Mechanical Issues and Recent Progress on the CRT Stand Design

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Revised on 7/29/2012

Introduction (1)

- *Originally the CRT data taking was planned to start at the beginning of September.*
  - *Using newly produced IRS2 daughter cards.*
  - *Having some improvements on cooling, HV divider and PMT sockets with alignment mechanism.*
- *Given the status, the highest priority is to get the proof of principle for the optics ASAP.*
  - *That is, for now, the improvement on the β-resolution given by the full PMT-coverage to the radiator end.*
    - *The improvement from the half-coverage to the full-coverage has been seen in Arita's MC study (See, Inami-san's talk in the BPID session).*
    - *We need to confirm it in data.*
  - *The strategy is to have a beam test on the LEPS beam line at SPring-8, using the FNAL prototype radiator and mirror and the CFD-readout modules ("LEPS prototype").*
    - *The LEPS beam will be available in Oct. 2^{nd} – 9^{th}.*
    - *No expansion block this time due to the shortage of financial/man-power resources to produce front/back-end modules.*

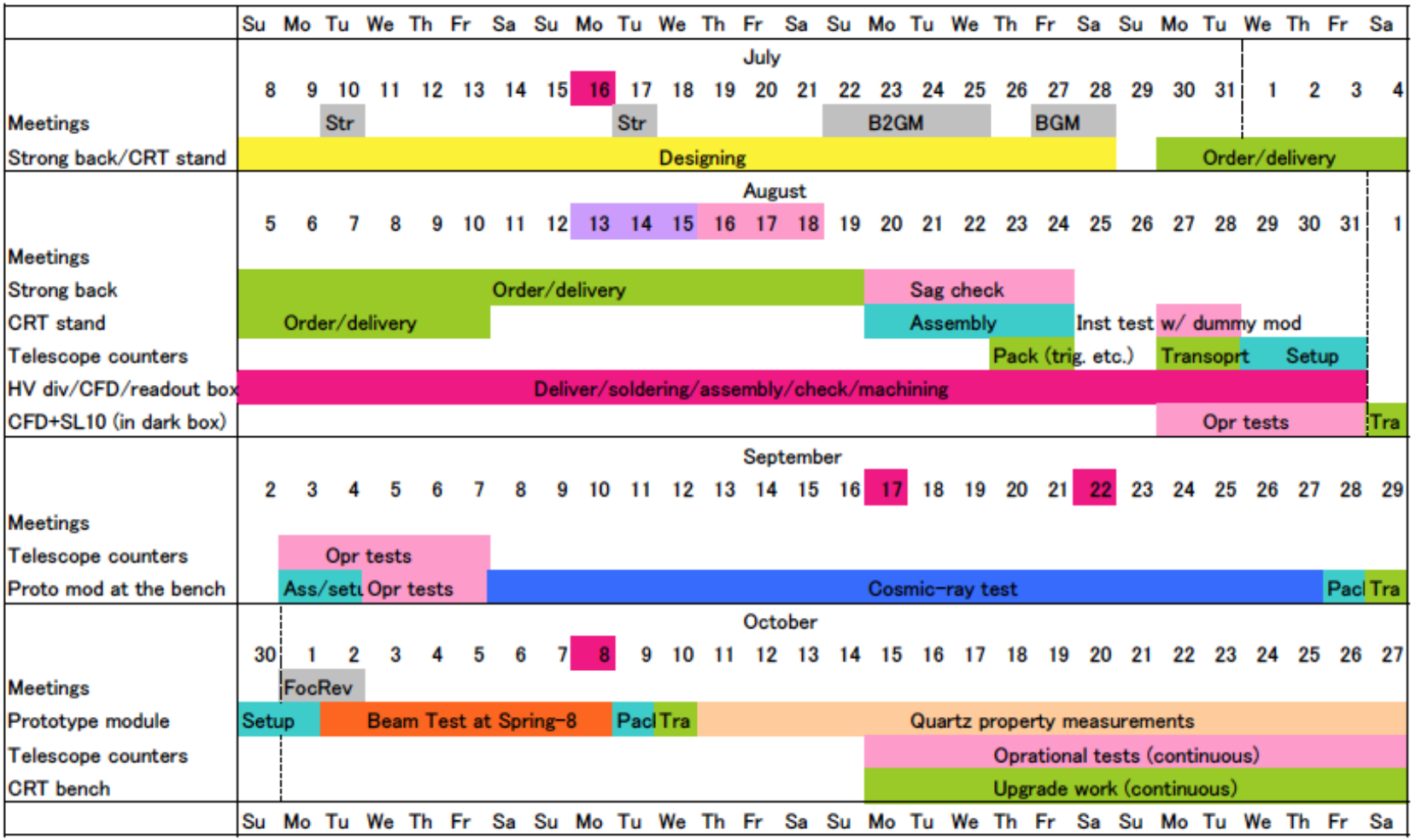
Introduction (2)

- *By the Oct. beam test, we need to prepare the readout system and to have operational tests and a cosmic-ray test for the "LEPS prototype".*
  - *The CFD-readout modules for 16ch. SL10 are supposed to be ready for use by the end of August.*
    - *As well as associated structures/jigs and back-end modules.*
  - *The results of the tests are important for the Focused Review (Oct. 1st – 2nd) to show some progress in the right direction.*

CRT assembly schedule – option A – (1)

- My proposal of the CRT assembly schedule ("option A") is shown below.

Schedule Option A

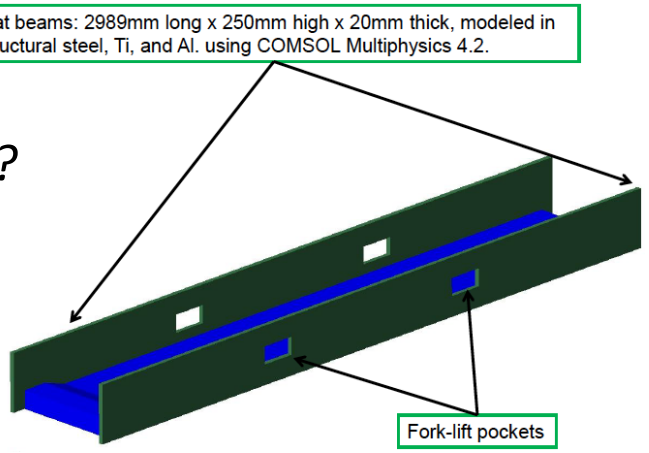


CRT assembly schedule – option A – (2)

