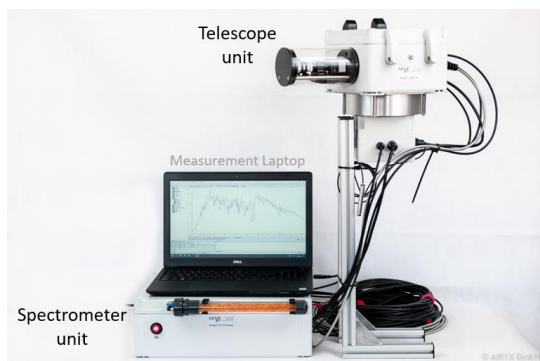


SkySpec 2D Instrument v.250

FAST AND ACCURATE SPECTRAL OBSERVATIONS OF SCATTERED AND DIRECT SUN LIGHT



SkySpec 2D spectrometer and telescope units



SkySpec 2D on tripod mount

The SkySpec instrument series performs fast, flexible and reliable atmospheric observations with the passive DOAS (Differential Optical Absorption Spectroscopy) method; according to VDI standard 4212. Ultra violet (UV) and visible (Vis) radiation spectra of direct and scattered sunlight in multiple viewing directions are acquired and analysed to obtain information on the spatial distributions of various trace gases (e.g. NO₂, SO₂, HCHO) and aerosols. The instrument's spectrometer unit houses two spectrometers and the control electronics for installation in the lab. The separated telescope unit is connected via glass fibre, power and data cables (typically 10 m) and is installed outside. This setup guarantees optimum stability and spectral data quality. The instrument is operated from an external PC connected over USB. The use of two spectrometers allows a broader spectral range (UV and Vis) measuring more trace gases and aerosol properties while achieving a high spectral resolution and avoiding spectral under-sampling (with FWHM > 5 pixel). The covered spectral range and resolution of the instruments can be adapted to the needs of the user. The ultra-low stray light spectrometers are temperature stabilized with a precision better than 0.02 °C to allow stable and reliable recording of spectral data. The motorised prism telescope can realise viewing elevation angles from -10° to 190° and includes an inclination sensor with automatic elevation adjustment for applications on moving platforms. In contrast to other SkySpec

instrument systems, the 2D system's telescope features an additional motor for horizontal rotation, allowing to point the telescope to any direction in the sky. Direct Sun spectra can be recorded with an optional motorised light diffuser system, which can be moved into the optics to reduce light intensity and realise a homogeneous Sun spectrum essential for good spectral data quality. The system allows to switch between direct Sun and scattered sunlight measurements within seconds. The horizontal telescope pointing is automatically calibrated from the Sun's position. In combination with the aforementioned real-time elevation adjustment, this allows very fast deployment of the SkySpec 2D without the need for levelling.

The telescope features only few moving parts on the outside, which guarantees low maintenance and long system life. The integrated telescope heating activates below 5 °C and avoids snow and ice on the optics.

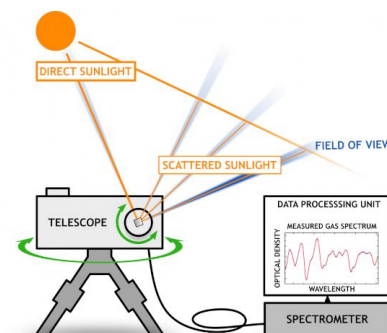
With the new model 250, the telescope can also be used separately with RS232 communication. Different telescopes can be switched between systems, providing flexibility also with regards to high precision spectroscopic applications other than passive DOAS. Humidity is now monitored in both, spectrometer and telescope unit, to reduce maintenance efforts.

MEASUREMENT GEOMETRIES

- Multi Axis (MAX)-DOAS measurements for vertical profiling and horizontal gradient detection of tropospheric aerosols and trace gases.
- Direct Sun DOAS measurements, for the retrieval of stratospheric and tropospheric trace gas total columns.
- Zenith Sky measurements with high sensitivity to stratospheric gases

APPLICATIONS

- Detection of numerous species, e.g. NO₂, O₃, SO₂, HCHO, H₂O, HONO, IO, BrO, Glyoxal
- Air quality monitoring in urban, rural and pristine environments
- Emission plume studies and total flux measurements of power plants, industrial complexes or volcanoes
- Scientific studies (e.g. atmospheric chemistry, validation of satellite data)
- Spectral analysis of surface reflections
- Long-term measurements with low maintenance requirements



Scheme of SkySpec 2D measurement geometry and principle.

