Concepts for cassette construction/installation

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(with significant input from Tom Chase and Julianna Abel)

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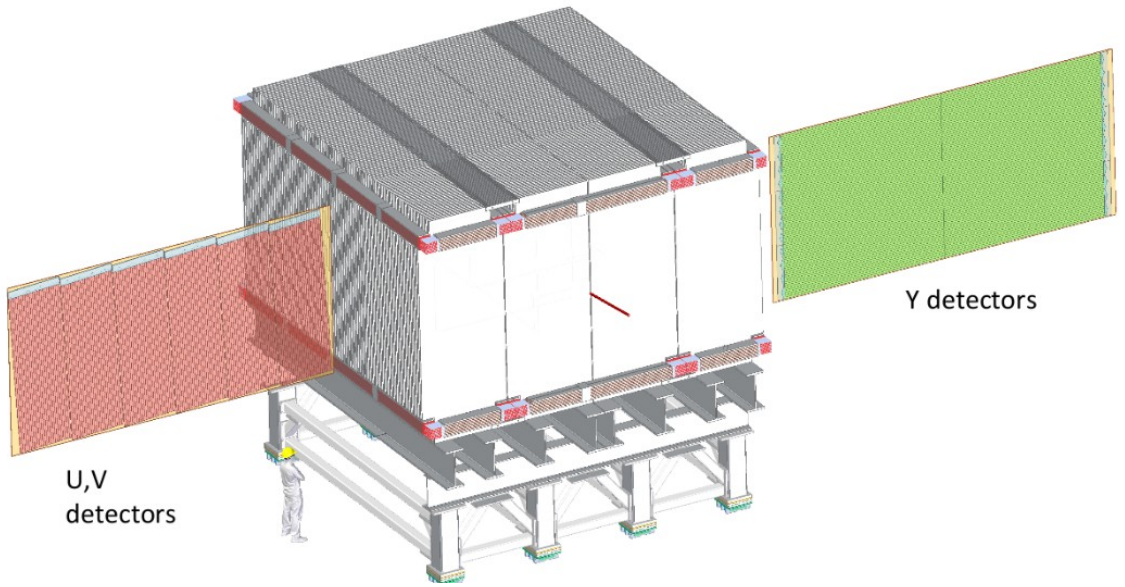
What is a cassette?

- Detector plane subdivided into six modules, built as independent objects
- Construction/installation plan requires them to be installed in a larger structure, and then “slid” into place as one unit
- We refer to this larger structure as a “cassette”

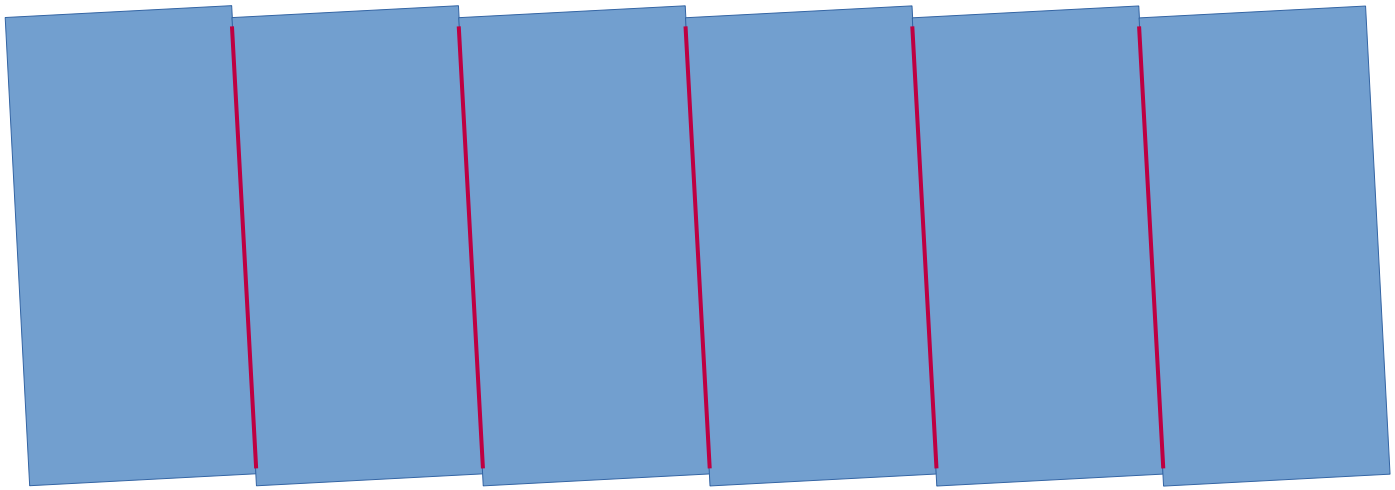


The concept

- Add as little material as possible, and just join six modules together
- Form flat tops and bottoms with as little extra weight as possible

