Outline of Detailed Silicon Simulation Code

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org.lcsim Classes

- Based upon CDF/Padova physical charge-deposition model
  - Code works, but an awful mess of Fortran. Much of the physics has survived, but code transformed beyond recognition. Considering the poor performance of the original code, this is a good thing.

- org.lcsim.recon.digisim.tracking
  - enum ChargeCarrier
  - Class SiStripDetector
  - Class SiStrips
  - Class DopedSilicon
  - Class TrackSegment
  - Class ReadoutChip
  - Class SiStripDetectorTest

enum ChargeCarrier

- Provides methods that return properties of charge carriers in silicon {ELECTRON, HOLE} for use by other classes.
- Use of enum allows for major simplification elsewhere. For example, strips of a double-sided detector can be represented as

```
private EnumMap<ChargeCarrier,SiStrips> _strips;
```

many functions can have forms like

```
public double tanLorentzAngle(double b_field, ChargeCarrier charge_carrier)
```

and both sides of double-sided silicon can be handled with

```
for (ChargeCarrier carrier : ChargeCarrier.values()) {process a side}
```

Class SiStripDetector

SiStripDetector is the key element:

```
// strips
private EnumMap<ChargeCarrier,SiStrips> _strips;
private EnumMap<ChargeCarrier,Double> _strip_angles;
private EnumMap<ChargeCarrier,Orientation> _side;

// bulk
private DopedSilicon _bulk;
private double _thickness;

// global
private BasicHep3Vector _b_field;
private double _depletion_voltage;
private double _bias_voltage;
```

All simulation of the physics of charge deposition on the strips takes place through this class:

```
public void depositCharge(TrackSegment track, double energy_loss)
```

Other Classes

- **`Class TrackSegment`** defines a segment of straight track in the silicon
- **`Class DopedSilicon`** provides important information about the bulk: ***mobilities, lorentz angle, etc.***
- **`Class SiStrips`** keeps track of what is happening on the strips: ***strip configuration, capacitance, charge deposited, transformation between 1-d position and { strip # , interstrip position }, etc.***
- **`Class ReadoutChip`** describes the analog (noise , crosstalk, integration fraction) and digital (digitization to ADC counts) response of the readout electronics, culminating with:

```
public double[] digitize(SiStripDetector detector, ChargeCarrier carrier)
```

Status

- Individual classes are implemented. Exception: delta-ray code is incomplete pending Geant4 studies with small range cuts.
- Overall task is complicated enough that pieces need to be tested individually before attempting to put it all together. Evidence: already finding bugs.
- Once all elements are are tested and together, finish SiStripDetectorTest and benchmark against original code.