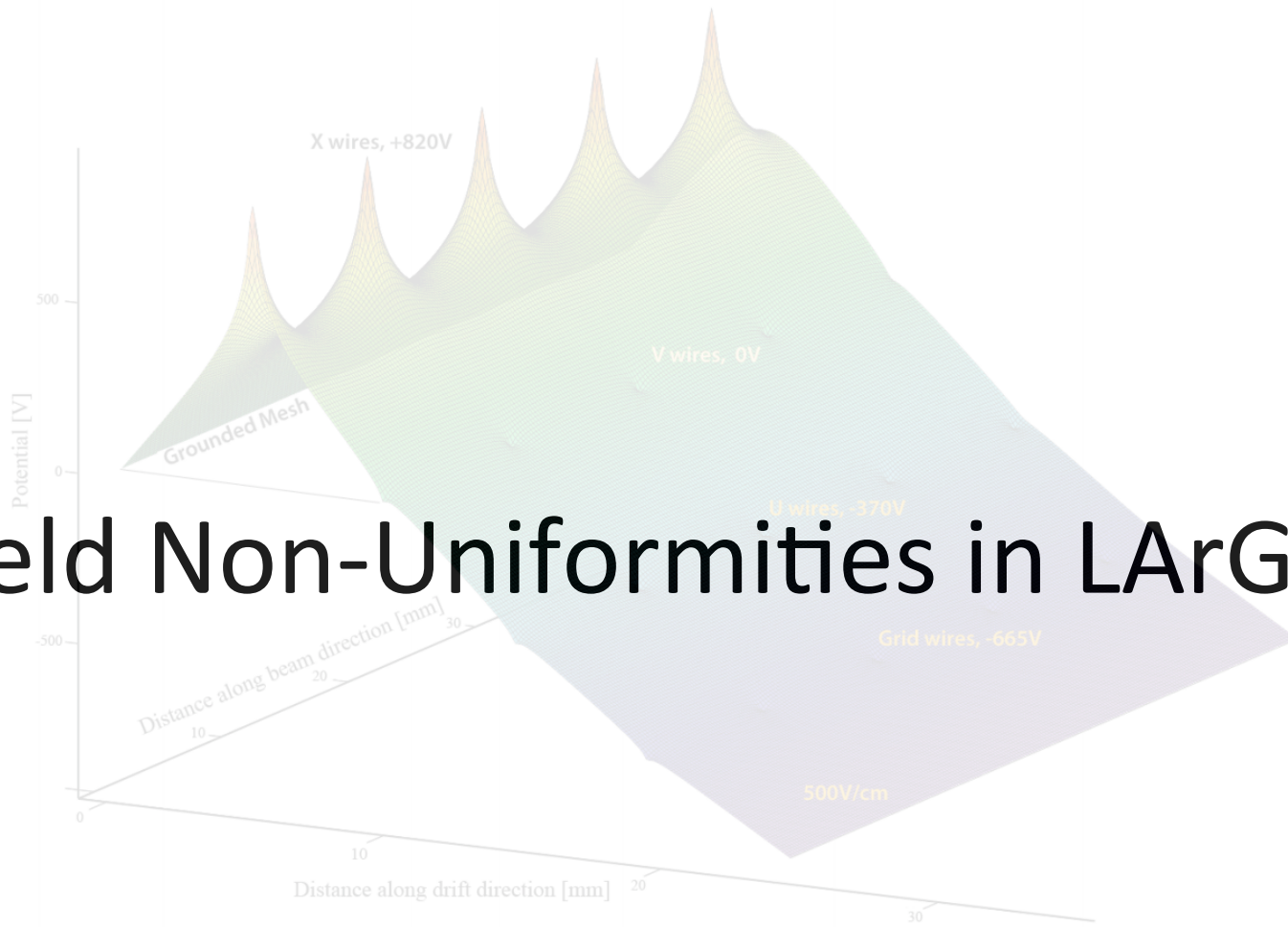


Field Non-Uniformities in LArG4



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Timescale: Not Urgent

- Simulation is good enough for most people.
 - Proton decay people will be interested in looking at as much of the active volume as possible
 - APA reconstruction people
- 35t would need the most customizability, but is close to data.
- DUNE FD/prototype definitely needs something to change ...eventually.
 - Quick fix, broad fix

