What Went Wrong
(You asked for it!)

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Beamtest Meeting

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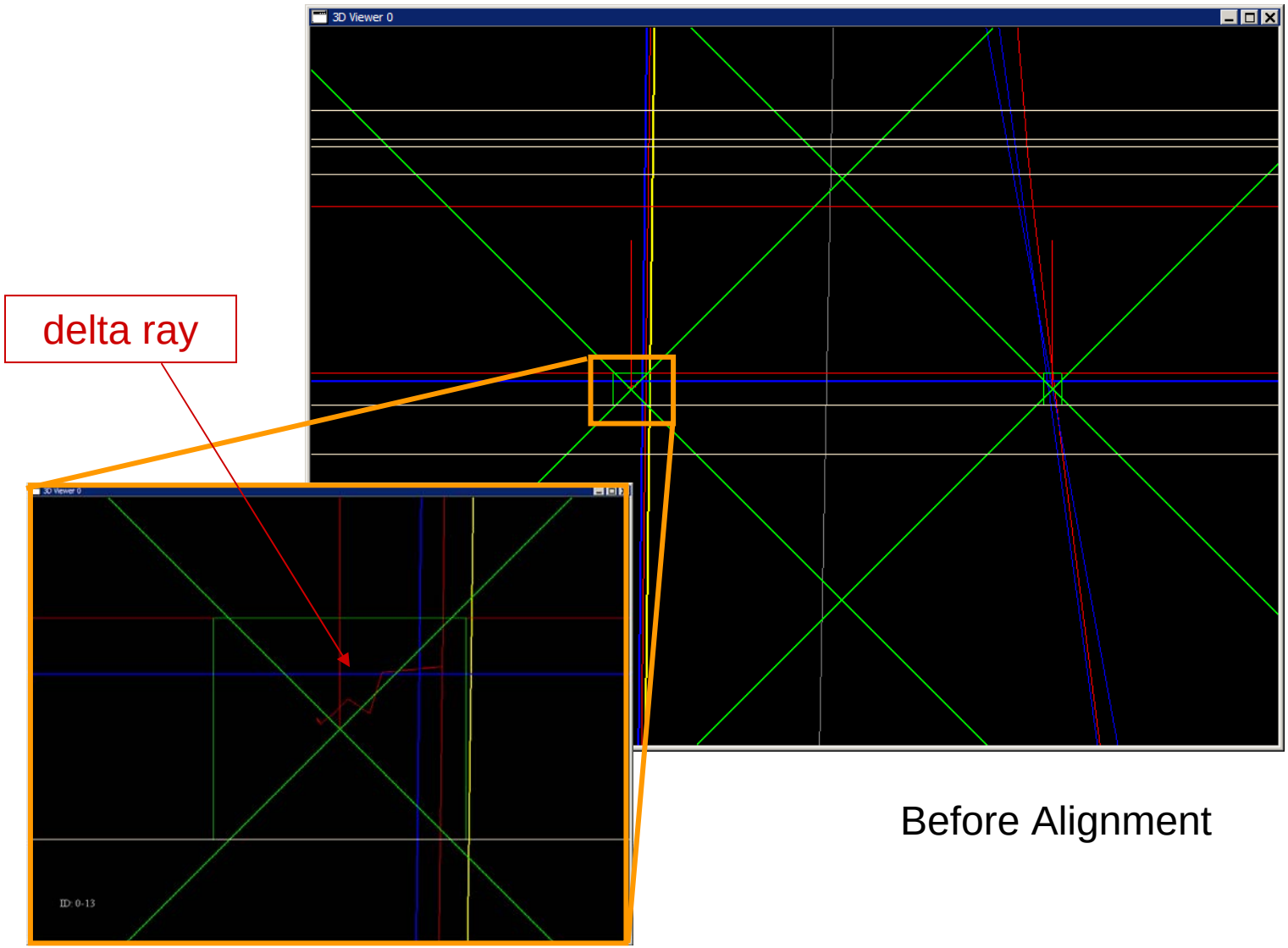
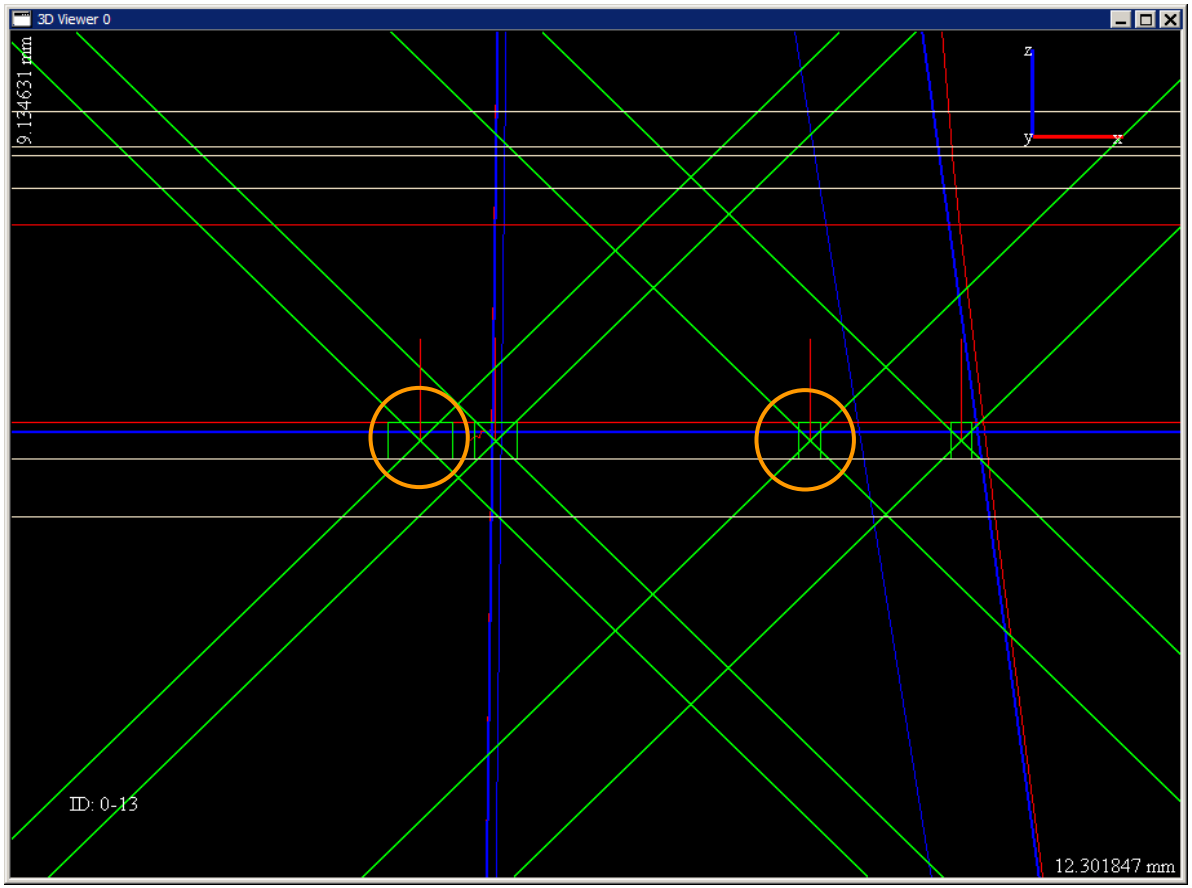
An Example of the Problem



