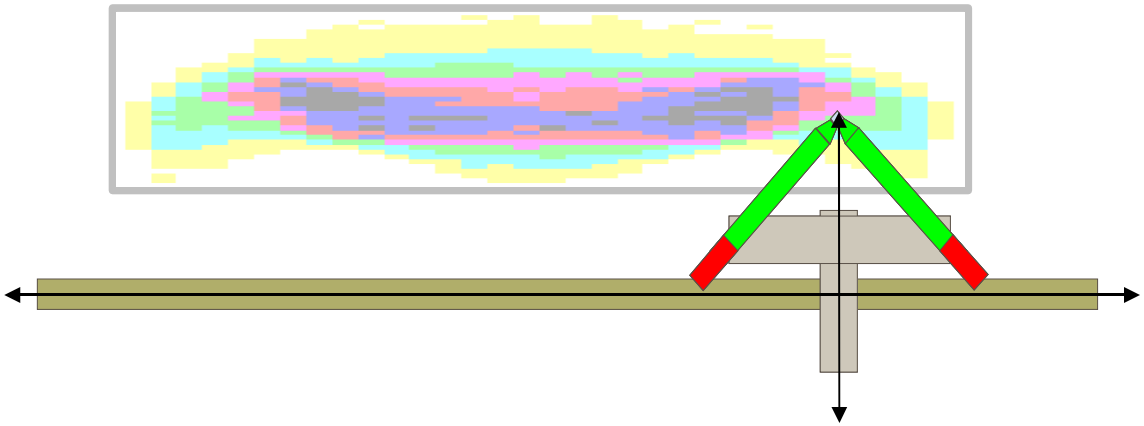
Scanner – part II.

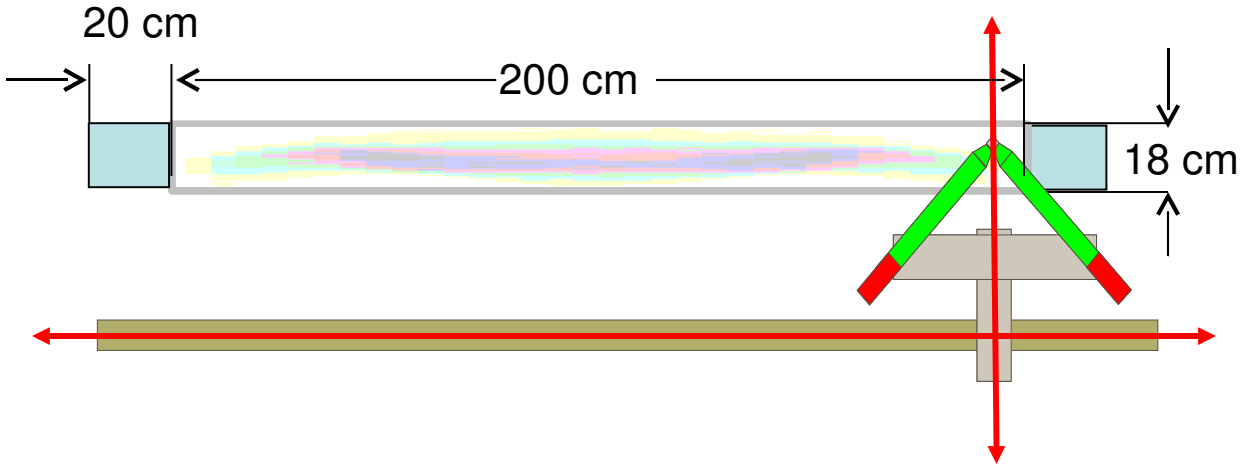
Outline

2. Design constraints
3. What we bought
    a. Parameters
    b. Signal Path
4. Discussion points
    a. Where to place the Table
    b. Al vs. Plexiglas as a scanner body



