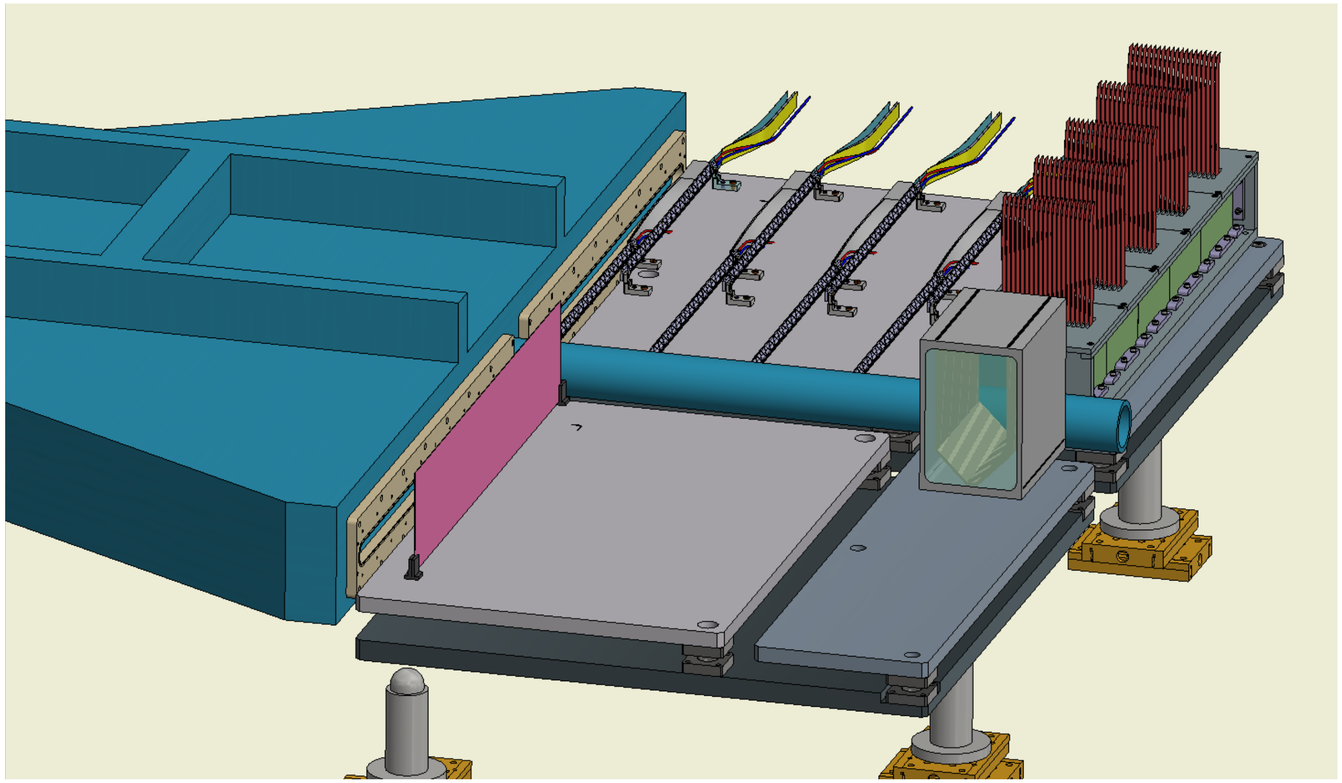
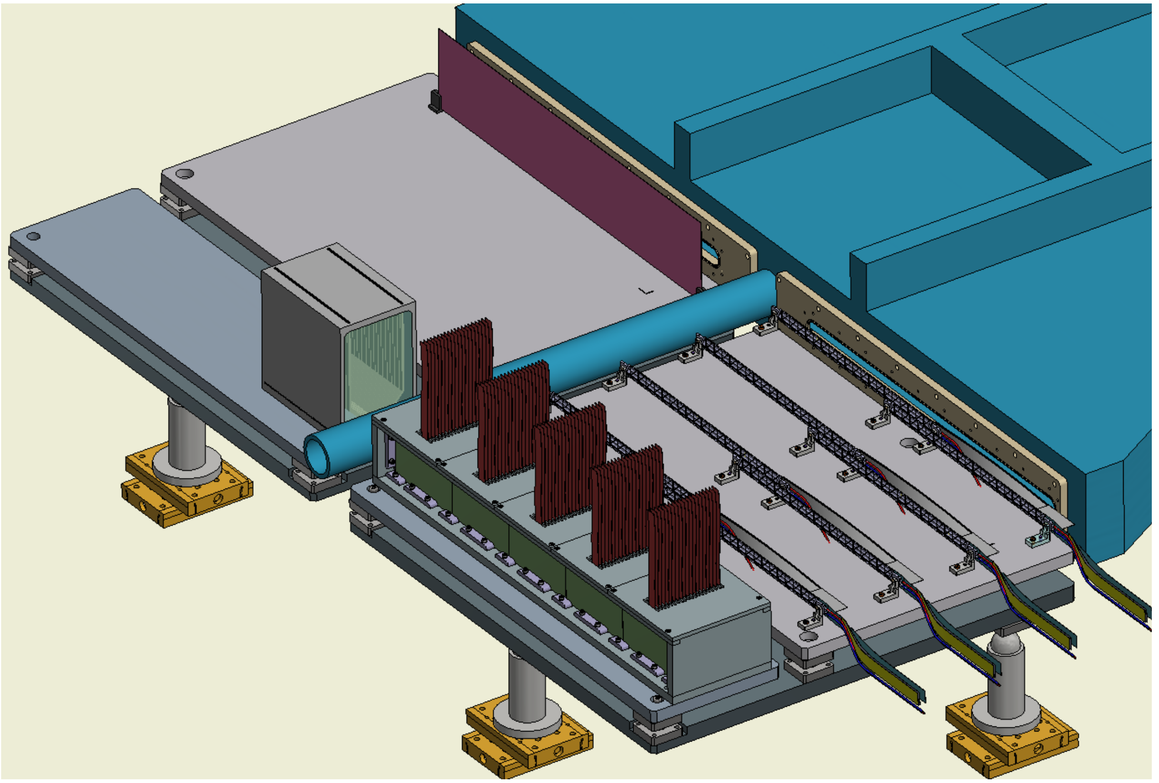
Vacuum chambers & the hybrid setup