PROPERTIES (TYPICAL)

Spectrometer specifications (typ.)^{1,2}	Config.	Range [nm]	FWHM [nm]	Filter
	UV-I	300-405	0.45	BG3
	UV-II	300-460	0.6	BG3
	Vis	420-565	0.6	BG40
Noise	10 ⁻⁴ at 1000 scans (= 60 s integration time)			
Quantum efficiency	UV: 60% with back-thinned detectors Vis: up to 80%			
Spectrometer temp. stability	20 °C (adjustable), ± 0.02 °C			
Wavelength calibration	Highly stable in-house calibration (typ. shifts < 0.01 nm), optionally: build in mercury-lamp or manual calibration			
Operation temperature range	Spectrometer unit: -10 °C to 40 °C Telescope: -30 °C to 50 °C			
Elevation range and accuracy	-10° to 190°, ± 0.2° automatic elevation correction			
Azimuth range and accuracy	-5° to 185°, ± 2° (360° virtually available due to > 180° elevation range)			
Field of view FWHM, vertical x horizontal	Scattered light: ≈ 0.3° x 1° Direct Sun ³ : ≈ 10° x 10°			

Mechanical stability	Robust for harsh environmental conditions, water proof (IP 64)	
Additional Sensors	Temperature:	1 °C accuracy, ambient, telescope, spectrometers, electronics
	Pressure:	0.5% accuracy, ambient
	Humidity:	± 3% accuracy in relative humidity, Spectrometer and telescope unit.
Measurement software	Included, customizable measurement routine (angles, time resolution)	
Start-up time	< 2 min	
Data communication	USB 2.0	
Power consumption	Typ. < 30 W (max. 100 W), 12 V	
Weight	Spectrometer unit	≈ 8 kg
	Telescope unit	≈ 7 kg
	Full setup (incl. Laptop, fibres, cables)	≈ 20 kg
Size	Spectrometer unit	40 x 35 x 13 cm ³
	Telescope unit	37 x 23 x 32 cm ³
Telescope mounting options	Wall mount, tripod or mast	

¹ Spectrometers equipped with colour filters to reduce stray light, ² Custom specifications are possible, ³ FOV widened due to diffusor system

OPTIONAL COMPONENTS & CONFIGURATIONS

- Custom spectrometer configuration and systems with only one spectrometer
- Integrated, wide FOV camera (2 cameras cover 0° to 180° elevation) to monitor measurement conditions
- Integrated mercury (HG) wavelength calibration lamp system
- Integrated diffusor system for homogenisation of direct Sun light
- Fibre and cable length of 15 or 20 m
- Heated Azimuth 2D motor (for low temperature operation)
- Telescope mounting frame / tripod + adapter
- Spare parts and maintenance set
- Pre-configured measurement PC (Notebook / Desktop)
- Spectral data analysis package
- Online installation and support service

ADVANTAGES

BENEFITS	INNOVATION
High measurement accuracy	<ul style="list-style-type: none"> • Coverage of large spectral range with high spectral resolution (no undersampling) • Ultra-low stray light spectrometers • Stable spectrometer temperatures, low noise • Spectrometer characterization included: wavelength calibration, offset, dark current, non-linearity • Real-time monitoring and automatic correction of telescope elevation for applications on moving platforms • Small telescope field of view (FOV) • High spectral quality in direct Sun mode
Simple setup & operation	<ul style="list-style-type: none"> • Simple instrument setup and start up • Fast, accurate and reproducible due to built-in inclination sensor • Automatic azimuth adjustment with direct Sun search • Low maintenance, easy cleaning of optics • Telescopes can be switched between systems • Easily adaptable measurement routine
Long lifetime	<ul style="list-style-type: none"> • Minimum outside moving parts • Water proof with IP64, snow resistant • Designed for long term operation • Spectrometer drying unit to avoid water condensation

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FIND MORE INFORMATION ON SKYSPEC PRODUCTS AND PERFORMANCE IN THE GENERAL SKYSPEC INSTRUMENT DESCRIPTION.