Constrains of scanner moving table

1. Moves independently in X and Y; travel length in X 250 cm, in Y 25 cm

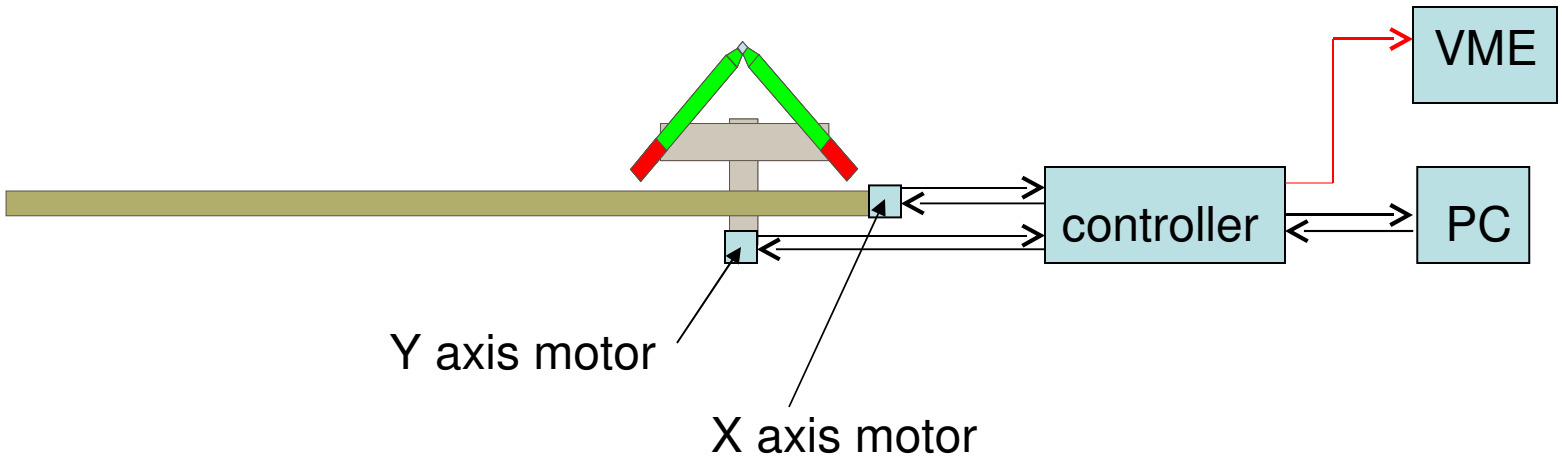


2. Nonmagnetic, since close to the beam envelope
3. Good precision (~1 mm) and reproducibility (~.01 mm)
4. Needs to move fast => scan the whole area within time frame when the beam is stable in Hall C (~20min)

→ Ball screw as a moving mechanism

Constraints of 2d motion assy

5. Computer control, we need to know, where the table is at least with the scaler rate (150Hz), the best to record table position continuously,



6. Limit and home switches + other independent check of the table position

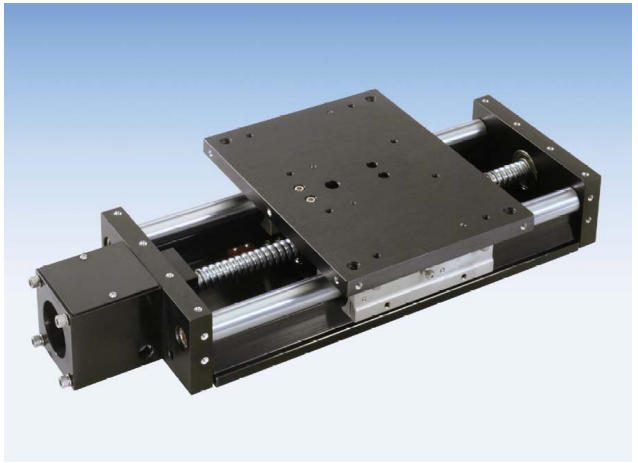
7. Has a complex design (to place in whatever orientation we want to)

Choice of scanner moving table

Vendors taken into account:

1.THK	⟹ Ball screws made out of steel. Not cost effective making this out of ss or Al.
2. Tolomatic	⟹ Similar answer
3. Rexroth-Bosh	⟹ late answer, with the estimate of $33k CAD only the x-y table
4. Parker-Dealer (Shelley)	⟹ Complicated design (3 table), with the estimate of $56k CAD (all package).
5. LinTech /Electromate	⟹ $34K CAD all package, relatively fast delivery.

Parameters of LinTech X-Y table



- X-Y nonmagnetic Table series90

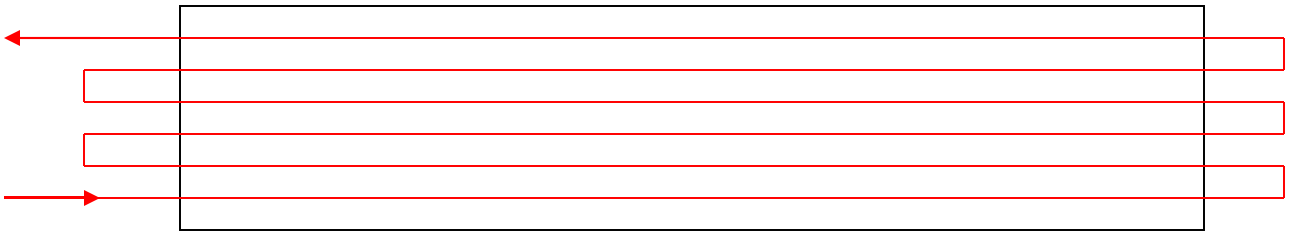
(316ss rails, Al, fluoronyliner composite bearings;

Travels X-102” (259cm), X-12” (30.5cm)

- 100 lb max load,
- X AXIS: 1.0”dia. X 1.0” lead Ball screw;
  NPL ball nut with custom loaded balls to reduce backlash to <.003”
  4 IPS. max speed
- Y AXIS: 0.62” dia. X 0.2” lead Ball screw with NPL nut;
  7 IPS. max. speed
- Y AXIS mounted on X AXIS.
- Proximity EOT & home switches on both axes.
- Rated for 1cm moves in 0.20 sec.

