HORIBA
Scientific

TGS-Series

Toroidal Grating Spectrograph

Coming from Synchrotron technologies

Compact

Stable

True Flat Field

No Motor

Robust

Fixed position

High Troughput

Grazing Incidence

JOBIN YVON
Technology

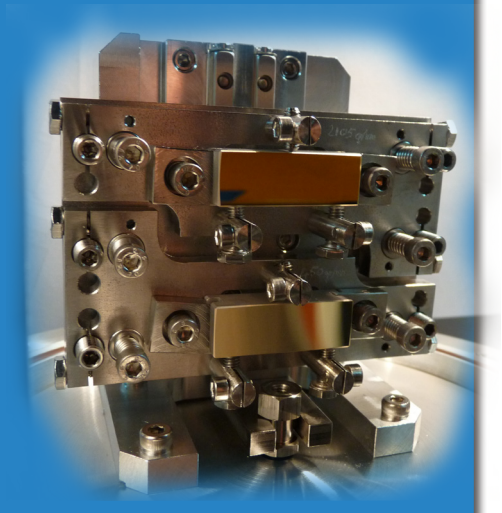
A spectrograph to explore the 9.5–170 nm spectral range

Variable Line Spacing Gratings

TGS use aberration-corrected VLS toroidal gratings which disperse and refocus the light from the entrance slit onto the exit focal plane of the spectrograph.

The groove spacing of these gratings is computer-optimized to produce high quality images with a minimum of astigmatism and coma over a large spectral range and even at high numerical aperture.

The VLS grating grooves are no longer straight and parallel, but instead correspond to confocal hyperboloids or ellipsoids. Optimizing the position, angles and arm lengths of the two recording beams provides the optical designer with the degrees of freedom necessary to minimize aberrations.



Two gratings in slider

The TGS (Toroidal Grating Spectrograph) series is especially designed for analyzing the whole VUV wavelength range from 9.5 to 170 nm with high spectral resolution thanks to its bi-dimensional flat field.

TGS300 in UHV version, with 2 gratings on slider

A full spectrum range is simultaneously acquired in a single acquisition when adding an array detector. With a standard DN100CF exit flange mounted on XY table, a 25 mm array detector will be easily optimized in wavelength centering and focusing over the 40 mm flat spectrum.

Applications

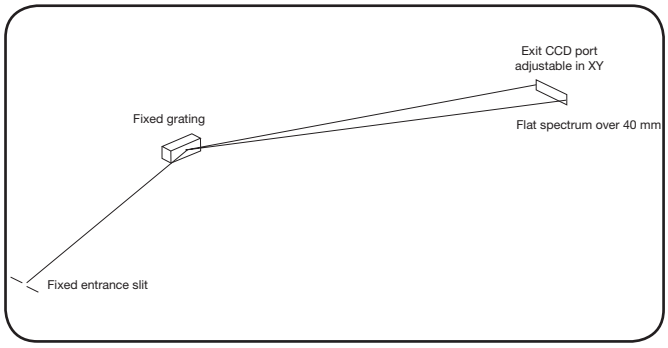
- **High Harmonic Generation**
- **EUV and UV Plasma analysis**
- **Light source characterization**
- **VUV Laser Analysis**

Features	Benefits
• Single Toroïdal Grating design	• Optimized for throughput
• Choice of three gratings	• Optimized spectral range and resolution
• Low astigmatism level	• 40 mm Flat field spectrograph
• Fixed grating position	• Robust
• CCD flange adjustable in exit focal plane	• In vacuum focus and central wavelength adjustment
• Choice of master or replica gratings	• Optimize damage threshold or cost
• Kinematic grating mount or two gratings slider	• Interchangeable gratings
• Compact design	• Less room consuming and easy to install
• High Vacuum compatible	• HV (10^{-6} mbar) – Optional UHV operation (10^{-9} mbar)

