

# iSES Remote Lab SDK

## Catalogue of hardware and software for remote laboratories



*Motto: We regard this catalogue as a basis for our co-operation.*

### Introduction

**iSES Remote Lab SDK** is an open modular hardware and software kit designed for easy creation of real remotely controlled laboratories (RCLs) that are accessible from *PC*, *tablets* and *smart phones*. This open development kit enables even beginners to build up their professional RCLs, ideal for education purposes. Developers may use any available common hardware. In order to share your experimental setup with the other Internet users, you only need to put our widget components together, which is also very easy. Remotely controlled labs based on *iSES Remote Lab SDK* provide the remote control and measurement with live video stream, easy experimental data record and download for further processing e.g. in MS Excel.



**Hardware:** Open modular system *iSES Remote Lab SDK* can communicate with *different measurement platforms* (*ISES*, and *Arduino* are ready; CMA CoachLab, Vernier etc. are tested), and also common universal measurement devices with a **COM** or **USB** port. Sample list of measurement instruments and other devices supported by the platform *iSES Remote Lab SDK*: multimeters like UT-61E, environmental multimeter DT-2232, power supply PSP 1405, ISES USB Geiger-Müller Counter, Ocean Optics USB 2000 series spectrometer, further universal rotation and linear motion stepper motors, or also school kits like the Phywe Franck-Hertz experiment, etc. **Arduino** products.

**Software:** Open modular system *iSES Remote Lab SDK* consists of approx. 20 freely distributable JavaScript objects in commented source code. However, widgets are highly configurable and provide many well documented options, which are available by default and which allow even non-programmers to build a complex measurement and control interface with data and video transfer. Software *iSES Remote Lab SDK* also includes 3 server applications: the MeasureServer that communicates with the hardware, freely distributable WebServer Nginx, and ImageServer application for webcam live video stream. Client PC should run an Internet browser supporting JavaScript.

**Remote experiment:** each remote experiment consists of measurement units, modules/sensors, software *iSES Remote Lab SDK* with special plugins for each measurement unit, and physics, chemistry, biology experimental setup itself.

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# 1. Hardware and software kit for remote laboratory with ISES platform

## ISES PCI Professional and iSES Remote Lab SDK

**ISES-PCI Professional:** 4x analog input channels for modules/sensors (0–5 V), 2x analog input channels for (yellow) sockets (0–5 V), 2x analog output channel (–5V – +5 V) for modules/sensors, 2x digital output channels for (red) sockets (0–5 V), sampling frequency 100 kHz. PCI or PCIe (PCI express) ADDA 12-bit card.

Note: Software iSES Remote Lab SDK can handle up to 4 ISES-PCI Professional units.



ISES Professional with(!) ADDA PCI or PCIe card, card is in PC

| <i>ISES-Professional with ADDA card, without modules (sensors)</i>   | Price in Euro / pc (without VAT) |
|--|----------------------------------|
| ISES-Professional with PCI card                                      | 950                              |
| Universal software iSES for LOCAL Lab                                | 100                              |
| Universal software iSES Remote Lab SDK with plugin ISES-Professional | 200                              |
| Relay card, external, with 16 Relays (1A, 240V DC), (optional)       | 150                              |
| Production of remote software on your demand and specs, (optional)   | 200                              |

## ISES-LAN and iSES Remote Lab SDK

Near future of remote experimenting – IoT (Internet of Things), measurement system **with a PC** (not Arduino, Raspberry Pi, ...), includes PC with Windows 10 Operating System, RAM 2GB, SSD disk 32/64 GB, LAN, WiFi, BT 4.0, HDMI, 3x USB (1 of them is required for ISES-LAN I/Os if used), repro.

**ISES-LAN:** 2x analog input channels for modules/sensors (0–5 V), 1x analog output channel for modules/sensors or (red) sockets (–5 – +5 V), 5x digital outputs/inputs, sampling frequency 100 kHz.

Note: Software iSES Remote Lab SDK can handle up to 4 ISES-LAN units.



ISES-LAN

| <i>ISES-LAN without modules (sensors)</i>                          | Price in Euro / pc (without VAT) |
|--|----------------------------------|
| ISES-LAN   | 600                              |
| Universal software iSES for LOCAL Lab                              | 100                              |
| Universal software iSES Remote Lab SDK with plugin ISES-LAN        | 200                              |
| Production of remote software on your demand and specs, (optional) | 200                              |

## ISES-USB

USB interface, 2x analog input channels for modules/sensors (0–5 V), 1x analog output channel (–5 – +5 V), 5x digital outputs/inputs, sampling frequency 100 kHz.

Note: Software iSES Remote Lab SDK can handle up to 4 ISES-USB units.



ISES USB

| <i>ISES-USB without modules (sensors)</i>                          | Price in Euro / pc (without VAT) |
|--|----------------------------------|
| ISES-USB   | 400                              |
| Universal software iSES for LOCAL Lab                              | 100                              |
| Universal software iSES Remote Lab SDK with plugin ISES-USB        | 200                              |
| Relay card, external, with 16 relays (1A, 240V DC), (optional)     | 150                              |
| Production of remote software on your demand and specs, (optional) | 200                              |

## ISES-LINK

ISES-LINK: 1x analog input channel for modules/sensors (0–5 V), 1x analog output channel for modules/sensors (–5 – +5 V), 5x digital I/O, sampling frequency 100 kHz.

Note: Software iSES Remote Lab SDK can handle up to 4 ISES-LINKs.



## ISES-LINK

| <i>ISES-LINK without modules (sensors)</i>                         | Price in Euro / pc (without VAT) |
|--|----------------------------------|
| ISES-LINK  | 650                              |
| Universal software iSES for LOCAL Lab                              | 100                              |
| Universal software iSES Remote Lab SDK with plugin ISES-LINK       | 200                              |
| Production of remote software on your demand and specs, (optional) | 200                              |

## ISES-WIN and iSES Remote Lab SDK

Near future of remote experimenting – IoT (Internet of Things), measurement system **with a PC** (not Arduino, Raspberry Pi, ...), includes PC with Windows 10 Operating System, RAM 4GB, SSD disk 64 GB, LAN, WiFi, BT 4.0, HDMI, 3x USB (1 of them is required for ISES-Win I/Os if used), repro.

**ISES-WIN:** 2x analog input channels for modules/sensors (0–5 V), 1x analog output channel for modules/sensors or (red) sockets (–5 – +5 V), 5x digital outputs/inputs, sampling frequency 100 kHz.

