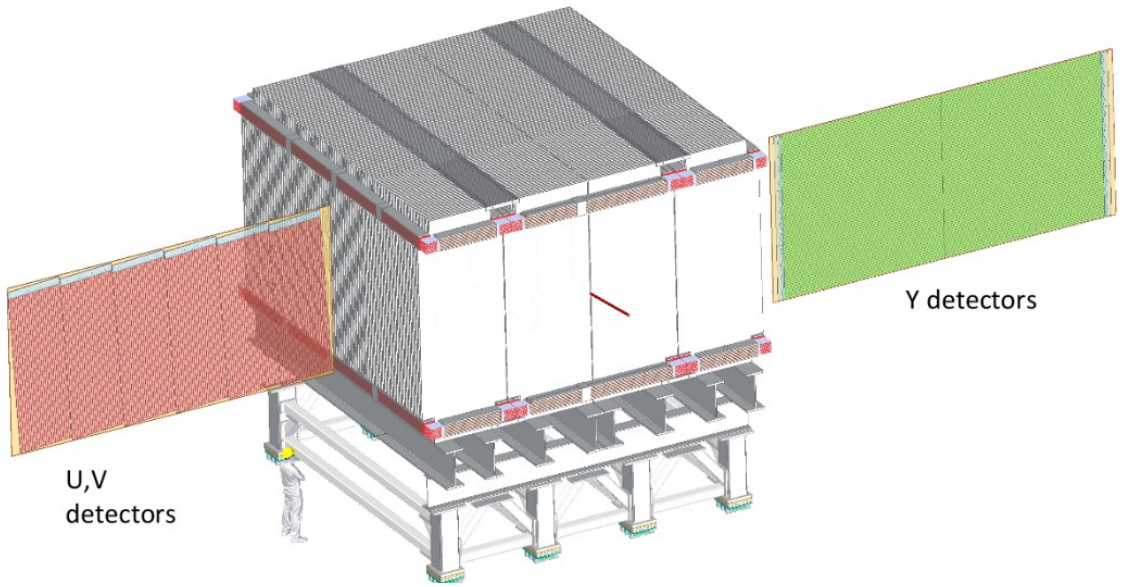
# Concepts for cassette construction/installation