How fast we can move the table

- At a constant speed to scan 25x250cm^2 area within 20 minutes,



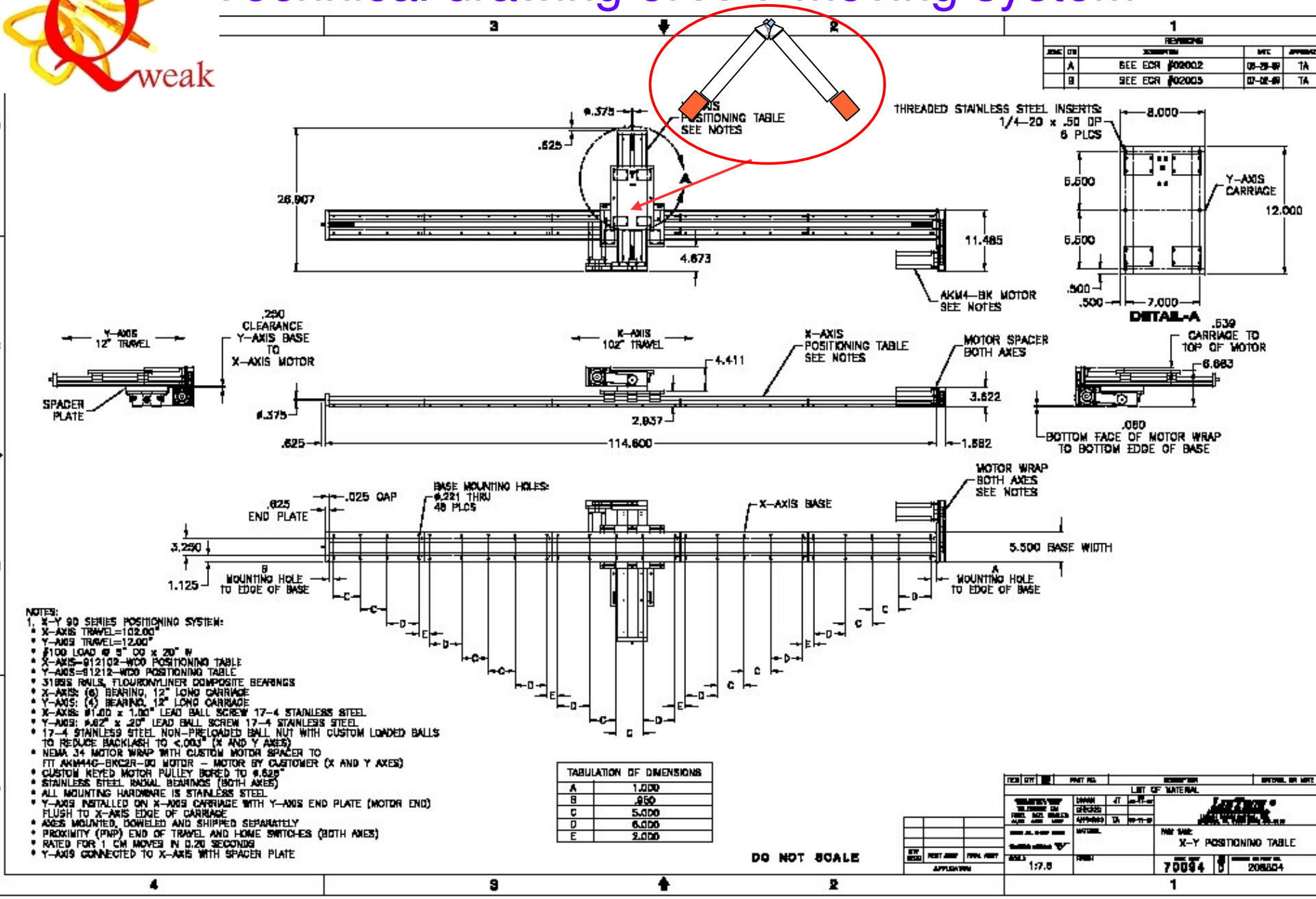
for 1x1x1 cm^2 scanner: Velocity = 5.4 cm/sec (~2.1 IPS)

for 1x1x2 cm^2 scanner: Velocity= 2.7 cm/sec (~1 IPS)

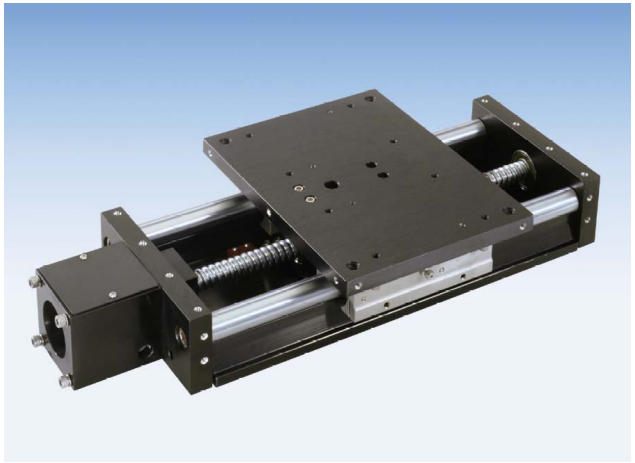
- From simulation one Cerenkov bar gets 800MHz @ 180μA (far area 5000cm^2), so for scanner 1x1x1 cm^2 rate 160kHz