Note: Software iSES Remote Lab SDK can handle up to 4 ISES-WIN units.



## ISES-WIN

| <i>ISES-WIN without modules (sensors)</i>                          | Price in Euro / pc (without VAT) |
|--|----------------------------------|
| ISES-WIN   | 250                              |
| Universal software iSES for LOCAL Lab                              | 100                              |
| Universal software iSES Remote Lab SDK with plugin ISES-LINK       | 200                              |
| Production of remote software on your demand and specs, (optional) | 200                              |

## ISES-modules and sensors for Physics, Chemistry, Biology for (remote) experiments

**Inputs modules / sensors** (temperature, voltmeter, ammeter, ...) are universal for all ISES platforms.

**Outputs modules / sensors** (relay, repro, booster, etc.) are universal for all ISES platforms with output channels.



Inputs and outputs modules / sensors (in the front is the ADDA PCI card)

| <b>Molules / sensors ISES</b>  | <b>Price in Euro / pc (without VAT)</b> |
|--|---|
| Thermometer ( $-20\text{ }^{\circ}\text{C}$ – $+120\text{ }^{\circ}\text{C}$ )         | 90                                      |
| Voltmeter, differential (ranges: 10 V, 1 V, 100 mV, 10 mV, or $\pm 5\text{ V}$ , etc.) | 90                                      |
| Ammeter, differential (ranges: 1 A, 100 mA, 10 mA, 1 mA, or $\pm 0.5\text{ A}$ , etc.) | 90                                      |
| Optical gate / Photometer  | 120                                     |
| Dynamometer (force sensor), differential 2.45 N / 250 gram                             | 200                                     |
| Microphone   | 90                                      |
| Manometer (10 kPa / 100 kPa)   | 150                                     |
| Magnetic induction meter (50 mT, 0.5 T)  | 120                                     |
| Capacity meter (1 nF, 10 nF, 100 nF, 10 $\mu\text{F}$ )                                | 90                                      |
| Ohm meter (1 k $\Omega$ , 10 k $\Omega$ , 100 k $\Omega$ , 10 M $\Omega$ )             | 90                                      |
| Heartbeat meter  | 120                                     |
| ECG meter with 3 electrodes  | 300                                     |
| Accelerometer $\pm 5\text{ G}$ , uniaxial  | 200                                     |
| Geiger-Müller counter  | 300                                     |
| Detector of water level with probes  | 150                                     |
| Booster -10 V – +10 V / 1 A  | 90                                      |
| Repro 4W   | 90                                      |
| Relay (ISES module)  | 80                                      |
| Relay Board (16x relay, 240 V / 1 A DC), extended card                                 | 150                                     |
| pH meter with glass electrode (0 – 14 pH)  | 150                                     |
| Conductivity meter with platinum electrode (0.1 mS, 1 mS, 10 mS, 100 mS)               | 150                                     |

\* For more details and technical parameters about ISES modules see <http://www.ises.info/old-site/index.php?f=moduly> (in Czech)

\*\* Possibility to use **Vernier**, **Pasco**, etc. analog sensors or **your own** device.

\*\*\* Note: **We can produce extra special plugins for your devices.**

On websites <http://www.ises.info/index.php/en/laboratory> you can find a showcase of remote experiments based on the hardware ISES and software iSES Remote Lab SDK. Many experiments also contain assignment, instructions for the measurement, and examples of data processing. Up to now we have built 18 advanced remote experiments at the secondary school and university level that we freely offer to you for use 365/7/24 in your school projects, lessons, and also free time activities. We are also preparing a reservation system ideal for teachers' demonstrations during lectures or lessons.

|   |   |
|---|---|
| Electromagnetic induction<br><a href="http://kdt-20.karlov.mff.cuni.cz/ovladani_2_en.html">http://kdt-20.karlov.mff.cuni.cz/ovladani_2_en.html</a>      | Meteorological station in Prague<br><a href="http://kdt-16.karlov.mff.cuni.cz/en/mereni.html">http://kdt-16.karlov.mff.cuni.cz/en/mereni.html</a> |
| Series RLC circuit<br><a href="http://kdt-30.karlov.mff.cuni.cz/index_en.html">http://kdt-30.karlov.mff.cuni.cz/index_en.html</a>                       | Rectifier<br><a href="http://kdt-19.karlov.mff.cuni.cz/index_en.html">http://kdt-19.karlov.mff.cuni.cz/index_en.html</a>                          |
| Solar energy conversion<br><a href="http://kdt-4.karlov.mff.cuni.cz/index_en.html">http://kdt-4.karlov.mff.cuni.cz/index_en.html</a>                    | Diffraction on microobject<br><a href="http://kdt-13.karlov.mff.cuni.cz/sterbina_en.html">http://kdt-13.karlov.mff.cuni.cz/sterbina_en.html</a>   |
| Water level control<br><a href="http://kdt-34.karlov.mff.cuni.cz/en/mereni.html">http://kdt-34.karlov.mff.cuni.cz/en/mereni.html</a>                    | Measurement of Planck constant<br><a href="http://kdt-33.karlov.mff.cuni.cz/index_en.html">http://kdt-33.karlov.mff.cuni.cz/index_en.html</a>     |
| Map of stations monitoring the natural background radiation<br><a href="http://kdt-1.karlov.mff.cuni.cz">http://kdt-1.karlov.mff.cuni.cz</a>            | Natural and driven oscillations<br><a href="http://kdt-17.karlov.mff.cuni.cz/index_en.html">http://kdt-17.karlov.mff.cuni.cz/index_en.html</a>    |
| Study of radioactivity (5 experiments)<br><a href="http://kdt-38.karlov.mff.cuni.cz/choice_en.html">http://kdt-38.karlov.mff.cuni.cz/choice_en.html</a> | Photoelectric effect<br><a href="http://kdt-29.karlov.mff.cuni.cz">http://kdt-29.karlov.mff.cuni.cz</a>   |

**Showcase of remote experiments with hardware ISES and software iSES Remote Lab SDK**



## 2. Hardware and software kit for remote labs with Arduino

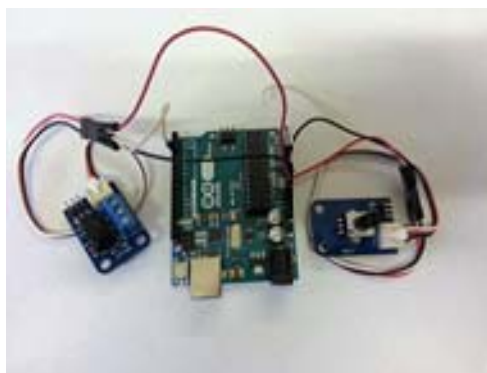
You may use the Arduino platform to create a remote laboratory experiment at very low costs. Arduino is used as ADDA device only, not as a programmable control element. Here we use only analog input pins A0–A5, and digital I/O pins D0–D13 for Arduino Uno, since for other Arduino boards (e.g. Arduino Mega, Galileo etc.) all the analog and digital I/O may be exploited.