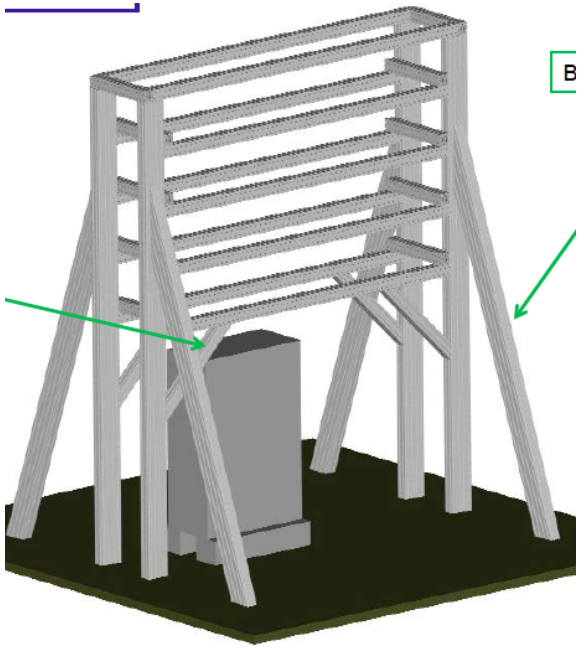
- *Hence, the CRT stand and Strong Back need to be ready for use by the beginning of September.*
  - *Considering the "Obon-break" (Aug. 13th – 15th) and the KEK power outage (Aug. 16th – 18th).*
- *Given the tight schedule, the existing design should be realized ASAP, taking into account possible extensions and modifications.*
  - *The existing design is based on Gary Varner's proposal and is modified/drawn by Marc Rosen.*
  - *Extensions/modifications should be applied time to time.*
  - *What are the mechanical issues for realization?*

Issues on the CRT design

- *Need to decide the followings.*
  - *Dimensions and "shelf"-spacing,*
    - *What is the baseline config.? Possible extensions?*
  - *Assembly method,*
    - *Where/how/how many people to assemble? Need a crane during the assembly? Where to anchor? How to secure the range stack?*
  - *Operation scheme.*
    - *How to install a module? How many incident positions to take? Use IP-assumed tracks?*
- *Need to evaluate the followings.*
  - *Sag of a counter module with the Strong Backs attached,*
  - *Sag of the beams of the CRT stand with counter modules installed,*
  - *Seismic performance assessment,*
    - *1G for vertical load, 0.25G for lateral load.*
    - *Natural frequency.*
  - *Cost.*