Joining module edges

- Plan is to glue modules together along edges



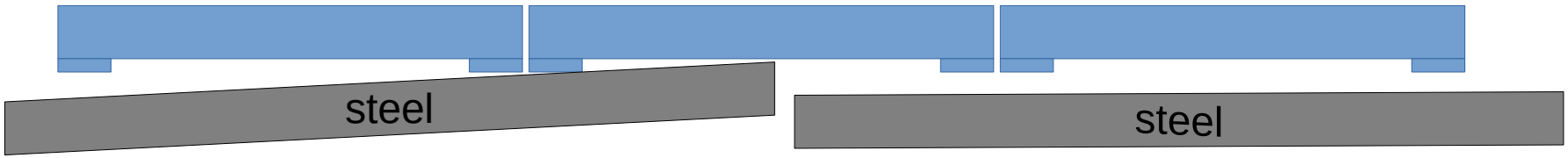
H-brackets

- If prototypes show glue isn’t strong enough to handle, we’ll need to use H-channels
- Crimps make these edges the thickest part
- We’d really like to not have to add more thickness here

etc

Crimp concerns

- Crimps make one face not flat
- The steel *could* have discontinuities between the plates, forming a sharp “edge”
- If a crimp hits such an edge as you move panels into place, it could open the crimp
- We should therefore fill the space between the crimps!
  - Thinking a thin layer of foam (lightweight) with a thin metal sheet



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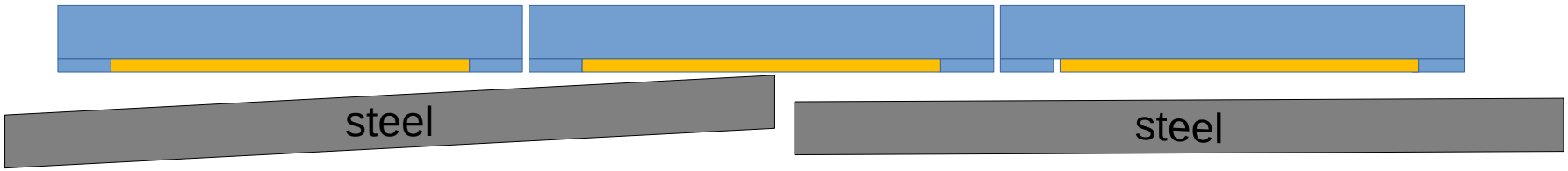
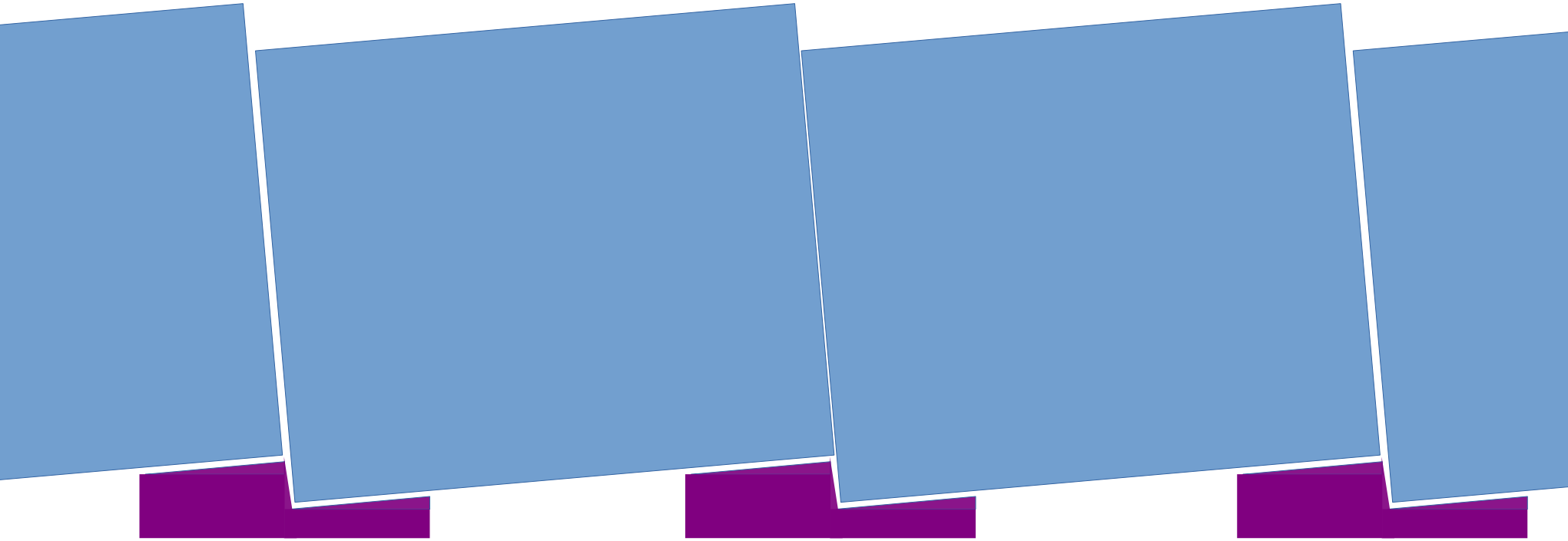


