Update on disks and tiling

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With inputs from Nicole Apadula, Eric Anderssen, Joe Silber,

Errors, misconceptions, and other are of course my own.

ePIC SVT DSC meeting
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Disk concept — core

We probably have not fully settled if we want to construct disks out of staves, rings, or planes,

In what follows, I will assume disks will be constructed of (half-) planes,

At least three common ways to construct a low(-er) mass plane:

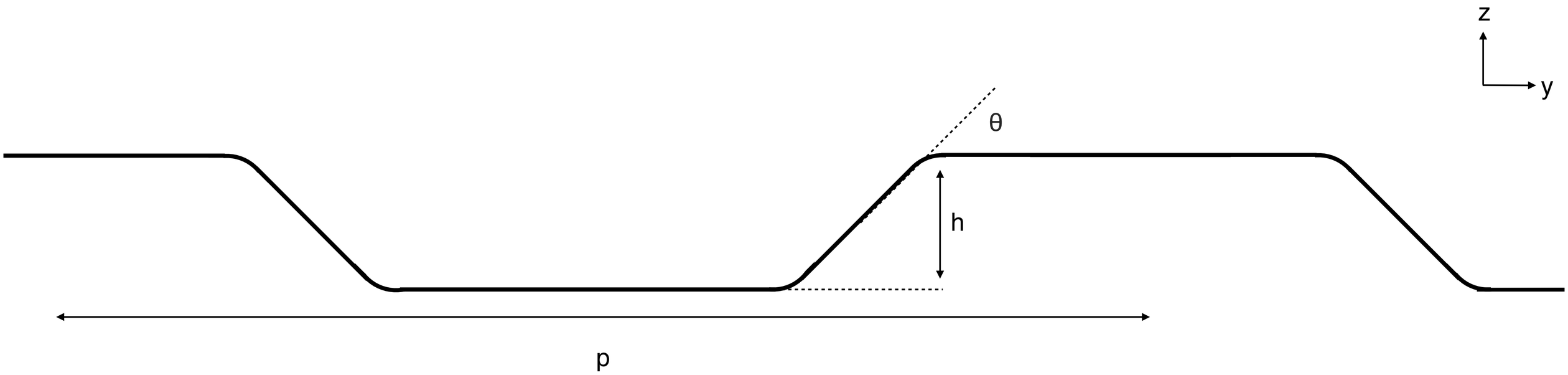
- Foam,
- Honeycomb,
- Corrugation.

Foam is not necessarily low(-est) mass, but may be needed strategically for cooling,

If we want to be able to have airflow internal to the structure, corrugation seems more straightforward than perforated honeycomb,

Choice to examine corrugation a bit further — topic for what follows.

Disk concept — corrugation core

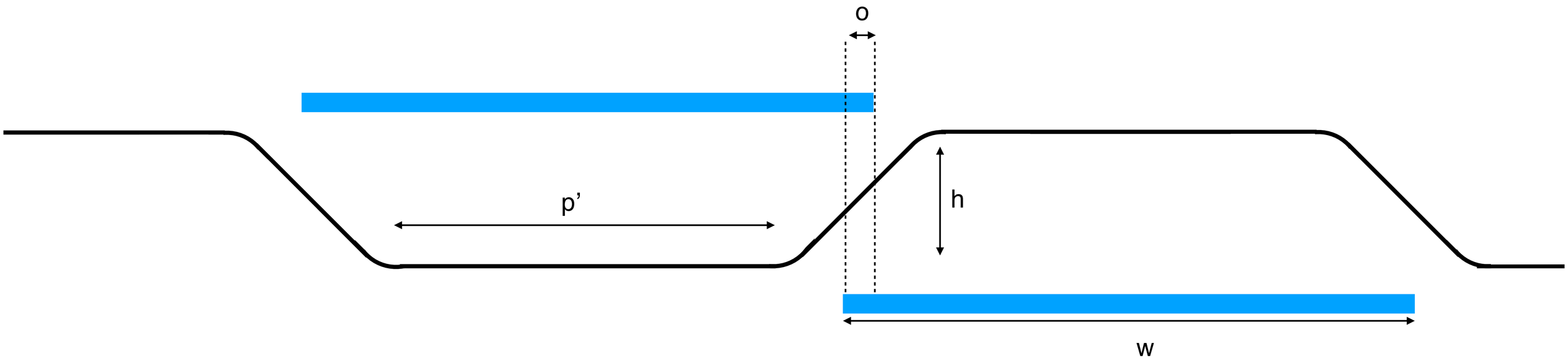


At least three relevant dimensions; pitch, height, and angle — others include length, thickness, …

