Metastasis which accounts for 90% of cancer-related deaths, occurs when cancer cells detach from their primary site and home in distant organ. Proliferation of these cells in host tissue provide the potential for new tumors growth that can be life-threatening if they are not diagnosed and treated in early stages. Larger lesions can be detected through non invasive clinical-imaging modalities such as MRI, CT and PET scans. Although these imaging modalities are capable of detecting large lesions caused by metastases, they do not offer the required sensitivity to detect small lesions caused by the early spread of metastatic tumour cells. Union for International Cancer Control (UICC), in world cancer day in 2019 used " I AM and I WILL " slogan to highlight the need for urgent action to increase early stage cancer detection to significantly improve patients.
Among all diagnostic tools, PET scans are using molecular imaging technique. In principle by improving PET scanner performance, we can diagnosis small metastatic lesions in early sages. However due to the small axial field of view in current clinical PET scanner, they are not sensitive enough to detect small metastasis lesions.
Since past few years, high-tech research groups start the research to improve performance of PET scanner in order to enhance sensitivity. All these trails led to develop first Total-Body PET (TB PET) scanner in the world, designed and constructed in California university (USA), called EXPLORER. It is able to cover whole the patients body at once and have sensitivity which is 40 times larger than current clinical PET scanners. Using this scanner opens new possibilities for the precise and personalized diagnosis that can increase remarkably treatment chance of patients. The main constrain of TB PET scans such as EXPLORER is the construction cost of these type of scanner that limit public accessibility. The price of such scanner is 10 million $ is too high for hospitals and research clinics.
Thanks to J-PET collaboration, Poland introduced a cost effective solution to obtain TB PET scanner based on J-PET technology.

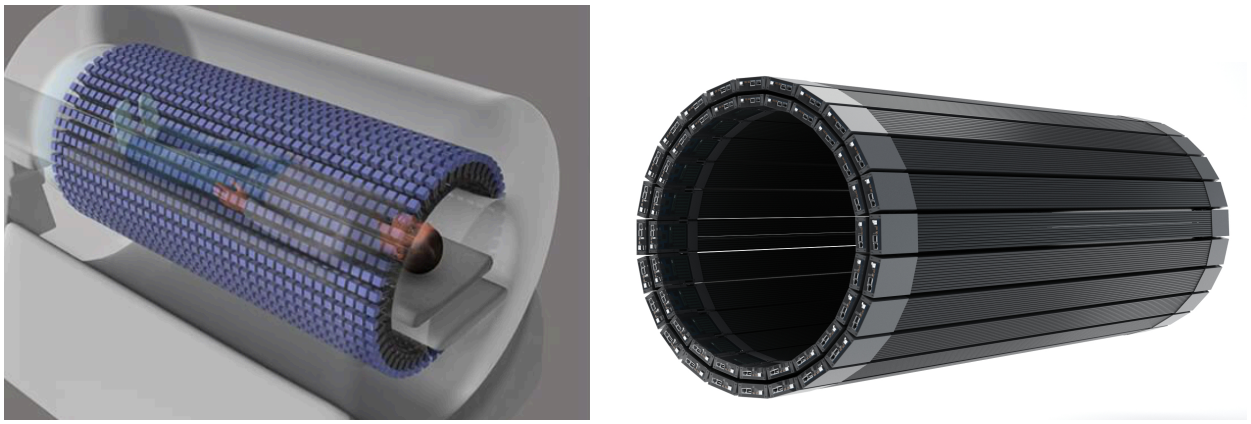

Figure 1. Left: Schematic view of the EXPLORER PET scan which provided 2m long axial FOV by adding detector rings. Right: Schematic view of designed Total-Body J-PET with 2m long plastic scintillators that coupled with SiPM at each ends.

As shown figure 1. There is a major difference of detectors arrangements in EXPLORER and TB J-PET. Thanks to this difference, J-PET technology has the ability to enlarge axial FOV to cover whole body with negligible cost in comparison to EXPLORER.
In this project I will elaborate characteristics of J-PET technology in view of small lesion detection as an important early diagnostic indication. The main aim of this research is making this characteristics as a function of properties of detectors such as thickness of plastic strips, precise detection time and characteristics of determining time and position resolutions in order to design such total body PET with J-PET technology capable of detection small lesions.