Generic Hit Formats

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Problem Statement

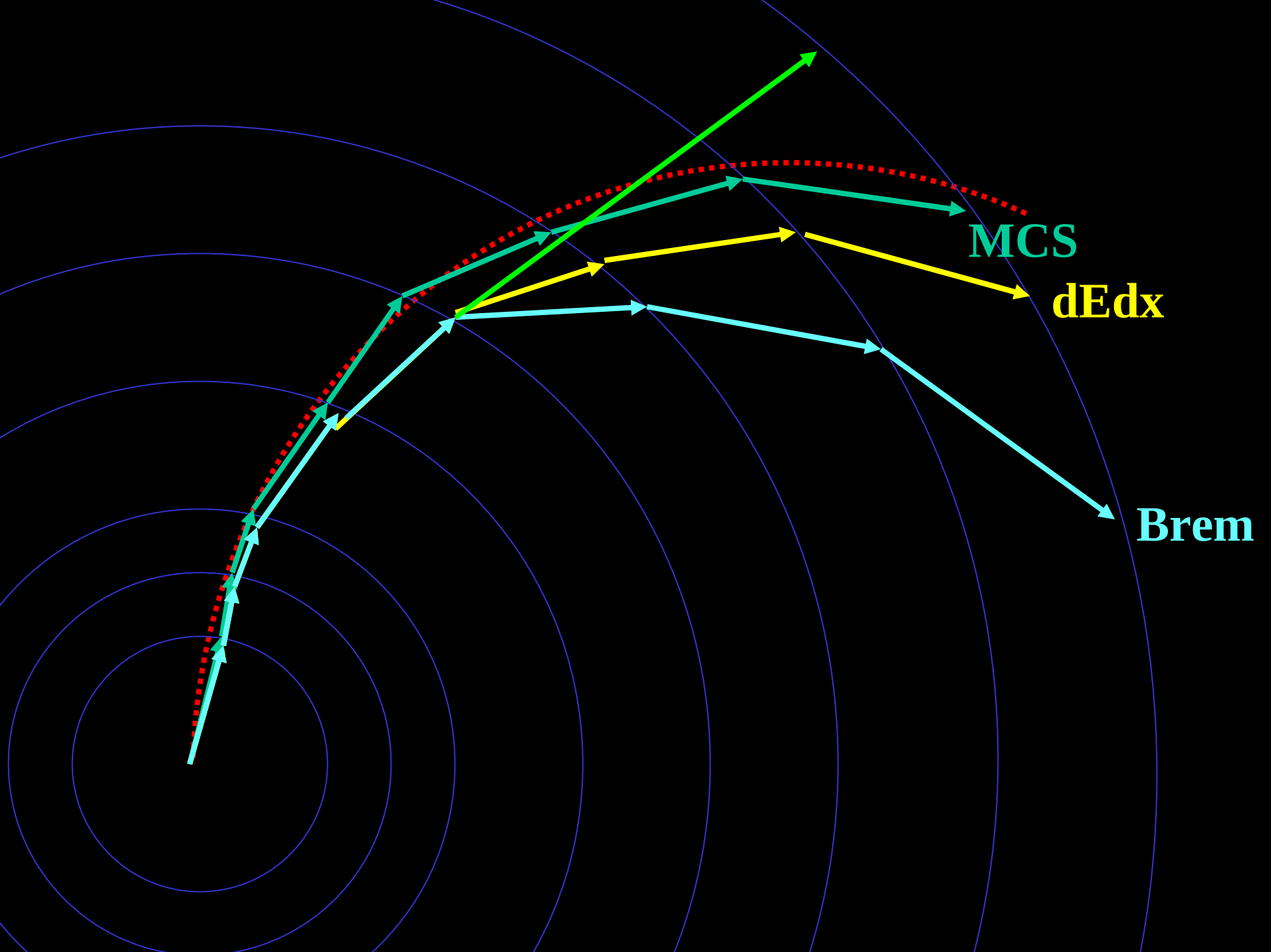
- We wish to define a generic output hit format for full simulations of the response of detector elements to physics events.
- Want to preserve the “true” Monte Carlo track information for later comparisons.
- Want to defer digitisation as much as possible to allow various resolutions, etc. to be efficiently studied.