The sensor has a width w,

p and w are not necessarily equal, although they are coupled,

Disk concept — corrugation core



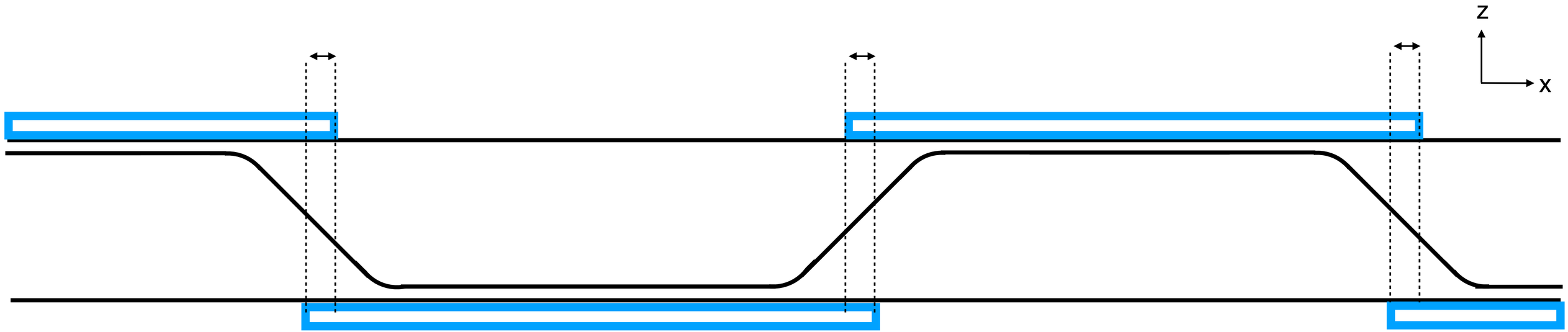
The sensor has a width w, which is beyond our control,

w is thought to be 19.564 mm — this may still change (by 1 mm or so),

p’ must be smaller than w to ensure full acceptance, while keeping the overlap o “small”,

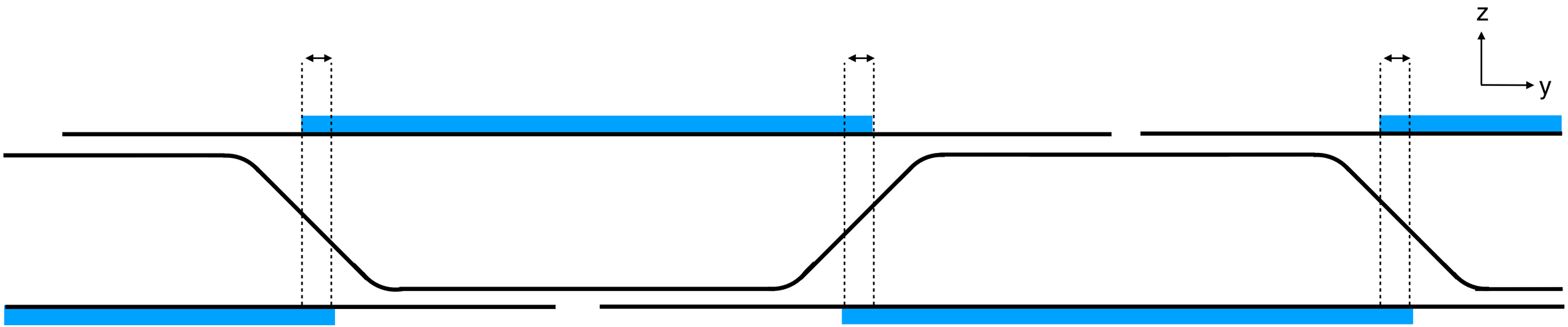
“small” needs to be informed by h, track angles and curvatures, and sensor dead-area(s),

Disk concept — sensor placement



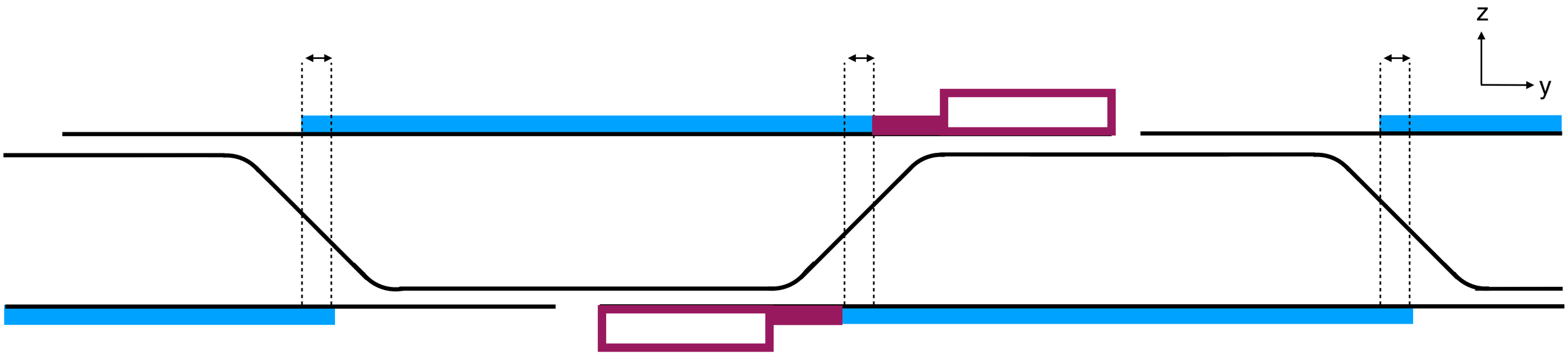
If we accept to link p and w, there are at least two natural choices to place the sensors,