Minimal requirements for Arduino remote labs: any Arduino board, software „iSES remote Lab SDK” with plugin Arduino, and a PC with WinXP – Win10 OS, with LAN and Internet.

### Arduino and „iSES Remote Lab SDK – lite version“

For remote experiment we need any Arduino board and the freeware „iSES Remote Lab SDK – lite version“, downloadable for free on the front page <http://www.ises.info>. Here is a guide: How to install the firmware into the Arduino and How to install and run the necessary servers (MeasureServer, WebServer, respectively ImageServer for a WEB camera).

Lite version has only 1 analog input pin A0 (e.g. for temperature sensor etc.) and 1 digital output pin D3 (e.g. for relay). Therefore the freeware iSES Remote Lab SDK – lite version allows a MEASUREMENT for 1 analog input, CONTROL for 1 digital output, RECORD and EXPORT (e.g. to MS EXCEL).



Arduino Uno as remote experiment with Potentiometer and Relay

| <b>Arduino and lite version without modules (sensors)</b>            | <b>Price in Euro / pc (without VAT)</b> |
|--|---|
| Arduino Uno (with firmware iSES Remote Lab SDK – lite for Arduino) * | 35 *                                    |
| Universal software Lite iSES Remote Lab SDK with plugin Arduino      | free                                    |
| Production of remote software on your demand and specs, (optional)   | 200                                     |

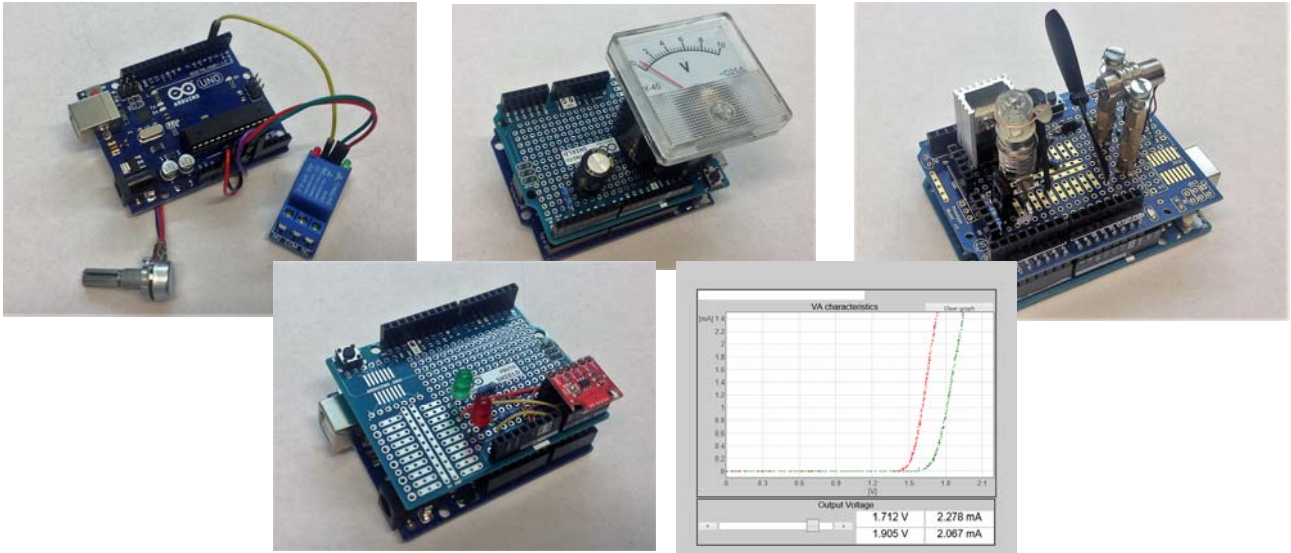
\* Firmware iSES remote Lab SDK – lite version you can install into your Arduino by yourself (free download on the front page <http://www.ises.info>).

### Arduino and „iSES Remote Lab SDK – full version”

Software “iSES Remote Lab SDK – full version” enables to create remote experiments with all platforms of Arduino (Uno, Due, Mega, Galileo, Leonardo, etc.). Full version has 15 analog input pins A0–A15 (e.g. for temperature sensor, light sensor, etc.) and 15 digital I/O pins D0–D15 (e.g. for relay or PWM for servo, etc.). Software iSES Remote Lab SDK full version allows a MEASUREMENT for 15 analog input, CONTROL for 15 digital output, RECORD, EXPORT (e.g. to MS EXCEL) and more 15 widgets for advanced management and processing.

| <b>Arduino and full version without modules (sensors)</b>                    | <b>Price in Euro / pc (without VAT)</b> |
|--|---|
| Arduino Uno (with firmware iSES Remote Lab SDK full version for Arduino)*    | 35 *                                    |
| Universal software Full iSES Remote Lab SDK with plugin Arduino              | 200                                     |
| Shield with the complete experiment „Ampere-Voltage characteristics of LEDs“ | 150                                     |
| Shield with the complete experiment „Capacitor charging and discharging      | 150                                     |
| Shield with the complete experiment „Temperature control“                    | 250                                     |
| Production of remote software on your demand and specs, (optional)           | 200                                     |

\* Firmware iSES remote Lab SDK you can install into your Arduino by yourself.



**Fig.:** Full real remote experiments with Arduino – 1. Examples with software kit “Remduino Lab SDK”, 2. Capacitor charging and discharging, 3. V-A characteristics of LED, 4. Temperature control – freely available at <http://www.ises.info>

### Arduino and Vernier Sensors and „iSES Remote Lab SDK“

Arduino Shield for Vernier sensors and software iSES Remote Lab SDK enables to create remote experiments with all the Arduino platforms (Uno, Due, Mega, Galileo, Leonardo, etc.) and with analog or digital Vernier sensors.