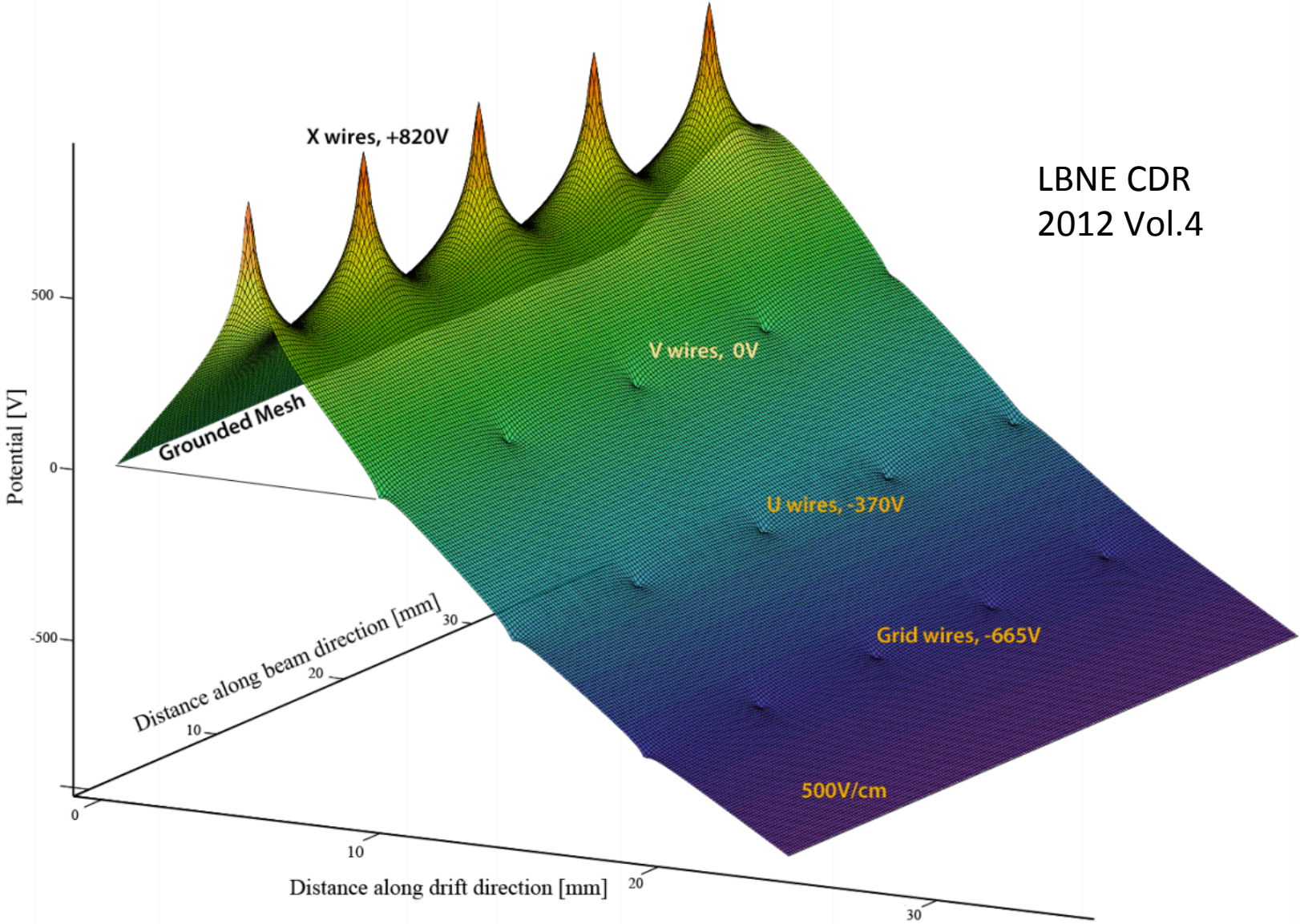
Simulation Recap

- **G4Step** gives LArSoft world coordinates and energy deposition
- LArVoxelReadout::**DriftIonizationElectrons**
 - passed the world coordinates
 - gets number of deposition electrons from IonizationAndScintillation
- DriftIonizationElectrons calculates:
 - **Channel** on which to put charge (sime::IDE) after accounting for transverse diffusion
 - **Drift time** after accounting for recombination, longitudinal diffusion, and varying fields in between wire planes

