The Beams and Applications Seminar Series

Computing Transfer Maps from Surface Field Data in 3 Dimensions

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Bldg. 401, room B2100
Friday, Feb 25, 10:00 am

Host: Katherine Harkay, ASD

Many advanced accelerator designs require the careful modeling of beam propagation through magnets with complicated 3-dimensional magnetic fields including fringe fields. These fields can now be computed reliably by a variety of magnet codes in the form of tables specifying all 3 field components on a fine 3-dimensional mesh both within the magnet and in the fringe field region outside the magnet. The problem is to use this data to calculate high-order transfer maps that describe beam propagation through these magnets. Such calculations require the knowledge of high derivatives of the vector potential in the vicinity of the beam. These derivatives cannot be obtained simply from the mesh data by high-order numerical differentiation since so doing amplifies round-off and truncation errors to unacceptable levels. This talk describes how this problem can be overcome in cases where the beam is confined to the interior of a long cylinder that fits within the magnet and also extends into the fringe-field regions. In particular, we treat the case of dipoles with a small gap and wide pole faces, where a cylinder with elliptic cross section is appropriate. The essential step is to employ only the normal field data on the surface of the cylinder to compute the interior vector potential. So doing produces a representation with controlled accuracy that exactly satisfies the Maxwell equations and is also manifestly analytic in the interior of the cylinder, thereby leading to reliable high derivatives. Because of the smoothing property of the inverse Laplacian, this method is also relatively insensitive to errors in the surface data. .

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