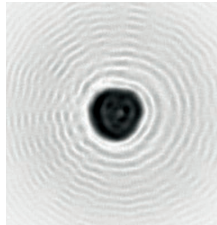
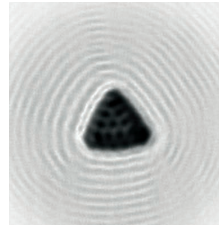


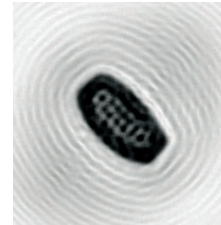
Swisens Poleno is based on groundbreaking technology for the precise and reliable identification of airborne particles and aerosols. It is specially optimized for the identification of pollen-taxa in real-time and its long-term monitoring. Swisens Poleno marks the beginning of a new era in the measurement of bioaerosols.



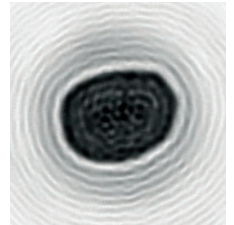
Ambrosia



Corylus avellana



Quercus robur



Fagus sylvatica



Swisens Poleno Air Flow Cytometer

The structure of Swisens Poleno is based on the analysis of:

- Holographic images
- Light scattering
- Polarization
- UV-induced fluorescence intensity and lifetime

The Swisens Poleno air flow cytometer provides the most independent characteristic values per particle available on the market. It renders a mosaic of information about the particles going through the system including high-resolution images of every single particle. Based on this rich dataset and in combination with state-of-the-art classification algorithms, outstanding quality of the classification results is achieved.

With these measurement methods, many independent features can be determined, allowing for the excellent quality of particle identification.



Monitoring Station Components

1. Sigma-2 inlet
2. Mobile router (up to 4G)
3. Swisens Poleno
4. Insulated weather protection housing with lightning protection
5. Integrated service station with 22" display and hinged keyboard
6. Air conditioning and mobile antenna; additional external weather station on request
7. Customizable easy to mount sub construction

The installation on the roof is possible by passenger lift and stairs. Total weight of weather protection housing with standard sub construction and device: 134 kg

Hardware	Basic	Standard
Integrated industrial PC (IPC)	x	x
High efficiency aerosol concentrator	x	x
Cleaning mechanism	x	x
Insertable sample collector	x	x
Straylight measurement setup	x	x
Holographic measurement setup	x	x
Fluorescence measurement setup		x
Polarization measurement setup		x
Software	Basic	Standard
Swisens Data Base	x	x
Swisens Data Explorer	x	x
Swisens Data Analyzer	x	x
Classification of pollen	x	x
Classification of smaller particles (spores, PM, allergens, ...)		x

Swisens Poleno Product Line

The Standard version of Swisens Poleno includes all available up-to-date measurement hardware including the measurement setups for holography, UV-induced fluorescence and polarization. It provides superior identification of countless pollen species but also smaller particles down to 1 µm like spores or particulate matter.

The Basic version of Swisens Poleno is a cost-effective entry point and specifically addresses the application of pollen monitoring. It provides stable, long-term measurement of the most important pollen species relevant to allergic people. The Basic version can be upgraded to the Standard version.

Both versions come with an IPC running a server with the Swisens Data Base, providing a flexible REST-API for easy access. Remote visualization and analysis are enabled by Swisens Data Explorer and Swisens Data Analyzer. The participation in the Swisens Ecosystem provides access to the Open Training Data Base and latest classification software.

Weather Protection

The customizable, lightweight weather protection housing comes with air conditioning, a mobile antenna and lightning protection as well as a Sigma-2 inlet. The system is easily maintainable due to an integrated service station with display and keyboard and telecommunications means for remote access and control. The construction allows for quick transportation and installation on location (e.g. on a roof) i.e. by passenger lift and stairs. There is no need for a complex installation by crane or external transport lift.

Features Of Complete Monitoring Station

- Long-term monitoring
- Remote access and control
- Device status monitoring and notification
- Maintenance friendly
- Adaptable to customer needs

Optional Accessory

- Swisens Atomizer
- External weather station

Swisens Poleno Function Principles

The schematic structure of the device in figure 1 shows an air-flow cytometer based on the analysis of light scattering, holographic images and UV-induced fluorescence. With these measurement methods, many independent features can be determined, allowing for the excellent quality of particle identification. An aerosol-concentrator with a concentration factor of 1000 enables a volume flow rate of 40 liters per minute to be analyzed, which enables high time resolution for the measurement of local pollen concentration within minutes.