Disk concept — sensor placement



Having a sensor module part of the face-sheets — as shown here — would seem preferred,

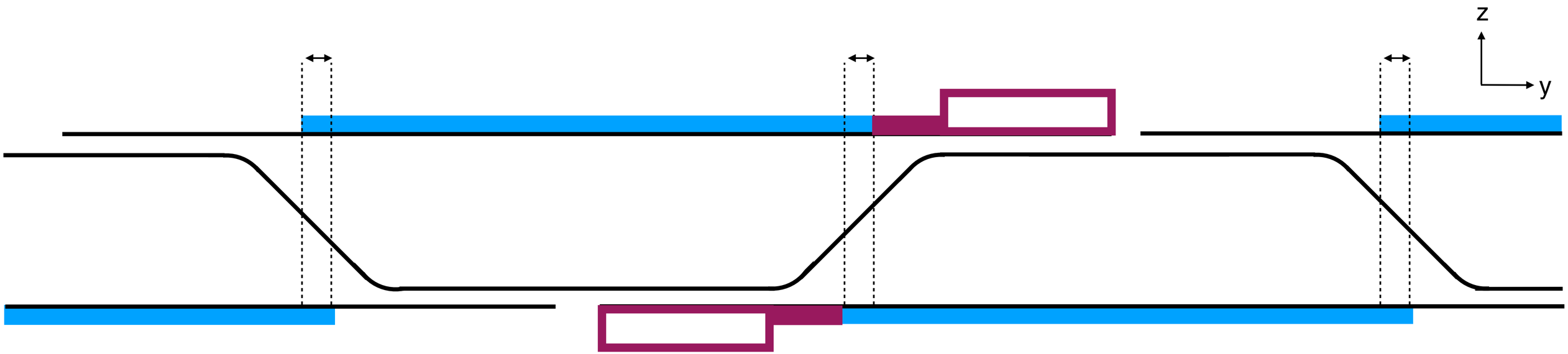
Disk concept — sensor placement



Having a sensor module part of the face-sheets — as shown here — would seem preferred,

Arguments include that services can be *guided* to areas with mechanical support

Disk concept — sensor placement

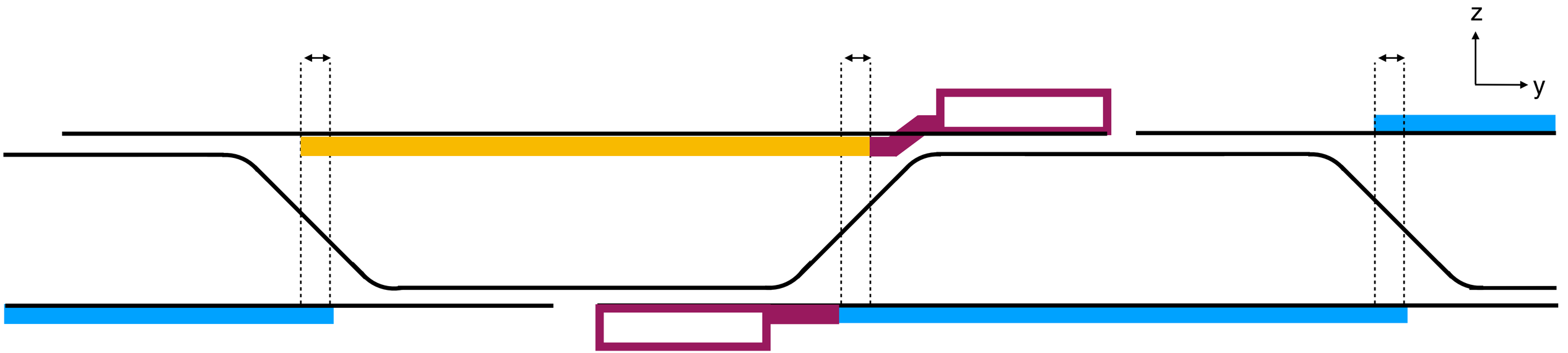


Having a sensor module part of the face-sheets — as shown here — would seem preferred,

Arguments include that services *can* be guided to areas with mechanical support

(services would naturally enter/exit at the periphery or short dimension w)