  1x1x2 cm^2 rate 320 kHz

Technical drawing of X-Y moving system



Parameters of LinTech X-Y table



1. Reproducibility depends on moving pattern,
   if unidirectional ->->->->->-> .0002” (5 microns)
   if bidirectional <-<-<->->-><-> .003” (78 microns)

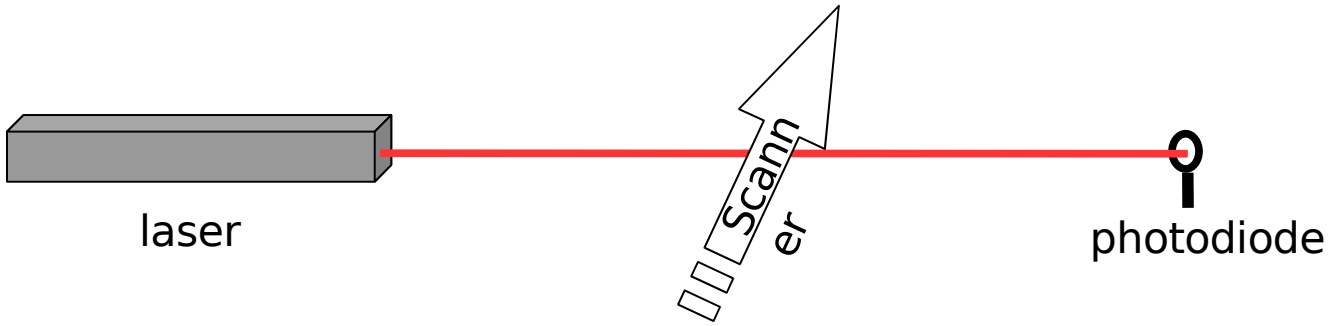
2. Position accuracy (error of lead screw) < 0.01”/ft (250microns/310mm)

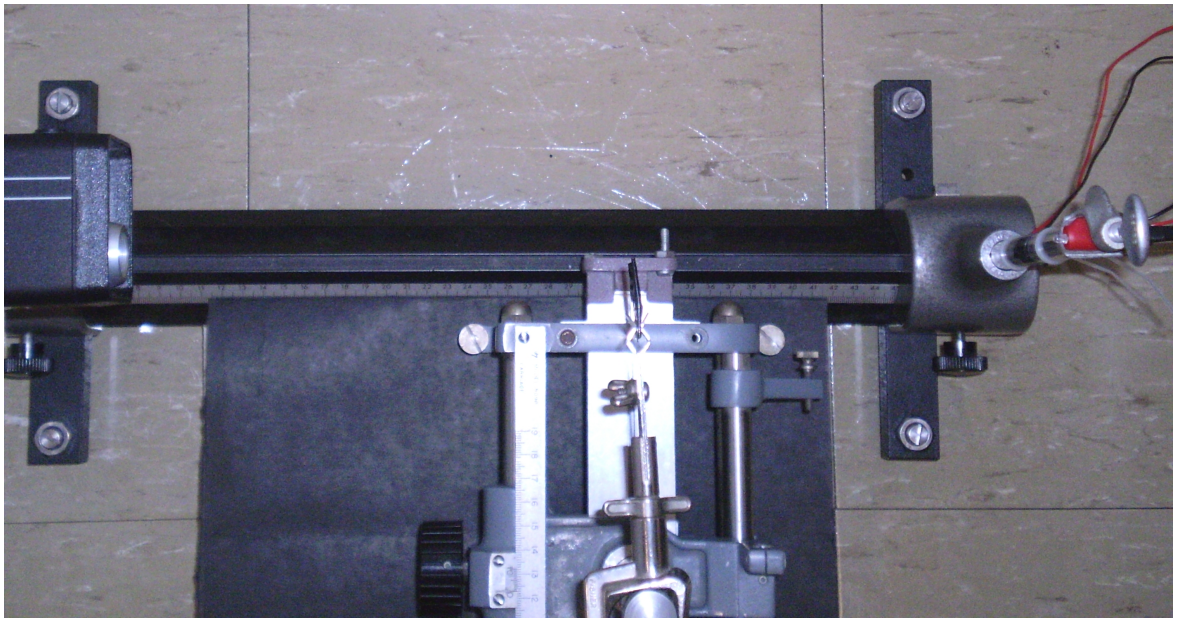
LASER system to convince yourself that the determination of position is accurate.

Goal of LASER system: 100microns

Laser Position Detection System (L. Cobus)

Goal: to be sure that if data is gathered for a certain point on the scan area, that the position of the scanner was recorded accurately, at the same time.



