

Technical specification ESA 4000^{plus}

The Echelle Spectra Analyzer ESA4000^{plus} has been developed for different applications in atomic spectroscopy, especially for LIBS applications.

For a simultaneous multi-element-analysis and to avoid interferences, atomic emission and absorption spectra have to be measured within a large wavelength range with a spectral resolution of few picometers. This extremely high spectral resolution is achieved for a simultaneous measurement of all relevant atomic lines using the provided Echelle spectrometer in combination with an intensified CCD camera system.

The detector system, consisting of a MCP image intensifier and a CCD sensor array of high pixel density, is located in the focal plane of the spectrometer. The image intensifier is controlled by electric signals at defined times referring to the laser pulse and can be opened like a camera shutter for the desired exposure times. The simultaneous detection of the entire wavelength range permits the optimal selection of atomic lines relevant for the application as well as the optimization of the signal-to-noise ratio.

The ESA4000^{plus} consists of the following units:

- UV-VIS-Echelle spectrograph with integrated ICCD camera for time-resolved, high sensitive measurements of two-dimensional spectra. Selectable readout rates allow frame rates up to 18 Hz (region of interest mode).
New: Revised camera board with Ethernet interface enables monitoring of camera functions and generates a lower readout noise, a high dynamic and high sensitive output are available.
- Compact electronic control unit with fast-pulse-generator for measurement of ultra-fast radiation processes, enables the control of pulsed radiation sources (Laser) as well as the synchronization with external trigger pulses (master- and slave-modi).
Q-switch divider function permits triggering of flash lamp and Q-switch with different frequencies.
- Integrated Industrial PC with keyboard
- Software package for control of measurement as well as analytical tools for spectra visualization and evaluation

Description of the units:

- UV-VIS-Echelle-Spectrograph:
 - Spectral range 200 to 780 nm;
 - Linear dispersion per pixel 5 pm at 200 nm to 19 pm at 780 nm
 - Entrance slit with fiber input, SMA-connector
- Image intensifier and CCD-camera:
 - CCD-Array Kodak KAF-1001 (1024x1024 pixel)
 - gated micro-channel plate (MCP), UV enhanced S20 photocathode
 - 16bit ADC, readout frequency 0.5, 1, 2 or 4 MHz selectable, programmable line- and pixel binning
 - TE-stabilization of temperature
- Fast-Pulse-Generator:
 - MCP gate able from 20 ns to 16 s
 - Enables the control of external radiation sources, e.g. laser (2 TTL-signal outputs)
- Controller:
 - Industrial-PC with Intel Core i7-4700EQ, 3.4 GHz, 1TB SSD, 8GB RAM
 - WINDOWS® 10
 - 19" Monitor, keyboard and mouse
 - Closed cooling circuit
- Interfaces:
 - 3x RS232, DVI, 6 x USB 2.0, 2 x USB 3.0, 2x GB Ethernet
 - 10-pin process control connector, Laser Sync output

Software

- ESAWIN - Software
 - Creation of Methods
 - Setting of measuring parameters (MCP-voltage, gate width, MCP delay time, number of measuring pulses)
 - Setting of spectra display and atomic line selection
 - Setting of calibration methods and parameters
 - Setting of output parameters
 - Control of measurement (Start, Stop with pre-selection of time or pulse, manual stop, triggered externally)
 - Display of selected atomic lines for desired elements
 - Data base processing for standard and atomic data base, Data import and export
 - Dialog controlled Menus
 - Spectra processing
 - Calculation of line intensities
 - Background subtraction
 - Calculation of concentration on the basis of previously selected method
 - Dialog controlled qualitative analysis
 - Dialog controlled quantitative analysis including calculation of errors (available upon extra agreement)
 - Dialog controlled calibration using different models
 - Online help function
- Manual:
 - ESA4000^{plus} Manual and ESAWIN Software Instruction

Technical Parameters

- Power supply:
 - 115 V / 230 V, 50 / 60 Hz
- Packing:
 - Special design of packing:
 - 1 special box for the transport of the spectrometer unit and control unit - reduced vibrations
 - This special box permits the optimal transport of the ESA4000^{plus} system and prevents transport damages, e.g. losing the optical adjustment or mechanical damages.
- Technical changes:
 - The producer reserves the right for technical changes due to technical progress.

Temperature Module for ESAWIN-Software

The Temperature Module allows the determination of excitation temperatures of different particle species (atoms and ions) in the plasma using the Boltzmann-plot-method.

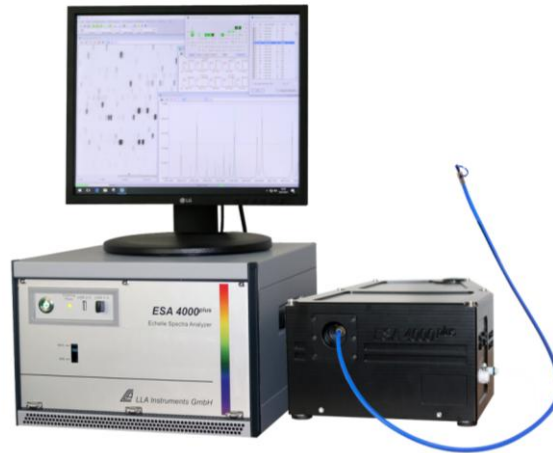
A typical problem with LIBS-measurements is the strongly varying excitation conditions that are due to the complicated interactions of laser beam and sample surface and between individual laser pulses. Measuring the laser power can give information about the energy released by the laser, but can only yield very few information about the amount of energy that has actually entered the specimen. Hence, the plasma-temperature will serve as an additional quantitative criterion for the evaluation of the stability of excitation conditions.

With the T-Module you get an additional data base containing the spectroscopic line data for the most important element lines. The files therein are a highly compressed excerpt from the *Kurucz-23 line data* (Online version of: 1995 Atomic Line Data (R.L. Kurucz and B. Bell) Kurucz CD-ROM No.23, Cambridge, Mass.: Smithsonian Astrophysical Observatory).

Installation

The installation takes place at customer's site and has duration of 1 day. The correct operation of the ESA4000^{plus} will be shown (i.e. the correct calibration of wavelengths and orders is shown) and an introduction into the software is given. **Further details see www.lla.de, Device series – Echelle spectrometer.**

ESA4000^{plus} – LAB



ESA4000^{plus} - OEM

Echelle Spectrometer ESA4000^{plus} with electronic control unit (Industrial PC, fast pulse generator and cooling unit)

ESA4000^{plus} – LAB Basic device, tabletop unit for use in and outside laboratory

ESA4000^{plus} – OEM 19” rack configuration for industrial process integration