Before Alignment

Current Version of Alignment



After Alignment: Extra Hits!

Two Alignment Strategies

1. Move the detector

Pro

- Geometry is exact – GEANT looks after alignment

Con

- Specifying the geometry is hard – can't take advantage of any symmetries
- Track reconstruction is complicated – tilted planes at arbitrary locations

2. Move the tracks

Pro

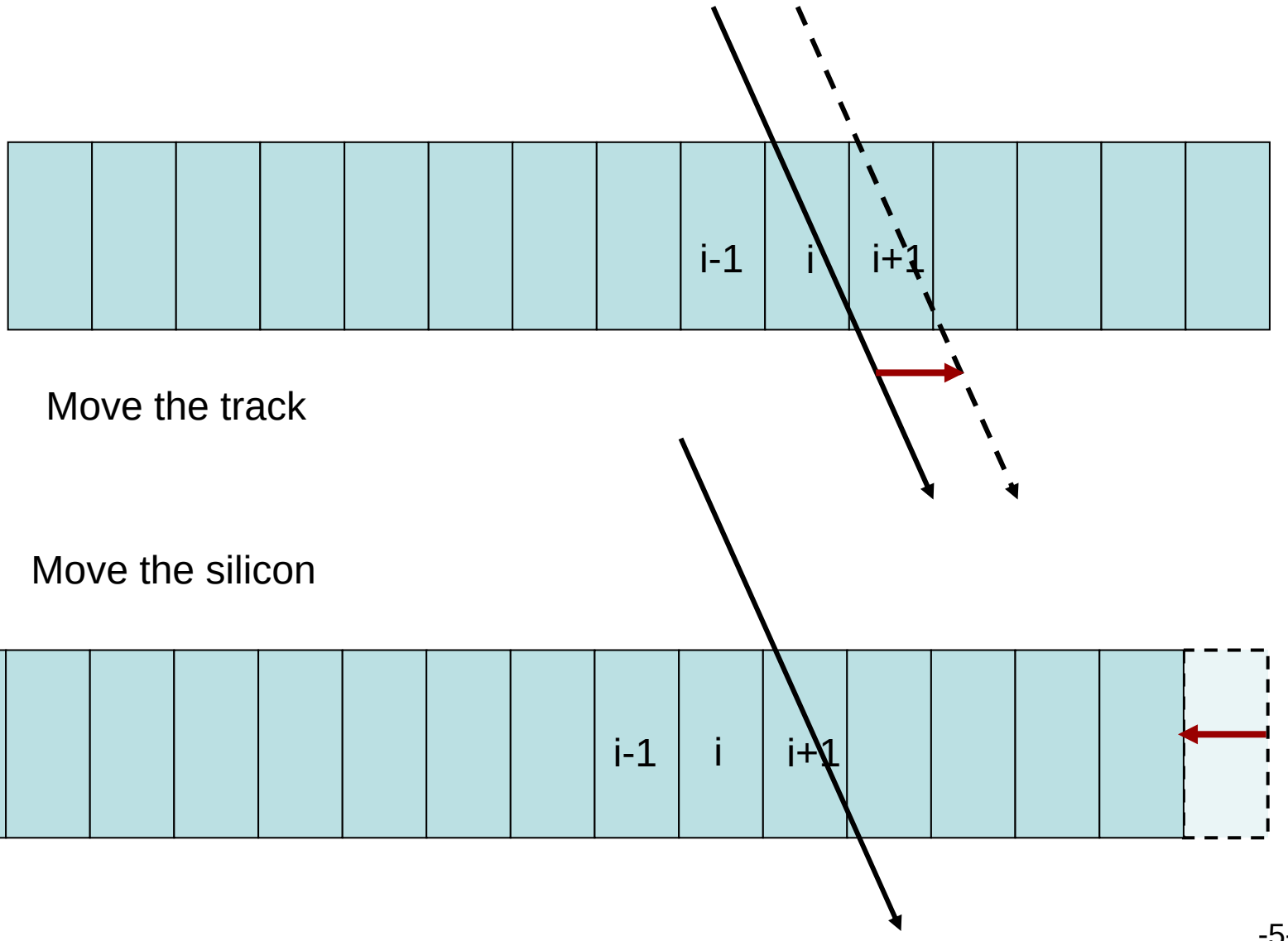
- Geometry is simple
- Recon is simple

Con

- Problems at the edges
- Tungsten doesn't "move" with the silicon
- Tricky decisions need to be made!
- We can't get the same event back. In general, angles change.