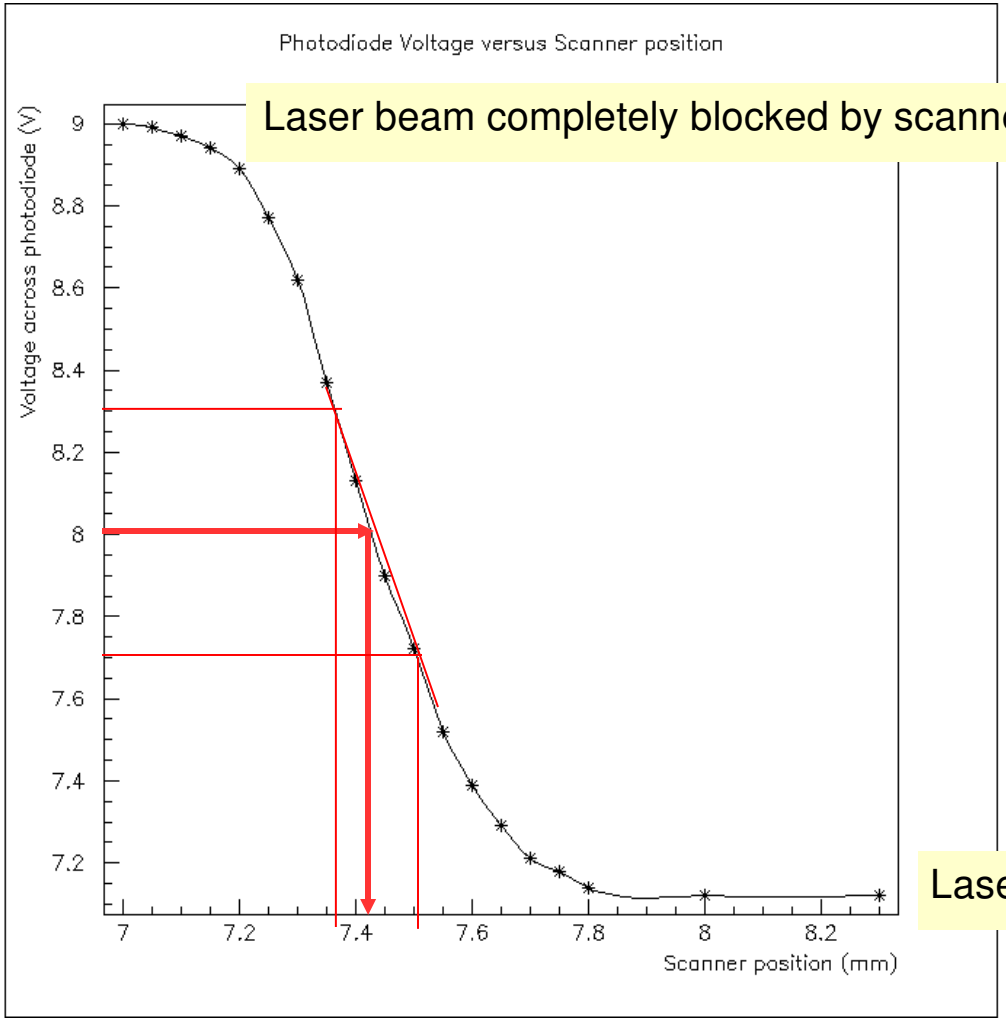


blocking arm simulates the scanner, moving between the laser and photodiode.

The arm was moved across in increments of 10microns or less, and the voltage across the photodiode was measured

Laser Position Detection System:

low the error in voltage translates to an error in position



Laser beam completely blocked by scanner

$\Delta V = 0.2V$ gives
$\Delta x \approx 40 - 70$ microns

Error in position
100 microns, or better

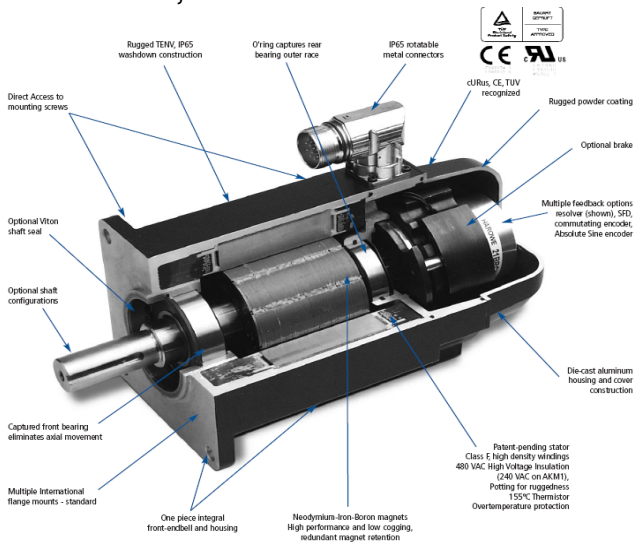
Laser beam unblocked by scanner

Parameters of LinTech X-Y table

DC Drive, 220 VAC required, one for each axis

Precision, speed, moving pattern depend on the feedback from AMK servomotor (resolver feedback)

Danaher DC servomotor with NEMA 34 mount, 24 VDC brake, resolver feedback device.