LArVoxelReadout::DriftIonizationElectrons

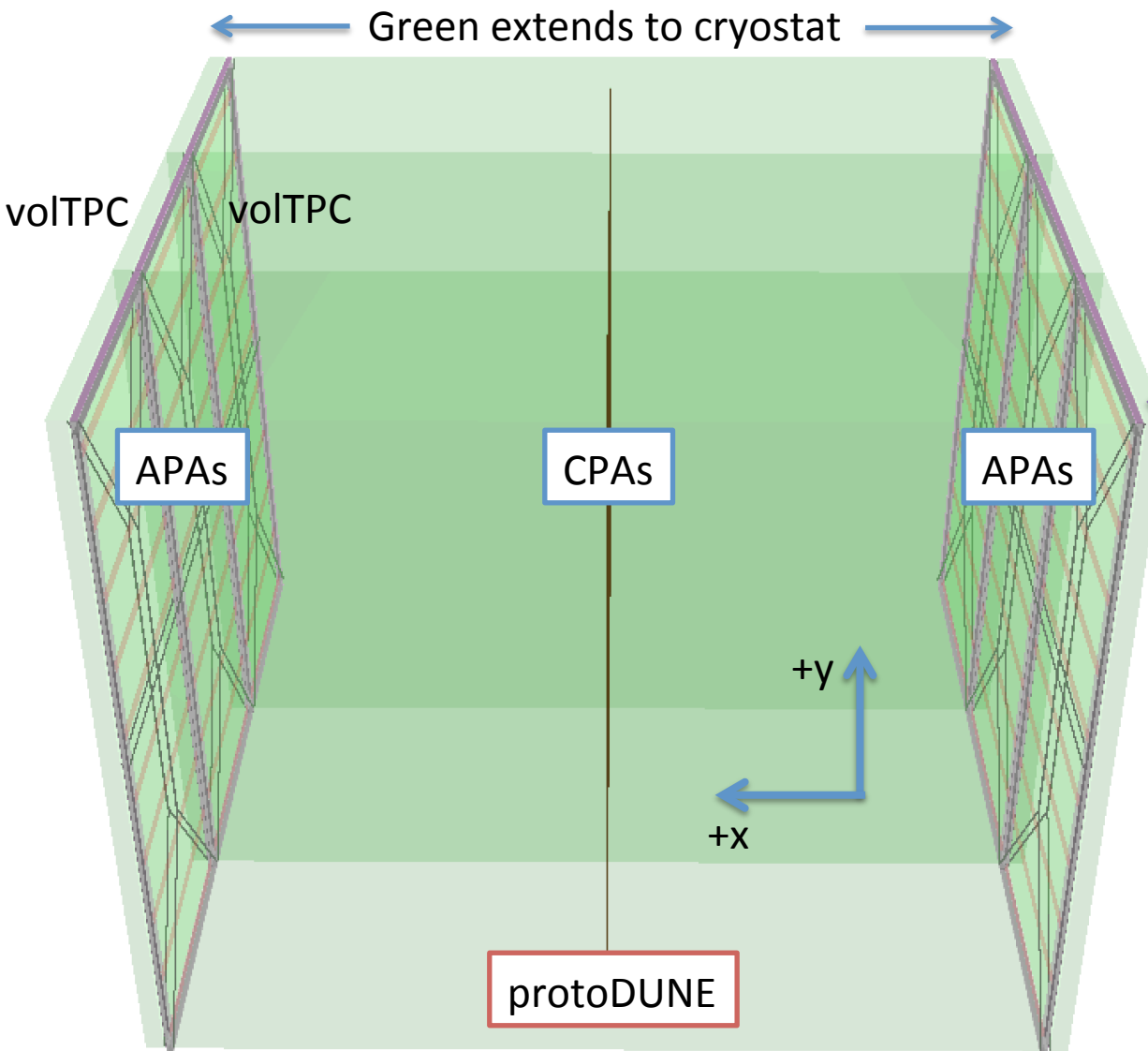
- Depending on electric field:
 - Velocity
 - Recombination
 - Longitudinal Diffusion
- Field assumed uniform throughout TPCActive
 - Except between wire planes while calculating drift time
- Kills any negative drift (which wouldn't happen anyway, later slide)
- Now the potential problems...