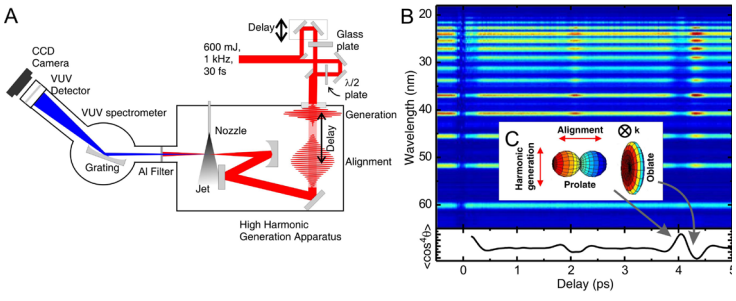
A Fixed system with Flat Field Focal plane

A grazing VLS designed to optimize resolution and efficiency

Based on HORIBA Scientific technology, the TGS series is designed around a single toroidal aberration corrected grating working in grazing incidence to increase the efficiency in the EUV range. Instead of having a fixed spherical grating and the exit port rotating on the Rowland circle as most of the other common design, the TGS has the particularity to have a flat field focal plane almost perpendicular to the exit axis of the instrument. Therefore, the CCD detector is fixed in position and acquires simultaneously a full spectrum with an unmatched throughput and resolution over the whole spectral range, making the TGS a very compact and stable solution.

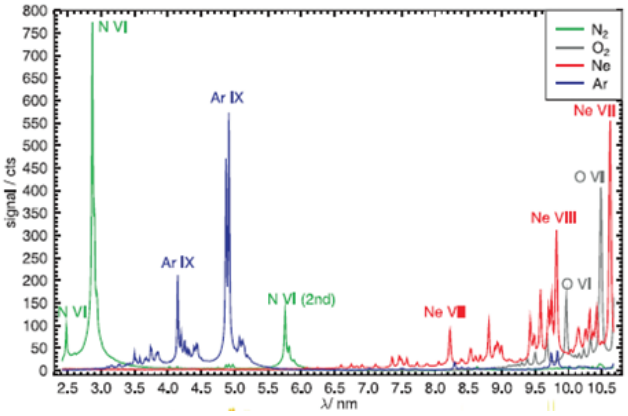


TGS300 optical layout



High harmonic generation from multiple orbitals in N_2 (B. K. McFarland, J. P. Farrell, P. H. Bucksbaum and M. Gühr, Science, **322**, 1232 (2008)

The calibration of the instrument with harmonics and plasma emission is described in: Calibration of a High Harmonic Spectrometer by Laser Induced Plasma Emission, J. P. Farrell, B. K. McFarland, P. H. Bucksbaum and M. Gühr, Optics Express, **17**, 15134-15144 (2009)



Pinch discharge operated in different working gases recorded with a custom TGS (HEXOS 1)

Gratings available

Model	Gratings		Spectral range		Exit Dispersion	Resolution (FWHM in nm)
	Part Number	Density (gr/mm)	nm	eV		
TGS300	541 00 220	2105	9.5 - 32	39 - 130	0.5 nm/mm at 9.5 nm, 0.6 nm/mm at 32 nm	2105 gr/mm 0.036 nm
	541 00 200	450	10 - 110	11 - 124	2.3 nm/mm at 10 nm, 2.7 nm/mm at 110 nm	450 gr/mm 0.075 nm
	541 00 210*	290	15.5 - 170	7 - 80	3.5 nm/mm at 15.5 nm, 4.2 nm/mm at 170 nm	290 gr/mm 0.11nm

