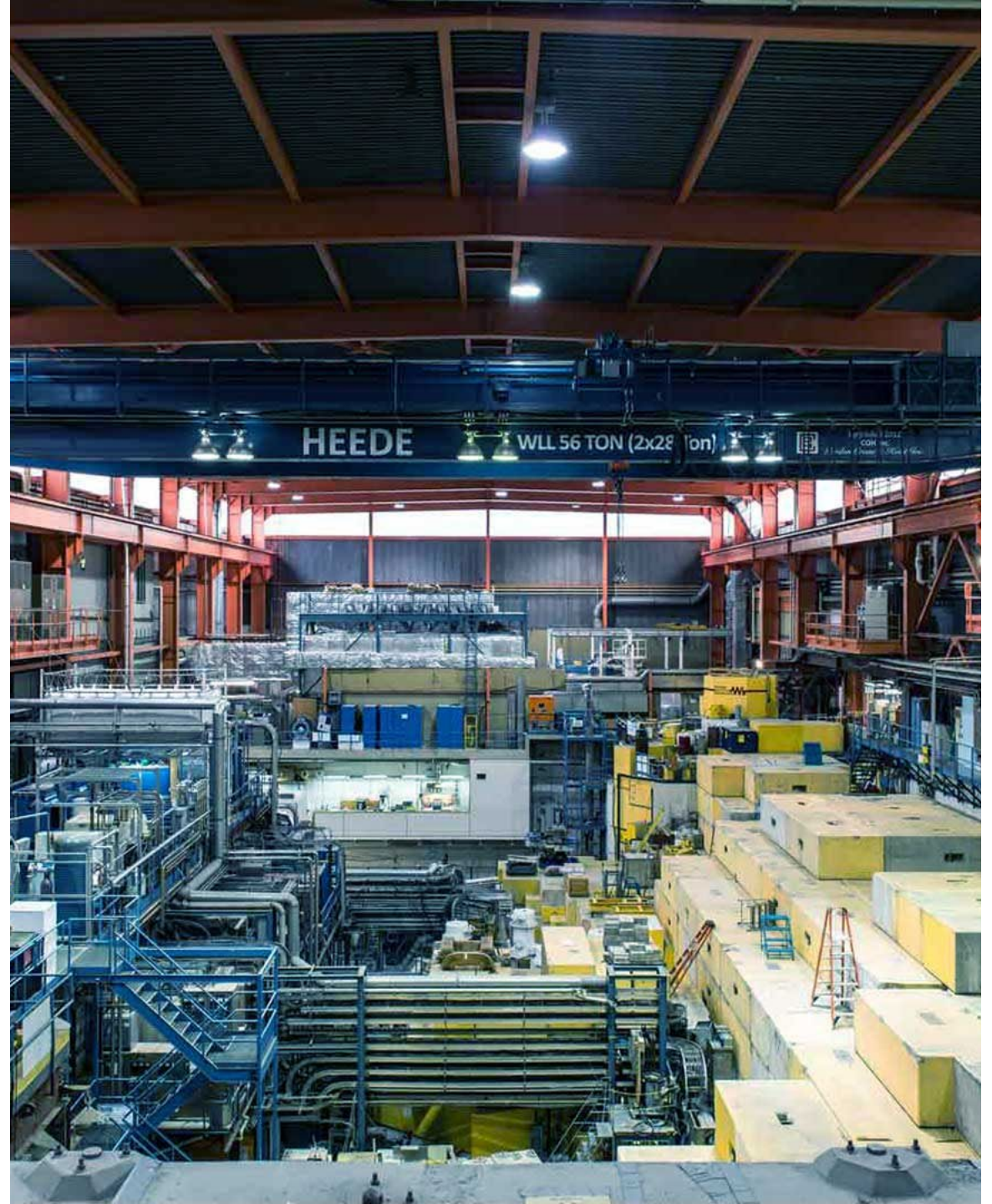


BL1A Update Science Week July 28, 2025

Syd Kreitzman

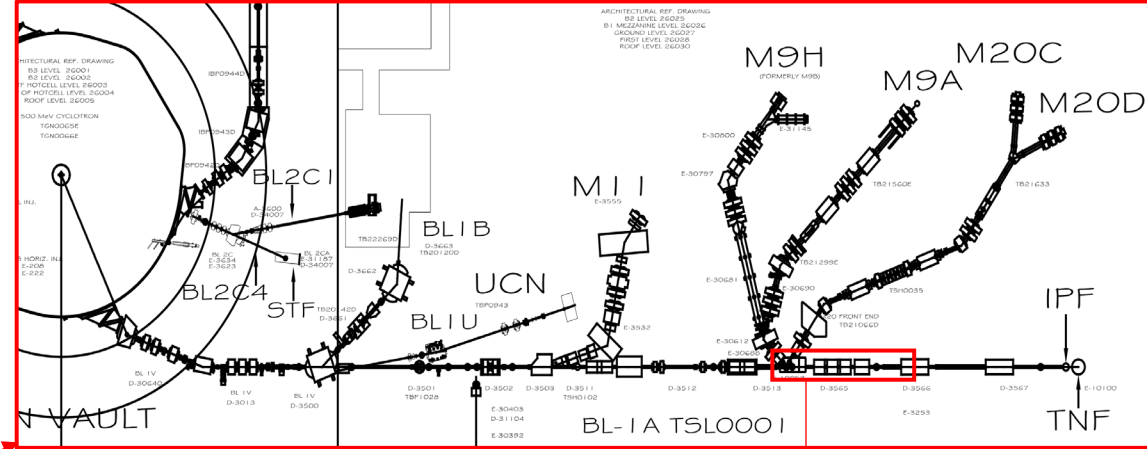
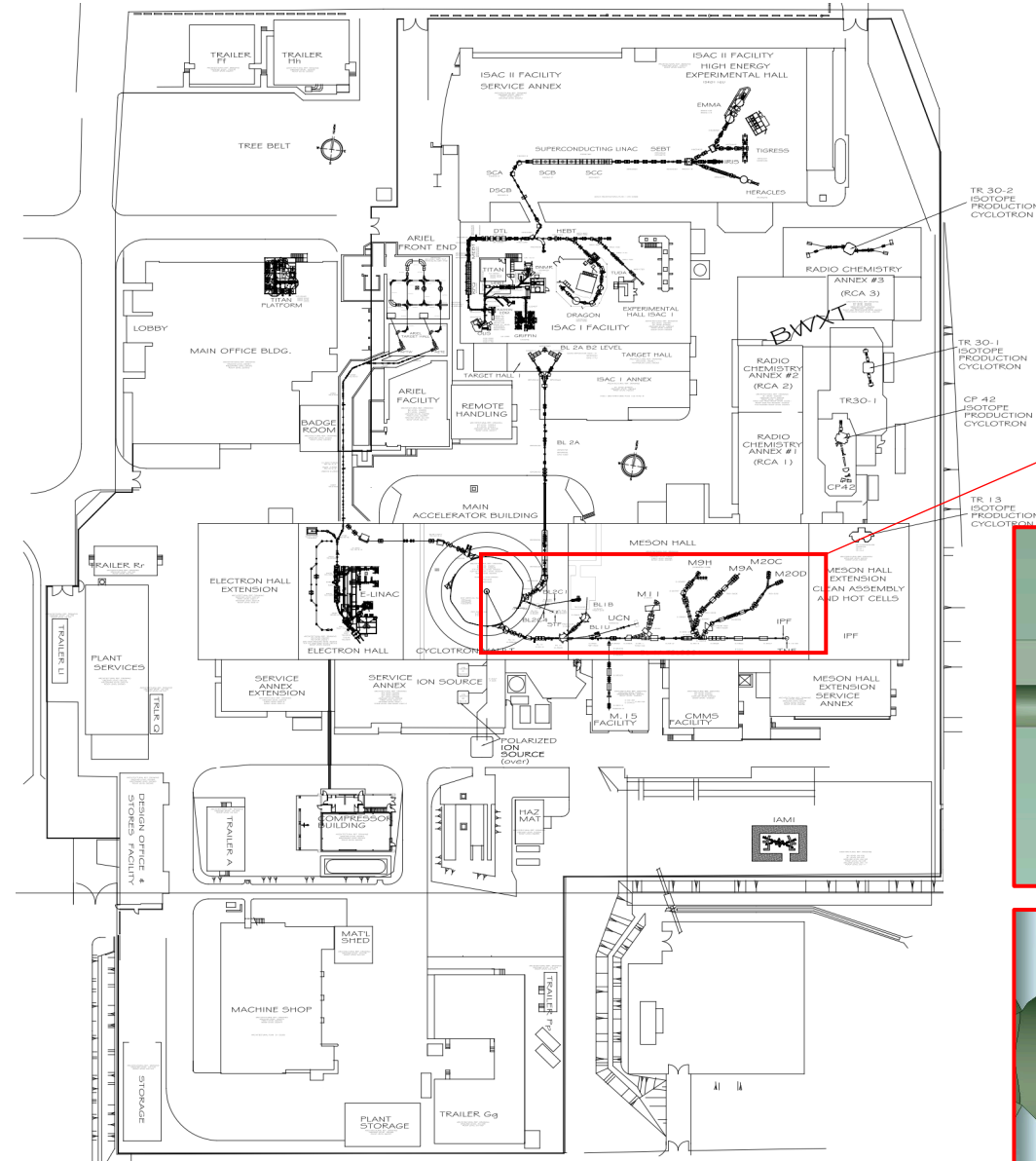
Physical Sciences Division

2025-08-05

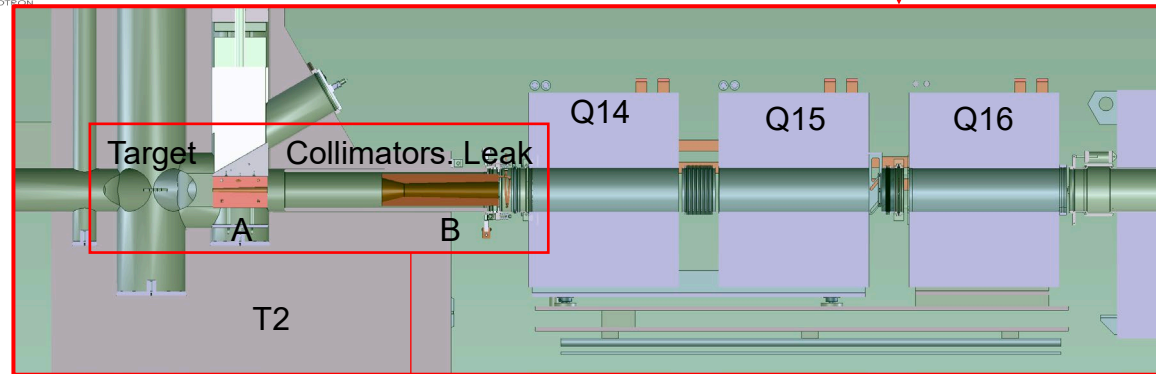


What is BL1A?