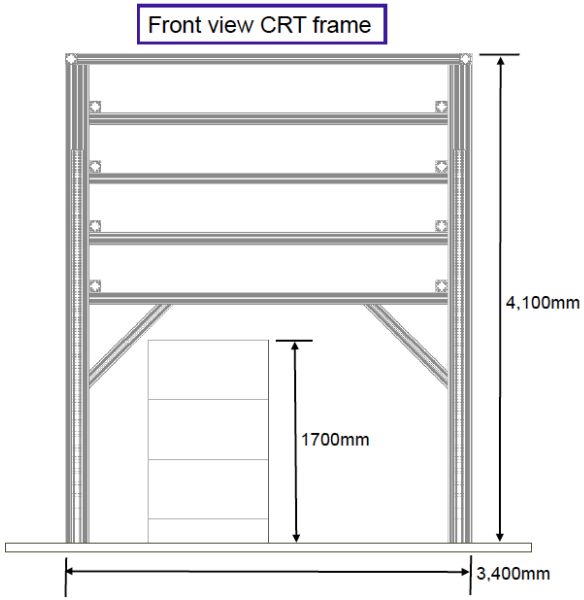
"Strong Back" by Marc Rosen



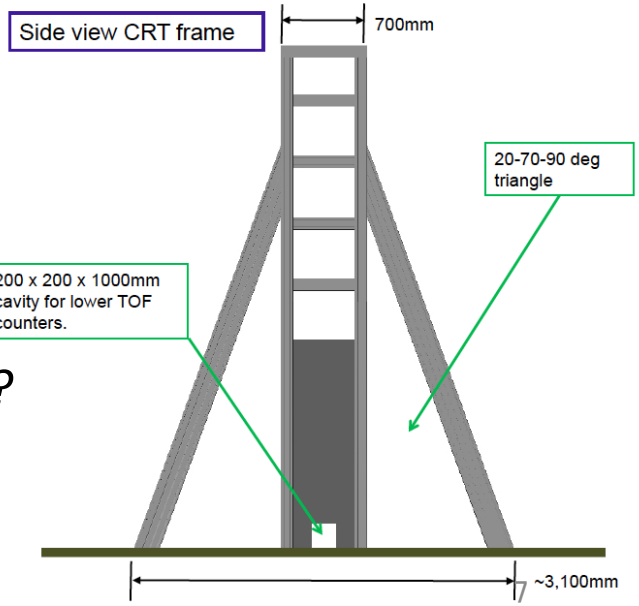
CRT stand by Marc Rosen

Dimensions and spacing

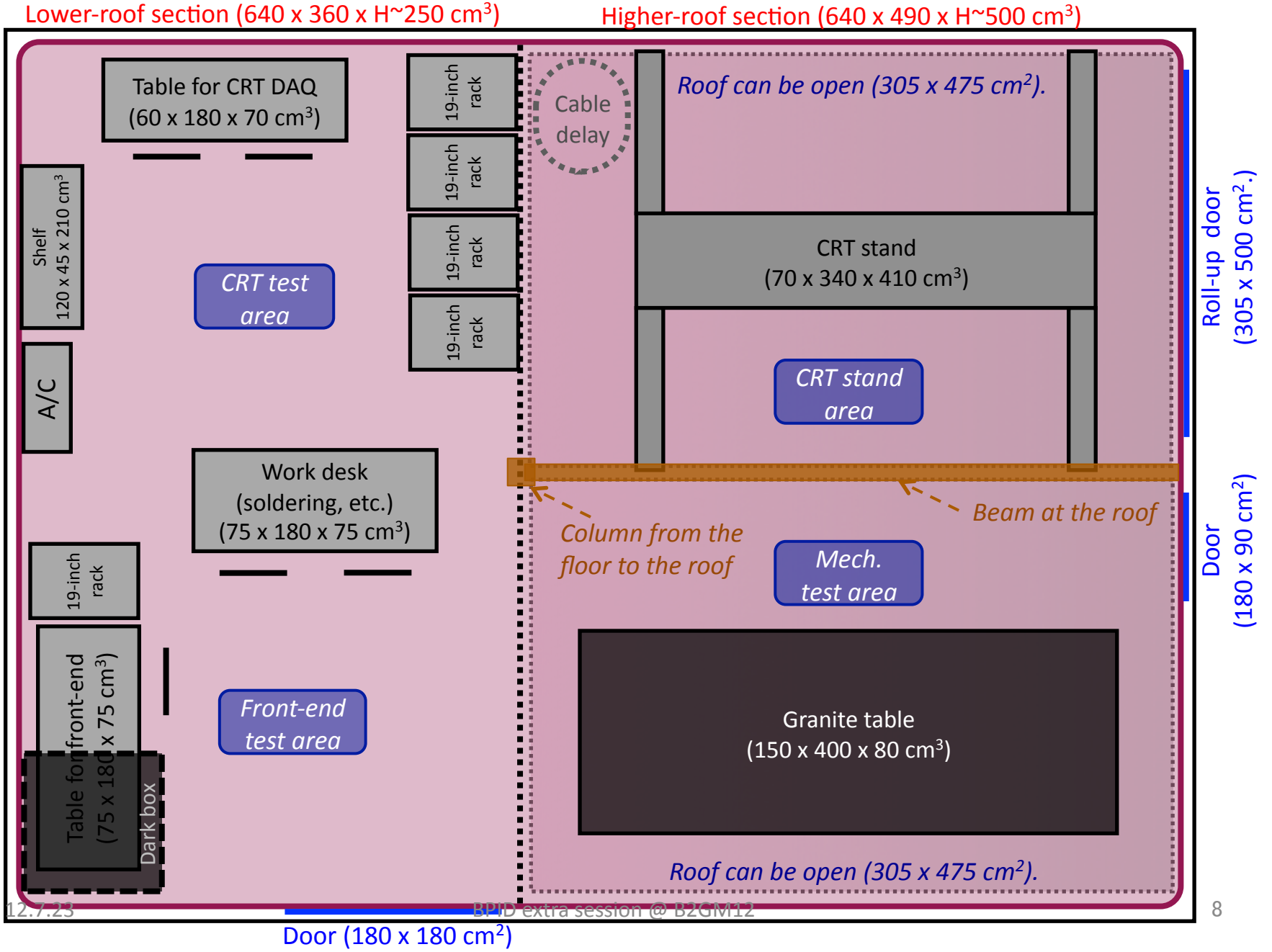
- *Dimensions and "shelf"-spacing.*
  - *Baseline: SciFi trackers, timing counters, TOF trig. counters and a range stack.*
  - *Extension: cherenkov counters for further β-selection?, a movable range stack?*
  - *Where/how to mount them? How much spaces do they need?*
  - *See Matt Barrett's talk and Jim Fast's talk in this session.*



- *Accumulation of small space-savings would help to lower the height or to make more spaces.*
  - *For safety (seismic proof), module installation and possible CRT extensions.*
    - *Al-beams: 100x200 mm² -> (50-100)x100 mm²?*
    - *D:700 mm -> D: 600 mm?*
    - *More steep slope for the buttresses?*
    - *Lead, instead of iron, for the range stack?*

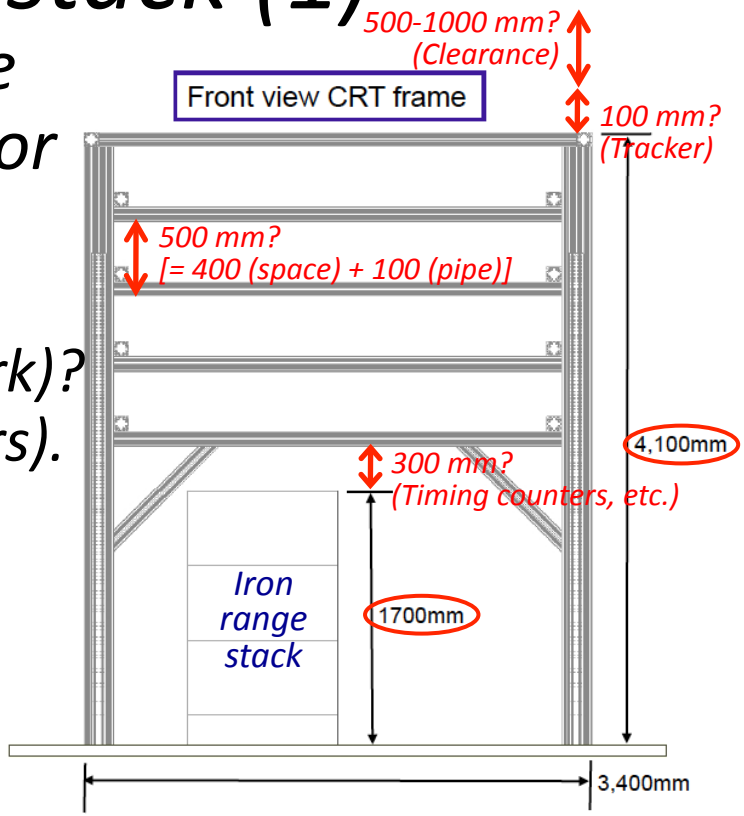


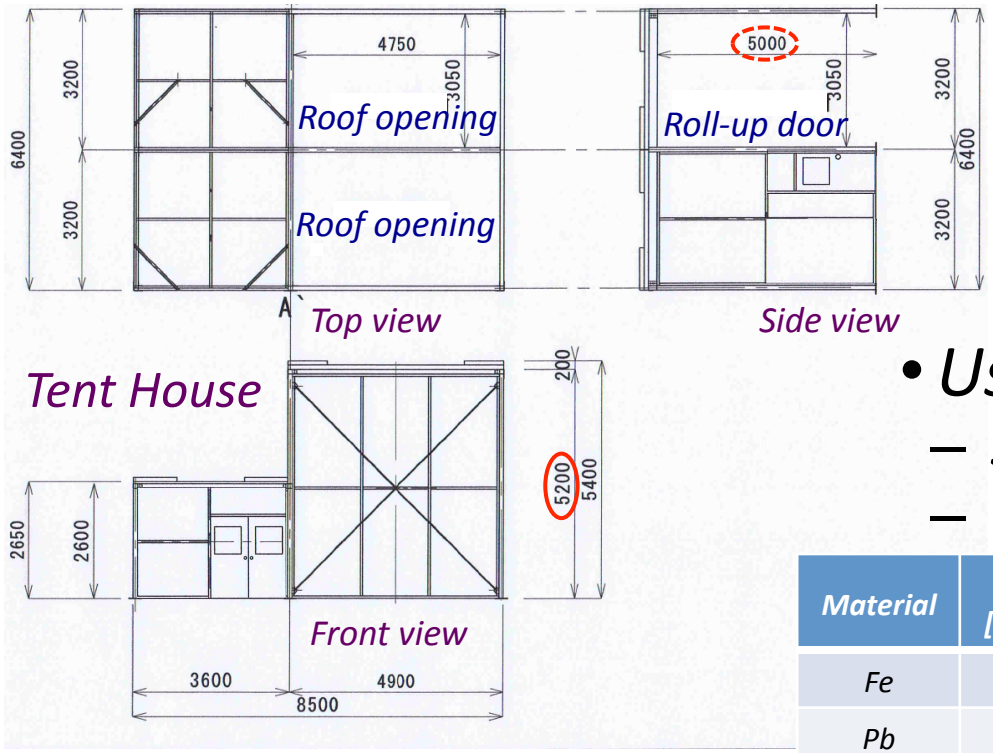
Layout plan for the Tent House (660 x 880 cm^2): ver. 2012/07/04