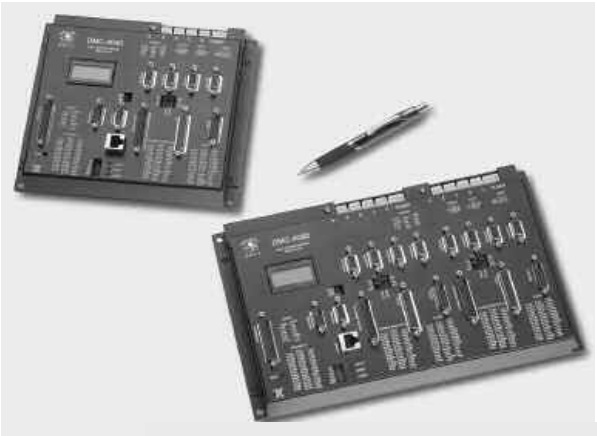
2 Axis Standalone Controller Galil DMC-4020-C012-1000

Accepts encoder input up to 22 MHz, Provides servo update rates as high as 32kHz, processes commands in as fast as 40 microsec. Dedicated Inputs and outputs per axis,

(3) 10/100BASE-T Ethernet port

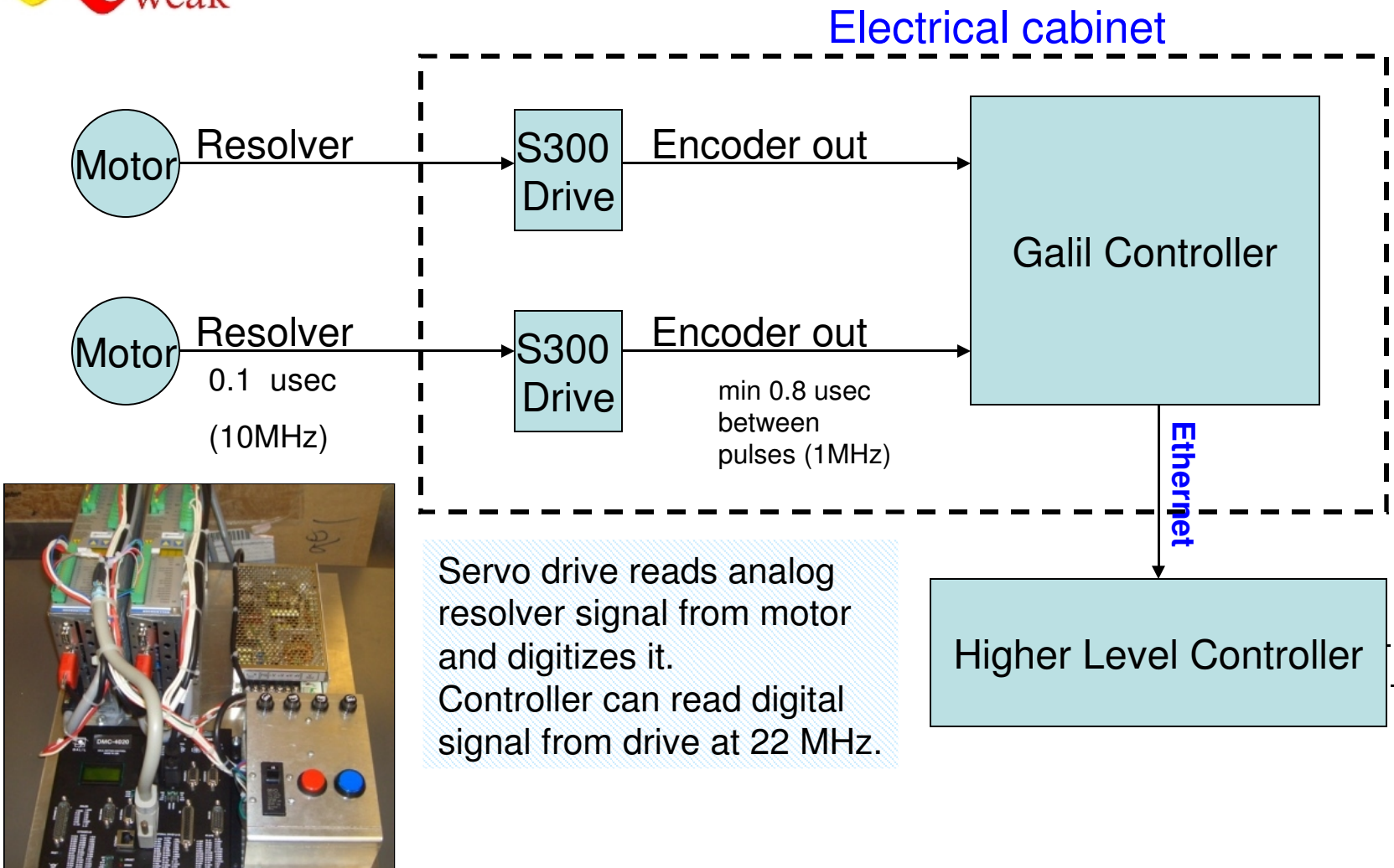
(4) RS232 ports up to 115 kbaud