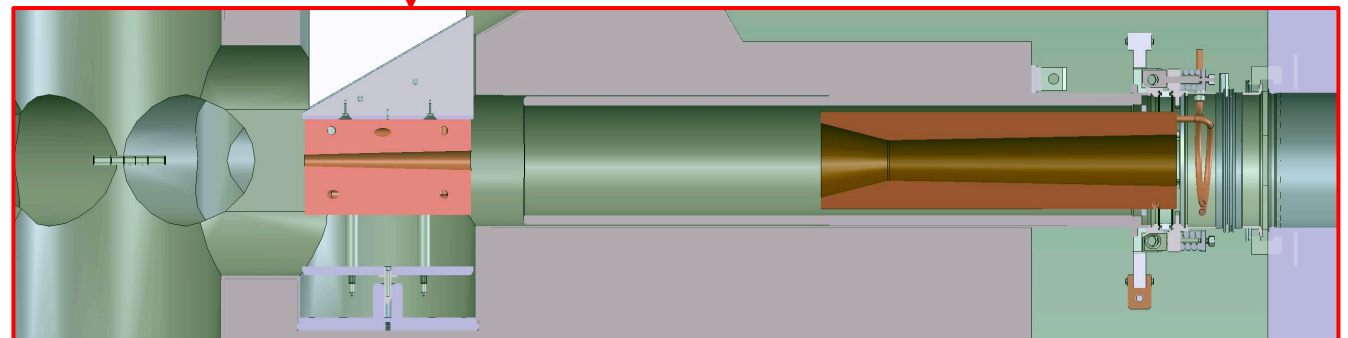
2



and what is the BL1A Project 560 about ?



- 1) Q14-15-16 triplet
- 2) Collimator leak
- 3) Alignments



Models on right via good offices of Keith. C. Ng

Why is BL1A ?.. (why is TRIUMF?*)

Experiment 243
Energy and angle dependence of the
 ${}^6\text{Li}(\pi^+, {}^3\text{He}){}^3\text{He}$ reaction
(G. Lolos, Regina)

In order to determine the angular dependence of $d\sigma/d\Omega$ for pion-induced fission of lithium, i.e. $\pi^+ + {}^6\text{Li} \rightarrow {}^3\text{He} + {}^3\text{He}$ Expt. 243 was proposed.

Fig. 45. World data on the ${}^6\text{Li}(\pi^+, {}^3\text{He}){}^3\text{He}$ reaction as a function of T_{π^+} (for: \blacktriangle -ORSAY, \triangle -LAMPF, \bullet -TRIUMF and \blacksquare -Saclay. Solid line is $d\sigma/d\Omega$ calculated in the (KDH) model while dotted line is for the (GW) model.

PARTICLE PHYSICS

Experiment 248
A study of the $\pi^+ \rightarrow e^+ \nu_e$ decay
(T. Numao, TRIUMF/Victoria)

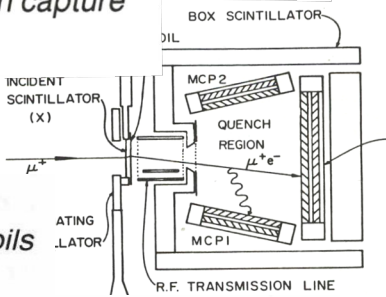
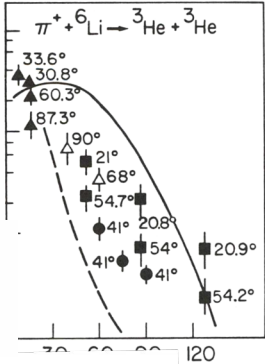
Experiment 47
Photon asymmetry in radiative muon capture
(M. Hasinoff, UBC)

Fundamental Physics

Experiment 168
2S muonium production from thin foils
(C. Oram, TRIUMF)

This year has seen the successful completion of this experiment by having measured the Lamb shift in muonium to be $1070 \pm 12 / -15$ MHz. The theoretical value is 1047.03 MHz.

*When Pierre Trudeau commissioned the TRIUMF cyclotron in 1976, the then-prime minister quipped: "I don't really know what a cyclotron is, but I am certainly very happy Canada has one."



500 MeV RADIOISOTOPE PRODUCTION

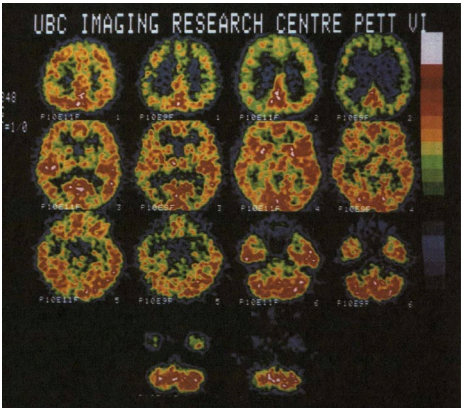
Proton irradiation facility for solids

The year 1984 was the fifth year of operation for the 500 MeV isotope production facility. The facility performed without failures and received 172 mAh, which is 21% more than in 1983. The use of the facility is illustrated in the following:

Year	mAh to facility	Targets irradiated	Targets delivered to AECL
1980	51	40	26
1981	56	53	38
1982	120	49	42
1983	142	70	74
1984	172	82	57

The following is a breakdown of the kind of radioisotopes produced in 1984:

Target material	Isotope	Number of targets irradiated	Number of targets delivered to AECL
CsCl	${}^{127}\text{Xe}$	73	49
In	${}^{109}\text{Cd}$	8	8
As	${}^{68}\text{Ge}$	1	0



Experiment 191
Muons and muonium on surfaces
(J. Brewer, UBC)

Muonium relaxation on silica surfaces

Our investigation of muonium absorption, trapping and diffusion on the surfaces of 7 nm silica powder grains has been intensified, with several interesting results.

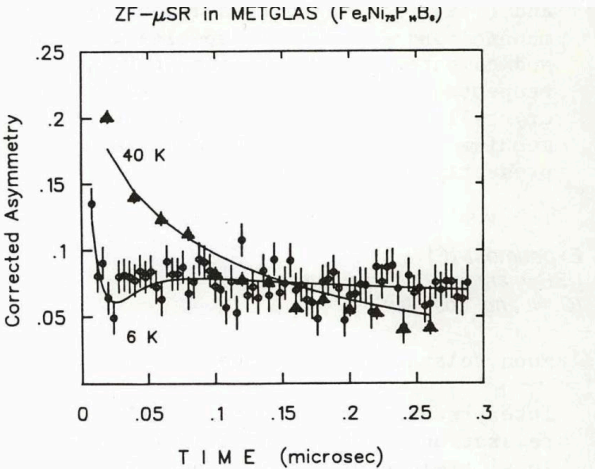


Fig. 66. Spin-glass relaxation in "Metglas".

RESEARCH IN CHEMISTRY AND SOLID-STATE PHYSICS

Experiment 140
Transfer effects for stopping π^- in $\text{H}_2\text{-D}_2$ mixtures
(D. Measday, UBC)

The results from Expt. 140 were published this year [Aniol et al. in Phys. Rev. A 28, 2684 (1983)]. In this work we investigated the influence of molecular structure on the nuclear capture probability of stopped negative pions in gaseous hydrogen isotopes.

What is wrong with BL1A ?

- The triplets do not cool properly due to the toxic mix of Radiation + Cu ions + Water + O₂ which results, over time, in clogging
 → they are marginally functional now, even with high pressure water flow
- the T2 plinth is tilted ... as it has been sitting amongst hygroscopic concrete blocks ... and over the years of leaks and hard knocks the concrete, now highly radioactive, has “crumbled”
 → causing a leak to manifest itself at the monument exit flange
 → it is difficult to tune the beamline into the TNF and IPF, and avoid excessive spills into the protect monitors.

WHITE
BLOCK “A”

WHITE
BLOCK “B”

PSI Center for Accelerator Science and Engineering Clogged Accelerator Magnets due to Metal Oxides as a Result of Oxygen and Carbon Dioxide in Distilled Water

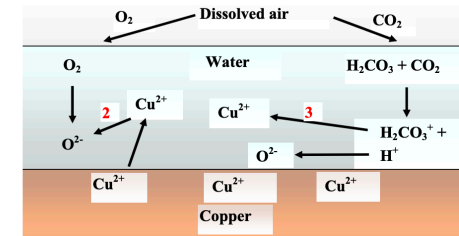
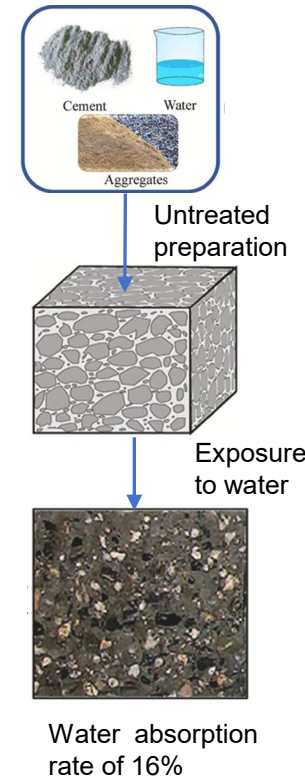
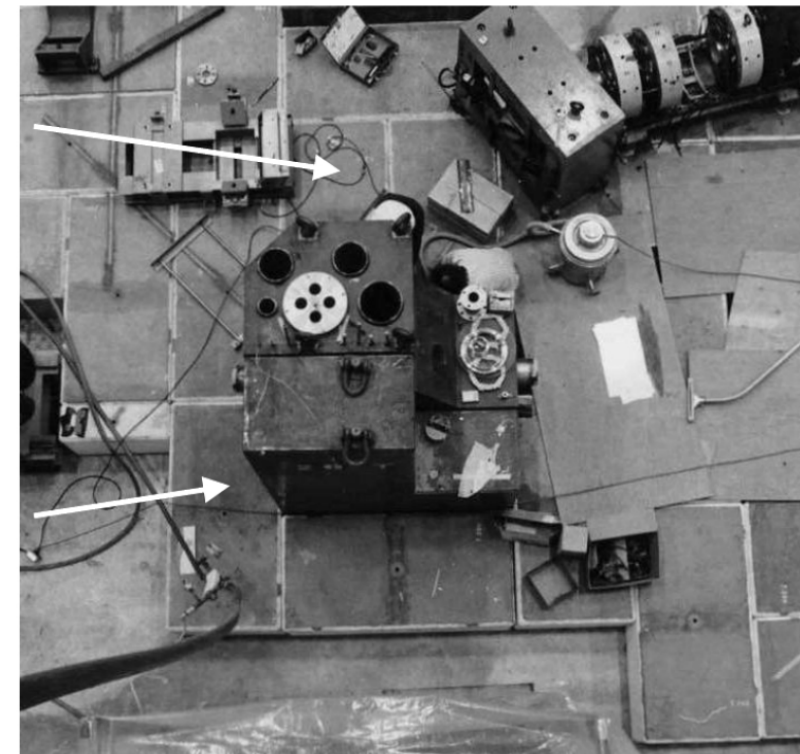


Fig. 1: Corrosion mechanism at a copper surface due to dissolved O₂ and CO₂ in the cooling water.