Arduino with Vernier sensors

| Arduino with Vernier Sensors  | Price in Euro / pc (without VAT) |
|---|----------------------------------|
| Arduino Uno board (with firmware iSES Remote Lab SDK for Vernier) * | 35 *                             |
| Universal software iSES Remote Lab SDK with plugin Arduino-Vernier  | 50                               |
| Arduino Shield for Vernier sensors                                  | 35                               |
| Vernier Force sensor  | 150                              |
| Vernier Temperature probe   | 75                               |
| Vernier Optical Gate  | 80                               |
| Vernier Gas Pressure sensor   | 130                              |
| Production of remote software on your demand and specs, (optional)  | 200                              |

\* Firmware iSES remote Lab SDK you can install into your Arduino by yourself.

### Arduino Relay board and „iSES Remote Lab SDK“

Special board with Arduino Duemilanove and 8 Relays (240 V / 1 A DC)





## Arduino Relay board

| <b>Arduino Relay board</b>  | <b>Price in Euro / pc (without VAT)</b> |
|---|---|
| Arduino Relay board<br>(with firmware iSES Remote Lab SDK, Arduino Relay board) * | 150*                                    |
| Universal software iSES Remote Lab SDK with plugin Arduino Relay board            | 100                                     |
| Production of remote software on your demand and specs, (optional)                | 200                                     |

\* Firmware iSES remote Lab SDK you can install into your Arduino Relay board by yourself.

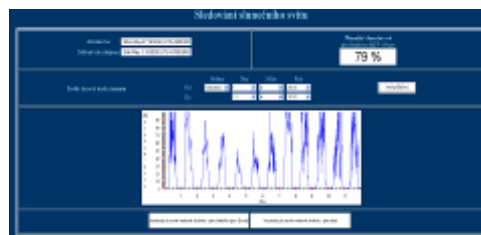
## 3. Hardware and software kits for remote labs with common laboratory instruments (multimeters, power supply, Geiger-Müller counter, spectrometer, etc.)

### Multifunction Environment Meter CEM DT-2232

The 4in1 environment meter designed for measurement of noise level, lighting, air humidity and temperature. It presents an ideal device for both professional and home applications. Parameters:  
Lighting: 40 – 40000 Lux, Sound 130 dB, accuracy +/- 3,5 dB, Humidity: 95% RH, Temperature: -20 °C – +750 °C.  
Measurement frequency: 1,5x/sec, RS-232 interface.



Environment Meter CEM DT-2232



Use DT-2232 for remote experiment  
Sunshine intensity monitoring

| <b>Multifunction Environment Meter CEM DT-2232, RS-232</b>         | <b>Price in Euro / pc (without VAT)</b> |
|--|---|
| Multifunction Environment Meter CEM DT-2232                        | 80                                      |
| Universal software iSES Remote Lab SDK with plugin for DT-2232     | 100                                     |
| Production of remote software on your demand and specs, (optional) | 200                                     |

### Laboratory power supply PSP 1405

Output voltage 0 – 40 VDC, output current 0 – 5 A. The laboratory power supply PSP 1405 can be fully operated and controlled by RS-232, input voltage: 230 VAC.



Laboratory power supply PSP 1405

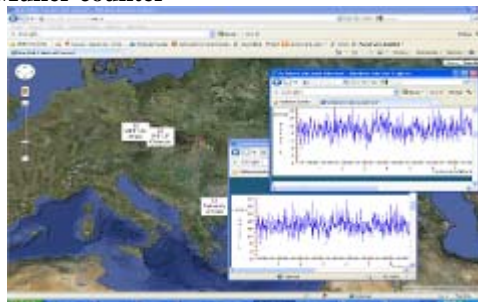
| <b>Laboratory power supply PSP 1405, RS-232</b>                    | <b>Price in Euro / pc (without VAT)</b> |
|--|---|
| Laboratory power supply PSP 1405                                   | 350                                     |
| Universal software iSES Remote Lab SDK with plugin for PSP 1405    | 100                                     |
| Production of remote software on your demand and specs, (optional) | 200                                     |

## USB Geiger–Müller counter

USB or ISES interface. Without power, only for USB port.



USB Geiger–Müller counter



Examples of use

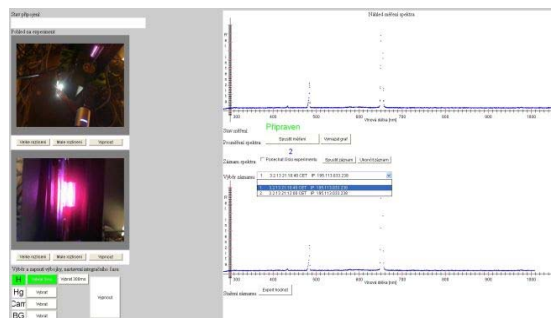
<http://kdt-26.karlov.mff.cuni.cz/>

<http://kdt-1.karlov.mff.cuni.cz>

| <b>USB Geiger–Müller counter</b>                                   | <b>Price in Euro / pc (without VAT)</b> |
|--|---|
| USB Geiger–Müller counter  | 350                                     |
| Universal software iSES Remote Lab SDK with plugin for G-M counter | 100                                     |
| Production of remote software on your demand and specs, (optional) | 200                                     |

## Spectrometer USB2000

Spectrometer USB2000+UV-VIS is a miniature Spectrometer, 200–850 nm, USB interface



Spectrometer Ocean Optics USB2000

Use of the Spectrometer USB2000 for remote experiment  
Spectral lines for Mercury lamp and H<sub>2</sub>

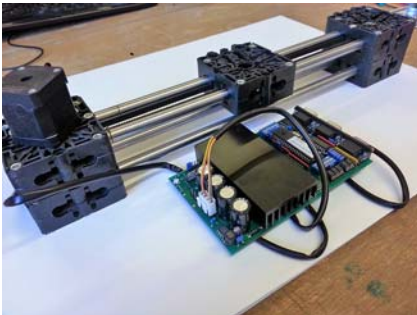
| <b>Spectrometer Ocean Optics USB2000, USB port</b>                  | <b>Price in Euro / pc (without VAT)</b> |
|---|---|
| Spectrometer Ocean Optics USB2000                                   | 3000 (?)                                |
| Universal software iSES Remote Lab SDK with plugin for Spectrometer | 100                                     |
| Production of remote software on your demand and specs, (optional)  | 200                                     |

(?) see current prices

## Stepper motors, Linear positioning, XY positioning

Robust industrial **linear** positioning device, max. 24 cm (longer available on request), advanced settings of the velocity and acceleration, estimated payload cca 5 kg (includes auto initialization, accuracy better than 0,2 mm, limit sensors, boxed electronics – complete solution for remote labs).