Galil's WSDK servo software, real time display of position and velocity



On the picture 4 and 8 axis

Signal Path of LinTech X-Y table



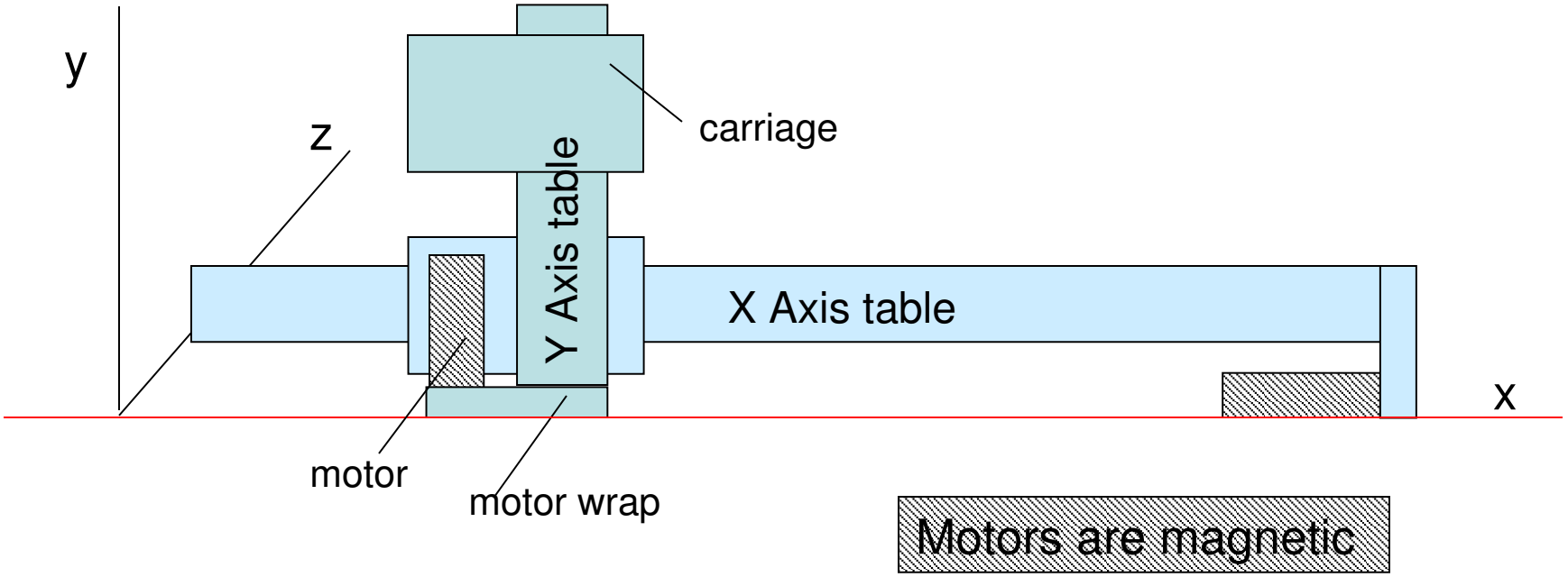
P.Wang

Discussion point 1): Where To place X-Y table

X-Y table dimensions:

x = 117" (298 cm)
y = 27” (69 cm)
z = ~8.5" (22 cm)

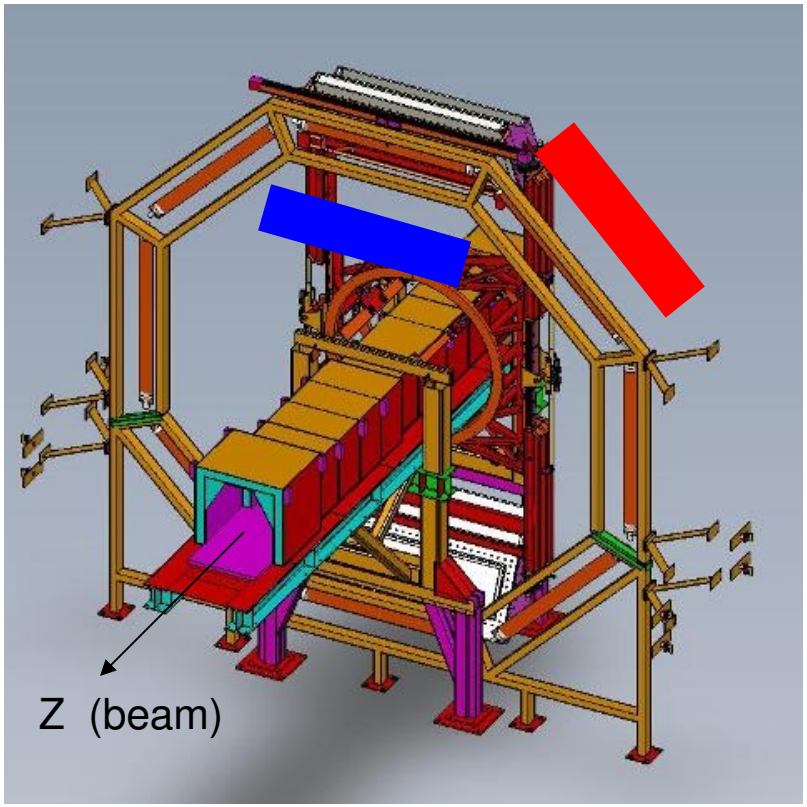
Add ~10 cm to z for a scanner assembly (in z we need at least 32cm)