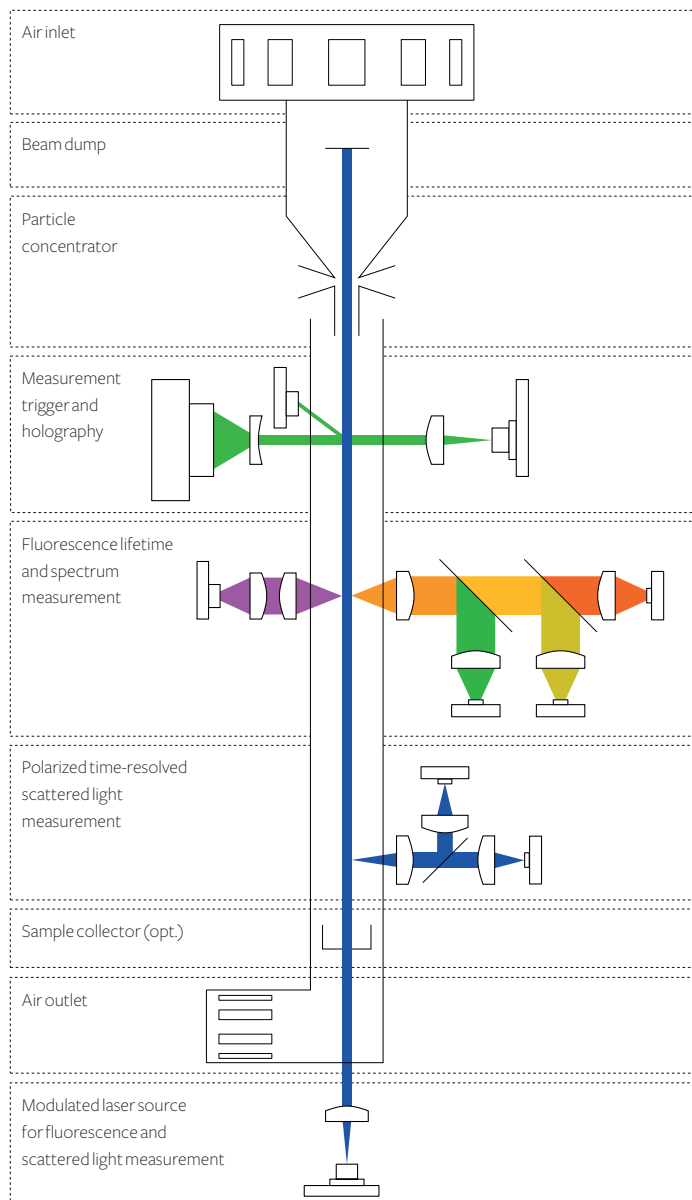


Figure 1: Swisens Poleno schematic structure

Morphological Features

Information about the morphology of each individual pollen-grain is collected with a high-resolution holography setup delivering images of the particles. The advantages of the setup include a wide field of view in x, y and z-axis while maintaining a very high resolution. Figures 2 to 4 show reconstructed images of pollen grains taken in flight with the holography measurement setup. The whole image shows an area of 115 x 115 μm . The time-resolved measurement of the vertical and horizontal polarized scattered light provides information about the surface structure, size and the polarization factor.

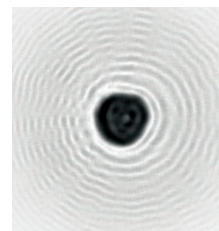


Figure 2: Ambrosia

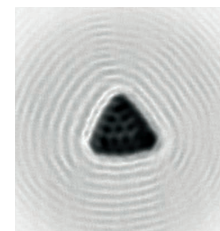


Figure 3: Corylus avellana



Figure 4: Quercus robur

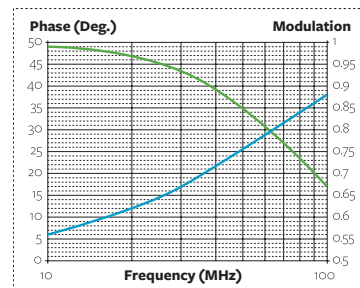


Figure 5: Fluorescence lifetime measurement data visualization

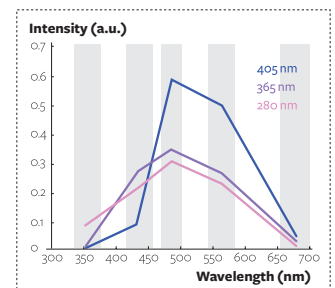


Figure 6: Fluorescence intensity measurement data visualization

Biochemical Composition

Complementary information in addition to the morphological features is collected by spectrally resolved fluorescence intensity and fluorescence lifetime measurements. This delivers an additional dimension of information and allows for the extremely accurate identification of the different pollen-taxa. Figure 5 shows the correlation phase and correlation magnitude for a single particle measured at different modulation frequencies. By means of curve fitting, the different lifetime components can be extracted. Figure 6 shows the fluorescence intensity measured at five different wavelengths ranging between 320 and 750 nm. There are three different modulated light sources (405 nm, 365 nm, 280 nm) to excite the particles as they are flying by.