Lead for the range stack (1)

- *Especially, a smaller height and more vertical spacing would be desirable for the CRT stand.*
  - *H < 5.2 m (phys. limit).*
  - *0.5-1 m clearance at the top (safety+work)?*
  - *16 cm for timing counters (4 cm x 4 layers).*





- *Use lead for the range stack.*
  - *Suggested by Alan Schwartz.*
  - *The height can be 1/3 of iron.*

Material	λ_T [g/cm^2]	λ_I [g/cm^2]	X_0 [g/cm^2]	$dE/dx\|_{min}$ [MeV·cm^2/g]	ρ [g/cm^3]	X_0/ρ [cm]
Fe	81.7	132.1	13.84	1.451	7.874	1.76
Pb	114.1	199.6	6.37	1.122	11.350	0.56
Pb/Fe	1.40	1.51	0.46	0.77	1.44	0.32

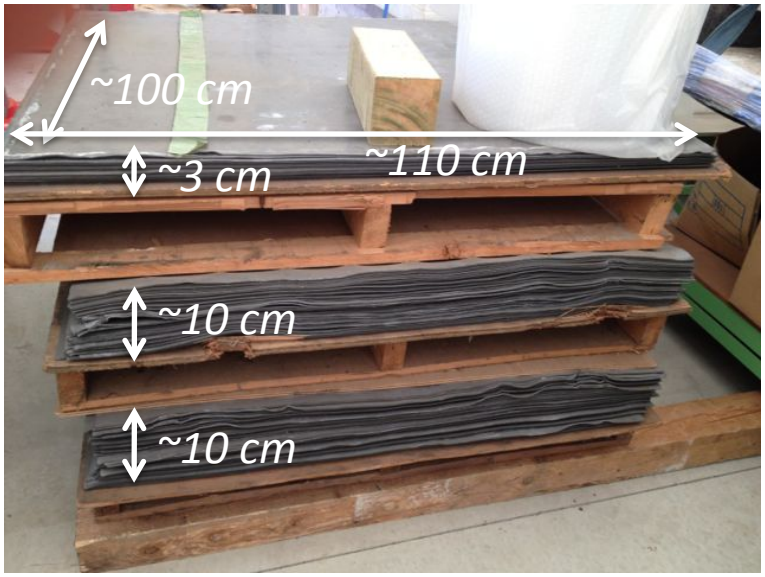
Lead for the range stack (1)'

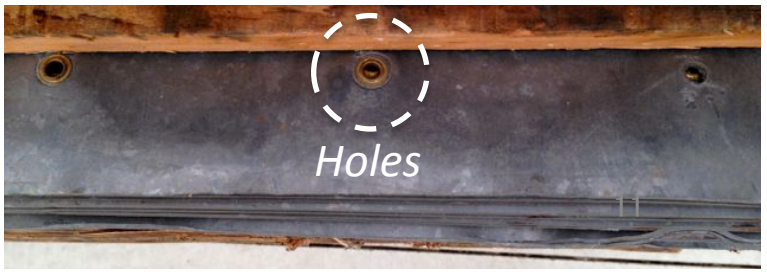
- Made a mistake to evaluate the range stack height.
  - Particle of interest is μ, not e.
  - We should have looked at the energy loss (dE/dx), not the radiation length (X0).
  - Resulting height reduction in Pb to Fe is only 11%.
    - ➢ No significant advantage to use lead instead of iron.

Material	λ_T [g/cm^2]	λ_I [g/cm^2]	X_0 [g/cm^2]	$dE/dx\|_{min}$ [MeV·cm^2/g]	ρ [g/cm^3]	dE/dx*ρ [MeV/cm]
Fe	81.7	132.1	13.84	1.451	7.874	11.425
Pb	114.1	199.6	6.37	1.122	11.350	12.735
Pb/Fe	1.40	1.51	0.46	0.77	1.44	1.11

Lead for the range stack (2)

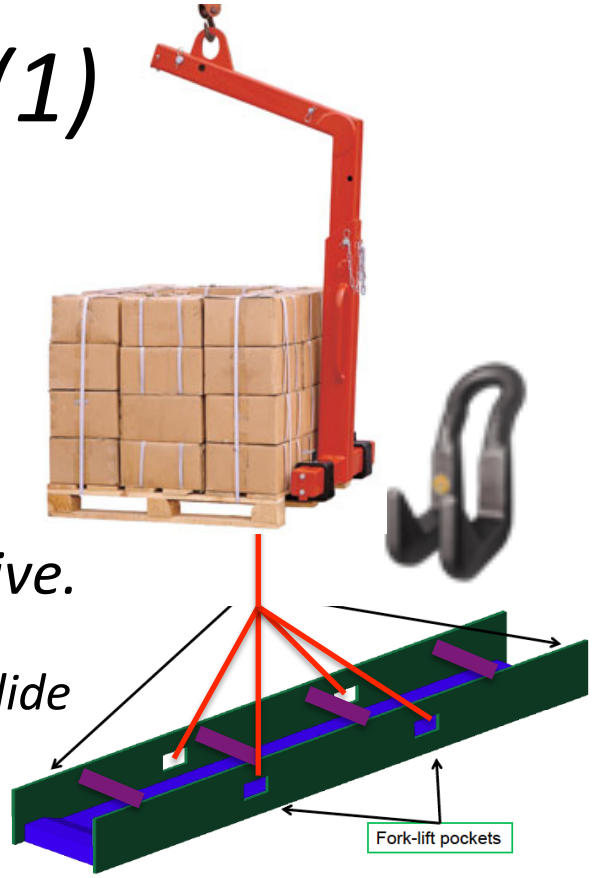
- *Hayashi-san kindly offered to use the lead stored in the Belle Tent.*
  - *Lead sheet (100 x 110 x ~23 cm^3)*
  - *Lead wool (25 kg x 8 boxes)*
- *Adachi-san is kindly trying to get more lead for us.*
  - *There are many lead bricks at East Counter Hall, but they belong to the J-PARC division. Can we use them?*
  - *Anything else?*