Louis, Noam

Mar 9 2021

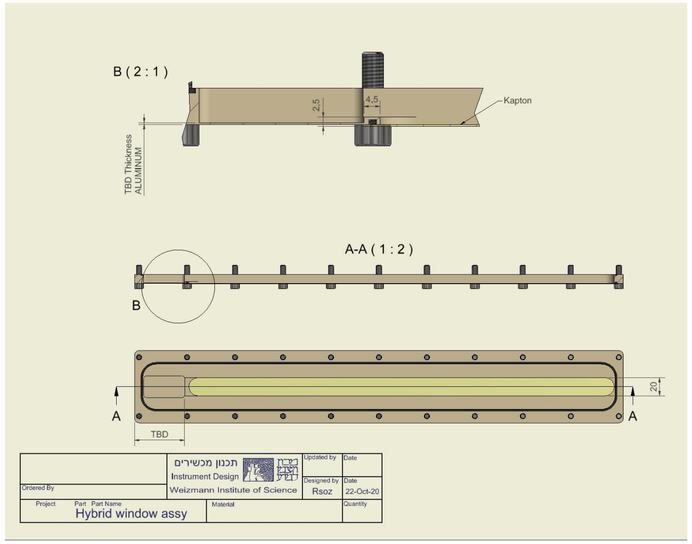
From the CDR

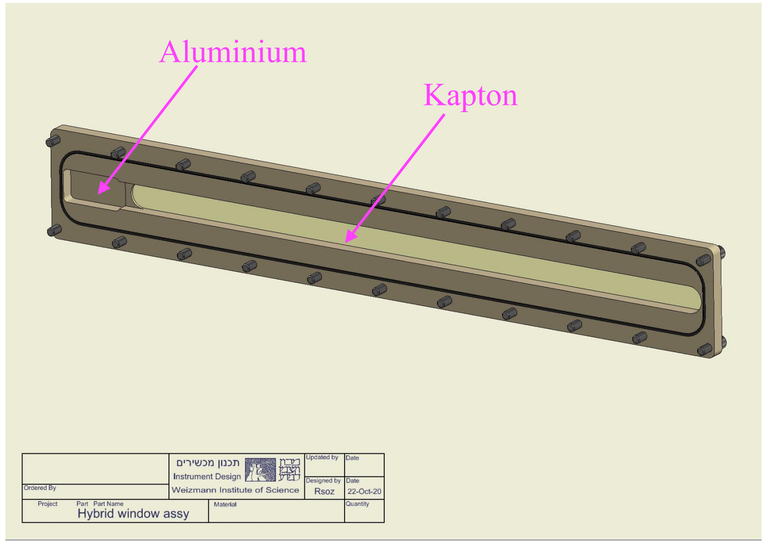


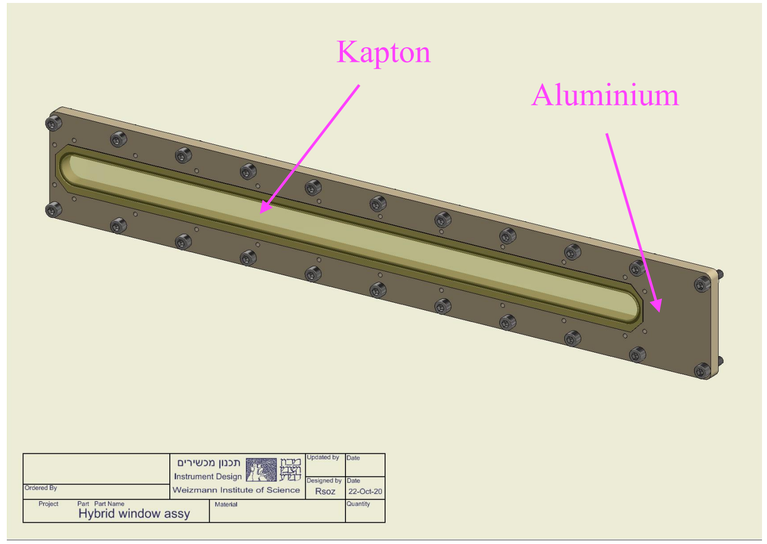


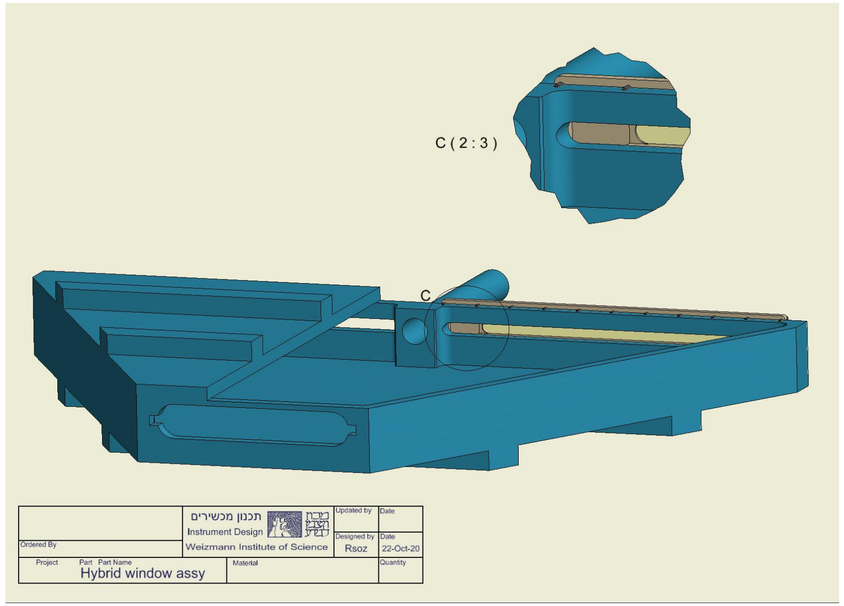
- in the latest design we went to simple movable stages instead of the hexapods
  - note that if we go hybrid then this solution will not be adequate (need ~hexapods)
- the composite window is implemented (see next slide) in cad but not in the simulation yet