Fig. 4: Filtered deposits of various copper oxides flushed out of QWB8, the last quadrupole magnet in the injection beam line. The pore size of the filter is 12 μm. The dry weight of the residuum amounts to 0.72 g.



Behold the Crumbling Blocks

5

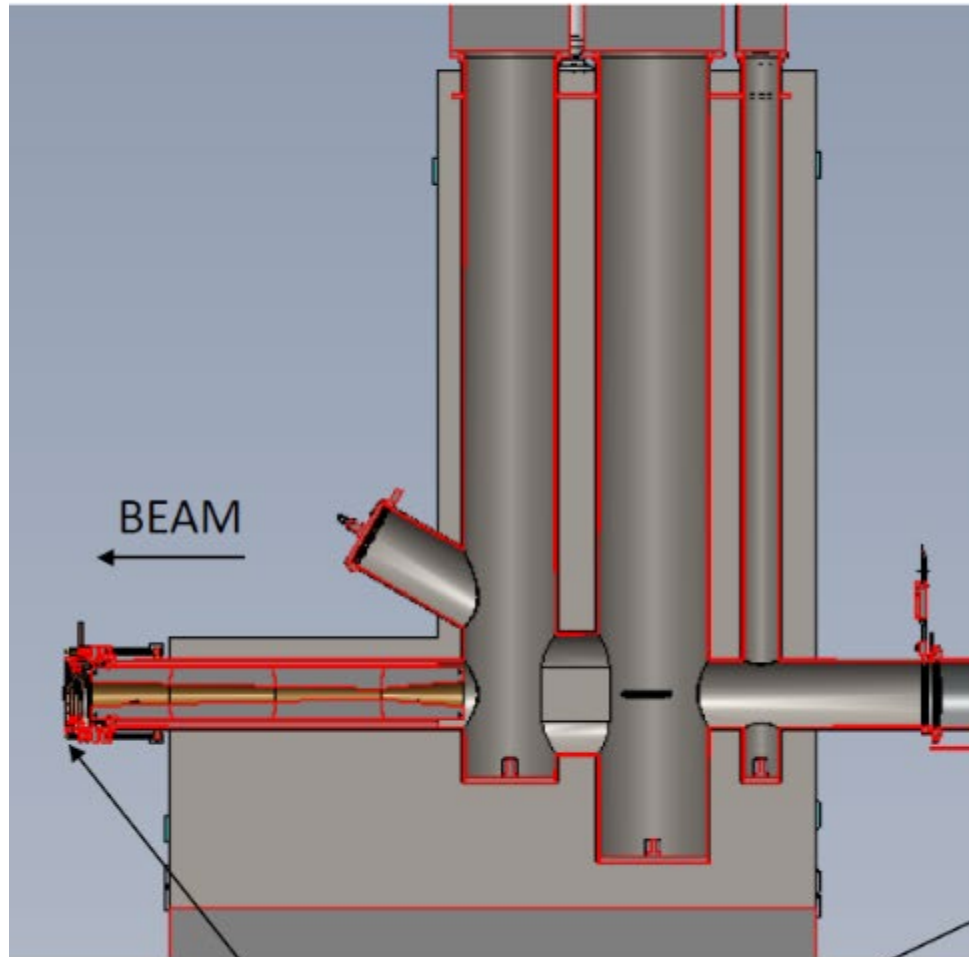


1AT2 Monument Support Block
South Side

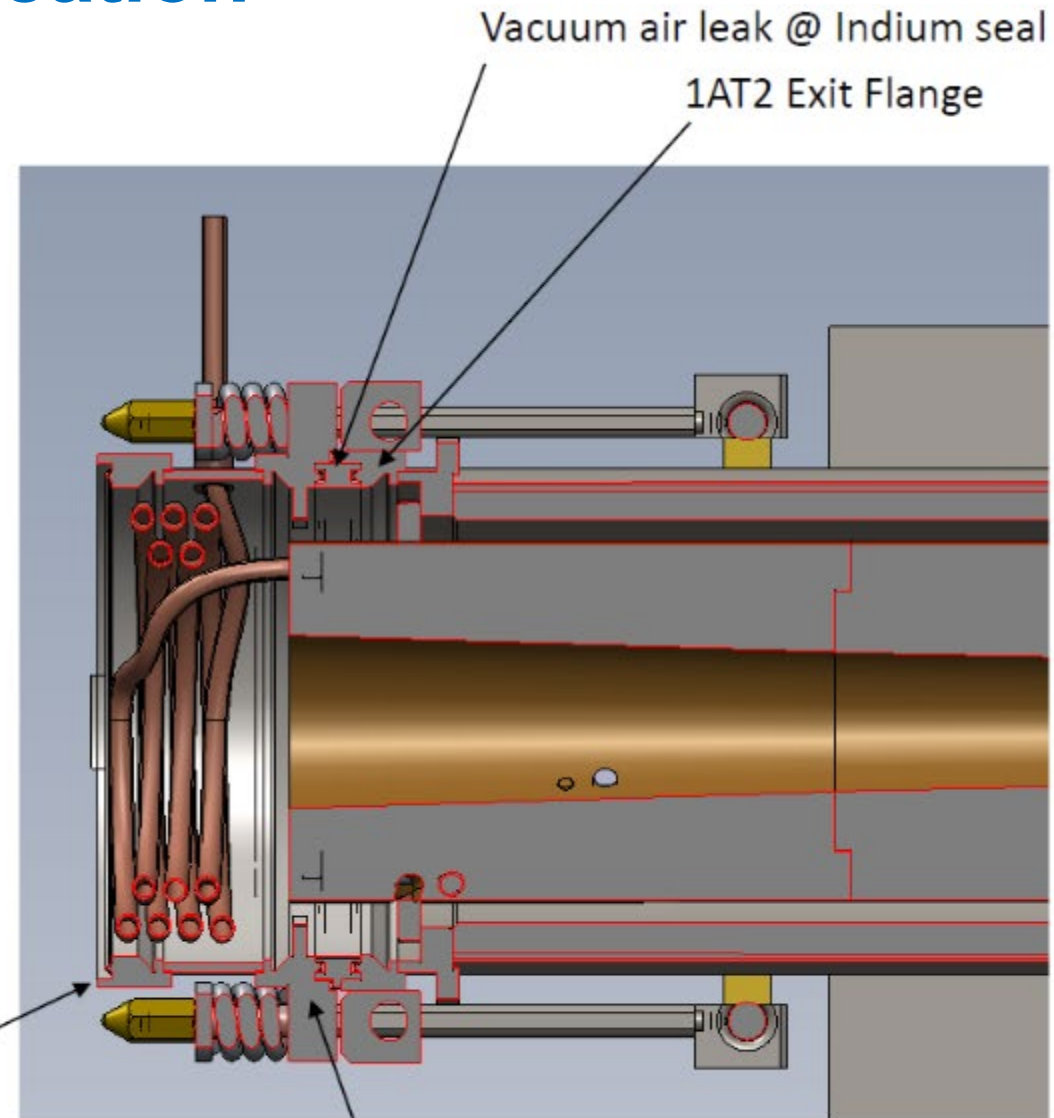
Taken During the 2003 Winter Shutdown
1AT2 Water Package Support Block Replacement

The Collimator Leak Location*

* good offices of Keith. C. Ng



Downstream Collimator Flange



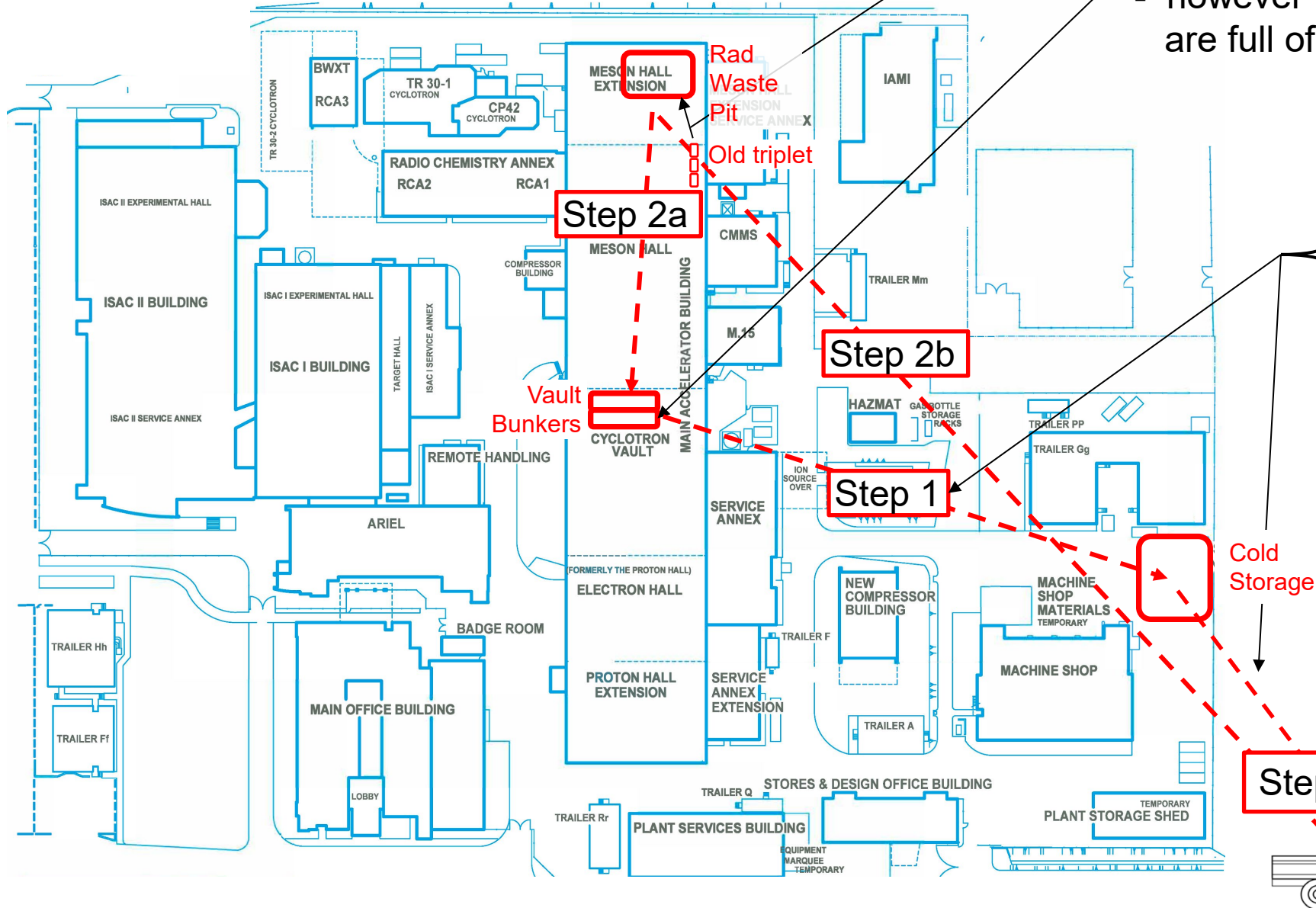
Up-stream Collimator Flange
fixed to Collimator B