Operation scheme (1)

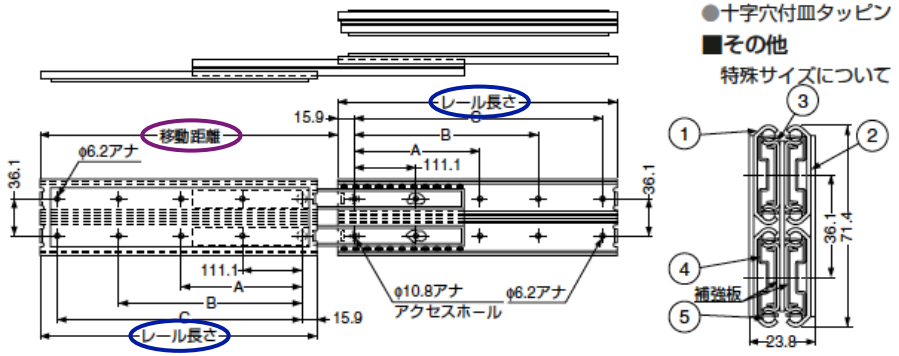
- Module installation scheme
  - Use of a crane folk (palette hunger) was considered, but seems not favored at KEK.
    - 1-2 cm level position adjustment is difficult.
    - Not an easy-operation through the roof opening.
    - Storage and cost (~300k yen?) issues.
  - Use of slide rails was proposed as an alternative.
    - Suggested by Matsuoka-san.
    - Place a counter module on a pair of slide-rails, then slide it into the CRT stand shelf.
    - Can be used in a usual operation with, for instance, hookers and/or slinging wires.
    - Need to put something, e.g. props, between the strong backs to prevent from unwanted moment.
  - The "slide-rail scheme" is being implemented in the CRT stand design.



スライドレール 3509 重量用

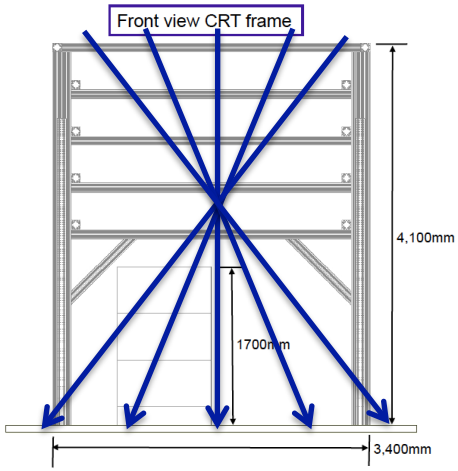
Length *Travel* *Load tolerance* *Price*

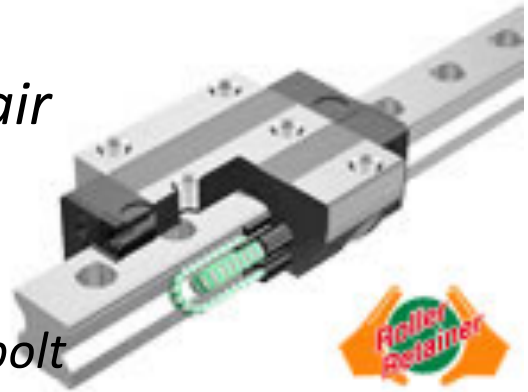
品番	レール長さ	移動距離	A	B	C	耐荷重		質量	1箱	¥定価
3509-12	305	327	–	149.2	273	2666N/ペア	272kgf/ペア	3.99kg/ペア	4セット	13,200/1セット
3509-14	356	378	–	200	323.8	2626N/ペア	268kgf/ペア	4.67kg/ペア	4セット	13,800/1セット
3509-16	406	428	–	250.8	374.6	2538N/ペア	259kgf/ペア	5.35kg/ペア	4セット	14,300/1セット
3509-18	457	479	212.7	301.6	425.4	2450N/ペア	250kgf/ペア	6.03kg/ペア	4セット	15,100/1セット
3509-20	508	530	238.1	352.4	476.2	2362N/ペア	241kgf/ペア	6.67kg/ペア	4セット	16,100/1セット
3509-22	559	581	263.5	403.2	527	2244N/ペア	229kgf/ペア	7.35kg/ペア	2セット	16,900/1セット
3509-24	610	632	288.9	454	577.8	2117N/ペア	216kgf/ペア	8.03kg/ペア	2セット	17,800/1セット
3509-26	660	682	314.3	504.8	628.6	1960N/ペア	200kgf/ペア	8.71kg/ペア	2セット	18,700/1セット
3509-28	711	733	339.7	555.6	679.4	1784N/ペア	182kgf/ペア	9.34kg/ペア	2セット	19,500/1セット



Operation scheme (2)

- *A movable range stack*
  - *It would be difficult to have full-coverage of the range stack over the quartz optics (~2.7 m).*
    - *Not easy to handle/secure such a massive range stack.*
    - *Even unnecessary. What is the required coverage, i.e. planned incident positions, then?*
  - *Inami-san suggested to use IP-assumed tracks.*
    - *What are "incident positions" within the acceptance?*
    - *Should a single module go through all the shelves?*
    - *Do we not need to move the range stack at all, then?*
  - *If we want the range stack be movable, use of pair of linear guides seems to work.*
    - *Suggested by Toshi Kawai (Nagoya engineering group) based on his experience with telescope construction.*
    - *Need an iron plate (~10 mm) under the linear guides to bolt them; the CRT stand can be anchored through the plate.*
    - *Need an iron plate (~20 mm) on top of the linear guide blocks to place the lead/iron.*
    - *A hand-winch works to move; a horizontal resistance can be a few percent of the vertical load.*