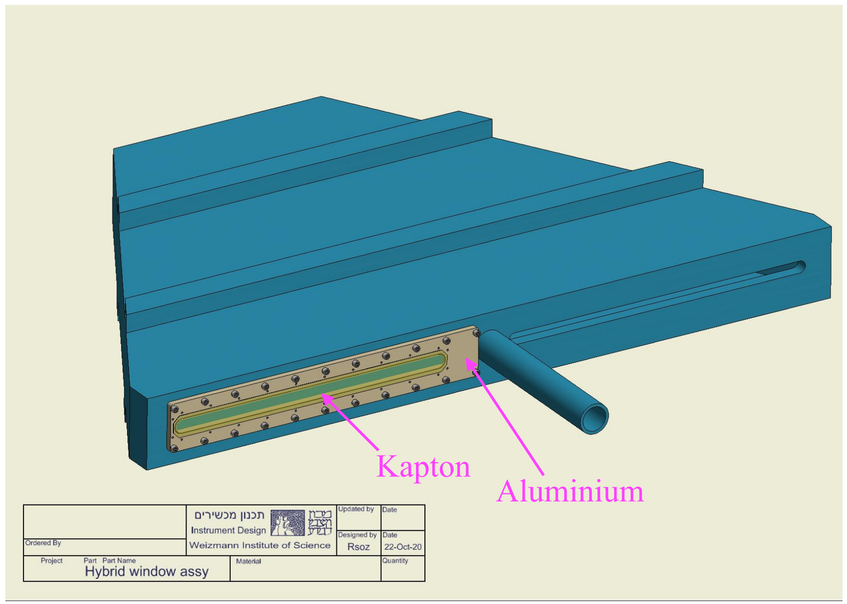
Newest exit-window design



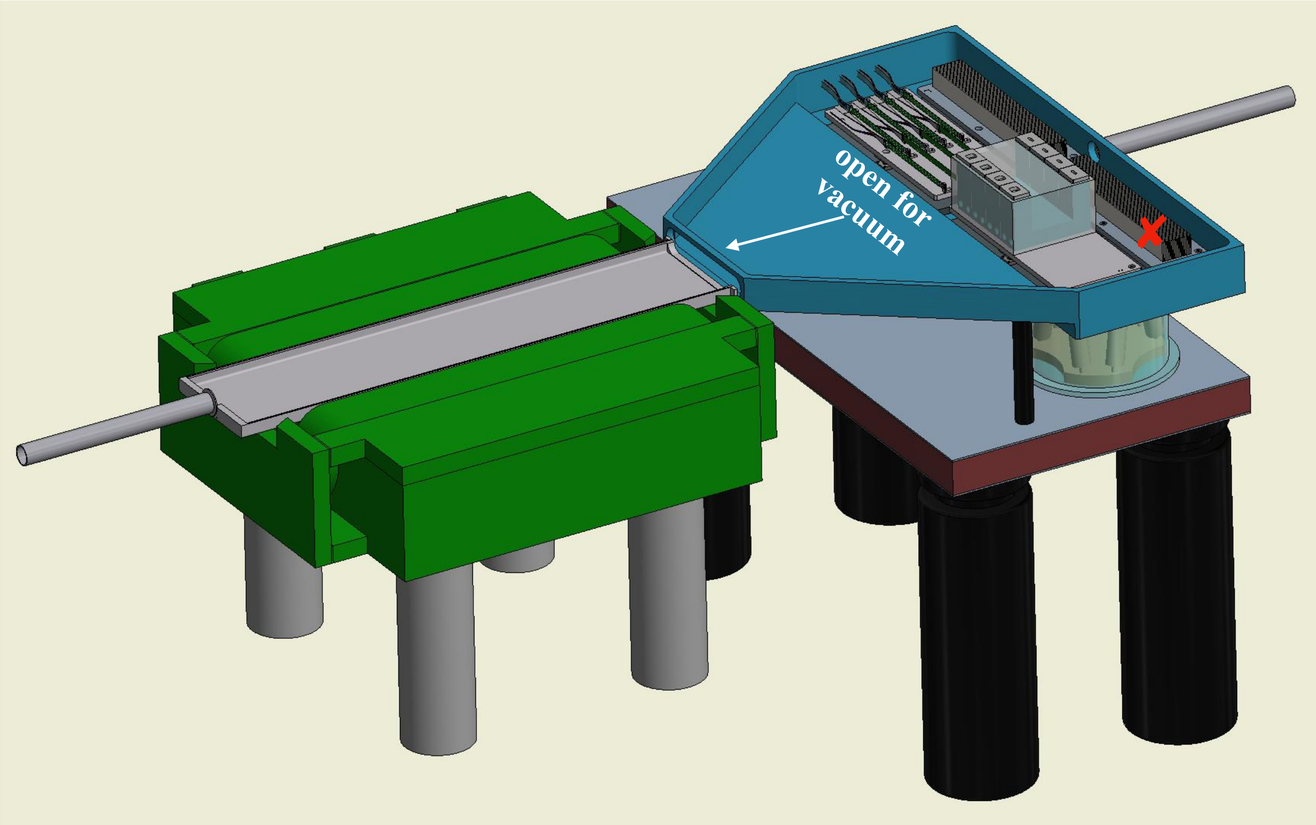


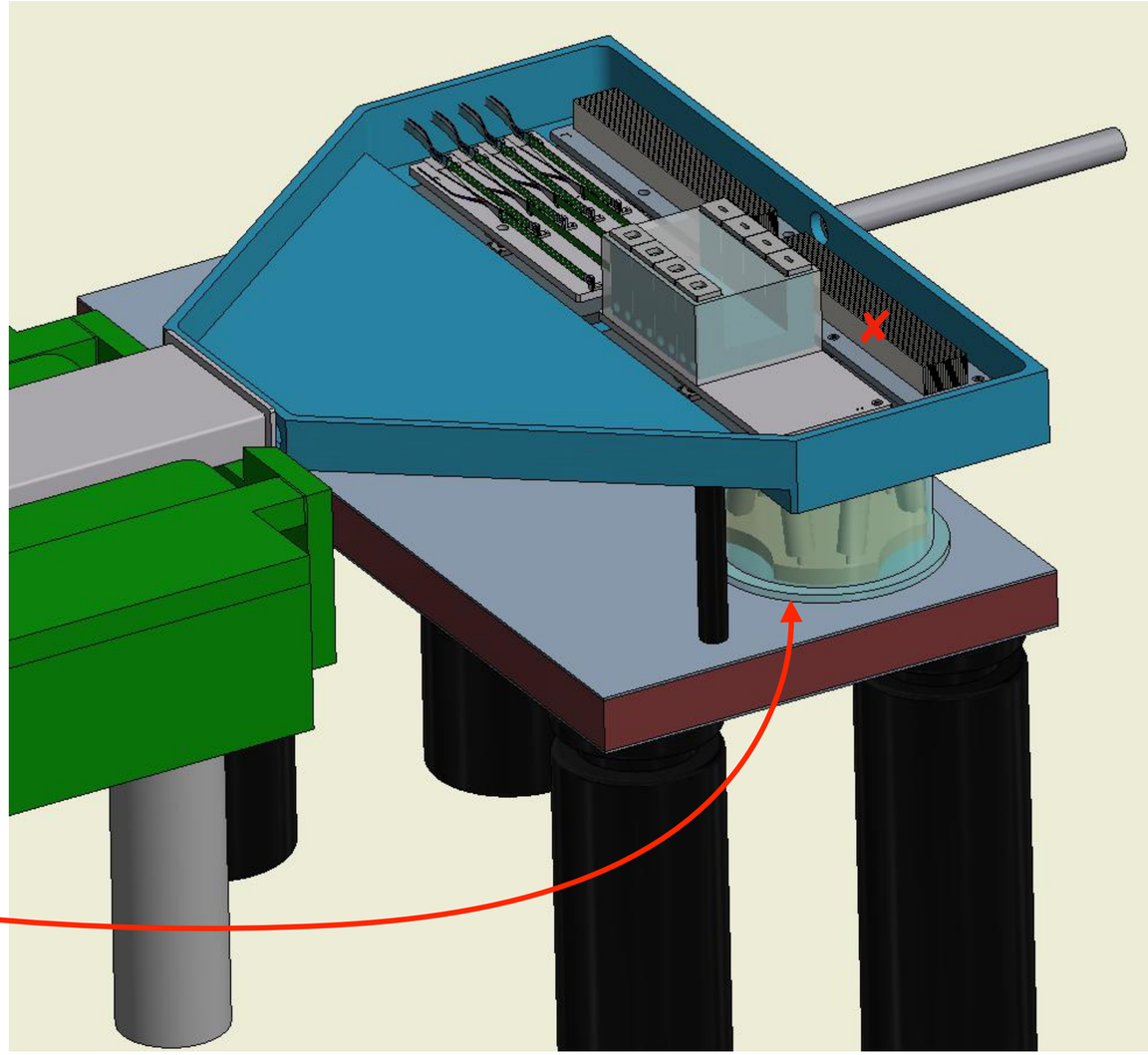






Old all-in-vacuum design





- The detectors' platform is floating inside the vacuum chamber with flexible sleeves placed around the hexapods to maintain the vacuum.
- Note there's no screen here and the Cherenkov is not in its new place
- Also there's another calo on the electron side (has been removed)
- Not sure if these hexapods can be in vacuum (surely more expensive)

Vacuum considerations

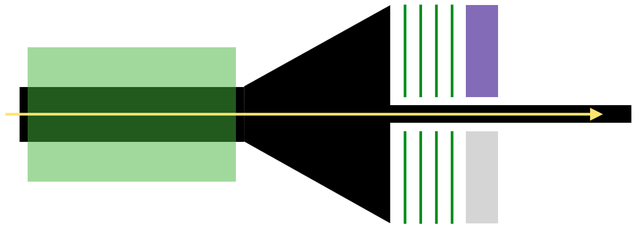