Andrew Furmanski

TMS Consortium Meeting
14th August 2024

# 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”

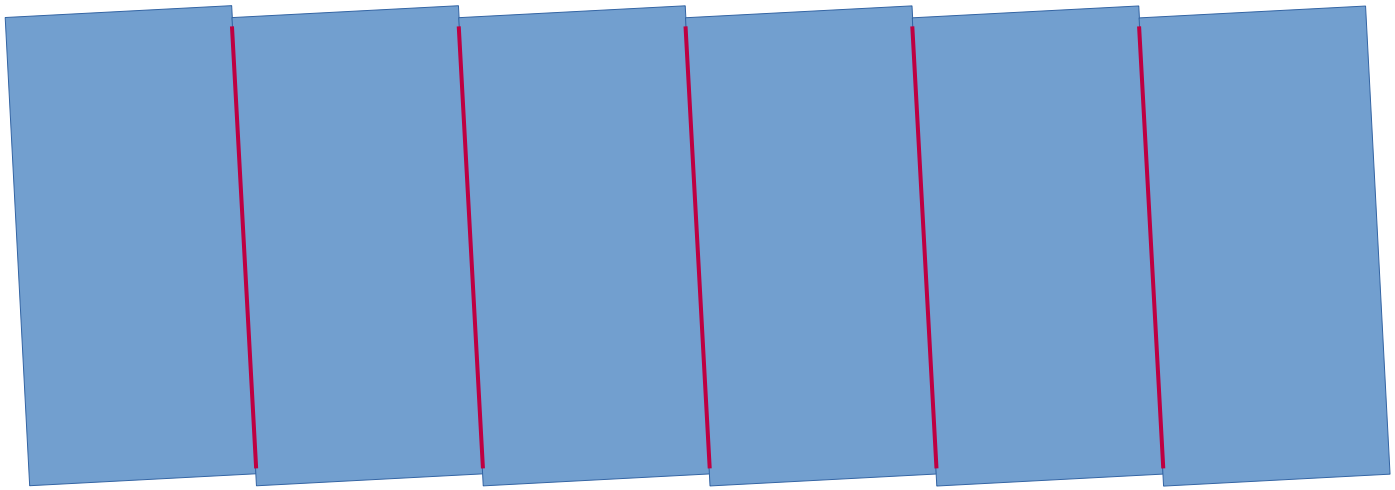


# The concept

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

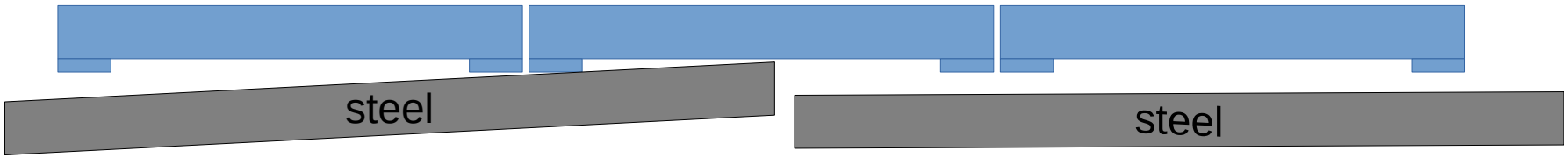
# Joining module edges

- Plan is to glue modules together along edges