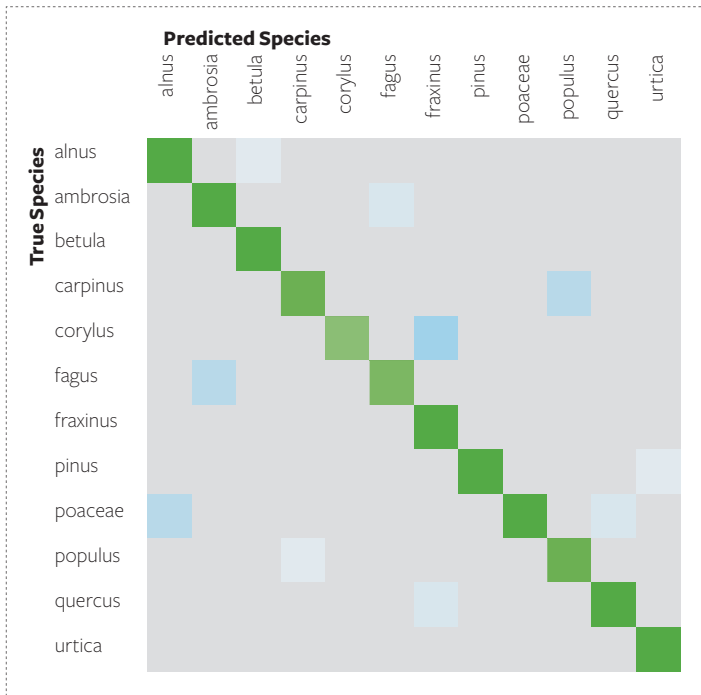


Figure 10: Identification quality shown by the confusion matrix

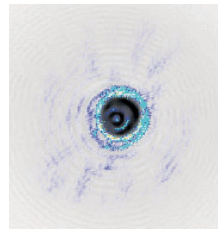


Figure 7: Ambrosia

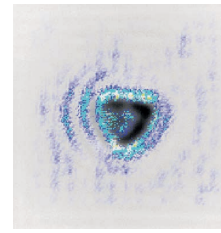


Figure 8: Corylus avellana

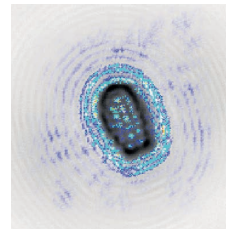


Figure 9: Quercus robur

Automatic Pollen-taxa Identification

The multifaceted mosaic of information gathered from each particle passing through the system is processed by state-of-the-art machine learning algorithms/neuronal networks. Figures 7 to 9 show the region of interest the algorithm is trained to observe regarding to the holographic images. These algorithms are integrated in each instrument. Furthermore, all raw data is accessible for the user as well.

The confusion matrix in Figure 10 shows the outstanding performance of Swisens Poleno. More than 12 different pollen species can be separated with high accuracy.

Specifications Of Swisens Poleno

Particle type

Pollen, spores, airborne solids

Particle size range

1 µm to 300 µm

Max. recom. particle concentration

30'000 particles per m³

Sampling time

Continuous operation

Flow rate

40 l/min

Particle concentrator

Concentr. factor 10 to 300 µm: 1000

Holography setup

Two 90° displaced images per particle

Pixel resolution: 0.6 µm/pixel

Number of pixels: 2048 x 1536

Frame rate: up to 55 images/second

Polarization measurement

Time resolution: 4 µs

Fluorescence (FL) excitation

LEDs: 280 nm, 365 nm

Laser diode: 405 nm

FL emission measurement ranges

Five carefully chosen spectral windows in the range of 320 to 750 nm

FL lifetime measurement range

0.5 to 20 ns for each of the five spectral windows

Power

100 to 240 VAC, 50/60 Hz,

150W peak incl. IPC

Ambient conditions

10°C to 40°C, 10 to 90% R.H.,

non-condensing. For field operation, the device must be installed in a weatherproof housing (see accessories).

Dimensions

28 x 32 x 47 cm³

Weight

26 kg

Interfaces

HDMI, RJ45, 2 x USB 3.0, 1 x USB 2.0,

RS232/RS485, 4 x digital I/O, 4 x analog I/O

Consumables

No consumables

(no filter change required)

Warranty

Two years

Complete Measurement System

Included items

- Swisens Poleno
- Sigma-2 geometry air inlet
- Insulated weather proof housing
- Adaptable easy to install sub construction
- Integrated service station with 22" display and hinged keyboard
- Integrated lightning protection
- Air-conditioning system
- Mobile router (up to 4G) and antenna

Optional accessories

- External weather station
- Swisens Atomizer

Dimensions

63 x 73 x 150 cm³

Total Weight

134 kg (incl. Swisens Poleno)

Communications

Ethernet, GSM/UMTS/LTE/WLAN

Power

100 to 240 VAC, 50/60 Hz, 750 W peak incl. air-conditioning