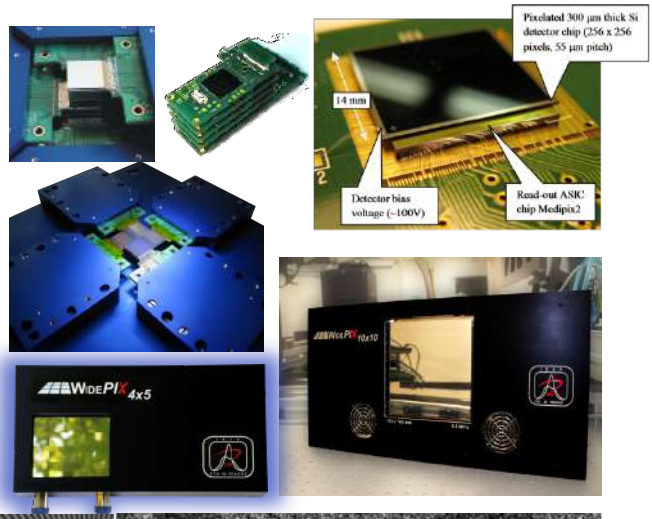
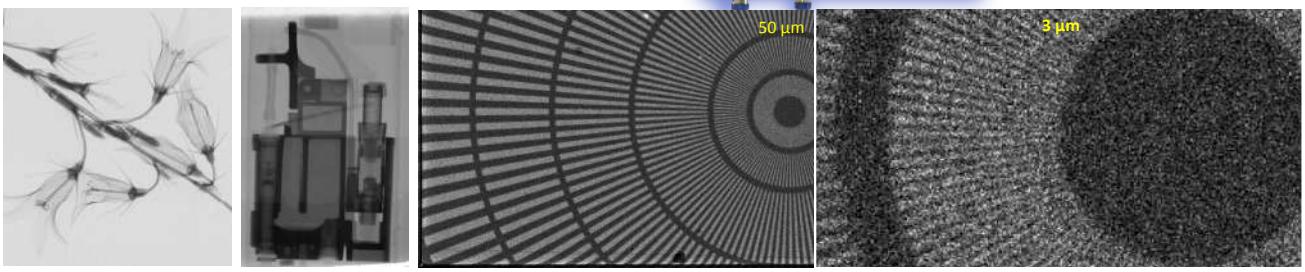
The **Institute of Experimental and Applied Physics** is the university institute of the **Czech Technical University in Prague** (hereinafter **IEAP CTU**). The CTU is the **oldest non-military technical university**, which was founded in 1707. The IEAP CTU was **established in 2002** as experimental base of the CTU for **research in subatomic physics and its applications**, specifically in **particle and nuclear physics**. The key experimental facility of the Institute is the **Van de Graaff accelerator**, which serves as a **tunable source of energetic ions and neutrons**. The Institute is also fully equipped for development purposes of new measurement methods and techniques. With regard to **BrightnESS project**, special attention has been paid to further development of **pixel detectors** for **high resolution X-ray and neutron radiography and tomography** and their application for **biomedical research and non-destructive material testing**.

HIGHLIGHTED RESULTS OF IEAP CTU IN WP4

Types of neutron detectors already developed at IEAP CTU:

- The developed detectors are based on hybrid technology connecting a pixelated semiconductor sensor with R/O **Timepix chip**. The chip (developed within the **Medipix2&3 collaboration**) contains 65k pixels of 55x55µm^2 per 2 cm^2. It permits to register a **position of an interacting ionizing quantum in the sensor and its ToA and/or ToT**.
- Presently available **sensors**: **Si, GaAs, CdTe, SiC, 3D-Si, stuffed 3D-Si**.
- **Convertors** based on **^{10}B and ^{6}Li** are used to detect **ultra-cold, cold, thermal and epithermal neutrons,** and **CH_2 for fast neutrons**.
- **Sensitive areas** from **2 cm^2 to 200 cm^2** (with dead area less than 1%).
- The fast **R/O systems** transferring the measured data from different developed Timepix based devices to PC by **USB2, USB3, Ethernet interfaces**, are available (some of them are displayed on the right).
- A prototype of **position sensitive detector of neutrons based on crossed strip sensors** (resolution of about 30 µm^2), what permits to increase neutron detection efficiency by stacking of sensors and place R/O electronics out of neutron beam, has been also developed.





Basic parameters of pixel neutron detector devices developed and tested in IEAP CTU:

- **Position sensitive detection of neutrons with resolution from 3 µm** (applying neutron cluster analysis) to 50 µm (in counting mode).
- **Noiseless neutron detection efficiency up to 7%** in case of planar arrangement of neutron converter to the pixelated sensor. Application of "stuffed" 3D-sensor technology promises an increase of the efficiency up to 20%.
- Capability to **measure time of single neutron arrival with 1.6 ns resolution** is well applicable for high resolution ToF experiments.

Fields of application:

- **High-resolution neutron radiography and tomography** with ultra-cold, cold, thermal and epithermal neutrons as illustrated above by images of bell flower, a lighter and of the Siemens star of reference.
- **Energy dependent radiography and tomography** performed **with resonance neutrons** by means of ToF technique.
- **Simultaneous neutron and X-ray radiography and tomography**.
- **Fast neutron radiography.**
- **Neutron diffraction, elastic and inelastic scattering experiments** on relatively small samples using ToF technique.
- **Measurement of composition and spectral characteristics of mixed neutron-gamma radiation fields** and their dosimetry through the network of Timepix wireless detection devices.

IMPACT AND SUSTAINABILITY FOR IEAP CTU

EXPANDING NETWORK

Through the BrightnESS project, IEAP CTU has extended its scientific contacts within European neutron imaging community.

INDUSTRY ACCESS

BrightnESS has broadened contacts between IEAP's industrial partners at the Czech republic with future customers interested in advanced detector technology at the European level.

GATEWAY TO NEW NEUTRON DETECTION TECHNOLOGIES

As part of Brightness project, we have started technological and methodical development of radiation hard Timepix-based devices.

BrightnESS is funded by the European Union Framework Programme for Research and Innovation Horizon 2020, under grant agreement 676548