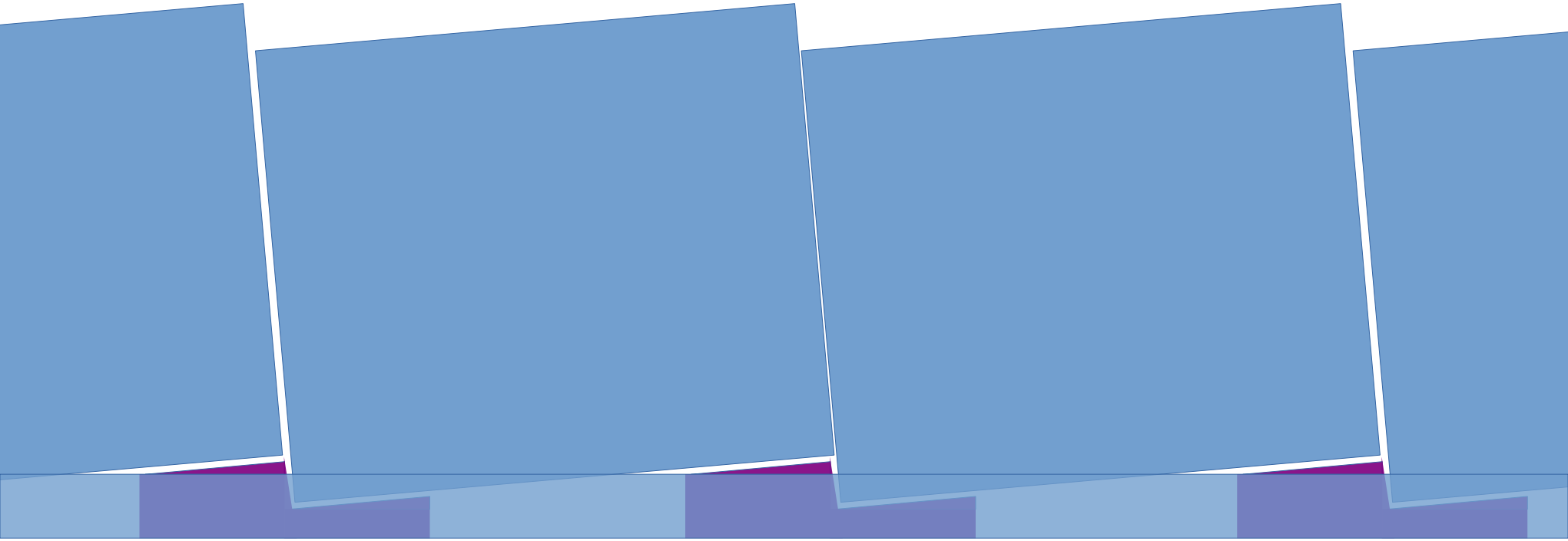
“Filling” the triangles



Modules have slight width variation due to scintillator tolerances
Absorb these tolerances by not filling the whole triangle