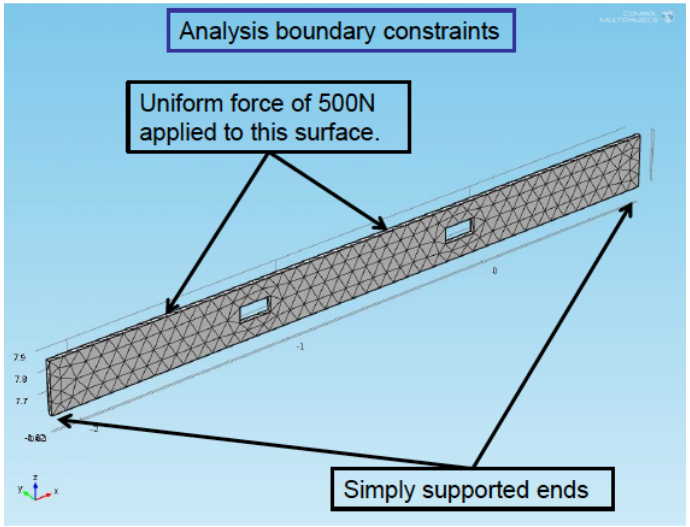


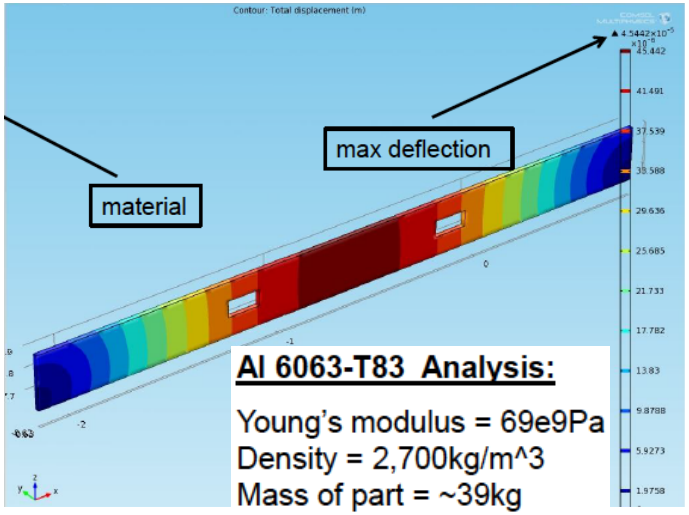


THK SHW35CA:
- ~150k yen/guide for 3m length.
- ~1 month to deliver.

Mechanical performance assessment

- *Sag of the Strong Back*
  - *Marc Rosen evaluated the sag using FEM.*
    - *A preliminary result indicates acceptable sag (~45 µm) sag for Al Strong Back (L2989 x H250 x T20 mm^3).*
  - *Need to incorporate more details.*
    - *Can we make the Strong Back smaller to reduce its weight and the vertical clearance in the CRT stand?*
    - *What about possible moments given by the installation scheme?*
- *Sag/seismic performance of the CRT stand.*
  - *Jim Fast and a PNNL engineer evaluated using FEM.*
    - *See Jim's talk in this session.*

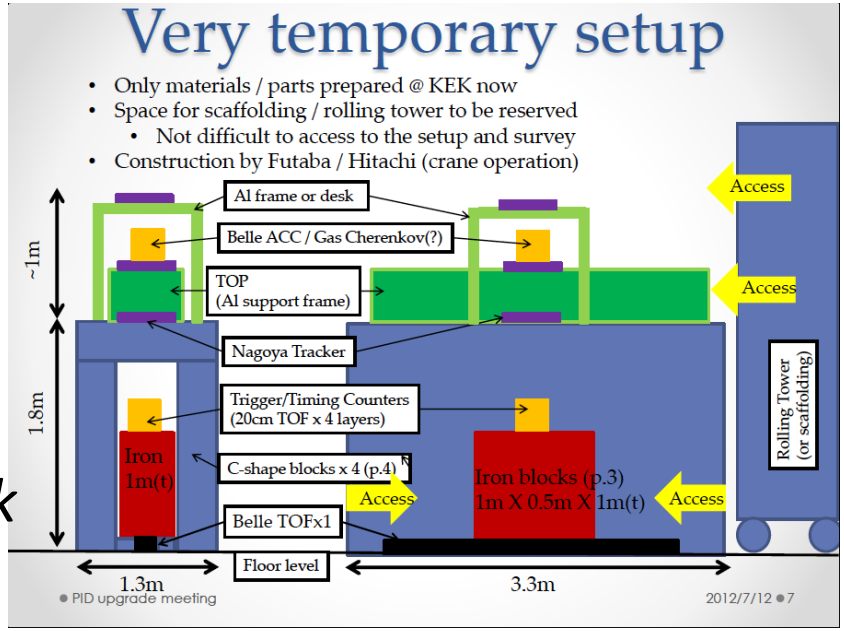




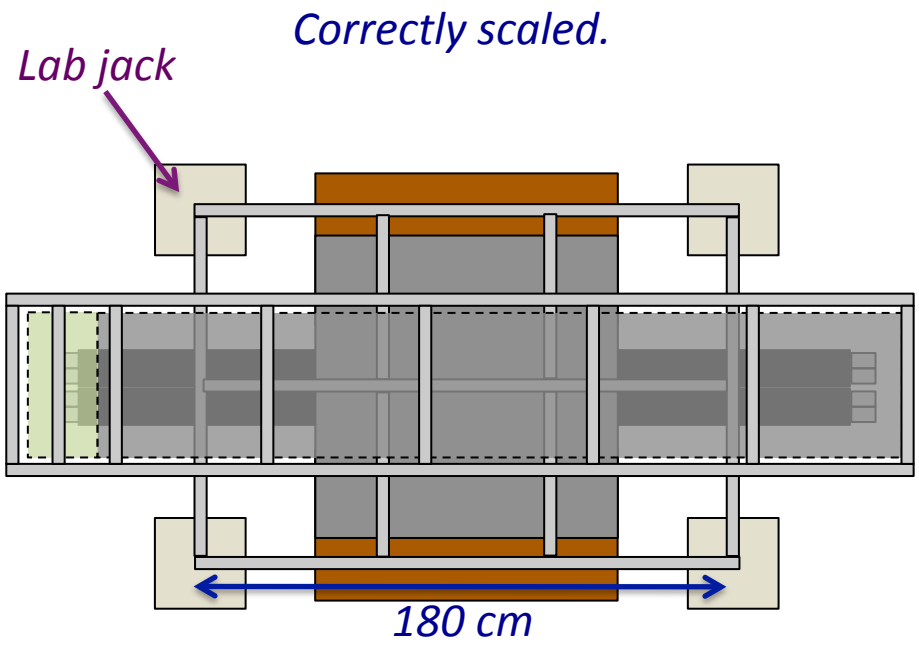
Consideration on the Sep. CRT test

- *To be used for the operational and CRT tests of the "LEPS prototype".*
  - *Less than 1 month running.*
  - *Need enough operational tests for the Oct. beam test.*
  - *For the Focused Review, even with a certain period CRT running, N_{hit} would be only the material to be presented.*
    - *β-selection would not be good enough to deliver a meaningful β-resolution.*