Disk concept — sensor placement



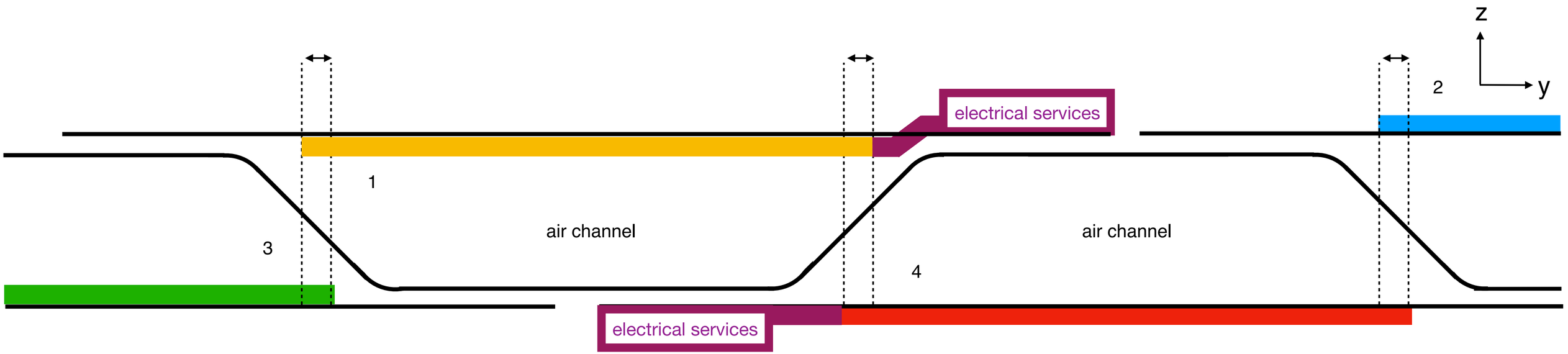
Having a sensor module part of the face-sheets — as shown here — would seem preferred,

Arguments include that services can be guided to areas with mechanical support

modules can be of different heights, thereby enabling *longitudinal* overlap,

or be two-sided with some sort of slot or cut-out for services.

Disk concept — sensor placement



Having a sensor module part of the face-sheets — as shown here — would seem preferred,

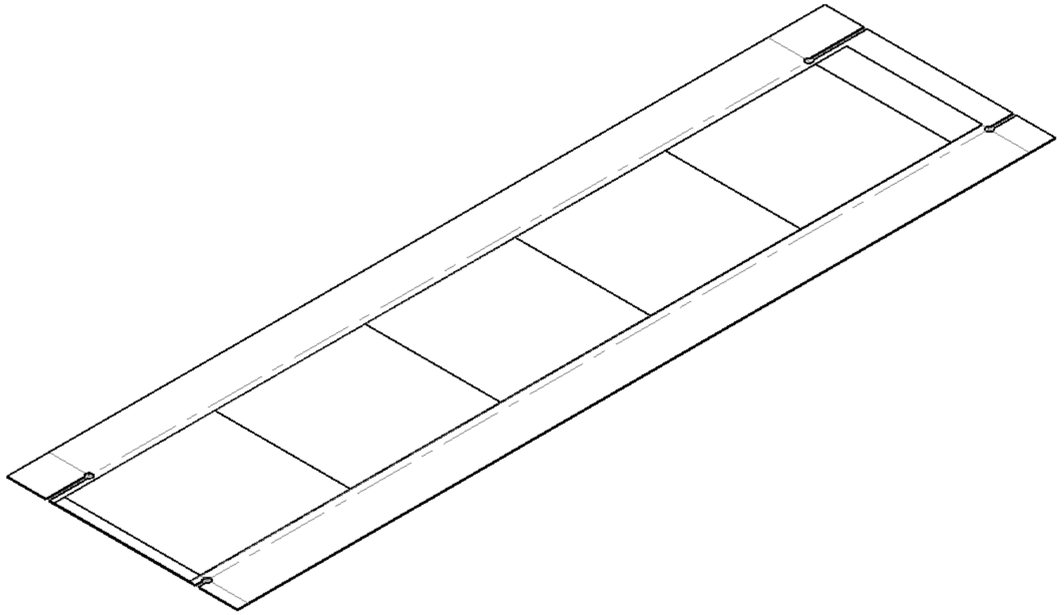
Arguments include that services can be guided to areas with mechanical support

Two module sides or heights would thus result in *four* sensor planes on the disk — color coded above