The Solutions

- Replace the quads with better quads
 - i.e. ones that avoid the Cu-Water chemistry problem
 - ones that have higher optical strengths and more steering capabilities
- Fix the collimator flange leak
 - take out the old one remotely (it is screamingly hot ... as in radio-isotope activated)
 - put in a new, better designed one i.e. with a bellows to accommodate present and future misalignments
- Adjust the positions of the collimators to compensate the T2 tilts
 - Measure the alignment offsets of; T2 protect monitor, target axis, and collimators A & B
 - From this data calculate the best offsets for T2 protect monitor (fully adjustable), CollB (one time adjustment), CollA (probably a one time adjustment) to “best align” everything with the beam axis
- None of this happens without finding space to store the “triplet” rad waste

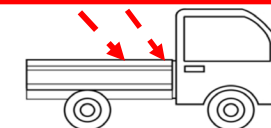
Old Triplet Waste Handling 2-step Shuffle*

The problem: Need to store triplet in rad waste pit
... but there is no room in it now.
- however ... two bunkers on the vault roof
are full of low activity steel ... so



- **Step1:** Expose one bunker move steel to cold storage, assay, and ship out
- Expose the other bunker move steel to cold storage, assay, and ship out ...
finished by end of Sept
- **Step2:** Start taking stuff out of rad waste pit, assay & either ship or store in previous bunkers. Continue with that process until enough space is available for the triplet
- **Step 3:** Solve “The problem”

... *dance routine
choreographed by Danka
Krsmanovic



Better Rad Hard Quads ... design idea has been around a long time

Fig. 1. Square, solid-conductor, m.i. cables.

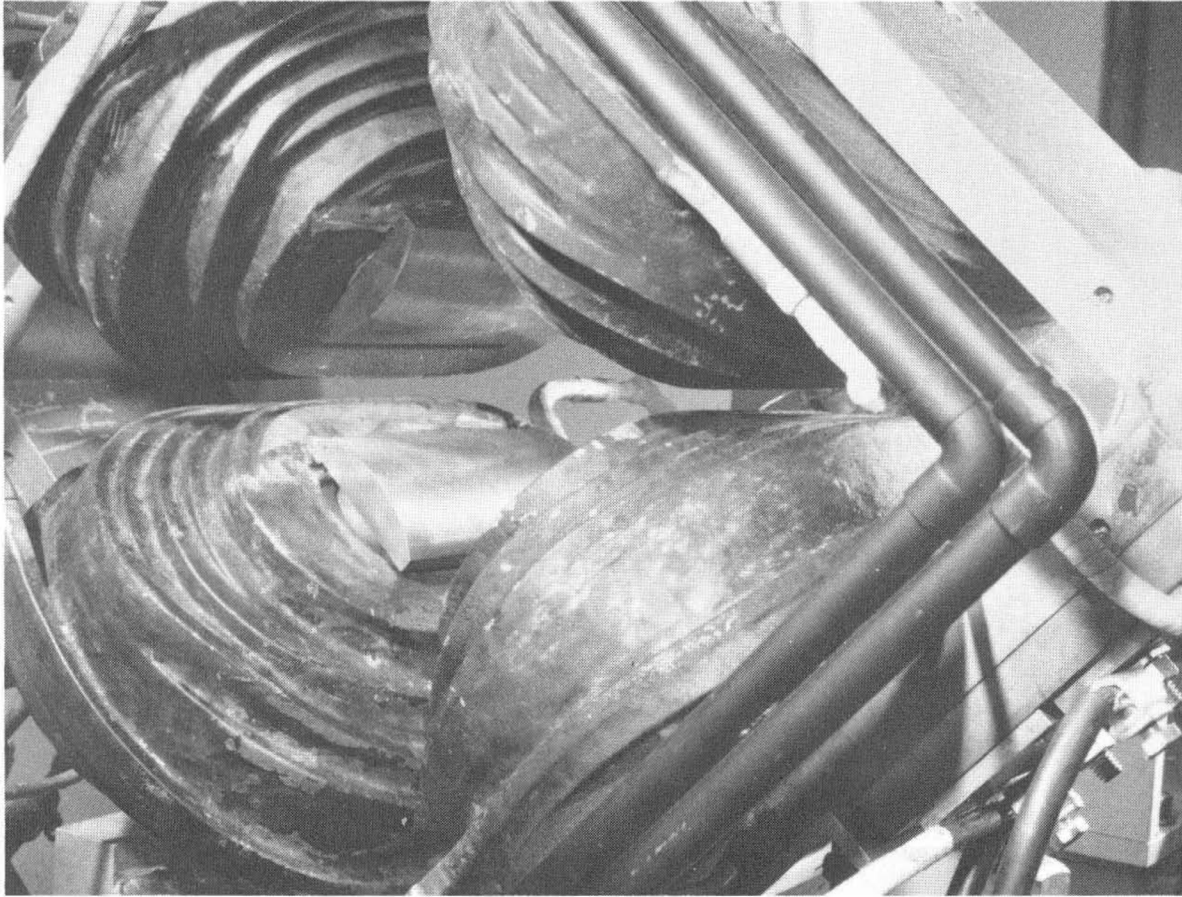
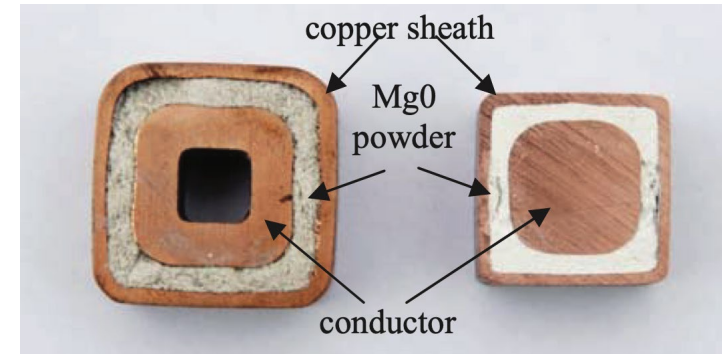


Fig. 2. 4-in. bore quadrupole wound with solid conductor, m.i. cable, externally cooled.

Proceedings of the 1970 Proton Linear Accelerator Conference,
Batavia, Illinois, USA

MINERAL-INSULATED CONDUCTORS FOR MAGNET COILS

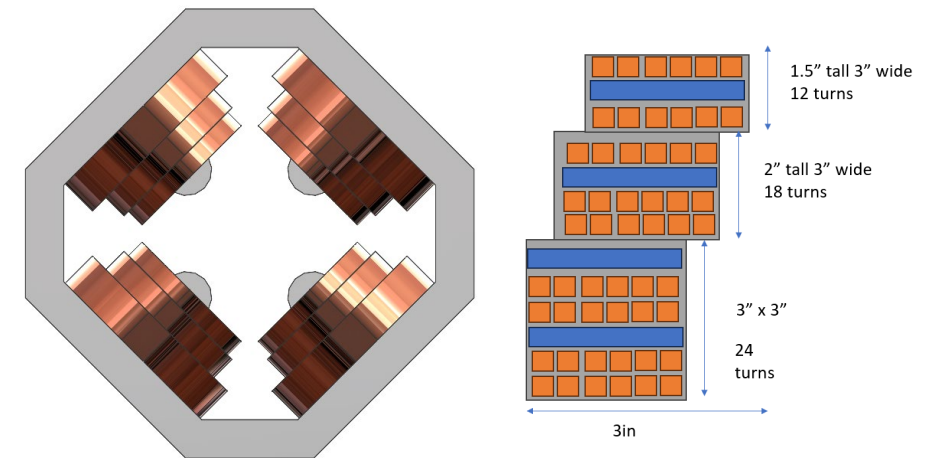
A. Harvey Los Alamos Scientific Laboratory Los Alamos New Mexico 87544



Two types of mineral (MI) insulated cables:

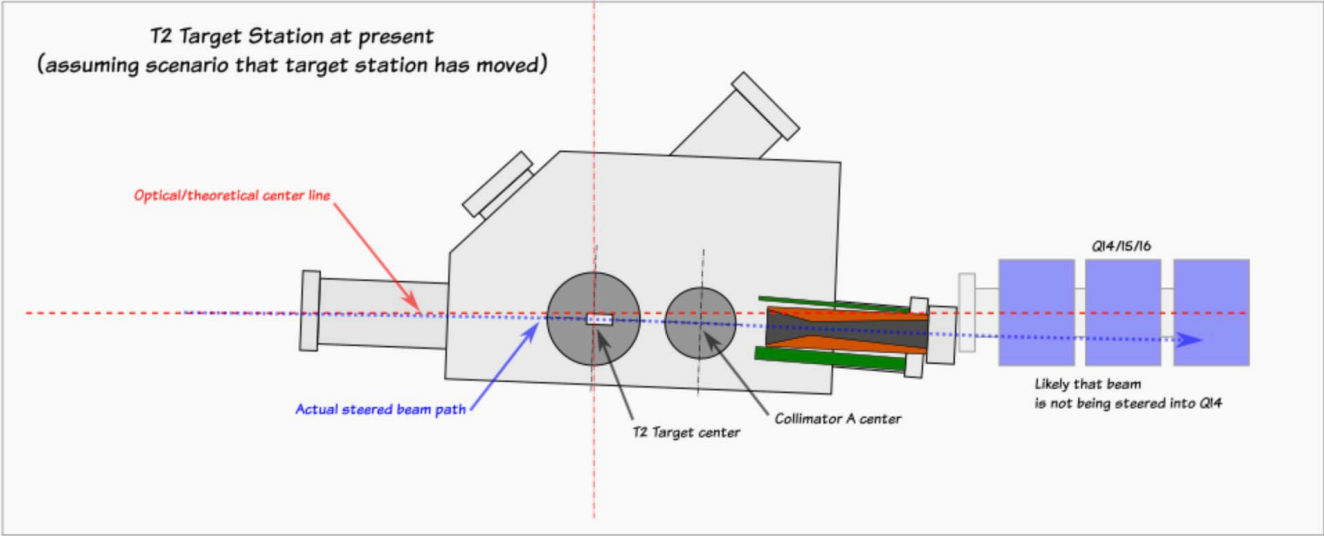
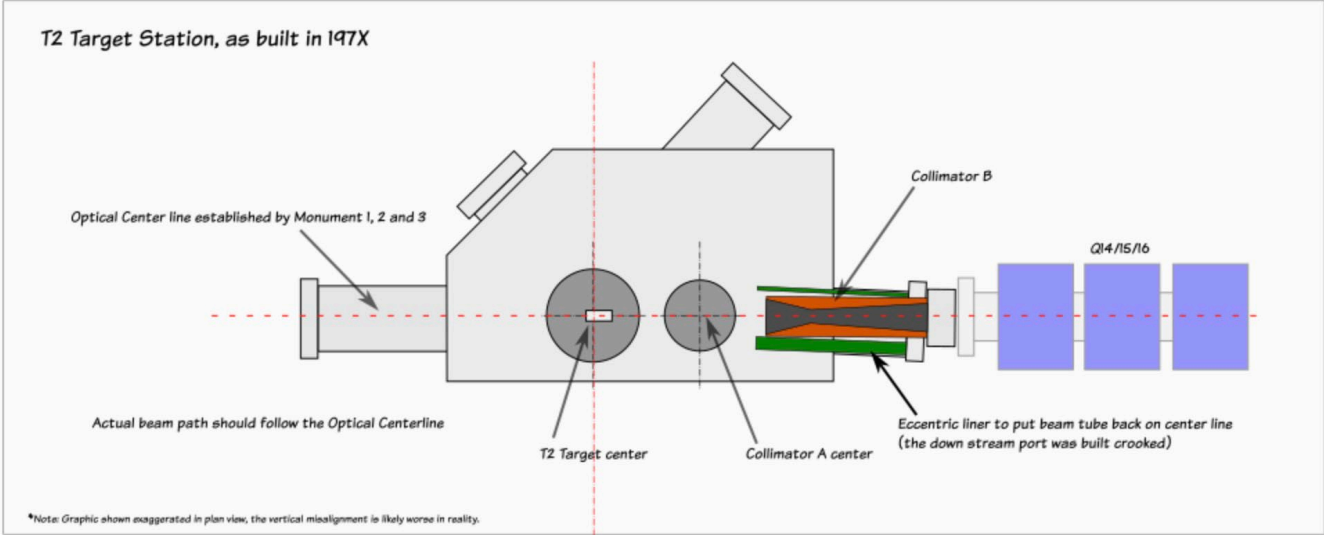
Left: Used in current Q14-16, subject to clogging in a high radiation environment

Right: Will be used in the new quads



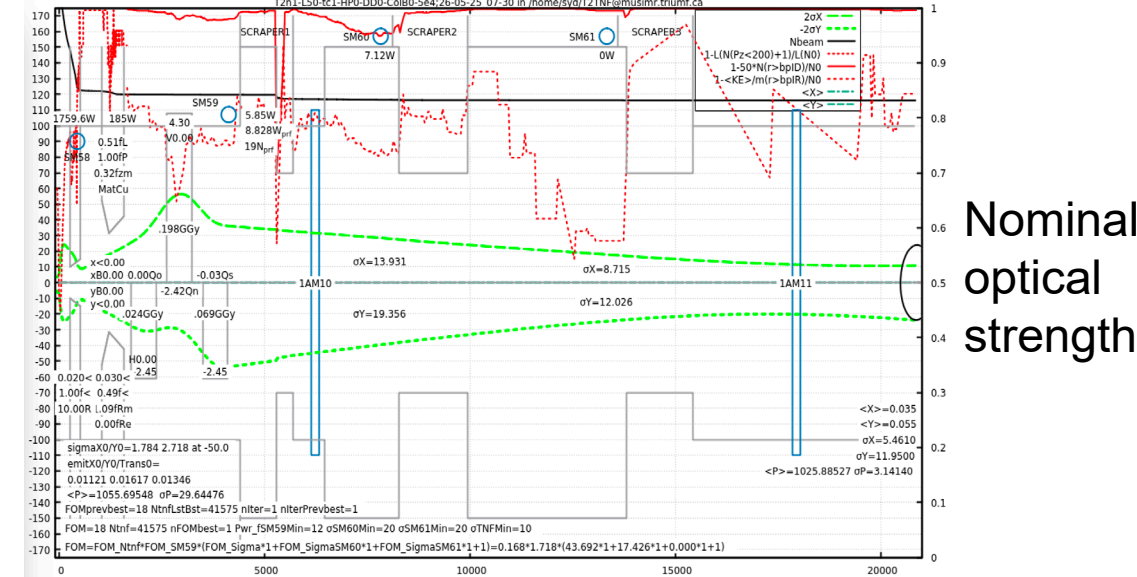
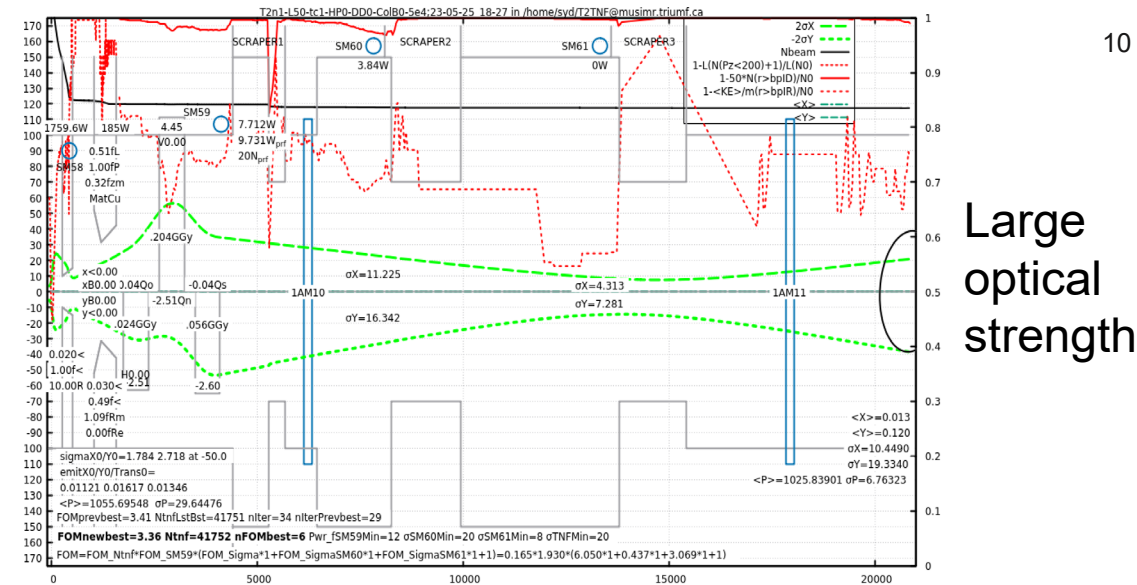
Initial coil design thoughts via. Claire Pierce

The effects of a tilted T2* ... & what to do about it if the alignment goes awry in the future