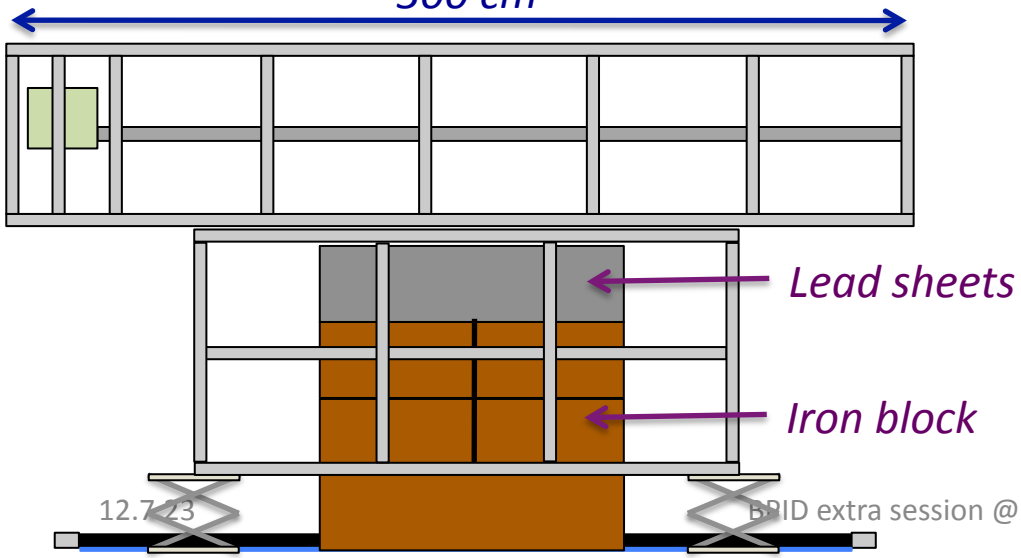
- *Realizing the above items ~~and using the lead sheets~~, we can build a simple CRT stand dedicated for the Sep. runs.*
  - *Suggested Hayakawa-san.*
  - *See Hayakawa-san's/Iijima-san's talk in this session for more details.*

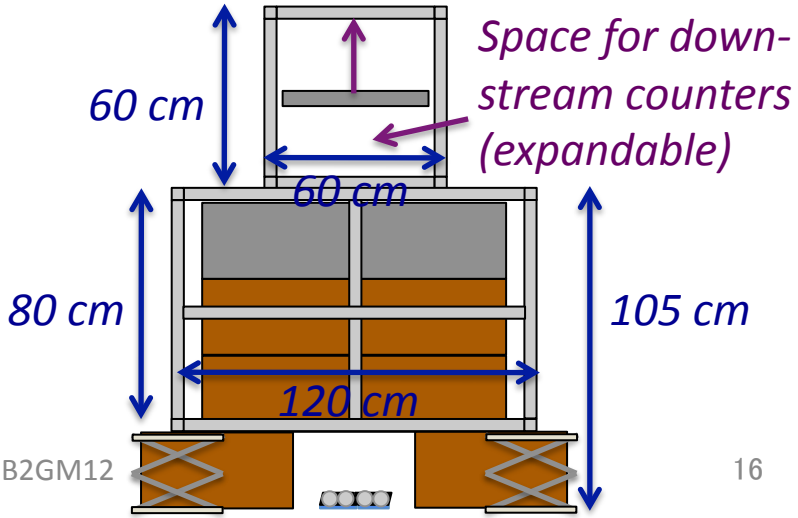


Further simplification of the CRT stand (1)

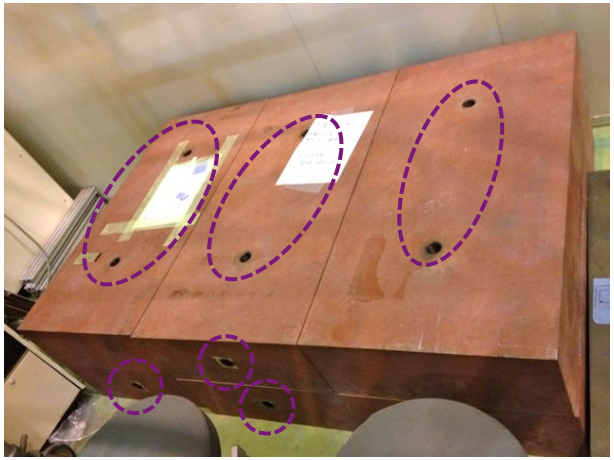


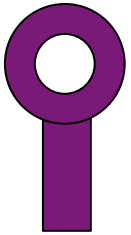
- *The range stack can be L100 x W100 x H~75 cm^3.*
  - *Using all the iron blocks and the lead sheets. (2 block for shim-up)*
  - ~~*Corresponding to H1.25 m of the iron range stack.*~~
- *We need to make an "Al-base".*
  - *Quick to assemble.*
  - *Easy access to a counter module.*
  - *Would cost ~50k yen.*



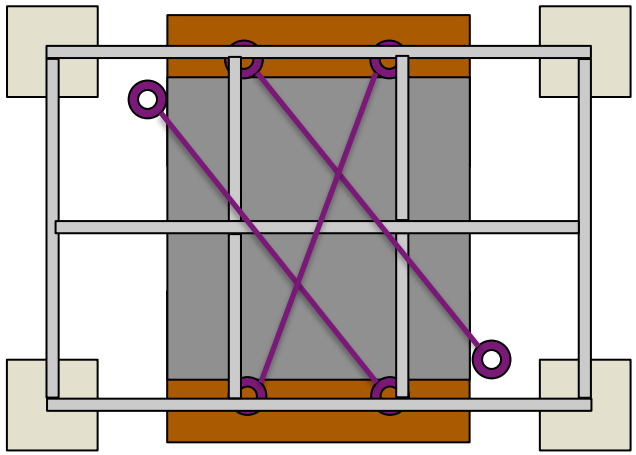


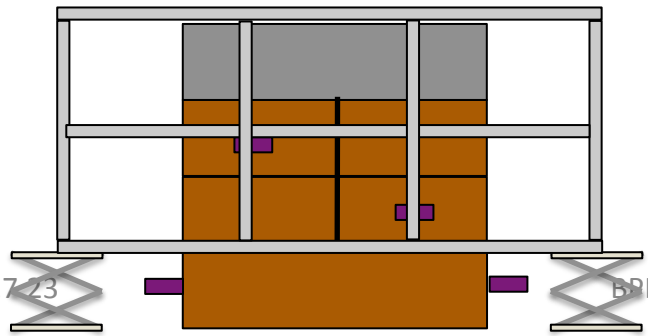
Further simplification of the CRT stand (2)