I chose the second.

A simple example



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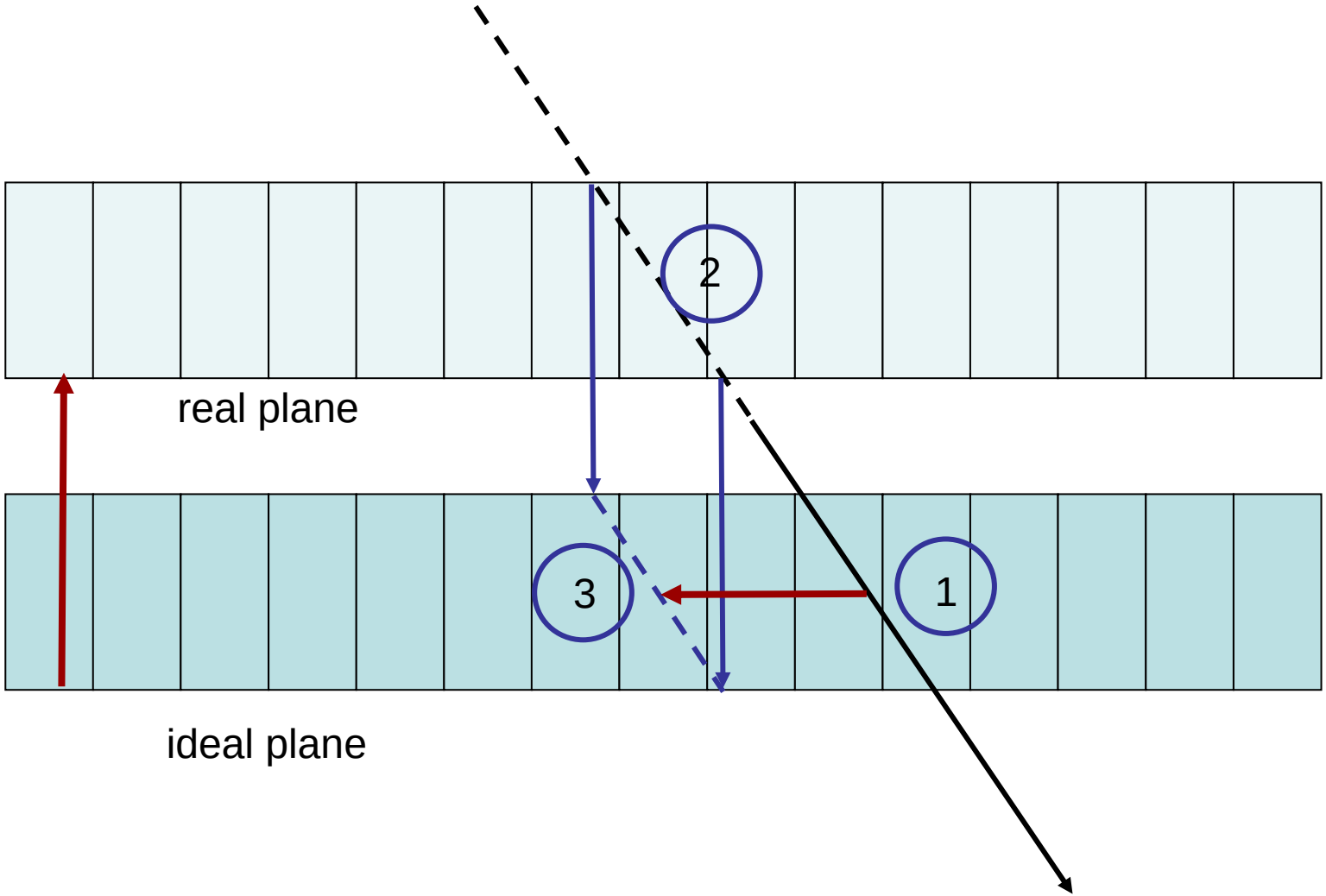
