

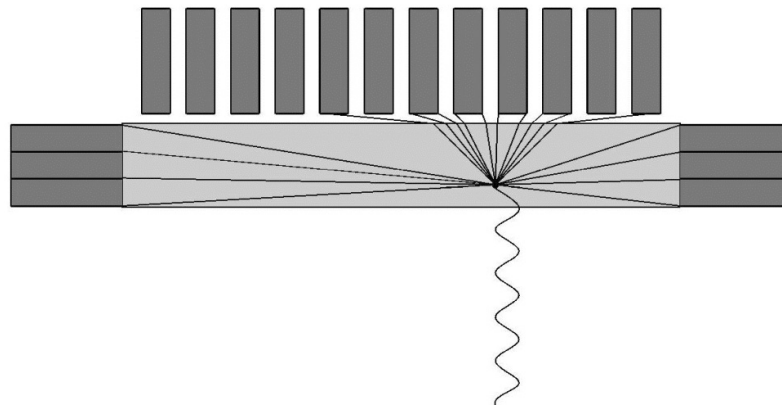
## POSTER SESSION

### P1. MATRIX-PET: A NOVEL PET DETECTOR CONCEPT BASED ON LARGE BLOCKS OF ORGANIC SCINTILLATORS

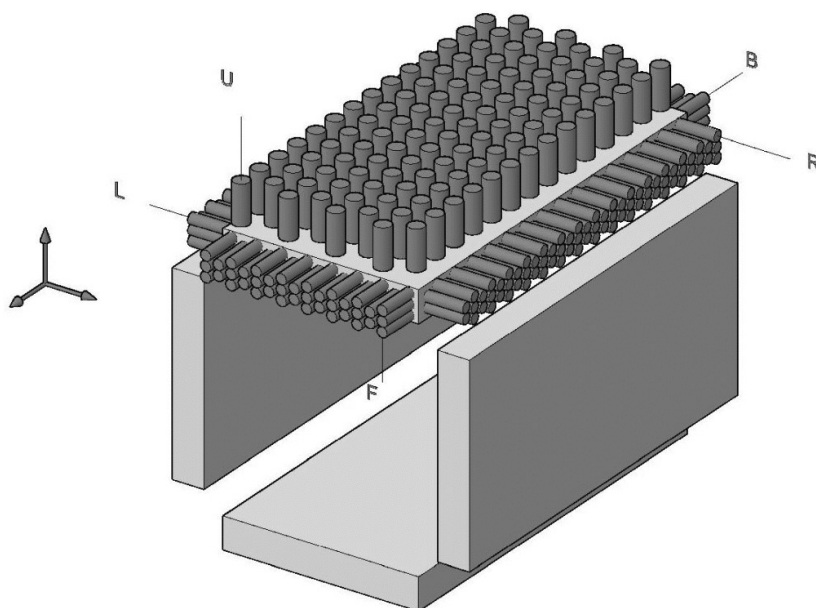
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Matrix-PET is a novel detector solution for the Positron Emission Tomography. It is one of the two methods which is developed at present at the Jagiellonian University [1]. The detector idea is a subject of a patent application [2]. Novelty of the concept lies in using the large and thick organic scintillators blocks as a detector of gamma quanta instead of crystal scintillators used in current commercial PET scanners. Its uniqueness constitutes the solution of light collection allowing for the conversion to the electric signal of direct light. The idea is demonstrated schematically in Figure 1. This method allows to achieve a time resolution which is not affected by the deformation of light pulses due to reflections at scintillators surfaces. Such PET detector would consist of organic scintillator plates. The plates could be set in many ways so as to cover the whole body of the patient, for example as it is shown in Figure 2. The measurement of time and amplitude of light signals is carried out by photomultipliers matrix arranged around the chamber. The interaction point within the plane of the plate can be reconstructed based on both: (i) the distribution of time of the signals from photomultipliers and (ii) distribution of amplitudes of the recorded signals. Such solution enables also determination of the depth at which the gamma quantum has been absorbed (DOI) on the basis of the distribution of amplitudes of signals from photomultipliers which can be arranged also on front and back sides. This feature allows to use thick plates without worsening of spatial resolution due to “the DOI problem” occurring in the current PET tomographs. Enlargement of the thickness, and high acceptance, enables efficient detection of gamma quanta using organic plastic scintillators, which are characterized by excellent time resolution. This solution would also enable effective usage of the TOF method permitting the determination of the annihilation point along the line-of-response based on the time difference in reaching the different scintillation plates by the gamma quanta. Polymer scintillators allow to obtain the time resolution better than 100 ps compared to 600 ps achievable in a current PET



**Figure 1.** Principle of light collection in the Matrix-PET



**Figure 2.** One of the possible arrangement of scintillation plates for the diagnostic chamber of matrix-PET. The location of quantum reaction in a plate plane may be determined with three independent methods based on the (i) amplitude of the signals from the upper layer (U), (ii) from amplitudes of signals from front (F) and back (B), and left (L) and right (R) photomultipliers and (iii) based on time differences of photomultiplier signals from the front and rear layers and left and right photomultipliers. The final result may be taken as the average weighted with appropriate measurement uncertainties

scanners. Such accuracy of TOF determination may significantly improve the sensitivity (image contrast) which increases inversely proportional with the time resolution and directly proportional to the size of the examined object [3].

## References

1. Moskal P et al. *Bio-Algorithms and Med-Systems* 2011; 73.
2. Moskal P. Patent applications: PCT/PL2010/00061 2010.
3. Karp JS et al. *J Nucl Med* 2008; 462.