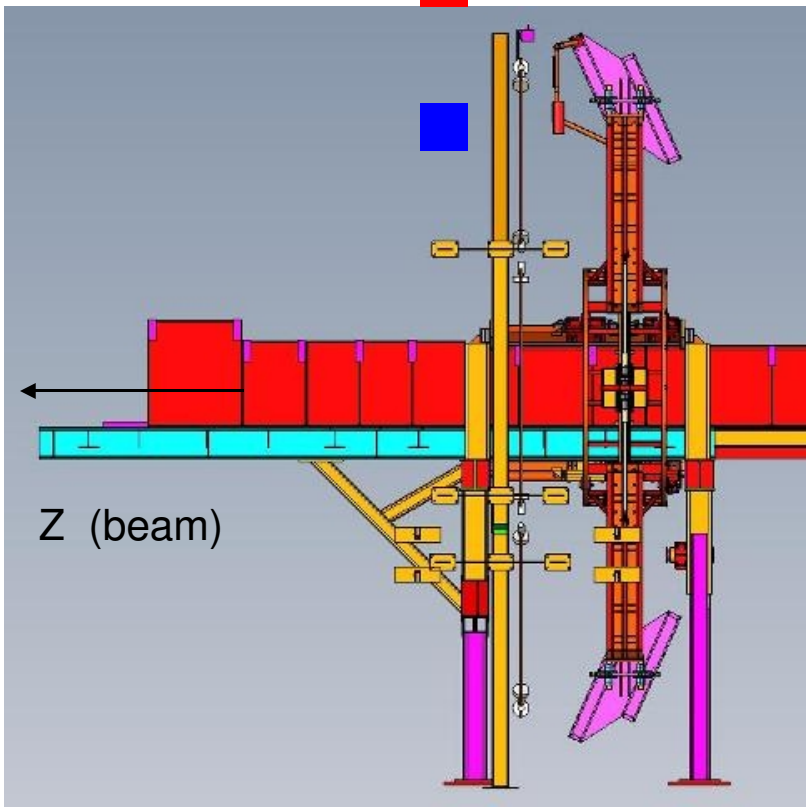


Discussion point 1): Where To place X-Y table

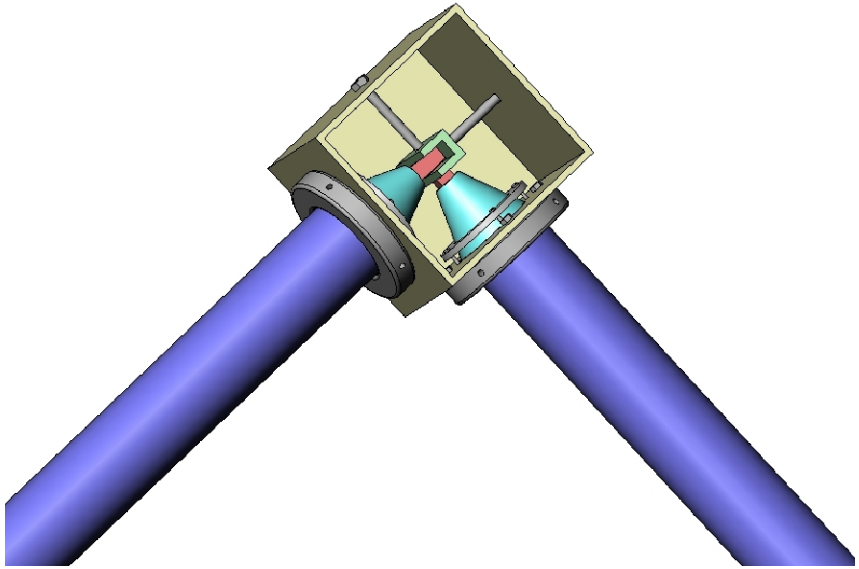
-Behind main detectors

-inside or outside the main detectors radius





Discussion point 2): Al or Plexiglas as a body of 2 tube scanner



Tube length: 2ft

Tube ID 2 1/8“

Thin wall 0.04”

Facts:	Al	Plexiglas (Lucite)
Radiation length (cm)	8.9	34.4

Radiation level: 100kRad, 300kRad

How crazy is to build the 2 tube scanner body out of Plexiglas ?

Summary

DONE:

- 2D table with good properties purchased
- Controller, motors, drivers arrived – connected together within the electrical cabinet
- Laser system to check the table position, designed, tested (100 μm accuracy)

Work to be done:

- programming the table
- try various moving patterns

Needs input:

- Where to place the table 2D table
- Engineering support from JLab
- Al vs. Plastic for a scanner tube