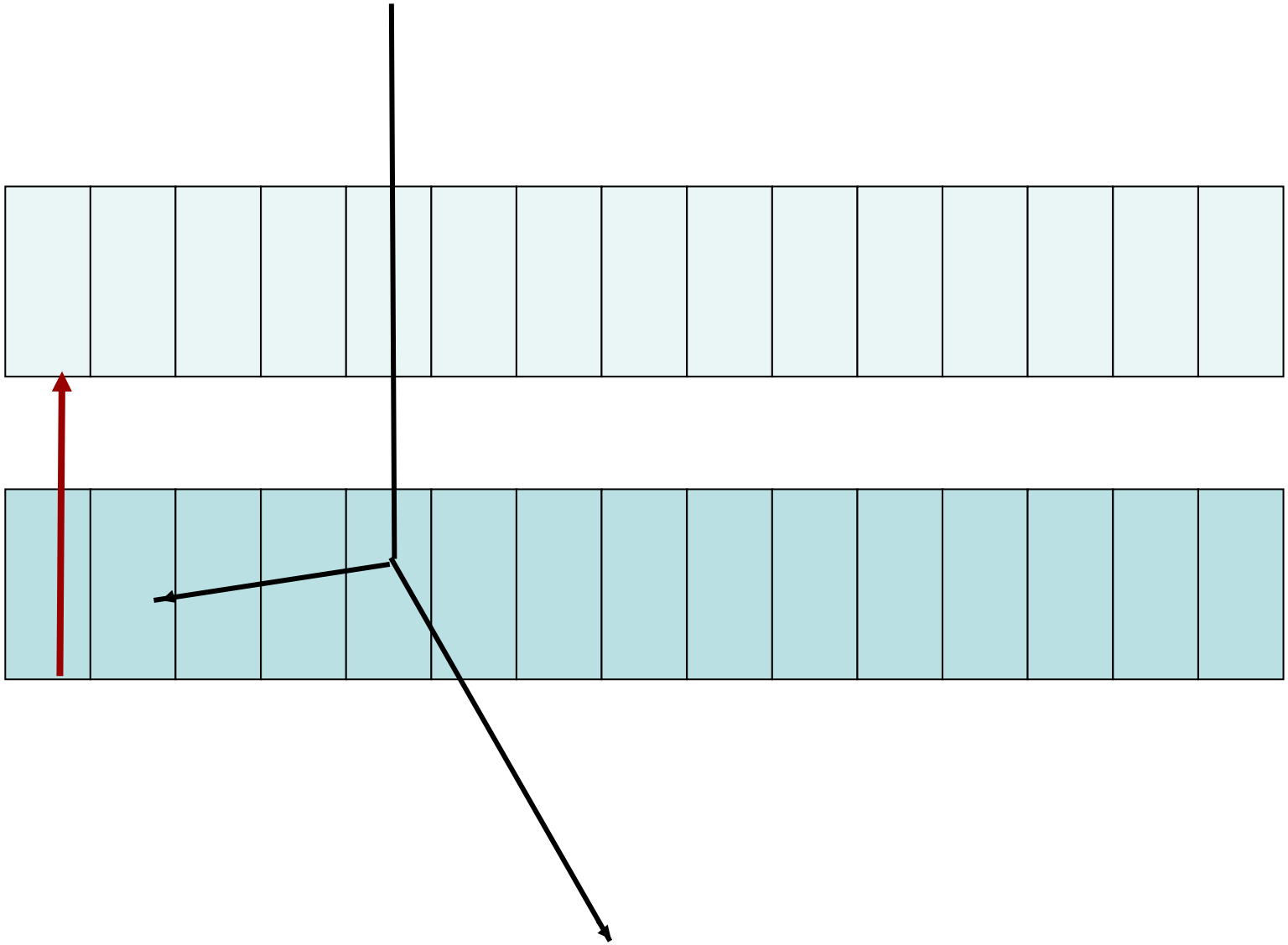
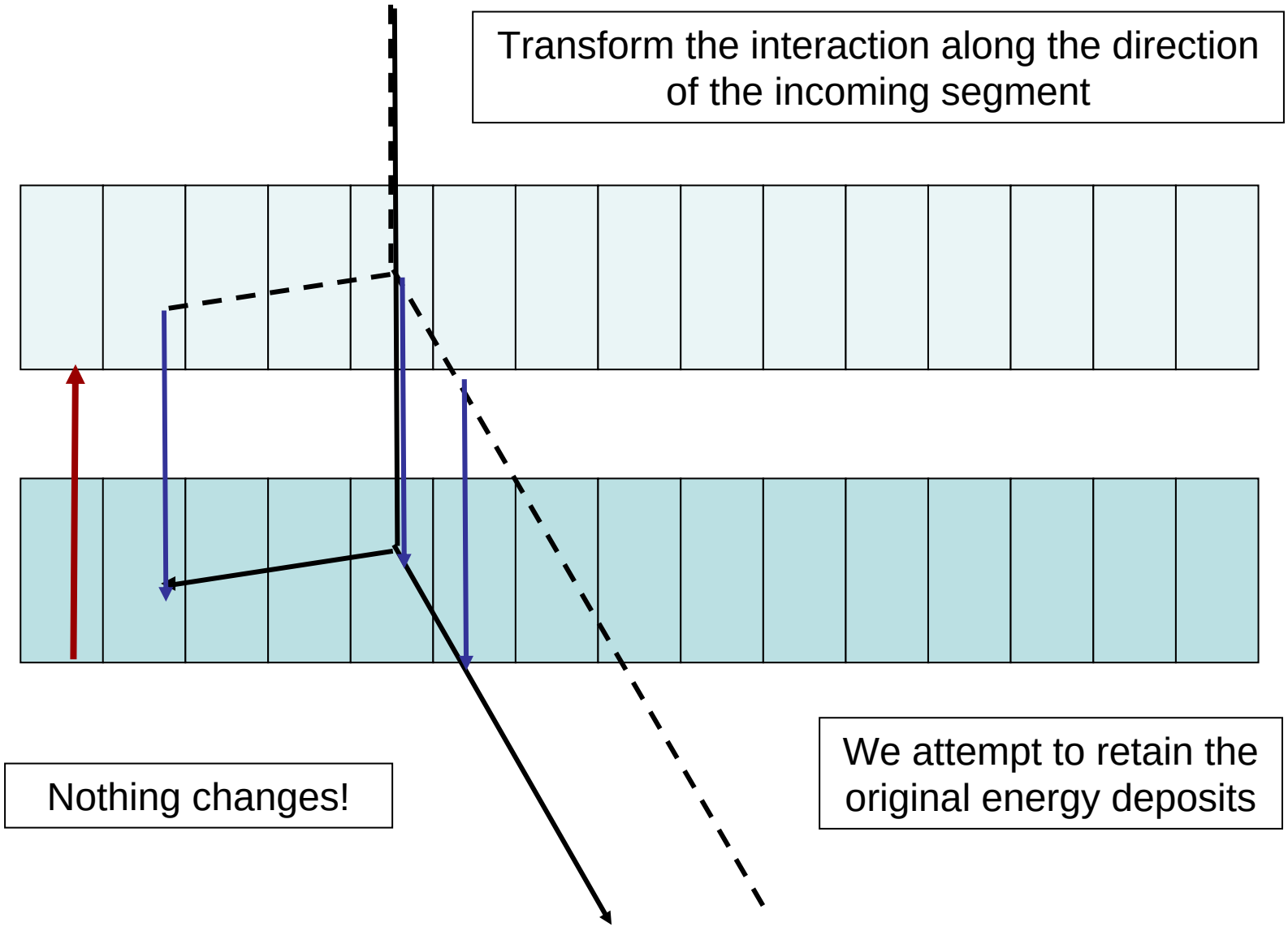
More complicated



