SU2P Staff Exchange

Case Study:- Andrew Moore

Title: THz Dimensional Metrology

Background

Dr Peter Siegel works at the Biological Imaging Centre, Beckman Institute (Caltech) and directs the Submillimeter Wave Advanced Technology (SWAT) group at JPL. Siegel and his team are internationally recognized as leaders in THz technology development. At the Beckman Institute, he is working on biological applications of THz technology, particularly the effects of THz radiation on cells.

Andrew Moore's research focuses on optical instrumentation and its application to provide hitherto unavailable data in manufacturing and the life sciences. During the exchange visit, we explored which upcoming advances in THz technology are most likely to enable future full-field dimensional metrology (i.e. the measurement of physical behaviour such as structure, shape and deformation) in manufacturing. The ultimate aim would be to devise full-field, sub-surface imaging modalities for high-value applications in manufacturing.

Outcomes of the visit

The major technical outcome of the short visit was to understand the importance of heterodyne detection for the applications undertaken at JPL, specifically spectroscopy for astronomy and atmospheric sensing, and frequency-modulated continuous wave (FMCW) radar for range measurements. The THz band is of interest in astronomy because it covers the blackbody radiation from interstellar material at 4K and for radar due to its ability to penetrate clothing at a sufficiently low energy so as to avoid ionisation-related health issues. Current work at JPL is focussed on fabricating and characterising monolithic microwave integrated circuit (MMIC) technology with increased frequency response for potential future space missions and further developing the JPL radar to demonstrate stand-off measurement of shape to identify person-borne concealed weapons.

Conclusion

The short exchange visit has proved invaluable to determine the most promising new and emerging THz technologies that will enable full-field THz inspection, for application in manufacturing. Experiments based on the findings of the initial visit are underway, to implement a range of full-field measurements using direct array detectors at room temperature (pyroelectric) and cooled (bolometers). Scanned-single-point and array detectors will be used as available. We will continue to monitor the development of THz sources and detectors, and look to exploit the links made into the area of mm-wave metrology.