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High-resolution and ultrafast imaging using betatron x-rays from laser wakefield accelerators ZULFIKAR NAJMUDIN, Imperial College London — Laser wakefield accelerators now routinely produce ∼GeV energy gain in ∼cm plasmas. and are simultaneously capable of producing high brightness and spatially coherent hard x-ray beams. This unique light-source has been used for medical applications, and also for ultrafast imaging in high energy density science. The experiments were performed with the Astra Gemini laser producing 10 J pulses with duration $\sim$ 40 fs focussed to produce a spot of 25μm ($fwhm$) in a gas-cell of variable length to produce a low divergence beam of x-rays. The length of the gas cell was optimised to produce high contrast x-ray images of radiographed test objects. This source was used for full tomographic imaging of a human trabecular bone sample, with resolution exceeding the $\sim 100\,\mu$m level required for CT applications. Phase-contrast imaging of human prostate and mouse neonates at the micron level was also demonstrated. These studies indicate the usefulness of these sources in research and clinical applications. The ultrafast nature of the source was also demonstrated by performing time resolved imaging of a laser driven shock. The ultrashort duration of the x-ray source essentially freeze the motion of these fast moving transient phenomena.

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