Standard Potential Distribution

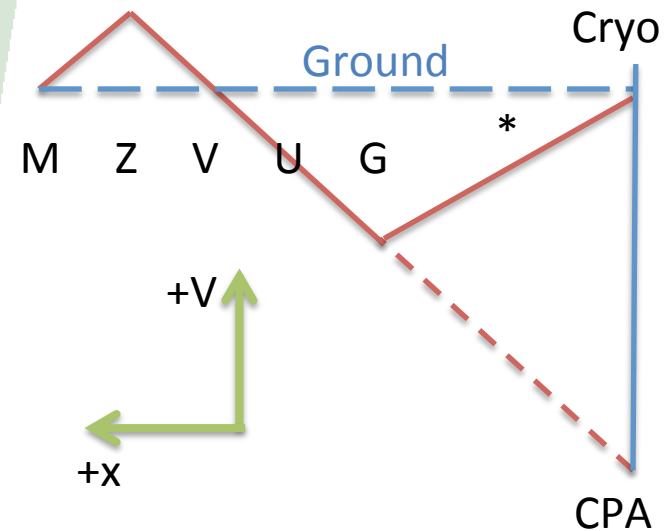


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DUNE APAs Next To Cryostat Walls



Dune FD and protoDUNE have APAs on the outside, 15 cm from the cryostat wall in the FD. This changes the field:

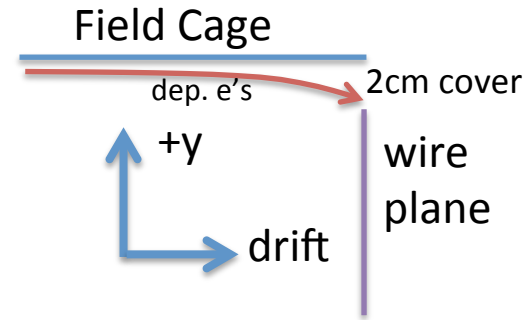
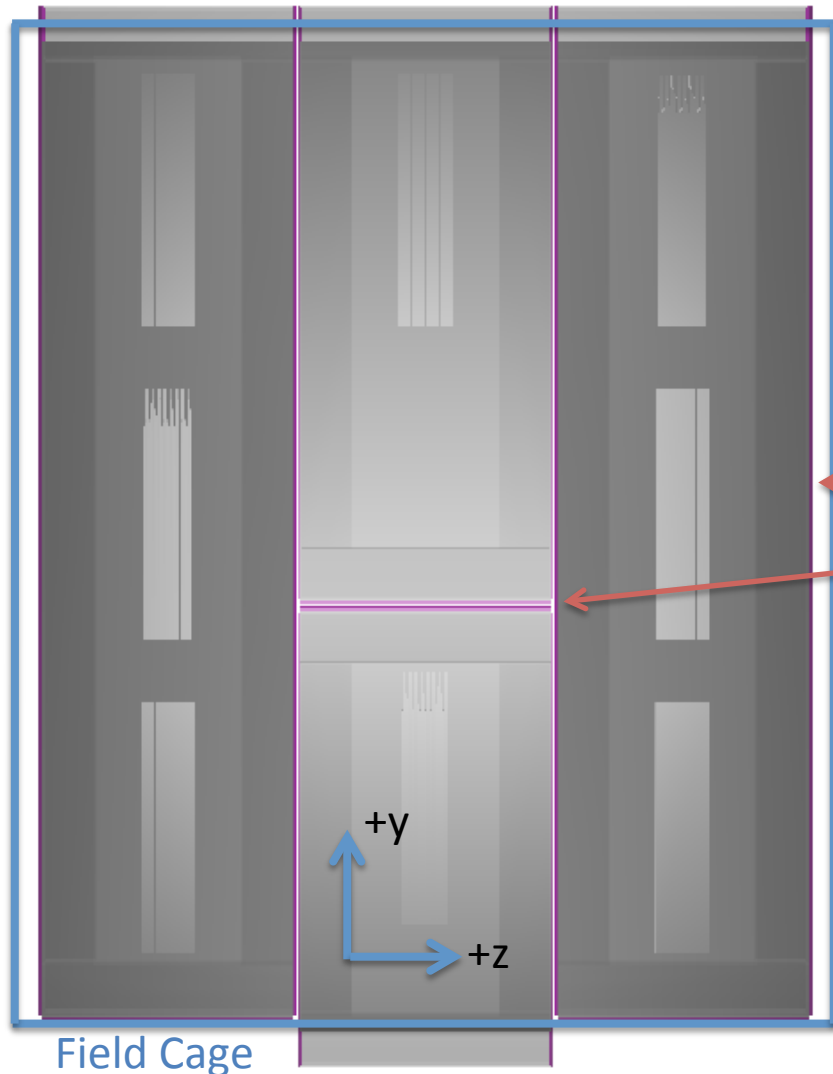