Types of Hits

- "Tracker" Hits
  - Position sensitive.
  - Particle unperturbed by measurement.
  - Save "ideal" hit information.
- "Calorimeter" Hits
  - Energy sensitive.
  - Enormous number of particles in shower precludes saving of each "ideal" hit.
  - Quantization necessary at simulation level.

Track Definition

- Particles suffer various indignities while traversing the detector.
- Knowing track parameters at a single point (*e.g.* the point of generation) is insufficient for precision fits due to material effects (dE/dx, MCS, bremsstrahlung) and field inhomogeneities.
  - No global functional form for the fit.
- Store track information at each hit.

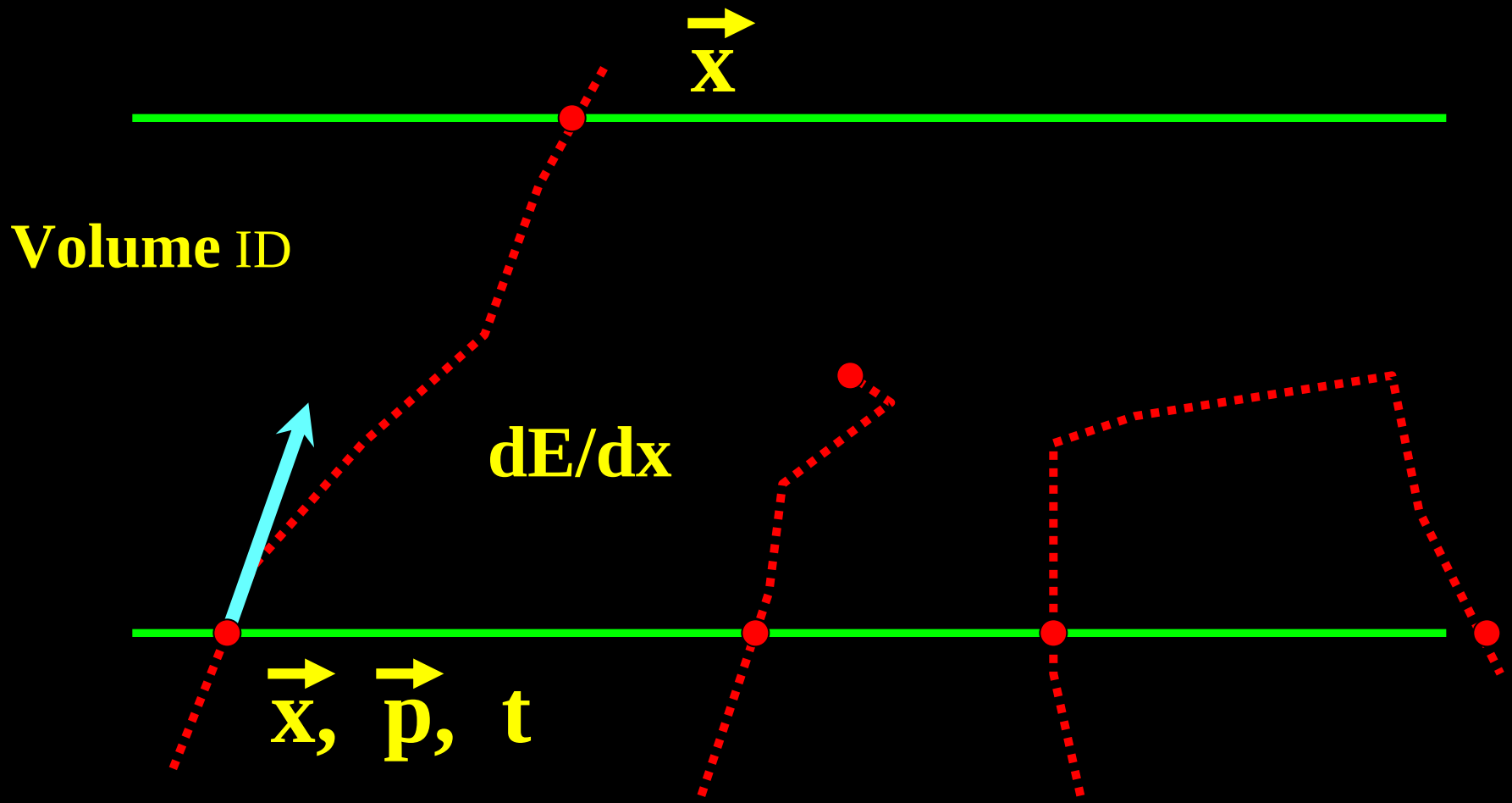

MCS
dEdx
Brem

“Tracker Hit”