Assume aluminium for these

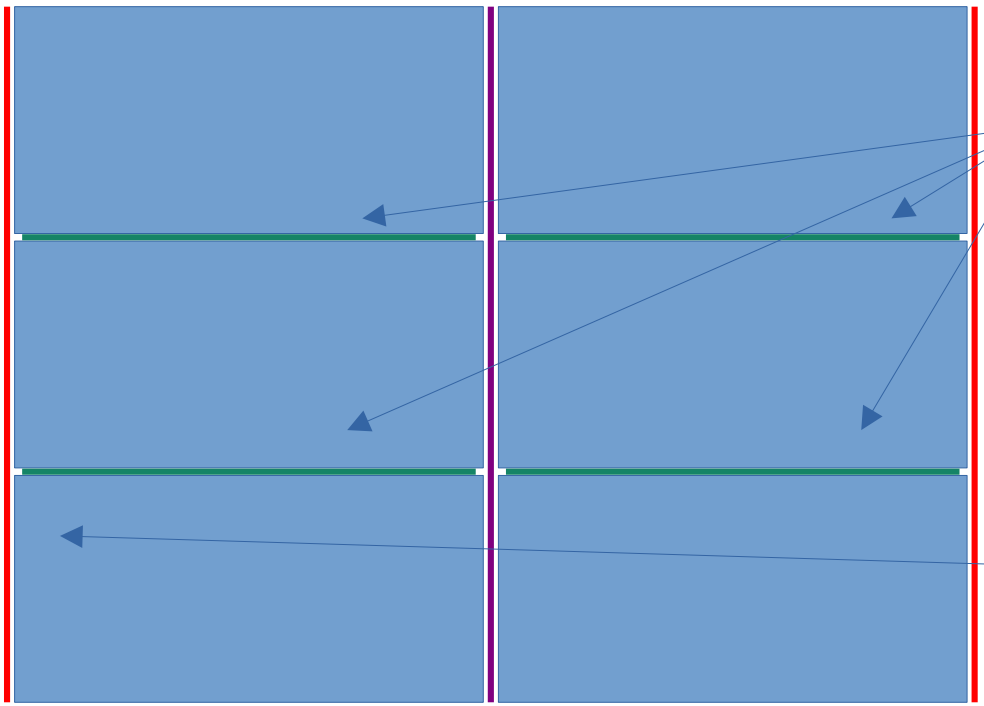
Joining the bottom edge



U-channel joins everything together

Horizontal counters

H-channel, but with gaps cut for crimps



Glue only (hopefully, again, need to test strength)

U-channel, but:
- Cut out gaps for crimps
- Cut out holes for optical connector

Open questions

- Top edge of U,V cassettes
- Cable storage
- Cable access
- We’re working on these

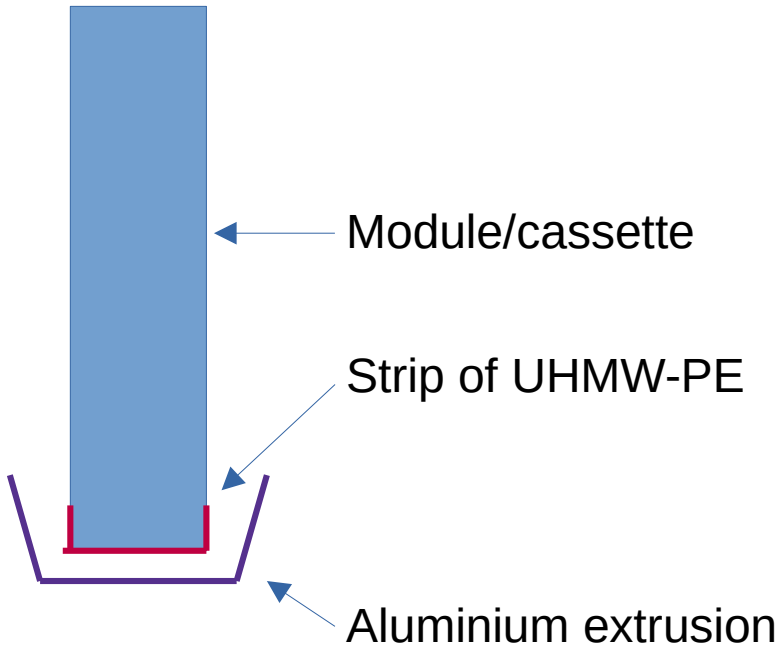
Considerations

- Cassette mass is over 400 kg
  - These are going to be challenging to manouvre
- Bottom edge is ~2cm x 7m – long and thin!
- Coils prevent use of crane to insert cassettes
  - Weight must be supported during installation (and we assume permanently) from below
  - We have discussed things like multiple lifts to move things through the coils – I don't like the idea