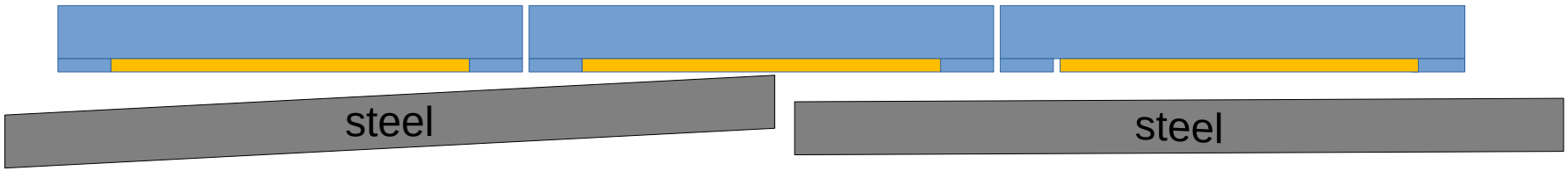
# Crimp concerns

- 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

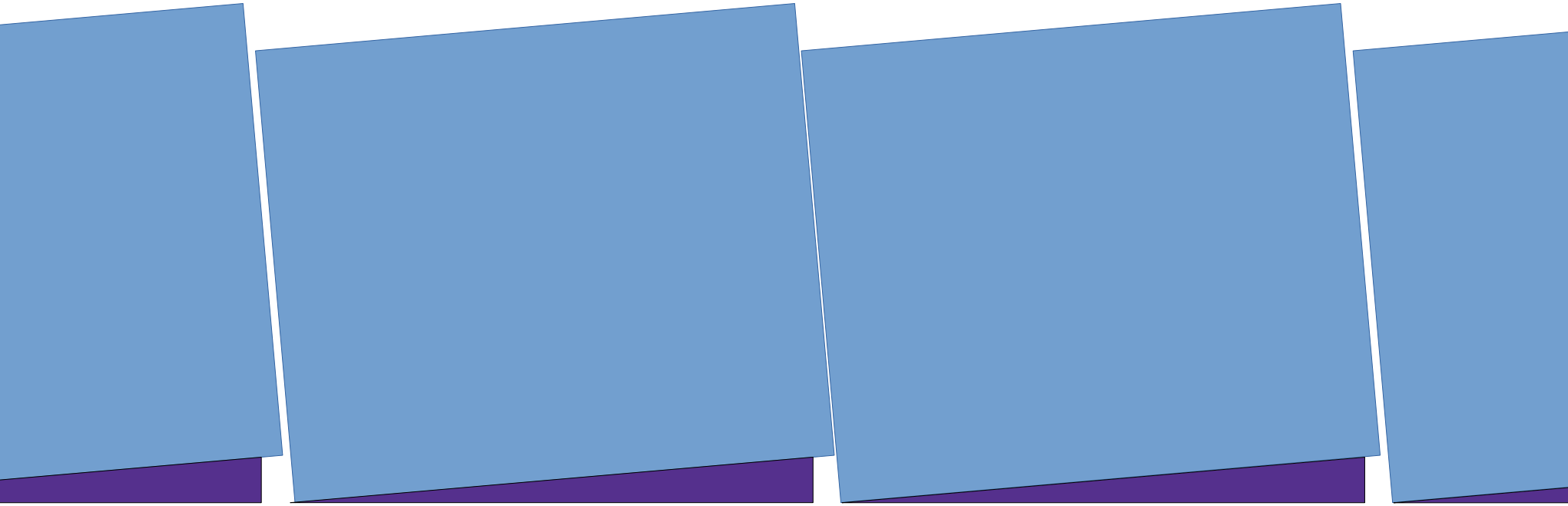


# Crimp concerns

- 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



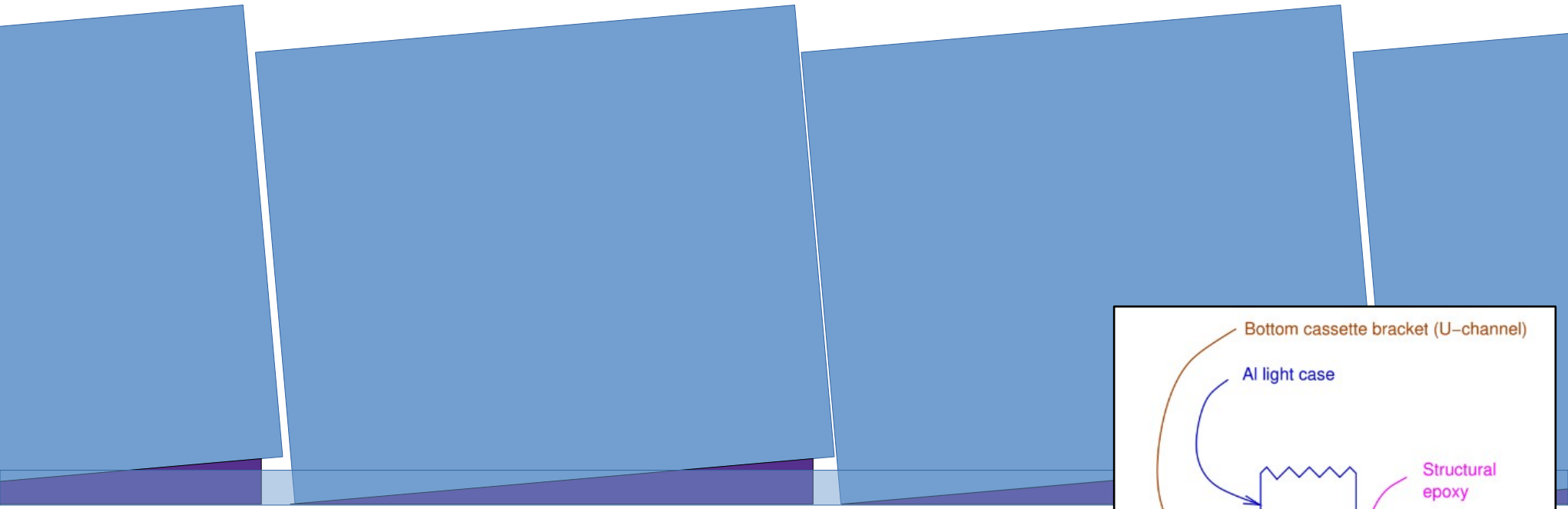
# “Filling” the triangles



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

Assume aluminium for these

