

## 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.

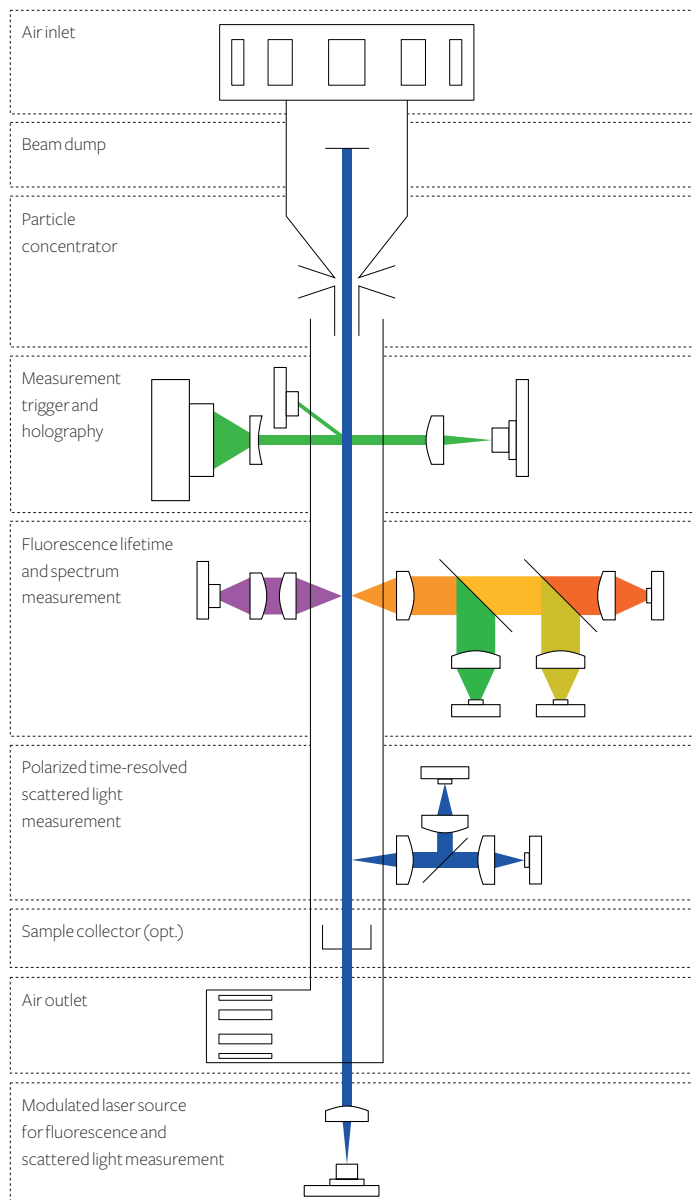


Figure 1: Swisens Poleno schematic structure

## 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  $\mu\text{m}$ . The time-resolved measurement of the vertical and horizontal polarized scattered light provides information about the surface structure, size and the polarization factor.

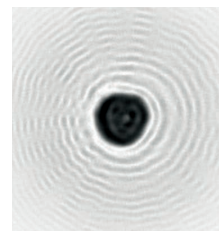


Figure 2: Ambrosia

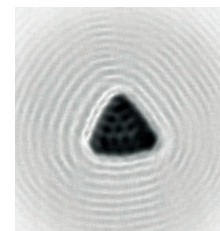


Figure 3: Corylus avellana



Figure 4: Quercus robur

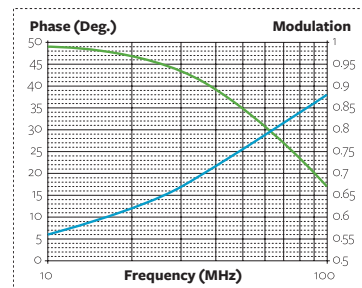


Figure 5: Fluorescence lifetime measurement data visualization

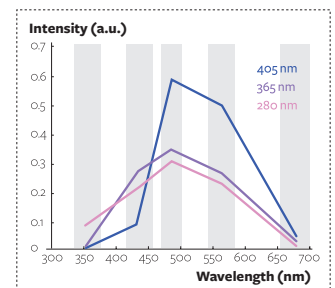


Figure 6: Fluorescence intensity measurement data visualization

## 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.

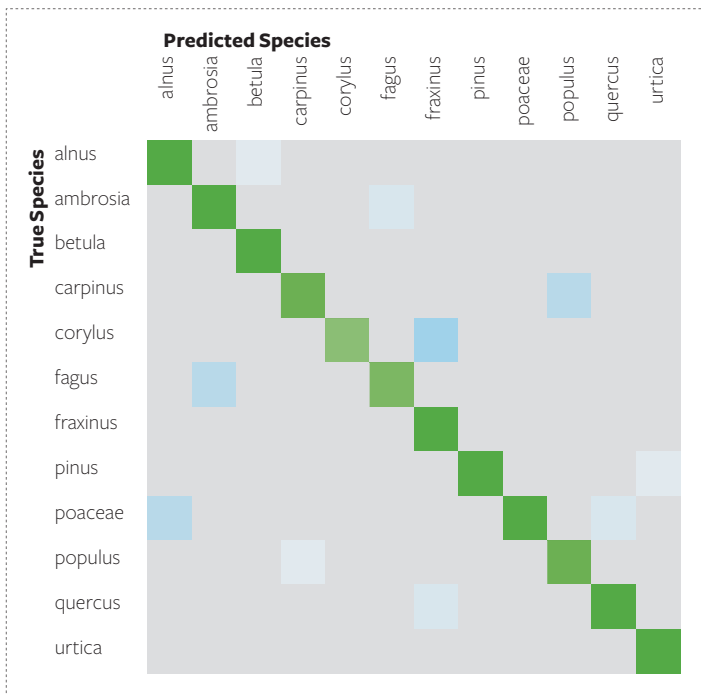


Figure 10: Identification quality shown by the confusion matrix

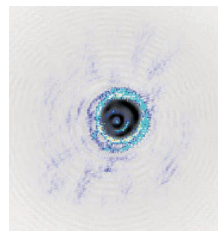


Figure 7: Ambrosia

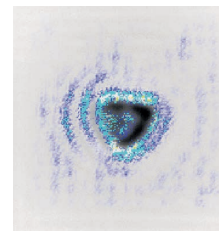


Figure 8: Corylus avellana

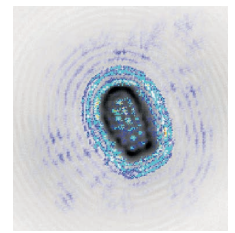


Figure 9: Quercus robur

### 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 m<sup>3</sup>

### 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 cm<sup>3</sup>

### 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 cm<sup>3</sup>

### 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