Module concept

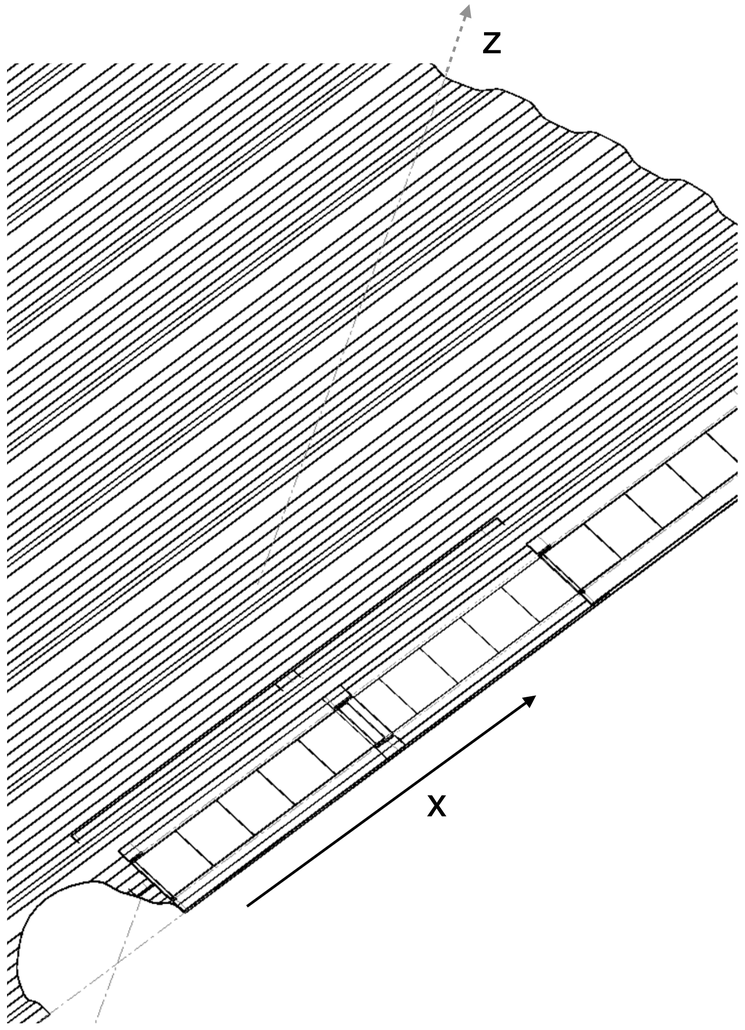
A “module” could have one or more sensors on either or both sides,

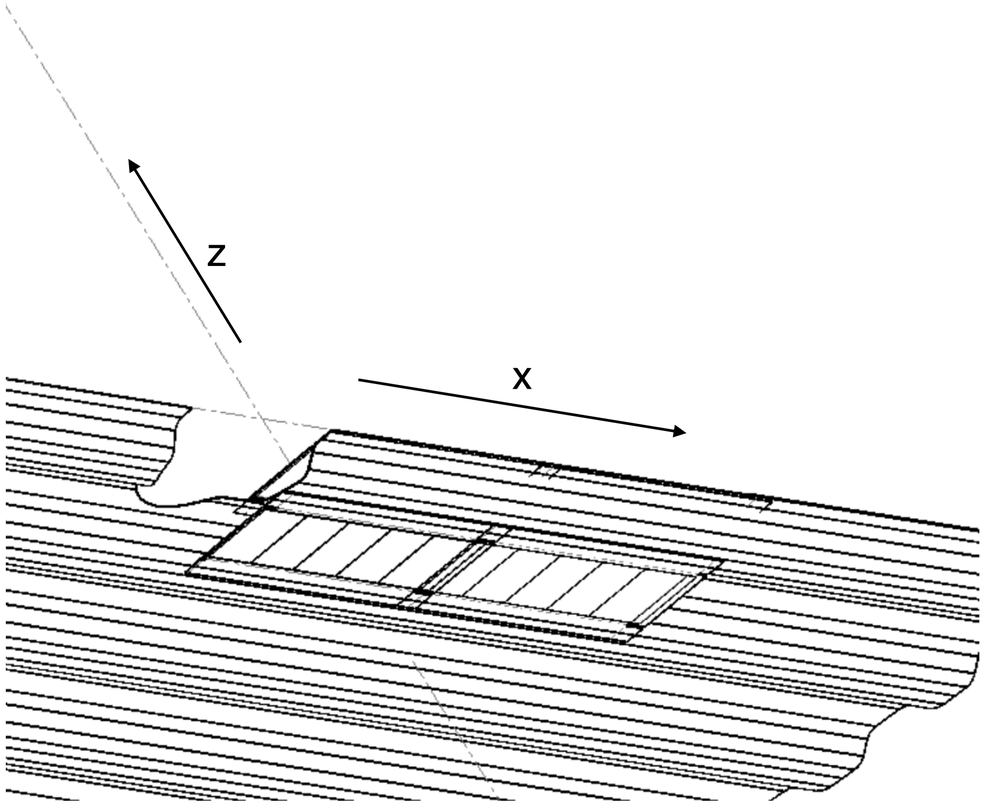
In its most rudimentary form, with one EIC LAS only, it might look something like this:



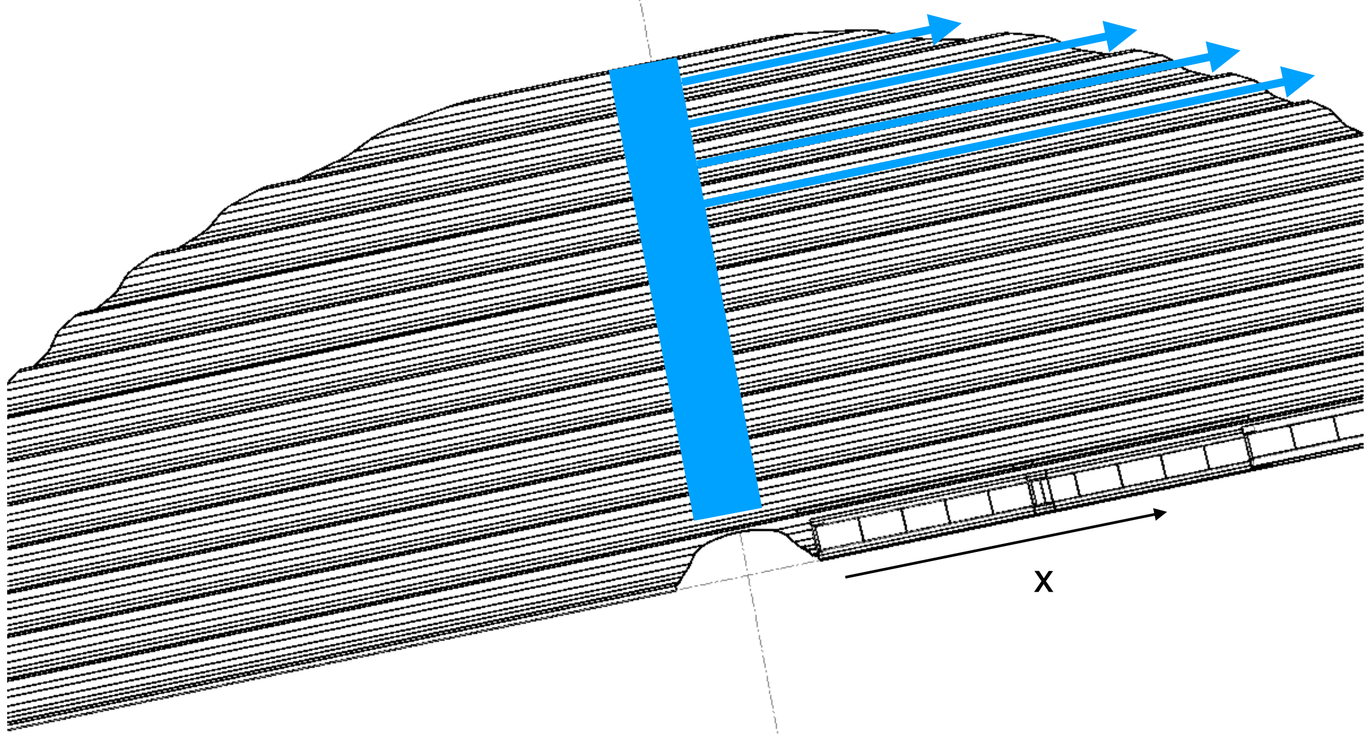
Note that the EIC LAS sensor here as five RSUs and peripheries on both sides. Its support extends slightly beyond the main periphery (likely needed for bonding) and the slots would allow for overlap along the length axis (provided the materials are all thin enough or the structure is not entirely flat).

Disk concept — module placement





Disk concept — internal air cooling (?)