# “Filling” the triangles

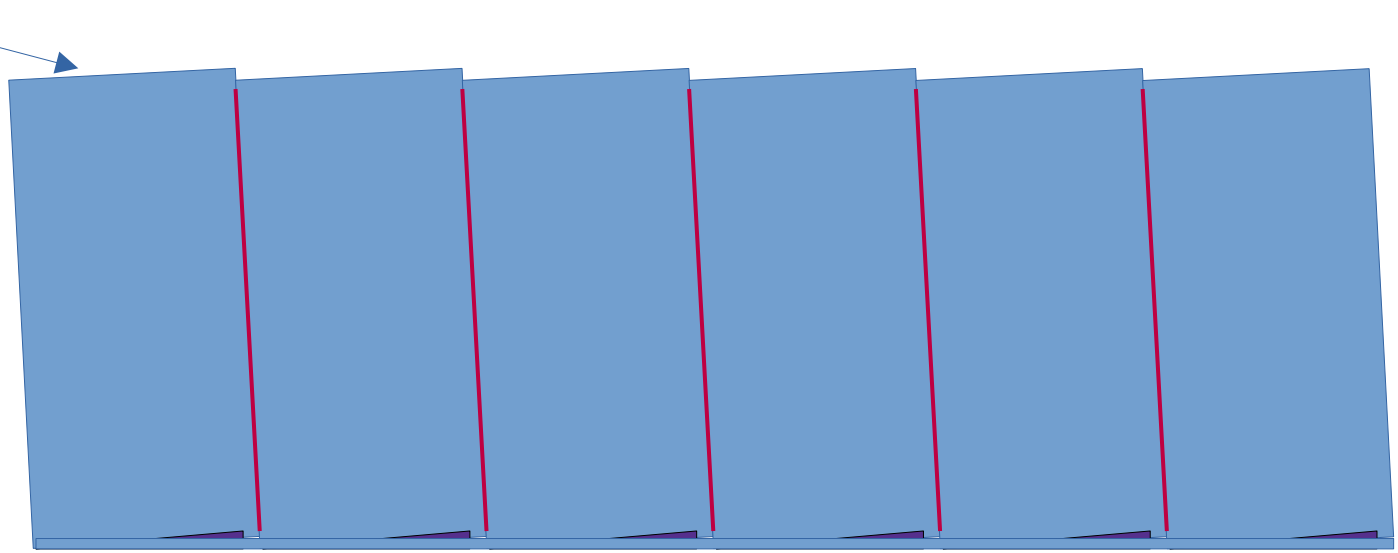





U-channel joins everything together

# A full plane

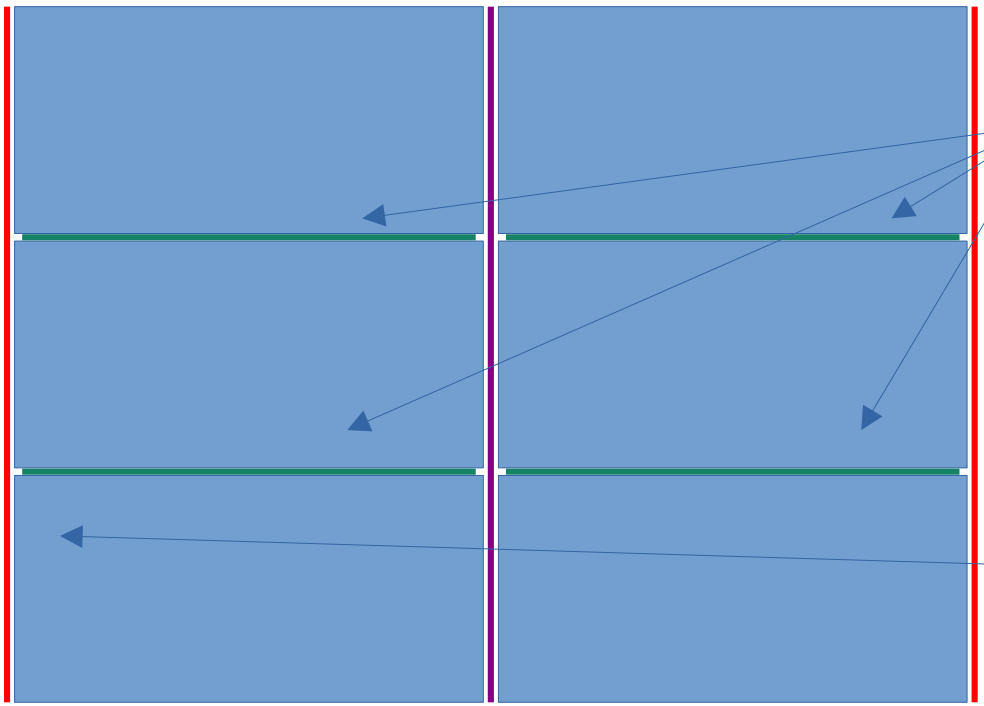
This edge tbd – working on a plan for cable routing



Note, U and V planes are *identical* in this picture, and are simply inserted the correct way for the orientation of choice