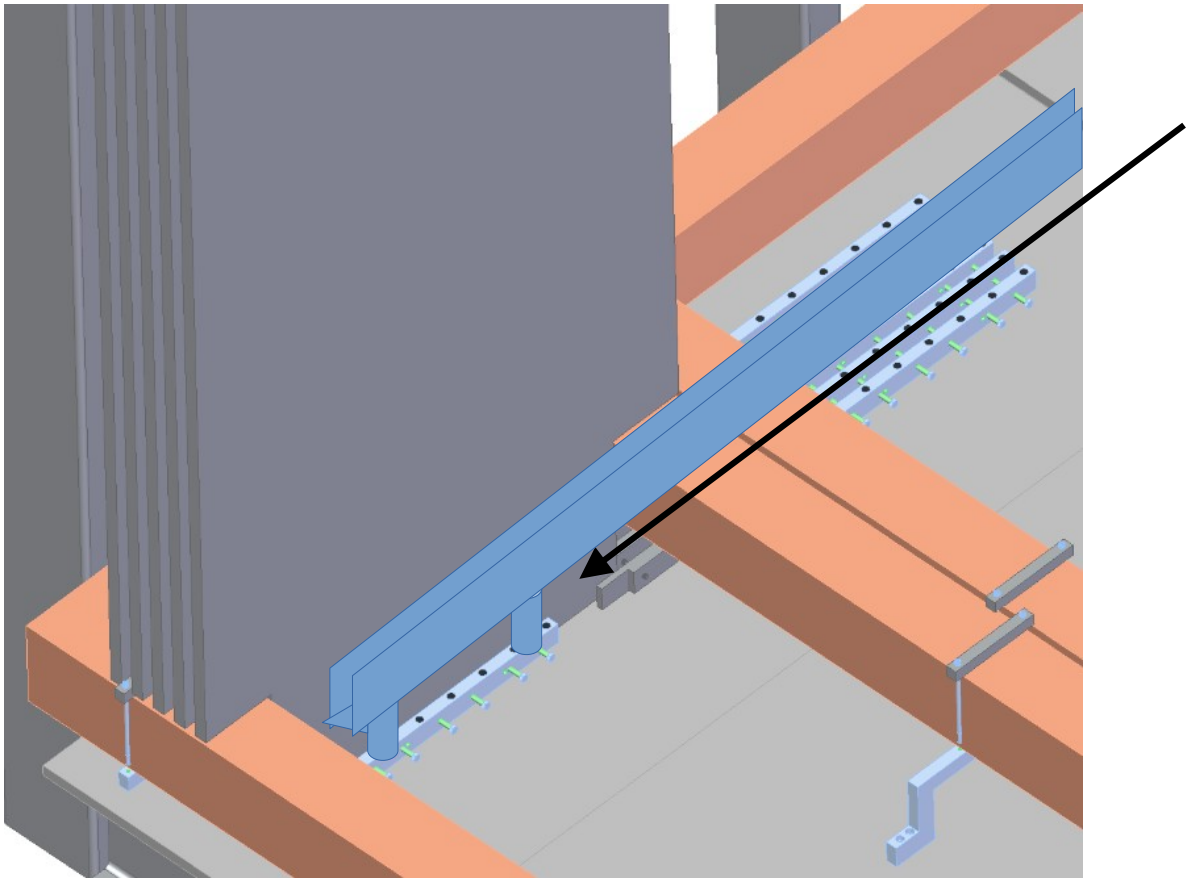
Slippery surfaces

- Ultra High Molecular Weight Polyethylene (UHMW-PE) has a very low coefficient of friction
  - Around 0.15
- This means a force of ~700N is needed to slide the modules
- This is the default plan, provided:
  - The coefficient of friction in lab tests is what is claimed
  - There are no other sticking points found (get it?)

“Rails”



How are rails supported?



