

Project Title: THz sensing and optimisation for biomedical applications

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Are you interested in applying physics to situations that could benefit medical diagnosis? Terahertz ( $10^{12}$  Hz, THz) pulsed imaging is a new technique with high resolution (about  $20\ \mu\text{m}$ ) and has only emerged recently as a potential new clinical tool for medical imaging. It is a totally non-destructive and non-ionising imaging modality as the average power of the pulse for producing the radiation is as small as 100 nW. The radiation produced is focused onto the sample of interest and then detected coherently. A point measurement is analogous to an ultrasound A-scan.



Reflections off different layers are used to determine the structure at various depths. THz light is very sensitive to hydrogen bonds. By Fourier transforming the time-domain data, useful spectroscopic information can also be revealed. Potential applications range from security imaging to medical diagnosis, but the analysis and instrumentation needs to be tailored for each application investigated. THz light can be generated and detected using photoconductive antennas. The useable frequency range of a THz system depends on the photoconductive devices as well as other factors such as optical alignment.

The proposed research will investigate and develop THz imaging approaches for providing immediate feedback on the condition of the skin. A variety of approaches to THz imaging will be investigated including high speed imaging techniques such as compressed sensing to speed up patient measurement times. The ultimate goal is to use THz imaging to detect early stages of skin cancer, or the lateral extent of tumours that are beneath the skin's surface, and not yet visible. Applicants do not need a medical background, more importantly, they need an interest in programming, optics, robotics and data analysis.

Prof MacPherson joined Warwick University in 2017 and has established a [THz research group](#) that lies within the [Ultrafast Photonics group](#). The PhD project will be linked with the £8M Terabotics Programme grant [Terabotics Programme Grant \(warwick.ac.uk\)](#) and will have links with the University Hospital of Coventry and Warwickshire (UHCW) as well as the University of Leeds and The university of Exeter.

For further information do not hesitate to contact Prof MacPherson directly on [e.macpherson@warwick.ac.uk](mailto:e.macpherson@warwick.ac.uk) This is a fully funded-PhD studentship at standard UK Research Council rates, available with a flexible start date from October 2025 onwards for a 3.5 year period. The Studentship covers university fees and a living stipend, and is available to UK and potentially international students.

For more information please see <http://go.warwick.ac.uk/PhysicsPG> .