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New Measurement Techniques Using a Novel X-band Transverse Deflecting Structure with Variable Polarization

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A transverse deflecting structure is a well-known device for the characterization of the longitudinal properties of an electron bunch in a linear accelerator. The standard use of such a cavity involves streaking the bunch along a transverse axis and analysing the image on a subsequent screen to find the bunch length and the slice properties along the other transverse axis. A novel X-band deflecting structure, which will allow the polarization of the deflecting field to be adjusted, is currently being designed as part of a collaboration between CERN, DESY and PSI. Using this cavity, the beam distribution can be characterized in all transverse directions. By collecting measurements of bunches streaked at different angles and combining them using tomographic techniques, 3D distributions of the charge density can be reconstructed. In addition, the device can be combined with quadrupole and dipole magnets for transverse and longitudinal phase space measurements. In this paper, possible measurements using this novel device are discussed and simulations are presented to show how these techniques could be applied, for example, at SINBAD, an upcoming research & development facility at DESY.

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