# 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

# Part II:
# Installation of a cassette

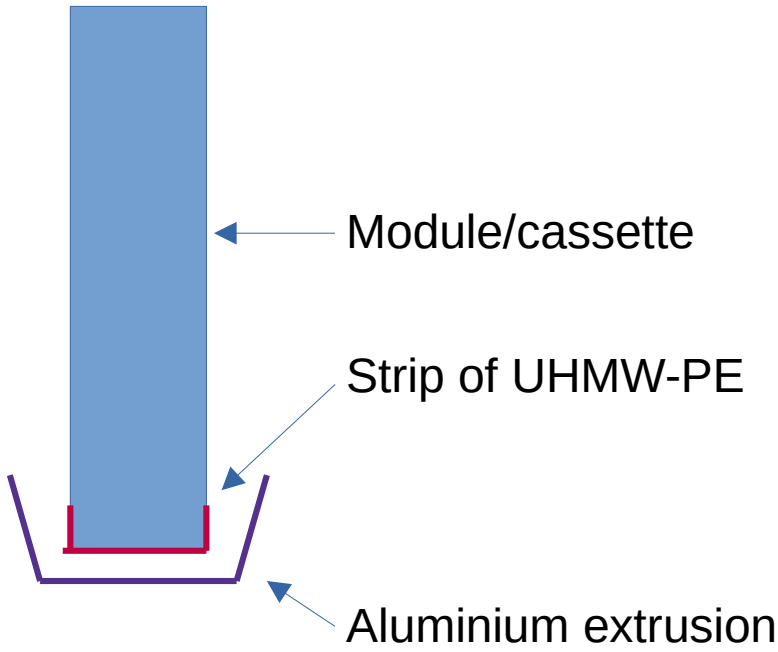
# Considerations

- 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

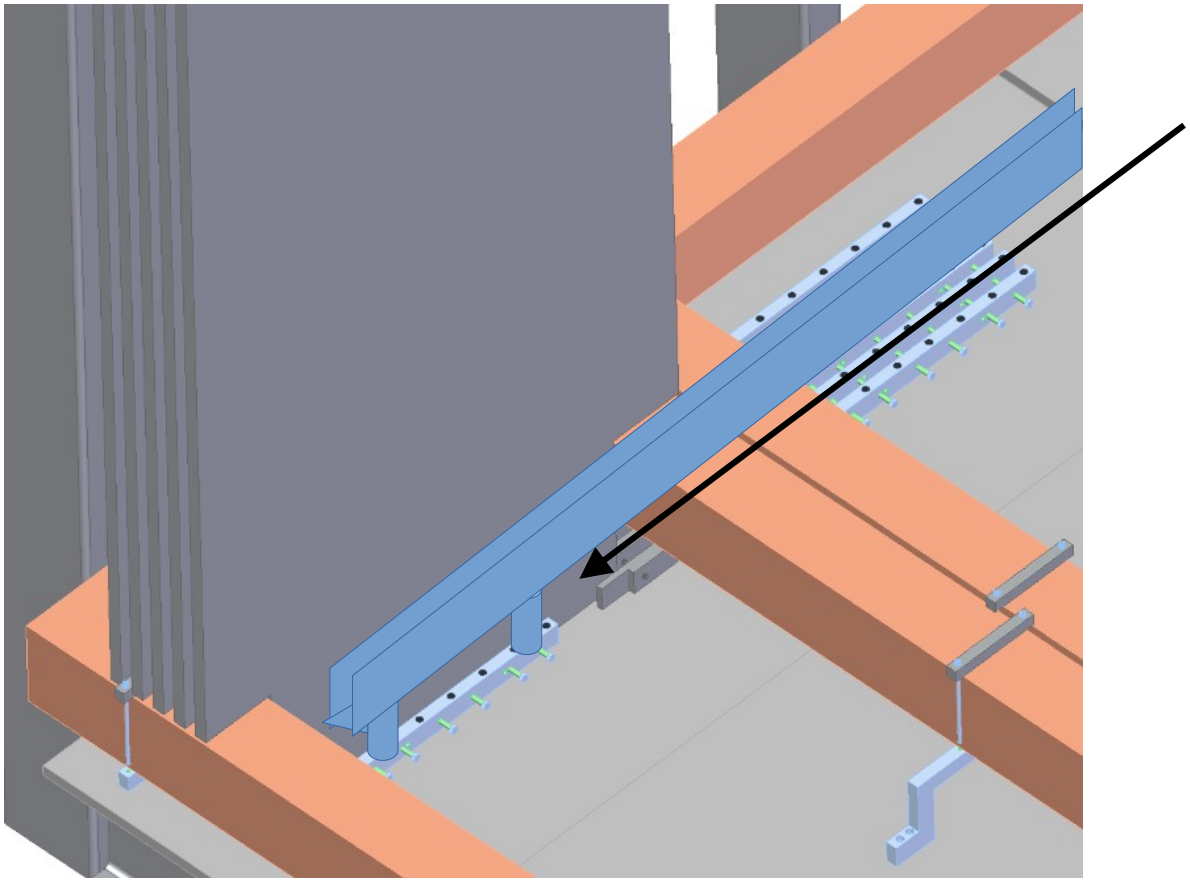
# Slippery surfaces

- 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

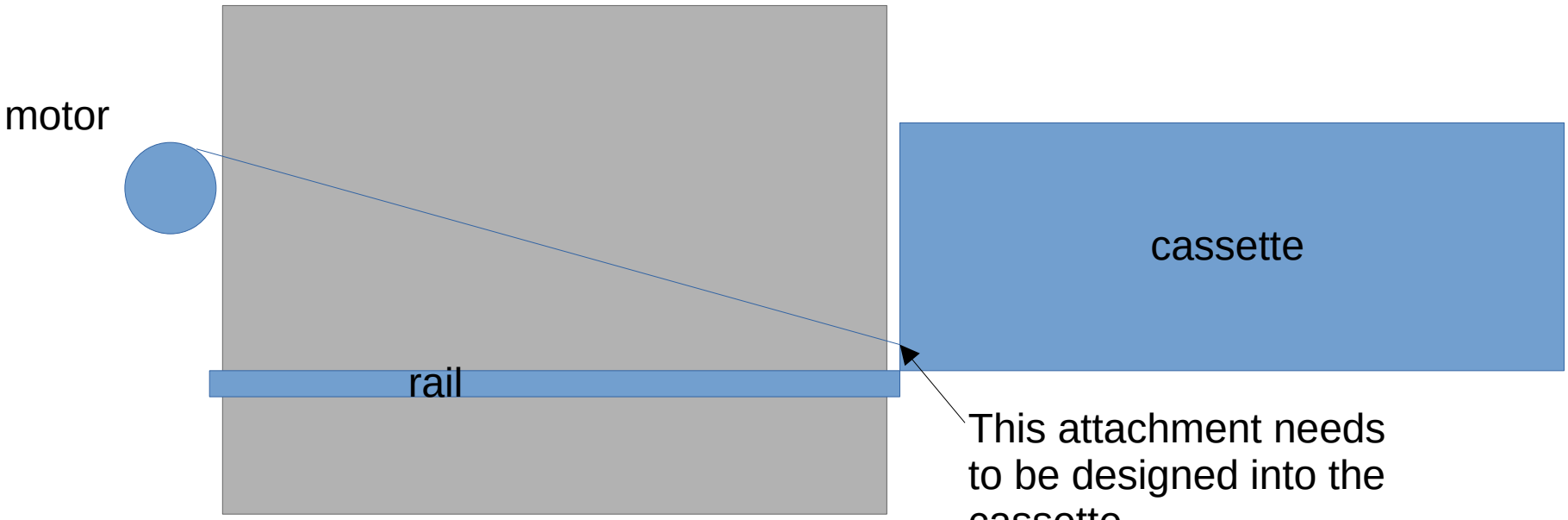
# Other support

- 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
- But pulling from the other side is superior
  - Floppy objects (like a cassette) should be in tension
- Pulling at an angle would reduce friction by lifting some of the cassette weight

