVERSION LTD

Sauletekio av. 10
 LT-10223 Vilnius
 Lithuania
 Tel. +370 (5) 2491830
 Fax. +370 (5) 698723
 E-mail: lc@lightcon.com