* Gratings are available in master or replica version

Options

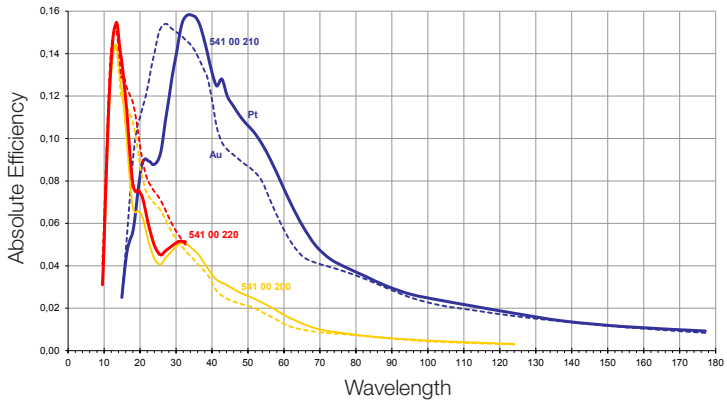
- Ultra High Vacuum (UHV, 10^{-9} mbar) version
- Slider for grating change under vacuum
- Removable entrance arm
- Laser kit for easy alignement

Accessories

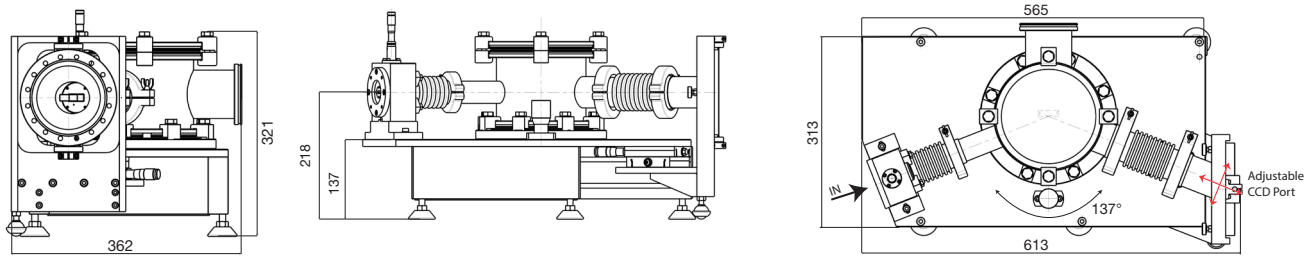
- EUV/UV light source
- CCD detectors

TGS Specifications

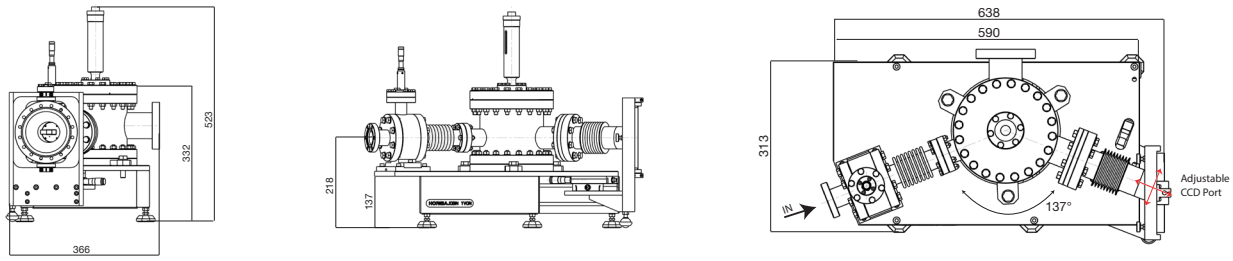
	TGS300
Optical design	Fixed toroidal VLS Grating (single optic)
Focal length	300 mm
Aperture	f/30
Optic coating	Pt (Au in option)
Deviation angle	137°
Vacuum	10^{-6} mbar (HV version) or 10^{-9} mbar (UHV version)
Pumping flange	DN63LF (DN63CF)
Entrance port	Micrometric slit (10 µm to 2 mm)
Exit port	Adjustable CCD port
Entrance flange	DN40 KF
Exit flange	DN100CF
Software	HORIBA Scientific software
PC Interface	RS232 - USB2



Theoretical Absolute Efficiency



TGS300 in HV version, two gratings on slider



TGS300 in UHV version, two gratings on slider

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