# Assumed plan



# Open questions

- Where are cassettes assembled?
  - For ease of transportation, on-site at Fermilab
  - Need to find a large space for assembly
- How are cassettes supported as they are pulled into place?
  - Temporary support structure, or hanging on crane?
- Top of U,V cassettes, cable routing/storage

# Backup

- Slides shown at Engineering Meeting last Friday

# 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

# H-brackets

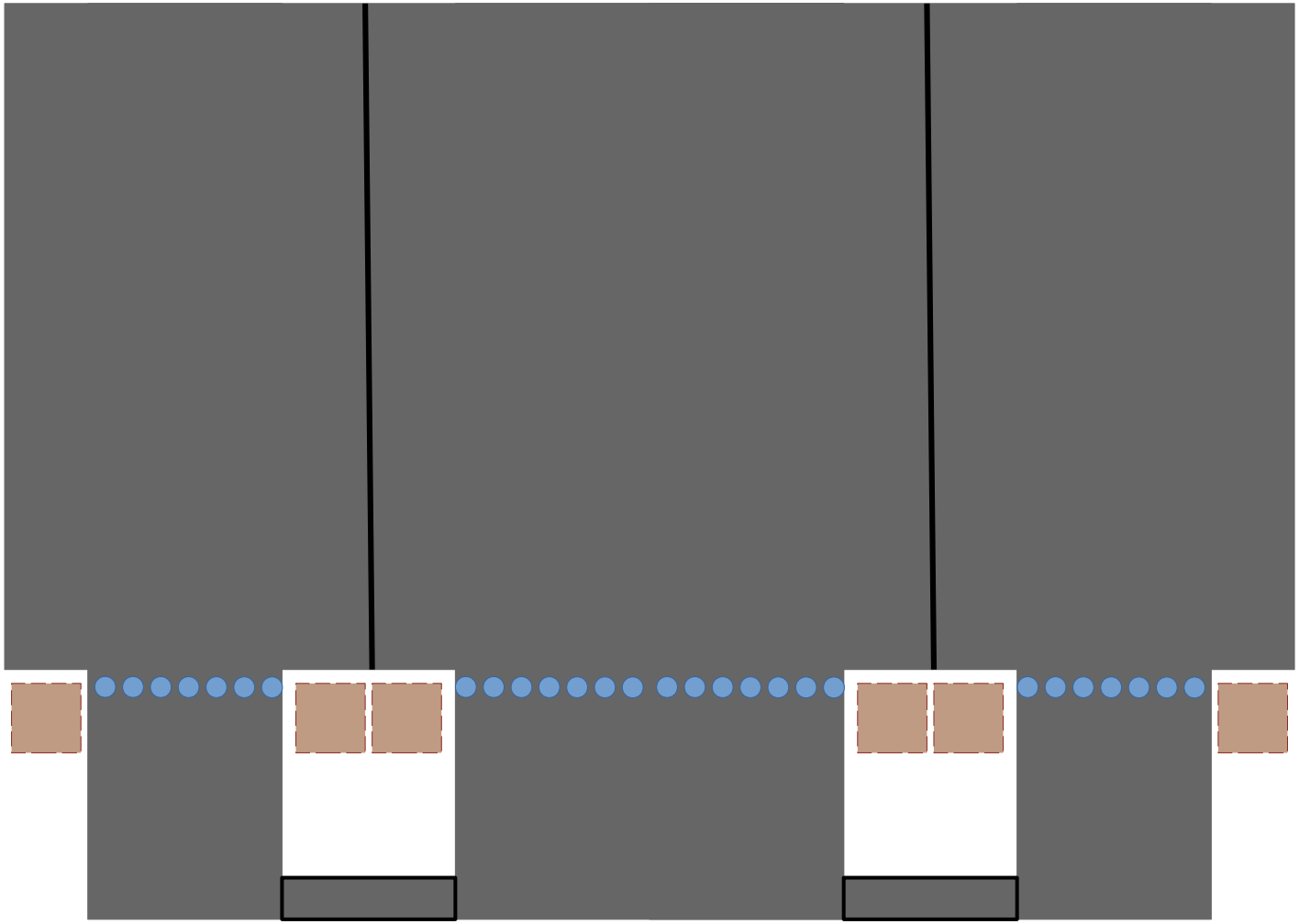
- If prototypes show glue isn’t strong enough to handle, we’ll need to use H-channels
- Crimps make these edges the thickest part
- We’d really like to not have to add more thickness here