*models above from the good offices of Keith. C. Ng

→ Make sure there is enough “optical strength” in the quads to steer effectively

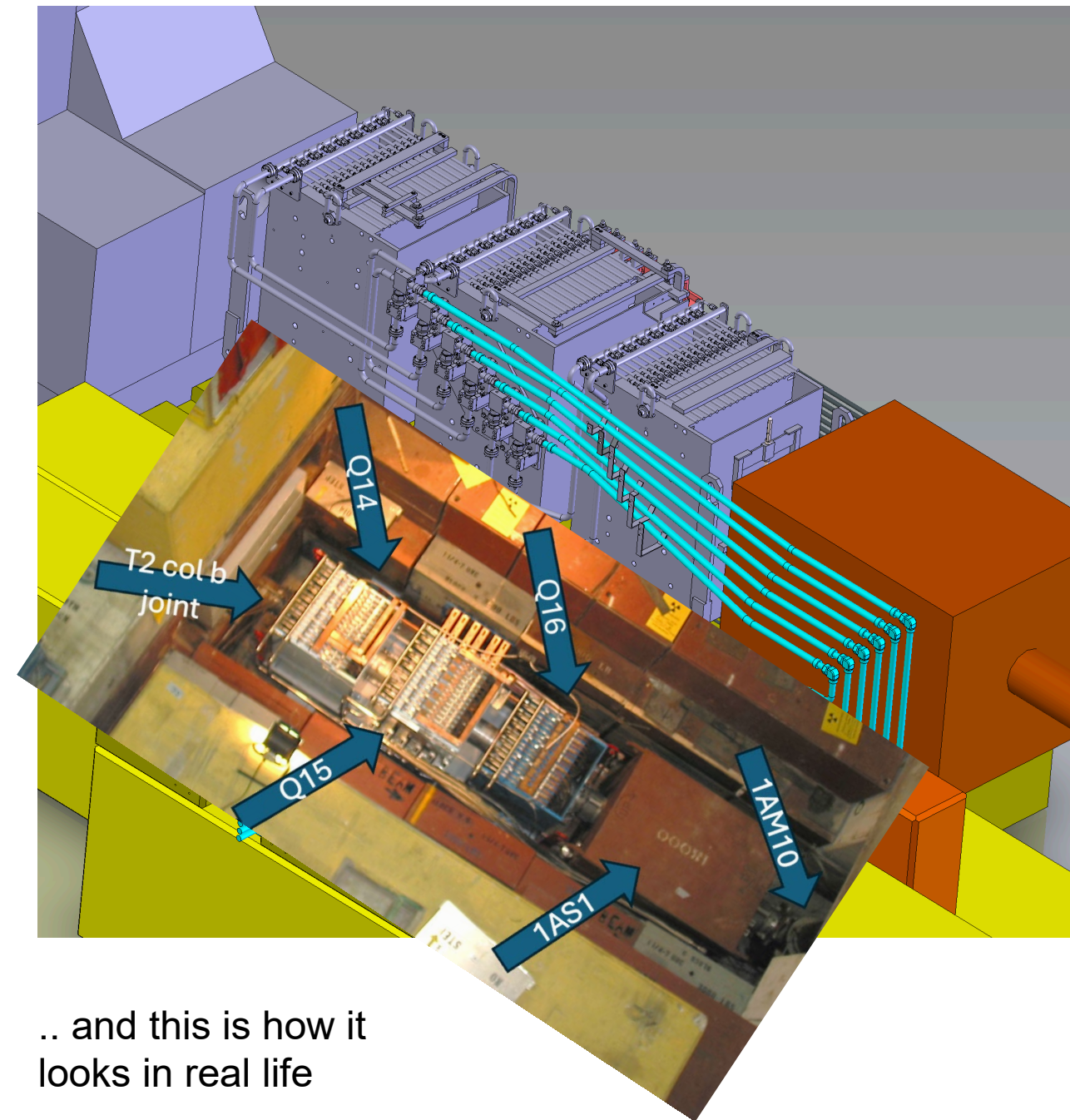


Large optical strength

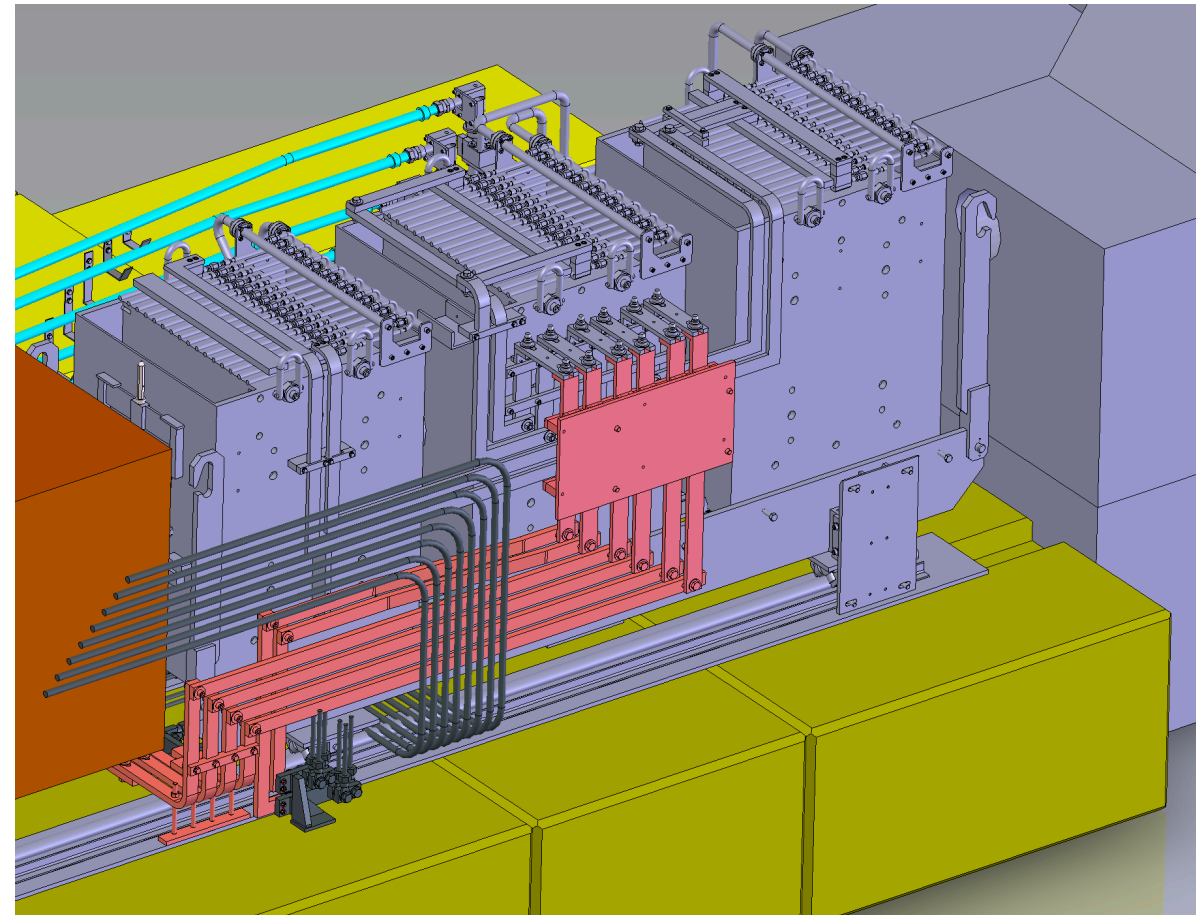
Nominal optical strength

2003 Triplet Replacement Design Service Connections will be substantially maintained

11



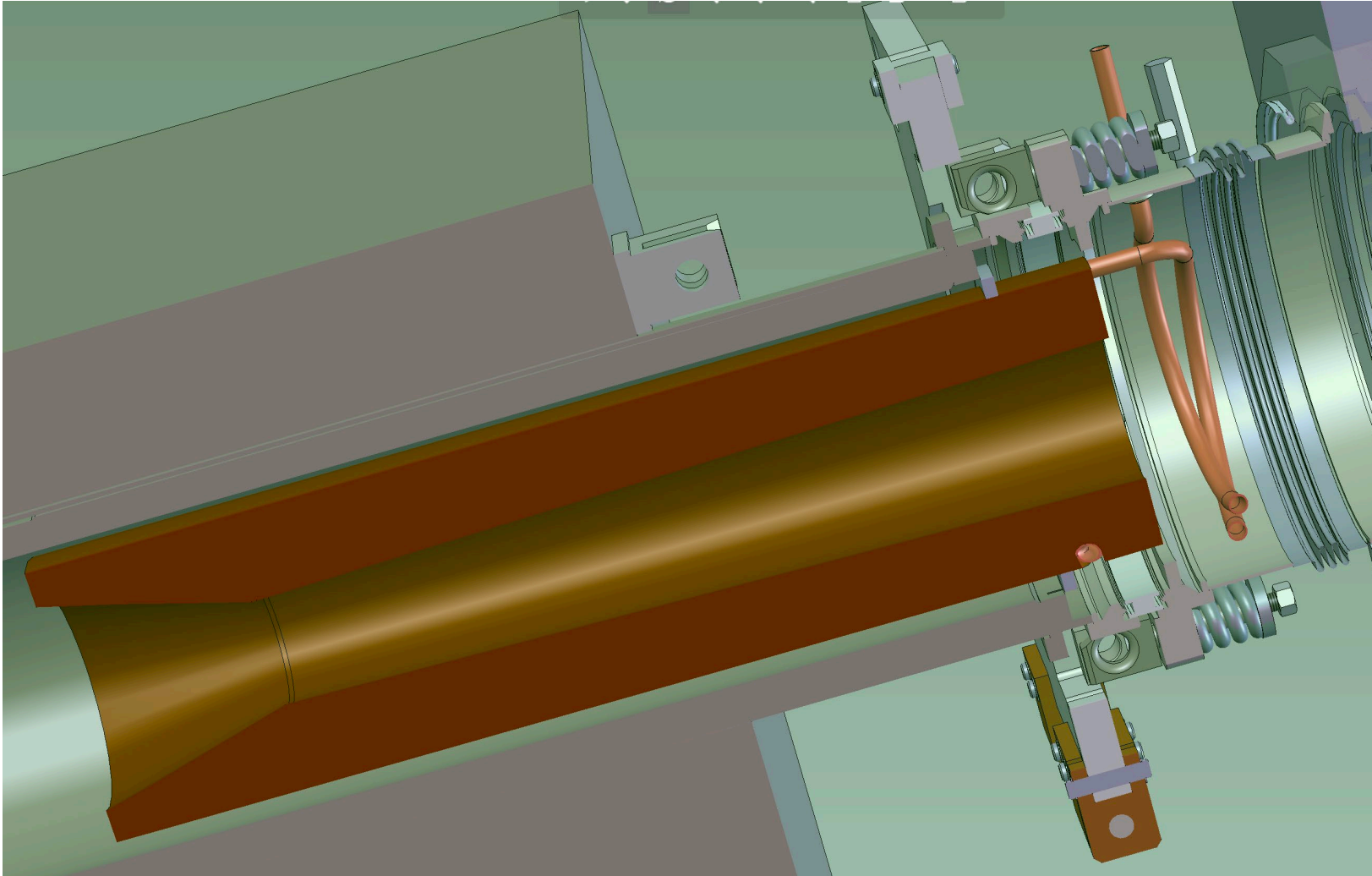
.. and this is how it
looks in real life



Shorten Collimator B and augment its Flange with a Bellows

... so it does a better job and won't leak if T2 moves again

12



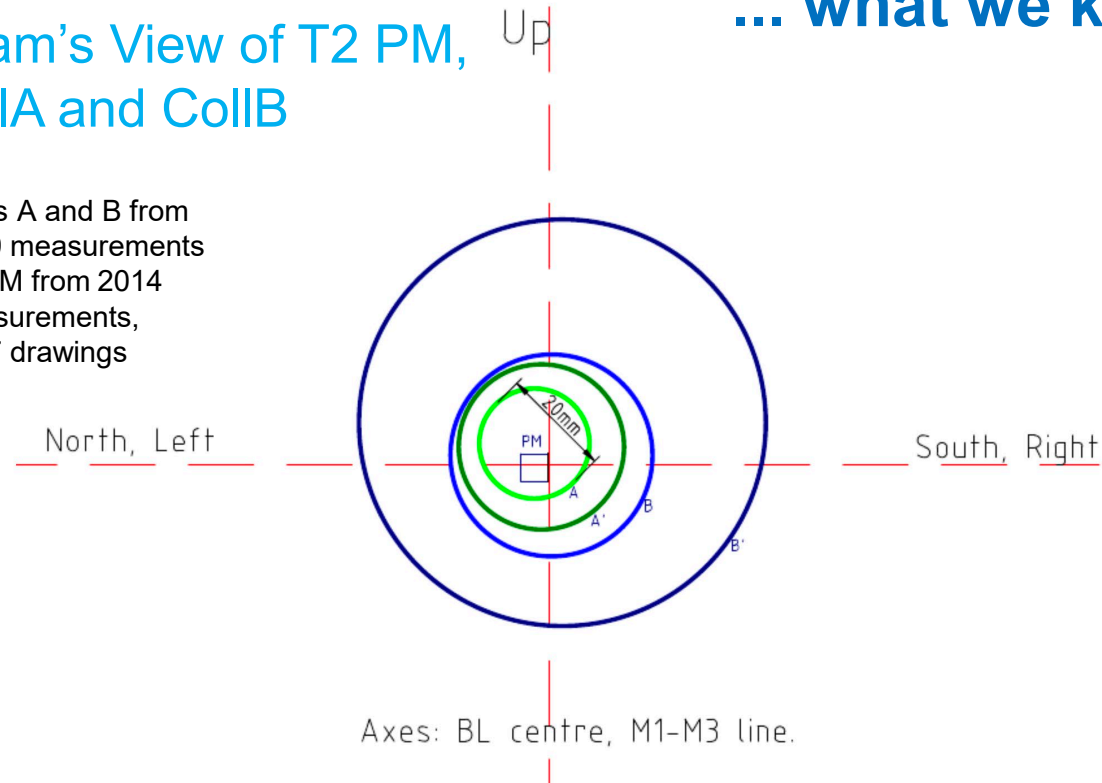
* good offices of Lige Zhang and Remote Handling Folks

