Future e+e- Silicon Detectors & Optimization for LLPs

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ECFA Focus Topic: LLPs

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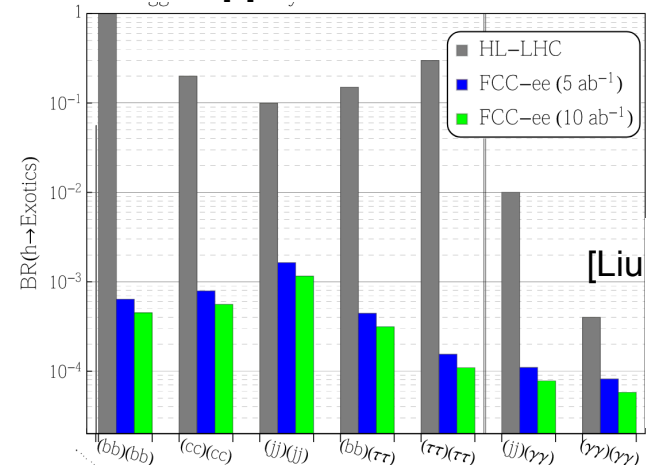
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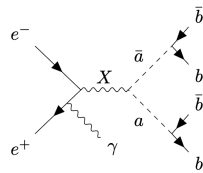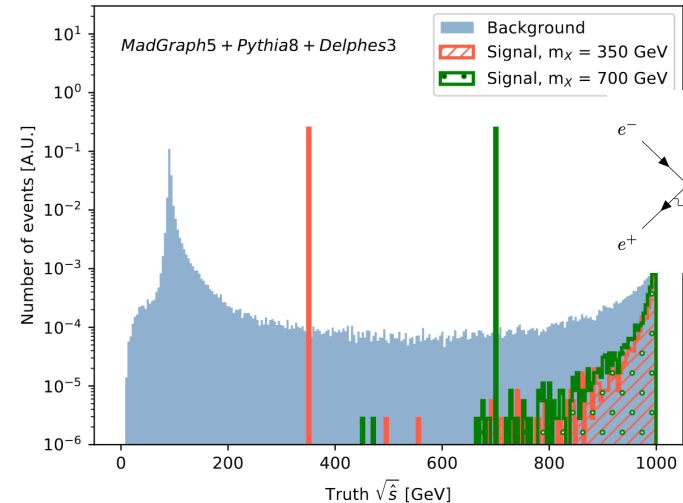
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- Physics drivers
  - ‣ Higgs physics: vertexing resolution, strange tagging..
  - ‣ Vector-like leptons
  - ‣ Exotics Higgs decays, axion-like particles: displaced vertices
  - ‣ Resonances/anomaly detection?

- → detector specifications
  - ‣ High granularity, spatial constraints (low material budget, low power)
  - ‣ Vertexing detector before silicon tracker with 25 × 25 μm² pixels, 3 μm single point resolution, power density < 30 mW/cm2

Y. Wang
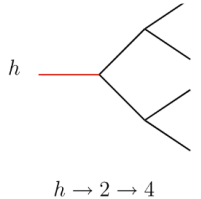
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The image behind contains text:
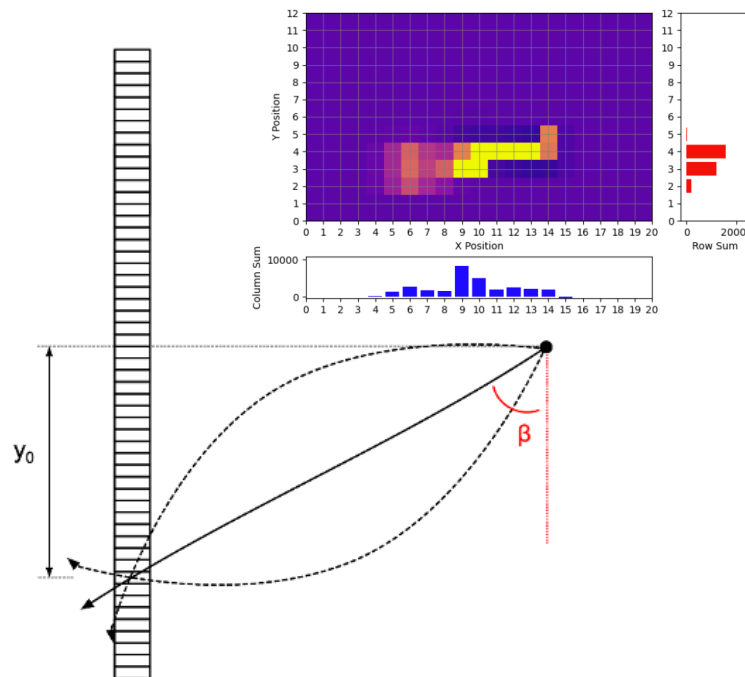"to model delta rays), a realistic electric field map resulting from the simultaneous solution of Poisson's Equation, carrier continuity equations, and various charge transport models, an established model of charge drift physics including mobilities, Hall Effect, and 3-D diffusion, a simulation of charge trapping and the signal induced from trapped charge, and a simulation of electronic noise, response, and threshold effects. A particularly valuable aspect of PixelAV used in this study is time evolution of the drift and induced currents in the pixel sensor."

- Working with '... [1, 2, 3]: futuri... datasets of CM...
  ‣ Allows for ... source: cla... pileup), reg...

- Studying embedded FPGAs (**eFPGAs**) as technology to perform *reconfigurable logic on-chip*
  ‣ Taped out 28nm proof-of-concept eFPGA at SLAC and get perfect closure of simple BDT on hardware with respect to golden software (quantized) result

Figure 2: (a): A schematic of the pixel sensor area and the specific region of interest (blue) of 21×13 pixels for a given cluster. The magnetic field is parallel to the sensor x-coordinate. (b): A diagram of three charged particles traversing our simulated silicon sensor at the same y_0 position. The sensor is viewed in the bending plane of the magnetic field. The solid track corresponds to a charged particle with high p_T, while the two dashed tracks correspond to low p_T particles with opposite charge.

Figure 2 sketches out key features of the pixel sensor and corresponding strategies employed by this paper. Within the pixel sensor area, we define a *cluster region of interest*, shown in blue, which corresponds to 21×13 pixels in x and y, respectively. This region is large enough to fully encompass a charge cluster and serves as input to the ... based extracted cluster features. The location (x, y) where the charged particle ... sensor mid-plane is uniformly distributed across the central 3×3 pixel array ...

Summary & Next Steps

- eFPGAs for on-detector silicon readout: open source <u>FABulous</u> framework development, radiation tolerance, etc.

- Study BSM models and specific detector simulations to estimate sensitivity gain for different on-detector compression schemes
  - ‣ Eg. Higgs exotic decays, vector-like leptons, axion-like particles, resonances, etc.

- Potential connection of smart readout with <u>MAPS</u>?