etc

# 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?

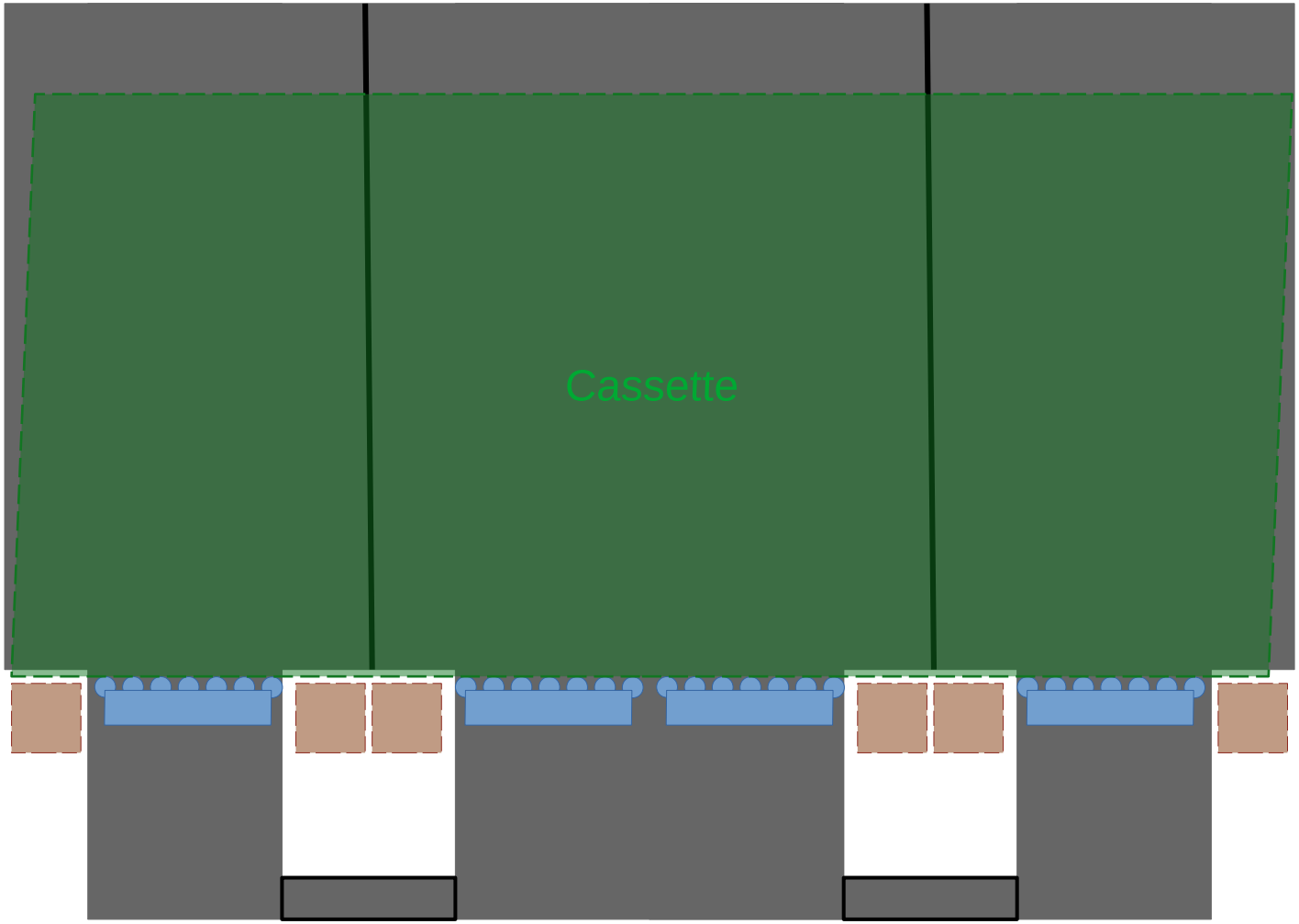
# Where do wheels go?



