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Characterisation of Bright X-ray Beams by Powder Diffraction

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It is well known that plasma accelerators can generate bright, energetic X-ray beams via transverse betatron oscillations of the accelerating electron bunch. Many of the applications of betatron radiation require the radiation to be well characterised, but this is difficult owing to large shot-to-shot fluctuations. It is therefore desirable to develop single-shot, non-invasive methods for characterizing broad-band X-ray beams.

We present such a method based on energy-resolved diffraction from a thin powdered target. We show, via numerical simulations, that the spectrum and divergence of the radiation can be retrieved from a single shot without apriori assumptions of the form of the spectrum. Since the diffracted X-rays are detected off-axis, the undiffracted portion of the beam can be used in applications. Simulations show that existing betatron sources have sufficient photons to be accurately characterised by this method.

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