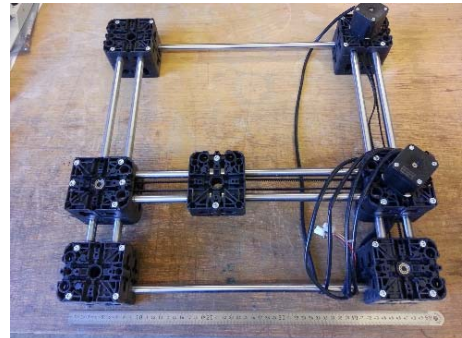
Robust industrial **XY positioning** device (with 2 stepper motors), max. 24 x 24 cm (longer available on request), advanced settings of the velocity and acceleration, estimated payload cca 5 kg, accuracy better than 0,2 mm, (includes auto initialization, limit sensors, boxed electronics – complete solution for remote labs).



**Linear positioning  
with control board, RS-232**



**Stepper motor**



**XY positioning**

| <b>Stepper motors, Linear positioning, XY positioning, RS-232</b>         | <b>Price in Euro / pc (without VAT)</b> |
|---|---|
| Linear positioning with control board, power supply, industrial equipment | 500                                     |
| XY positioning with control board, power supply, industrial equipment     | 1200                                    |
| Universal software iSES Remote Lab SDK with plugin positioning            | 200                                     |
| Production of remote software on your demand and specs, (optional)        | 200                                     |

## Water level control

Remote Water Level Control is a remote laboratory demonstration. You can observe and control various real experimental setups across the Internet. Very simple remote control for beginners.

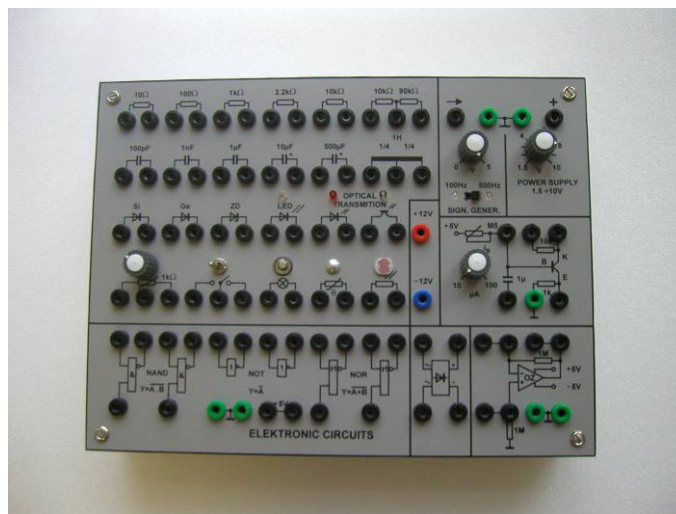


| <i>Water Level Control as remote experiment</i>                             | Price in Euro / pc (without VAT) |
|---|----------------------------------|
| Water Level Control, kit without sensors, without moduls Detector and Relay | 300                              |
| Software iSES Remote Lab SDK for Water level control                        | 200                              |
| Production of remote software on your demand and specs, (optional)          | 200                              |

## Basic electronic elements kit

**Basic electronic elements kit** contains 40 basic electronic components (resistors, capacitors, coils, diodes, non-linear elements), some basic circuits: Transistor in CE wiring, Optical transmission with optical fiber, basic circuits with operational amplifiers, rectifiers, digital electronics, etc.). On the panel are Sine wave generator (100 Hz and 500 Hz, amplitude control), fixed (+12V, -12V, 5V) or variable power supplies (1.5–10 V). The panel can be operated as a passive or with external power supply (+12V, -12V).

With the **Basic electronic elements kit** you can build many remote experiments on Electronics



## Basic electronic elements kit

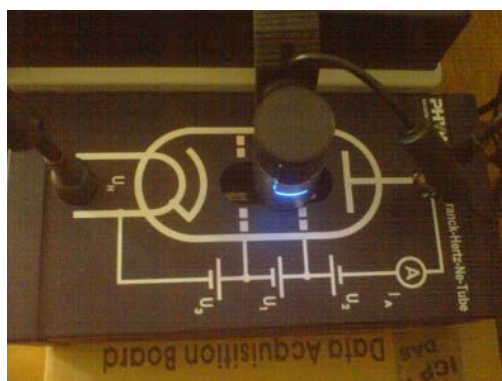
| <i>Basic electronic elements kit</i>                               | Price in Euro / pc (without VAT) |
|--|----------------------------------|
| Basic electronic elements kit                                      | 250                              |
| Production of remote software on your demand and specs, (optional) | 200                              |

## 4. Hardware and software kit for remote labs with common school aids

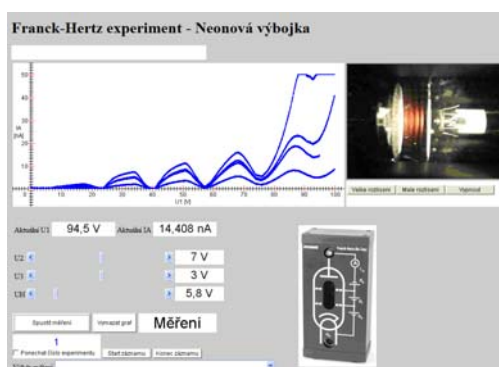
### Phywe Franck–Hertz experiment kit as a remote lab

An example how to exploit a traditional local school aids (Phywe Franck-Hertz experiment) as a remotely controlled experiment.

If you own the complete school set “Phywe Franck Hertz experiment”, you can turn to the remote one, **only with software “iSES remote Lab SDK for Franck Hertz”**. And your experiment will be accessible as remote lab to anyone, anytime and anywhere, even on any mobile device (tablets or smartphones).



Phywe Franck-Hertz experiment as a classic local school aid



### Phywe Franck-Hertz experiment as a remote lab

Apparatus is situated at the Pedagogical faculty of Masaryk University in Brno, remote experiment is available on website <http://147.251.192.82>

| <b><i>Franck Hertz experiment (Phywe) as a remote lab</i></b>                   | <b>Price in Euro / pc (without VAT)</b> |
|---|---|
| <b>You own <i>Phywe(!) Franck Hertz experiment</i></b>                          | <b>See Phywe</b>                        |
| <b>WEB camera, (optional) *</b>   | <b>100</b>                              |
| <b>Software iSES Remote Lab SDK with plugin for the Phywe Franck-Hertz exp.</b> | <b>200</b>                              |
| <b>Production of remote software on your demand and specs, (optional)</b>       | <b>200</b>                              |

\* You can use your similar devices.