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

# Where do wheels go?

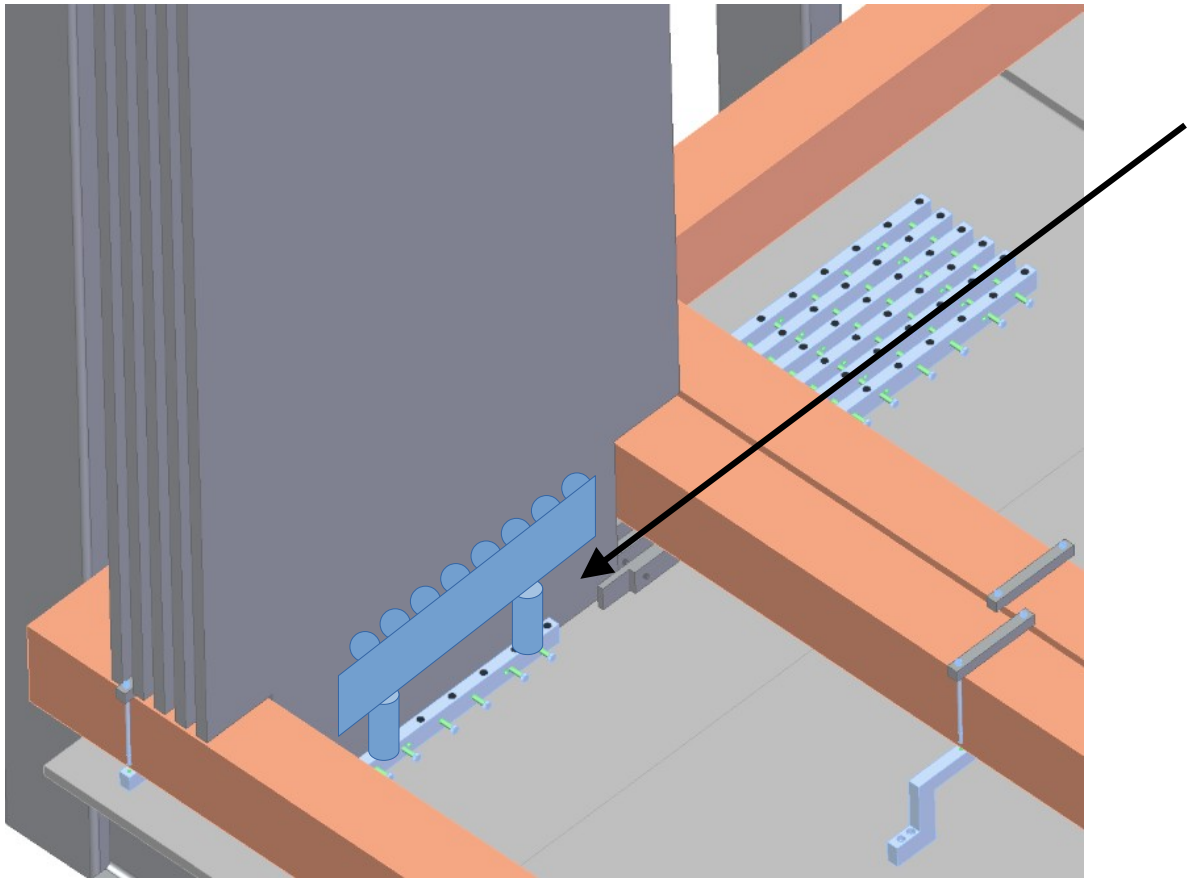



Wheels can live in the space between the coils – only the top edge has to be above the coil height

Minimal impact on available space for measurements

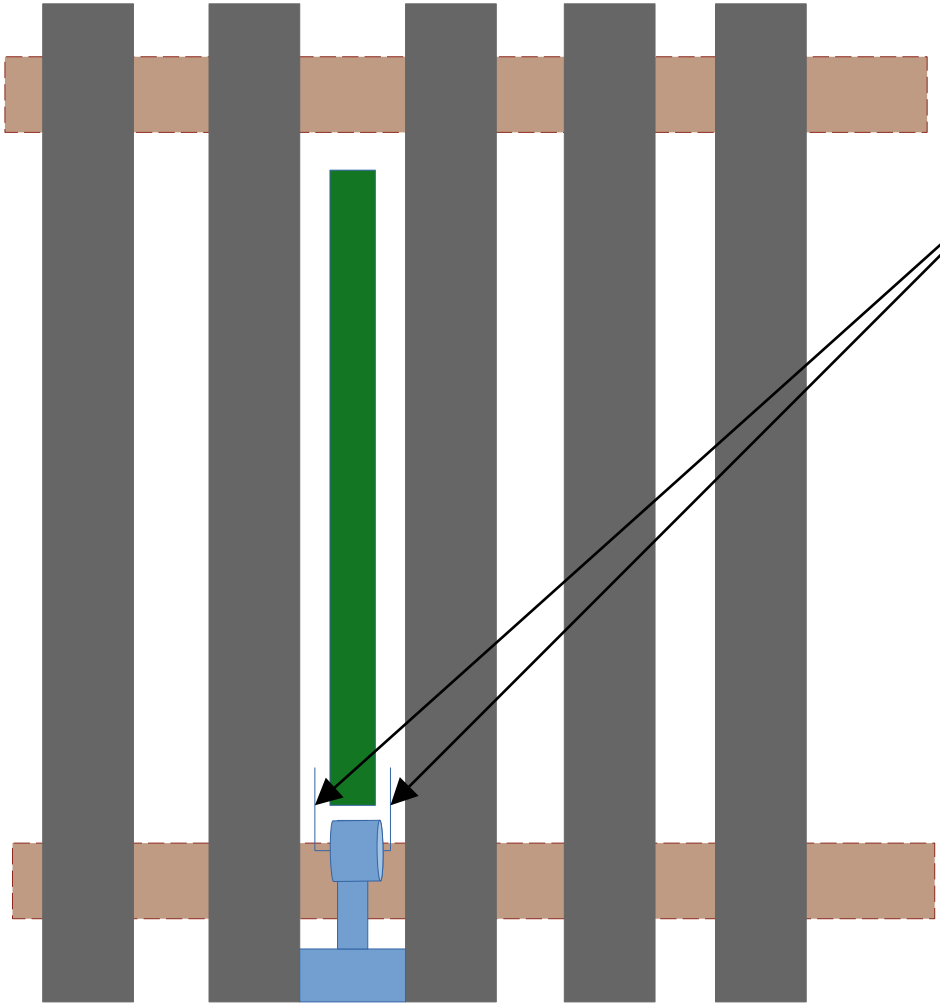
Pre-assemble (or purchase) multi-roller assemblies

# 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!