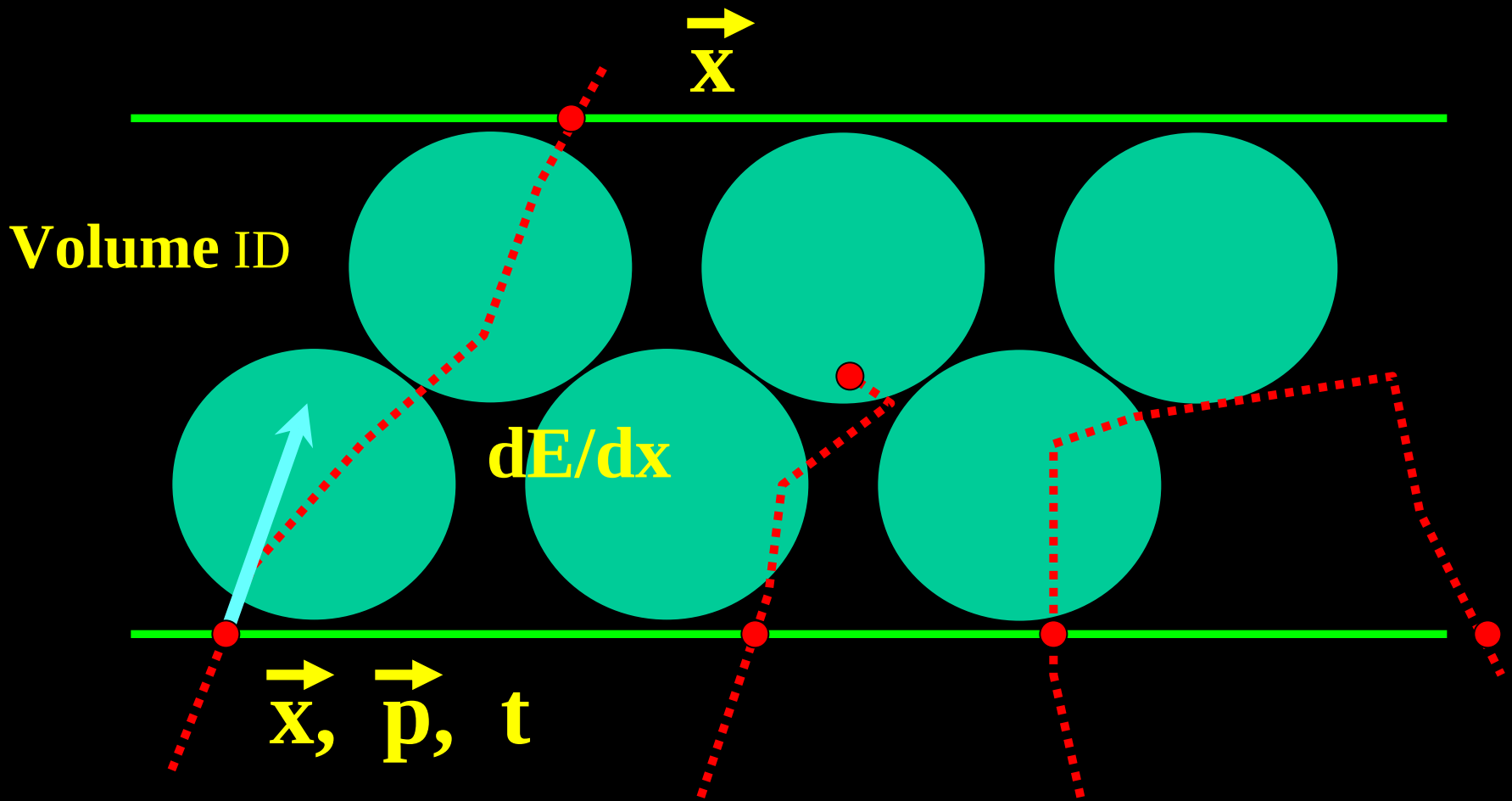
- MC Track Number
- Encoded detector ID (encoding is detector dependent)
- Global hit position at entrance to sensitive volume
- Global hit position at exit of sensitive volume
- Track momentum at entrance to sensitive volume
- Energy deposited by track in sensitive volume
- Time of track's crossing