## 5. Completed sets of remote laboratory experiments

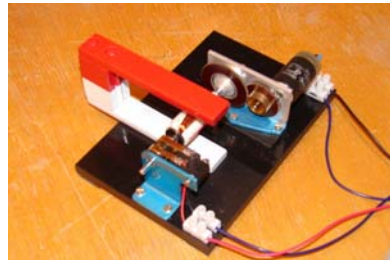
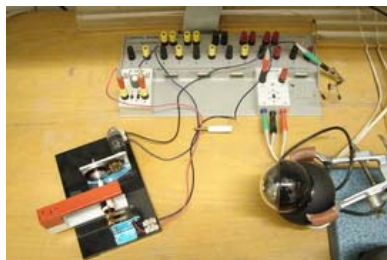
We can produce complete remote experiments on your request. You can choose any of our ready-made experiments and we replicate it for you.

Or you can design your own new remote experiment and we will produce that for you, including the software for its remote control. Please contact us to specify the experiment design and price.

Prices of some of our remote experiments are estimated below:

### Electromagnetic induction

[http://kdt-20.karlov.mff.cuni.cz/ovladani\\_2\\_en.html](http://kdt-20.karlov.mff.cuni.cz/ovladani_2_en.html)



Remote experiment Electromagnetic induction,  
right “Electromagnetic induction kit”

| <b>Electromagnetic induction as a remote experiment</b>   | <b>Price in Euro / pc (without VAT)</b> |
|---|---|
| “Electromagnetic induction kit”, complete, (on a right picture), without modules  | 400                                     |
| System ISES Professional, complete (ADDA card, 12bit/100 kHz, panel ISES) or other system ISES (ISES-LAN (550 Euro), ISES-USB (350 Euro)) | 950                                     |
| Modules V-metr and Booster (2 modules)  | 180                                     |
| Power supply +/- 12 V / 3 A, fixed *  | 350                                     |
| WEB camera *  | 100                                     |
| Software iSES Remote Lab SDK for Electromagnetic induction  | 200                                     |
| Production of remote software on your demand and specs, (optional)  | 200                                     |

\* You can use your similar devices.

### Water level control

<http://kdt-34.karlov.mff.cuni.cz/en/mereni.html>

The demonstration Remote Water Level Control is a simple remote control for beginners. You can observe and control water level across the Internet. Multiuser access.



Remote experiment Water level control

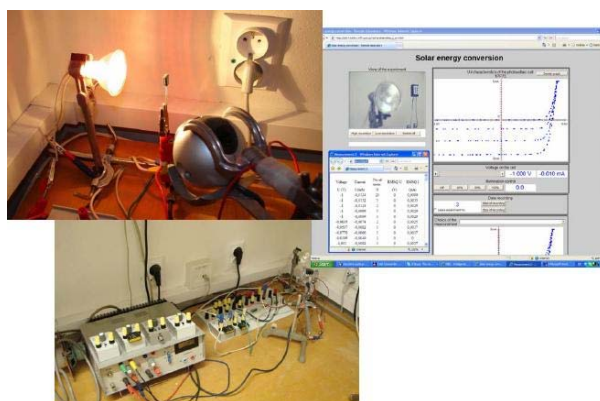
| <b>Water Level Control as a remote lab</b>  | <b>Price in Euro / pc<br/>(without VAT)</b> |
|---|---|
| Water Level Control, kit without sensors, without the module Detector and Relay   | 300   |
| System ISES Professional, complete (ADDA card, 12bit/100 kHz, panel ISES) or other system ISES (ISES-LAN (550 Euro), ISES-USB (350 Euro)) | 950   |
| Modules Detector, Relay   | 180   |
| Power supply +12 V / 1 A, fixed *   | 200   |
| WEB camera *  | 100   |
| Software iSES Remote Lab SDK for Water level control  | 200   |
| Production of remote software on your demand and specs, (optional)  | 200   |

\* You can use your similar devices.

## Solar energy conversion

[http://kdt-4.karlov.mff.cuni.cz/index\\_en.html](http://kdt-4.karlov.mff.cuni.cz/index_en.html)

Measurement of the *Ampere-Voltage* characteristics of a photovoltaic cell for various intensities of light.



Remote experiment Solar energy conversion

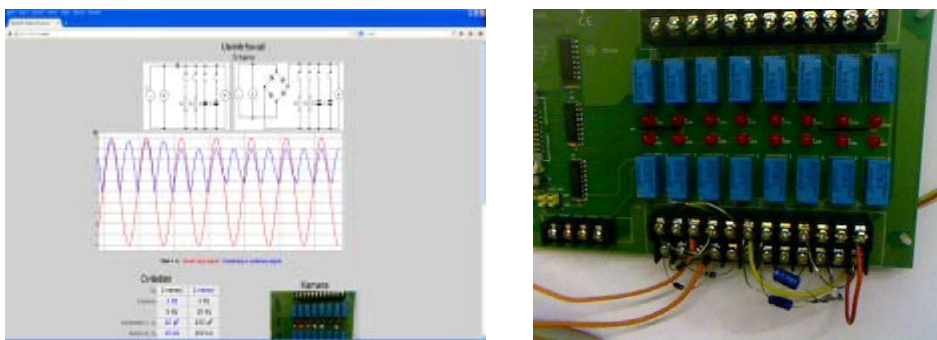
| <b>Solar energy conversion as a remote lab</b>  | <b>Price in Euro / pc (without VAT)</b> |
|---|---|
| Solar energy conversion, kit without sensors, without modules V-meter and A-meter   | 250                                     |
| System ISES Professional, complete (ADDA card, 12bit/100 kHz, panel ISES) or other system ISES (ISES-LAN (550 Euro), ISES-USB (350 Euro)) | 950                                     |
| Modules V-meter, A-meter  | 180                                     |
| Power supply +30V/3A with analog control or another power supply with control (analog, COM, USB, etc.) *                                  | 250                                     |
| WEB camera *  | 100                                     |
| Software iSES Remote Lab SDK for Solar energy conversion  | 200                                     |
| Production of remote software on your demand and specs, (optional)  | 200                                     |

\* You can use your similar devices.