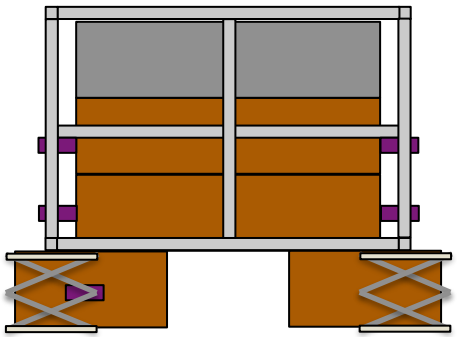




- *The sheets, blocks and Al-base can be tied together using eye-bolts and wires.*
  - *There are threaded holes at the top and one side of the iron blocks.*
- *We can use 6 more iron blocks.*
  - *Each is L100 x W50 x H50 cm^3.*
  - *Adachi-san kindly keeps them at the North Counter Hall.*
  - *Need experts' comments on how high the range stack can be for such a simple bench.*



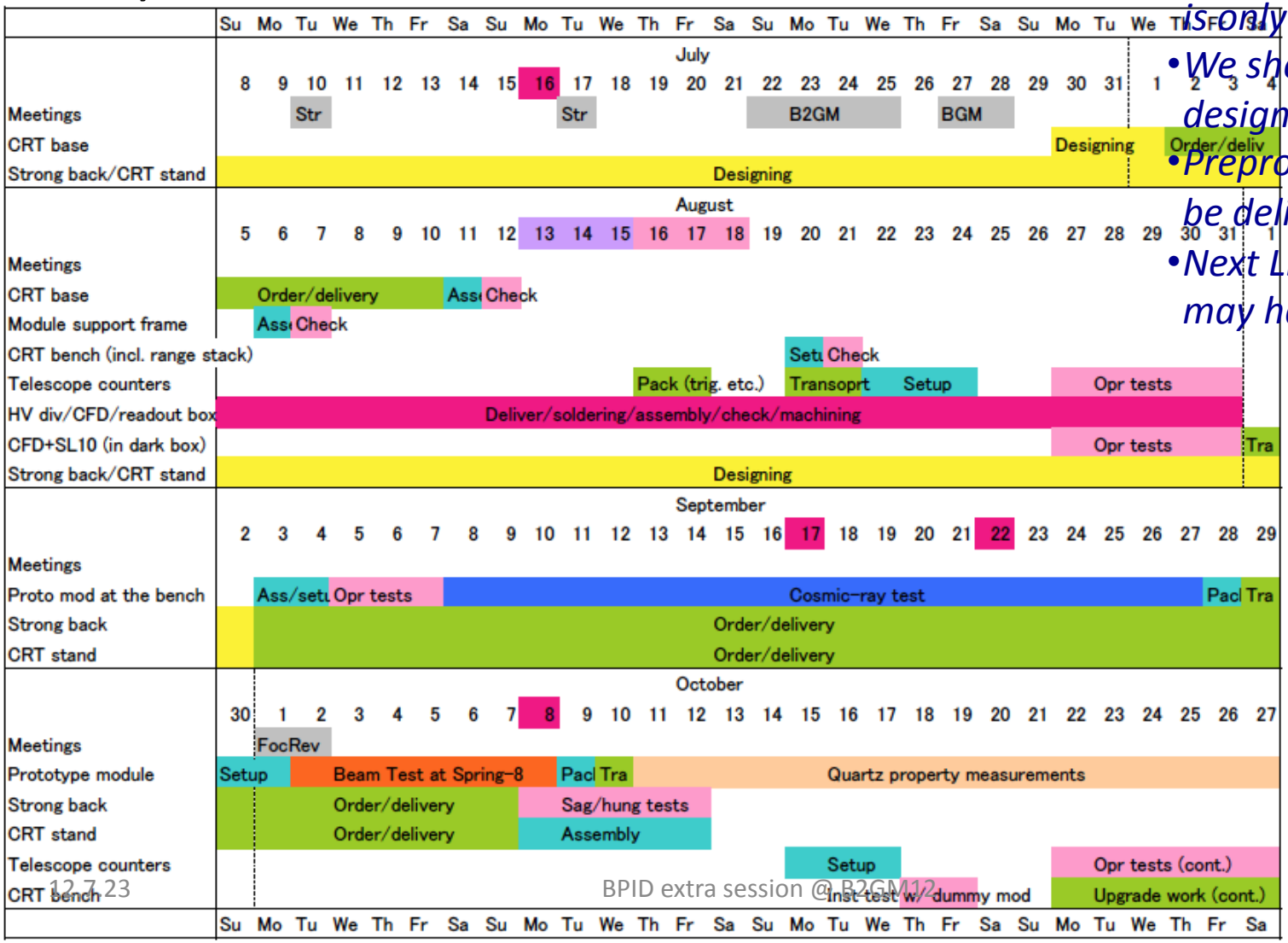




CRT assembly schedule – option B –

- *My proposal of the CRT assembly schedule ("option B") is shown below.*

Schedule Option B



- *Extension of designing is only ~1 month.*
- *We should realize the design in Oct.*
- *Preproduction bars will be delivered in Dec.*
- *Next LEPS beam test may happen in Dec.*

Summary

- *There are progresses on the CRT stand design.*
  - *Especially many people got involved seriously.*
  - *We should keep the activity level.*
- *There are, however, still various parameters, assembly method and operation scheme.*
  - *Need inputs form MC studies.*
  - *Need to discuss the possible conditions, e.g. incident positions, to take CR data.*
  - *Need to decide the base line configuration and possible extensions on the CRT test bench.*
  - *Iterate designing examining using FEM.*
- *Having a simple, temporary CRT bench can be considered for the Sep. CRT runs.*
  - *Giving ~1 month to finalize the CRT stand design based on careful considerations/discussions on the long-term CRT tests.*