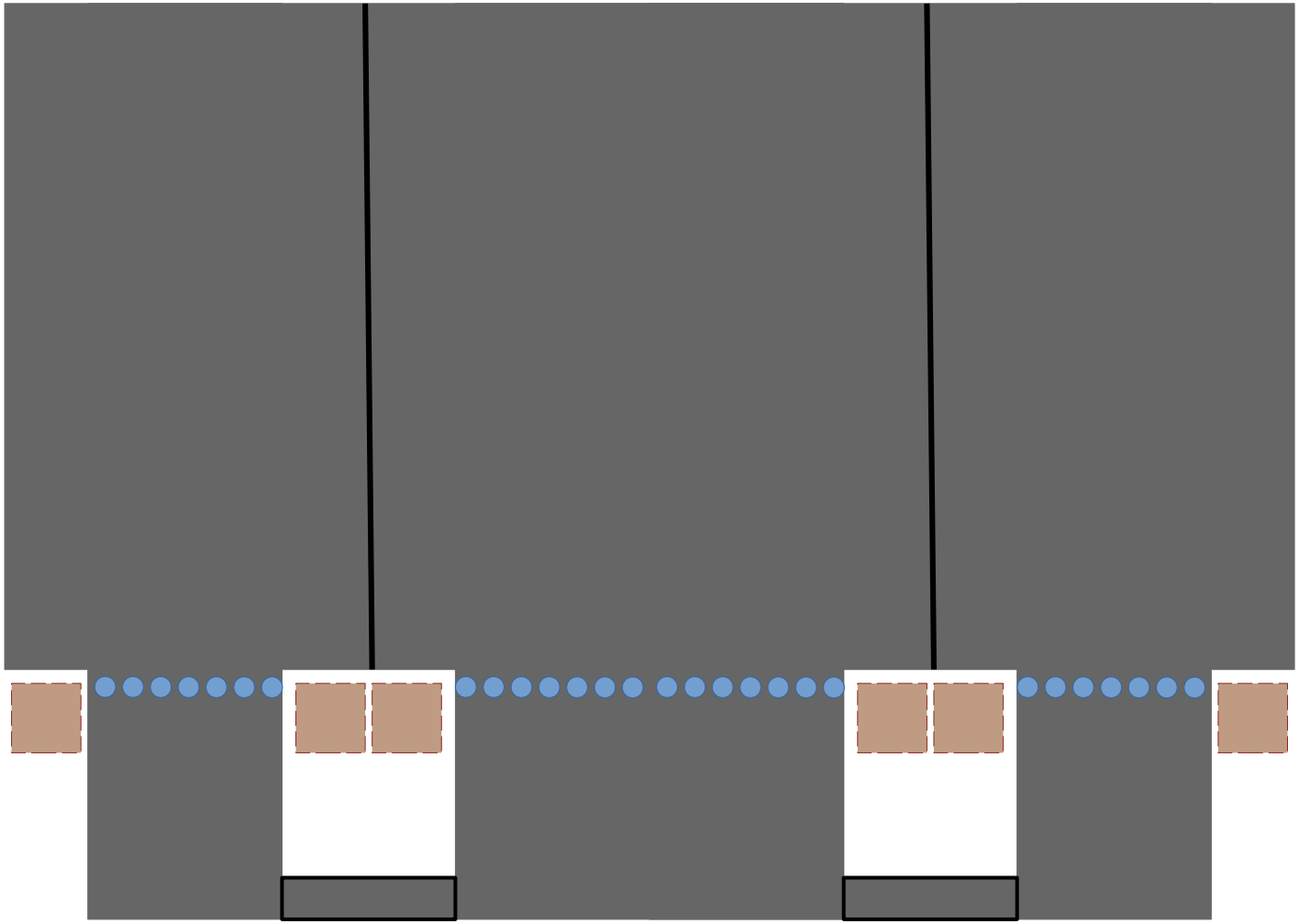
Ideally, integrate spacers with “legs” that a rail can be mounted on

These would be installed in between steel sheets

Wheels/rollers

- If we can't slide the module, we'll need to roll it
- Assume a large number of small wheels
  - Spread out load over a larger contact surface
  - Less concern about tolerances – redundant wheels if things aren't perfectly flat
