Materials and methods. Radium-223 has a half-life of 11.4 days. 95.3% fraction of its energy is emitted as α-particles, 3.6% as β-particles and 1.1% as γ-radiation. The γ-rays associated with Ra-223 decay and its daughters allow for radioactivity measurements of Ra-223-Chloride by standard Capintec-CRC-15R and spectrum creation, peak selection in imaging by SPECT-γ-camera.

The most prominently γ-emissions of Ra-223 and its daughters are 269.5 KeV (14%) Ra-223, 271.2 KeV (11%) Rn-219 and 351 KeV (13%) Bi-211.

Results. Capintec-CRC-15R-s/n158895 (pure Argon gas ionization chamber) was calibrated for accuracy, constancy, linearity and geometry.

It was also calibrated with two NIST traceable radium-223 standard vials. Calibration setup in 29-6-2015 determined the calibration number and storage of Ra-223 in calibrator's memory and a user key was created.

Energy spectra of the two samples positioned on the ElScint-SPECT-γ-camera head surface were recorded graphically to study the energy distribution, decide the energy peak selection, the net area under each γ-ray peak, the full-energy-peak efficiency and put right factors.

Conclusion. Correction factors found that should be applied for accurate quantitative imaging measurements in patient-specific therapy by Ra-223-chloride. A protocol with all Ra-223 therapy steps in our institute has completed.

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MOBILE PET INSERT FOR SIMULTANEOUS PET/MRI IMAGING

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Access to the anatomical and functional information about the body interior is possible with tomography techniques relying on the registration of radiation from the tissues. Modern medicine offers: Positron Emission Tomography, Magnetic Resonance and Computer Tomography. One of the present technological challenges is to combine the PET and MR scanners to work as single device to provide PET/MR images.

Presented solution of a portable-PET scanner will allow simultaneous registration of PET and MR images utilizing existing MR scanners. The developed device is based on the strip-PET concept consisting of detection modules, each build from a plastic scintillator strip connected at both ends with silicon photomultipliers array. In the proposed solution determination of the point of annihilation along the direction of the gamma quanta flight path, is based on the time difference registered in various detection modules. It is important to stress that the utilized silicon photomultipliers are insensitive to the MR magnetic field. In order to position two tomographic images with respect to each other we will use watermarks, seen by MRI system. Since this method explicitly specify the position of the MRI with respect to PET scanner therefore it enables for synchronize both tomographic images. The advantage of this solution is to eliminate the possibility of artifacts in tomographic images hindering the identification of potentially cancerous lesions.

In the talk we will present developed solution of a mobile-PET insert to MR scanners. The presentation will include the characteristics of a proposed device together with the advantages over present solutions.

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NOVEL J-PET SCANNER COMBINED WITH POSITRON ANNIHILATION LIFETIME SPECTROSCOPY TECHNIQUE AS A TOOL FOR MORPHOMETRIC IMAGING

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Positron Annihilation Lifetime Spectroscopy (PALS) allows examining structure of materials at nano and sub-nanometer level. This technique is based on the lifetime and production intensity of ortho-positronium atoms in free volumes of given structures. It is mostly used for studies of organic materials. However there exist also few results, e.g. by groups of Y. C. Jean and R. Pietrzak, showing that morphology of cells is correlated with the PALS parameters.

Jagiellonian Positron Emission Tomograph (J-PET) is a multipurpose detector which will be used for investigations with positronium atoms in life-sciences as well as for medical diagnostics. Such prototype based on plastic scintillators and fully compatible with MRI is currently being developed at the Jagiellonian University in Krakow, Poland.

In this talk results of the first experiments conducted by the J-PET collaboration will be presented.

We performed PALS studies of well known structures such as silica and of some model micro-organisms, e.g. *Saccharomyces cerevisiae* both with dry and aqueous samples allowing to determine the correlation between hygroscopicity of the cell and PALS parameters. As a result, we proved that PALS can be successfully used for studies of living organisms their dynamics and its relation to the cells morphology.

This result opens perspective for simultaneous determination of early and advanced stages of carcinogenesis by observing changes in biomechanical parameters between normal and tumour cells and standard PET examination. J-PET detection system combined with PALS technique will be more accurate and affordable for cancer diagnostics.

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HYBRID TOF-PET/MRI LOCAL TRANSCEIVER COIL

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In order to enhance diagnostic capabilities Positron Emission Tomography (PET) and Magnetic Resonance Imaging (MRI) devices are combined into a single hybrid device providing an access to both metabolic and morphological information during a single examination. Typically the PET detectors are placed inside the diagnostic volume of the MRI scanner, however being outside the commonly used local transmit-receiver (transceiver) coils such as head or chest coils. Coils are made of plastic parts and metal conductors on which annihilation gamma quanta may scatter before reaching the PET detectors scintillating material. This fact could cause the worsening of PET images spatial resolution and the field-of-view for the PET detectors.

We propose a solution based on a novel PET tomograph concept comprising multiple detection modules, built from polymer scintillation strip ended with silicon photodetectors, arranged circumferentially inside the working volume of the MRI local transceiver coil. The adaptive of the polymer scintillators in both shape and size properties allows for a use of a standard MRI coils constructions to be combined with PET detection system without influence on the coil shape, geometry and material properties optimized so far.

Current work is focused on a dedicated detection electronics development based on silicon photodetectors arrays and digital signal processing unit that will operate in high static magnetic field as well as radiofrequency waves environment of MRI scanner.

The novel approach to the hybrid local coil construction would allow for using any existing MRI system extending its functionality by the PET imaging feature.

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NOVEL PLASTIC SCINITLLATORS FOR THE FULLY DIGITAL AND MRI COMPATIBLE J-PET SCANNER

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Jagiellonian Postitron Emission Tomography (J-PET) scanner based on plastic scintillators has been developed at the Jagiellonian University. This innovative solution enables cost effective construction of PET detector with large field of view. At present we are working on the solution which would allow for the simultaneous PET and Magnetic Resonance Imaging (MRI). For that purpose we will use silicon photomultiplier (SiPM) readout which can be applied in the strong magnetic field of the MRI scanner.

In this talk we will present results of the development of a novel scintillator material (referred to as the J-PET scintillator). The purpose of the development was the elaboration of scintillator with optical properties allowing for more efficient registration of photons with SiPM array with respect to the presently available plastics scintillators and at the same time with the superior timing characteristics. The novelty of the elaborated concept lies in usage of 2-(4-styrylphenylbenzoxazole) as a scintillation additive – wavelength shifter. The substance has been used for the first time as a scintillator dopant. J-PET scintillators were manufactured via bulk polymerization of styrene or vinyltoluene and the optimal concentration of the 2-(4-styrylphenylbenzoxazole) was set by maximizing the light output and timing properties.

In the talk properties of J-PET scintillators will be presented and discussed in view of its application for the PET/MR imaging, and the performance of the developed material will be compared to the properties of commercially available scintillators.

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SPECTRAL CT: ON THE ACCURACY OF CONCENTRATION AND EFFECTIVE ATOMIC NUMBER ESTIMATION

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Introduction. Spectral CT has been an emerging new clinical innovation that enables better discrimination and characterization of tissues.

Purpose. To assess the accuracy of a new fast kVp-switch spectral CT scanner in estimating the concentration and effective atomic number (Z_{eff}) of iodine (I) in contrast enhanced tissue mimicking vessels.

Materials and methods. A cardiac CT phantom that simulates the chest of a medium-sized patient with respect to density and attenuation characteristics was coupled with four cylindrical vessels filled