- Need to minimise the range where the electron-beam is traveling in air (high bkg, safety, etc)
- Want to avoid the interaction of the beam with the exit-window material (whatever it is)
- Vacuum in the XFEL's beam-pipe is 1e-6 Pa (1e-11 bar) - TBC
  - Vacuum chambers (IP, rectangular in the dipole, triangular before the detectors) should be pumped as well (calculate the requirement from the volume to be pumped and the vacuum level to be reached)
  - Louis and Rajendra were checking "turbo pumps" for the CDR:
    - >10 k€/pump
    - (laser beam-line)x2 + (IP chamber)x1 + (target chamber)x1 + (electron beam-line)x2 + (detectors)x1
    - not counting the FWD pipe yet (see discussion in last meeting)
  - long time (~45') to pump something large like the IP box (confirmed with Ishay)
- Options for the IP detectors:
  - nothing in vacuum (now)
  - everything is in vacuum
  - part is in vacuum and part is not
    - mostly the electron part

} - can it be inside vacuum mechanically?
- should it be remotely movable inside the chamber?
- how to route out ~4 different kinds of services?
- can the screen's light be guided out easily?

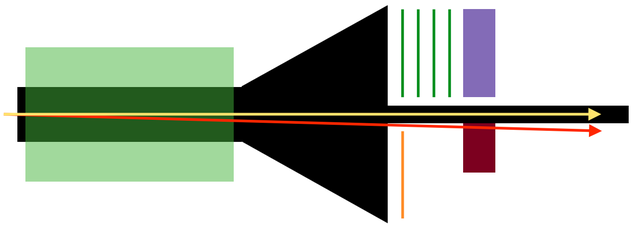
Chamber options: top view

Dipole, Electron beam, Photon beam, Tracker, Calo, Cherenkov, Screen, Chambers, TBD