- Wheels (and bearings etc) need to be non-magnetic. Could imagine making them out of plastic?

Where do wheels go?



Wheels can live in the space between the coils – only the top edge has to be above the coil height

Minimal impact on available space for measurements

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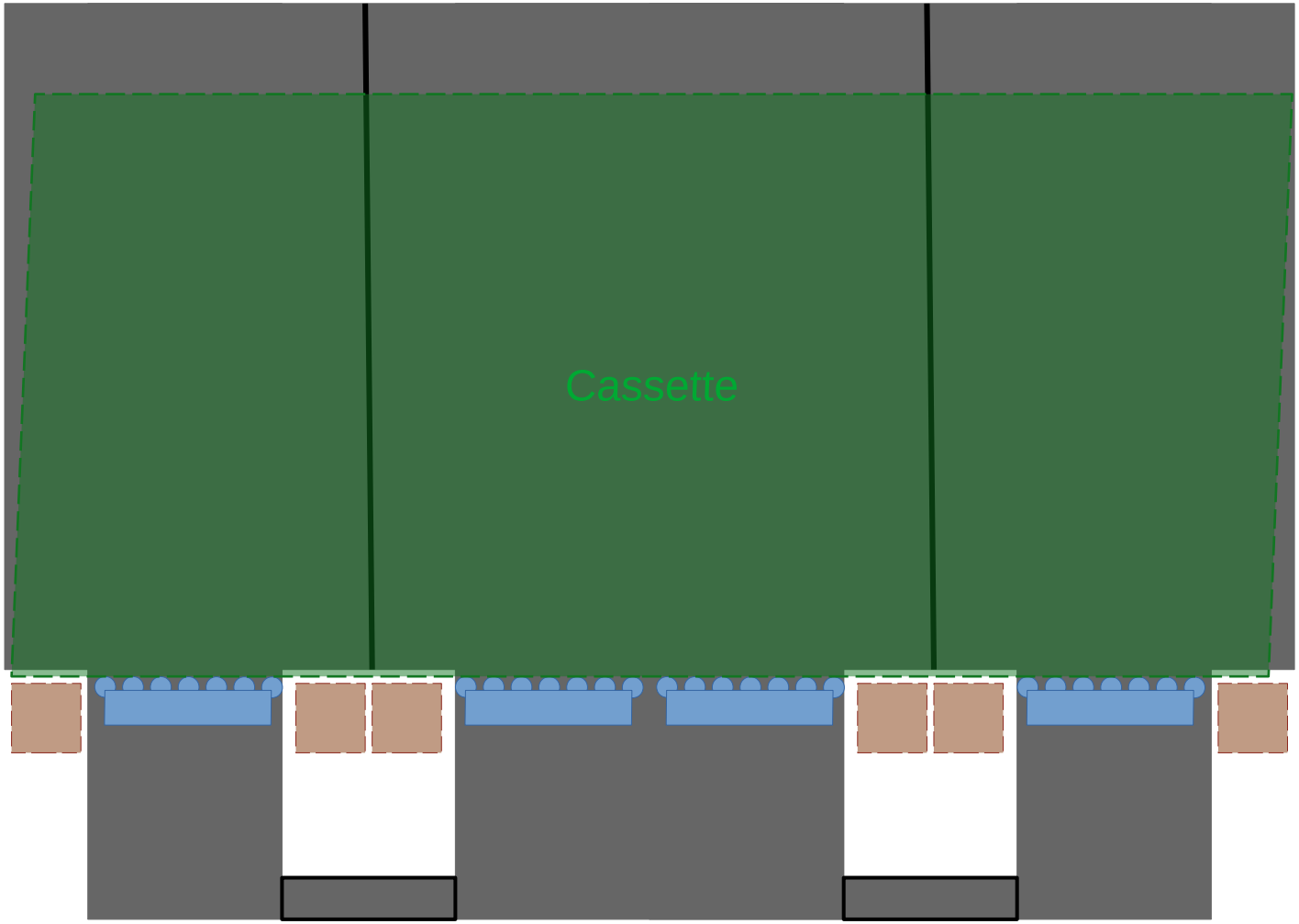

