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Novel Design of a Miniature Highly Accurate Three-Axis Hall Sensor

The single-axis Hall probe magnetic measurements performed at the Paul Scherrer Institute (PSI) are the state of the art in the magnetic field mapping. Controlling the alignment of the probes as well as repeated thorough calibration against non-linearity effects, temperature dependence and offset, result in a precision better than 50 μT or 10^{-4} for 1T fields. Highly precise three-axis magnetic field measurements with a high spatial resolution are however needed in some cases, for an accurate determination of the magnetic axis of solenoids or for a precise measurement of inhomogeneous magnetic fields, for example in beam-line insertion devices. None of today's commercially available three-axis Hall probes offers the same accuracy that can be reached with single-axis probes. The reasons for this are poor spatial resolution, noise, or the lack of possibility to measure in a single point is space and time. For this particular reason, there is a clearly defined need for a high precision three-axis magnetic field sensor in facilities such as synchrotron light sources and future Free Electron Lasers, but also in the research community in general. The PSI magnet section is designing and developing a three-axis Hall sensor using an original sensor form that allows measurements of the full field vector in three dimensions in a single point in space and time with unrivaled accuracy. The unique design of this three-axis Hall sensor will be presented.