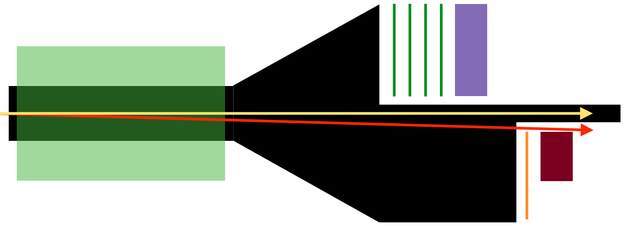
γ+laser #1



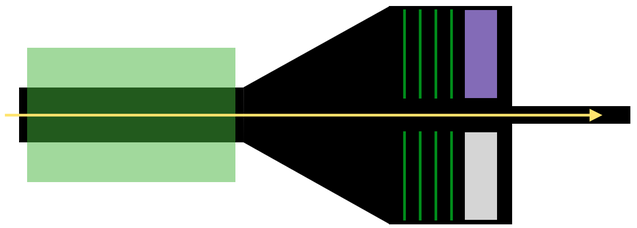
e+laser #1



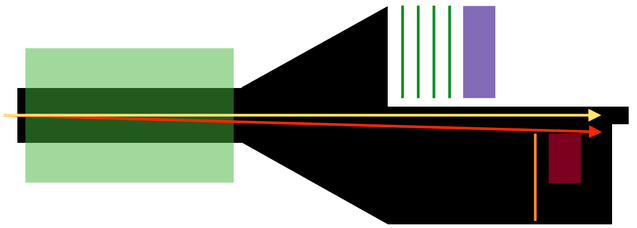
e+laser #2



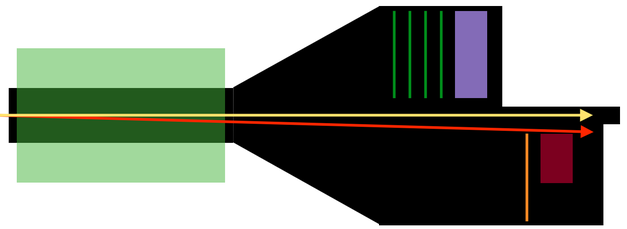
γ+laser #2



e+laser #3