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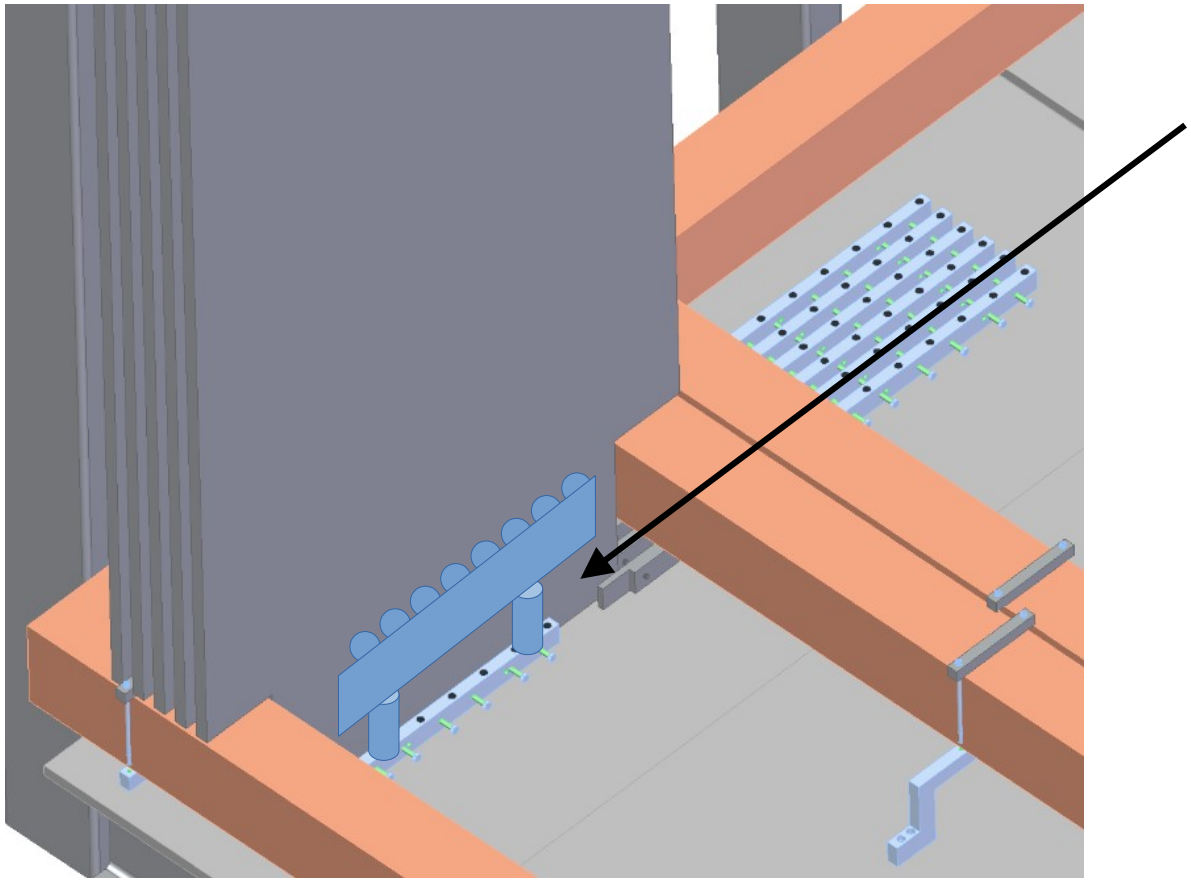
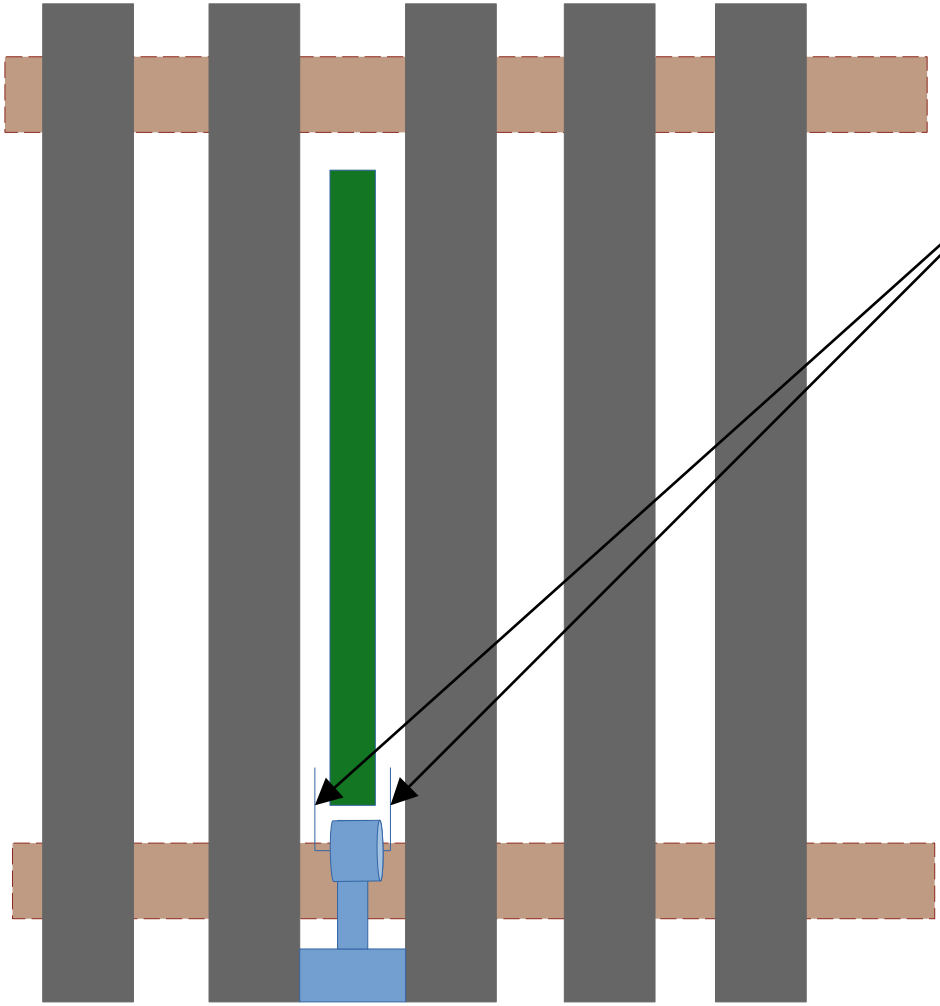
Pre-assemble (or purchase) multi-roller assemblies

How are wheels supported?



Same as rails, supports can be integrated with the spacers

Side guides



Might need to add guides to keep the module in the right place

Alternatively, use rollers that effectively fill the space!

Other support

- Right now the default plan is to the the cassettes sitting on a rail or rollers
- And leave the rest to “be where it will be”
- This allows the (flexible) scintillator to potentially bend with the steel as needed

Push or pull

- I’ve always assumed modules are “pushed” in from one side
- Is there a reason they can’t be pulled from the opposite side?
- Pulling at an angle would reduce friction by lifting some of the cassette weight

Frames for transport

- Cassettes will be large, heavy, and floppy
- I am assuming they'll need to be put into stronger frames for transport
- One frame could hold multiple cassettes
- Frames can be taken all the way to the detector edge

Installation process

- Cassettes placed in a transport frame
- Transport frame can have rollers/rails that match the detector
- 1. Line cassette up with slot in steel
- 2. Push/pull cassette out of transport frame into slot
- 3. Attach blocks to rail ends to hold module in X-direction
- 4. Move to next slot, repeat