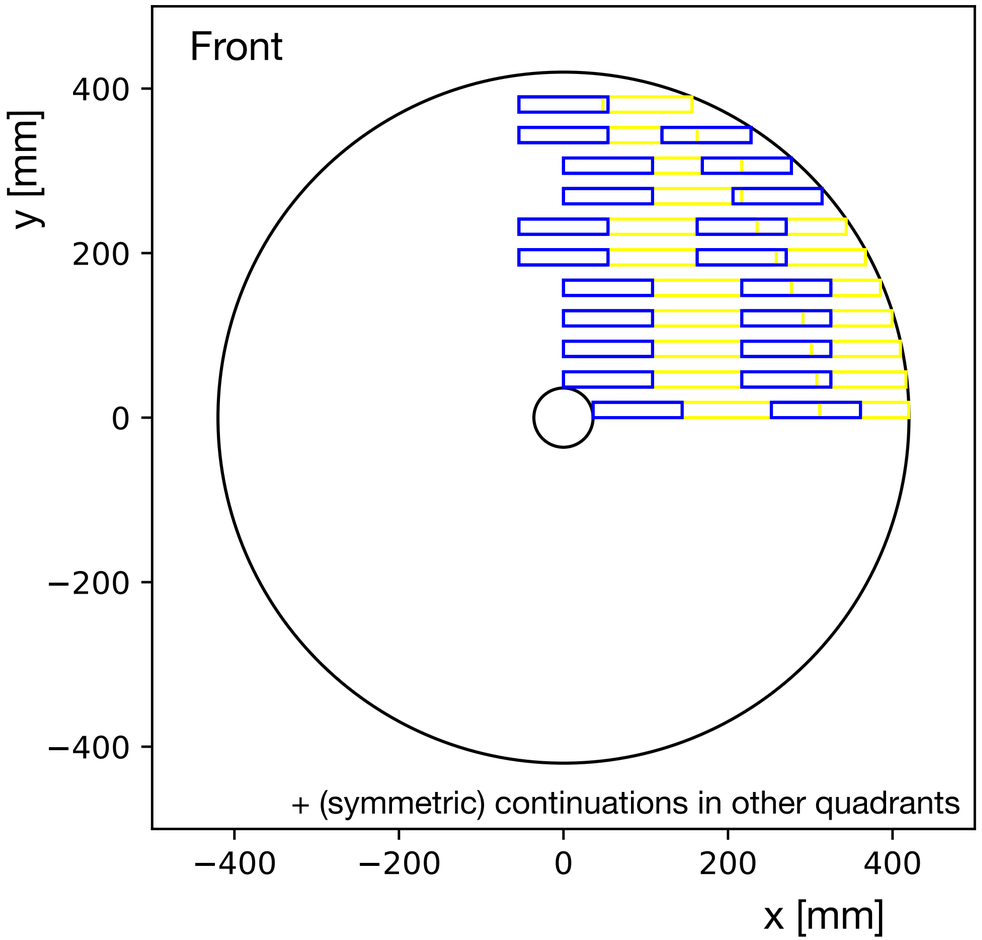


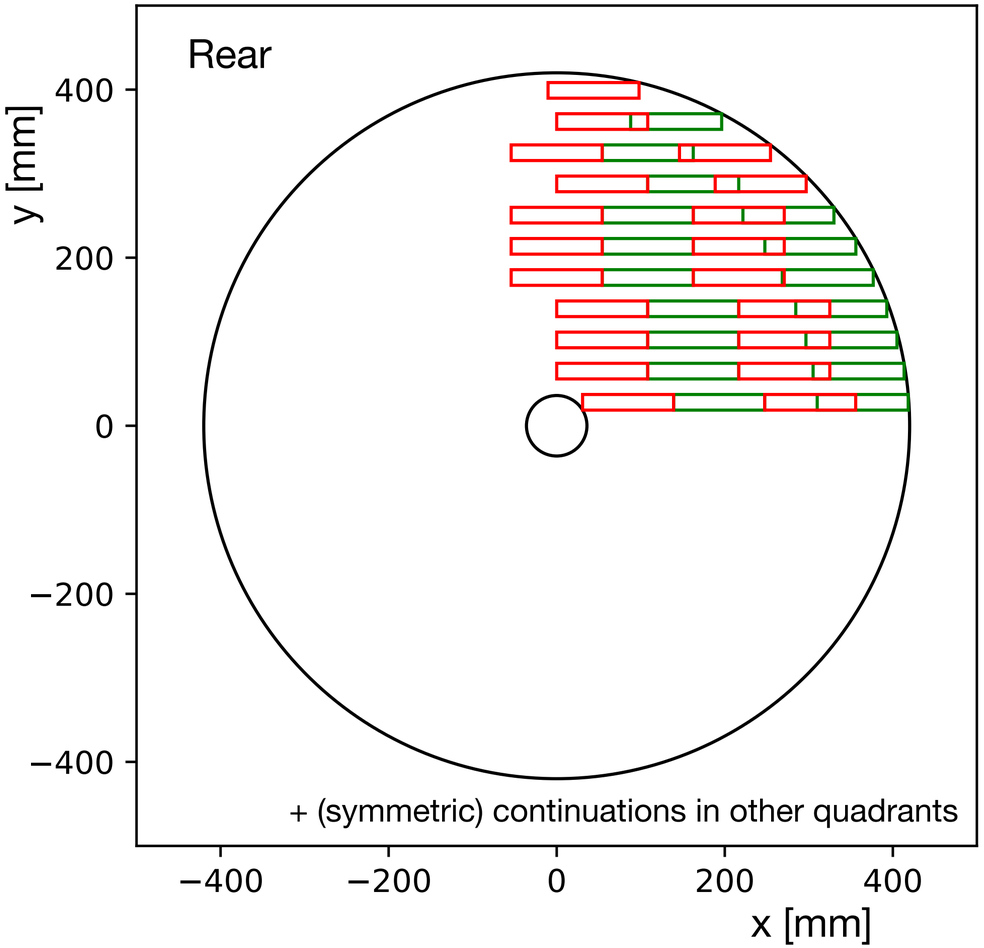
An internal channel might do the trick; something similar near the beampipe (?),

Lots to figure out and work ahead.