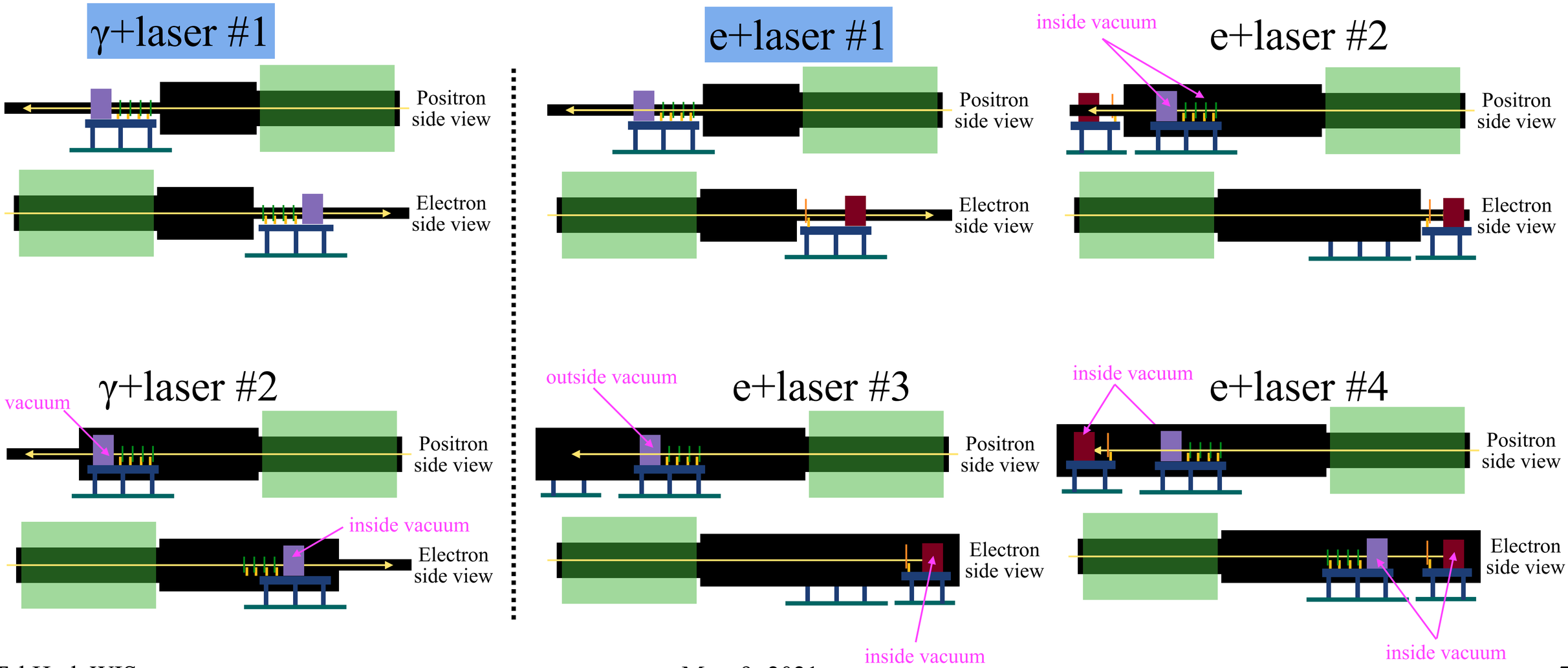


e+laser #4



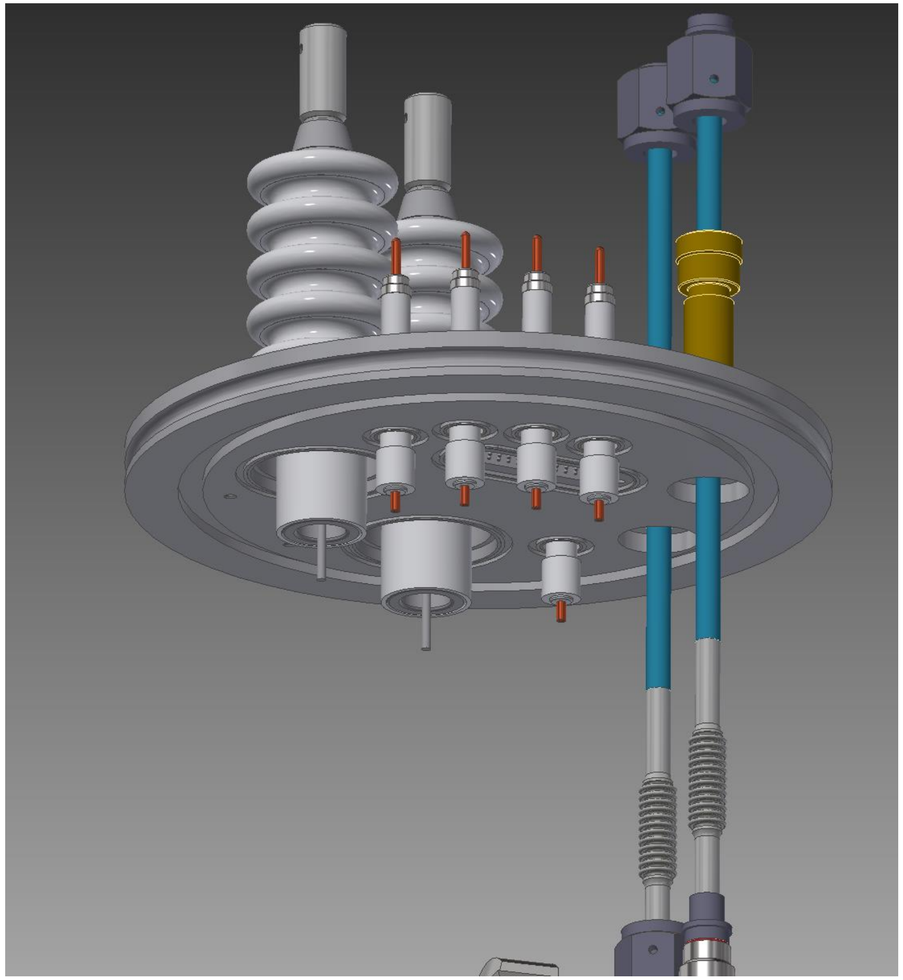
Chamber options: side view

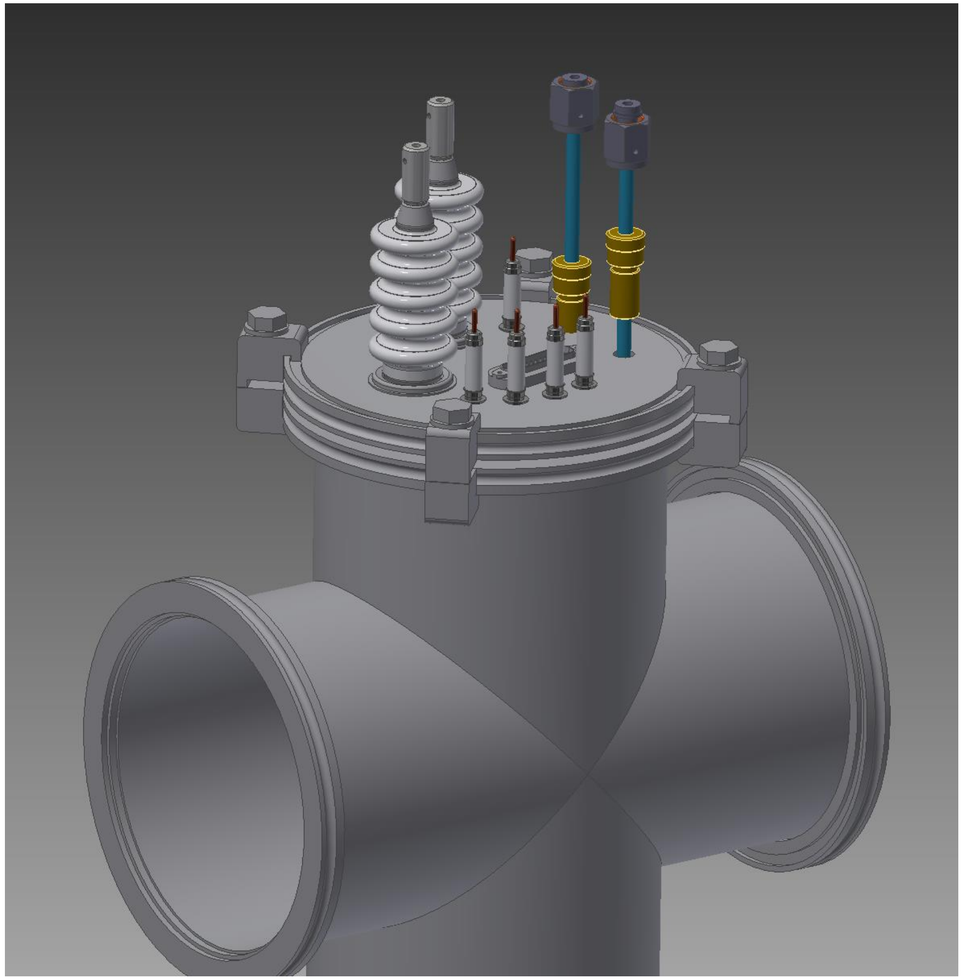
Dipole, Electron beam, Photon beam, Tracker, Calo, Cherenkov, Screen, Chambers, TBD



