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Generalization of the One Dimensional Modeling and Design Considerations of Spiral Si Drift Detectors: Flat (Straight) Drift Channels and Constant Drift Fields

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The one-dimensional design consideration for the spiral (cylindrical geometry) Si drift detector (SDD) described in literature [1-2] has been modified and generalized for small drift distance (R) compatible to the detector thickness (d), i.e. for R~d, and for non uniform backside biasing situations. With smaller R, an array of SDD with small pixel size down to a few hundreds of microns will be possible. Also, by applying a non uniform biasing voltage with a gradient similar (proportional) to the front side, one can increase the reach-through voltage, resulting in a large drift field for carriers. This can be important for large R (> 3mm), or for high resistivity Si substrates (>8 kΩ cm). In the modeling, the one-dimensional solution to solve the electric potential and drift field, as well as the spiral design have been modified and generalized for all cases. With a careful design of electric field profiles on both sides, one can obtain the optimum case of of a spiral SDD with a strait (flat) drift channel and constant drift field throughout the carrier drift channel. The previous solution in the literature is an approximation of this work for R» d and with a curved drift channel.

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