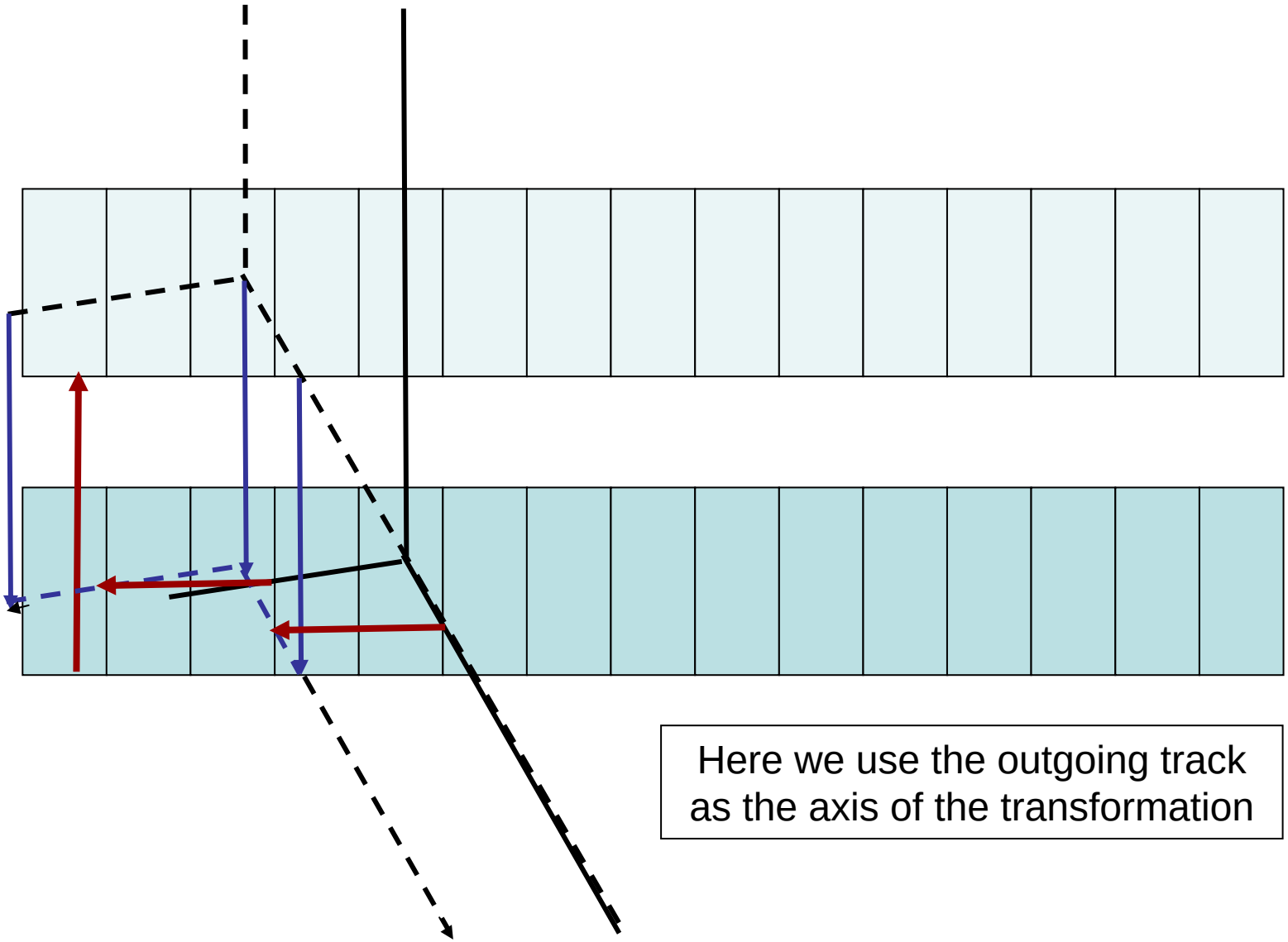
Even More complicated!



