

# Pixel detector based particle camera as a motivation tool for practical physics education demonstrating properties of radiation and elementary particles in a comprehensible way

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**Abstract:** Practically oriented teaching represents inestimable means in motivation of students to boost their interest in understanding. Especially when focusing on technically oriented subjects. The educational kit SESTRA (School Educational Set with Timepix for Radiation Analysis) has been developed at IEAP CTU in Prague with intention to allow simple access of students to microcosmos experiments practicable in regular classes. The kit includes the particle camera supplemented with a wide set of accessories and detailed guidelines. The proposed workshop aims to provide live demonstrations in order to reveal the full potential of the kit via exemplary hands-on exercises guided by skilled lecturers.

## Particle camera “making invisible visible”

The Timepix pixel detector[1] became established as an extraordinary instrument proving outstanding performance in visualising and recognizing different types of ionising radiation via analysis of characteristics tracks left in pixel matrix after interaction of impacting radiation[2]. The kit SESTRA (School Educational Set with Timepix for Radiation Analysis) was developed at IEAP CTU in Prague[3] as a part of the technology and knowledge transfer initiative performed in the frame of CERN Medipix collaboration[4]. The advanced pixel detector Timepix adapted in the form of a particle camera[5][6] allows to observe invisible radiation without the necessity of deep understanding of complex detector technology, image processing and data analysis techniques enabling a wide range of common users to fully benefit even if having just a basic awareness about the instrument itself. The Fig.1 presents SESTRA kit and its content (on left) and a group of students working with the particle camera (on right).

## Arrangement of the practical workshop

The proposed workshop aims to provide practical experience to attendants via hands-on exercises guided by skilled lecturers. About 4 to 6 fully equipped SESTRA educational kits would be deployed and accessible to attendants at the time. In order to maximally reveal the potential and benefits of particle camera application in the field of education the workshop participants will be exposed to several representative exercises to practise by themselves under professional guidance. The practical demonstrations intend to cover very basics (e.g. the way of displaying radioactive particle interactions in pixel detector, difference between tracks caused by alpha, beta, gamma radiation, etc.) as well as more advanced tasks (e.g. study of radiation properties, observation of background radiation, demonstration of radiography working principle, etc.) and also slightly pointing on further complex tasks. The participants are led to get their own personal experience in order to let them fully consider potential and undoubted benefits of application of a particle camera in the field of education.



Fig. 1. Left - SESTRA kit (School Education Set with Timepix for Radiation Analysis) accessories deployed on the table (namely: MiniPIX EDU particle camera, mounting rails, camera holder, radiation source holder, uranium glass, thoria rod, Am241 300 kBq gamma source, Am241 9.6 kBq alpha/gamma source, container with potassium salt, empty container for samples, set of shielding plates, radiography adapters heads, sample patterns for alpha radiography and gamma radiography, vacuum cleaner grate adapter, USB cable, USB flash drive with control and visualisation software); Right - Elementary school students at classes observing properties of alpha particles under supervision of a physics teacher..

### Positive experience in practically oriented education by means of particle camera

During the years, multiple classes, specialised workshops and various training courses were organised by lecturers from IEAP CTU in Prague while focusing on a diverse types of participants (generally distinguished by a different age and different knowledge background, thus ranging from classes for young students at elementary schools, high school students, university students and also training sessions for physics teachers or highly specialised events like nuclear instrumentation schools for highly educated attendants). In all cases, the practically oriented education by means of particle camera proved high scalability when course guidelines[7] are adopted adequately to a targeting group of attendants.

### References

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