Disk concept — tiling

The layout of modules — here with 5 RSUs — onto a large disk could now be done as follows:



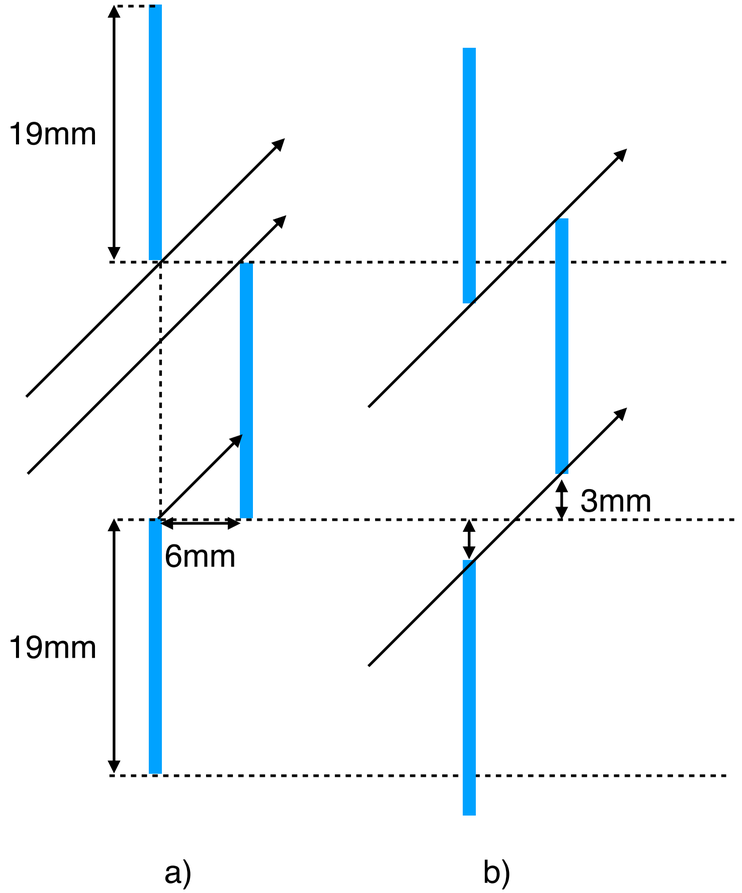


Note: algorithm makes some approximations on overlap / takes some short-cuts so far — (defined) work ahead,

To be done: disks with other radii and (offset) beam-openings, vary n RSU (n = 5 seems reasonable), service routing, …

Disk concept — thickness and track angle

Disk thickness and/or displacement between sensors of multiple mm needs to be taken into account for steep-angle tracks; for a 6mm “thick” disk, a 45° angle would seem to imply the need for 6 mm of overlap (!),



The “obvious” way to minimize this would be to reduce the disk thickness, which may or may not be practical,

Less obvious may be a shift of the sensors along the plane, depending on their location — this is illustrated on the left (middle panel),

Such a shift would need to depend on the y coordinate on the plane; it would be positive (negative) for positive (negative) y,

Need to (fast) simulate this — including vertex spread and track curvature,

The worst case scenarios would presumably be for (innermost) disks 0 and 1 on either side of the IP,

Conceptually similar for most/all tiling schemes.

Disk core — start of some prototyping

No doubt, lots more can be calculated, simulated, etc.

Perhaps enough is known to let “analysis paralysis” go hand-in-hand with “prototyping”,

Mold on the left just arrived,

- Pitch ~ 35 mm, 6 mm height, 45^{o} angle,
- Sized for approximately a quarter of ED0/HD0,

Thinned diced silicon of EIC LAS dimensions ordered, likewise heating elements.

Concluding remarks

Several approaches to tiling sensors onto disks over time — Leo, Walt, ES, **Peter**, Nikki, Chinmay, …

Take one approach that allows some mechanical progress to be made ~now a step further:

- no show-stopper identified at this time with a single 1 by 5 EIC LAS variant; interestingly 1 by 5 seems preferred over 1 by 6 (or 1 by 4),
- increased silicon sensor overlap seems likely compared to mixed-orientation layouts, although there are trade-offs,
- layout insensitive to small changes in sensor width,
- different topology for electrical interfaces compared to mixed-orientation layouts,
- different acceptance at the inner radii compared to mixed-orientation layout,

My goal here is/was *not* to argue superiority of one approach versus another; we probably do not yet know enough to do so scientifically — I certainly do not know now if tiling onto a (segmented) face-sheet is preferred over an approach with modules,

Likewise, I am *not* arguing here that one EIC LAS variant will do.

It does seem timely to me to start imposing mechanical and routing constraints in tiling studies going forward; acceptance gaps from a range of realistic disk thicknesses, for example, would seem similar in size to gaps from peripheries.