One Possibility

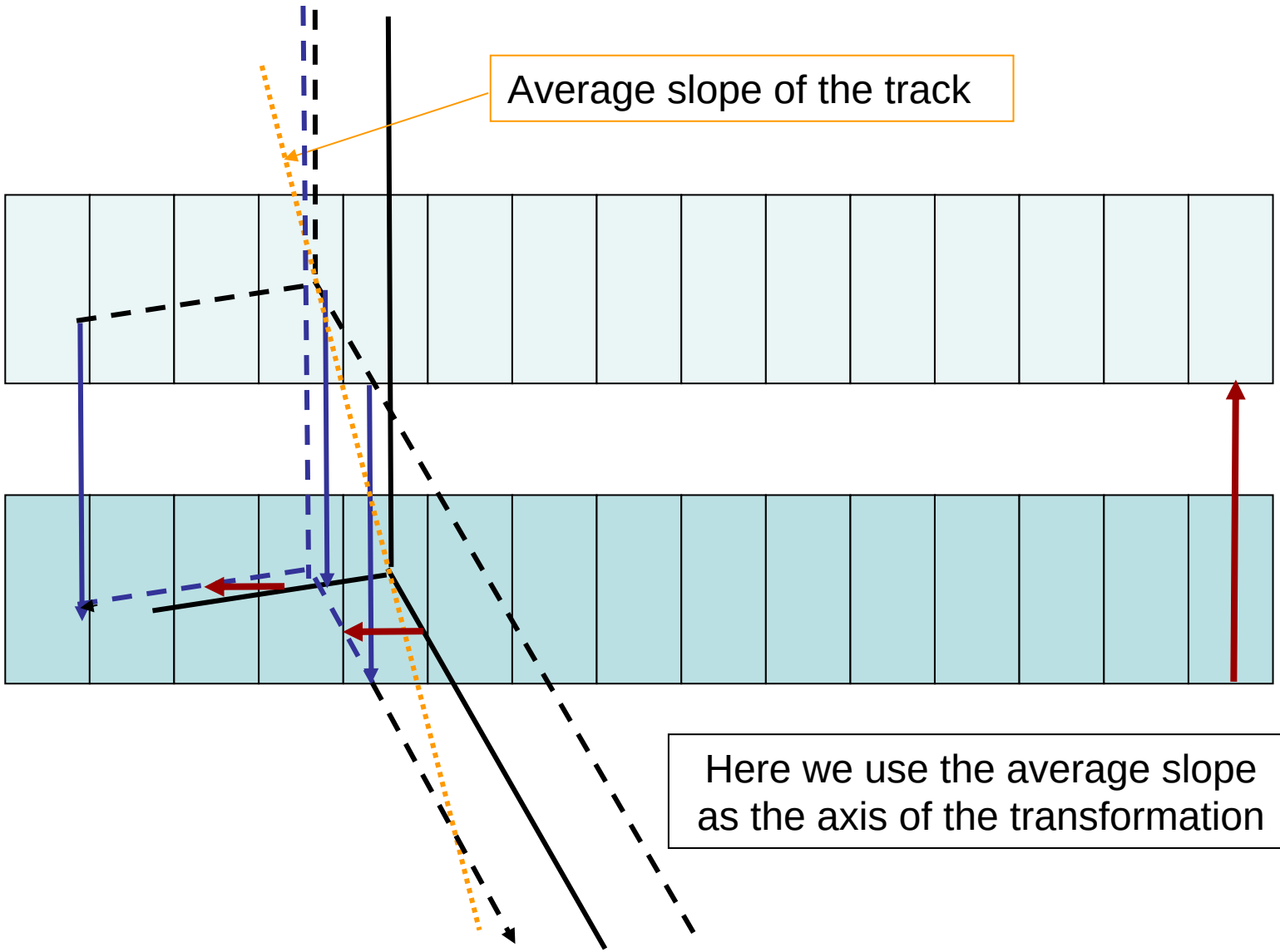


Another

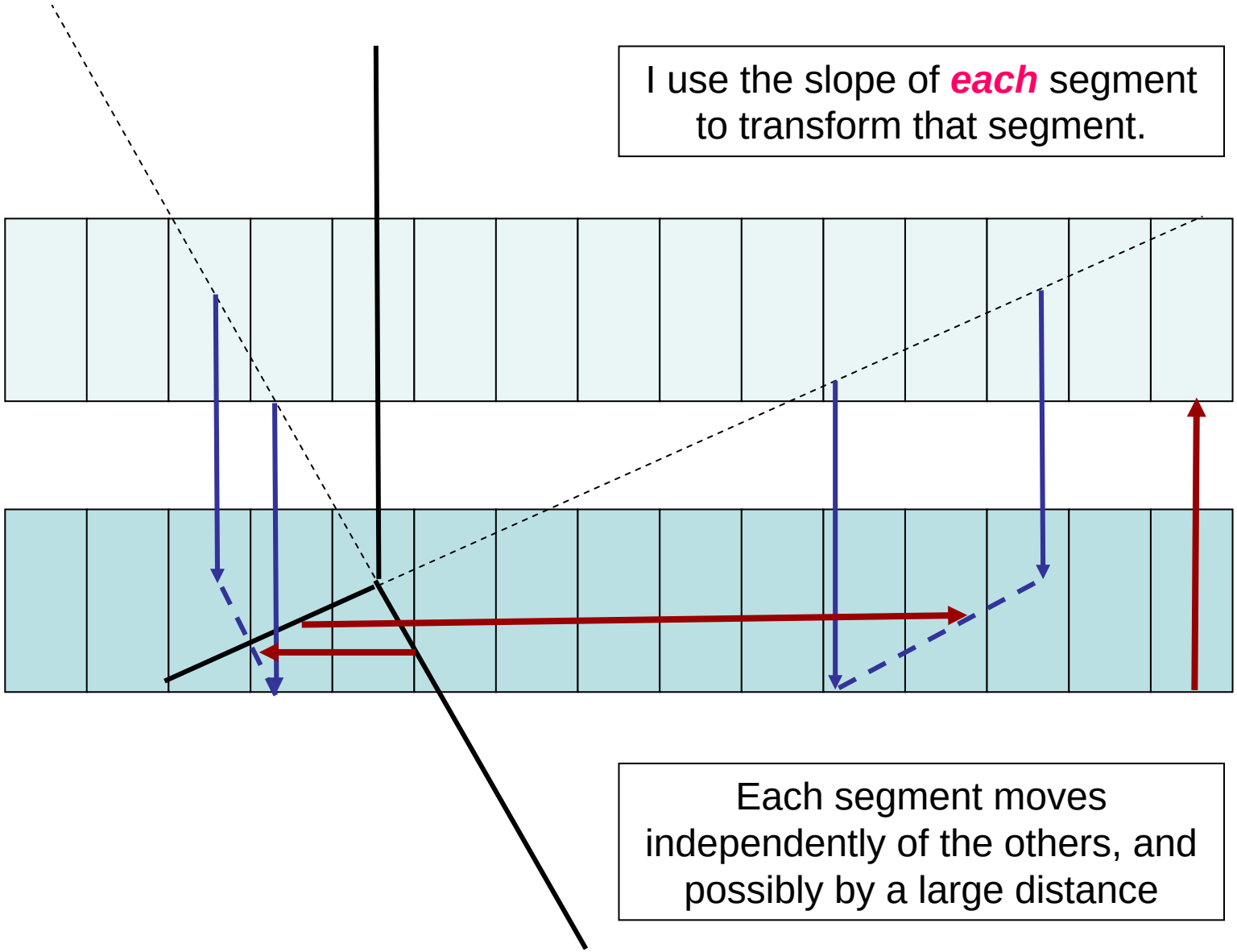


Here we use the outgoing track