Photonic Platform For Detection Of Significant Low Amount Of DNA

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Liquid biopsy has the potential to revolutionize the future of cancer diagnostics and disease management. The biomarkers for cancer present in blood are very diluted and difficult to measure. Droplet digital PCR (dPCR), real time PCR and Next Generation Sequencing are techniques that can measure minimum concentrations of biomarkers such as free circulating DNA fragments relevant to cancer diagnostics. The adoption of these techniques has been held back by complicated workflow, specific reagents, costly equipment and slow read out times.
Optics and photonics technologies, and high-sensitivity molecular diagnostic tests, already play key roles in the practice of healthcare. These technologies are essential for developing advanced tools for observing and measuring symptoms and treating patients with less invasive, more cost-effective methods.
Our technology could be a promising tool for early cancer detection. The principle of the our photonic detection system is based on exposing a sample of wavelength shifting material coupled to free DNA to light of certain wavelength and detecting afterwards the wavelength shifted light. The amount of shifted light for a given amount of input light provides information about the amount of free DNA in the sample. Thus, to optimize the signal to background ratio is of significant importance. Current systems are using photodiodes to detect the light. These devices have a low internal gain and a relatively large dark current, leading to the fact that at least few thousand photons are needed for detection. The developed setup is using photomultipliers (PMT) for the detection of the light. This kind of sensor has a high internal gain and allows therefore the detection of single photons. Furthermore, PMTs allow to measure the arrival time of the different photons with high precision. The combination of low detection threshold and timing information will allow to detect significant lower amounts of free DNA (at picomolar range). Moreover, the detection of low amount nucleic acid without amplification or sequencing opens the market for detection of another diseases such as: (I) Viral diseases (COVID-19..) by viral RNA or (II) Nosocomial infections by pathogenic bacterial DNA.