- Hit number
- Local hit position at entrance to sensitive volume
- Local hit position at exit of sensitive volume
- Step size used by simulator in sensitive volume

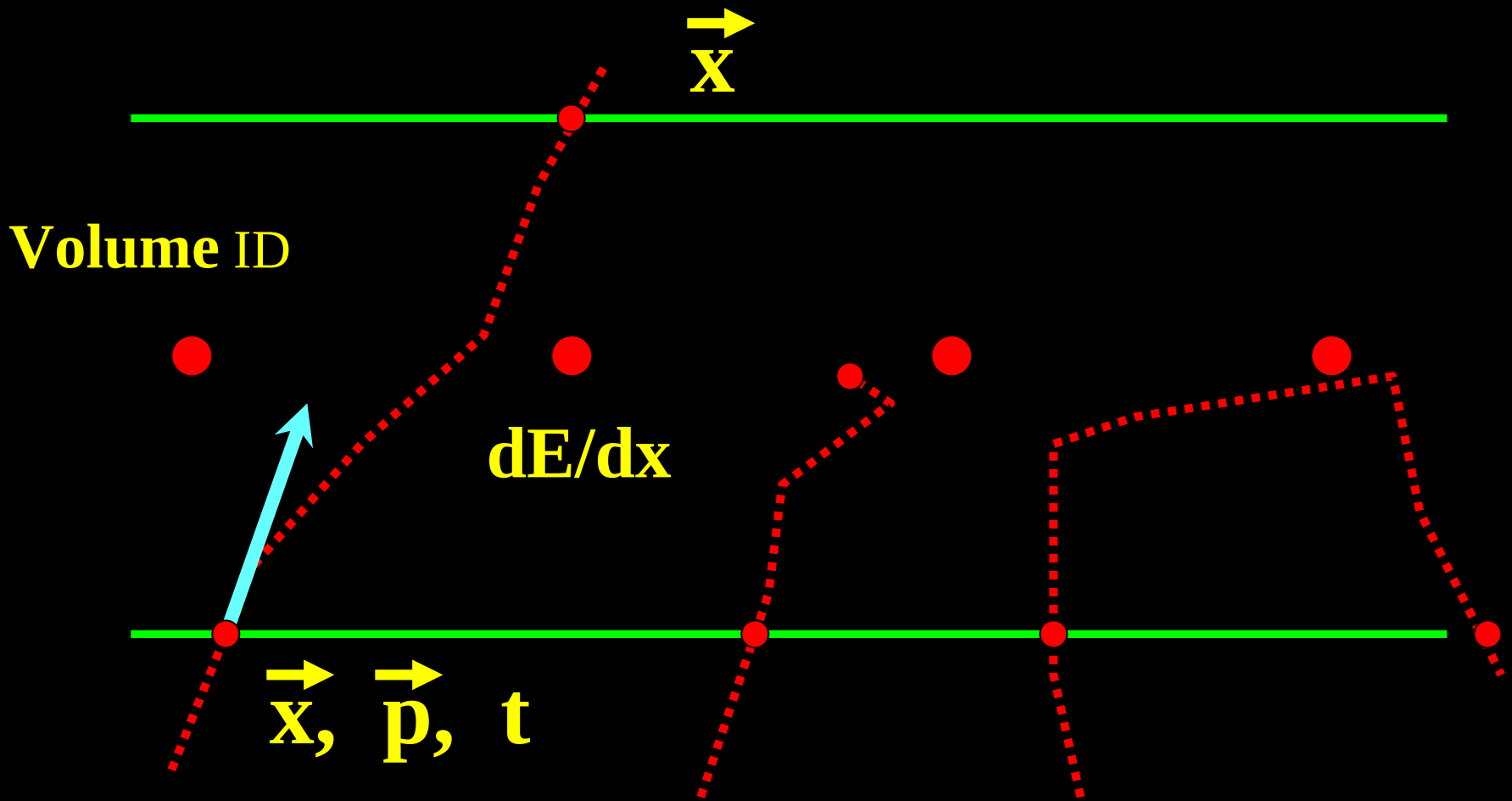
Digitization



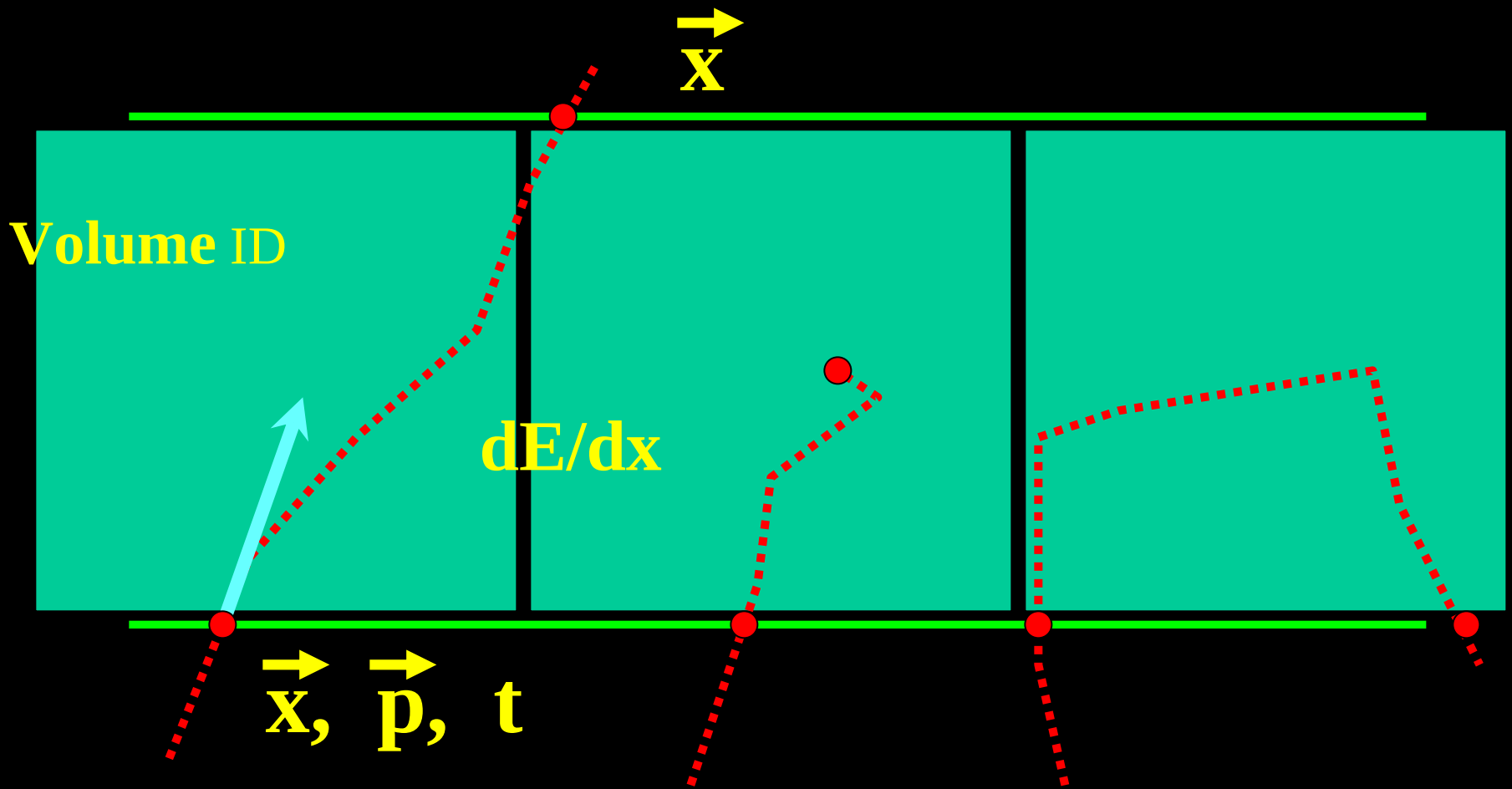
Sci-Fi Digitization



Drift Chamber Digitization



Pixel Digitization



Calorimeter Hit

- Encoded detector ID (encoding is detector dependent)
- MC ID and energy deposited by each contributing particle

- Hit Number
- Cell position
  - Radius, Phi, Z of cell
  - X, Y, Z of cell
- Total energy deposited in cell

Summary

- Storing “ideal” hits gives detailed information about MC track.
- Deferring digitisation allows studies of detector resolution to be efficiently conducted.
- Can approximate the same in calorimeter by defining small cells, then ganging later.
- Aim to have GEANT4 with SIO persistence implementation early next year.