Measure the Alignments, and re-align to the best degree possible, ... what we know today*

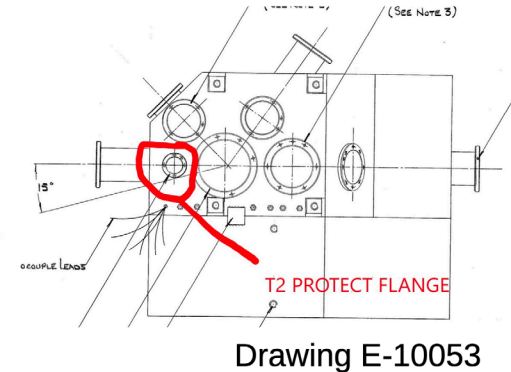
13

Beam's View of T2 PM, CollA and CollB

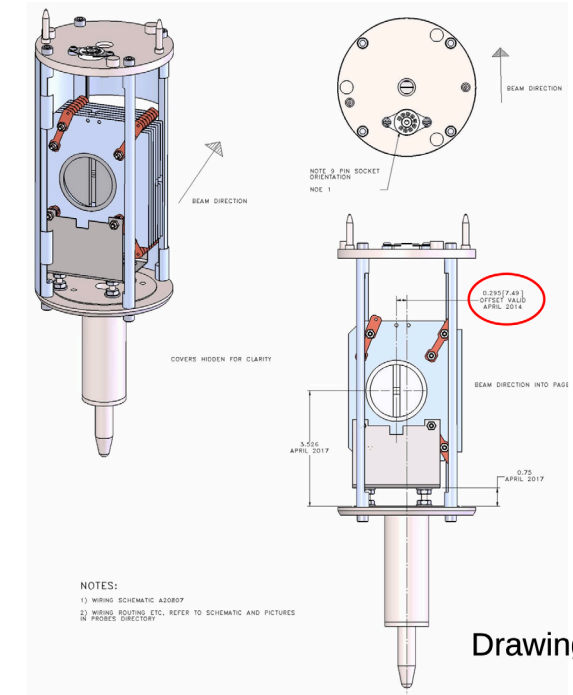
Coll's A and B from
2009 measurements
T2 PM from 2014
measurements,
2017 drawings



T2 Protect Monitor



5 x 5mm aperture is offset
7.49mm to North wrt alignment
pin & receptacle.



- Items which are easier to align:
 - Target height
 - T2 protect monitor
 - Target position
 - CollB position and orientation, since it must be rebuilt anyway

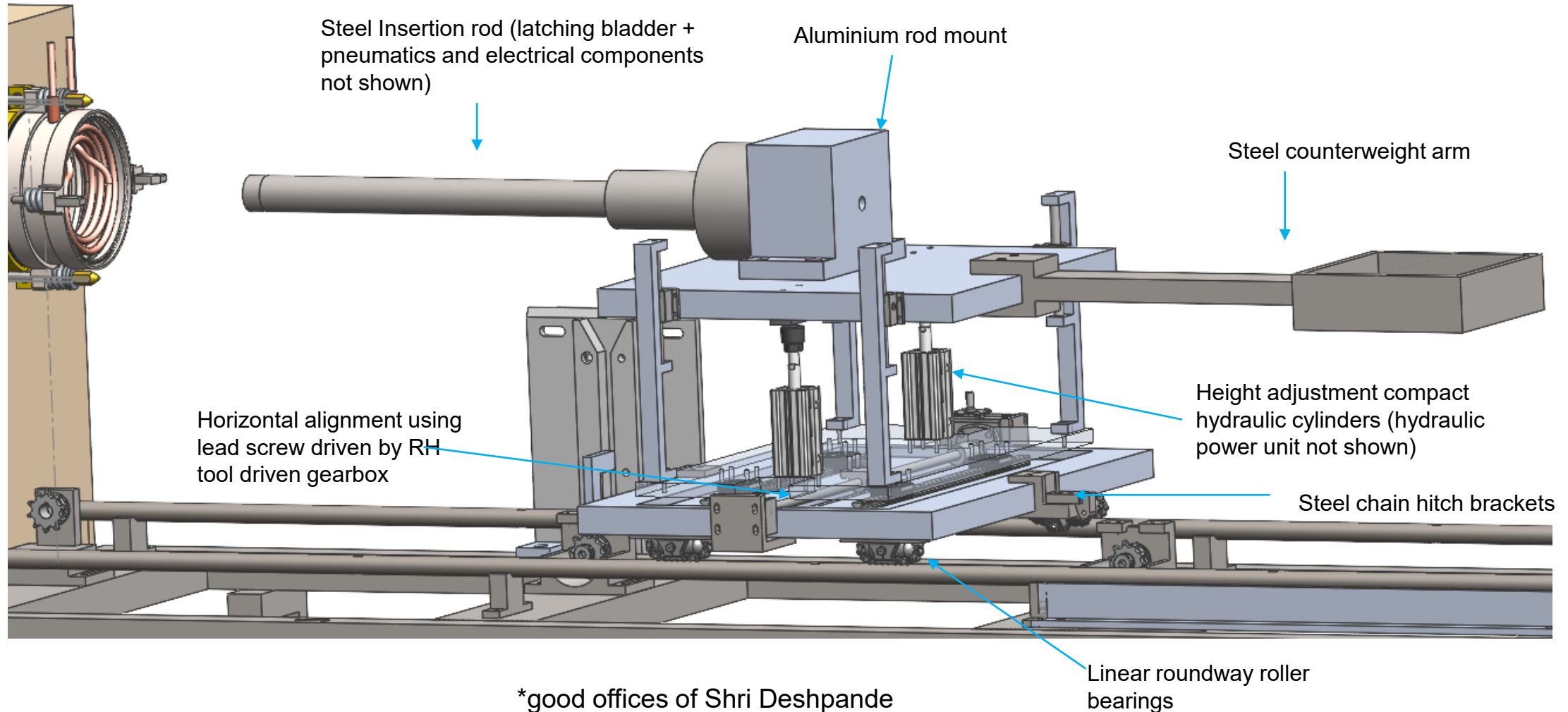
- Items which are harder to align:
 - CollA orientation (if not rebuilt)
 - CollA height

*good offices of Gerald Morris

Remote Handling design* to remove/reinstall CollimatoB

14

Cart assembly



Collimator B Proctology :

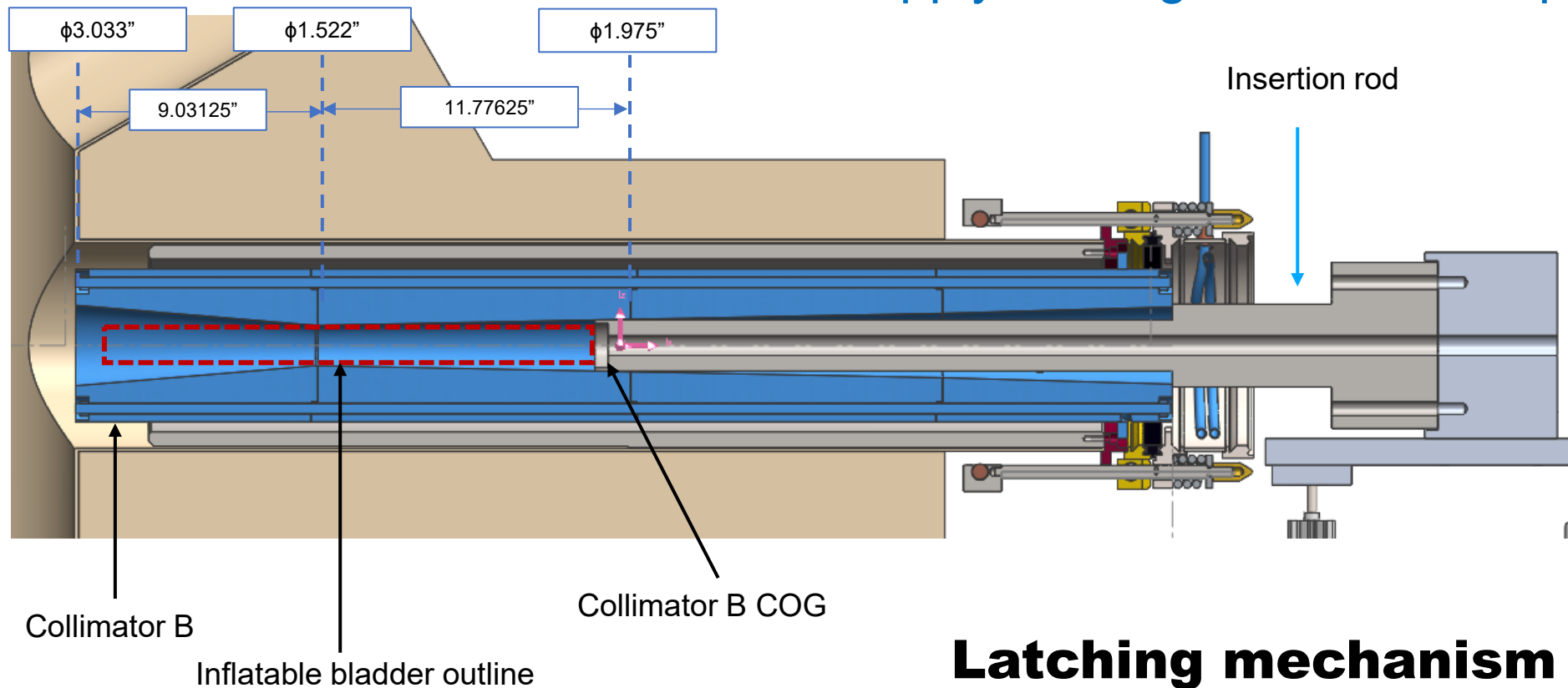
Insert the deflated inflatable bladder, inflate ... and pull

... Hopefully the extraction is without drama ?

... However, after 40yrs CollB may be very stuck?