as the axis of the transformation

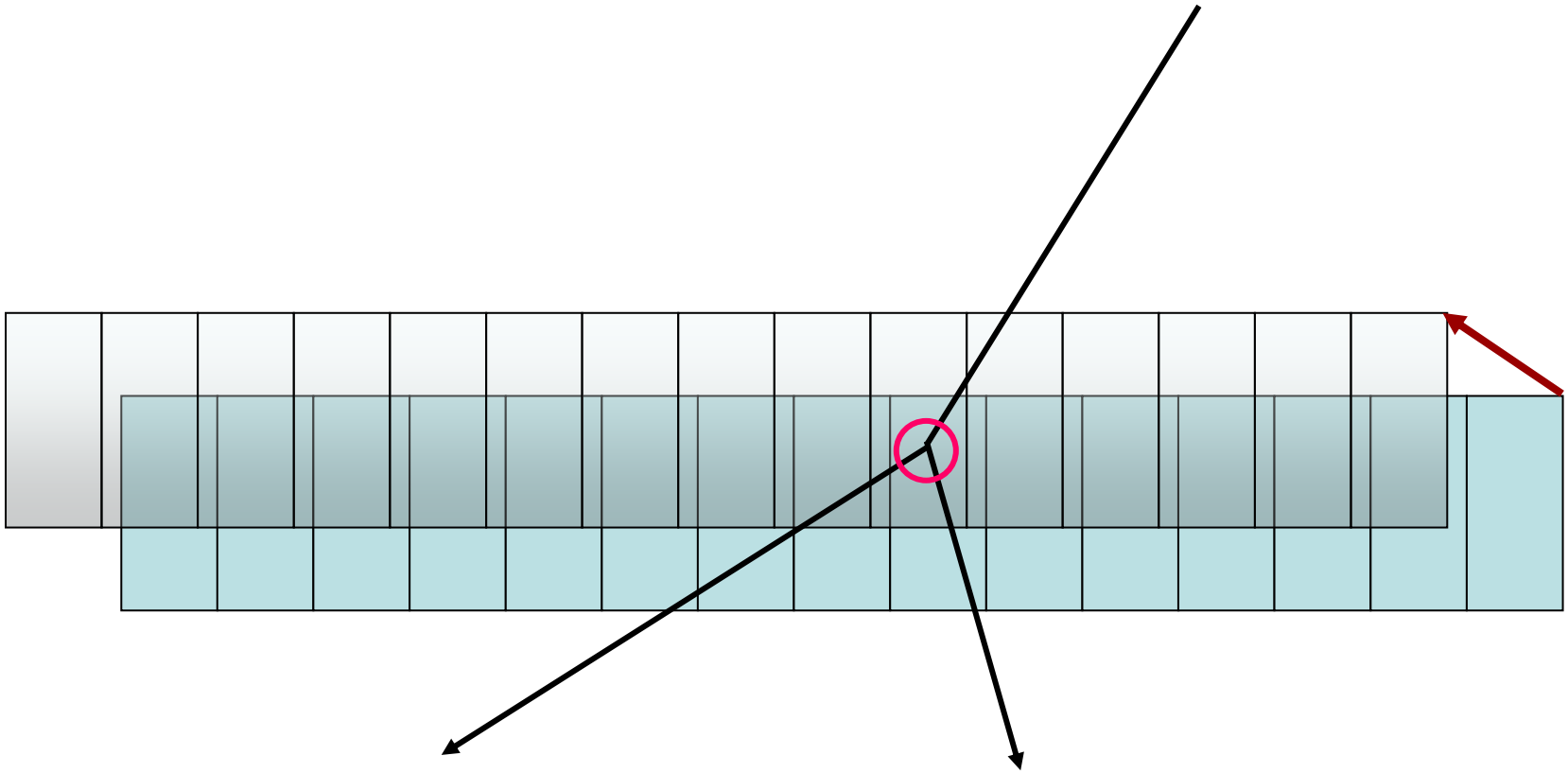
And another, maybe the best



What I did wrong



Even worse!