* Field is low, so recombination is much higher

Software Problem

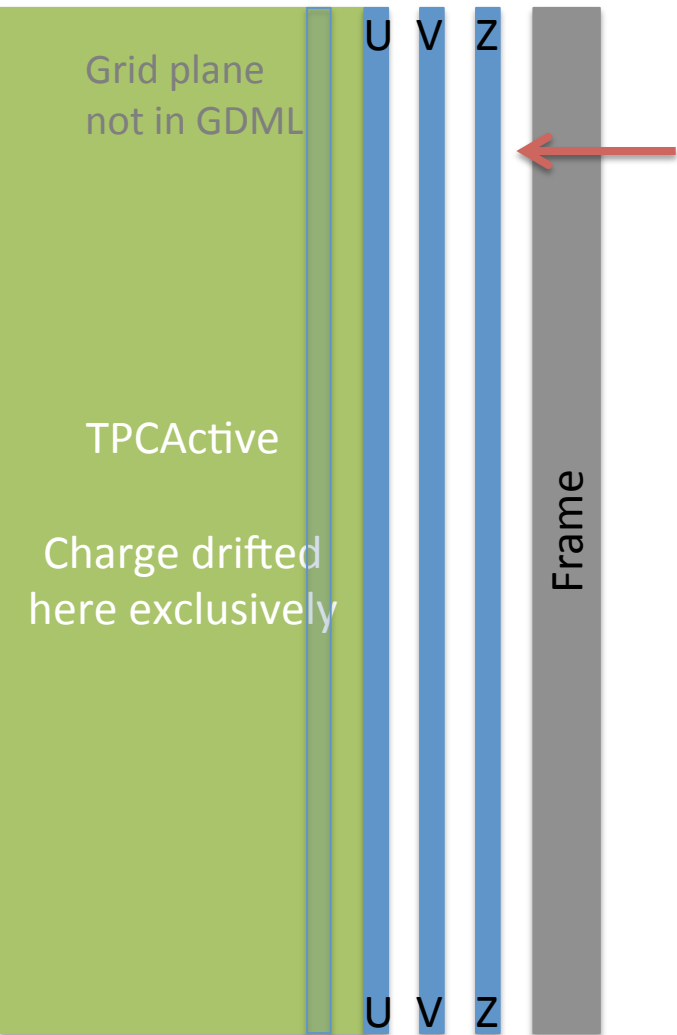
- Need 2 TPCGeo volumes per APA for sorting and channel mapping
- “volTPC*” must contain one “volTPCActive”
 - LArVoxelReadoutGeometry::FindNestedVolume
 - Quick fix: allow zero active volumes, no drift on the outsides is close enough
- General Fix: Calculate drift time as a function of ionization position in world coordinates

35t Field Oddities



- Gaps between field cage and nearest wires
 - Vertical (fig. above)
 - Horizontal
- Gaps between APAs
- For now:
 - nearest wire bends inward the right way
 - DetSim handles some fancy potentialities at edges (Tom Junk)

Simulation in between Planes



- Nothing in the midst of the planes is drifted
 - Makes sense for single-TPCs
 - APA designs impacted more here
- Varying field still accounted for in drift time calculation
- ~7cm thick slab of dead region for every APA
- Extend TPCActive to contain wireplanes into the frame?

Electric Field: Detector Specific Implementation

- Much like IonizationAndScintillation, except selected by a helper class like the Geometry (Gianluca's idea)
 - Would need to be initialized at some point since it depends on Geometry
- Base class agnostic to implementation
 - Input: **world position** of ion., time/space charge?
 - Output: **drift time** and **final yz position** of ion.
 - In-between: parameterized function, database, ...
- Pull current calculation in DriftIonizationElectrons into a standard implementation
 - helper would route all other users to that

just initial thoughts

Takeaway Points

- FD (or any APA geo) Reconstruction challenges if we discover significant effects in 35t
- Regain drift in the midst of the wireplanes
- Make field user-implementable.
 - Think about most general/elegant, Any solutions here are just initial suggestions
 - Should we think bigger? Any valuable foresight?