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Towards a crystal undulator

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A crystal undulator is similar to a normal undulator as typically found at a synchrotron for the production of extremely brilliant X-ray beams. The difference is the magnetic lattice is realized by the periodic electrostatic potential of a crystal lattice seen from the reference frame of the GeV range electron or positron beam. The extremely relativistic incident particle beam is captured in a high index crystallographic channel of a crystal superlattice. The particle beam will then "see" a many Tesla range periodically varying magnetic field with a few micron pitch.
This method could theoretically lead to an MeV range gamma ray laser by the FEL principal. We have investigated a prototype diamond superlattice (produced by Element Six) using x-ray diffraction topography. The undulator fabrication principle involved CVD growth of diamond on a diamond substrate while varying the concentration of boron in the gas phase during growth. This leads to the periodic variation of the lattice dilatation by the varying concentration of the single substitutional boron impurity atom.

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