When the offset plane overlaps the ideal one, I try to keep the interaction point at the same place (same space coordinates), which means that the height in the silicon changes, which means that the energy deposit changes.

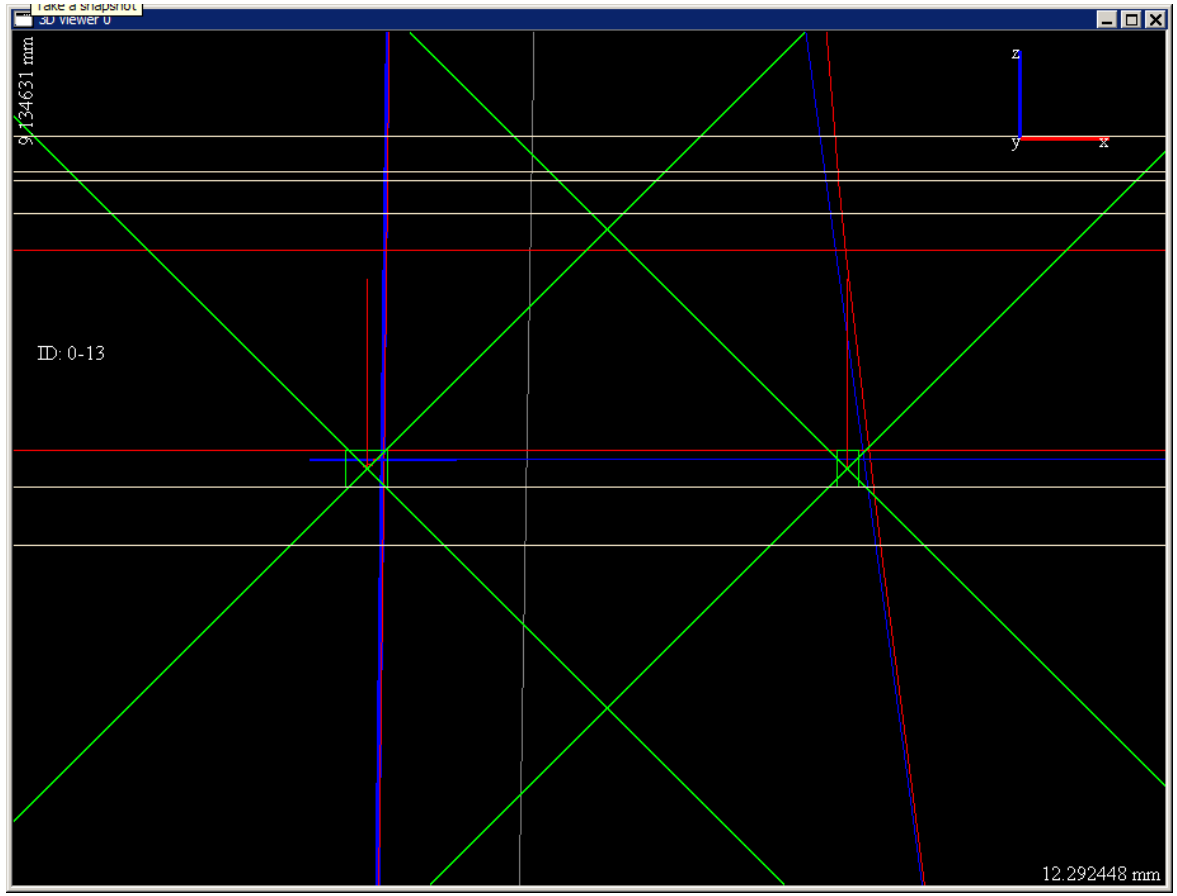
Actually, as you may have guessed by now, I don't really know what I'm doing!

The kludgey fix

Instead of using the slope of each segment to correct that segment, I use the slope of the incoming particle to correct all segments.

This helps, but I'm still not sure what happens in all cases, for example, for interactions in the silicon, where the nominal and real planes overlap.

After the Fix



After Alignment: No extra hits

A question

Why does the bad alignment code seem to fix the hits deficit?

- The bad alignment widens the clusters and adds extra hits in the vicinity of the track.
- The number of extra hits scales roughly with the number of delta rays in the event.
  - The effect is less for muons.
- Perhaps this is imitating the real (missing) source of the missing hits. Possibilities:
  - Added delta rays
  - An new mechanism to produce low-energy electrons near the track
  - More beam particles
  - ???

Can this be done right?

- A more correct approach:
  - anchor each interaction (conversion, delta ray, etc.) vertically to the element in which it occurs (silicon, tungsten, wall, etc.).
  - Move the interactions with the face or tray constants.
  - Project the segments in each plane back into the silicon along the line connecting the nearest interactions on either side.
- This requires a complete model of the event.
- I think that this is technically feasible, but will be complicated to implement.
- And it still doesn't reproduce the event exactly, due to the problems already mentioned.
- If it works correctly it should end up the same as not doing using the alignment at all… is it worth it?

What now?

- My “fixed” code works better than before, but I don’t have much confidence that it’s completely under control.
- For now, I suggest that we don’t use alignment in the MC.
  - Except this is one possible “ad-hoc” fix, for testing for effects on the classification trees.
  - Another, simpler, would be to scale the variables in the ntuple.
- We should explore the possibility of doing alignment “correctly,” that is, of putting the misalignments into the initial geometry.
  - Eliminates all of these arcane transformations
  - Deals correctly with the edges
  - But: is this too much effort for a small payback?