## Rectifier

[http://kdt-19.karlov.mff.cuni.cz/index\\_en.html](http://kdt-19.karlov.mff.cuni.cz/index_en.html)

Half-wave and Full-wave rectifier, optional load, optional smoothing, possibility to change the frequency.



Remote experiment Rectifier

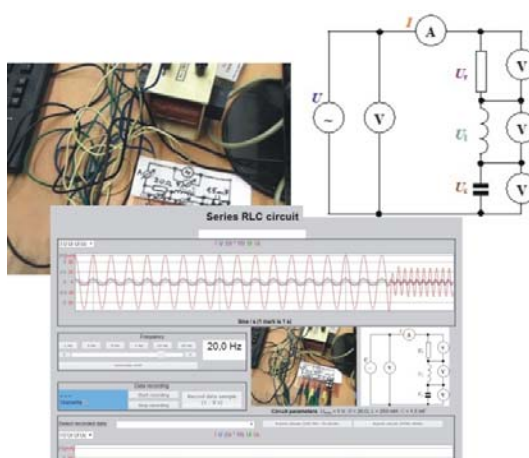
| <b>Remote experiment Rectifier</b>  | <b>Price in Euro / pc (without VAT)</b> |
|---|---|
| Rectifier, kit without sensors, without modules   | 200                                     |
| System ISES Professional, complete (ADDA card, 12bit/100 kHz, panel ISES) or other system ISES (ISES-LAN (550 Euro), ISES-USB (350 Euro)) | 950                                     |
| Modules V-meter, Booster  | 180                                     |
| Relay board (16x Relay)   | 150                                     |
| WEB camera *  | 100                                     |
| Software iSES Remote Lab SDK for Remote experiment Rectifier  | 200                                     |
| Production of remote software on your demand and specs, (optional)  | 200                                     |

\* You can use your similar devices.

## Serial RLC circuit

[http://kdt-30.karlov.mff.cuni.cz/index\\_en.html](http://kdt-30.karlov.mff.cuni.cz/index_en.html)

Remote experiment „Serial RLC circuit“ illustrating the time dependencies of current and voltage, phase shift, and the resonance phenomenon in a serial RLC circuit.



Remote experiment serial RLC circuit

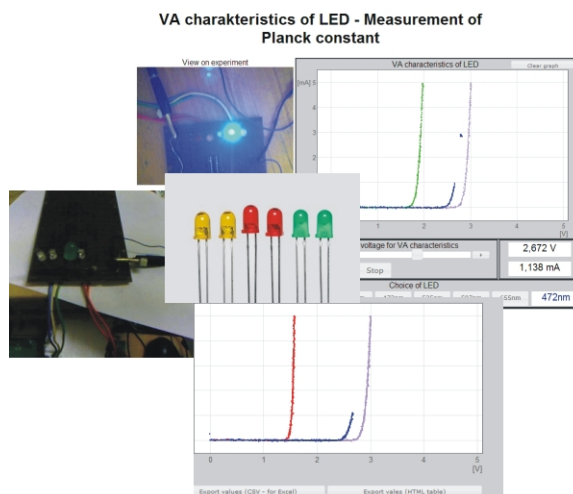
| <b>Serial RLC circuit as a remote lab</b>  | <b>Price in Euro / pc (without VAT)</b> |
|--|---|
| Serial RLC circuit, kit without sensors, without modules   | 250                                     |
| System ISES Professional (ONLY), complete (ADDA card, 12bit/100 kHz, panel ISES), NOT other system ISES (ISES-LAN (550 Euro), ISES-USB (350 Euro)) | 950                                     |
| Modules V-meter (3x), A-meter (1x), booster (1x)   | 450                                     |
| WEB camera *   | 100                                     |
| Software iSES Remote Lab SDK for Serial RLC circuit  | 200                                     |
| Production of remote software on your demand and specs, (optional)   | 200                                     |

\* You can use your similar devices.

## Ampere-voltage characteristics of LEDs - Measurement of the Planck constant

[http://kdt-33.karlov.mff.cuni.cz/index\\_en.html](http://kdt-33.karlov.mff.cuni.cz/index_en.html)

Remote experiment „A-V characteristics of LEDs - Measurement of the Planck constant“ is a remotely controlled laboratory, which allows user to measure A-V characteristics of 5 LEDs with different wavelengths.



### Remote experiment A-V characteristics of LEDs - Measurement of Planck constant

| Remote experiment A-V characteristics of LEDs-Planck constant   | Price in Euro / pc (without VAT) |
|---|----------------------------------|
| Remote experiment A-V characteristics, kit without sensors, without modules   | 200                              |
| System ISES Professional, complete (ADDA card, 12bit/100 kHz, panel ISES) or other system ISES (ISES-LAN (550 Euro), ISES-USB (350 Euro)) | 950                              |
| Modules V-meter, A-meter, Booster   | 270                              |
| Relay board (16x Relay)   | 150                              |
| WEB camera *  | 100                              |
| Software iSES Remote Lab SDK for Remote experiment AV-characteristics   | 200                              |
| Production of remote software on your demand and specs, (optional)  | 200                              |

\* You can use your similar devices.

## Radioactivity (5 experiments)

[http://kdt-38.karlov.mff.cuni.cz/choice\\_en.html](http://kdt-38.karlov.mff.cuni.cz/choice_en.html)

Hard-to-build remote experiment, using school radioactive source of ionizing radiation:  $^{241}\text{Am}$ , declared activity  $A = 300 \text{ kBq}$ ,  $\alpha$  radiation is shielded,  $\gamma$  radiation at energy 60 keV comes out of the source in collimated (narrower) beam. XY positioning (for distance, or for shielding). Two Geiger-Müller counters (GM1 measures the gamma-photon count in the dependence on the distance, or the barriers thickness, GM2 measures natural background radiation).