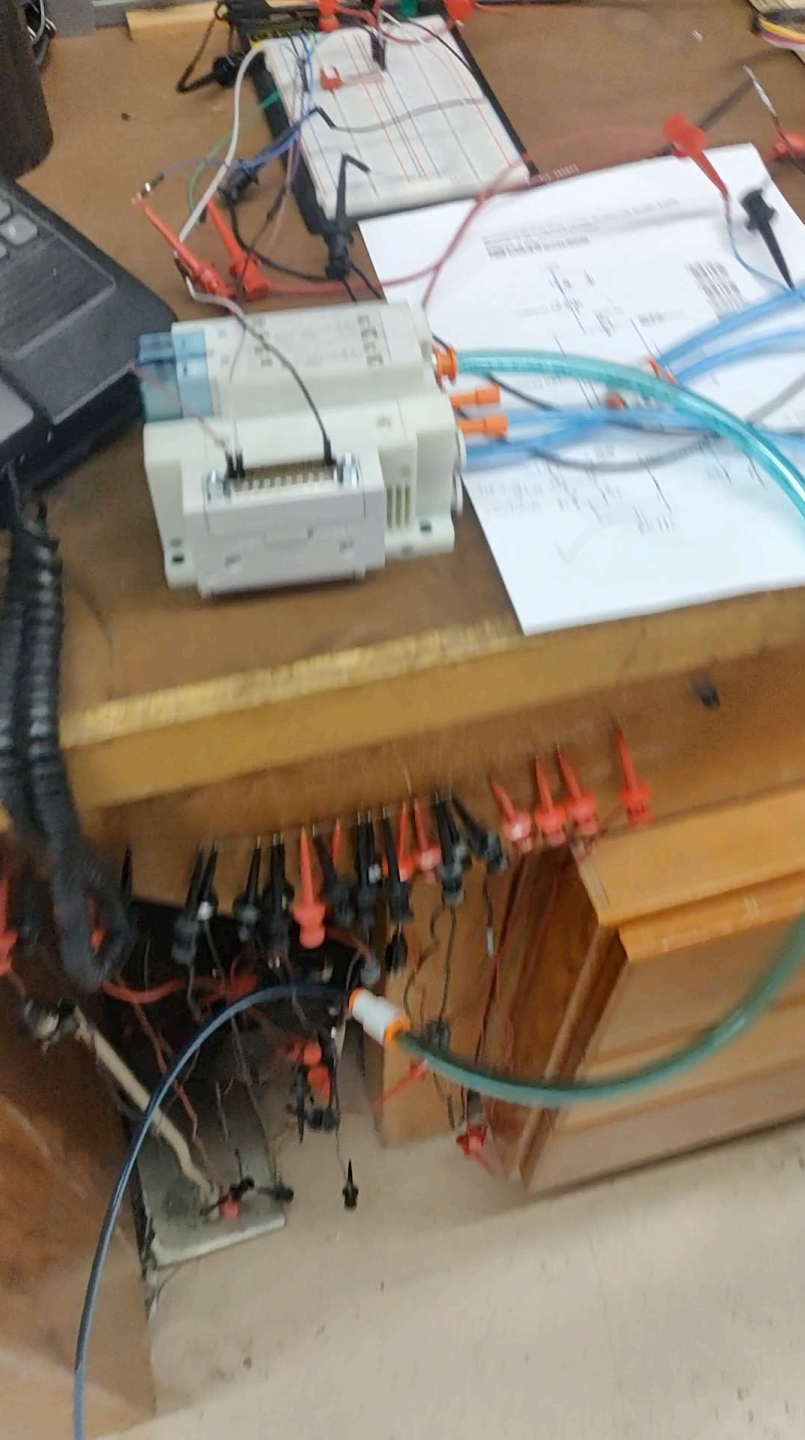
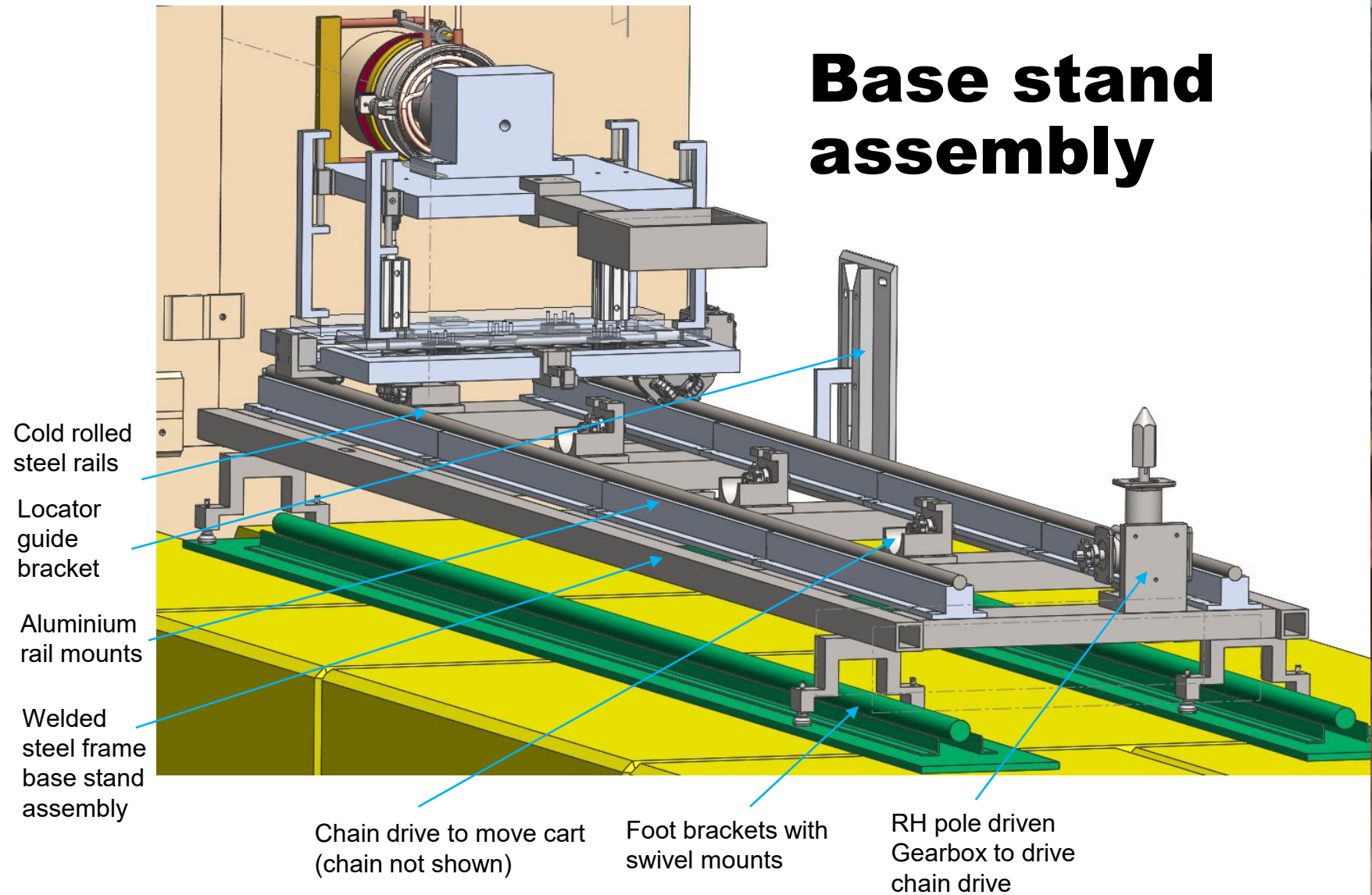
... hope for the best ... be prepared for the worst

→ apply leverage to lift ... then pull



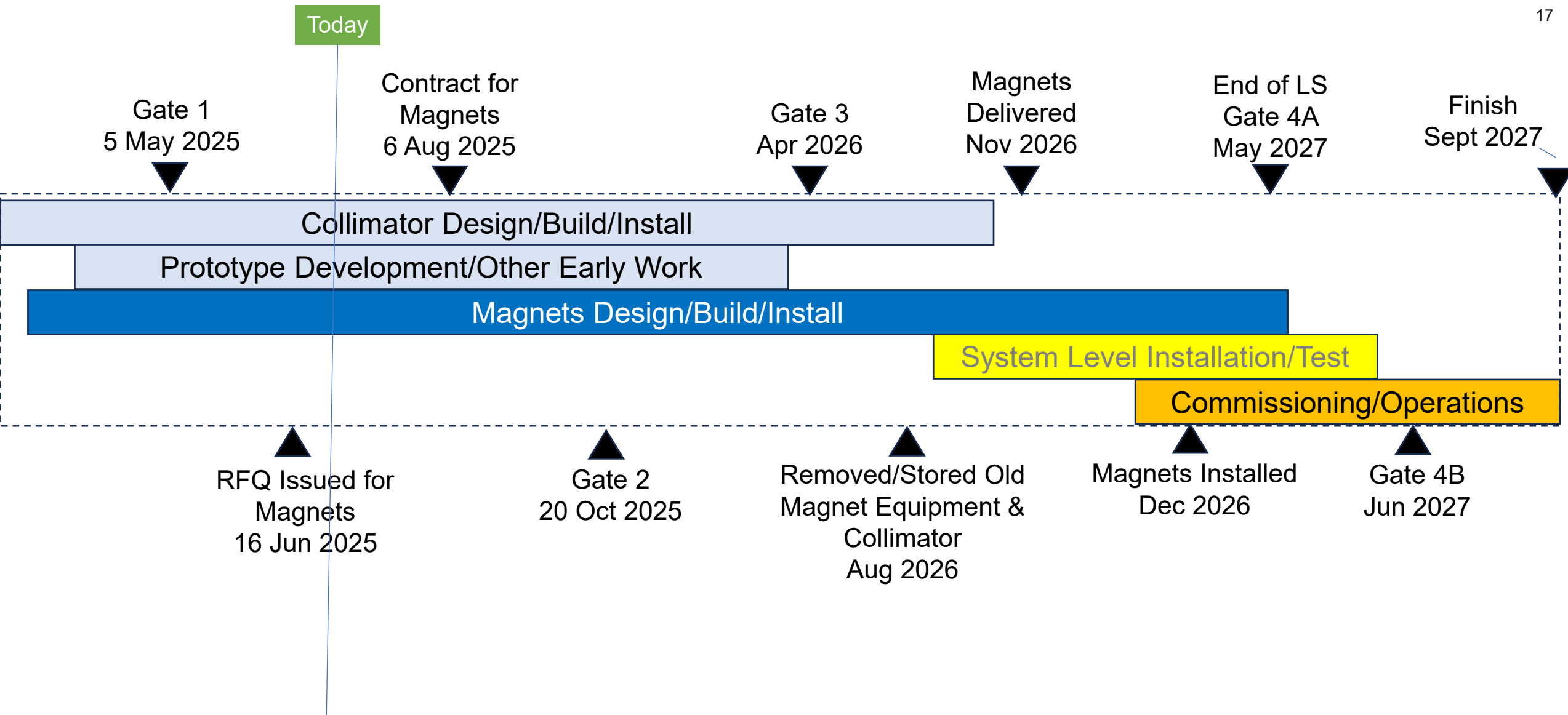
Extraction Trolley Inserted into Coll B:

Base stand assembly



How Long will all this take i.e. BL1A - Milestones

17



Thank you
Merci

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