Feedthroughs

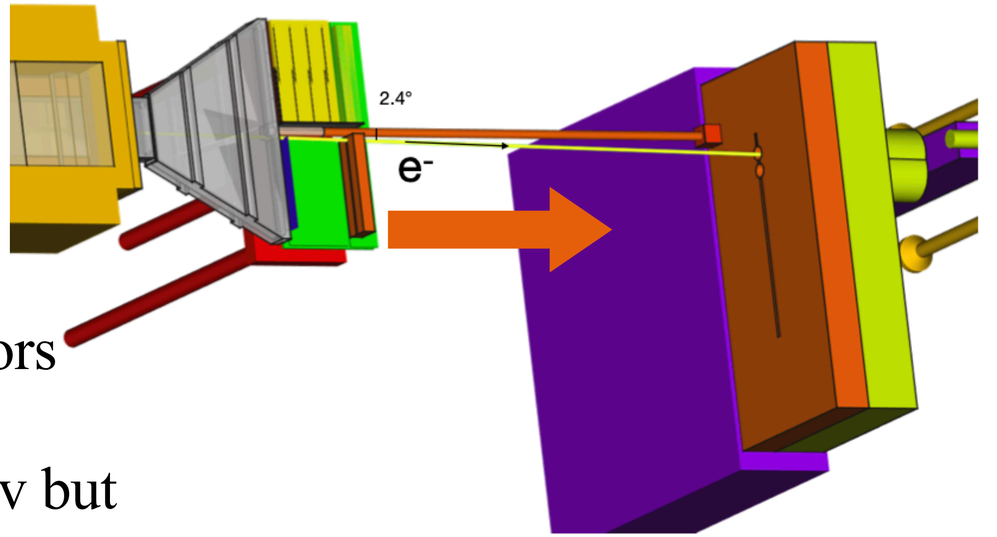
- Just one example of how we'd connect different interfaces in and out of the vacuum
- This is doable but obviously complicated
- We'd need at least 4 different designs of these





Hybrid considerations

- We won't be able to reach a 2 T B-field?
  - this is bad for the low-ξ runs (Compton edges)
  - **Louis:** push the screen+Cherenkov downstream by ~1.5 m
    - edge reconstruction is possible even with 1.5 T (**Ruth**)
    - need only one dump for the electron beam after the detectors

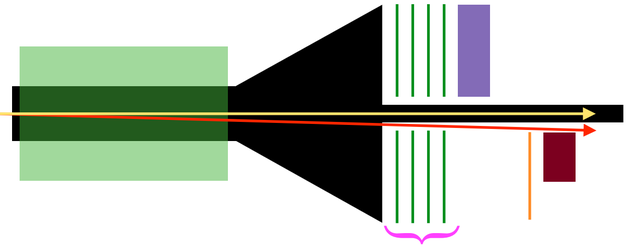


- Tracker can be in the same z position as the screen+Cherenkov but
  - away from the beam path when running in e+laser mode
  - inline with the positron tracker when running in γ+laser mode
  - how to swap between the setups?
    - when in/out of vacuum?

- Easiest hybrid w/o vacuum scenario is like e+laser #2 but w/o the extended chamber on the electron side

- Also need to discuss the upstream movable conversion target

e+laser #2hybrid

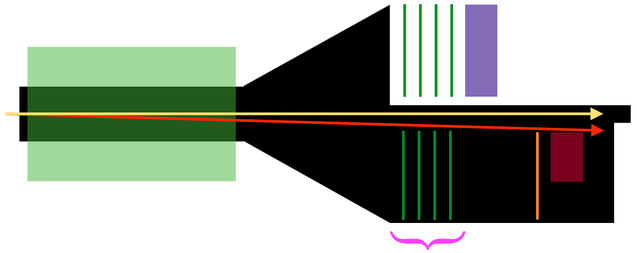


The electron tracker is away (below?) from the Comptons path in e+laser mode and inline with the positron tracker in γ+laser mode

Hybrid considerations

- With vacuum, the easiest option is e+laser #3 but with a movable electron tracker
- The design can be similar to what was pursued in the design seen in slide 4
  - the electron side chamber is going all the way to the dump
  - there is an asymmetry with the positron side (has exit window) and the electron side (in vacuum)
- If we go that way, then putting also the positron side in vacuum will not add much complication on top…

e+laser #3hybrid



The electron tracker is away (below?) from the Comptons path in e+laser mode and inline with the positron tracker in γ+laser mode