List of all radioactivity experiments:

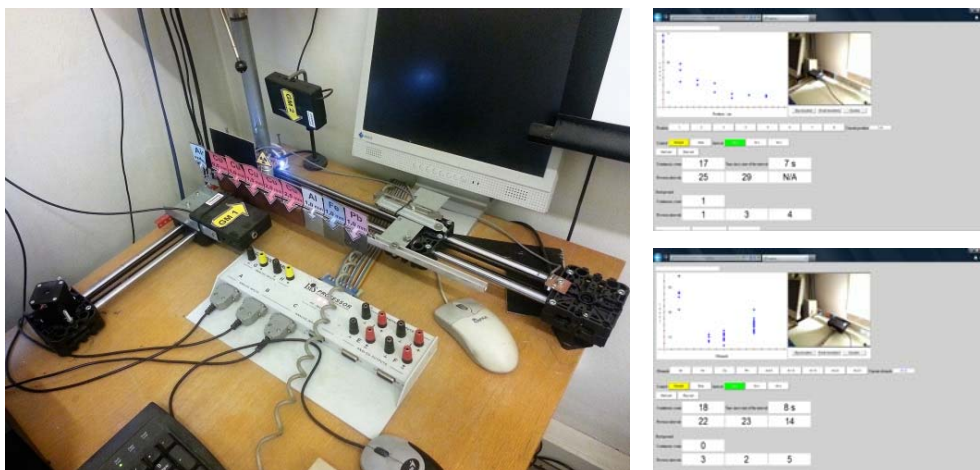
[Protection against ionizing radiation by distance](#)

[Protection against ionizing radiation by shielding](#)

[Monitoring of the natural background radiation](#)

[Choice of downloadable data from all radioactivity experiments](#)

[Map of stations which monitor natural background radiation](#)



Remote experiment „Radioactivity“ (5 experiments)

| <b>Remote experiment Radioactivity</b>   | <b>Price in Euro / pc (without VAT)</b> |
|--|---|
| Assembly of the remote experiment Radioactivity without sensors, modules, XY positioning, source ionizing radiation, ...                                 | 300                                     |
| XY positioning with control board, power supply, industrial equipment  | 1200                                    |
| System ISES Professional, complete (ADDA card, 12bit/100 kHz, panel ISES) or other system ISES (ISES-LAN (550 Euro), ISES-USB (350 Euro))                | 950                                     |
| Modules Geiger–Müller Detector for ISES (2x)   | 640                                     |
| School Source of ionizing radiation: 241-Am (valid for Czech Rep., possible obstacles concerning export/import of radioactive material to/from abroad) * | 350                                     |
| WEB camera *   | 100                                     |
| Software iSES Remote Lab SDK for Radioactivity   | 300                                     |
| Production of remote software on your demand and specs, (optional)   | 300                                     |

\* You can use your similar devices.

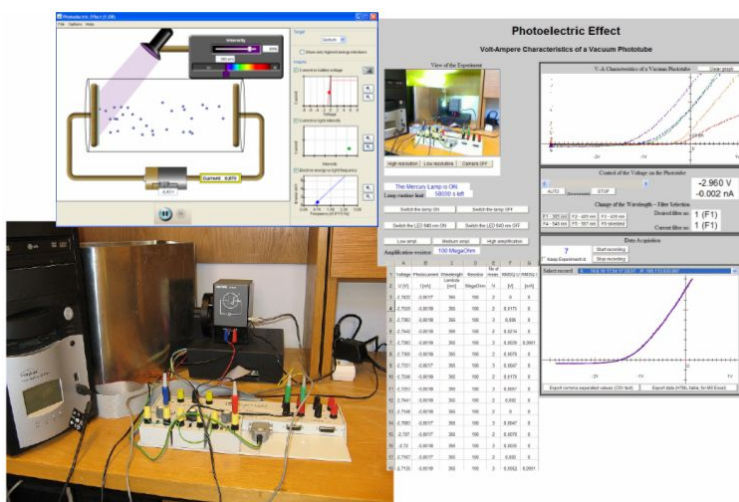
## Photoelectric effect

<http://kdt-29.karlov.mff.cuni.cz/>

In our remote laboratory two common methods to study the photoelectric effect are available:

- [Charging a capacitor up to the stopping voltage](#) – simpler method.
- [Study of the ampere-voltage characteristics of a \(Phywe\) vacuum phototube](#) – more complex method, suitable for university students and students of technical subjects.

Hard-to-build, complicated and expensive remote experiment. Final price depends on specific requirements.



Remote experiment „Photoelectric effect“



| <b>Remote experiment Photoelectric effect</b>   | <b>Price in Euro / pc (without VAT)</b> |
|---|---|
| Assembly of the remote experiment Photoelectric effect without sensors, modules, Vacuum Phototube cell Phywe, Carusel, ...                | 900                                     |
| Phywe Vacuum Phototube  | 480 (?)                                 |
| Phywe Amplifier for the photocell   | 200 (?)                                 |
| Carusel (6 positions) for filters, USB control  | 450 (?)                                 |
| Narrow-band interference filters (5x)   | 250 (?)                                 |
| Mercury lamp  | 300                                     |
| System ISES Professional, complete (ADDA card, 12bit/100 kHz, panel ISES) or other system ISES (ISES-LAN (550 Euro), ISES-USB (350 Euro)) | 950                                     |
| Modules V-meter (3x)  | 270                                     |
| WEB camera  | 100                                     |
| Software iSES Remote Lab SDK for the photoelectric effect   | 300                                     |
| Production of remote software on your demand and specs, (optional)  | 300                                     |

(?) see current prices

## 6. Cooperation Offer

All our remote experiments available on websites <http://www.ises.info/index.php/en/laboratory> are free to use. We will be pleased if you inform us about your experience with them (and send us the link to your web sites). Thank you in advance.

All remote experiments are situated at Faculty of Mathematics and Physics, Charles University in Prague. We can prepare the reservation system for you and we can provide remote experiments as a service (conditions must be accepted by the university).

We can organize workshops „Remote laboratory“ for you in Prague or at your place.

We can organize international conference in Prague at the Faculty of Mathematics and Physics.

We can organize videoconferencing, webinars, etc. We have videoconferencing system Polycom VSX 7000 (multipoint).

**We seek collaborators, manufacturers, and dealers.**

## 7. Contacts, business informations

The ISES team at Faculty of Mathematics and Physics, Charles University:

*Assoc. Prof. Dr. Frantisek Lustig* , [Frantisek.Lustig@mff.cuni.cz](mailto:Frantisek.Lustig@mff.cuni.cz)

and Ph.D. students:

*Jiri Dvorak*

*Pavel Kuriscak*

*Pavel Brom*

all from the Faculty of Mathematics and Physics, Prague, Czech Republic

### Business informations:

Contact, **Orders**, ...

Small and Medium Enterprise:

**RNDr. Frantisek Lustig**

Production of school equipment

U Druhe Baterie 29

162 00 Prague 6

Czech Republic

We are the Payer of VAT: VAT reg. no.: CZ530126261

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